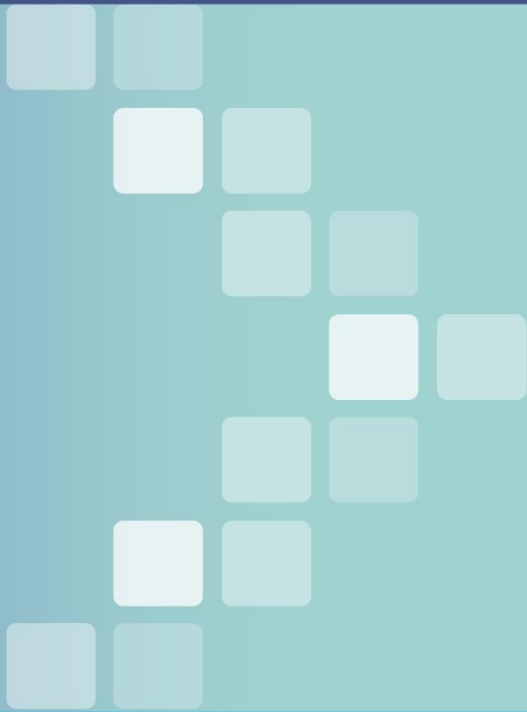


# Anaerobic Digestion Screening Tool USER MANUAL



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Tool Support: [biogastoolkit@epa.gov](mailto:biogastoolkit@epa.gov)



# Anaerobic Digestion (AD) Screening Tool User Manual

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# 1. OVERVIEW

## 1.1 Organization of User Manual

The municipal solid waste (MSW) and agricultural sectors are significant sources of short-lived climate pollutant (SLCP) emissions, especially methane and black carbon. Anaerobic digestion (AD) is a natural process in which bacteria break down organic matter in an oxygen-free environment to form biogas and digestate. AD systems provide a variety of environmental and public health benefits that reduce SLCPs, divert organic waste, reduce odors, and destroy pathogens. The Global Methane Initiative (GMI) developed the AD Screening Tool to support biogas developers in conducting preliminary feasibility assessments of the volume of biogas their AD system could generate based on available waste streams. The tool will provide a first-order estimate of the potential quantity of gas and digestate that could be produced annually by a given waste stream, as well as estimates of emissions reductions from the project.

Additionally, the tool provides users with inputs for the EPA's Organics Economics (OrganEcs) tool based on the digester characteristics input here. The OrganEcs tool can be used to estimate the costs associated with anaerobic digestion and organic waste management projects.<sup>1</sup>

This manual contains:

- An overview of the tool and its design (Section 1),
- Detailed documentation on how to use the tool and interpret results (Section 2),
- Explanation of the tool's assumptions, methodology, and limitations (Section 3), and
- A list of sources used to develop this user manual (Section 4)

## 1.2 Organization of Spreadsheet Tool

AD Screening Tool's tabs are categorized in five sections (outline below).

- **Brown** tabs provide instructions, notes, assumptions, default values references, and additional information.
- **Blue** tabs require users to enter data.
- **Black** tabs provide several tables and charts that summarize the tool's outputs.
- **Yellow** tabs provide information on assumptions and defaults.
- **Grey** tabs provide more detailed information and calculations used to run the analysis.

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<sup>1</sup> More information about OrganEcs can be found at:  
<https://www.waste.ccacoalition.org/document/organecs-cost-estimating-tool-managing-source-separated-organic-waste-version-21>

The following lists provide an overview of information covered under each tab:

#### Basic Tool Information (Brown Tabs)

1. Introduction
2. Instructions
14. References
15. Help
16. Methodology

#### Data Inputs (Blue Tabs)

3. Digester Inputs
4. Emissions Inputs

#### Outputs (Black Tabs)

5. Annual Summary
6. Biogas Production
7. Digestate Production
8. Estimated Emissions Reductions

#### Assumptions and Defaults (Yellow Tabs)

9. Feedstock Characteristics
10. Feedstock Toxicity Info
11. Calibration Factors
12. OrganEcs Input Sheet
13. MCF

#### Detailed Information and Calculations (Grey Tabs)

17. Manure Related Reductions
18. Other Wastes Reductions
19. Storage
20. Methane Gen.& Utilization
21. Electricity Use
22. Flaring & Leakage

## 1.3 Entering Data

When you open the tool, you will be prompted to enable the tool's macros. You must enable macros for the tool to function correctly. You will either be prompted with a pop-up upon opening the tool, or a yellow warning bar will appear at the top of the program asking you to "Enable Content." If you did not choose to enable macros, close the tool and reopen it, and you will have the option again to enable macros.

Enter data for your current or proposed organic waste feedstocks and management information into all blue (■) cells. Some of the blue cells contain helpful hints and definitions that will appear when you click on them.

**Yellow** (■) cells are default values that are automatically provided. You can change these values if you have local data available. You can reset any user-entered data to original default values by clicking on the "Reset Default Values" buttons provided on each data input page.

The light **grey** (■) cells, except for those in columns labeled "source" or "notes," contain calculated values that cannot be edited.

Specific instructions for entering data into each tab can be found in the sections below.

## 2. USING THE AD SCREENING TOOL: TAB-BY-TAB GUIDE

### 2.1 Basic Information

#### 2.1.1 Cover

The Cover tab includes attribution and contact information.

#### 2.1.2 Introduction

The Introduction tab contains a brief description of the AD Screening Tool and how it can be used.

#### 2.1.3 Instructions

The Instructions tab describes how to use the tool, providing general guidance for the data entry and output tabs.

- Macros in the Excel tool automate several functions in the tool, including the “Reset Default Value” buttons found on the input tabs. Macro functions automate processes in Excel files, but most organizations do not automatically allow macros to run due to security risks. Enable macros for the tool to ensure that the tool’s automated functions run while in use. For more information on Enabling or Disabling Macros, see Microsoft Support’s Help Page: <https://support.microsoft.com/en-us/office/enable-or-disable-macros-in-office-files-12b036fd-d140-4e74-b45e-16fed1a7e5c6>.
  - Users must "Enable Macros." Users will be prompted to do so when opening the workbook.

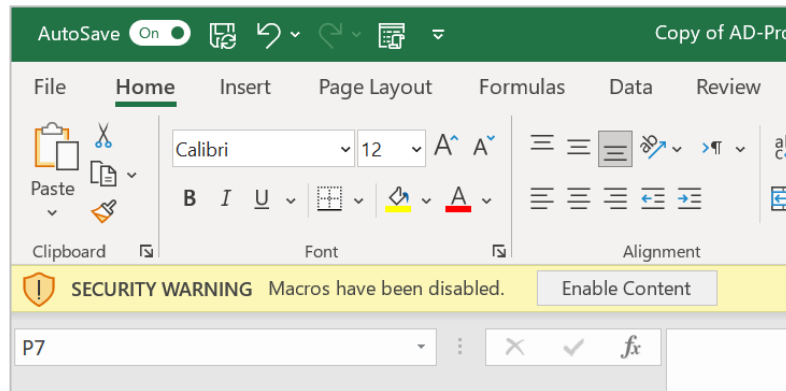


Figure 1: Enabling Macros after opening the AD Screening Tool

- If not prompted to enable macros, the user can enable macros at File → Options> Trust Center → Trust Center Settings.
- Use the following instructions to enable macros only for the duration that the file is open.
  - When you close the file, and then reopen it, the warning appears again.
  - Click the File tab.

- In the Security Warning area, click Enable Content.
- Select Advanced Options.
- In the Microsoft Office Security Options dialog box, click Enable content for this session for each macro.

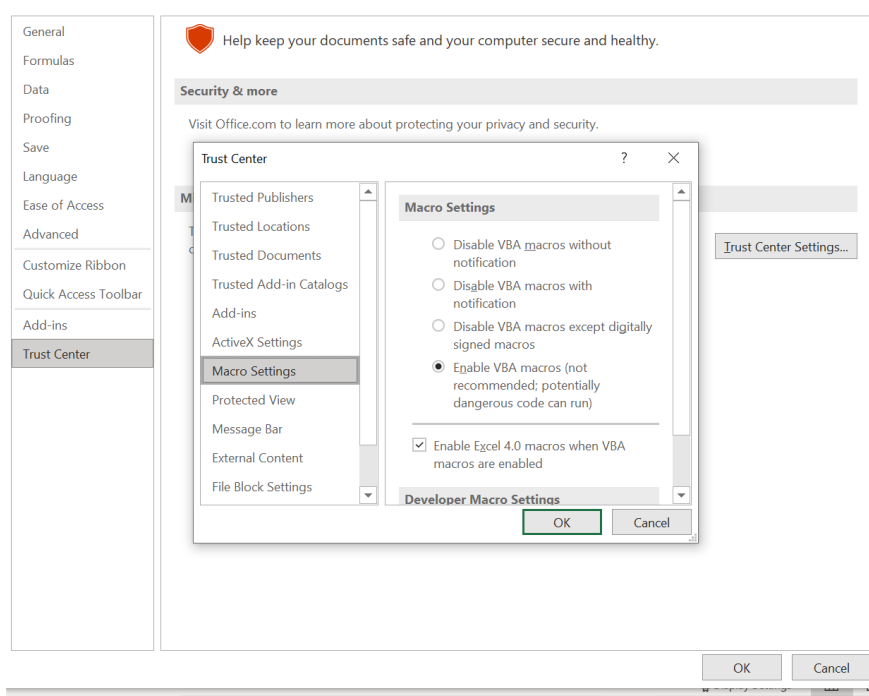


Figure 2: Enabling Macros through the Excel Security Settings

- Enter data into the **blue** (■) cells on the “3-Digester Inputs” tab. Users must enter data in every cell that is shaded **blue** (■). This information will be used to generate biogas and digestate estimates.
  - For every data point the user enters, the user should make a note of the information source or any assumptions made. The tool provides space for the users to make annotations.
- There are several **yellow** (■) cells on the “3-Digester Inputs” tab. These cells represent default values or assumptions. Users are not required to change these values but are encouraged to do so if local data are available.

#### Tips

- The tool provides suggestions and guidance for several of the **blue** (■) data fields. Users will see the guidance when they click the cells. Work through data entry with the User Manual to ensure data are entered correctly.
- Some cells have automatic validity checks. If a user enters an incorrect value or does not choose a valid selection, the automatic validity cell will turn **red**, and an error message will appear. Please correct the error before continuing.



## 2.2 User Inputs

### 2.2.1 Digester Inputs

This tab collects generation project information including the project name, location, AD reactor type and temperature, and if the system will include dewatering equipment.<sup>2</sup>

The image below shows the required **blue** (■) cells on the “3-Digester Inputs” tab, filled out with sample data from a case study of Bar-Way Farms in Deerfield, MA.

#### *Minimum Data Requirements*

The following data requirements on the “3-Digester Inputs” tab are the minimum data needed to produce the annual biogas and digestate production estimates on the “5-Annual Summary,” “6-Biogas Production,” and “7-Digestate Production” tabs. You can run the analysis using only the following inputs on the “3-Digester Inputs” tab:

- Project Name
- Project City/Municipality
- Project Country
- Planned AD type: wet or dry
- Will the system installation include dewatering equipment?
  - If yes, what is the solid capture efficiency (%)
- Feedstock Type and Amount

**Note:** Additional data entered on the “4-Emissions Inputs” tab will populate results on the “8-Emission Reductions” tab but is not required to populate the “5-Annual Summary,” “6-Biogas Production,” and “7-Digestate Production” tabs.

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<sup>2</sup> Dewatering equipment reduces the water content of the biosolids post-digestions to reduce the hauling cost. For more information: Review the [Water Environment Federation's Anaerobic Digestion Fundamentals Factsheet](#).

## Data Entry

Anaerobic Digester Feedstock Inputs				
<b>Instructions:</b>				
Please enter your project's information. The information entered in this sheet will be used throughout this workbook. Users must enter data in every cell that is shaded <b>BLUE</b> . This information will be used to generate biogas and digestate production. For every data point the user enters, the user should make a note of the information source or any assumptions made. The tool provides space for the users to make annotations. <b>YELLOW</b> cells represent default values or assumptions. Users do not need to change these values, but are encouraged to do so if local data are available. There is programed information for over 95 default waste types available for the user to choose from, or they may enter their own.				
Project Name	Bar-Way Farm			<b>Legend</b> <span style="background-color: #ADD8E6;"> </span> Required Input <span style="background-color: #FFFF00;"> </span> Calculated Value <span style="background-color: #FFC0CB;"> </span> Warning <span style="background-color: #FFFF00;"> </span> Default Value
City/Municipality	Deerfield, Mass.			
Country	U.S.			
<b>General Information &amp; Questions</b>		<b>Answer</b>		
Is the planned AD a wet or dry system?		Wet		
What will the reactor temperature be?		Mesophilic		
Will the system installation include post-digestion dewatering equipment?		Yes		
If "Yes", what is the solid capture efficiency of the dewatering equipment?		75%		
<b>Note:</b> In the Feedstock List column, select from either <b>General</b> or <b>Specific</b> . Select <b>General</b> from the Feedstock list to show general categories in the Feedstock Type column to streamline data entry. If the user knows specific animal waste or food products, select <b>Specific</b> from the Feedstock List to show the full list of option in the Feedstock Type column.				
Feedstock Stream Information				
Feedstock List	Feedstock Type	Feedstock Totals	Units	User Notes
General	Lactating Cow	25.00	short tons/day	
General	Mixed Food Waste With Non-Veg.	100.00	short tons/day	
General			kg/day	
General			kg/day	

Figure 3: Digester Inputs Data Entry Table with Sample Data

Write in your project name, city/municipality, and country name.

In the General Information and Questions table:

- Planned AD system is set to a default value of Wet. If you choose to change from the default value, select "Dry" from the dropdown list. When you click on the cell to choose Wet or Dry from the dropdown list, a note will appear defining the conditions of a Wet and Dry system.
- Reactor temperature is set to a default value of Mesophilic. If you choose to change from the default value, select another option from the dropdown list.
- Select Yes or No to indicate if the system will include dewatering equipment
- If you selected Yes to indicate that the project will include dewatering equipment, enter a whole number percentage for the solid capture efficiency of the system.

In the Feedstock table, you will add in all organic feedstocks that will feed the AD system.

- In the Feedstock List column, select from either General or Specific in the drop-down list.
  - This selection will change the list of feedstocks in the Feedstock Type column.
  - Selecting General from the Feedstock List column will show a general list of the more common feedstock categories in the Feedstock Type column to streamline data entry.
  - Selecting specific from the Feedstock List will show the full list of all feedstock options in the Feedstock Type column.
- After choosing from the General or Specific Feedstock list, select the Feedstock Type from the pre-set drop-down list.
- Enter a numerical value for the Feedstock Total and select the appropriate units.
- Optional: Write-in additional notes in the User Notes column.

## Summary Information

- **AD Waste Substrate Summary Information (B34:F40)** – This table shows the calculated moisture content, total solids, volatile solids, inserts or ash, current biogas production, and current digestate production based on the feedstock inputs.
- **Bioreactor Design Summary Information (B41:F44)** – This table shows the solid retention time, waste stream carbon to nitrogen (C:N) ratio, and the recommended bioreactor type.
- **Science & Error Check (B45:F47)** – This table analyzes the substrate results to indicate if the reactor type has the optimal mix of total solids based on the system design (Yes or No) in cell D46. In cell D47, the table indicates if the C:N ratio is optimal for AD (Yes or No). *Note that AD projects can be still be viable even if these checks indicate that the system does not have the optimal mix of total solids or the optimal C:N ratio.*

## Default Values on the Digester Inputs tab

- **Feedstock Characteristics (F16:O31)** – Default values are set for moisture content, total solids, volatile solids, inert materials and ash, nitrogen content, carbon content, proteins, fats, and sugars and starches. You can override the default percentages with site-specific information. To reset any of the fields, click on the “Reset” buttons, located below each column.
- **Biogas Composition (C58:C65)** – Default information on the recommended composition of the planned AD system substrate. You can override the default values by writing in alternate values. To reset any of the fields, click on the “Reset Gas Composition” button to the right of the table.
- **Other Default Assumptions (C68:C72)** – Default information on the recommended composition of the planned AD system substrate. You can override the default values by writing in alternate values. To reset any of the fields, click on the “Reset Gas Composition” button to the right of the table.

## 2.2.2 Emissions Inputs

Data entered on the “4-Emissions Inputs” tab will populate results on the “8-Emission Reductions” tab to calculate the annual projected net emissions reductions from the AD project. Entering data on the Emissions Inputs tab is not required to estimate biogas production, but it is an optional feature that will calculate the methane emission reductions associated with your project..

## Waste Management and Storage

Waste Management and Storage Emission Reduction Instructions:		
Baseline emissions are determined based on the management systems in place for manure and co-digested wastes prior to the use of the AD system. Users should select a primary management system for the waste and an average reporting temperature. These factors determine the Methane Conversion Factor (MCF) used in subsequent calculations. MCF values can be viewed in the MCF tab of this workbook.		
Waste Management and Storage Emission Reductions	Value	Units
Primary Previous Management System for Manure	Pit storage below animal confinements <1 mo.	(select one)
Primary Previous Management System for Other Waste	Landfill	(select one)
Average Reporting Period Temperature (°C)	13	celsius
<b>Storage</b>		
Does the facility temporarily store any organic Feedstocks on-site?	Yes	(Yes/No)
If Yes, please choose a storage system	Dry lot	(select one)
Total Days Waste Stored Temporarily per Year	67	days per year

Figure 4: Waste Management and Storage Data Entry Table with Sample Data

- Select a previous management system for manure from the drop-down list. This indicates the type of system used for manure management before the development of the AD system.
- Select a previous management system for other waste from the drop-down list. This indicates the type of system used for the management of other waste streams before the development of the AD system.
- Write in the reporting period temperature and select the temperature units (Celsius or Fahrenheit) from the drop-down list.
- Select Yes or No to indicate if the facility temporarily stores organic feedstocks on-site.
  - If yes, select a storage system from the drop-down list.
  - If yes, enter a whole number value for the total days the waste was stored annually.

### Methane Utilization

Methane Utilization Instructions:			
Biogas produced onsite sometimes can be combusted to generate electricity, used as boiler, furnace, or combustion engine fuel onsite. If gas is burned onsite, enter the estimated percentage of gas per day that will be combusted. The default for methane utilization is set at 90 percent. The user can enter their own methane utilization percent by typing in a whole number percent in cell B22 below. Emissions factors for the combustion processes are based on IPCC (2006) values.			
If gas is not utilized onsite and will only be flared, enter 0 for utilization percentage and choose "none" for combustion process. If the utilization percent is 0, the total flare percentage in cell B27 below will be 100%			
20	Methane Utilization	Value	Units
21		90%	percent
22	Methane Utilization Percent		Notes
23	Combustion Process		(select one)

Figure 5: Methane Utilization Data Entry Table

- If methane is utilized onsite, enter the whole number percentage of methane utilized onsite (for example, to enter 85 percent type “85” instead of “0.85”). The tool assumes that 90 percent of methane will be utilized onsite, with the remaining 10 percent sent to flare, based on [EPA’s eGRID database](#). Ideally, projects utilizing methane onsite will have a utilization percent higher than 90 percent or even reaching 100 percent. To override the default value, enter a whole number to replace 90 in cell B22.
  - If methane is not utilized onsite, enter 0.
- Select the combustion process from the drop-down list.
  - If methane is not utilized onsite, select “none.”

### Flaring

Flaring Instructions:			
Methane sent to a flare is combusted, but this process is not 100 percent efficient. Some methane is released to the environment due to incomplete combustion, or flaring may take place if the generator is offline. Additionally, some projects may flare all methane instead of utilizing it on-site. The measured methane sent to flaring is calculated using the percentage entered above in cell B22. The sum of methane utilization and methane sent to flare should equal 100 percent.			
To calculate methane released due to flaring, the amount of methane sent to flare is multiplied by the combustion process efficiency. Default combustion efficiencies are from the UNFCCC CDM (2017) and are based on the type of flare used. If more specific information about a flare’s efficiency is known, users may override the recommended default. The button to the right resets the flaring default value.			
24	Flaring	Value	Units
25		10%	percent
26	Flaring		Notes
27	Percentage of Methane sent to Flare		(select one)
28	Flare Type		(select one)
29	Use Default Efficiency?		(select one)
30	Combustion Process Efficiency	0%	percent

Figure 6: Flaring Data Entry Table

- The measured methane sent to flare is automatically calculated using the percentage entered for methane utilization above in cell B22. The sum of methane utilization and methane sent to flare should equal 100 percent.
- Select the flare type from the drop-down list.
- Select Yes or No to use default combustion process efficiency.
  - If you select “No,” enter the combustion process efficiency.

- If you enter your own grid data but wish to return to the default values, click the “Reset Flaring Defaults” button to the right of the table.

### Electricity Consumption and Generation

Electricity Consumption and Generation Instructions:			
AD projects can source electricity from the grid or use electricity generated to power their own operations. Grid emissions estimates are derived from country-level emissions data from IEA (2018) and generation data from BP (2018). Users may override default emissions rates with more specific information if it is available. Users can also indicate grid gross loss - the amount of electricity lost due to transmission as a percent of total generation - or the default based on US values for 2019 will be used (eGRID 2019).			
If electricity is generated onsite and consumed by the project, the tool subtracts this amount of consumption from the total electricity consumption. Biogas specific emissions factors from IPCC (2006) are then applied to the onsite generation. The user can supply more specific emissions factors for biogas if available. The button to the right resets the leakage default values.			
32			
33	Electricity Consumption and Generation	Value	Units
34	Country	China	(select one)
35	Electricity Generation		
36	Is electricity generated and used onsite?	Yes	(Yes/No)
37	How much onsite generation is consumed?	4	kWh per day
38	Project Biogas CO <sub>2</sub> Emissions Factor	57.61	kg/MMBtu
39	Project Biogas CH <sub>4</sub> Emissions Factor	0.00106	g/MMBtu
40	Direct Electricity Use		
41	How much Electricity is consumed from the grid?	56	kWh per day
42	Use Default Grid Data?	Yes	(select one)
43	Default Grid Emissions Rate	0.72	kgCO <sub>2</sub> /kWh
44	If no, what is your Grid Emissions factor?		
45	Grid Gross Loss	5.1%	percent

Figure 7: Electricity Consumption and Generation Data Entry Table with Sample Data

- Select the country from the drop-down list.
- Select Yes or No to indicate is electricity is generated and used onsite.
  - If you select “No,” cells B37:B39 will turn grey. Do not enter data into the grey cells.
  - If you select “Yes,” enter a numerical value for the amount of kilowatt-hours (kWh) consumed per day.
  - If you select “Yes,” the project biogas CO<sub>2</sub> and CO<sub>4</sub> emissions factor defaults will automatically populate cells B38 and B39.
- Enter a numerical value in kWh per day to indicate how much electricity is used from the electricity grid.
- Select Yes or No to indicate if the tool should use default grid data.
  - If you select “No,” enter the grid emissions rate and grid gross loss percentage.
  - If you enter your own grid data but wish to return to the default values, click the “Reset Electricity Consumption and Generation Defaults” button to the right of the table.

### Leakage

Leakage Instructions:			
Some degree of leakage occurs from all Anaerobic Digesters. Leakage is the methane released through pipes, equipment, and other apparatuses used to generate biogas. This tool uses the UNFCCC CDM (2017) default leakage rate of 10% of methane production, but the user may override the recommended defaults. The tool using the previously entered waste and equipment inputs calculates methane production. The button to the right resets the leakage default values.			
47			
48	Leakage	Value	Units
49	Assumed Fraction of Methane Leakage	10%	percent

Figure 8: Leakage Data Entry Table with Sample Data

- Some degree of leakage occurs from all AD systems. Leakage is the methane released through pipes, equipment, and other apparatuses used to generate biogas. This tool uses the UNFCCC CDM (2017) default leakage rate of 10 percent of methane production, but the user may override the recommended defaults by typing in a whole number percentage in cell B50.

## 2.3 Outputs

### 2.3.1 Annual Summary

The Annual Summary tab estimates the planned AD system's annual digestate and biogas production and options for energy recovery. The results are a first-order estimate, the actual AD production could vary based on waste characteristics, system design, and system operation.

The biogas production estimates are provided as a range of likely values (low and high), as well as the theoretical maximum potential. Actual biogas production values can vary considerably, based on differences in the design and operations of AD systems. It is expected that the biogas production from the selected feedstocks will be within the low and high estimated values, but they could be as high as the theoretical maximum potential.

The biogas production estimates are calculated using calibration factors, found on the Calibration Factors tab. EPA developed the calibration factors by comparing the results of the AD Screening Tool to measured biogas production data collected by EPA from more than operational 100 AD systems. For each operational system, EPA developed a ratio of the measured data to the modeled values from the AD Screening Tool. The calibration factors represent the 25<sup>th</sup> and 75<sup>th</sup> percentile values of the ratio between measured and modeled data. The theoretical maximum potential values are the uncalibrated estimates generated by the AD Screening Tool. Biogas production can be viewed in m<sup>3</sup>/year or standard cubic feet per year (scf/year).

The digestate production estimates the total non-biodegradable solids, remaining volatile solids, digester solids, dry sludge, and liquid effluent. If you indicated that the AD system would not install dewatering equipment, the dry sludge and liquid effluent values will appear as "N/A".

The tool provides energy recovery option estimates as examples of the types of energy that could be produced from the biogas. These energy options are mutually exclusive, meaning that the plant will not be capable of producing two or more of the estimates shown.

The final table provides an overview of bioreactor toxicity to indicate waste stream inhibitors that could impact at AD project. Each feedstock input will appear in the table. This table is provided as a reference, to indicate potential sources of toxicity commonly associated with each selected feedstock.

### 2.3.2 Biogas Production

This tab shows the total estimated biogas and methane produced daily based on the feedstock inputs entered. The tab includes a bar chart showing biogas production by feedstock type per retention period. The table shows the biogas production breakdown by feedstock type.

### 2.3.3 Digestate Production

This tab shows the total estimated digestate produced daily based on the feedstock inputs entered. The tab includes a bar chart showing digestate production by feedstock type per retention period. The table shows the digestate production breakdown by feedstock type.

## 2.3.4 Emission Reductions

This tab shows the estimated baseline emission reductions, project emission reductions, and net emissions reductions from the AD system.

The results are based on the SLCP global warming potentials table at the bottom of the tab, which can be updated with alternative values. To reset default values, select the reset button to the right of the table.

SLCP		Notes	Information Source
40	Black Carbon	900	Based on total climate forcing (all effects). This GWP is cited in the IPCC AR5 (Myhre et al., 2013). Myhre et al., 2013; Bond et al., 2013
41	Methane (bio)	25	The IPCC AR4 report (Forster et al., 2007) does not differentiate between biogenic and fossil methane. Forster et al., 2007
42	Methane (fossil)	25	The IPCC AR4 report (Forster et al., 2007) does not differentiate between biogenic and fossil methane. Forster et al., 2007

Figure 9: Global Warming Potential Default Values

## 2.4 Default Values and Assumptions

The AD Screening Tool includes several tabs with the default values and assumptions used to calculate the biogas and digestate production and the methane emission reductions.

### 2.4.1 Feedstock Characteristics

This tab shows the default feedstock characteristics and the data sources, including the moisture content, total and volatile solids, methane yield, and bulk density. This table is used to populate the default values for each feedstock on the Digester Inputs tab.

### 2.4.2 Feedstock Toxicity

This tab shows the potential inhibitors to the AD system by feedstock type, including potential sources of toxicity commonly associated with each feedstock. This table is used to populate the possible inhibitors table on the Annual Summary tab.

### 2.4.3 Calibration Factors

This tab lists the calibration factors developed using actual observation data from an AD project. These calibration factors are used to determine the low, high, and theoretical maximum biogas output on the Annual Summary tab. The development of the calibration factors is discussed in section 2.3.1.

### 2.4.4 OrganEcs Input

This tab shows inputs that can be used in EPA's Organics Economics (OrganEcs) tool to estimate costs associated with an organic waste management project. OrganEcs requires inputs on the characteristics of the waste stream for the waste management project. This tab allows you to copy the results of AD Screening Tool directly into the input for the OrganEcs AD tool.<sup>3</sup>

<sup>3</sup> Learn more about the OrganEcs tool at: <https://www.waste.ccacoalition.org/document/organecs-cost-estimating-tool-managing-source-separated-organic-waste-version-21>



### **2.4.5 Methane Conversion Factors (MCF)**

This tab shows the methane conversion factors or the percentage of a waste's maximum methane production capacity achieved during waste management and disposal. The values are used to calculate baseline emissions from manure on the Manure Related Emissions tab, baseline emissions from other wastes on the Other Wastes Reduction tab, as well as temporary storage emissions on the Storage tab.

## **2.5 Tool Information**

### **2.5.1 References**

This tab lists call data sources used to create the tool, with one citation per row.

### **2.5.2 Help**

This tab provides the email address for the tool developers and a link to the GMI website for additional information.

### **2.5.3 Methodology**

This tab provides an overview of the methodology used in the tool.

## **2.6 Calculations**

The following tabs include the background calculations to estimate the biogas and digestate production and methane emission reductions, using the selected feedstocks.

### **2.6.1 Manure Related Reductions**

This tab calculates the baseline emissions from manure using the Digester Inputs data entry table and the MCF values on the MCF tab.

### **2.6.2 Other Wastes Reductions**

This tab calculates the baseline emissions from co-digested waste using the Digester Inputs data entry table and the MCF values on the MCF tab.

### **2.6.3 Storage**

This tab calculates the temporary storage emissions associated with the feedstocks entered on the Digester Inputs tab and the MCF values on the MCF tab.

### **2.6.4 Methane Generation and Utilization**

This tab shows the methane generation and utilization default values that correspond with the methane utilization selection on the Emissions Input tab.



### **2.6.5 Electricity Use**

This tab shows the electricity generation and use default values used on the Emissions Input tab.

### **2.6.6 Flaring and Leakage**

This tab shows the flaring and leakage default values used on the Emissions Input tab.

## **3. LIMITATIONS**

The AD Screening Tool provides a first-order estimate of the potential quantity of gas and digestate that could be produced annually by a given waste stream, as well as estimates of methane emissions reductions from the project.

This tool is intended as a pre-feasibility screening tool, to help users understand the approximate amount of biogas that can be generated from various organic waste feedstocks. The biogas production estimates from the tool are based on feedstock characteristics from published literature, which are listed on the References tab in the tool. However, many feedstocks, particularly composite feedstocks such as mixed food waste, can vary widely in their biogas production potential.

The tool has been calibrated against real-world data to ensure that the biogas production values are as accurate as possible. However, the actual biogas production of an operational AD system will depend on the waste characteristics, reactor temperature, system design limitations, and daily operations.

For these reasons, it is necessary to conduct additional modeling and analysis using site-specific data before initiating development of an AD system.