

State Inventory Tool

User Guide for Estimating Emissions From Municipal Solid Waste

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ACKNOWLEDGEMENTS

The SIT was originally developed in conjunction with EPA's state and local programs to automate the steps states would need to take in developing their own emission estimates in a manner that was consistent with prevailing national and state guidelines. The result was a user-friendly set of eleven modules that help users estimate greenhouse gas emissions and removals at the state level. CGS is supporting updates to the tool to facilitate continuity in state inventory development and improvement work at the state level.

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This section of the User Guide provides instruction on using the Municipal Solid Waste module of the State Inventory Tool (SIT), and describes the methodology used for estimating greenhouse gas (GHG) emissions from municipal solid waste management at the state level.

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1.1 MODULE OVERVIEW

This User Guide accompanies and explains the Municipal Solid Waste module of the SIT.

Because most state inventories developed today rely heavily on the SIT, User Guides have been developed for each of the SIT modules. These modules contain largely updated methodologies that are, for the most part, consistent with the Inventory of U.S. Greenhouse Gas Emissions and Sinks (EPA 2025a) and related disaggregated data by state. Users can refer to the chapters and annexes of the U.S. Inventory and the Center for Global Sustainability (CGS) FAQ page to obtain additional information not found in the SIT or in the companion User's Guides. Future updates will be consistent with the Center for Global Sustainability at University of Maryland's Greenhouse Gas Inventory and Analysis for the United States (GHGIA) (Desai et al. 2026).

In recent years, EPA also published an annual Inventory of U.S. Greenhouse Gas Emissions and Sinks by State (EPA 2024a) to make available consistent state-level GHG data for all states for use by states, researchers, and the general public. There will be differences between the latest EPA developed state-level estimates and inventory estimates developed by states using the SIT or other tools. Inventories compiled by states may differ for several reasons, and differences do not necessarily mean that one set of estimates is more accurate, or "correct". The CGS plans to continue EPA's initiative to publish an updated annual crosswalk guide to facilitate understanding methodological differences between methods in the current GHGIA, its disaggregation by state and SIT source categories, methods, and data.

The Municipal Solid Waste module calculates methane (CH_4) emissions from landfilling of municipal solid waste (MSW) and carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions from the combustion of MSW. While the module provides default data for most inputs, if you have access to more comprehensive data sources, they should be used in place of the default data (see Box 1 for suggestions of possible data sources). If using outside data sources, or for a more thorough understanding of the tool, please refer to the following Methodology section for data requirements and methodology.

Box 1: State Solid Waste Data Sources

In-state sources, such as state departments of environmental protection, should be consulted first. Otherwise, default data provided by the Municipal Solid Waste module may be used.

In landfills, CH_4 and CO_2 are produced from anaerobic decomposition of organic matter by methanogenic bacteria. Organic waste first decomposes aerobically (in the presence of oxygen) and is then decomposed by anaerobic non-methanogenic bacteria, which convert organic material to simpler forms like cellulose, amino acids, sugars, and fats. These simple substances are further broken down to gases and short-chain organic compounds (e.g., H_2 , CO_2 , CH_3COOH , HCOOH , and CH_3OH), which support the growth of methanogenic bacteria. The bacteria further metabolize these fermentation products into stabilized organic materials and "biogas," which consists of approximately 50 percent CO_2 and 50 percent CH_4 by volume. Additionally, some landfills flare recovered landfill gas, which converts the CH_4 portion of the gas to CO_2 . There are also some landfills that collect and burn landfill gas for electricity production or other energy

uses (known as landfill-gas-to-energy projects, or LFGTE), which are treated similarly to landfills that flare their gas.

Neither the CO₂ emitted directly as biogas nor the CO₂ emitted from combusting CH₄ at flares is counted as an anthropogenic greenhouse gas (GHG) emission. The source of the CO₂ is primarily the decomposition of organic materials derived from biomass sources (e.g., crops, forests), and in the United States these sources are grown and harvested on a sustainable basis. Sustainable harvesting implies that photosynthesis (which removes CO₂ from the atmosphere) is equal to decomposition (which adds CO₂ to the atmosphere).

Waste combustion emits both CO₂ and N₂O. CO₂ is produced from the oxidation of organic materials in waste, such as paper, food scraps, yard trimmings, and plastic. As with CO₂ from biogas and oxidation of CH₄, CO₂ emissions from biogenic sources (e.g., paper and food scraps) are not counted in GHG inventories because they simply return CO₂ that plants previously absorbed through photosynthesis to the atmosphere. However, some CO₂ is from non-biogenic sources (e.g., plastic and rubber made from petroleum), and is thus counted in GHG emission inventories. N₂O is produced at the high temperature found in waste combustors by the combination of nitrogen (both nitrogen contained in the waste and nitrogen gas in the air) and oxygen gas in the air.

Users should also note that an additional waste-related greenhouse gas sink, carbon storage from landfilled yard trimmings and food scraps, is accounted for in the Land-Use Change and Forestry module of the SIT.

1.1.1 Data Requirements

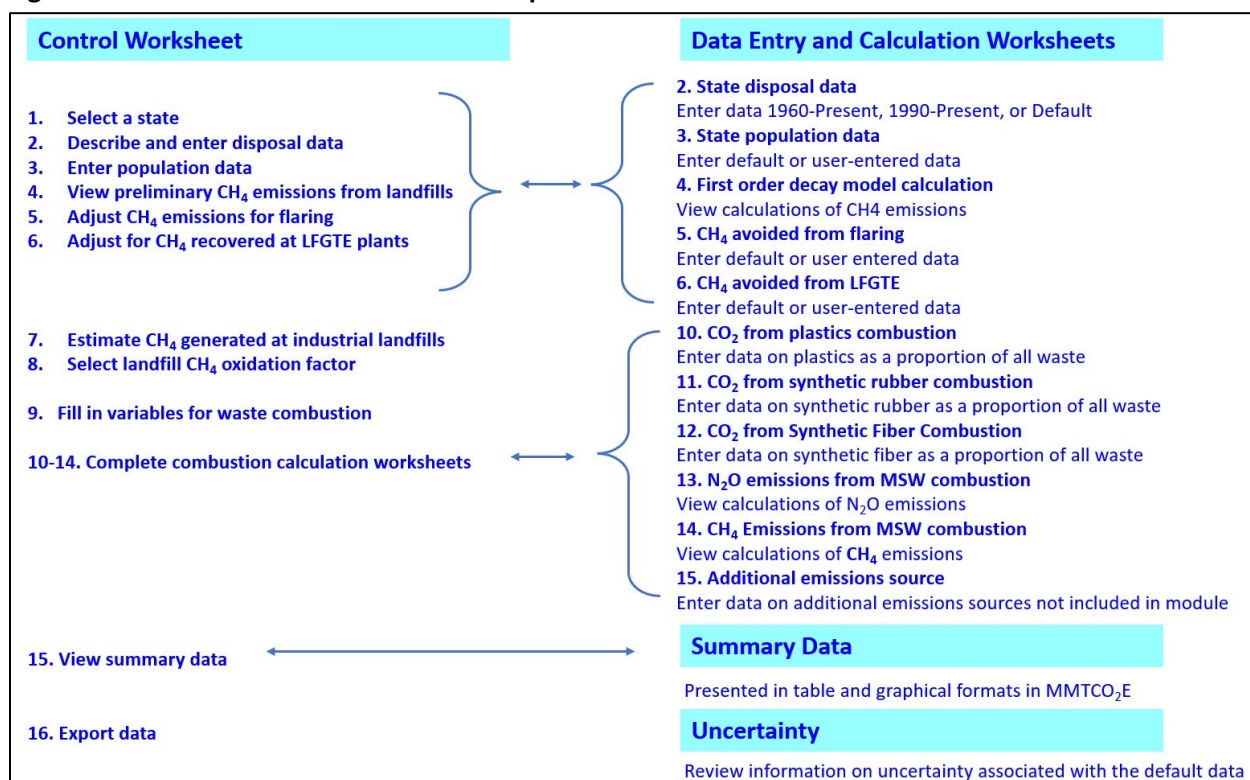
To calculate GHG emissions from municipal solid waste management, the data listed in Table 1 are required inputs (again, note that defaults are available for most of these data).

Table 1. Required Data Inputs for the Municipal Solid Waste Module

Solid Waste Sectors	Input Data
Landfills	Amount of MSW landfilled in state from 1960 through the present OR from 1990 through the present (short tons) State population data, 1960 through the present Amount of CH₄ flared/recovered at landfills (short tons) Industrial landfill CH₄ emissions, as a percent of MSW landfill emissions Percent of landfill CH₄ oxidized at the landfill surface (oxidation factor)
Waste Combustion	Fraction of plastics, synthetic rubber, and synthetic fiber that is oxidized in a combustion facility Amount of MSW combusted for 1990 through the present (short tons)
Plastic Combustion	Polyethylene terephthalate (PET) as a proportion of all MSW discards High-density polyethylene (HDPE) as a proportion of all MSW discards Polyvinyl chloride (PVC) as a proportion of all MSW discards Low-density/linear low-density polyethylene (LDPE/LLDPE) as a proportion of all MSW discards Polypropylene (PP) as a proportion of all MSW discards Polystyrene (PS) as a proportion of all MSW discards Other plastic as a proportion of all MSW discards
Synthetic Rubber Combustion	Synthetic rubber durables as a proportion of all MSW discards Synthetic rubber clothing and footwear as a proportion of all MSW discards Other synthetic rubber non-durables as a proportion of all MSW discards Synthetic rubber containers and packaging as a proportion of all MSW discards
Synthetic Fiber Combustion	Synthetic fiber as a proportion of all MSW discards

1.1.2 Tool Layout

Because the methodology of the Municipal Solid Waste module is complex, it is important to understand the module's overall design. The layout of the Municipal Solid Waste module and the purpose of its worksheets are presented in Figure 1.

Figure 1. Flow of Information in the Municipal Solid Waste Module

1.2 METHODOLOGY

This section provides a guide to using the Municipal Solid Waste module of the SIT to estimate GHG emissions from municipal solid waste management. The two sectors within the Municipal Solid Waste module, landfills and combustion, are treated separately. Steps 4 through 8 address the estimation of landfill CH₄, while Step 9 deals with combustion.

The Solid Waste module follows the general methodology from the National Inventory Report (NIR) GHG Inventory by U.S. State. However, municipal waste default data in SIT are based on national landfilling rates and state population, while the GHG Inventory by U.S. State uses GHGRP data that is scaled up to account for non-reporting landfills. Additionally, industrial waste SIT default data uses a percent of MSW emissions to estimate industrial landfill emissions (default is 7%), whereas the GHG Inventory by U.S. State uses production volumes of pulp & paper, fruit & vegetables, and meat, which is then multiplied by a country and sector specific disposal factor and used to calculate CH₄ emissions. Note that SIT estimates emission from wastewater separately in the Wastewater module.

The following steps are involved in estimating emissions using the Municipal Solid Waste module: (1) select a state; (2) describe and enter state disposal information; (3) enter population data; (4) view preliminary CH₄ emissions from landfills; (5) adjust CH₄ emissions for the amount that is flared; (6) adjust for the amount of CH₄ recovered at landfill-gas-to-energy plants; (7) estimate CH₄ generated at industrial landfills; (8) select landfill CH₄ oxidation factor; (9) fill in the variables used for waste combustion; (10)

complete the CO₂ from synthetic rubber combustion worksheet; (11) complete the CO₂ from synthetic fiber combustion worksheet; (12) complete the CO₂ from the combustion of synthetic fibers worksheet; (13) review estimates on the N₂O from MSW combustion worksheet; (14) review estimates on the CH₄ from MSW combustion worksheet; (15) add additional emission sources (optional); and (16) review summary information. Most of these steps take place on the control worksheet. The Municipal Solid Waste module will automatically calculate emissions after you make choices on the control worksheet and enter the required data on the individual sector worksheets. The tool provides default sector data for most sectors.

Step (1) Select a State

To begin, select the state you are interested in evaluating. By selecting a state, the rest of the tool will automatically reset to reflect the appropriate state default data and assumptions for use in subsequent steps of the tool.

Step (2) Describe and Enter State Disposal Data

On the control worksheet, select the radio button that corresponds to the data you would like to use as shown in Figure 2. There are three data options for entering waste disposal data:

Option 1: If you have state-specific information on waste disposal from 1960 to the present, then no further disposal or population (see Step (3)) data are needed.

Option 2: If you have state data on waste disposal for 1990 through the present, but not dating back to 1960, the module will estimate waste disposal using historical population data and national per capita landfilling rates.

Option 3: If do not have state-specific disposal data, you may use the default disposal data already loaded into the module. Default disposal data were estimated by allocating national waste disposal data (U.S. EPA 2018) to the state level on the basis of a state's historical population (U.S. Census 2023).

Clicking either of the first two user-entered data options will take you directly to a disposal data entry worksheet where you will enter annual state disposal into the yellow input cells. If you choose to use the available default disposal data provided in the module, you may navigate to the data-entry worksheet using the gray "View / Enter Data" arrow to the right of the selection buttons.

The uncertainty associated with the three state disposal options varies. The range of uncertainty represented by these three options is highly variable. Option 1 is preferable, if the state-specific data entered into the module is well-documented and comprehensive. Option 2 attempts to leverage near-term historical data and to scale national information on per capita disposal, state population, and national population information to back cast waste disposal estimates. This approach draws on several assumptions, namely that per capita generation in the state is the same as per capita generation at the national level. Option 3 has the least reliance on state information, making it the easiest, but potentially the least certain of the three options.

The module uses a statistical model, known as a first order decay (FOD) model, to calculate landfill emissions. In the FOD model, the CH₄ emission rate is a function of the quantity of waste deposited in landfills (in short tons) over the previous 30 years.

Figure 2. Example of Steps 1 through 4 on the Control Worksheet

The screenshot shows the 'State Inventory Tool - Municipal Solid Waste Module' window. Red arrows and callouts guide the user through the initial steps:

- Step 1:** 'Choose a state' points to the 'Select a State...' dropdown menu.
- Step 2:** 'Select button corresponding to the type of disposal data you have...' points to the radio buttons for 'annual disposal data' and 'no disposal data'. A callout '...or choose the default data' points to the 'I have no data...' option. Another callout 'Click here to find possible data sources.' points to a link.
- Step 3:** 'Go to data entry sheets' points to the 'View / Enter Data' button. 'Choose default or other population data' points to the radio buttons for population data.
- Step 4:** 'View preliminary CH₄ emission calculations' points to the 'Go to the Calculations Sheet' button.

Other visible elements include 'Consult EIIP Guidance', 'Reset ALL!', and a 'Landfills' section header.

Step (3) Enter Population Data

Unless you have entered disposal data for 1960 through the present, state population data will be required to calculate emissions. The module automatically uses the default population data (from U.S. Census). If you want to use population data from another source, click on the radio button indicating you would like to use your own data. This action will automatically take you to the population data entry worksheet; you may also navigate to this worksheet... using the gray arrow ("View / Enter Data") to the right of the selection buttons, as shown in Figure 4.

Landfills

Step (4) View Preliminary CH₄ Emissions from Landfills

Once you have made your selections and entered data for the previous three steps, you may view preliminary calculations of CH₄ emissions from MSW landfills in your state by clicking on the gray arrow that says "Go to the Calculations Sheet." This worksheet shows the preliminary results of the FOD model

calculations for MSW. These calculations are considered preliminary because CH₄ emissions for the amount collected and burned and the amount oxidized at the surface of the landfill is considered in later steps. The FOD model estimates the potential CH₄ emissions that occur during the inventory year, but which are associated with the waste landfilled over the past thirty years at minimum, using Equation 1.

Equation 1. First Order Decay Model Equation

$$Q_{Tx} = A \times k \times R_x \times L_o \times e^{-k(T-x)}$$

Where, Q_{Tx} = Amount of CH₄ generated in year T by the waste R_x ,

T = Current year

x = Year of waste input

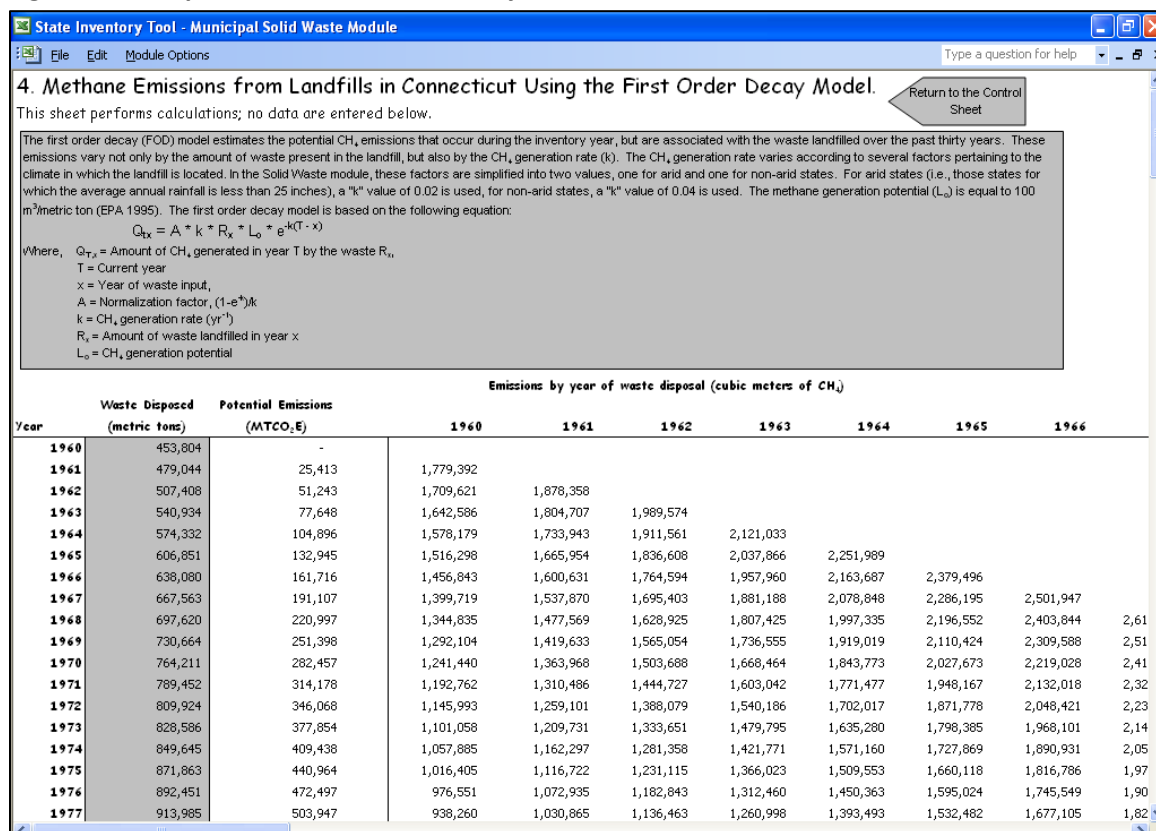
A = Normalization factor $(1-e^{-k})/k$

k = CH₄ generation rate (yr⁻¹)

R_x = Amount of waste landfilled in year x

L_o = CH₄ generation potential

As the equation shows, emissions vary not only by the amount of waste present in the landfill, but also by the CH₄ generation rate (k). The CH₄ generation rate varies according to several factors pertaining to the climate in which the landfill is located and is automatically chosen based on the selected state from Step (1). Figure 3 shows the worksheet where the FOD model is applied. It is not necessary to enter any information on this worksheet, as its purpose is to clarify how the FOD model is applied to the previously entered data.

Figure 3. Example of the First Order Decay Model Calculations Worksheet

Step (5) Adjusted CH₄ Emissions for Amount of CH₄ Flared

The control worksheet offers three options for adjusting the module to reflect the amount of CH₄ that is flared:

- Option 1: If you have state-specific data on short tons of CH₄ flared, you may enter these data by clicking on the corresponding radio button, as shown in Figure 4, and then entering your data on the Flaring worksheet;
- Option 2: If you would like to use available default data provided in the module, select to use the default amount of CH₄ flared, which is based on U.S. EPA (2024b) data; or
- Option 3: If you do not want to account for flaring of landfill gas in your state, you may choose to omit this section.

Figure 4. Example of Steps 5 through 8 on the Control Worksheet

State Inventory Tool - Municipal Solid Waste Module

5. Adjust CH₄ emissions for amount of CH₄ flared.
If methane flares are in use at landfills in your state, you can enter estimates of the gas flared. You can also use default data (if available), or omit this section. Default data comes from EPA's Landfill Methane Outreach Project (LMOP) database.

Flaring Data

☐ I have data on tons of methane flared.

☐ Use the default (based on information provided by flare vendors).

☐ Omit this section; do not account for flaring.

6. Adjust CH₄ emissions for amount of CH₄ recovered at landfill-gas-to-energy (LFGTE) projects.
If Landfill Gas to Energy (LFGTE) Projects exist in your state, enter estimates of the landfill gas recovered. You can also use default data (if available), or omit this section. Default data comes from EPA's Landfill Methane Outreach Project (LMOP) database.

Recovery Data

☐ I have data on tons of methane recovered.

☐ I do not have data; use the default (LMOP).

☐ Omit this section; do not account for LFGTE projects.

7. Estimate CH₄ generated at industrial landfills.
Methane generation from industrial landfills in the U.S. is assumed to be approximately 7% of generation from MSW landfills. You can adjust this value, if you wish, below, or enter a value of zero to omit industrial landfills from this module.

Methane emissions from industrial landfills are equal to of methane generation from MSW landfills in my state.

8. Select landfill CH₄ oxidation factor
The EPA estimates that 10% of landfill methane that is not flared or recovered is oxidized in the top layer of soil over the landfill. Methane emissions are then reduced by this "oxidation factor." This factor is affected by many factors, including latitude and soil characteristics. You may use the default or enter your own value below.

Oxidation Factor Used

Use the Default? (Check for Yes) ☐

9. Fill in the variables that are used to estimate emissions from waste combustion.
Either Type in the value/percentage or Click the Default Box.

Waste Combustion

Enter CH₄ oxidation factor

Check box for default ☐

Go to data entry sheets

Choose type of CH₄ flaring data

Choose type of LFGTE data

Enter emissions from industrial landfills %

View / Enter / Edit Data

Gas collection systems have been put in place at many landfills. At some landfills the CH₄ collected by these systems is flared. As explained in the Module Overview, the CO₂ produced by flaring is not counted as anthropogenic GHG emissions under the accounting system used in the module, so the quantity of CH₄ collected and flared may be subtracted from the total amount of MSW landfill CH₄ produced, as shown in Equation 2. Likewise, CH₄ that is collected and used to create electricity may also be subtracted, as discussed in Step (6) below.

Equation 2. Net CH₄ Emissions from Landfills

$$\text{Preliminary Net CH}_4 \text{ Emissions} = \text{Total CH}_4 \text{ Generated} - \text{CH}_4 \text{ Flared or Recovered for Energy} - \text{CH}_4 \text{ Oxidized in Landfill}$$

Step (6) Adjust for Amount of CH₄ Recovered at Landfill-Gas-to-Energy Plants

As mentioned in Step (5), some landfills collect and burn landfill gas to produce energy. Such operations are known as landfill gas to energy (LFGTE) plants. The CH₄ collected and burned as part of that landfill gas should be subtracted from the total CH₄ generation, as shown in Equation 2.

The following three options for adjusting CH₄ emissions for the amount recovered at LFGTE plants are provided on the control worksheet:

Option 1: If you have state-specific data on short tons of CH₄ burned in LFGTE facilities, you may enter those data by clicking on the corresponding radio button, as shown in Figure 6, and then entering your data on the LFGTE worksheet;

Option 2: If you would like to use default data provided in the module, select to use the default amount of CH₄ recovered at LFGTE plants, which is based on U.S. EPA (2024b) data; or

Option 3: If you do not account for CH₄ recovered at LFGTE plants, you may choose to omit this section and not account for LFGTE operations.

Step (7) Estimate CH₄ Generated at Industrial Landfills

Up to this point, all information entered in the module refers to CH₄ generated from MSW landfills. However, CH₄ is also generated from waste deposited in non-hazardous industrial landfills. Although CH₄ generation from non-hazardous industrial landfills is believed to be small relative to that from MSW landfills, industrial landfill CH₄ generation is still a significant source of CH₄ emissions. CH₄ generation from industrial landfills does not include CH₄ generation from industrial waste disposed of into MSW landfills, as these emissions have already been accounted for in the module.

The quantity of waste in industrial landfills and the quantity of CH₄ that it generates must be estimated due to a lack of data. Based on estimates of the quantity of waste in place at industrial landfills and on the estimated organic content of industrial landfills compared to MSW landfills, U.S. EPA (1993) estimated that CH₄ generation from industrial landfills in the United States is approximately 7 percent of CH₄ generation from MSW landfills in the United States, prior to adjusting for flaring and recovery or oxidation. If you have outside information, you may adjust this percent in the yellow box, as shown in Figure 6.

Step (8) View Preliminary CH₄ Emissions from Landfills

The default assumption in Step (8) of the control worksheet is that 10 percent of the CH₄ generated that is not flared or recovered is oxidized in the soil (this holds for industrial landfills also). To use the default percent, click on the check box. To use your own oxidation factor, enter it in the yellow box as shown in Figure 6. If the user-specific inputs do not match the default data in the control worksheet (i.e., the default value is overwritten), the text will appear red.

Regardless of whether a landfill gas recovery system is in place, uncollected CH₄ will pass upward through the landfill cover or surrounding soils, where it may be oxidized (Whalen, Reeburgh and Sandbeck 1990). The amount of oxidation that occurs is uncertain and depends on latitude (affecting surface soil temperature), soil characteristics, and other factors.

Waste Combustion

Step (9) View Preliminary CH₄ Emissions from Landfills

As described in the Module Overview, combustion of fossil-fuel derived materials in MSW results in emissions of anthropogenic CO₂, N₂O, and CH₄. To develop an estimate of CO₂ emissions, the module calculates combustion of the fossil-derived carbon in MSW for three waste categories: plastics, synthetic fibers (e.g. textiles), and synthetic rubber (U.S. EPA 2018). The defaults in the Municipal Solid Waste module use information on the typical composition of discards in the U.S. solid waste stream to estimate the mass of each of these waste types that is combusted and estimates the proportion of each material that comprises fossil carbon. The module defaults also assume that 98 percent of the fossil carbon is converted to CO₂ in the combustion process (with the balance remaining in the ash).

Some of the data inputs required to complete estimates of GHG emissions from waste combustion are entered on the control worksheet as shown in Figure 7, and the remaining data inputs are entered on individual calculation worksheets for each type of material, as well as for N₂O and CH₄ emissions.

Fraction of Waste Oxidized

Enter the fraction of carbon that is oxidized for each material type in the yellow boxes on the control worksheet as shown in Figure 5. To use the default percent oxidized (98 percent); use the check boxes to the right of the yellow cells. If the user-specific inputs do not match the default data in the control worksheet (i.e., the default value is overwritten), the text will appear red.

Figure 5. Example of Steps 9 through 11 on the Control Worksheet

State Inventory Tool - Municipal Solid Waste Module

Waste Combustion

9. Fill in the variables that are used to estimate emissions from waste combustion.
Either Type in the value/percentage or Click the Default Box

Fraction Oxidized	Default Fraction Oxidized	Fraction Oxidized Used	Use Default? (Check for Yes)
Plastics	98%	98%	☐
Synthetic Rubber in MSW	98%	98%	☐
Synthetic Fibers	98%	98%	☐

Enter waste combustion data for your state or use the default values

Waste Combustion Data

☐ I have data on tons of municipal solid waste combusted, 1990-2008.

☐ Use the default data.

View / Enter / Edit Data

10. - 13. Proceed to the following combustion worksheets to calculate emissions:

10. CO₂ from Plastics Combustion [Go to the Plastics Combustion Sheet](#)

11. CO₂ from Combustion of Synthetic Rubber in MSW [Go to the Synthetic Rubber Combustion Sheet](#)

12. CO₂ from Combustion of Synthetic Fibers [Go to the Synthetic Fiber Combustion Sheet](#)

13. N₂O from MSW Combustion [Go to the N₂O from MSW Combustion Sheet](#)

14. CH₄ from MSW Combustion [Go to the CH₄ from MSW Combustion Sheet](#)

15. After completing steps 1 through 14, click [View Results to proceed to the emissions summary worksheet for California](#)

[View Summary Sheet](#)

16. Export the results for use in the Synthesis tool

[Export Data](#)

Default or User-Entered Data

The module allows you to enter your own data on short tons of waste combusted in-state for the years 1990 through the present, or to use the default data, which is based on BioCycle (1991-2008). Choose the appropriate radio button; if you choose to enter your own data, this action will take you to the data entry worksheet. You may also navigate to this sheet using the gray “View / Enter / Edit Data” arrow to the right of the buttons. After completing this section of the control worksheet, go on to the combustion sector calculation worksheets.

Step (10) Complete the CO₂ from Plastics Combustion Calculation Worksheet

There are separate worksheets for each of the three types of fossil-derived MSW (plastics, synthetic rubber, and synthetic fiber) and each of the worksheets is similar in layout. An example of the plastics combustion worksheet is shown in Figure 8. Emissions are calculated using the following equation:

Equation 3. CO₂ Emissions from Combustion

CO₂ Emissions (MTCO₂E) =

$$\text{Material as Proportion of all Discards (\%)} \times \text{Total MSW Combusted (short tons)} \times \text{Carbon Content (\%)} \times \text{Fraction Oxidized (\%)} \times 44/12 \text{ (CO}_2 \text{ to C ratio)} \times 0.9072 \text{ (short tons to metric tons conversion)}$$

On the plastics combustion worksheet, enter the proportion of each type of plastic (PET, HDPE, PVC, LDPE/LLDPE, PP, PS, and other) as a percent of total discards in the blue cells. The default data are from U.S. EPA (2018) and may be selected by clicking the check box for each year, as shown in Figure 6, or by clicking the box “Select All Defaults.” Total tons of waste combusted are drawn from the data you entered in Step (9); default carbon contents are provided for each type of plastic. Once you have entered data for each year, you may proceed to the synthetic rubber combustion worksheet by clicking on the gray arrow at the top of the page.

Figure 6. Example of Plastics Combustion Calculation Worksheet

10. CO₂ from Plastics Combustion in Connecticut

In the calculation of CO₂ emissions from plastics combusted, Default values or user-supplied data are used. This value is then multiplied by the proportion of combusted waste, and the fraction oxidized to determine CO₂ emissions. These values are then converted to MTCO₂E. The methodology and factors used for these calculations are discussed in detail in Solid Waste Chapter of the User's Guide.

Return to the Control Sheet | Go to the Synthetic Rubber Combustion Sheet

Select All Defaults | Clear All Data

CO₂ from Plastics Combustion 1990 ☒ Default Proportion of Discards?

Plastics	Proportion of Discards	State MSW Combusted (short tons)	Carbon Content	Fraction Oxidized	Emissions (MTCE)	Emissions (MTCO ₂ E)
PET	9.7%	1,711,000	79%	0.98	116,678	427,819
HDPE	0.7%	1,711,000	63%	0.98	6,850	
PVC	1.7%	1,711,000	86%	0.98	22,250	
LDPE/LLDPE	0.8%	1,711,000	38%	0.98	4,747	
PP	2.7%	1,711,000	86%	0.98	35,600	
PS	15%	1,711,000	96%	0.98	19,636	72,000
Other	12%	1,711,000	92%	0.98	16,963	62,198
	1.1%	1,711,000	66%	0.98	10,632	38,986

CO₂ from Plastics Combustion 1991 ☒ Default Proportion of Discards?

Plastics	Proportion of Discards	State MSW Combusted (short tons)	Carbon Content	Fraction Oxidized	Emissions (MTCE)	Emissions (MTCO ₂ E)
PET	10.8%	1,885,000	79%	0.98	143,006	524,355
HDPE	0.8%	1,885,000	63%	0.98	8,396	30,784
PVC				0.98	27,270	99,991
LDPE/LLDPE				0.98	5,818	21,331
PP				0.98	43,633	159,986
PS	13%	1,885,000	92%	0.98	24,067	88,246
Other	12%	1,885,000	66%	0.98	20,791	76,233
				0.98	13,032	47,783

CO₂ from Plastics Combustion 1992 ☒ Default Proportion of Discards?

Plastics	Proportion of Discards	State MSW Combusted (short tons)	Carbon Content	Fraction Oxidized	Emissions (MTCE)	Emissions (MTCO ₂ E)
PET						
HDPE						
PVC						
LDPE/LLDPE						
PP						
PS						
Other						

Step (11) Complete the CO₂ from Synthetic Rubber Combustion Calculation Worksheet

The synthetic rubber combustion worksheet is identical to the plastic combustion worksheet, except that it calculates emissions for durable goods, non-durable goods (clothing and footwear, and other non-durables), and packaging and containers made of synthetic rubber. Enter the proportion of each

type of rubber in the green cells as a percent of total discards, or select the default data (U.S. EPA 2018). Once you have entered data for each year, you may proceed to the synthetic fiber combustion worksheet by clicking on the gray arrow at the top of the page.

Step (12) Complete the CO₂ from Synthetic Fiber Combustion Calculation Worksheet

Again, this worksheet is identical to the worksheets for plastic and synthetic rubber combustion. Enter synthetic fiber as a proportion of all discards, in the orange cells, or choose the default proportions. The carbon content provided is a weighted average of the carbon contents of the major synthetic fibers used in the United States. Once you have entered data for each year, you may proceed to the N₂O from MSW combustion worksheet by clicking on the gray arrow at the top of the page.

Step (13) Review Estimates on the N₂O from MSW Combustion Calculation Worksheet

This worksheet does not require any data inputs; it presents an example of how the emissions are calculated based on the following equation (the emission factor is from U.S. EPA 2025):

Equation 4. N₂O Emissions from Combustion

$$\text{N}_2\text{O Emissions (MTCO}_2\text{E)} = \text{MSW Combusted (short tons)} \times 0.00005 \text{ (emission factor in tons N}_2\text{O/ton MSW)} \times 265 \text{ (N}_2\text{O GWP)} \times 0.9072 \text{ (short tons to metric tons conversion)}$$

Step (14) Review Estimates on the CH₄ from MSW Combustion Calculation Worksheet

This worksheet does not require any data inputs; it presents an example of how the emissions are calculated based on the following equation (the emission factor is from U.S. EPA 2025):

Equation 5. CH₄ Emissions from Combustion

$$\text{CH}_4 \text{ Emissions (MTCO}_2\text{E)} = \text{MSW Combusted (short tons)} \times 0.00002 \text{ (emission factor in tons CH}_4\text{/ton MSW)} \times 28 \text{ (CH}_4\text{ GWP)} \times 0.9072 \text{ (short tons to metric tons conversion)}$$

Step (15) Enter Additional Emissions Sources to Additional Emissions Sources Worksheet if Applicable

Users may use this worksheet to input data about additional emissions sources that are not included in this module or any other module. Additional emissions sources should be reported in MMTCO₂e. Figure 7 shows two options for entering data into this worksheet (please select only one):

Option A: Add up to ten additional emission sources in column B, lines 10-19. Select CO₂, N₂O, or CH₄ from the dropdown menu in column C. Enter the emissions in MMTCO₂e for each year 1990-2021 in the yellow cells.

Option B: Enter the total CO₂, N₂O, or CH₄ emissions (lines 30-32) for all other emissions sources for each year 1990-2021 in the yellow cells in MMTCO₂e.

Figure 7. Example Additional Emissions Sources Worksheet

B15

2. (OPTIONAL) Additional Emission Sources for Select a State. . .

Click here to find where these data are

Additional Emission Sources Data
Please use the "Additional Emission Sources" section of this sheet to enter any additional emission sources you would like to include in the inventory that are not captured in this or any other module. There are two options for entering data in this worksheet (please select only one).

Option A: Add up to ten additional emission sources in the column B, lines 10-19. Select CO₂, CH₄, or N₂O from the dropdown menu in column C. Enter the emissions in MMTCO₂e for each year 1990-2021 in the yellow cells.

Option B: Enter the total CH₄ (row 30), CO₂ (line 31), or N₂O (line 32) emissions for all other emissions sources for each year 1990-2021 in the yellow cells in MMTCO₂e.

If waste disposal estimates were based on population, assess additional emissions sources carefully to avoid double counting. For emission sources that do not have any default data or are not accounted for within the State Inventory Tool, state-level data are available here: <https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals>

Return to the Control Sheet

Clear All Data

Additional Emission Sources (MMTCO₂e)

Option A

Source	Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003

Please enter a brief description of these emissions (e.g., Plastics Combustion). This is for your reference only.

Option A Totals:

Additional Methane Emissions	CH ₄	
Additional Carbon Dioxide Emissions	CO ₂	
Additional Nitrous Oxide Emissions	N ₂ O	

Option B

Additional Methane Emissions	CH ₄	
Additional Carbon Dioxide Emissions	CO ₂	
Additional Nitrous Oxide Emissions	N ₂ O	

Step (16) Review Summary Information

The steps above provide estimates of total emissions and reductions from municipal solid waste management. The information from the control worksheet and data entry worksheets is collected on the summary worksheet, which displays results in million metric tons of carbon dioxide equivalent (MMTCO₂e). Figure 8 shows the summary worksheet that sums the emissions from all sectors in the Municipal Solid Waste module. In addition, the results are displayed in graphical format at the bottom of the summary worksheets.

Figure 8. Example of the Emissions Summary Worksheet in the Municipal Solid Waste Module

State Inventory Tool - Municipal Solid Waste Module

File Edit Module Options Type a question for help

1.4 Connecticut Emissions Summary

This Worksheet Provides a Summary of Emissions from Landfills and Waste Combustion Once All Control Steps Have Been Completed.

Return to the Control Sheet Review discussion of uncertainty associated with these results

Emissions were not calculated for the following sources: Waste Combustion- Synthetic Rubber.

Total Emissions from Landfills and Waste Combustion (MMTCO₂E)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CH ₄	0.855	0.879	0.873	0.793	0.784	0.770	0.762	0.753	0.63
CO ₂	0.545	0.669	0.579	0.496	0.689	0.705	0.737	0.758	0.85
N ₂ O	0.021	0.023	0.020	0.016	0.023	0.023	0.022	0.022	0.02
Total	1.420	1.572	1.473	1.305	1.495	1.497	1.520	1.533	1.51

CH₄ Emissions from Landfills (MTCO₂E)

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Potential CH₄	949,517	976,917	970,140	969,933	959,418	943,906	934,997	925,605	916,57
MSW Generation	887,399	913,007	906,672	906,479	896,653	882,156	873,829	865,051	856,60
Industrial Generation	62,118	63,910	63,467	63,454	62,766	61,751	61,168	60,554	59,96
CH₄ Avoided	-	-	-	(88,858)	(88,858)	(88,858)	(88,858)	(88,858)	(211,56)
Flare	-	-	-	-	-	-	-	-	-
Landfill Gas-to-Energy	-	-	-	(88,858)	(88,858)	(88,858)	(88,858)	(88,858)	(211,56)
Oxidation at MSW Landfills	88,740	91,301	90,667	81,762	80,779	79,330	78,497	77,619	64,50
Oxidation at Industrial Landfills	6,212	6,391	6,347	6,345	6,277	6,175	6,117	6,055	5,99
Total CH₄ Emissions	854,565	879,226	873,126	792,967	783,504	769,544	761,525	753,072	634,50

1.3 UNCERTAINTY

In the upper right-hand corner of the summary worksheet is a button: “Review discussion of uncertainty associated with these results.” By clicking on this button, you are taken to a worksheet that discusses the uncertainty surrounding the activity data and emission factors, and how the uncertainty estimates for this source category affect the uncertainty of the emission estimates for your state.

1.4 REFERENCES

BioCycle. 1991-2008. “The State of Garbage in America: Annual Nationwide Survey.” *BioCycle*.

M. Desai, V. Camobreco, T. Hedger, W. Irving, K. Rewcastle, J. Steller, L. Barbieri, M. Weitz, T. Murumkar, A. Fawcett, J. Lou, R. Cui, and N. Hultman. (2026). Greenhouse Gas Inventory and Analysis for the United States: 1990-2024. Center for Global Sustainability, University of Maryland, College Park.

U.S. Census Bureau. 2023. *Press Kit: Vintage 2023 National and State Population Estimates*. U.S. Census Bureau, Washington, DC. Available online at: <https://www.census.gov/newsroom/press-kits/2023/national-state-population-estimates.html>.

U.S. EPA. 1993. *Anthropogenic Methane Emissions in the United States: Report to Congress*. Global Change Division, Office of Air and Radiation, U.S. Environmental Protection Agency, EPA/430-R-93-003. Washington, DC.

U.S. EPA. 2018. *Advancing Sustainable Materials Management Facts and Figures*. Available online at: <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management>.

U.S. EPA. 2024a. Methodology report for inventory of U.S. greenhouse gas emissions and sinks by state: 1990–2022 (EPA-430-R-24-006). September. https://www.epa.gov/system/files/documents/2024-09/method-report_ghgibystate-508-september.pdf

U.S. EPA. 2024b. Landfill Gas-to-Energy Project Database 2024, Landfill Methane and Outreach Program. Obtained from EPA on September 16, 2024. State-level data are available online at: <https://www.epa.gov/lmop/project-and-landfill-data-state>.

U.S. EPA. (2025). Inventory of U.S. greenhouse gas emissions and sinks: 1990–2023 (EPA 430-R-25-003) [Unpublished annual report released via Freedom of Information Act Request]

Whalen, S.C., W.S. Reeburgh, and K.A. Sandbeck. 1990. “Rapid Methane Oxidation in a Landfill Cover Soil,” *Applied and Environmental Microbiology*. November 1990.