

State Inventory Tool

User Guide for Estimating Carbon Dioxide And Methane Emissions From Natural Gas and Oil Systems

SEPTEMBER 2026

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.

Modules and User Guides updates prepared by:

ICF

Prepared for:

Center for Global Sustainability, University of Maryland

This section of the User Guide provides instruction on using the Natural Gas and Oil Systems module of the State Inventory Tool (SIT), and describes the methodology used for estimating greenhouse gas emissions from natural gas and oil systems at the state level.

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1.1MODULE OVERVIEW

This User Guide accompanies and explains the Natural Gas and Oil Systems 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 2025) and related disaggregated data by state. Users can refer to the chapters and annexes of the U.S. Inventory to obtain additional information not found in the SIT or in the companion User Guide. 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 Natural Gas and Oil Systems module calculates methane (CH₄) and carbon dioxide (CO₂) emissions from natural gas systems (including production, transmission, venting and flaring, and distribution) and petroleum systems (including production, refining, and transport). The module does not currently include post-meter or abandoned oil or gas wells. The module provides default data for all emission factors and provides some activity data; however, EPA encourages the use of more comprehensive data sources if they are available. Currently default data are not available in the SIT for the transmission, and distribution of natural gas or the refining, and transportation of oil. If using outside data sources, or for a more thorough understanding of the module, please refer to the following discussion for data requirements and methodology.

1.1.1 Data Requirements

To calculate CH₄ and CO₂ emissions from natural gas and oil systems, the following data are required:

- The number of wells and offshore platforms;
- Amount of natural gas vented and flared;
- The number of miles of gathering pipeline;
- The number of gas processing plants and compressor stations;
- The number of miles of transmission pipeline;
- The number of miles of distribution pipeline, if possible, by type (e.g., cast iron, steel, plastic)

- The total number of services (e.g., gas meters);
- Data on oil production, refining, and transportation; and
- Emission factors for each of the above activities.

A complete list of the activities for which activity data and emission factors are necessary to complete the Natural Gas and Oil Systems module is provided in Table 1.

Table 1. Data Requirements for the Natural Gas and Oil Systems Module

Module Worksheet	Activity Data and Emission Factors Required
Natural Gas - Production	Number of wells Number of shallow-water off-shore platforms Number of deep-water off-shore platforms Emission factors for all of the above (MT CH ₄ /well or platform)
Natural Gas - Transmission	Miles of gathering pipeline Number of gas processing plants Number of gas transmission compressor stations ¹ Number of gas storage compressor stations ¹ Miles of transmission pipeline Number of LNG storage compressor stations Emission factors for all of the above (MT CH ₄ /unit)
Natural Gas - Distribution	Miles of cast iron distribution pipeline ² Miles of unprotected steel distribution pipeline ² Miles of protected steel distribution pipeline ² Miles of plastic distribution pipeline ² Number of services Number of unprotected steel services Number of protected steel services Emission factors for all of the above (MT CH ₄ /unit) Emission factor for alternate method* (MT CH ₄ /per mile of distribution pipeline)
Natural Gas - Venting and Flaring	Billion BTUs of natural gas vented and flared Emission factor (MT CO ₂ /Billion Btu natural gas vented and flared)
Petroleum Systems	Barrels of oil produced Barrels of oil refined Barrels of oil transported Emission factor (kg CH ₄ /1000 barrels)

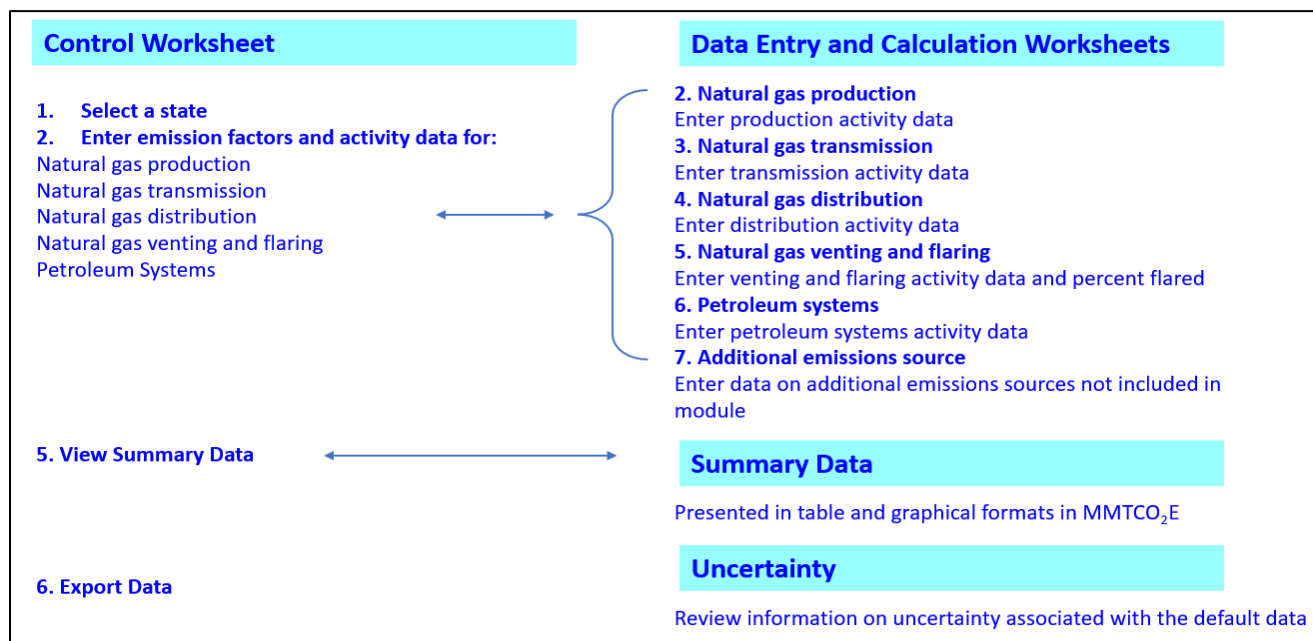
¹ An alternate method is available in which only total transmission pipeline miles are required, and the number of gas transmission and storage compressor stations is calculated based on this entry.

² An alternate method is available in which only total distribution pipeline miles are required, rather than by pipeline type.

1.1.2 Tool Layout

Because there are multiple sections to complete within the Natural Gas and Oil Systems module, it is important to understand the module's overall design. The layout of the Natural Gas and Oil Systems module and the purpose of its worksheets are presented in Figure 1.

Figure 1. Flow of Information in the Natural Gas and Oil Systems Module*



* These worksheets are the primary worksheets used in the Natural Gas and Oil Systems module; subsequent worksheets are used to populate the default data and are provided for informational purposes only.

1.2 METHODOLOGY

This section provides instructions for using the Natural Gas and Oil Systems module of the SIT to estimate fugitive emissions from natural gas and oil systems. Emissions are calculated for several subcategories, including the production, flaring, transmission, and distribution of natural gas and the production, refining, and transportation of oil. Within the Natural Gas and Oil Systems module, it is important to account for emissions from natural gas and petroleum systems

Box 1: State Energy Data Sources

Note that no default activity data are available for the transmission or distribution of natural gas. If state-specific data sources are not available, users can obtain much of the required data from the Energy Information Administration (EIA) (<http://eia.doe.gov>). The Mineral Management Services (MMS) also provides a comprehensive source of data for off-shore oil and gas production activities (<http://www.mms.gov>). In addition, the Office of Pipeline Safety (OPS) has detailed and exhaustive data on all kinds of pipeline (transmission, gathering, distribution, services) that is accessible to the public on its website (<http://ops.dot.gov/stats.htm>). The SIT has more detailed recommendations for data sources for each activity on the gas and oil data sources worksheets.

separately because the emission factors and methods are fuel specific. Because the methodology differs for each subcategory, they are discussed separately, and specific examples are provided.

The Natural Gas and Oil Systems module automatically calculates emissions after you enter activity data for each worksheet (and select or enter the emission factors on the control worksheet). The tool provides default data for venting and flaring of natural gas and the number of natural gas wells, but data must be obtained for the remaining subcategories (see Box 1 for suggestions on where to find data). The exclusion of default data for transmission and distribution and refining and transportation of oil causes the NGO module's estimates to be much lower than U.S. Inventory.

Not all GHG Inventory by U.S. State sources are included in SIT (e.g., meters in distribution segment, post-meter, abandoned oil and gas wells). SIT does not have default data for the transmission and distribution of natural gas or the refining and transportation of oil, while the Inventory by U.S. State includes emissions estimates for all components of fossil fuel related activities, including production, transmissions, storage, and distribution as well as abandoned wells.

This User's Guide provides an overview of the estimation methodology used in the Natural Gas and Oil Systems module by walking through the following steps: (1) select a state; (2) enter emission factors and activity data for natural gas production; (3) enter emission factors and activity data for natural gas transmission; (4) enter emission factors and activity data for natural gas distribution; (5) enter emission factors and activity data for natural gas venting and flaring; (6) enter emission factors and activity data for petroleum systems; (7) enter additional emission sources; and (8) review summary information.

For all subcategories, the basic process is to multiply the activity data by the emission factor to obtain the emission estimate, which is then converted to million metric tons carbon dioxide equivalent (MMTCO₂E) by multiplying by the GWP of CH₄ (28) and dividing by 10⁶. The general equation used to calculate emissions from natural gas systems is shown in Equation 1. The equation used for venting and flaring of natural gas is similar but includes the flaring percent and does not include the GWP because emissions are already in units of CO₂, as shown in Equation 2. The equation used for petroleum systems is shown in Equation 3.

Equation 1. General Emission Equation for Natural Gas Systems

$$\begin{aligned} \text{Emissions (MMTCO}_2\text{E)} = \\ \text{Activity Data} \times \text{Emission Factor (MT CH}_4\text{/unit activity data)} \times 28 \text{ (GWP)} \\ \div 1,000,000 \text{ (MT/MMT)} \end{aligned}$$

Equation 2. Emission Equation for Venting and Flaring of Natural Gas

$$\begin{aligned} \text{Emissions (MMTCO}_2\text{E)} = \\ \text{Activity Data (BBtu)} \times \text{Emission Factor (MT CO}_2\text{/BBtu)} \times \% \text{ flared} \div \\ 10^6 \text{ (MT/MMT)} \end{aligned}$$

Equation 3. General Emission Equation for Petroleum Systems

$$\text{Emissions (MMTCO}_2\text{E)} = \text{Activity Data ('000 barrels)} \times \text{Emission Factor (kg CH}_4\text{'000 barrels)} \times 1,000 \text{ (kg/MT)} \times 28 \text{ (GWP)} \div 10^6 \text{ (MT/MMT)}$$

Step (1) Select a State

To begin, select the state for which you would like to perform the analysis. This step will automatically select the appropriate state default data for the remainder of the calculations throughout the tool.

**Step (2) Enter Emission Factors and Activity Data for Natural Gas Production
Control Worksheet**

On the control worksheet, either select the default data provided or enter user-specified gas and activity-specific emission factors that will be used throughout the tool. To proceed with the default emission factors, select the “Check/Uncheck All” button or check the default box directly to the right of individual yellow input cells. Note that these numbers can be overwritten if you discover that the data for your state differ from the default data provided by the tool. To enter user-specified inputs, enter data directly into the yellow input 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. See Figure 2 for locations of the “Check/Uncheck All” buttons, individual default check boxes, and yellow input cells. Information on emission factors is discussed below.

Figure 2. Control Worksheet for the Natural Gas and Oil Systems Module

State Inventory Tool - Natural Gas and Oil Systems

File Edit Module Options

State Inventory Tool - Emissions from Natural Gas and Oil Systems

1. Choose a State. California Consult EIIIP Guidance Reset ALL!

2. - 5. Enter emission factors and activity data for natural gas production and proceed to the respective worksheets to enter activity data.

Either type in the value or click the default box.

Emission factors express the amount of methane emitted per activity unit (e.g. per mile of pipeline, per transmission compressor station, etc.) or the amount of carbon dioxide emitted per activity unit (e.g. per Btu of natural gas vented and flared) each year. The default values are based on national data. Please use state-specific data whenever possible.

Natural Gas Emission Factors

Activity	Default Emission Factor	Factor Used	Use Default (Check for Yes)
2. Enter Emission Factors and Activity Data for Natural Gas Production			
Metric tons of CH ₄ per Well	Variable by year	Variable by year	☒
Metric tons of CH ₄ per shallow water off-shore platforms in the Gulf of Mexico and Pacific	134.8	134.82	☒
Metric tons of CH ₄ per deepwater off-shore platforms in the Gulf of Mexico and Pacific	558.5	558.54	☒
3. Enter Emission Factors and Activity Data for Natural Gas Transmission			
Metric tons of CH ₄ per mile of gathering pipeline	0.40	0.40	☒
Metric tons of CH ₄ per gas processing plant	1250	1249.95	☒
Metric tons of CH ₄ per gas transmission compressor station	984	983.66	☒
Metric tons of CH ₄ per gas storage compressor station	964	964.15	☒
Metric tons of CH ₄ per mile of transmission pipeline	0.62	0.62	☒
Metric tons of CH ₄ per LNG storage compressor station	1185	1184.99	☒
4. Enter Emission Factors and Activity Data for Natural Gas Distribution			
Two methodologies for calculating emissions are presented below. If you have emission factors and data available for the preferred methodology, please estimate emissions for this methodology. Otherwise, please use the alternate methodology.			
Preferred Methodology			
Metric tons of CH ₄ per mile of cast iron distribution pipeline	5.80	5.80	☒
Metric tons of CH ₄ per mile of unprotected steel distribution pipeline	2.12	2.12	☒
Metric tons of CH ₄ per mile of protected steel distribution pipeline	0.060	0.060	☒
Metric tons of CH ₄ per mile of plastic distribution pipeline	0.37	0.37	☒
Alternate Methodology			
Metric tons of CH ₄ per mile of distribution pipeline	0.54	0.54	☒
Metric tons of CH ₄ per service	0.015	0.0153	☒
Metric tons of CH ₄ per unprotected steel services	0.033	0.0328	☒
Metric tons of CH ₄ per protected steel services	0.003	0.0034	☒
5. Enter Emission Factors and Activity Data for Natural Gas Venting and Flaring			
Metric tons of CO ₂ per Billion BTUs of natural gas vented and flared	54.7	54.71	☒

Click here to begin [Natural Gas - Production](#) [Natural Gas - Transmission](#) [Natural Gas - Distribution](#) [Natural Gas - Venting/Flaring](#) [Petroleum Systems](#) [Summary](#) [Uncertainty](#) [Gas T](#)

Annotations:

- Select All Defaults:** Points to the "Check / Uncheck All" button.
- Required Data:** Points to the "Factor Used" column for production and transmission activities.
- Individual Default Data Check Boxes:** Points to the "Use Default (Check for Yes)" column for distribution activities.

Default emission factors are provided in the Natural Gas and Oil Systems module for all natural gas and petroleum system activities, or they can be provided by the user. Examples of the emission factors being used are shown in each of the specific sector worksheet figures shown in subsequent steps.

The emission factors for natural gas systems, except production, are based on a number of sources including the Greenhouse Gas Reporting Program (GHGRP), a study by the Gas Research Institute and the U.S. Environmental Protection Agency (GRI 1996)—especially for earlier years of the time series--and several other more recent studies.

To simplify the amount of data required in the SIT, each of the default emission factors provided accounts for emissions from several activities. For example, the default emission factor for natural gas production per well approximates emissions not just from wells but also from pneumatic devices, dehydrator vents, Kimray pumps, gas engines, and well clean-ups. Therefore, if users are supplying state-specific emission factors, all aspects of emissions must be considered.

For the natural gas production sector, enter emission factors on the control sheet in the yellow cells. The default emission factors for natural gas wells vary by year and region, while the default emission factors for offshore deep-water and shallow-water platforms do not vary by region or year. The emission factors for natural gas well production are based on the emission factors used in U.S. EPA (2025)

Natural Gas Production Worksheet

Most gas production is from gas or oil wells. Gathering lines are used to bring raw gas to a collection point or points within a production field. Because CH_4 is the major component of natural gas, leaks or venting from the gathering systems result in CH_4 emissions.

Natural gas is usually processed in gas plants to remove and process the natural gas liquids and to prepare the natural gas for pipeline transportation. During processing, natural gas is dried, and a variety of processes may be used to remove most of the heavier hydrocarbons, or condensate, from the gas. Processed gas is then injected into the natural gas transmission system, and the heavier hydrocarbons are marketed separately. Major CH_4 emission sources in the gas processing are compressor fugitives, compressor exhaust, vents, pneumatic devices, and blowdown.

On the natural gas production worksheet, shown in Figure 3, the orange cells indicate where the required activity data are entered manually. Default data for natural gas well production from EIA (2026) is available for most states. Emissions are calculated by multiplying activity data by the appropriate emission factor to obtain the total CH_4 emissions in metric tons. Then, the total emissions are converted into MMTCO_2E , by multiplying by the GWP for CH_4 (28) and dividing by 10^6 (Equation 1).

Figure 3. Example of Activity Data and Emission Factors Applied in the Natural Gas Production Worksheet

2. Emissions from Natural Gas Production Activities in California

Click here to find where these data are available.

Emissions from Natural Gas Production are calculated as the sum of emissions from the three categories of production sites: onshore wells, offshore shallow water platforms in the Gulf of Mexico and Pacific, and offshore deepwater platforms in the Gulf of Mexico and Pacific. The number of gas production sites (wells or platforms) is multiplied by a site-specific emission factor. These values are then converted to metric tons of CO₂ equivalent and metric tons of carbon equivalent, and summed across the three types of production sites. Note that default emission factors are available through 2022. To facilitate emission calculations for 2023, the tool utilizes 2022 emission factors as proxies for emission factors 2023-2025. Emission factors for 2023 will be updated as soon as new data become available. For further details, refer to the Methane Emissions from Natural Gas and Oil Systems Chapter of the User's Guide.

Return to Control Sheet Go to Summary Sheet

Check All Boxes Clear All Data

Natural Gas - Production 1990

☒ Default Activity Data

Activity Data	Emission Factor metric tons CH ₄ per year per activity unit	Metric Tons CH ₄	Emission Factors
Total number of wells	1,952	10.46	11,725
Number of shallow water off-shore platforms in the Gulf of Mexico and Pacific	8899.00	-	-
Number of deepwater off-shore platforms in the Gulf of Mexico and Pacific	93836.00	-	-
Total		11,725	0.33

Natural Gas - Production 1991

☒ Default Activity Data

Activity Data	Emission Factor metric tons CH ₄ per year per activity unit	Metric Tons CH ₄	MMTCO ₂ E
Total number of wells	1,377	10.46	14,403
Number of shallow water off-shore platforms in the Gulf of Mexico and Pacific	8899.00	-	-
Number of deepwater off-shore platforms in the Gulf of Mexico and Pacific	93836.00	-	-
Total		14,403	0.40

Natural Gas - Production 1992

☒ Default Activity Data

Activity Data	Emission Factor metric tons CH ₄ per year per activity unit	Metric Tons CH ₄	MMTCO ₂ E
Total number of wells	1,126	10.83	12,195
Number of shallow water off-shore platforms in the Gulf of Mexico and Pacific	8899.00	-	-
Number of deepwater off-shore platforms in the Gulf of Mexico and Pacific	93836.00	-	-
Total		12,195	0.34

Step (3) Enter Emission Factors and Activity Data for Natural Gas Transmission

Transmission pipelines are large diameter, high-pressure lines that transport gas from production fields, processing plants, storage facilities, and other sources of supply over long distances to local distribution companies or to large volume customers. A variety of facilities support the overall system, including metering stations, maintenance facilities, and compressor stations located along pipeline routes. Compressor stations, which maintain the pressure in the pipeline, generally include upstream scrubbers, where the incoming gas is cleaned of particles and liquids before entering the compressors. Reciprocating engines and turbines are used to drive the compressors. Major CH₄ emission sources are chronic leaks, compressor fugitives, compressor exhaust, vents, and pneumatic devices.

Control Worksheet

On the control sheet, enter emission factors (in metric tons of CH₄ per unit) for gathering pipeline, gas processing plants, gas transmission compressor stations, gas storage compressor stations, transmission pipeline, and LNG storage compressor stations.

Natural Gas Transmission Worksheet

For the transmission worksheet, an alternate method is available if data on the number of gas transmission and storage stations is not accessible. To use the alternate method, check the box at the top of each year's calculations, and make sure to enter 'miles of transmission pipeline' in the activity data. The tool will then estimate the quantity of these stations based on transmission pipeline mileage. An example of the transmission worksheet is shown in Figure 4 (input cells shown in blue).

Figure 4. Example of Activity Data and Emission Factors Applied in the Natural Gas Transmission Worksheet

State Inventory Tool - Natural Gas and Oil Systems

File Edit Module Options Type a question for help

3. Emission from Natural Gas Activities in California

Click here to find where these data are available.

Emissions from Natural Gas Transmission are calculated as the sum of methane emissions from the pipelines that transport gas, the gas processing stations, the transmission compressor stations, and gas storage compressor facilities. Emissions from each source are calculated as the product of the activity factor (e.g., miles of pipeline or number of stations) and the source-specific emission factor. Source emissions are converted to metric tons of CO₂ equivalent and metric tons of carbon equivalent, and then summed. For further details, refer to the Methane Emissions from Natural Gas and Oil Systems Chapter of the User's Guide.

If your state does not have data about the number of gas transmission and storage stations, then check the boxes below. You will still need to enter 'Miles of transmission pipeline'. The tool will then estimate the quantity of these stations based on transmission pipeline mileage that you enter, using the factors below. In either case, be sure to enter data in the cells marked with an arrow -->

Return to Control Sheet
Check All Boxes
Clear All Data

Number Of Gas Transmission Compressor Stations/Mile of Transmission Pipeline 0.0060 Number Of Gas Storage Compressor Stations/Mile of Transmission Pipeline 0.0015

Check box if no data for compressor stations

Natural Gas - Transmission 1990 ☒ Check if you don't have data for gas transmission and storage compressor stations for this year.

Activity Data	Emission Factor metric tons CH ₄ per year per activity unit	Metric Tons CH ₄	MMTCO ₂ E	MMTCE
Miles of gathering pipeline				
Number of gas processing plants				
Number of LNG storage compressor stations				
Miles of transmission pipeline	0.8			
Number of gas transmission compressor stations	982.7			
Number of gas storage compressor stations	964.1			
Total				

Required Activity Data **Emission Factors**

Natural Gas - Transmission 1991 ☒ Check if you don't have data for gas transmission and storage compressor stations for this year.

Activity Data	Emission Factor metric tons CH ₄ per year per activity unit	Metric Tons CH ₄	MMTCO ₂ E	MMTCE
Miles of gathering pipeline	0.4			
Number of gas processing plants	1249.3			
Number of LNG storage compressor stations	1185.0			
Miles of transmission pipeline	0.8			

Control Natural Gas - Production Natural Gas - Transmission Natural Gas - Distribution Natural Gas - Venting Flaring Petroli

Step (4) Enter Emission Factors and Activity Data for Natural Gas Distribution

Distribution pipelines are extensive networks of generally small diameter, low-pressure pipelines. Gas enters distribution networks from transmission systems at city gate stations, where the pressure is reduced for distribution within cities or towns. Major CH₄ emission sources are chronic leaks, meters, regulators, and mishaps.

Control Worksheet

If you are using the preferred method of calculating emissions from natural gas distribution, enter emission factors (in metric tons of CH₄ per mile of pipeline) for cast iron distribution pipeline, unprotected steel distribution pipeline, protected steel distribution pipeline, and plastic distribution pipeline. If you are using the alternate method, you need only enter an emission factor of metric tons of

CH₄ per mile of distribution pipeline (all types of pipeline). Then for both methods, enter the emission factors for all natural gas services (i.e., end-users), for unprotected steel services, and for protected steel services.

Natural Gas Distribution Worksheet

For distribution, states are encouraged to use the method provided for calculating emissions from specific types of distribution pipeline. However, an alternate method is offered based on a single emission factor for total distribution pipeline. If data are unavailable for the mileage of specific pipeline types, then check the box at the top of each year's calculations and enter the total pipeline mileage where indicated. The green input cells in Figure 5 show where activity data are required.

Figure 5. Example of Activity Data and Emission Factors Applied in the Natural Gas Distribution Worksheet

4. Emissions from Natural Gas Activities in California

Emissions from Natural Gas Distribution are calculated as the sum of emissions from distribution pipelines and end services. The activity factor for each type of pipeline (e.g., miles of plastic distribution pipeline) is multiplied by the corresponding emission factor. The number of services is multiplied by a general emission factor and type-specific emission factors. Pipeline and service emissions are then converted to metric tons of CO₂ equivalent and metric tons of carbon equivalent, and summed. For further details, refer to the Methane Emissions from Natural Gas and Oil Systems Chapter of the User's Guide.

States are encouraged to use the preferred method for calculating emissions from distribution pipeline. Distribution material can be obtained from the OPS website for each state and year. If you cannot obtain data on the mileage, then check the boxes below. The tool will then estimate emissions from these sources based on a single emission pipeline. Enter data in the cells marked by the arrow -->.

Return to Control Sheet
Check All Boxes

Natural Gas - Distribution 1990 ☒ Check here if you wish to use the alternative method for this year

Activity Data	Emission Factor	Metric Tons CH ₄	MMTCO ₂ E	MMTCE
metric tons CH ₄ per year per activity unit				
Distribution pipeline				
Preferred Method				
Miles of east iron distribution pipeline	5.80			
Miles of unprotected steel distribution pipeline	2.12			
Miles of protected steel distribution pipeline	0.06			
Miles of plastic distribution pipeline	0.37			
Alternate Method				
Total miles of distribution pipeline				
Services				
Total number of services	0.02			
Number of unprotected steel services	0.03			
Number of protected steel services	0.00			
Total				

Natural Gas - Distribution 1991 ☐ Check here if you wish to use the alternative method for this year

Activity Data	Emission Factor	Metric Tons CH ₄	MMTCO ₂ E	MMTCE
metric tons CH ₄ per year per activity unit				
Distribution pipeline				
Preferred Method				

Step (5) Enter Emission Factors and Activity Data for Natural Gas Venting and Flaring

Control Worksheet

Enter the emission factor for natural gas venting and flaring on the control worksheet. This emission factor must account for both vented and flared natural gas.

Natural Gas Venting and Flaring Worksheet

The venting and flaring worksheet is unique because it calculates CO₂ emissions from flaring, and it requires both activity data for the amount of natural gas vented and flared, and the percent of gas flared. Default activity data are available in the SIT for most states from the EIA Natural Gas Navigator (EIA 2026). An example of the use of the activity data, emission factor, and percent flared can be seen in Figure 6 (input cells are shown in pink). While the required activity data for this worksheet is the total amount that is vented and flared, the emissions calculations are for the amount of gas that's flared. The SIT assumes that 80 percent of this gas is flared and that the remaining 20 percent (i.e., the amount that's vented) must be accounted for in the petroleum systems production category. Because there is no default data for petroleum systems in the SIT, the user must make sure that the amount of gas flared is not double counted when calculating emissions from the petroleum systems category.

Venting and flaring refer to the disposal of gas that cannot be contained or otherwise handled. Venting and flaring activities are associated with combined oil and gas production and take place in production areas where gas pipeline infrastructure is incomplete, and the natural gas is not injected into reservoirs.

Figure 6. Example of Activity Data and Emission Factor Applied in the Natural Gas Venting and Flaring Worksheet

State Inventory Tool - Natural Gas and Oil Systems

5. Emissions from Natural Gas Activities in California

Click here to find where these data are available.

Emissions from Natural Gas Venting and Flaring are calculated as the percent of emissions flared. The amount of gas that is vented or flared is multiplied by a National emission factor. This total of potential emissions is then multiplied by the percentage of gas flared and converted to million metric tons of carbon equivalent.

Return to Control Sheet | Go to Summary Sheet

Check All Boxes | Use National Default Flaring Percent (80%)

Emission Factor

	Activity Data	Emission Factor	Metric Tons CO ₂	Percent Flared	MMTCE
1990					
Natural Gas - Venting and Flaring	1,376	54.71	75,205	80%	0.02
1991					
Natural Gas - Venting and Flaring	1,583	54.71	86,624	80%	0.02

Activity Data (Billion BTU): 1,376 (1990), 1,583 (1991)

Emission Factor (metric tons CO₂ per year billion BTU): 54.71

Metric Tons CO₂: 75,205 (1990), 86,624 (1991)

Percent Flared: 80%

MMTCE: 0.02

Step (6) Enter Emission Factors and Activity Data for Petroleum Systems

Control Worksheet

The petroleum system emission factors used in the SIT are implied emission factors derived from U.S. EPA (2025). Using the available published oil system emission estimates, the implied emission factors were developed by dividing the emission estimates from each of the major activity groups (production, refining, and transportation) by the appropriate activity data at the national level. These implied emission factors are calculated for each year in the SIT. States are encouraged to use state-specific

emission factors if data are available, as actual emissions depend on site-specific characteristics including facility design, operation, and maintenance.

Petroleum Systems Worksheet

Required data for the petroleum systems worksheet include the amount of oil produced (including venting), refined, and transported in the state. Figure 7 shows an example of the data used for this sector, the yellow cells are input cells. Default data are not provided in the SIT, so users must input data for emissions to be estimated. If state-specific data sources are not available, users can obtain oil production data from EIA's Petroleum Supply Annual.¹ Refining data can be calculated using data from the Petroleum Supply Annual and the calculator provided in the SIT on the oil data sources worksheet. Currently, no uniform data source has been identified for oil transportation activities, so in the absence of other information it is recommended that users assume that the amount of oil transported is equivalent to the amount of oil refined in the state.

Figure 7. Example of Activity Data and Emission Factors Applied in the Petroleum Systems Worksheet

6. Emissions from Petroleum Production, Refining, and Transportation in California

Emissions from Petroleum Systems are calculated as the sum of emissions from three sectors—Production, Refining, and Transportation. The activity factor (number of barrels of oil) for each sector is multiplied by the sector-specific emission factor. These emissions are then converted to metric tons of CO₂ equivalent and metric tons of carbon equivalent, and summed. Note that default emission factors are available through 2022. To facilitate emission calculations for 2023, the tool utilizes 2022 emission factors as proxies for emission factors in 2023-2025. Emission factors for 2023 will be updated as soon as new data become available. For further details, refer to the Methane Emissions from Natural Gas and Oil Systems Chapter of the User's Guide.

Return to Control Sheet | Go to Summary Sheet | Check All Boxes | Clear All Data

Petroleum Systems	1990	Default Activity Data	Emission Factors	Metric Tons CH ₄	MMTCO ₂ E
Activity Data					
'000 barrels	320,868				
Oil Production	320,868	609.67	194,376	5.44	
Oil Refining		5.26	-	-	
Oil Transportation		1.34	-	-	
Total			194,376	5.44	

Petroleum Systems	1991	Default Activity Data	Required Activity Data	Metric Tons CH ₄	MMTCO ₂ E
Activity Data					
'000 barrels	318,488				
Oil Production	318,488	602.04	192,351	5.39	
Oil Refining		5.26	-	-	
Oil Transportation		1.34	-	-	
Total			192,351	5.39	

Petroleum Systems	1992	Default Activity Data		Metric Tons CH ₄	MMTCO ₂ E
Activity Data					
'000 barrels	305,488				
Oil Production	305,488	608.67	185,942	5.21	
Oil Refining		5.26	-	-	
Oil Transportation		1.29	-	-	
Total			185,942	5.21	

In the SIT, CH₄ emissions from oil systems are estimated using approach that is simpler than the method used for natural gas systems, but it is also less accurate. The SIT calculates emissions by multiplying the required state-level data on oil production, refining, and transportation by the appropriate emission factors and summing across activity types to calculate total emissions, as shown in Equation 3. The

¹ Available online at: <http://www.eia.gov/petroleum/supply/annual/volume1/>.

general sources of CH₄ emissions from oil systems that should be accounted for can be categorized into emissions from: (1) normal operations, (2) routine maintenance, and (3) system upsets and accidents.

Normal operations include emissions from the day-to-day operations of a facility. Oil production and transportation facilities can emit CH₄ due to a wide variety of operating practices and factors, including emissions from pneumatic devices, leaks from system components, emissions from process vents, emissions from starting and stopping reciprocating engines or turbines, and emissions during drilling activities.

Routine maintenance includes regular and periodic activities performed in the operation of the facility. These activities may be conducted frequently, such as launching and receiving scrapers (pigs) in a pipeline, or infrequently, such as evacuation of pipes (“blowdown”) for periodic testing or repair. In each case, the required procedures release gas from the affected equipment. Releases also occur during maintenance of wells (“well workovers”) and during replacement or maintenance of fittings.

System upsets are unplanned events in the system. The most common upset is a sudden pressure surge resulting from the failure of a pressure regulator. The potential for unplanned pressure surges is considered during facility design, and facilities are provided with pressure relief systems to protect the equipment from damage due to the increased pressure. Relief systems vary in design. In some cases, gases released through relief valves may be collected and transported to a flare for combustion or re-compressed and reinjected into the system. In these cases, CH₄ emissions associated with pressure relief events will be small. In older facilities, relief systems may vent gases directly into the atmosphere or send gases to flare systems where complete combustion may not be achieved. The frequency of system upsets varies with the facility design and the operating practices. In particular, facilities operating well below capacity are less likely to experience system upsets and related emissions. Emissions associated with accidents are also included in the category of upsets.

Step (7) 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 8 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 or CH₄ from the dropdown menu in column C. Enter the emissions in MMTCO₂e for each year 1990-2022 in the yellow cells.

Option B: Enter the total CO₂ (line 29) and/or total CH₄ emissions (line 30) for all other emissions sources for each year 1990-2022 in the yellow cells in MMTCO₂e.

Figure 8. Example Additional Emissions Sources Worksheet

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

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 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 (line 26) and/or total CH₄ emissions (line 30) for all other emissions sources for each year 1990-2021 in the yellow cells in MMTCO₂e.

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 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

Additional Carbon Dioxide Emissions CO₂

Additional Methane Emissions CH₄

Option B

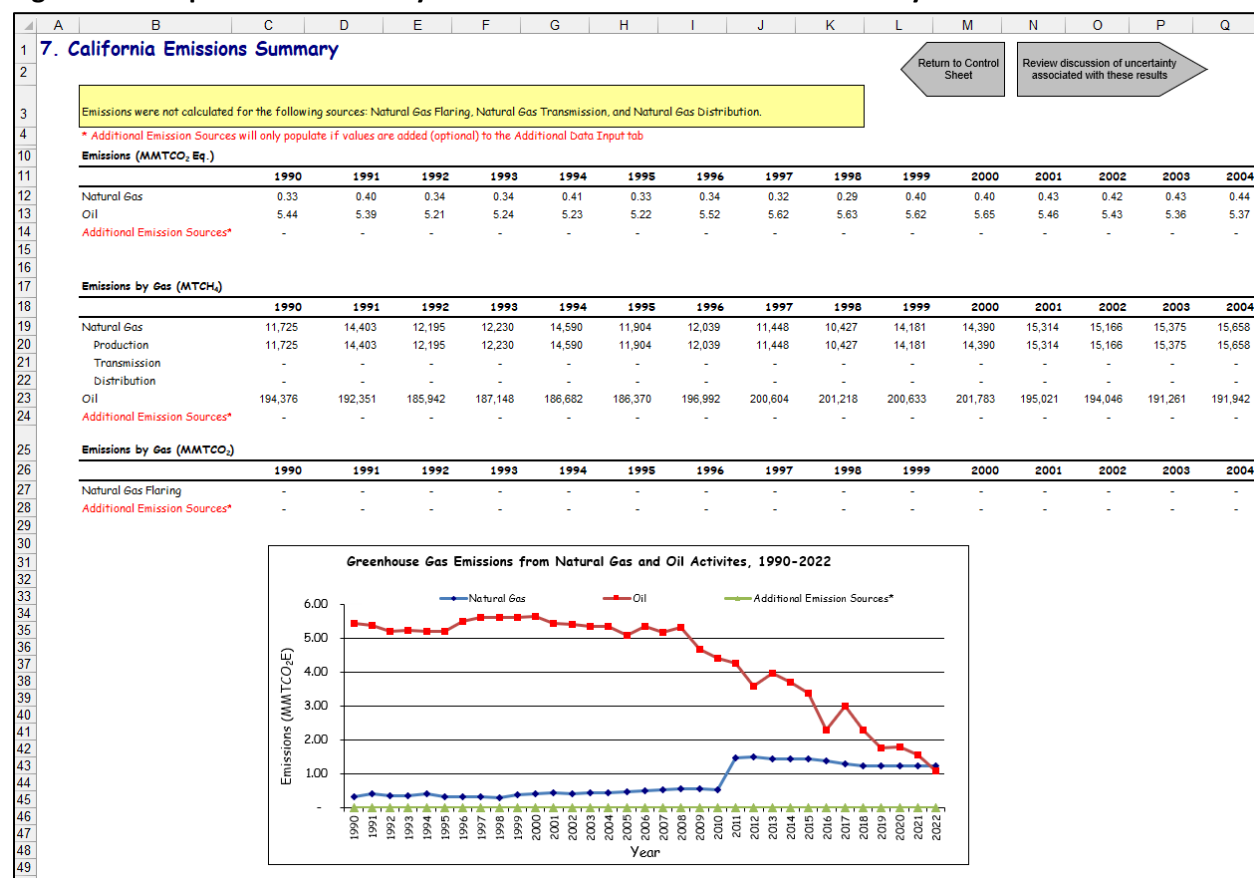
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Additional Carbon Dioxide Emissions CO ₂														
Additional Methane Emissions CH ₄														

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>

Step (8) Review Summary Information

The steps above provide estimates of total emissions for each natural gas and oil activity. These are summed over all activities, for each year, and the information is collected on the summary worksheet. The summary worksheet displays results in MMTCO₂e, as well as by individual gas. Additionally, the summary worksheet provides an overview of sources excluded from the current emission estimates. Users should check this list to see if they wish to go back and enter data for any of the omitted activities. Figure 9 shows the summary worksheet that sums the emissions from all sectors in the Natural Gas and Oil Systems module. In addition, the results are displayed in graphical format at the bottom of the summary worksheet.

Figure 9. Example of the Summary Worksheet in the Natural Gas and Oil Systems Module



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

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