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# **USER'S GUIDE FOR ESTIMATING METHANE AND NITROUS OXIDE EMISSIONS FROM STATIONARY COMBUSTION USING THE STATE INVENTORY TOOL**

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This section of the User's Guide provides instruction on using the CH<sub>4</sub> and N<sub>2</sub>O Stationary Combustion module of the State Inventory Tool (SIT), and describes the methodology used for estimating greenhouse gas emissions from stationary combustion at the state level.

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## 1.1 GETTING STARTED

The Stationary Combustion<sup>1</sup> module was developed using Microsoft® Excel 2000. While the module will operate with older versions of Excel, it functions best with Excel 2000 or later. If you are using Excel 2007 or later, instructions for opening the module will vary as outlined in the Excel basics below. Before you use the Stationary Combustion module, make sure your computer meets the system requirements. In order to install and run the Stationary Combustion module, you must have:

- IBM-PC compatible computer with the Windows 95 operating system or later;
- Microsoft® Excel 1997 or later, with calculation set to automatic and macros enabled;
- Hard drive with at least 20MB free; and
- Monitor display setting of 800 x 600 or greater.

### Microsoft Excel Settings

**Excel 2003 and Earlier:** For the SIT modules to function properly, Excel must be set to automatic calculation. To check this setting, launch Microsoft Excel before opening the Stationary Combustion module. Go to the Tools menu and select “Options...” Click on the “Calculations” tab and make sure that the radio button next to “Automatic” is selected, and then click on “OK” to close the window. The security settings (discussed next) can also be adjusted at this time.

**Excel 2007 and Later:** For the SIT modules to function properly, Excel must be set to automatic calculation. Go to the Formulas ribbon and select “Calculation Options.” Make sure that the box next to the “Automatic” option is checked from the pop-up menu.

### Microsoft Excel Security

**Excel 2003 and Earlier:** Because the SIT employs macros, you must have Excel security set to medium (recommended) or low (not recommended). To change this setting, launch Microsoft Excel before opening the Stationary Combustion module. Once in Excel, go to the Tools menu, click on the Macro sub-menu, and then select “Security” (see Figure 1). The Security pop-up box will appear. Click on the “Security Level” tab and select medium. When set to high, macros are automatically disabled; when set to medium, Excel will give you the choice to enable macros; when set to low, macros are always enabled.

When Excel security is set to medium, users are asked upon opening the module whether to enable macros. Macros must be enabled in order for the Stationary Combustion module to work. Once they are enabled, the module will open to the control worksheet. A message

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<sup>1</sup> Due to nuances associated with estimating non-CO<sub>2</sub> emissions associated with combustion, there are three modules focusing on emissions from combustion: the CO<sub>2</sub>FFC module (which calculates CO<sub>2</sub>), the stationary combustion module (which calculates CH<sub>4</sub> and N<sub>2</sub>O), and the mobile combustion module (which calculates CH<sub>4</sub> and N<sub>2</sub>O from transportation activities).

box will appear welcoming the user to the module. Clicking on the “x” in the upper-right-hand corner of the message box will close it.

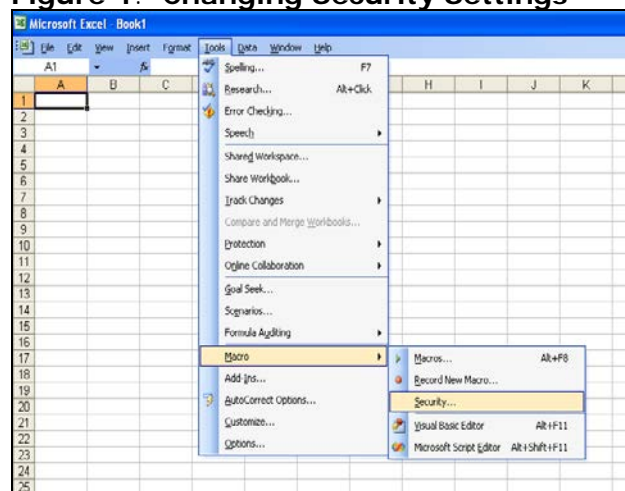
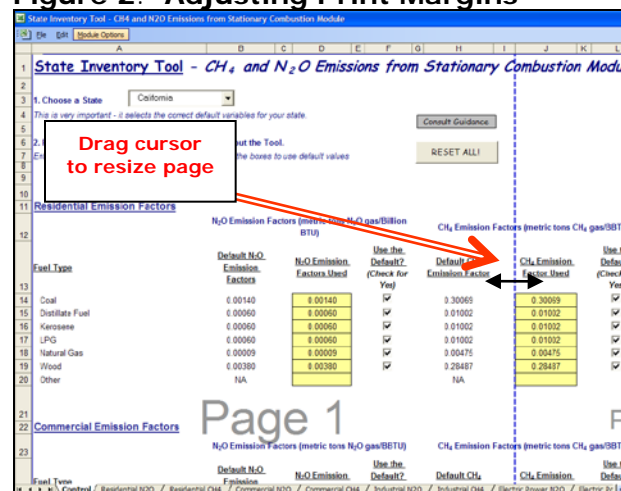
**Excel 2007 and Later:** If Excel’s security settings are set at the default level a Security Warning appears above the formula box in Excel when the Stationary Combustion module is initially opened. The Security Warning lets the user know that some active content from the spreadsheet has been disabled, meaning that Excel has prevented the macros in the spreadsheet from functioning. Because SIT needs macros in order to function properly, the user must click the “Options” button in the security message and then select, “Enable this content” in the pop-up box. Enabling the macro content for the SIT in this way only enables macros temporarily in Excel but does not change the macro security settings. Once macros are enabled, a message box will appear welcoming the user to module. Click on the “x” in the upper right-hand corner to close the message box.

If the Security Warning does not appear when the module is first opened, it may be necessary to change the security settings for macros. To change the setting, first exit out of the Stationary Combustion module and re-launch Microsoft Excel before opening the Stationary Combustion module. Next, click on the Microsoft Excel icon in the top left of the screen. Scroll to the bottom of the menu and select the “Excel Options” button to the right of the main menu. When the Excel Options box appears, select “Trust Center” in left hand menu of the box. Next, click the grey “Trust Center Settings” button. When the Trust Center options box appears, click “Macro Settings” in the left hand menu and select “Disable all macros with notification.” Once the security level has been adjusted, open the Stationary Combustion module and enable macros in the manner described in the preceding paragraph.

### Viewing and Printing Data and Results

The Stationary Combustion module contains some features to allow users to adjust the screen view and the appearance of the worksheets when they are printed. Once a module has been opened, you can adjust the zoom by going to the Module Options Menu, and either typing in a zoom percentage or selecting one from the drop down menu. In addition, data may not all appear on a single screen within each worksheet; if not, you may need to scroll up or down to view additional information.

You may also adjust the print margins of the worksheets to ensure that desired portions of the Stationary Combustion module are printed. To do so, go to the File menu, and then select “Print Preview.” Click on “Page Break Preview” and drag the blue lines to the desired positions (see Figure 2). To print this view, go to the File menu, and click “Print.” To return to the normal view, go to the File menu, click “Print Preview,” and then click “Normal View.”

**Figure 1. Changing Security Settings****Figure 2. Adjusting Print Margins**

## 1.2 MODULE OVERVIEW

This User's Guide accompanies and explains the Stationary Combustion module of the SIT. The SIT was developed in conjunction with EPA's Emissions Inventory Improvement Program (EIIP). Prior to the development of the SIT, EPA developed the States Workbook for estimating greenhouse gas emissions. In 1998, EPA revisited the States Workbook and expanded it to follow the format of EIIP guidance documents for criteria air pollutants. The result was a comprehensive, stepwise approach to estimating greenhouse gas emissions at the state level. This detailed methodology was appreciated by states with the capacity to devote considerable time and resources to the development of emission inventories. For other states, the EIIP guidance was overwhelming and impractical for them to follow from scratch. EPA recognized the resource constraints facing the states and developed the SIT. The ten modules of the SIT corresponded to the EIIP chapters and attempted 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.

Because most state inventories developed today rely heavily on the tools, User's Guides have been developed for each of the SIT modules. States interested in reviewing detailed methodological information should consult Volume VIII of the EIIP guidance documents. Even though the greenhouse gas volume will not be updated on a regular basis, it provides additional information and in some cases, alternate approaches not found in the SIT or the companion User's Guide.

The Stationary Combustion module calculates methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions for the fuel types and end-use sectors indicated in Table 1. While the module provides default data for fuel types (where possible), users are encouraged to input state-specific default data if it is available. If using outside data sources, or for a more thorough understanding of the approach used to estimate emissions, please refer to the following discussion for data requirements and methodology.

### 1.2.1 Data Requirements

To calculate CH<sub>4</sub> and N<sub>2</sub>O emissions from stationary combustion, the following data are required:

- Fossil fuel consumption by fuel type and sector;
- Wood consumption by sector;
- Non-energy consumption by fuel type for the industrial sector; and
- Emission factors by fuel type and sector.

Because the CH<sub>4</sub> and N<sub>2</sub>O emission factors vary by fuel type, it is necessary to compile consumption data for the fuel types provided in Table 1.

Energy consumption statistics should be collected on an energy basis—preferably in British thermal units (Btu). Statistics providing energy consumption data in other units, such as barrels or tons, may be used, but require conversion to Btu by using the heat content of the specific fuel. If the conversion to energy units is necessary, the heat contents that were used should be documented. Please note that even data given in Btu may be preceded by a prefix indicating order of magnitude (i.e. thousand, million, billion). For a better understanding of the quantity prefixes used with Btu, refer to Box 1.

#### Box 1: Energy Units

A British thermal unit (Btu) is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2 Fahrenheit.

Btu	British thermal unit	1 Btu
MBtu	Thousand Btu	1x10 <sup>3</sup> Btu
MMBtu	Million Btu	1x10 <sup>6</sup> Btu
BBtu	Billion Btu	1x10 <sup>9</sup> Btu
TBtu	Trillion Btu	1x10 <sup>12</sup> Btu
QBtu	Quadrillion Btu	1x10 <sup>15</sup> Btu

**Table 1. Fuel Types Consumed by Sector**

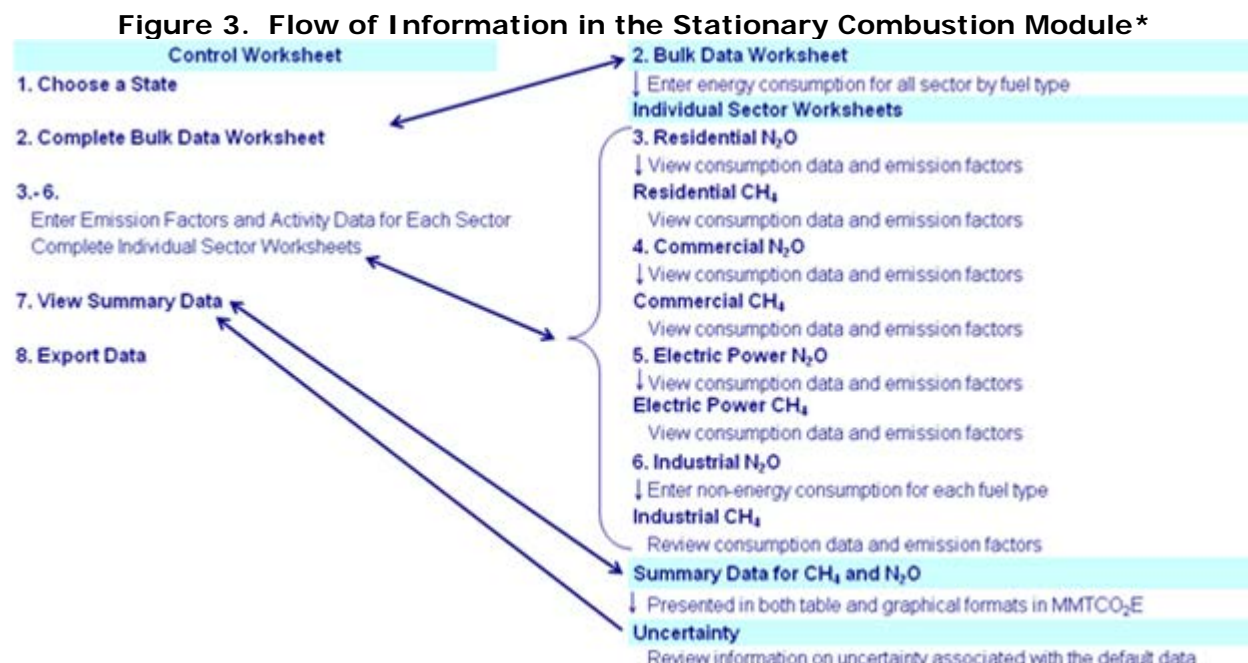
<b>Residential</b>	<b>Commercial</b>	<b>Industrial</b>	<b>Electric Utilities</b>
<b>Coal</b>	<b>Coal</b>	<b>Coking Coal</b> <b>Independent Power</b> <b>Coal</b> <b>Other Coal</b>	<b>Coal</b>
<b>Natural Gas</b>	<b>Natural Gas</b>	<b>Natural Gas</b>	<b>Natural Gas</b>
<b>Petroleum:</b> Distillate Fuel Kerosene Hydrocarbon Gas Liquids	<b>Petroleum:</b> Distillate Fuel Kerosene Hydrocarbon Gas Liquids Motor Gasoline Residual Fuel	<b>Petroleum:</b> Distillate Fuel Kerosene LPG Motor Gasoline Residual Fuel Lubricants Asphalt & Road Oil Crude Oil Feedstocks Naphthas < 401°F Other oils > 401°F Misc. Petroleum Products Petroleum Coke Pentanes Plus Still Gas Special Naphthas Unfinished Oils Waxes Aviation Gasoline Blending Components Motor Gasoline Blending Components	<b>Petroleum:</b> Distillate Fuel Residual Fuel Petroleum Coke
<b>Wood</b>	<b>Wood</b>	<b>Wood</b>	<b>Wood</b>
<b>Other (e.g. geothermal)</b>	<b>Other (e.g. geothermal)</b>	<b>Other (e.g. geothermal)</b>	<b>Other (e.g. geothermal)</b>

Source: U.S. EPA 2020.



### 1.2.2 Tool Layout

Because there are multiple steps to complete within the Stationary Combustion module, it is important to understand the module's overall design. The layout of the Stationary Combustion module and the purpose of its worksheets are presented in Figure 3.



\* These worksheets are the primary worksheets used in the Stationary Combustion module; subsequent worksheets are used to populate the default data and are provided for informational purposes only.

## 1.3 METHODOLOGY

This section provides instructions for using the Stationary Combustion module of the SIT to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions from sectors that consume fossil fuels and wood. Within the Stationary Combustion module, these sectors are residential, commercial, industrial, and electric power. Because the methodology is similar in all sectors, a general methodology is discussed and specific examples for each sector are provided.

The Stationary Combustion module automatically calculates emissions after you enter energy consumption data (and the factors on the control worksheet). The tool provides default energy consumption data, which comes from the EIA's State Energy Consumption, Price, and Expenditure Estimates (SEDS) EIA (2020).<sup>2</sup> However, other more

### Box 2: State Energy Data Sources

In-state sources, such as state energy commissions or public utility commissions, should be consulted first. Otherwise, default data provided by the Stationary Combustion module may be used. Fuel statistics should be provided on an energy basis (e.g., in Btu).

<sup>2</sup> These data are available at <https://www.eia.gov/state/seds/>.

state-specific data may be used if available (see Box 2 for suggestions on where to find data).

The Stationary Combustion module follows the general methodology outlined in the EIIP guidance, however because of the automation of the calculations within the tool, the order of steps discussed in this User's Guide do not follow the order of steps discussed within the EIIP guidance document. This User's Guide provides an overview of the estimation methodology used in the Stationary Combustion module by walking through the following eight steps: (1) select a state; (2) complete the bulk data energy consumption worksheet; (3) enter emission factors for the residential sector and view estimates; (4) enter emission factors for the commercial sector and view estimates; (5) enter emission factors for the electric power sector and view estimates; (6) enter emission factors for the industrial sector and view estimates; (7) review summary information; and (8) export data.

The general equation used to calculate CH<sub>4</sub> and N<sub>2</sub>O emissions from fuel combustion in the residential, commercial, and electric power sectors is shown in Equation 1. The equation used for fuels in the industrial end-use sector is similar, but includes the non-energy use of fuels, as shown in Equation 2.

#### Equation 1. General Emission Equation

$$\text{Emissions (MMTCO}_2\text{E)} = \text{Consumption (BBtu)} \times \text{Emission Factor (MT/BBtu)} \times \text{GWP} \div 1,000,000 \text{ (to yield MMTCO}_2\text{E)}$$

#### Equation 2. Emission Equation for the Industrial Sector

$$\text{Emissions (MMTCO}_2\text{E)} = [\text{Total Consumption (BBtu)} - \text{Non-Energy Consumption (BBtu)}] \times \text{Emission Factor (MT/BBtu)} \times \text{GWP} \div 1,000,000 \text{ (to yield MMTCO}_2\text{E)}$$

### 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) Complete the Bulk Energy Consumption Data Worksheet

The energy consumption data entered in the "Bulk Energy Consumption Data" (bulk data) worksheet feed into the calculation worksheets for each sector. Modifying the consumption data in this worksheet will change the consumption estimates on each sector calculation worksheet. The default data are automatically populated in the yellow cells by sector and fuel type for the selected state. On the bulk data worksheet, presented as an example in Figure 4, the yellow cells indicate where the required energy activity data are entered either manually or automatically from default data. Default data in the yellow cells on this worksheet can be overwritten with state-specific data. To revert to default data for all sectors and fuel types, click on the "Refresh Default Data" button at the top of the worksheet. Energy consumption data from the CO<sub>2</sub>FFC module can also be copied and pasted directly into the input space on the bulk data worksheet to ensure identical energy

consumption inputs are used in both modules. To copy and paste values from the CO<sub>2</sub>FFC module, have both modules open and highlight the data that will be copied from the CO<sub>2</sub>FFC module. Next, select Edit/Copy from the menu bar. In the Stationary Combustion module, select the cell(s) where the data will be pasted into, and select Edit/Paste Specials/Values. Click on the "Proceed to Calculation Worksheet" button to begin/continue estimating emissions, or click on the "Return to Control" button to return to the control worksheet to continue entering emission factors.

**Figure 4. Example of the Required Energy Consumption Data in the Bulk Data Worksheet**

The screenshot shows a spreadsheet titled "State Inventory Tool - GHG and N2O Emissions from Stationary Combustion Module". The main table is "Default Energy Consumption in Colorado, billion btu (Bbtu)". The table has columns for years 1990 through 2000 and rows for various sectors and fuels. Red arrows point to buttons: "Refresh Default Data", "Proceed to Calculation Worksheets", and "Return to Control". A red box highlights the "Required Energy Data" column.

Sector and Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Commercial Coal	992	1,143	1,004	675	430	379	259	1,076	352	2,024	1,546
Commercial Distillate Fuel	2,576	2,772	4,016	3,883	5,987	4,093	4,26				
Commercial Kerosene	55	60	38	40	36	26	3				
Commercial Natural Gas	66,769					1,418	1,35				
Commercial Residual Fuel						301	1,348	186	196	850	854
Commercial Wood						67,585	69,960	69,708	63,528	59,367	60,753
Commercial Other	800	835	881	1,020	977	986	1,024	1,397	1,221	1,284	1,374
Electric Power Coal	320,752	313,657	323,644	330,082	340,392	327,951	342,494	345,510	356,162	352,825	376,872
Electric Power Distillate Fuel	291	206	280	163	190	163	204	222	497	412	1,106
Electric Power Natural Gas	13,432	13,473	13,445	12,067	20,407	24,085	29,075	27,936	34,736	43,107	66,799
Electric Power Petroleum Coke											
Electric Power Residual Fuel	0	292	230		0	50	99	0	0	9	46
Electric Power Wood											
Electric Power Other											
Industrial Asphalt and Road Oil	21,614	20,620	21,172	22,647	27,794	24,889	25,906	17,078	31,518	14,179	25,681
Industrial Aviation Gasoline Blending Components	1	(0)	1	1	35	30	39	50	21	33	20
Industrial Coal	15,383	15,558	14,784	16,328	18,477	15,814	7,923	15,704	8,331	9,111	9,270
Industrial Coking Coal											
Industrial Crude Oil											
Industrial Distillate Fuel						15,350	16,012	17,811	17,816	19,610	19,072
Industrial Feedstocks, Naphtha less than 401 F								258	289	315	331
Industrial Feedstocks, Other Oils greater than 401 F								393	464	441	389
Industrial Kerosene	103	94	42	66	20	27	34	30	63	35	27
Industrial LPG	3,533	4,346	4,078	4,830	4,305	4,687	4,904	5,553	4,288	1,944	11,211
Industrial Lubricants	1,481	1,325	1,351	1,375	1,437	1,413	1,371	1,448	1,516	1,532	1,509

### Step (3) through Step (5) Enter Emission Factors for Each Sector (Excluding Industrial Sector) and View Emission Estimates

#### Control Worksheet

For each sector, you must enter the relevant emission factors on the control worksheet before proceeding to each individual sector worksheet to view estimates. Either select the default data provided or enter user-specified, fuel and sector-specific emission factors that will be used throughout the tool. To proceed with the default data, select the "Check/Uncheck All" button for each step (residential, commercial, electric power, and industrial) or check the default box directly to the right of individual yellow input cells. Note that this number 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 5 for locations of the "Check/Uncheck All" buttons, individual default check boxes, and yellow input cells. Information on emission factors is discussed below.

**Figure 5. Control Worksheet for the Stationary Combustion Module**

**State Inventory Tool - CH<sub>4</sub> and N<sub>2</sub>O Emissions from Stationary Combustion Module**

1. Choose a State: Colorado

2. Complete the Bulk Data Energy Consumption Worksheet

3-6. Fill in the emission factors that are used throughout the module and then proceed to the corresponding sector worksheet to input activity data.

3. Residential Emission Factors

Fuel Type	H <sub>2</sub> O Emission Factors (metric tons H <sub>2</sub> O gas BBTU)			CH <sub>4</sub> Emission Factors (metric tons CH <sub>4</sub> gas BBTU)		
	Default H <sub>2</sub> O Emission Factors	H <sub>2</sub> O Emission Factor Used	Use the Default? (Check for Yes)	Default CH <sub>4</sub> Emission Factors	CH <sub>4</sub> Emission Factor Used	Use the Default? (Check for Yes)
Coal	0.0015	0.00150	<input checked="" type="checkbox"/>	0.30069	0.30069	<input checked="" type="checkbox"/>
Distillate Fuel	0.0006	0.00060	<input checked="" type="checkbox"/>	0.01002	0.01002	<input checked="" type="checkbox"/>
Kerosene	0.0006	0.00060	<input checked="" type="checkbox"/>	0.01002	0.01002	<input checked="" type="checkbox"/>
LPG	0.0006	0.00060	<input checked="" type="checkbox"/>	0.01002	0.01002	<input checked="" type="checkbox"/>
Natural Gas	0.00009	0.00009	<input checked="" type="checkbox"/>	0.00475	0.00475	<input checked="" type="checkbox"/>
Wood	0.0038	0.00380	<input checked="" type="checkbox"/>	0.28487	0.28487	<input checked="" type="checkbox"/>
Other	NA			NA		

4. Commercial Emission Factors

Fuel Type	H <sub>2</sub> O Emission Factors (metric tons H <sub>2</sub> O gas BBTU)			CH <sub>4</sub> Emission Factors (metric tons CH <sub>4</sub> gas BBTU)		
	Default H <sub>2</sub> O Emission Factors	H <sub>2</sub> O Emission Factor Used	Use the Default? (Check for Yes)	Default CH <sub>4</sub> Emission Factors	CH <sub>4</sub> Emission Factor Used	Use the Default? (Check for Yes)
Coal	0.0015		<input type="checkbox"/>	0.01002		<input type="checkbox"/>
Distillate Fuel	0.0006		<input type="checkbox"/>	0.01002		<input type="checkbox"/>
Kerosene	0.0006		<input type="checkbox"/>	0.01002		<input type="checkbox"/>
LPG	0.0006		<input type="checkbox"/>	0.01002		<input type="checkbox"/>
Motor Gasoline	0.0006		<input type="checkbox"/>	0.01002		<input type="checkbox"/>
Residual Fuel	0.0006		<input type="checkbox"/>	0.01002		<input type="checkbox"/>
Natural Gas	0.00009		<input type="checkbox"/>	0.00475		<input type="checkbox"/>
Wood	0.0038		<input type="checkbox"/>	0.28487		<input type="checkbox"/>

Navigation: Control / Default State Energy Data Table / Residential N<sub>2</sub>O / Residential CH<sub>4</sub> / Commercial N<sub>2</sub>O / Commercial CH<sub>4</sub> / Electric Power N<sub>2</sub>O / Electric Power CH<sub>4</sub> / Industrial N<sub>2</sub>O / Industrial CH<sub>4</sub>

### Emission Factors

Default emission factors are provided in the Stationary Combustion module for all fuel types and sectors and are available from IPCC (2006); however, users may choose to specify their own. Figure 6 presents an example of the emission factors used in the commercial sector N<sub>2</sub>O worksheet. In general, emissions of CH<sub>4</sub> and N<sub>2</sub>O will vary with the type of fuel burned, the size and vintage of the combustion technology, the maintenance and operation of the combustion equipment, and the type of pollution control technology used.

N<sub>2</sub>O is produced from the combustion of fuels, with the level of N<sub>2</sub>O emissions dependent on the combustion temperature. The highest N<sub>2</sub>O emissions occur at a temperature of 1,000 degrees Kelvin. For combustion temperatures below 800 or above 1,200 degrees Kelvin (980 to 1,700 degrees Fahrenheit), the N<sub>2</sub>O emissions are negligible (IPCC 1997).

CH<sub>4</sub>, carbon monoxide, and non-CH<sub>4</sub> volatile organic compounds are unburned gaseous combustibles that are emitted in small quantities due to incomplete combustion; more of these gases are released when combustion temperatures are relatively low. Emissions of these gases are also influenced by technology type, size, vintage, maintenance, operation, and emission controls. Larger, higher efficiency combustion facilities tend to reach higher combustion temperatures and thus emit less of these gases. Emissions may range several orders of magnitude above the average for facilities that are improperly maintained or poorly operated, which is often the case for older units. Similarly, during start-up periods,

combustion efficiency is lowest, causing emissions of carbon monoxide and non-CH<sub>4</sub> volatile organic compounds to be higher than during periods of full operation.

### Individual Sector Worksheets

Navigate to the individual sector worksheets from the control worksheet using the gray arrows to the right of the emission factors for each sector. Except for the industrial sector, the worksheets for each sector have the same basic set-up. On the residential N<sub>2</sub>O sector worksheet, shown in Figure 6, the cells in the first column indicate where the required energy activity data were entered from the bulk data worksheet. This activity data are converted into emissions (in units of MMTCO<sub>2</sub>E) using the emission factors entered on the control worksheet, the energy consumption data entered on the bulk data worksheet, and the calculation method shown in Equation 1. Note that consumption data are entered on the bulk data worksheet and is pulled into the corresponding sector worksheet for each sector. After entering or selecting default data on the control and bulk data worksheets, users should review the worksheets to make sure emission factors and activity data are properly applied. Click on the orange "Click here for the bulk data worksheet." button to return to the energy consumption data entry worksheet. An example of a CH<sub>4</sub> worksheet for the electric power sector is shown in Figure 7.

The activity data used to populate the energy consumption input cells is annual state energy consumption data based on *primary fuel type* (e.g., coal, petroleum, and natural gas) and *secondary fuel type* (e.g., gasoline, residual oil, natural gas, etc.) *by sector* (e.g., residential, commercial, industrial, and electric utilities). A list of potential fuel types consumed in each sector is provided in Table 1 and is included in the Stationary Combustion module.

The Stationary Combustion module calculates emissions for each sector by multiplying consumption by the appropriate emission factor to obtain the total CH<sub>4</sub> or N<sub>2</sub>O emissions in metric tons. Then, the total emissions are converted into MMTCO<sub>2</sub>E, by multiplying by the GWP (25 for CH<sub>4</sub> or 298 for N<sub>2</sub>O)<sup>3</sup> and dividing by 10<sup>6</sup> to express emissions in MMTCO<sub>2</sub>E (Equation 1).

#### Box 3: Caution When Using Non-Default Fuel Consumption Data

If you use fuel consumption data that is different from the default data, please be aware of double counting. For example, EIA's SEDS data for industrial coal consumption includes coal used to make synthetic natural gas, which is accounted for in both industrial coal and natural gas consumption data. This double-counting issue has been corrected for in the default dataset contained in the Stationary Combustion module; similar adjustments may need to be made to outside data sources. State-specific natural gas data can be obtained from Table 12 of EIA's Historical Natural Gas Annual EIA (EIA 2001) and Table 8 of EIA's Natural Gas Annual EIA (EIA 2019) (and is also provided in the Stationary Combustion module).

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<sup>3</sup> The decision was made in the January 31, 2014 "Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013." These global warming potential values were agreed upon by decision 24/CP.19.



**Figure 6. Example of the Required Energy Data and Emission Factors Applied in the Residential N<sub>2</sub>O Worksheet**

State Inventory Tool - CH<sub>4</sub> and N<sub>2</sub>O Emissions from Stationary Combustion Module

File Edit Module Options

2. Residential Consumption and N<sub>2</sub>O emissions in Colorado

Click here to find possible data sources.

Click here for the bulk data worksheet.

N<sub>2</sub>O emissions from stationary combustion in the residential sector are calculated using the IPCC Tier 1 approach. Consumption of each fuel is multiplied by a fuel-specific N<sub>2</sub>O emission factor. The resulting fuel emission values, in metric tons N<sub>2</sub>O, are then multiplied by the global warming potential, converted to million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>E), and summed. For further detail on this method, please refer to the Stationary Chapter in the User's Guide. Click on the orange "Click here for the bulk data worksheet." button to return to the energy consumption data entry worksheet.

Note that default emission factors are available through 2008. To facilitate emission calculations for later years, the tool utilizes 2008 emission factors as proxies for emission factors in subsequent years (2009 through 2020). Emission factors for 2009 and beyond will be updated as soon as new data become available. For further detail on this method, refer to the Stationary Combustion Chapter in the User's Guide.

Return to the Control Sheet

Go to the Residential CH<sub>4</sub> Sheet

Residential Sector N<sub>2</sub>O 1990

Fuel Type	Consumption (Billion Btu)	Emission Factor (metric tons N <sub>2</sub> O/Btu)	Emissions (metric tons N <sub>2</sub> O)	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Coal	241	0.00050	0.1205	210	0.0000	0.0000
Distillate Fuel	860	0.00000	0.0000	210	0.0000	0.0000
Kerosene	127	0.00000	0.0000	210	0.0000	0.0000
LPG	4,106	0.00040	1.6424	210	0.0003	0.0003
Natural Gas	32,301	0.00000	0.0000	210	0.0000	0.0000
Wood	7,388	0.00038	2.8074	210	0.0004	0.0004
Other	-	0.00000	0.0000	210	0.0000	0.0000
<b>Total</b>					<b>0.0003</b>	<b>0.0003</b>

Residential Sector N<sub>2</sub>O 1991

Fuel Type	Consumption (Billion Btu)	Emission Factor (metric tons N <sub>2</sub> O/Btu)	Emissions (metric tons N <sub>2</sub> O)	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Coal	251	0.00050	0.1255	210	0.0000	0.0000
Distillate Fuel	910	0.00000	0.0000	210	0.0000	0.0000
Kerosene	127	0.00000	0.0000	210	0.0000	0.0000
LPG	4,106	0.00040	1.6424	210	0.0003	0.0003
Natural Gas	32,301	0.00000	0.0000	210	0.0000	0.0000
Wood	7,388	0.00038	2.8074	210	0.0004	0.0004
Other	-	0.00000	0.0000	210	0.0000	0.0000
<b>Total</b>					<b>0.0004</b>	<b>0.0004</b>

Residential Sector N<sub>2</sub>O 1992

Fuel Type	Consumption (Billion Btu)	Emission Factor (metric tons N <sub>2</sub> O/Btu)	Emissions (metric tons N <sub>2</sub> O)	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Coal	220	0.00050	0.1100	210	0.0000	0.0000
Distillate Fuel	904	0.00000	0.0000	210	0.0000	0.0000
Kerosene	203	0.00000	0.0000	210	0.0000	0.0000
LPG	4,106	0.00040	1.6424	210	0.0003	0.0003
Natural Gas	32,301	0.00000	0.0000	210	0.0000	0.0000
Wood	7,388	0.00038	2.8074	210	0.0004	0.0004
Other	-	0.00000	0.0000	210	0.0000	0.0000
<b>Total</b>					<b>0.0003</b>	<b>0.0003</b>

Required Energy Data

Emission Factors

State Inventory Tool - CH<sub>4</sub> and N<sub>2</sub>O Emissions from Stationary Combustion Module

File Edit Module Options

4. Electric Power Sector Consumption and CH<sub>4</sub> emissions in California

CH<sub>4</sub> emissions from stationary combustion in the electric power sector are calculated using the IPCC Tier 1 approach. Consumption of each fuel is multiplied by a fuel-specific CH<sub>4</sub> emission factor. The resulting fuel emission values, in metric tons CH<sub>4</sub>, are then multiplied by the global warming potential, converted to million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>E), and summed. For further detail on this method, please refer to the Stationary Chapter in the User's Guide.

Return to the Control Sheet

Return to the Electric Power N<sub>2</sub>O Sheet

Electric Power Sector CH<sub>4</sub> 1990

Fuel Type	Consumption (Billion Btu)	Emission Factor (metric tons CH <sub>4</sub> /Btu)	Emissions (metric tons CH <sub>4</sub> )	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Coal	18,840	0.00100	18.840	21	0.0000	0.0000
Distillate Fuel	1,538	0.00301	4.628	21	0.0000	0.0000
Petroleum Coke	4,931	0.00301	14.828	21	0.0000	0.0000
Residual Fuel	2,071	0.00301	6.233	21	0.0001	0.0003
Natural Gas	64,106	0.00095	61.699	21	0.0004	0.0013
Wood	7,151	0.00095	6.791	21	0.0000	0.0001
Other	-	0.00000	0.0000	21	0.0000	0.0000
<b>Total</b>					<b>0.0005</b>	<b>0.0118</b>

Electric Power Sector CH<sub>4</sub> 1991

Fuel Type	Consumption (Billion Btu)	Emission Factor (metric tons CH <sub>4</sub> /Btu)	Emissions (metric tons CH <sub>4</sub> )	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Coal	25,499	0.00100	25.499	21	0.0000	0.0001
Distillate Fuel	811	0.00301	2.440	21	0.0000	0.0000
Petroleum Coke	7,590	0.00301	22.823	21	0.0000	0.0000

Energy Consumption Data

Emission Factors

**Figure 7. Example of the Applied Data in the Electric Power CH<sub>4</sub> Worksheet**

State Inventory Tool - CH<sub>4</sub> and N<sub>2</sub>O Emissions from Stationary Combustion Module

File Edit Module Options

4. Electric Power Sector Consumption and CH<sub>4</sub> emissions in California

CH<sub>4</sub> emissions from stationary combustion in the electric power sector are calculated using the IPCC Tier 1 approach. Consumption of each fuel is multiplied by a fuel-specific CH<sub>4</sub> emission factor. The resulting fuel emission values, in metric tons CH<sub>4</sub>, are then multiplied by the global warming potential, converted to million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>E), and summed. For further detail on this method, please refer to the Stationary Chapter in the User's Guide.

Return to the Control Sheet

Return to the Electric Power N<sub>2</sub>O Sheet

Electric Power Sector CH<sub>4</sub> 1990

Fuel Type	Consumption (Billion Btu)	Emission Factor (metric tons CH <sub>4</sub> /Btu)	Emissions (metric tons CH <sub>4</sub> )	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Coal	18,840	0.00100	18.840	21	0.0000	0.0000
Distillate Fuel	1,538	0.00301	4.628	21	0.0000	0.0000
Petroleum Coke	4,931	0.00301	14.828	21	0.0000	0.0000
Residual Fuel	2,071	0.00301	6.233	21	0.0001	0.0003
Natural Gas	64,106	0.00095	61.699	21	0.0004	0.0013
Wood	7,151	0.00095	6.791	21	0.0000	0.0001
Other	-	0.00000	0.0000	21	0.0000	0.0000
<b>Total</b>					<b>0.0005</b>	<b>0.0118</b>

Electric Power Sector CH<sub>4</sub> 1991

Fuel Type	Consumption (Billion Btu)	Emission Factor (metric tons CH <sub>4</sub> /Btu)	Emissions (metric tons CH <sub>4</sub> )	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Coal	25,499	0.00100	25.499	21	0.0000	0.0001
Distillate Fuel	811	0.00301	2.440	21	0.0000	0.0000
Petroleum Coke	7,590	0.00301	22.823	21	0.0000	0.0000

Energy Consumption Data

Emission Factors

## Step (6): Enter Emission Factors and Non-Energy Use Activity Data for the Industrial Sector

First, complete the control worksheet and bulk data worksheet for the industrial sector, as described above. Then use the gray navigational arrows to move to the industrial sector worksheets. The industrial worksheets are unique because both total energy consumption and total non-energy consumption are required as inputs to calculate CH<sub>4</sub> and N<sub>2</sub>O emissions, seen in Figure 8 (non-energy input cells are shown in green). This is necessary because most fossil fuels have at least some non-energy uses. For example, LPG is used for production of solvents and synthetic rubber; oil is used to produce asphalt, naphthas, and lubricants; and coal is used to produce coke, yielding crude light oil and crude tar as by-products that are used in the chemical industry. Because these fuels are not combusted when used for purposes such as these, their consumption should be subtracted from statistics that include total fuel use.

The Stationary Combustion module estimates net combustible consumption by subtracting non-energy consumption from the total consumption. From this point forward, the industrial worksheet functions in the same manner as the other sector worksheets. The net combustible consumption is multiplied by the appropriate emission factor to obtain the total CH<sub>4</sub> or N<sub>2</sub>O emissions in metric tons. Then, the total emissions are converted into MMTCO<sub>2</sub>E, by multiplying by the GWP (25 for CH<sub>4</sub> or 298 for N<sub>2</sub>O) and dividing by 10<sup>6</sup> to express emissions in MMTCO<sub>2</sub>E (Equation 2). Click on the orange "Click here for the bulk data worksheet." button to return to the energy consumption data entry worksheet.

**Figure 8. Example of Energy and Non-Energy Data Consumption Data Applied in the Industrial Worksheet**

State Inventory Tool - CH<sub>4</sub> and N<sub>2</sub>O Emissions from Stationary Combustion Module

File Edit Module Options

5. Industrial Consumption and N<sub>2</sub>O emissions in Colorado

Click here to find possible data sources.

Click here for the bulk data worksheet.

N<sub>2</sub>O emissions from stationary combustion in the industrial sector are calculated using the IPCC Tier 1 approach. First, non-energy consumption by fuel type is subtracted from the energy consumption for each fuel type. The resulting energy consumption of each fuel is multiplied by a fuel-specific N<sub>2</sub>O emission factor. The resulting fuel emission values, in metric tons N<sub>2</sub>O, are then multiplied by the global warming potential, converted to million metric tons of carbon equivalent (MMTCE), then to million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>E), and summed. For further detail on this method, please refer to the Stationary Chapter in the User's Guide. Click on the orange "Click here for the bulk data worksheet." button to return to the energy consumption data entry worksheet.

Note that default emission factors are available through 2008. To facilitate emission calculations for later years, the tool utilizes 2008 emission factors as proxies for emission factors in subsequent years (2009 through 2020). Emission factors for 2009 and beyond will be updated as soon as new data become available. For further detail on this method, refer to the Stationary Combustion Chapter in the User's Guide.

Return to the Control Sheet

Go to the Industrial CH<sub>4</sub> Sheet

Check All Boxes

Clear All Data

Industrial Sector N<sub>2</sub>O

1990

Default Non-Energy Consumption Data?

	Total Consumption (Tillion Btu)	Non Energy Consumption (Tillion Btu)	Emission Factor (metric tons N <sub>2</sub> O/Btu)	Emissions (metric tons N <sub>2</sub> O)	GWP	Emissions (MMTCE)	Emissions (MMTCO <sub>2</sub> E)
Fuel Type							
Coking Coal	-	-	0.00000	-	310	0.000	0.000
Other Coal	6,363	77	0.00000	-	310	0.000	0.000
Asphalt and Road Oil	21,694	21,694	0.00000	-	310	0.000	0.000
Aviation Gasoline Blending Components	1	-	0.00000	-	310	0.000	0.000
Crude Oil	-	-	0.00000	-	310	0.000	0.000
Distillate Fuel	6,739	6,739	0.00000	-	310	0.000	0.000
Feedstocks, Naphtha less than 40°F	-	-	0.00000	-	310	0.000	0.000
Feedstocks, Other Oils greater than 40°F	-	-	0.00000	-	310	0.000	0.000
Kerosene	103	-	0.00000	-	310	0.000	0.000
LPG	3,533	2	0.00000	-	310	0.000	0.000
Lubricants	1,481	-	0.00000	-	310	0.000	0.000
Motor Gasoline	2,935	-	0.00000	-	310	0.000	0.000
Motor Gasoline Blending Components	273	-	0.00000	-	310	0.000	0.000
Misc. Petro Products	-	-	0.00000	-	310	0.000	0.000
Petroleum Coke	1,782	206	0.00000	-	310	0.000	0.000
Petroleum Plus	-	-	0.00000	-	310	0.000	0.000
Residual Fuel	79	-	0.00000	-	310	0.000	0.000
Still Gas	7,485	180	0.00000	-	310	0.000	0.000
Special Naphtha	290	374	0.00000	-	310	0.000	0.000
Unrefined Oil	13,731	-	0.00000	-	310	0.000	0.000
Waxes	-	-	0.00000	-	310	0.000	0.000
Natural Gas	66,451	2,283	0.00000	-	310	0.000	0.000
Wood	331	N/A	0.00000	-	310	0.000	0.000
Other	-	-	0.00000	-	310	0.000	0.000
<b>Total</b>						<b>0.000</b>	<b>0.000</b>

Required Non-Energy Consumption Data

Industrial Sector N<sub>2</sub>O

1991

Default Non-Energy Consumption Data?

Industrial Sector N<sub>2</sub>O

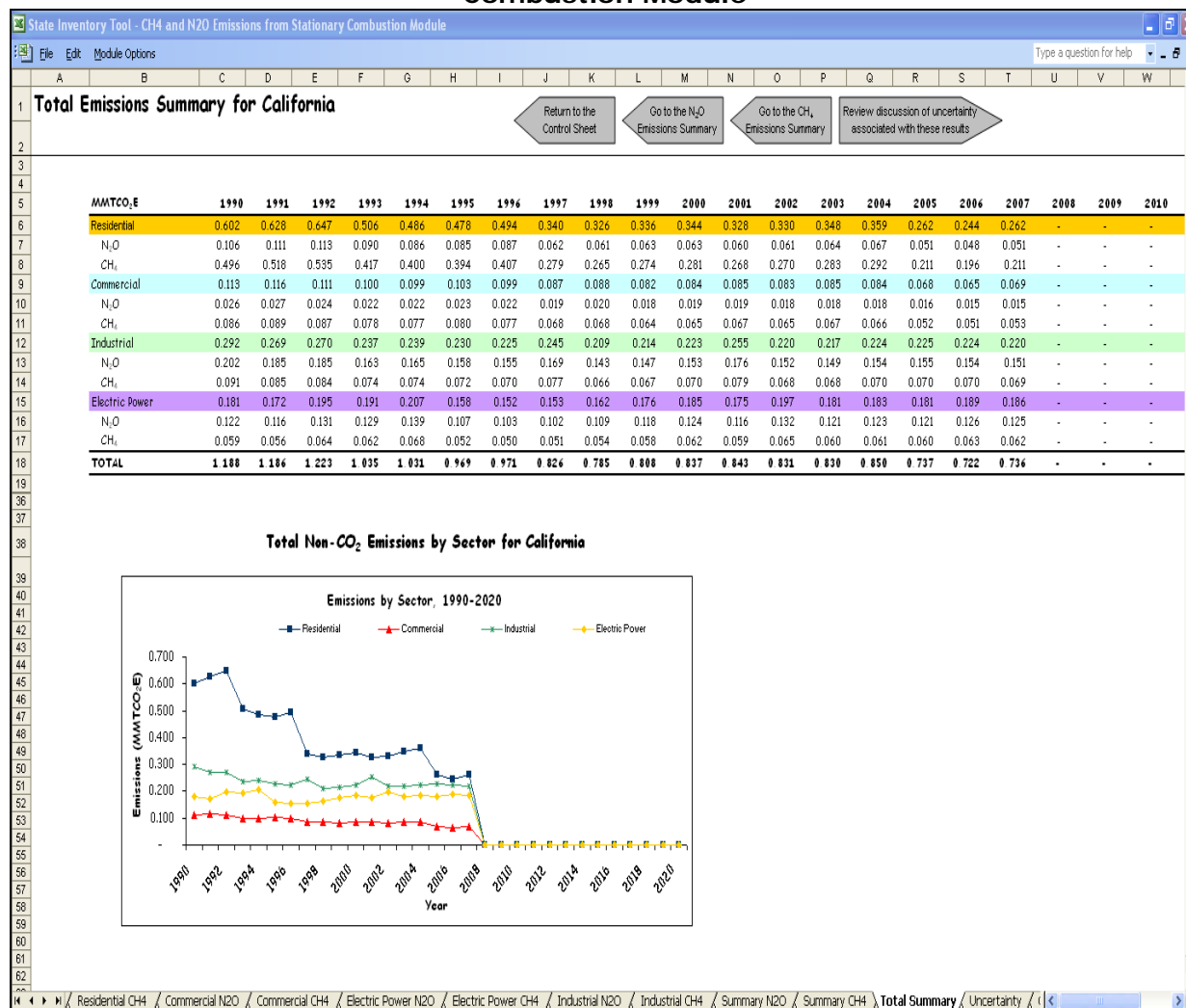
1992

Default Non-Energy Consumption Data?

## Step (7): Review Summary Information

The steps above provide estimates of total CH<sub>4</sub> and N<sub>2</sub>O emissions by sector. These are summed over all fuel types and sectors, for each year, and the information is collected on the summary worksheets. There are three summary worksheets, one for CH<sub>4</sub>, one for N<sub>2</sub>O, and one for total emissions. Each worksheet displays results in MMTCO<sub>2</sub>E. Figure 9 shows the summary worksheet that sums the emissions from all sectors in the Stationary Combustion module. In addition, the results are displayed in graphical format at the bottom of each summary worksheet.

**Figure 9. Example of the Emissions Summary Worksheet in the Stationary Combustion Module**



## Step (8): Export Data

The final step is to export the summary data. Exporting data allows the estimates from each module to be combined later by the Synthesis Module to produce a comprehensive greenhouse gas inventory for the state.

To access the "Export Data" button, return to the control worksheet and scroll down to the bottom (8). Click on the "Export Data" button and a message box will open that reminds



the user to make sure all sections of the module have been completed. If you make any changes to the Stationary Combustion module later, you will then need to re-export the results.

Clicking “OK” prompts you to save the file. The file is already named, so you only need to choose a convenient place to save the file. After the file is saved, a message box will appear indicating that the data was successfully exported.

While completing the modules, you are encouraged to save each completed module; doing so will enable you to easily make changes without re-running it entirely.

**Note: the resulting export file should not be modified.** The export file contains a summary worksheet that allows users to view the results, as well as a separate data worksheet with an unformatted version of the results. The second worksheet, the data worksheet, contains the information that is exported to the Synthesis Tool. Users may not modify that worksheet. Adding/removing rows, moving data, or making other modifications jeopardize the ability of the Synthesis Module to accurately analyze the data.

Following data export, the module may be reset and run for an additional state. Alternatively, you may run the remaining modules of the State Inventory Tool to obtain a comprehensive profile of emissions for your state.

## 1.4 UNCERTAINTY

In the upper right-hand corner of the Summary worksheets 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.

## 1.5 REFERENCES

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