

EPA's Climate CHECK

Climate Change Emission Calculator Kit

TRAINING



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ICF International

16th Annual International Emission Inventory
Conference
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Overview

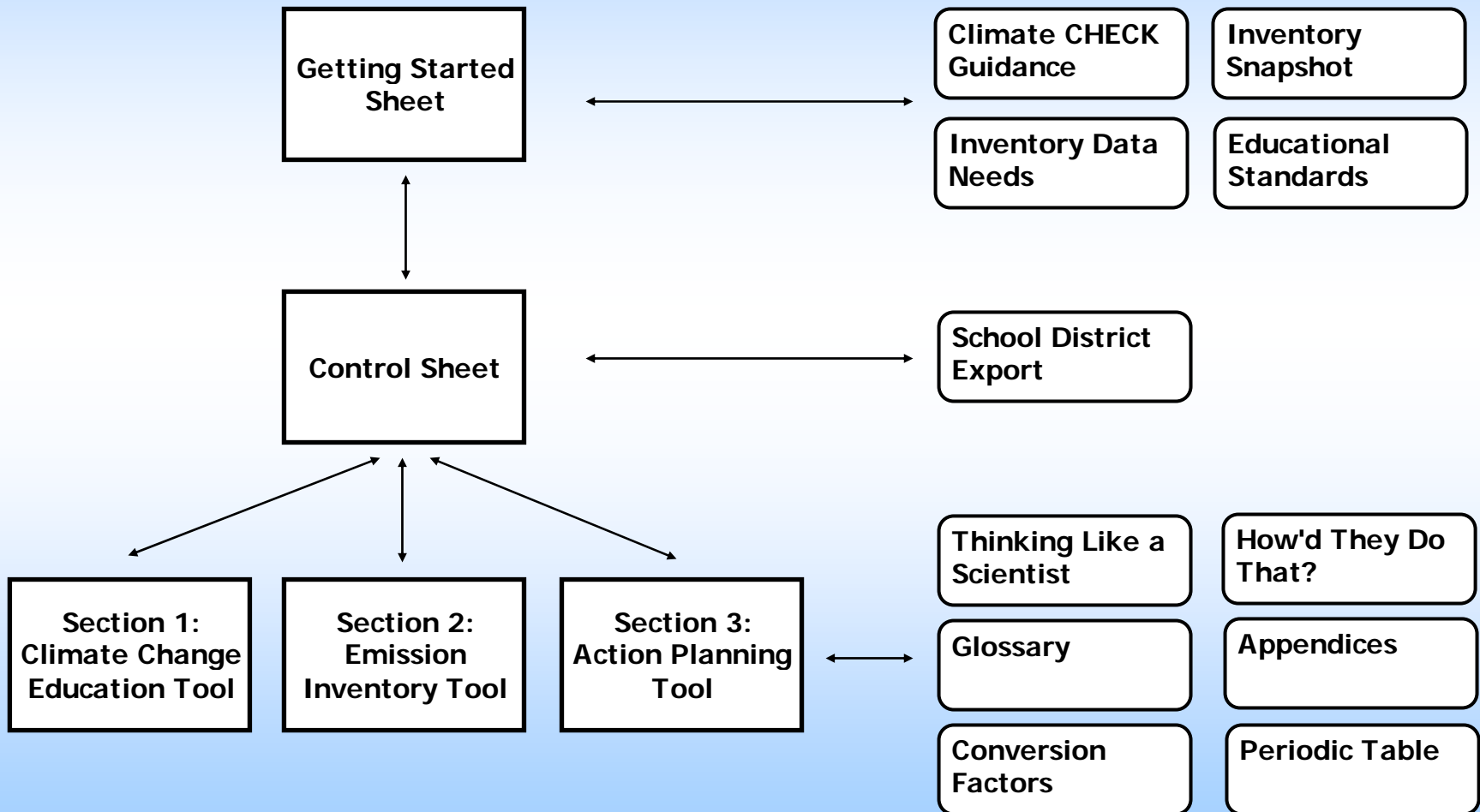
- What is Climate CHECK?
- Climate CHECK Structure
- Climate CHECK Content
- How can I get Climate CHECK



What is Climate CHECK?

- Excel-based tool designed to educate, estimate, and mitigate.
 - **Educate** high-school students about climate change and GHG emissions.
 - **Estimate** their school's GHG emissions by performing an emission inventory.
 - **Mitigate** their school's GHG emissions by developing and implementing an Action Plan.

Climate CHECK Structure



Welcome to EPA's Climate Change Emission Calculator Kit (Climate CHECK)

[Get Started!](#)

Climate CHECK is an interactive kit designed to:

- **Educate** high-school students about climate change and greenhouse gas (GHG) emissions,
- **Estimate** your school's GHG emissions by performing an emission inventory,
- **Mitigate** your school's GHG emissions by developing and implementing an Action Plan.

To begin using Climate CHECK, please click the "Get Started!" navigational button located in the top right-hand corner of this sheet.



Important information before you begin:

- 1) Before proceeding, **please register Climate CHECK** by sending an email containing your name, title, school name (if applicable), and the class level and subject you teach (if applicable) to ClimateCHECK@icfi.com. Registering Climate CHECK will ensure that you receive all updates to the kit. Questions and comments concerning Climate CHECK may also be sent to this address.
- 2) Please note: **Climate CHECK uses macros**. To make sure Climate CHECK functions properly, please make sure Excel's macro settings are set to "medium" and choose to enable macros when prompted. To do so, before opening Climate CHECK:
 - Open Excel.
 - From the "Tools" dropdown list, select "Options."
 - On the "Security" tab, select the "Macro Security" button, choose "Medium," and press "ok."
 - Close Excel and open the Climate CHECK file.
 - When prompted by the dialog box upon opening Climate CHECK, please choose to "Enable Macros."
- 3) Climate CHECK was developed using **Excel 2003 and Windows XP**, and tested on Excel 2002. While the kit will function on older versions of Excel and Windows, these system settings are optimal.
- 4) Monitors with resolution settings of 1024X768 allow for optimal viewing of Climate CHECK.
- 5) Climate CHECK uses methods to estimate GHG emissions that were established by the Intergovernmental Panel on Climate Change (IPCC) and are used to develop EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks*.

Developed By

ICF
INTERNATIONAL



Climate CHECK - *Getting Started!*

[Welcome Sheet](#)
[Control Sheet](#)


Stationary Sources



Purchased Electricity and Steam



Mobile Sources



Waste Sent to Landfill



Wastewater



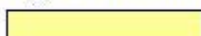
Land Management



Refrigerants and Air Conditioners

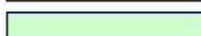
Now that you know some basics about performing an inventory, you can move ahead to the next sheet to begin the process of performing an inventory of your school's GHG emissions. Before you do, it might be helpful to familiarize yourself with some things to look out for from the list below.

Things to look out for:



Pale Yellow Cells

These are the cells where you need to enter information or data. Press enter once you fill-out the cell.



Pale Green Cells

These are the cells where Climate CHECK reports your emission results.



Pale Orange Cells

These are the cells where Climate CHECK reports emission reductions or carbon that is sequestered. Sequestered emissions refer to carbon that is bound in materials or plants rather than emitted to the atmosphere as CO₂.

[Next Sheet](#)

Navigational Arrows Use these to navigate through Climate CHECK.



Click to Print! Just press this button to quickly print out the current sheet.

Informational Chalkboards

Information chalkboards provide extra bits of information to help you complete emission estimates and navigate through Climate CHECK.

Calculate

Click the "Calculate" button to perform calculations.

Delete

The "Delete" button erases calculations you've made.

Climate CHECK - *Getting Started!*

[Welcome Sheet](#)[Control Sheet](#)

Did you know that everyday activities you do in your school can actually impact the climate? Heating your school, lighting your classroom, and disposing of your school's waste can cause greenhouse gas (GHG) emissions. These emissions can contribute to global warming, a phenomenon in which human activities can influence the temperature of the earth's atmosphere. This influence on the earth's atmospheric temperature can alter climate causing it to change. Scientists call this altering of earth's climate, climate change.

So, what is climate change anyway? And, how do my daily activities contribute to it? Climate change is a change in long-term weather patterns (such as temperature and annual rainfall). Some changes in climate occur naturally. Human activities that result in GHG emissions (like those mentioned above) can also cause changes in climate. When GHGs are emitted, they trap energy in the atmosphere, which can alter the world's climate.



How can I learn more about climate change and how to reduce GHG emissions at my school? EPA has created Climate CHECK to help you better understand climate change and create an inventory of the GHG emissions that result from activities at your school. Once you know how your school is contributing to GHG emissions, you can figure out how to reduce them!

Get Started!

The primary purpose of Climate CHECK is to help you learn about GHG emissions by performing an emission inventory for your school and investigating ways to reduce your school's GHG emissions. While performing the inventory, Climate CHECK provides information on GHGs, climate change, and other relevant information. The inventory is divided into sources, which are activities that release GHGs into the atmosphere. Information about GHG emission inventories and Climate CHECK's formatting and structure are below. When you are ready to perform an inventory you can click the "Control Sheet" arrow at the top of this sheet.

The buttons below provide additional resources that can be accessed through this sheet. These include guidance on how best to use Climate CHECK to perform an inventory at your school, a GHG emission inventory snapshot sheet that allows you to quickly estimate your school's GHG emissions from several key sources, a listing of the types of data you will need to perform a GHG emission inventory, information on how Climate CHECK meets the National Science Content Standards, and a sheet that explains the units (kgCO₂E) Climate CHECK uses to report emissions. Each of these can be accessed by clicking the buttons below.

[Guidance](#)[Inventory Snapshot](#)[Inventory Data Needs](#)[Educational Standards](#)[Understanding Units](#)

What's a GHG emission inventory, and how can I create one for my school? A GHG emission inventory is a way to keep track of the GHGs that result from activities that take place at your school. An inventory does not measure GHGs directly. Instead, you estimate GHG emissions using data on school activities that ultimately result in GHG emissions. Scientists call these type of data "activity data." You can calculate GHG emissions by multiplying activity data by an emission factor. An emission factor tells us the amount of GHG emissions that are produced for each unit of activity data.

Climate CHECK - *The Control Sheet*

[Previous Sheet](#)

Section 1 - Learn about GHGs and Climate Change

Click on the button below to learn about the greenhouse effect and the carbon cycle.

[The Greenhouse Effect](#)

Click on the button below to learn about climate change and how GHGs are affecting climate.

[Climate Change Info](#)

Click on the button below to learn about the impacts of climate change.

[Climate Change Impacts](#)

Click on the button below to find more information on GHGs, climate change, and ways to reduce GHG emissions for students as well as educational resources for teachers.

[Links](#)

Section 2 - Perform an Inventory of Your School's GHG Emissions

Once you've filled out the school-specific information above, click the "Prepare Climate CHECK!" button below to set up Climate CHECK for your School, then hit the "Let's Go" navigational button to begin performing an inventory.

[Prepare Climate CHECK!](#)[Let's Go!](#)

Quick Links

Click the links below to jump to the sheet

[Stationary Combustion](#)[Purchased Electricity and Steam](#)[Mobile Sources](#)[Landfilled Solid Waste](#)[Wastewater Treatment](#)[Refrigeration and Air Conditioning](#)[Land Management](#)[Emissions Summary](#)

Reset the Kit



Have you already performed an inventory using the kit and would like to clear all the data to perform an inventory for another year or another school? No problem! Just click the reset button to reset the entire kit.

Section 1: Climate Change Education

- Provides text describing the greenhouse effect, the carbon cycle, and climate change drivers, science, and impacts.
- Supports the text with true-or-false and multiple choice questions.

EPA's Climate CHECK

File Edit Module Options Type a question for help

The Greenhouse Effect and the Carbon Cycle

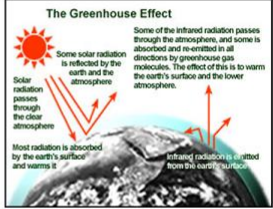
Return

Key Words:

- ★ Greenhouse Effect
- ★ Solar Radiation
- ★ Thermal Radiation
- ★ Climate
- ★ Climate Change
- ★ Non-Anthropogenic
- ★ Anthropogenic

The Greenhouse Effect

The **greenhouse effect** is a natural phenomenon that keeps our planet warm enough to sustain life. Greenhouses work by trapping heat from the Sun. Greenhouse gases (GHGs) in the Earth's atmosphere work in the same way. The Sun gives off **solar radiation**, some of which is reflected back into space by clouds, and some of which passes through the atmosphere to warm the Earth's surface. This heat is then emitted from the Earth as **thermal radiation**, which has a longer wavelength than solar radiation. GHGs in the atmosphere, such as water vapor, carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄), trap some of this thermal radiation and prevent it from escaping out to space. In this way, the atmosphere acts as a blanket that uses thermal radiation to keep the Earth warm. The diagram to the right illustrates the greenhouse effect.



The diagram illustrates the greenhouse effect. It shows the Sun emitting solar radiation, which passes through the atmosphere to warm the Earth's surface. The Earth's surface then emits thermal radiation, which is partially trapped by greenhouse gases in the atmosphere, warming the atmosphere and the surface. Labels include: 'Some solar radiation is reflected by the north and the atmosphere', 'Solar radiation passes through the clear atmosphere', 'Most radiation is absorbed by the earth's surface and warms it', 'Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the earth's surface and the lower atmosphere.', and 'Trapping radiation is emitted from the earth's surface'.

True or False: The greenhouse effect is bad for the environment.

☐ True ☐ False

So Why Do We Care about the Greenhouse Effect?

The greenhouse effect keeps the Earth warm enough to sustain life. But if the greenhouse effect becomes too strong, could result in **unwelcome warming**. Changes in average temperatures over time—even very small ones—result in what we call "climate change." Changes in our climate can have far-reaching impacts—from effects on crop growth to changes in sea level to changes in the prevalence of severe weather. Think about how the weather and ecosystems vary in your state compared with a state much farther north or south. The types of wildlife (do you have bears nearby? lizards?), plants (do you have trees that are 200 years old? do you have any cacti? do you have any desert plants? do you have any tropical plants?), and

Exercise: True/False

All GHGs are caused by human activity.

Section 1: Climate Change Education



True or False: All GHGs are caused by human activity.

True

False

Correct!

Answer: False Most GHGs occur naturally in the environment. The most important GHG—water vapor—is responsible for two-thirds of the greenhouse effect and is formed by the evaporation of water from oceans, lakes, and other sources. Other GHGs can occur naturally as well: for example, CO₂ is released as a waste product when humans and other mammals breathe. These types of emissions are considered to be **natural** or non-anthropogenic sources. These sources are normally balanced by natural **sinks**, such as trees and the ocean, which absorb GHGs from the atmosphere.

However, some human activities, such as burning fossil fuels for energy, cause emissions of GHGs that would not have occurred naturally. These human-induced emissions are called anthropogenic emissions. Even though anthropogenic emissions account for a relatively small portion of all of the GHGs in the atmosphere, they upset the natural balance between sources and sinks and increase the greenhouse effect. The result is an overall warming of the Earth's surface. In fact, global average surface temperatures have increased 0.5-1.0°F since the late 1800s. The 20th century's 10 warmest years all occurred in the last 15 years of the century (1985-1999).

Answer: False — *Most GHGs occur naturally in the environment...however, some human activities, such as burning fossil fuels for energy, cause emissions of GHGs that would not have occurred naturally. These human-induced emissions are called anthropogenic emissions.*

Section 2: Emission Inventory

- Individual Source Sheets walk students through calculations to estimate GHG emissions from:
 - Stationary Combustion
 - Purchased Elec. and Steam
 - Mobile Combustion
 - Landfilled Solid Waste
 - Wastewater Treatment
 - Refrigeration and AC
 - Land Management
- GHG emissions include:
 - Carbon Dioxide (CO₂)
 - Methane (CH₄)
 - Nitrous Oxide (N₂O)
 - Hydroflourocarbons (HFCs)

The screenshot shows the 'Stationary Combustion' module of EPA's Climate CHECK software. It includes a table for fuel consumption, calculation steps for CO₂ emissions, and a final summary of oxidized carbon.

Stationary Combustion

Key Words: Fossil Fuel, Carbon Content, Oxidation Factor, Incomplete Combustion, Global Warming Potential, Carbon Dioxide Equivalent, Boiler.

Table 1: Fuel Consumption in Stationary Sources (e.g., boilers, furnaces, etc.)

Device Name	Device Type	Fuel Type	Quantity of Fuel Used	Units	Carbon Content Value	Unit	Oxidation Factor (%)
Basement Boiler	Boiler	Fuel Oil	5,000	Liters	0.85	kg C/liter	99.0%

To calculate CO₂ emissions, follow the steps below.

Step 1) Calculate Total Carbon

Device Name	Fuel Consumed	X	Carbon Content	=	Carbon in Fuel
Basement Boiler	5,000 Liters of Fuel Oil	x	0.85 kg C/liter	=	4,250 (kg)

Step 2) Calculate Amount of Carbon Oxidized into CO₂

Device Name	Carbon in Fuel (kg)	X	Oxidation Factor (%)	=	Oxidized Carbon (kg of C)
Basement Boiler	4,250	x	99.0%	=	

Total oxidized carbon from stationary combustion at your school is: kg of C

Oxidizing this carbon produces: kg of CO₂

Why does carbon dioxide seem heavier than carbon?

Thinking like a scientist...

CH₄ and N₂O Emissions

Exercise:

If the fuel oil consumed annually at your school contains approximately 4,200 kg of carbon, how many kg of carbon dioxide will be produced through its oxidation?

Table 1: Fuel Consumption in Stationary Sources (e.g., boilers, furnaces, etc.)

Device Name	Device Type	Fuel Type	Quantity of		Carbon Content		Oxidation Factor (%)
			Fuel Used	Units	Value	Unit	
Basement Boiler	Boiler	Fuel Oil	5,000	Liters	0.85	kg C/liter	99.0%

Add Another Device

Remove Last Device

To calculate CO₂ emissions, follow the steps below.

Step 1) Calculate Total Carbon

Device Name

Fuel Consumed

X

Carbon Content

=

Carbon in Fuel (kg)

Basement Boiler

5,000

Liters of Fuel Oil

x

0.85

kg C/liter

=

4,250

Step 2) Calculate Amount of Carbon Oxidized into CO₂

Device Name

Carbon in Fuel (kg)

X

Oxidation Factor (%)

=

Oxidized Carbon (kg of C)

Basement Boiler

4,250

x

99.0%

=

4,208

Calculate

Delete

Total oxidized carbon from stationary combustion at your school is: 4,208 kg of C

Oxidizing this carbon produces: kg of CO₂

Why does carbon dioxide seem heavier than carbon?

Thinking like a scientist...

Answer: Approximately 15,400 kg of CO₂
(CO₂ has approximately 3.67 times the mass of C)

Table 1: Fuel Consumption in Stationary Sources (e.g., boilers, furnaces, etc.)

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X

Carbon Content

=

Carbon in Fuel (kg)

Basement Boiler

5,000

Liters of Fuel Oil

x

0.85

kg C/liter

=

4,250

Step 2) Calculate Amount of Carbon Oxidized into CO₂

Device Name

Carbon in Fuel (kg)

X

Oxidation Factor (%)

=

Oxidized Carbon (kg of C)

Basement Boiler

4,250

x

99.0%

=

4,208

Calculate

Delete

Total oxidized carbon from stationary combustion at your school is: 4,208 kg of C
Oxidizing this carbon produces: 15,428 kg of CO₂

Why does carbon dioxide seem heavier than carbon?

Thinking like a scientist...


Thinking Like a Scientist...

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Carbon (C) vs. Carbon Dioxide (CO₂)

In 2003, U.S. emissions of CO₂ equaled 5,842 million metric tons. These CO₂ emissions occurred when carbon contained in fossil fuels, wood, and other carbon-based materials oxidized (underwent a chemical reaction with oxygen) usually because the fossil fuel, wood, or carbon-based material was combusted. During the oxidation process, each carbon atom picked up two oxygen atoms to become CO₂.

This same process happens at your school when fuels containing carbon such as natural gas, propane, or gasoline are combusted in stationary sources (e.g., boilers, heaters, generators) or mobile sources (e.g., cars, trucks, tractors).

 **Carbon dioxide must have more mass than carbon because it contains two additional oxygen atoms, but how much more?**

Using a periodic table of the elements in your classroom, on the web, or in this kit, enter the atomic mass of a carbon atom and an oxygen atom in the yellow cells below.

Periodic Table

Atomic mass of a **carbon** atom:**12**

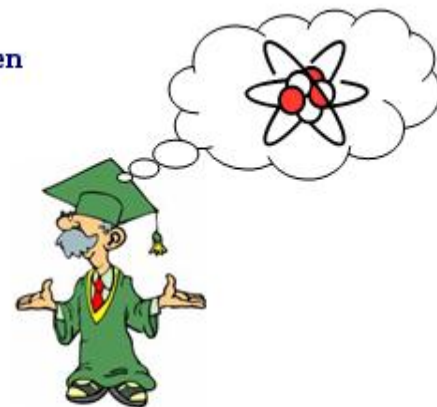
(mean relative)

Correct!

Atomic mass of an **oxygen** atom:**16**

(mean relative)

Correct!



The mass of a molecule of CO₂ is equal to:

The mass of **one** carbon atom: **12** plus the mass of **two** oxygen atoms: **16** + **16** = **32**

The mass of a molecule of CO₂ is: **12** + **32** = **44**

The percent of carbon in CO₂ is equal to the mass of carbon: **12** mass of a carbon atom Correct!

...divided by the mass of CO₂: **44** mass of a CO₂ molecule Correct!

27.27% percent of carbon in carbon dioxide

Carbon has 27.27 percent as much mass as carbon dioxide.

Periodic Table of Elements*

* Excludes Lanthanoids and Actinoids

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1 1.01 H																	2 4.00 He		
3 6.94 Li	4 9.01 Be													5 10.81 B	6 12.01 C	7 14.01 N	8 16.00 O	9 19.00 F	10 20.18 Ne
11 22.99 Na	12 24.31 Mg													13 26.98 Al	14 26.98 Si	15 30.97 P	16 32.06 S	17 35.45 Cl	18 39.95 Ar
19 39.0 K	20 40.08 Ca	21 44.96 Sc	22 47.88 Ti	23 50.94 V	24 52.00 Cr	25 54.94 Mn	26 55.85 Fe	27 58.93 Co	28 (58.70) Ni	29 63.55 Cu	30 (65.38) Zn	31 69.72 Ga	32 72.59 Ge	33 74.91 As	34 78.96 Se	35 79.90 Br	36 83.80 Kr		
37 85.47 Rb	38 87.62 Sr	39 88.91 Y	40 91.22 Zr	41 91.22 Nb	42 95.94 Mo	43 (98.91) Tc	44 101.07 Ru	45 102.91 Rh	46 (106.42) Pd	47 107.87 Ag	48 112.41 Cd	49 114.82 In	50 118.69 Sn	51 121.75 Sb	52 127.60 Te	53 126.9 I	54 131.29 Xe		
55 132.9 Cs	56 137.33 Ba	71 174.91 Lu	72 178.49 Hf	73 180.95 Ta	74 183.85 W	75 186.21 Re	76 190.02 Os	77 192.22 Ir	78 195.08 Pt	79 196.97 Au	80 200.59 Hg	81 204.38 Tl	82 207.20 Pb	83 208.98 Bi	84 (209) Po	85 (210) At	86 (222) Rn		
87 (223.0) Fr	88 226.03 Ra	103 (262.1) Lr	104 (261.1) Rf	105 (262.1) Db	106 (263.1) Sg	107 (264.1) Bh	108 (265.1) Hs	109 (268) Mt	110 (269) Uun	111 (272) Uuu	112 (277) Uub	114 (283) Uuq		116 (283) Uuh		118 (293) Uuo			

Atomic Number

Atomic Mass

Stationary Combustion

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Key Words:

- ★ Fossil Fuel
- ★ Global Warming Potential
- ★ Carbon Content
- ★ Carbon Dioxide Equivalent
- ★ Oxidation Factor
- ★ Boiler
- ★ Incomplete Combustion

Total oxidized carbon from stationary combustion at your school is:

4,208 kg of C

Oxidizing this carbon produces:

15,428 kg of CO₂

Why does carbon dioxide seem heavier than carbon?



Thinking like a scientist...

CH₄ and N₂O Emissions

Although most GHG emissions from Stationary Combustion are in the form of CO₂, two other gases -- methane (CH₄) and nitrous oxide (N₂O) -- are also important emissions from these sources. Methane is a byproduct of **incomplete combustion** of the carbon in fossil fuels, while N₂O is formed when combustion of fossil fuels causes the oxidation of atmospheric nitrogen.

The amount of these gases produced during fossil fuel combustion depends on the amount and type of fuel combusted, control technologies, and age of the devices. Fuel types have their own emission factors, which express the amount of CH₄ or N₂O produced per kilogram of fuel combusted.



CH₄ and N₂O emissions from stationary combustion at your school are:

CH₄

2.5

N₂O

0.2

kg

Like CO₂, emissions of CH₄ and N₂O absorb heat given off by the earth's surface; however, they transfer the heat to the atmosphere differently than CO₂. An amount of CH₄ or N₂O transfers more heat to the atmosphere than the same amount of CO₂. Scientists call a GHG's ability to heat the atmosphere relative to CO₂ its **Global Warming Potential (GWP)**. If a gas has a **GWP** of 100, then 1 ton of that gas has the same impact on climate as 100 tons of CO₂.

GWPs are used to weight different gases into a common unit so that emissions from all gases can be compared. Scientists often use **carbon dioxide equivalent (CO₂ Eq. or CO₂E)** as the common unit. One ton of **CO₂E** has the same impact of carbon as 1 ton of CO₂. Without this conversion, emissions of different gases cannot be compared in a meaningful way since 1 ton of, say, N₂O has a very different impact on climate than 1 ton of CO₂.

Using the table in **Appendix B**, fill in the appropriate GWPs in the cells below. Then, complete the calculation to convert CH₄ and N₂O emissions into units of CO₂ Equivalent.

How'd they do that? *Calculation Explanations*

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Methane (CH₄) and Nitrous Oxide (N₂O) from Stationary Combustion

Background Information:

Methane and nitrous oxide emissions from stationary combustion are determined by multiplying the amount of fuel combusted by the amount of heat generated through that combustion (heat content). The resulting value reports the heat generated by combusting the fuel in Million British Thermal Units (MMBTU). The heat generated in MMBtu is then converted to Giga Joules (another energy unit) and multiplied by that fuel's CH₄ or N₂O emission factor.

Factors:

Heat Content

	Value	Unit
Coal	23.38	MMBtu/ mt
Natural Gas	0.036	MMBtu/ l
Propane	0.031	MMBtu/ l
Gasoline	0.044	MMBtu/ l
Diesel Fuel	0.049	MMBtu/ l
Fuel Oil	0.053	MMBtu/ l
Kerosene	0.048	MMBtu/ l

CH₄ and N₂O Emissions Factors

CH ₄	Unit	N ₂ O	Unit
10	g/GJ	1.4	g/GJ
5	g/GJ	0.1	g/GJ
10	g/GJ	0.6	g/GJ
10	g/GJ	0.6	g/GJ
10	g/GJ	0.6	g/GJ
10	g/GJ	0.6	g/GJ
10	g/GJ	0.6	g/GJ
10	g/GJ	0.6	g/GJ

Conversion Factors

Value	Unit
1.055	MMBtu/ GJ ²

Example Equation:

Templeton Heights High School combusts 5,000,000 liters of natural gas in a natural gas boiler each year.

How many **kilograms** of CH₄ does the school produce through this combustion?

 kg

round to the nearest whole number

How many **kilograms** of N₂O does the school produce through this combustion?

 kg

round to the nearest whole number

[Hide Answers](#)

Methane from Natural Gas

$$5,000,000 \text{ liters} \times \frac{0.036 \text{ MMBtu}}{1 \text{ liter}} \times \frac{1 \text{ GJ}}{1.055 \text{ MMBtu}} \times \frac{5 \text{ grams CH}_4}{1 \text{ GJ}} \times \frac{1 \text{ kg}}{1000 \text{ grams}} = 853 \text{ kg CH}_4$$

Nitrous Oxide from Natural Gas

$$5,000,000 \text{ liters} \times \frac{0.036 \text{ MMBtu}}{1 \text{ liter}} \times \frac{1 \text{ GJ}}{1.055 \text{ MMBtu}} \times \frac{0.1 \text{ grams N}_2\text{O}}{1 \text{ GJ}} \times \frac{1 \text{ kg}}{1000 \text{ grams}} = 17 \text{ kg N}_2\text{O}$$

Sources:

1. IPCC Stationary Combustion Emissions Factors Tier 1 (2006)

Stationary Combustion

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Key Words:

- ★ Fossil Fuel
- ★ Global Warming Potential
- ★ Carbon Content
- ★ Carbon Dioxide Equivalent
- ★ Oxidation Factor
- ★ Boiler
- ★ Incomplete Combustion

CH₄ and N₂O Emissions

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The amount of these gases produced during fossil fuel combustion depends on the amount and type of fuel combusted, control technologies, and age of the devices. Fuel types have their own emission factors, which express the amount of CH₄ or N₂O produced per kilogram of fuel combusted.



CH₄ and N₂O emissions from stationary combustion at your school are:

CH ₄	N ₂ O	kg
2.5	0.2	

Like CO₂, emissions of CH₄ and N₂O absorb heat given off by the earth's surface; however, they transfer the heat to the atmosphere differently than CO₂. An amount of CH₄ or N₂O transfers more heat to the atmosphere than the same amount of CO₂. Scientists call a GHG's ability to heat the atmosphere relative to CO₂ its **Global Warming Potential (GWP)**. If a gas has a **GWP** of 100, then 1 ton of that gas has the same impact on climate as 100 tons of CO₂.

GWPs are used to weight different gases into a common unit so that emissions from all gases can be compared. Scientists often use **carbon dioxide equivalent (CO₂ Eq. or CO₂E)** as the common unit. One ton of **CO₂E** has the same impact of carbon as 1 ton of CO₂. Without this conversion, emissions of different gases cannot be compared in a meaningful way since 1 ton of, say, N₂O has a very different impact on climate than 1 ton of CO₂.

Using the table in **Appendix B**, fill in the appropriate GWPs in the cells below. Then, complete the calculation to convert CH₄ and N₂O emissions into units of CO₂ Equivalent.

	Emissions (kg)		GWP		Emissions	
CH ₄	2.5	X		=		kg CO ₂ E
N ₂ O	0.2	X		=		kg CO ₂ E

[Calculate](#)
[Delete](#)

Exercise: What is methane's Global Warming Potential (GWP)? Nitrous oxide?

Stationary Combustion

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Appendix

Glossary

Conversions

Key Words:

- ★ Fossil Fuel
- ★ Carbon Content
- ★ Oxidation Factor
- ★ Incomplete Combustion

- ★ Global Warming Potential
- ★ Carbon Dioxide Equivalent
- ★ Boiler

CH₄ and N₂O Emissions

Although most GHG emissions from Stationary Combustion are in the form of CO₂, two other gases -- methane (CH₄) and nitrous oxide (N₂O) -- are also important emissions from these sources. Methane is a byproduct of **incomplete combustion** of the carbon in fossil fuels, while N₂O is formed when combustion of fossil fuels causes the oxidation of atmospheric nitrogen.

The amount of these gases produced during fossil fuel combustion depends on the amount and type of fuel combusted, control technologies, and age of the devices. Fuel types have their own emission factors, which express the amount of CH₄ or N₂O produced per kilogram of fuel combusted.



CH₄ and N₂O emissions from stationary combustion at your school are:

CH ₄	N ₂ O	
2.5	0.2	kg

Like CO₂, emissions of CH₄ and N₂O absorb heat given off by the earth's surface; however, they transfer the heat to the atmosphere differently than CO₂. An amount of CH₄ or N₂O transfers more heat to the atmosphere than the same amount of CO₂. Scientists call a GHG's ability to heat the atmosphere relative to CO₂ its **Global Warming Potential (GWP)**. If a gas has a **GWP** of 100, then 1 ton of that gas has the same impact on climate as 100 tons of CO₂.

GWPs are used to weight different gases into a common unit so that emissions from all gases can be compared. Scientists often use **carbon dioxide equivalent (CO₂ Eq. or CO₂E)** as the common unit. One ton of **CO₂E** has the same impact of carbon as 1 ton of CO₂. Without this conversion, emissions of different gases cannot be compared in a meaningful way since 1 ton of, say, N₂O has a very different impact on climate than 1 ton of CO₂.

Using the table in **Appendix B**, fill in the appropriate GWPs in the cells below. Then, complete the calculation to convert CH₄ and N₂O emissions into units of CO₂ Equivalent.

	Emissions (kg)			GWP			Emissions	
CH ₄	2.5	x		21	=		53	kg CO ₂ E
N ₂ O	0.2	x		310	=		62	kg CO ₂ E

Calculate

Delete

Answer: According to the IPCC's SAR, methane's GWP is 21 and nitrous oxide's GWP is 310.

Section 3: Action Planning

- Following an emission inventory, students can use Section 3 to plan actions to reduce emissions by Sector (e.g., Energy, Transportation)
- Students enter actions and percent reductions in emissions by source on Action Planning Sheets.
- These “mitigation actions” are summarized in an “Action Plan” that can be printed, signed, and displayed at their school.

The screenshot displays the 'Energy Mitigation' section of EPA's Climate CHECK software. The title bar reads 'EPA's Climate CHECK'. The main heading is 'Energy Mitigation: Reducing Emissions from Stationary Sources and Purchased Electricity and Steam'. Navigation buttons include 'Previous Sheet', 'Next Sheet', and 'Return to Control'. The 'Action Items' section asks for actions to reduce energy used for cooling, with a text box containing 'Replace inefficient boiler with more energy-efficient model.' Below this, a progress bar shows a 15% reduction, with a table indicating that these actions would prevent the release of 15,994 kg CO₂E. A summary row shows that if goals are achieved, cooling-related emissions will be 90,593 kg CO₂E. The 'Lighting' section shows current emissions of 37,981 kg CO₂E. A 'Ways to Reduce Emissions from Lighting' list includes: 'Turn off lights when not in use', 'Use natural lighting', and 'Install automatic lighting controls'. Another 'Action Items' section for lighting is at the bottom with empty text boxes.

EPA's Climate CHECK

Energy Mitigation:
Reducing Emissions from Stationary Sources and Purchased Electricity and Steam

Previous Sheet Next Sheet Return to Control

Action Items
What are some actions your school can take to reduce energy used for cooling? You can write these actions in the cells below.

Replace inefficient boiler with more energy-efficient model.

If your school takes these actions, by how much do you estimate your school can reduce energy used for cooling? 15% percent

These actions would prevent the release of 15,994 kg CO₂E

If your school achieves the energy reduction goals established by these actions, your school's cooling related emissions will be 90,593 kg CO₂E

Lighting Emissions 37,981 kg CO₂E

Did you know that schools can reduce their energy use by between 5 and 20 percent simply by turning off lights in unoccupied rooms?

Ways to Reduce Emissions from Lighting

- Turn off lights when not in use
- Use natural lighting
- Install automatic lighting controls

Action Items
What are some actions your school can take to reduce energy used for lighting? You can write these actions in the cells below.

Energy Mitigation:

Reducing Emissions from Stationary Sources and Purchased Electricity and Steam

[Previous Sheet](#)[Next Sheet](#)[Return to Control](#)

Action Items

What are some actions your school can take to reduce energy used for cooling? You can write these actions in the cells below.



Replace inefficient boiler with more energy-efficient model.



If your school takes these actions, by how much do you estimate your school can reduce energy used for cooling?

15% percent

These actions would prevent the release of

15,986 kg CO₂E

If your school achieves the energy reduction goals established by these actions, your school's cooling related emissions will be

90,588 kg CO₂E

Lighting

Emissions 77,981 kg CO₂E

Ways to Reduce Emissions from Lighting

Did you know that schools can reduce their energy use by between 8 and 20 percent simply by turning off lights in unoccupied rooms?

- Turn off lights when not in use
- Use natural lighting
- Install automatic lighting controls

Action Items

What are some actions your school can take to reduce energy used for lighting? You can write these actions in the cells below.



Action Plan

[Previous Sheet](#)
[Return to Control](#)

Action Plan for DC School

The following emissions were estimated for your school.

GHG Emissions (kgCO₂E)

	CO ₂	CH ₄	N ₂ O	HFC	Total
Stationary Sources	15,428	53	47		15,527
Purchased Electricity	244,411				244,411
Purchased Steam	0				0
Mobile Sources	1,440,564	1,350	5,139		1,447,054
Waste		79,386			79,386
Wastewater		2,564	643		3,207
Air Conditioning and Refrigeration				1,156	1,156
Land Management	1,180	0	9		1,190

We are committed to taking the following actions in order to achieve GHG emission reductions at our school.

Energy Action Team Name: _____

Emission Reductions: 15,986 kg CO₂E

- Replace inefficient boiler with more energy-efficient model.
- Start a bike-to-school program
- Install energy-efficient light fixtures
- Shut off computers and other electronic equipment over night
- Plant trees
- Install energy-efficient windows
- Purchase alternative-fuel school buses
-
-
-

School District Compiler

- After completing an emission inventory and action plan, students can export the results of their inventory and email them to their school district to support district-wide climate change programs.

The screenshot shows the 'EPA's Climate CHECK' application window. The title bar includes 'File', 'Edit', and 'Module Options' menus, along with a search bar and window controls. The main content area is titled 'School District Sheet' and features a 'Return' button. The interface is divided into four numbered steps:

- 1 Import data from schools**
 - Individual method**
Press the button below and follow instructions to load the data from one school.
 - Batch method**
Place all data files in a single directory first.
Then press the button below and follow instructions to load data from more than one school.
- 2 Calculate Totals**
When you have imported all of the data from the schools, press the button below to calculate total emissions.
- 3 Set up the results viewer**
Click the button below to prepare the viewer.
- 4 View the results**
Pick different schools or total

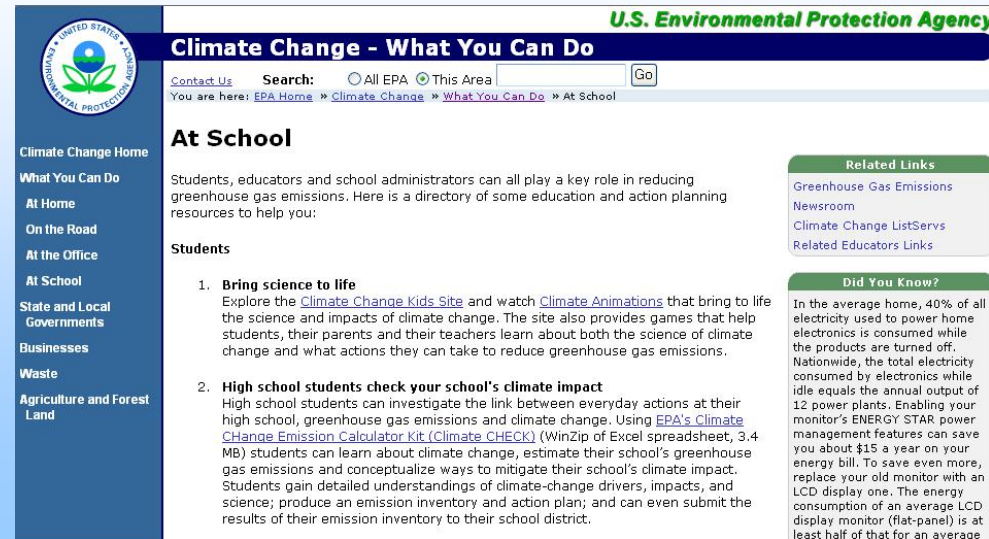
At the bottom left, there is a 'School Information' table with columns for School, Year, and a third column (partially visible). At the bottom right, there is a cartoon illustration of a red schoolhouse with a bell tower, a flagpole with the American flag, a green tree, and a smiling sun.

How can I get Climate CHECK?

- EPA's global warming website
 - <http://www.epa.gov/climatechange/wycd/school.html>
- ClimateCHECK@icfi.com
- Special thanks to Karen Scott of EPA
Scott.Karen@epa.gov



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A screenshot of the EPA website's "Climate Change - What You Can Do" section. The page has a blue header with the EPA logo and the title "Climate Change - What You Can Do". Below the header is a search bar and a breadcrumb trail: "You are here: EPA Home » Climate Change » What You Can Do » At School". The main content area is titled "At School" and includes a paragraph about the role of students, educators, and school administrators in reducing greenhouse gas emissions. Below this is a section for "Students" with two numbered links: "1. Bring science to life" and "2. High school students check your school's climate impact". On the right side, there are two boxes: "Related Links" with links to "Greenhouse Gas Emissions", "Newsroom", "Climate Change ListServs", and "Related Educators Links"; and "Did You Know?" with a fact about electricity consumption in homes.