

Teacher Guide

Fossil Fuel Use and Carbon Dioxide Emissions

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Activity Focus: Students interpret and visualize data records of U.S. fossil fuel use, the amount of carbon dioxide released from the burning of fossil fuels, and how the various energy-use sectors emit different amounts of carbon dioxide into the atmosphere. The Kyoto protocol is also introduced.

Major Concepts: Burning fossil fuels releases carbon dioxide into the atmosphere. Different energy-use sectors use different fossil fuels and thus contribute different amounts of carbon dioxide to the atmosphere; the U.S.'s generation of electricity and fueling of transportation are the largest carbon dioxide contributors. The Kyoto protocol requires the U.S. to reduce its carbon dioxide emissions.

Objectives: After completing this activity, students will be able to:

- understand that burning coal releases more carbon dioxide than natural gas, and that burning petroleum releases the least amount of carbon dioxide
- explain that in the U.S., the burning of coal to generate electricity and the burning of petroleum (gasoline) in cars and trucks (transportation sector) are the major sources of atmospheric carbon dioxide
- describe the Kyoto protocol and its possible impact on atmospheric carbon dioxide levels and fossil fuel use in the U.S
- transform data into a graphic form

Materials and Preparation: You will need to prepare the following materials before conducting this activity.

- Copy the *Fossil Fuel Use and Carbon Dioxide Emissions* data interpretation and visualization activity (make 1 copy per student).
- Provide each student/group with graph paper for answering the data transformation questions. You may want to provide each group with a transparency of grid paper for them to record their transformations.
- Make a transparency or PowerPoint slide for each data set (appendix) for use in the class discussion. You may want to make various colored sets of copies of the data set for groups of students.

Procedures: Students may work individually or as a group to complete the activity. You may want students to work in pairs, using the think-share-pair strategy.

1. Introduce the activity by showing students the carbon dioxide cartoon (appendix). Ask students to share their interpretation of the cartoon; what they think the cartoon means. What energy source is used and how is it used? How does the cartoon relate to energy use and global warming? Next ask students to identify

- some of the energy sources they use on a daily basis. List these energy sources on the board and organize by energy use sector (e.g., residential, commercial, transportation, industrial, electric generation). Indicate that in this activity students will be investigating how fossil fuel (energy) use impacts the atmosphere. Have students answer the “what I currently know and think” questions before starting the activity.
2. Organize students into small groups of 3-4, pairs, or have students work independently on the activity. Provide the appropriate number of copies. If students are working in small groups, have them read and discuss as a group each question before recording a consensus response. If students are working in pairs, have students read and answer the questions and then share and discuss their ideas/answers. Students should work in the same group or pairs throughout the module.
 3. Discuss the activity as a class, asking students to share their responses to the questions. Ask other students to share additional information/responses. Have several groups share their data transformations and explain how and why they re-visualized the data (You may want to provide each group with a grid paper transparency.). Show each data set (master in appendix) as students share their responses. Use the data set to focus the discussion.
 4. Have students reflect on their ideas by re-answering the engage questions writing their responses to the “what I now know and think” questions and have them reflect on their own thinking by completing the “how my ideas and thinking have changed” question.
 5. Collect student/group responses. Administer assessment item.

Assessments: The following assessments may be used as a pre/post activity assessment or as part of a module assessment.

- Which fossil fuel releases the most carbon dioxide into the atmosphere?
- Which fossil fuel use (sector) contributes the most carbon dioxide?
- How does burning fossil fuels affect the level of carbon dioxide in the atmosphere?
- How might the Kyoto protocol impact fossil fuel use in the U.S.?

Quiz: The following quiz may be used as a post activity assessment.

Which fossil fuel use sector contributes the most carbon dioxide to the atmosphere?

- A. Residential
- B. Electrical
- C. Commercial
- D. Industrial

E. Transportation

When fossil fuels are burned, energy and _____ are released.

True or False. Atmospheric carbon dioxide levels have increased since the 1950s.

Which fossil fuels release the most carbon dioxide when burned?

- A. Natural gas
- B. Petroleum
- C. Coal
- D. Electricity

Bibliography

Energy Information Administration (2006) <http://www.eia.doe.gov/>

EPA (2002). *US Climate Action Report*.

<http://yosemite.epa.gov/OAR/globalwarming.nsf/content/ResourceCenterPublicationsUSClimateActionReport.html>

EPA. Global Warming.

<http://yosemite.epa.gov/oar/globalwarming.nsf/content/indexarchive.html>

U.S. Greenhouse Gas Inventory Reports INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2004 (April 2006) USEPA #430-R-06-002

<http://www.epa.gov/climatechange/emissions/usinventoryreport.html>

Appendix:

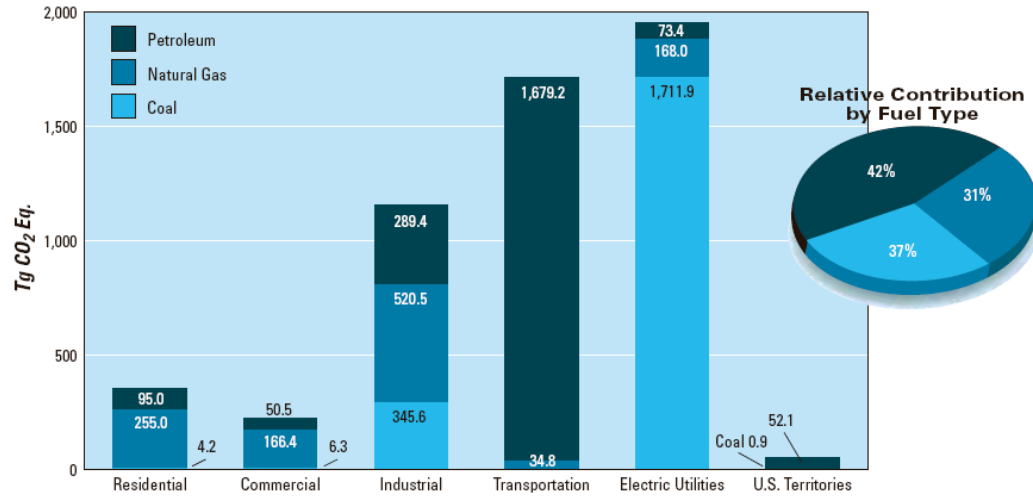


Table 1. Carbon dioxide emissions from energy

Year	1998	2000	2002	2004	2006*
Total U.S. carbon dioxide emissions	5,272	5,534	5,502	5,657	5,757
Carbon dioxide emissions from electrical generation	2,155	2,269	2,234	2,291	2,351
Carbon dioxide emissions from the transportation sector	1,663	1,770	1,802	1,860	1,900

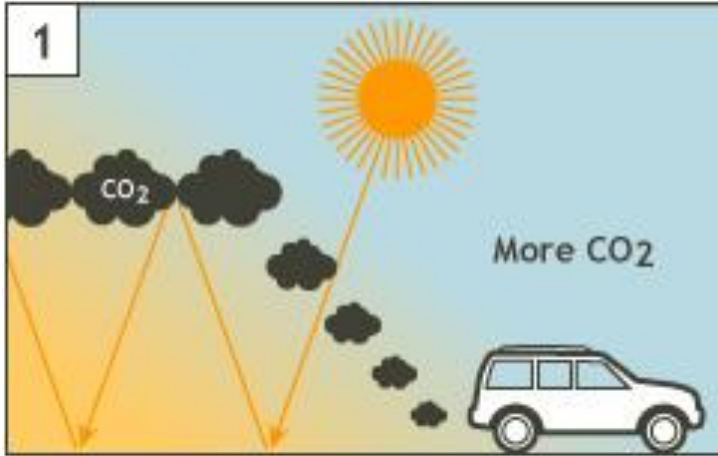
Unit: Tg CO₂ Eq. Source: EPA; *Estimated

Table 2. Approximate Annual Carbon Dioxide Emissions by Energy Sector for Selected States

State	Business (Commercial)	Electric Power	Homes (Residential)	Industry	Transportation	Total
Illinois	12	86	24	40	66	227
Indiana	6	115	9	57	43	230
Michigan	11	73	23	30	56	193
Ohio	11	118	19	35	69	252
Wisconsin	6	44	10	21	30	110

In million metric tons, rounded. Source: EIA

Country	Reduction Target (Percent)	Country	Reduction Target (Percent)
Australia	+8.0	Liechtenstein	-8.0
Austria (R)	-13.0	Lithuania (R)	-8.0
Belgium (R)	-7.5	Luxembourg (R)	-28.0
Bulgaria (R)	-8.0	Monaco	-8.0
Canada (R)	-6.0	Netherlands (R)	-6.0
Croatia	-5.0	New Zealand (R)	0.0
Czech Republic (R)	-8.0	Norway (R)	+1.0
Denmark (R)	-21.0	Poland (R)	-6.0
Estonia (R)	-8.0	Portugal (R)	+27.0
European Community (R) ^a	-8.0	Romania (R)	-8.0
Finland (R)	0.0	Russia	0.0
France (R)	0.0	Slovakia (R)	-8.0
Germany (R)	-21.0	Slovenia (R)	-8.0
Greece (R)	+25.0	Spain (R)	+15.0
Hungary (R)	-6.0	Sweden (R)	+4.0
Iceland (R)	+10.0	Switzerland (R)	-8.0
Ireland (R)	+13.0	Ukraine	0.0
Italy (R)	-6.5	United Kingdom (R)	-12.5
Japan (R)	-6.0	United States	-7.0
Latvia (R)	-8.0		



Carbon dioxide cartoon