



activity 1

Section 1. Gathering Information

Energy in the U.S. Web-quest

SUMMARY

Students visit various Web sites and complete the *Web-quest Exploration Guide* to learn about renewable and nonrenewable energy sources and current and future consumption trends in the U.S. As a culminating project, students create posters and present to the class.

BACKGROUND

Energy in the United States

Energy is fundamental to life on Earth. We depend on energy for nearly everything. It takes energy to light, cool, and heat our homes. It also takes energy to fuel our vehicles, grow our food, and power our machinery and technology.

Energy demands are increasing. At the same time, there is growing concern about the negative effects of climate change on the environment and people. As a result, there is increased interest in exploring ways to harness energy from renewable, locally available resources.

did you know?

From 2006 to 2030, total energy consumption in the United States is expected to grow by 19 percent.

(U.S. EIA, 2008a)

These efforts may aid in reducing the production of greenhouse gases and increase energy security.

Much of the energy we use is in the form of electricity, which is made from a variety of resources. Energy resources used in the United States (U.S.) include nonrenewable sources (such as petro-

did you know?

In 2004, the U.S. consumed 100 quadrillion British thermal units (Btu) of energy:

- 41 quadrillion Btu of petroleum,
- 23 quadrillion Btu of natural gas,
- 22 quadrillion Btu of coal,
- 8 quadrillion Btu of nuclear energy, and
- 6 quadrillion Btu of renewable energy.

(U.S. EIA, 2005)

leum, natural gas, coal, and nuclear) and renewable sources (such as wind, solar, biomass, hydroelectric, and geothermal).

Nonrenewable Energy Sources

Currently, most electricity in Florida is produced using nonrenewable resources. Fossil fuels, such as coal, petroleum, and natural gas, are **nonrenewable** because they cannot be replenished in a short period of time—they started to form millions of years ago and are still forming!

did you know?

In 2006, approximately 86 percent of the energy consumed in the U.S. was produced with coal, petroleum, and natural gas.

(U.S. EIA, 2008b)

SUBJECTS

Science, Language Arts

KEY QUESTIONS

1. What are nonrenewable and renewable energy sources?
2. What are the advantages and disadvantages of nonrenewable and renewable energy sources?
3. What are current and future U.S. and international energy consumption trends?
4. How is energy generated in your community?

OBJECTIVES

By the end of the activity, students will be able to do the following:

1. Compare advantages, disadvantages, and impacts of nonrenewable and renewable energy sources (SC.912.L.17.1.1; SC.912.L.17.1.9; SC.912.L.17.1.8; SC.912.E.6.6).
2. Assess current and future state, national, and international energy production and consumption trends.
3. Synthesize information gathered by creating a poster and presenting this poster to the class (LA.1112.5.2.3).

MATERIALS

- Copies of *Energy in the U.S. Web-quest Exploration Guide* for each student
- Computers with Internet access for each student or pair of students
- Headphones for each student for video/audio sections

TIME ESTIMATE

1 hour

Energy Units

In order to understand energy production, it is important to know how we measure energy. Units of energy used in the U.S. are called British thermal units (Btu), kilowatts (kW), kilowatt hours (kWh), and megawatts (MW).

British thermal unit (Btu):

The amount of heat required to increase the temperature of 1 pound of water 1 degree Fahrenheit (U.S. EIA, 2006).

Kilowatt (kW): The rate of electrical power output, which is equal to 1,000 watts. (A watt (*w*) is the basic measurement of electricity used in the U.S.)

Kilowatt hour (kWh): A measure of energy consumption, equal to 1,000 watts over a one-hour period. The kWh is what your utility provider measures to determine how much electricity your household uses.

Megawatt (MW): A measure of power plant electricity generation capacity, which is equal to 1,000,000 watts.

CONVERSIONS

- One million Btu equals approximately 8 gallons of gasoline.
- One billion Btu equals all the electricity that 300 average U.S. households consume in one month.
- One trillion Btu equals 500 railroad cars of coal, each weighing 100 tons.
- One quadrillion Btu equals 172 million barrels of crude oil.

Fossil fuels are found in the top layer of the Earth's crust and are formed from remains of plants and animals. Fossil fuels have historically provided the U.S. with a reliable, cheap, and easily produced energy source.

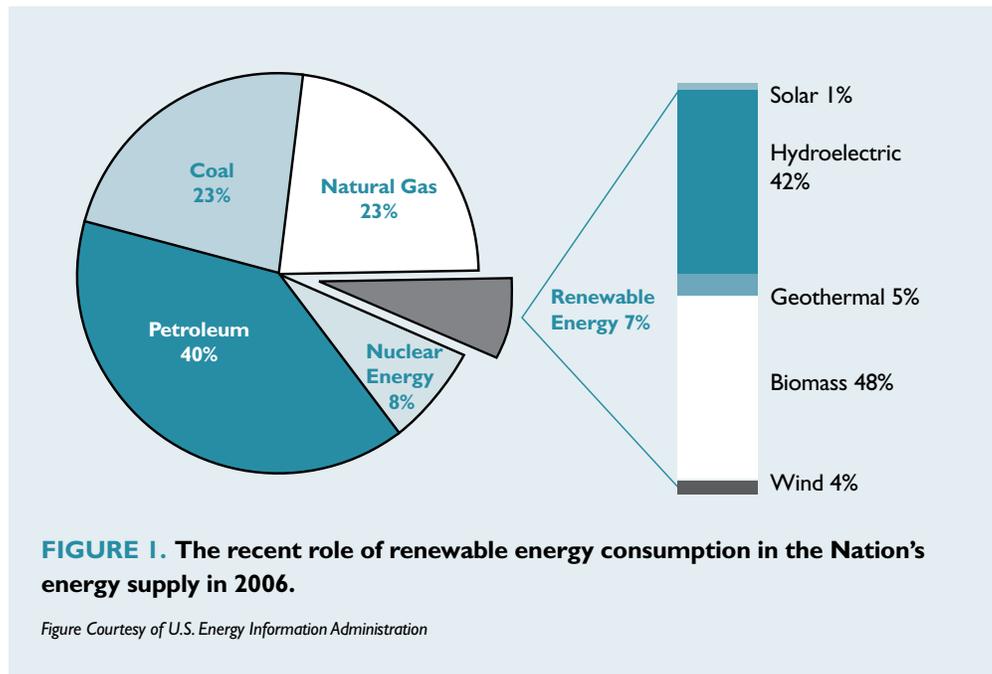
When fossil fuels are burned, greenhouse gases are emitted. These gases include carbon dioxide, water vapor, methane, and nitrous oxide. At small quantities most of these gases are not harmful, but they have been building up in the atmosphere over the last century. Greenhouse gases trap heat from the sun in the Earth's atmosphere, preventing it from escaping into space. While greenhouse gases are naturally found in the atmosphere, burning fossil fuels is contributing to an overall increase in the amounts of these gases. The increasing level of these gases is leading to an overall change in the Earth's climate.

Renewable Energy Sources

In 2006, 7 percent of the energy supply in the United States was produced by renewable resources (Figure 1). Renewable energy sources include solar, wind, biomass, hydrogen, geothermal, hydropower, and ocean (thermal and tidal) (NREL, 2008). **Renewable** energy sources are either continuously replenished, like the sun and wind, or are replenished over a reasonably short period of time, like biomass from trees or crops (NREL, 2008).

did you know?

The Energy Policy Act of 2005 includes a number of provisions to encourage the use of renewable energy to produce electricity. It provides federal tax credits for using renewable fuels.





TEACHER

Teacher Instructions

Preparation

1. Read the *Background Information* provided at the beginning of this activity and make copies if you plan to assign reading before the activity.
2. Go through the *Web-quest Exploration Guide* on your own to familiarize yourself with the topic and activity.
3. Ensure that each Web site link is operational and that the video segments upload correctly.

Procedure

1. When students are at computer stations, pass out copies of the *Web-quest Exploration Guide* and provide them with the web address to open the PDF file from the program Web site (this will enable them to utilize active hyperlinks). Also, pass out headphones. Ask students to wear headphones during video/audio sections of the Web-quest or if headphones are unavailable, ask them to lower or mute the volume.
2. Review instructions with your class and make sure each student completes his or her own worksheet.
3. When students complete the Web-quest, initiate a class discussion using the *Discussion Questions*. If time is limited, you can do the discussion the following day or assign the questions as student homework.
4. After completing this Web-quest, ask students to create a poster using the information they collected about energy in the U.S. The overarching topic of the poster can be open to students. For example, it could focus on renewable energy, impacts of energy on the environment, trends in U.S. energy consumption, or a comparison of U.S. energy consumption to other countries. Students should use graphics or pictures. Encourage students to draw or use magazine clippings or photos and to be as creative as possible. Students should also cite evidence and resources from the Web-quest in the poster text. Posters can be displayed around the classroom, lunchroom, or in school hallways.

Assessment Suggestions

OBJECTIVE 1:

Review student answers to *Web-quest Exploration Guide*, parts I–III and VII.

OBJECTIVE 2:

Review student answers to *Web-quest Exploration Guide*, parts IV–VI and VIII.

OBJECTIVE 3:

Score student posters using the rubric on the following page.



TEACHER

Extensions

- Teach students about energy saving tips for your school. Go to <http://www.ase.org/content/article/detail/625> for more information and have students identify ways for their school to save energy. Have students write a report or a letter to the principal and local school board.
- Ask a local utility representative to come to your school to answer questions and do an energy audit with your students. Ask the representative about ways the school might improve energy efficiency and conservation. Ask students to work together to write a report to the principal and school board or write an article about the findings for the local newspaper.
- Have students do a home energy audit. An online audit is available at <http://hes.lbl.gov/>. If you want to simplify this, you can type up a worksheet using the information on the audit Web site. After completing the home energy audit, instruct students to prepare a report or presentation for the class. After all the students have completed their presentations, facilitate a class discussion about ways students might improve energy efficiency in their homes.

■ Student Poster Rubric: *Energy in the U.S. Web-quest*

Category	4 Above Standards	3 Meets Standards	2 Approaching Standards	1 Below Standards
Graphics – Originality	Several of the graphics used on the poster reflect an exceptional degree of student creativity in their creation and/or display.	One or two of the graphics used on the poster reflect student creativity in their creation and/or display.	The graphics are made by the student, but are based on the designs or ideas of others.	No graphics made by the student are included.
Content – Accuracy	At least 7 accurate facts are displayed on the poster.	5-6 accurate facts are displayed on the poster.	3-4 accurate facts are displayed on the poster.	Less than 3 accurate facts are displayed on the poster.
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout, and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed. It is not attractive.
Knowledge Gained	Student can accurately answer all questions related to facts in the poster and processes used to create the poster.	Student can accurately answer most questions related to facts in the poster and processes used to create the poster.	Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster.	Student appears to have insufficient knowledge about the facts or processes used in the poster.
Grammar	There are no grammatical mistakes on the poster.	There is 1 grammatical mistake on the poster.	There are 2 grammatical mistakes on the poster.	There are 3 or more grammatical mistakes on the poster.

Resources

- Florida Energy Office and Climate Commission: <http://www.dep.state.fl.us/energy/>
- U.S. Department of Energy: <http://www.energy.gov/>
- U.S. Energy Information Administration: www.eia.doe.gov
- National Renewable Energy Laboratory: www.nrel.gov



NAME _____

DATE _____

PERIOD _____

Energy demand is growing in the United States and around the world. At the same time, there is increasing public and political concern about the future of energy resources and the impact of energy generation and consumption on the environment. With energy demand increasing, it is important for us to know where our energy comes from, how much we consume, and how we can contribute to energy conservation and a clean energy future. This *Web-quest Exploration Guide* will direct you to several online resources related to energy. Follow the instructions and complete the worksheet to turn in to your teacher.

I. WHAT IS NONRENEWABLE ENERGY?

- ▶ Go to the *United States Environmental Protection Agency Clean Energy Web* site: <http://www.epa.gov/cleanenergy/>
- ▶ Click on *How does energy use affect my environment* under the *Energy and You* menu.
- ▶ Click on the links to *Coal, Oil, Natural Gas, and Nuclear* and fill out the following chart:

Nonrenewable Energy Resource	Description	Environmental Impacts
Coal		
Oil		
Natural Gas		
Nuclear		

- ▶ Next, go to the *Environmental Literacy Council Web* site: <http://www.enviroliteracy.org/>
- ▶ Click on *Energy* on the left menu and then Click on *Fossil Fuels* on the right menu.
- ▶ Answer the following questions:

1. What are some advantages of using fossil fuels?

2. Why do experts describe the rate of fossil fuel use as “unsustainable”?



II. WHAT IS RENEWABLE ENERGY?

- ▶ Go to the *National Renewable Energy Laboratory (NREL)* Web site:
http://www.nrel.gov/learning/re_basics.html
- ▶ Fill out the following chart. List the seven renewable energy resources described on the *NREL* Web site, and briefly describe ways in which these resources can produce energy (click on each link to get more information).

<i>Renewable Energy Resource</i>	<i>Description</i>



III. RENEWABLE ENERGY VIDEO

- ▶ Go to the *National Geographic Video* Web site: <http://video.nationalgeographic.com/video/index.html>
- ▶ Click on *Energy* under the *Environmental Video* menu.
- ▶ Put on your headphones and watch the video, *Alternative Energy* (the video will play automatically).
- ▶ Answer the following questions:

1. Why do you think renewable energy is gaining attention in the U.S.?

2. What do you think are the barriers that are preventing the U.S. from utilizing more renewable energy sources?

IV. INTERNATIONAL ENERGY CONSUMPTION

- ▶ Go to the *International Energy Agency Dynamic Maps* Web site: <http://www.iea.org/country/maps.asp>
- ▶ Click on *Go to the Map* under *Map Energy Indicators*.
- ▶ Click on *Map Energy Indicators* in the upper left corner and select *Energy Consumption*.
- ▶ Click on *North America*, click on the *United States*, and record the statistics below.
- ▶ Click on *Asia (including China)*, select *China*, and record the statistics below.
- ▶ Click on *OECD Europe*, select a country of your choice, and record the statistics below.
- ▶ Click on *Africa*, select *Zimbabwe*, and record the statistics below:

International Energy Indicators				
Country	Population (million)	GDP ¹ (billion 2000 U.S. \$)	Energy Production (Mtoe) ²	Electricity Consumption (TWh) ³
U.S.				
China				
OECD Euro- pean Country: _____				
Zimbabwe				

¹ GDP = Gross Domestic Product: Total market value of all goods and services produced within the country in a given time. GDP = consumption + gross investment + government spending + (exports-imports).

² Million Tonnes of Oil Equivalent (Mtoe) is a unit of energy used for expressing the amount of energy released by burning one tonne of crude oil (see http://en.wikipedia.org/wiki/Tonne_of_oil_equivalent for more information).

³ Terawatt hour (TWh) is a unit of energy used for expressing the amount of produced energy, electricity, and heat. 1 TWh = 1 trillion (10¹² watts) (see <http://en.wikipedia.org/wiki/Watt#Terawatt> for more information).



- ▶ Based on the data you've recorded in the chart above, provide two reasons why you think the U.S. and China produce and consume much larger amounts of electricity.

V. WHAT TYPES OF ENERGY DO WE CONSUME IN THE U.S.?

- ▶ Go to the U.S. Energy Information Administration Web site: http://tonto.eia.doe.gov/energy_in_brief/renewable_energy.cfm
- ▶ Answer the following questions: (The data is updated yearly, so you will need to fill in the year for the data provided on the Web site).

1. In ____ (year), how much energy did the U.S. consume? _____
2. In ____ (year), what percentage of energy in the U.S. came from fossil fuels? _____
3. In ____ (year), what percentage of energy in the U.S. came from renewable sources?
Give answer in Btu and as a percentage. _____

4. List the renewable energy sources that were consumed in 2006 and the percentage of total renewable energy consumed:

Source: _____

Percentage: _____

VI. ENERGY IN YOUR STATE

- ▶ Go to the U.S. Energy Information Administration State Energy Profiles Web site: <http://tonto.eia.doe.gov/state/>
- ▶ Select your state from the list, and select and record two interesting quick facts about energy in your state.

State:

Quick Fact 1:

Quick Fact 2:



VII. POWER PROFILER: HOW CLEAN IS THE ELECTRICITY I USE?

- ▶ Go to the U.S. Environmental Protection Agency Clean Energy Web site:
<http://www.epa.gov/cleanenergy/energy-and-you/how-clean.html>
- ▶ Enter your five-digit zip code in the box.
- ▶ Select the utility company that provides your electricity (this can be found on a copy of your home electric bill). Click Next.
- ▶ Review Graph 1: *What is my fuel mix?*
- ▶ Fill in the following chart:

Fuel Mix						
	Coal	Gas	Oil	Nuclear	Hydro	Non-Hydro Renewables
Your region's fuel mix (%)						
National fuel mix (%)						

- ▶ Next, click on the button *Buy Green Power* under *How Can I Make a Difference* and select your state. List a utility or program that utilizes green power products and the type of product(s) used.

State:

Utility Name:

Program Name:

Type:

VIII. FUTURE ENERGY CONSUMPTION TRENDS IN THE U.S.

- ▶ Go to the U.S. Energy Information Administration/Annual Energy Review Web site:
<http://www.eia.doe.gov/emeu/aer/>
- ▶ Click on *Consumption by Source*.
- ▶ Review *Figure 6*. What are the projected trends for energy consumption in the U.S. to the year 2030?



STUDENT

Conclusion

Energy demands are growing, placing an increasing strain on global energy resources. In the U.S., the current energy systems rely heavily on nonrenewable resources. The challenges associated with using these resources and their projected availability put their future use in question. Increasing the amount of energy produced from renewable resources will help expand our energy options. In addition, conserving energy through new technologies and changes in behavior are important steps for creating a more sustainable energy future. Now that you have learned about various renewable and nonrenewable energy sources, as well as energy consumption in the U.S., you can take part in a class discussion prompted by the discussion questions.

Discussion Questions

- 1 What agencies or organizations sponsored the Web sites you collected information from and what might their bias be?
- 2 Do you think the information presented on the Web sites is balanced?
- 3 What makes some energy sources renewable and others nonrenewable?
- 4 What are the advantages of using renewable energy sources?
- 5 Do you think the U.S. has an obligation to reduce its use of nonrenewable energy sources? Why?
- 6 What future energy trends do you think are likely for the U.S.?