Energy Analysis

Students use graphs of historical data and research historical and societal events to determine and analyze trends in energy.

Grade Levels:

- Int Intermediate
- Sec Secondary

Subject Areas:

- Science
- Social Studies
- Math
- Technology

National Energy Education Development Project
NEED Mission Statement

The mission of The NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

Teacher Advisory Board Statement

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

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Energy Data Used in NEED Materials

NEED believes in providing the most recently reported energy data available to our teachers and students. Most statistics and data are derived from the U.S. Energy Information Administration’s Annual Energy Review that is published yearly. Working in partnership with EIA, NEED includes easy to understand data in our curriculum materials. To do further research, visit the EIA website at www.eia.gov. EIA’s Energy Kids site has great lessons and activities for students at www.eia.gov/kids.
Energy Analysis

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Standards Correlation Information

www.NEED.org/curriculumcorrelations

Next Generation Science Standards
- This guide effectively supports many Next Generation Science Standards. This material can satisfy performance expectations, science and engineering practices, disciplinary core ideas, and cross cutting concepts within your required curriculum. For more details on these correlations, please visit NEED’s curriculum correlations website.

Common Core State Standards
- This guide has been correlated to the Common Core State Standards in both language arts and mathematics. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED curriculum correlations website.

Individual State Science Standards
- This guide has been correlated to each state’s individual science standards. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED website.
Background

Students practice graphing data, research historical events, and analyze the graphs in this guide and the Energy Information Administration’s annually published data to determine and explain energy trends in the United States during the last 50-75 years.

Objectives

- Students will be able to analyze graphical representations of energy data and infer and explain present and historical trends.
- Students will be able to synthesize information from multiple graphs and text to be able to infer and explain trends and make predictions.
- Students will be able to describe current energy use in the United States.

Materials

- Energy Information Administration (EIA) website: www.eia.gov/totalenergy/data/annual/index.cfm
- U.S. history textbook as a resource
- NEED’s Intermediate and/or Secondary Energy Infobook (available online at www.NEED.org)
- Digital or overhead projector

Preparation

- Familiarize yourself with the activity, the Energy Flow, 2013 diagram on page 7, with the graphs in this guide, and the data available on the EIA website. An explanation of the energy flow diagram can be found on page 10.
- Make copies of the U.S. Energy Data sheet and U.S. Energy Timeline for each student (pages 11-14).
- Make copies of the energy flows and graphs you want the students to analyze from this guide (pages 17-26) and the EIA web page. You can have all of the students use the same graphs and conduct classroom discussions or assign groups of students to different sets of graphs and have them make presentations to the class.
- Make copies of the pages you have chosen from NEED’s Energy Infobook. Energy source “At-a-glance” fact sheets are also available online at www.NEED.org/content.asp?contentid=151.

Procedure

Part One—Introduction: Energy Yesterday, Today, and Tomorrow

1. Introduce the activity by discussing with students how energy has been used throughout the history of the United States, the changing energy sources that have been used, and the major historical events that have had an effect on energy. Hand out the U.S. Energy Timeline, and check EIA’s Energy Kid’s “Energy Timelines” for more research at www.eia.gov/kids/energy.cfm?page=timelines.
2. Discuss with students the energy sources we use today and the purposes for which they are used. Hand out the Energy Flow, 2013 master and use the explanation to give an overview of current energy consumption and production.
3. Hand out U.S. Energy Data sheets. Discuss how students can graphically compare aspects of the data to determine energy trends. Discuss with students that the future energy picture will change and energy trends might help to identify ways in which the future energy picture could change.

Grade Levels

- Intermediate, grades 6-8
- Secondary, grades 9-12

Time

Three to five 45-minute class periods plus outside research and homework

Web Resources

- Go online to access data from the Energy Information Administration in the U.S. Department of Energy at www.eia.gov/totalenergy/data/annual/index.cfm and select “annual” under the “Data” tab.
- Make sure 2013 is selected for the year; some data sets display multiple years. This might allow for an interesting discussion among your students.
- If 2013 is not available on EIA’s page, or if you wish to download other years’ data, go to www.eia.gov/totalenergy/data/annual/archive/energyflow.cfm.
Part Two—Graphing Data

1. Have the students create graphs in class and as homework to answer the following questions:
   • How has per capita consumption of energy changed in the last 50-75 years?
   • How has the percentage of energy we import from other countries changed in the last 50-75 years?
   • How has the mix of energy sources changed in the last 50-75 years for production, consumption, fossil fuels, nuclear energy, and renewable energy sources?

2. Check the students’ graphs for accuracy and understanding. Project the sample graphs on pages 15-16 and discuss the answers to the questions.

Part Three—Analyzing Data and Determining Energy Trends (pages 17-26)

1. Explain that in this assignment the students will analyze the information in the graphs, determine the trends that are implied by the information, and research historical events that may have affected or may affect those trends. There are two options outlined below for completing this part of the activity.

Option One: All Students Analyzing the Same Graphs

• If all of the students are assigned the same graphs, distribute the background information and sets of graphs you have chosen, and have each student write an explanation of the graphs, the trends, and the significant historical events. Allow them to begin the assignment in class and give them several days to complete the assignment as homework.

• Discuss the assignment upon completion to develop a consensus within the group.

Option Two: Groups of Students Analyzing Different Sets of Graphs

• If the students are working in groups to analyze different sets of graphs, divide the students into groups and distribute the background information and sets of graphs you have chosen for them to analyze. Explain that each group will prepare a five-minute presentation for the class to explain the graphs, the trends, and the significant historical events. Allow the groups to begin the assignment in class and give them several days to complete the assignment, either as homework or as class work.

• Monitor group work.

• Have each group make its presentation.

• Discuss the assignment upon completion to develop an overall sense of what will happen in the energy sector in the near future and possible events that could have an effect on that direction.

☑ Evaluation

1. Evaluate individual and group work according to your own expectations.

2. Evaluate the activity with the students using the Evaluation Form on page 27 and return it to NEED.

 ☐ Technology Extensions

• Have the students conduct web-based research and prepare digital presentations on one aspect of energy and how its use has changed in the last 50-75 years.

• Have students create their own graphics to showcase an aspect of energy consumption.
Energy Flow, 2013

Production

- Coal 19.99Q
- Natural Gas 24.89Q
- Crude Oil 15.77Q
- Natural Gas Plant Liquids 3.47Q
- Nuclear Electric Power 8.27Q
- Renewable Energy 9.30Q
- Petroleum 21.09Q
- Other Imports 3.45Q
- Stock Change and Other 3.12Q
- Domestic Production 81.69Q

Exports 11.80Q

- Petroleum 7.19Q
- Other Exports 4.62Q

Imports 24.54Q

- Fossil Fuels 64.12Q
- Domestic Production 81.69Q
- Stock Change and Other 3.12Q
- Natural Gas 26.63Q
- Petroleum 35.10Q
- Nuclear Electric Power 8.27Q
- Renewable Energy 9.29Q

Total Supply 109.35Q

Consumption

- Residential 21.13Q
- Commercial 17.93Q
- Industrial 31.46Q
- Transportation 27.01Q
- Consumption (total demand) 97.53Q

Data: U.S. Energy Information Administration/Annual Energy Review
Energy Flow Answer Keys

Coal Flow Chart, 2013
(MILLION SHORT TONS)

Data: U.S. Energy Information Administration

Natural Gas Flow Chart, 2013
(TRILLION CUBIC FEET)

Data: U.S. Energy Information Administration
Energy Analysis

Energy Measurements

1 cal = Calorie—a measure of heat energy—the amount of heat energy needed to raise the temperature of one gram of water by one degree Celsius.

1 cal = 4.187 joules

1 Btu = British thermal unit—a measure of heat energy—the amount of heat energy needed to raise the temperature of one pound of water by one degree Fahrenheit. One Btu is approximately the amount of energy released by the burning of one wooden kitchen match.

1 Btu = 1,055 joules
1 Btu = 252 calories
1 Q = Quad—1 quadrillion Btu. Quads are used to measure very large quantities of energy. The U.S. uses one quad of energy about every 3.68 days.

1 therm = 102,700 Btu; approximately the amount of heat energy in one Ccf of natural gas.

1 kWh = Kilowatt-hour—one kilowatt of electricity over one hour. One kilowatt-hour of electricity is the amount of energy it takes to burn a 100 watt light bulb for 10 hours. The average cost of one kilowatt-hour of electricity for residential customers in the U.S. is about twelve cents.

1 kWh = 3.6 million joules (3.6 Mj)
1 kWh = 3,412 Btu

1 cf = Cubic foot—a measure of volume—one cf of natural gas contains about 1,027 Btu.

1 Ccf = One hundred cubic feet—one Ccf of natural gas contains about one therm of heat energy.
1 Mcf = One thousand cubic feet—one Mcf of natural gas for residential consumers costs $10.32.

Energy Flow Diagram Explanation

The left side of the diagram shows energy production (supply) figures for 2013 in the U.S. by source and imports:

- The top four on the list—coal, natural gas, crude oil, and natural gas plant liquids (NGPL)—are fossil fuels that provided 64.12 quads of energy.
- Uranium (nuclear) produced 8.27 quads of energy.
- Renewables (solar, wind, hydropower, geothermal, and biomass) produced 9.30 quads of energy.
- The bottom shows imports, mostly crude oil and petroleum products, that produced 21.09 quads of energy while all other imported energy produced 3.45 quads of energy.
- The diagram shows that most of 2013 U.S. energy supply came from fossil fuels and that the U.S. imported 22.44 percent of its total energy supply.

The right side of the diagram shows energy consumption figures by energy source and sector of the economy. Electricity generation has been included in these consumption figures.

- The U.S. exported 11.80 quads of energy in 2013.
- The residential sector (homes) consumed 21.13 quads of energy or 21.67 percent of total energy consumption.
- The commercial sector (businesses) consumed 17.93 quads of energy or 18.38 percent of total energy consumption.
- The industrial sector (manufacturing) consumed 31.46 quads of energy or 32.26 percent of total energy consumption.
- The transportation sector (vehicles) consumed 27.01 quads of energy or 27.69 percent of total energy consumption.
### Basic Energy Information

<table>
<thead>
<tr>
<th>DATE</th>
<th>POPULATION</th>
<th>PRODUCTION (IN QUADS)</th>
<th>CONSUMPTION (IN QUADS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>152,300,000</td>
<td>35.5</td>
<td>34.6</td>
</tr>
<tr>
<td>1960</td>
<td>180,700,000</td>
<td>42.8</td>
<td>45.1</td>
</tr>
<tr>
<td>1970</td>
<td>205,100,000</td>
<td>63.5</td>
<td>67.8</td>
</tr>
<tr>
<td>1980</td>
<td>227,200,000</td>
<td>67.2</td>
<td>78.1</td>
</tr>
<tr>
<td>1990</td>
<td>249,600,000</td>
<td>70.7</td>
<td>84.5</td>
</tr>
<tr>
<td>2000</td>
<td>282,200,000</td>
<td>71.3</td>
<td>98.8</td>
</tr>
<tr>
<td>2007*</td>
<td>301,400,000</td>
<td>71.4</td>
<td>101.4</td>
</tr>
<tr>
<td>2010</td>
<td>309,100,000</td>
<td>75.0</td>
<td>98.0</td>
</tr>
<tr>
<td>2013</td>
<td>316,128,839</td>
<td>81.9</td>
<td>97.8</td>
</tr>
</tbody>
</table>

### Energy Production By Source (Quadrillion Btu)

<table>
<thead>
<tr>
<th>DATE</th>
<th>COAL</th>
<th>NATURAL GAS</th>
<th>PETROLEUM</th>
<th>URANIUM (NUCLEAR)</th>
<th>RENEWABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>14.1</td>
<td>6.2</td>
<td>11.4</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>1960</td>
<td>10.8</td>
<td>12.7</td>
<td>14.9</td>
<td>0</td>
<td>2.9</td>
</tr>
<tr>
<td>1970</td>
<td>14.6</td>
<td>21.7</td>
<td>20.4</td>
<td>0.2</td>
<td>4.1</td>
</tr>
<tr>
<td>1980</td>
<td>18.6</td>
<td>19.9</td>
<td>18.2</td>
<td>2.7</td>
<td>5.4</td>
</tr>
<tr>
<td>1990</td>
<td>22.5</td>
<td>18.3</td>
<td>15.6</td>
<td>6.1</td>
<td>6.0</td>
</tr>
<tr>
<td>2000</td>
<td>22.7</td>
<td>19.7</td>
<td>12.4</td>
<td>7.9</td>
<td>6.1</td>
</tr>
<tr>
<td>2007*</td>
<td>23.5</td>
<td>19.8</td>
<td>10.7</td>
<td>8.5</td>
<td>6.5</td>
</tr>
<tr>
<td>2010</td>
<td>22.1</td>
<td>22.1</td>
<td>11.7</td>
<td>8.4</td>
<td>8.1</td>
</tr>
<tr>
<td>2013</td>
<td>19.99</td>
<td>24.99</td>
<td>15.80</td>
<td>8.27</td>
<td>9.30</td>
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</table>

### Energy Consumption By Source (Quadrillion Btu)

<table>
<thead>
<tr>
<th>DATE</th>
<th>COAL</th>
<th>NATURAL GAS</th>
<th>PETROLEUM</th>
<th>URANIUM (NUCLEAR)</th>
<th>RENEWABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>12.3</td>
<td>6.0</td>
<td>13.3</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>1960</td>
<td>9.8</td>
<td>12.4</td>
<td>19.9</td>
<td>0</td>
<td>2.9</td>
</tr>
<tr>
<td>1970</td>
<td>12.3</td>
<td>21.8</td>
<td>29.5</td>
<td>0.2</td>
<td>4.1</td>
</tr>
<tr>
<td>1980</td>
<td>15.4</td>
<td>20.2</td>
<td>34.2</td>
<td>2.7</td>
<td>5.4</td>
</tr>
<tr>
<td>1990</td>
<td>19.2</td>
<td>19.6</td>
<td>33.6</td>
<td>6.1</td>
<td>6.0</td>
</tr>
<tr>
<td>2000</td>
<td>22.6</td>
<td>23.8</td>
<td>38.3</td>
<td>7.9</td>
<td>6.1</td>
</tr>
<tr>
<td>2007*</td>
<td>22.7</td>
<td>23.7</td>
<td>39.8</td>
<td>8.5</td>
<td>6.6</td>
</tr>
<tr>
<td>2010</td>
<td>20.8</td>
<td>24.5</td>
<td>36.0</td>
<td>8.4</td>
<td>8.0</td>
</tr>
<tr>
<td>2013</td>
<td>18.08</td>
<td>25.95</td>
<td>34.39</td>
<td>8.27</td>
<td>9.30</td>
</tr>
</tbody>
</table>

*2007—largest consumption of energy in U.S. history.

Data: EIA
# U.S. Energy Timeline

## 1950s

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>Americans owned 50 million cars; oil surpassed coal as the country's number one fuel source</td>
</tr>
<tr>
<td>1953</td>
<td>First atomic reactor to produce power began operation in Idaho</td>
</tr>
<tr>
<td>1954</td>
<td>Bell Labs invented the first solar cell</td>
</tr>
<tr>
<td>1954</td>
<td>The Atomic Energy Act of 1954 was passed</td>
</tr>
<tr>
<td>1955</td>
<td>More Americans traveled by air than by train</td>
</tr>
<tr>
<td>1956</td>
<td>First load of containers (truck trailers) transported aboard a cargo ship by sea for less than the cost of trucking them over land</td>
</tr>
<tr>
<td>1957</td>
<td>Shippingport reactor in Pennsylvania was the first nuclear power plant to provide electricity to customers in the U.S.</td>
</tr>
<tr>
<td>1958</td>
<td>The Jet Age began when airline companies began replacing propeller planes with jet planes; they used kerosene, which was less expensive than gasoline</td>
</tr>
<tr>
<td>1959</td>
<td>First fuel cell designed to produce electricity from hydrogen and oxygen</td>
</tr>
</tbody>
</table>

## 1960s

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>OPEC - Organization of Petroleum Exporting Countries – established to control oil production</td>
</tr>
<tr>
<td>1960</td>
<td>First commercial-scale geothermal power plant began operation in California at The Geysers</td>
</tr>
<tr>
<td>1961</td>
<td>Coal had become the major fuel used by electric utilities in the United States to generate electricity</td>
</tr>
<tr>
<td>1965</td>
<td>Fuel cells used in the space program</td>
</tr>
<tr>
<td>1965</td>
<td>Recycling program started for aluminum cans</td>
</tr>
<tr>
<td>1969</td>
<td>Oil discovered on Alaska's northern slope</td>
</tr>
</tbody>
</table>

## 1970s

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>Environmental Protection Agency (EPA) created</td>
</tr>
<tr>
<td>1970</td>
<td>First waste-to-energy plant began operation</td>
</tr>
<tr>
<td>1971</td>
<td>Surface mines replaced underground mines as the leading source of coal produced in the United States</td>
</tr>
<tr>
<td>1973-74</td>
<td>Arab oil embargo to protest Arab/Israeli War. The OPEC oil embargo focused attention on the energy crisis and resulted in:</td>
</tr>
<tr>
<td></td>
<td>- An increase in demand for U.S. coal</td>
</tr>
<tr>
<td></td>
<td>- Gasoline rationing</td>
</tr>
<tr>
<td></td>
<td>- Emergency Highway Energy Conservation Act of 1974, part of a nationwide effort to reduce oil consumption</td>
</tr>
<tr>
<td></td>
<td>- 55 mile per hour speed limits imposed</td>
</tr>
<tr>
<td></td>
<td>- Plastic recycling began – plastic bottles replace glass containers</td>
</tr>
<tr>
<td></td>
<td>- Nuclear Regulatory Commission (NRC) created to regulate the nuclear industry</td>
</tr>
<tr>
<td></td>
<td>- Interest in space applications of photovoltaics grew</td>
</tr>
<tr>
<td></td>
<td>- High oil prices increased interest in other energy sources, such as wind energy</td>
</tr>
<tr>
<td>1975</td>
<td>Strategic Petroleum Reserve began</td>
</tr>
<tr>
<td>1976</td>
<td>Electric Vehicle Act enacted</td>
</tr>
<tr>
<td>1977</td>
<td>Trans-Atlantic oil pipeline opened</td>
</tr>
<tr>
<td>1977</td>
<td>Department of Energy created</td>
</tr>
<tr>
<td>1977</td>
<td>The Surface Mining Control and Reclamation Act of 1977 enacted to reduce the environmental impact of surface mining, required mines no longer being used to be &quot;reclaimed&quot; or restored to their natural state</td>
</tr>
<tr>
<td>1977</td>
<td>Federal Energy Regulatory Commission (FERC) created to regulate energy production and transmission</td>
</tr>
<tr>
<td>1978</td>
<td>Public Utility Regulatory Policies Act (PURPA) of 1978 enacted to promote greater use of renewable energy, cogeneration, and small power projects</td>
</tr>
<tr>
<td>1978</td>
<td>Iranian Revolution shut down oil exports</td>
</tr>
<tr>
<td>1979</td>
<td>Nuclear accident at Three Mile Island nuclear power plant in Pennsylvania</td>
</tr>
<tr>
<td>1979</td>
<td>OPEC raised crude oil prices (prices tripled between January 1979 and September 1980)</td>
</tr>
<tr>
<td>1979</td>
<td>President Carter announced effort to reduce dependence on foreign oil</td>
</tr>
</tbody>
</table>
### 1980s

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>For the first time, nuclear energy generated more electricity than oil in the United States</td>
</tr>
<tr>
<td>1980</td>
<td>First PV power plant opened in Utah</td>
</tr>
<tr>
<td>1981</td>
<td>Government price controls end on crude oil and petroleum products – now supply and demand set domestic crude prices</td>
</tr>
<tr>
<td>1982</td>
<td>First solar-thermal power plant opened in California</td>
</tr>
<tr>
<td>1984</td>
<td>Nuclear replaced hydropower as the second-largest source of electricity in the United States, after coal</td>
</tr>
<tr>
<td>1985</td>
<td>New cars and light trucks required to meet a Corporate Average Fuel Economy (CAFE) Standard for fuel economy of 27.5 miles per gallon</td>
</tr>
<tr>
<td>1986</td>
<td>Clean Coal Technology Act passed</td>
</tr>
<tr>
<td>1986</td>
<td>Chernobyl nuclear power plant accident in the former USSR (now Ukraine)</td>
</tr>
<tr>
<td>1986</td>
<td>OPEC lowered price of crude for first time by increasing production, oil consumption grew quickly while prices remained low</td>
</tr>
<tr>
<td>1989</td>
<td>Exxon Valdez oil tanker spilled 240,000 barrels of crude oil in Alaska’s Prince William Sound</td>
</tr>
<tr>
<td>1989</td>
<td>High efficiency PV cells developed</td>
</tr>
</tbody>
</table>

### 1990s

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>More than 2,200 megawatts of wind energy capacity installed in California — more than half of the world's capacity at the time</td>
</tr>
<tr>
<td>1990</td>
<td>Clean Air Act Amendments required many changes to gasoline and diesel fuels to make them pollute less</td>
</tr>
<tr>
<td>1990</td>
<td>Iraq invaded Kuwait causing crude oil price increase</td>
</tr>
<tr>
<td>1992</td>
<td>Recycling legislation adopted by 15 states</td>
</tr>
<tr>
<td>1992</td>
<td>President Bush issued Executive Order 12780, which stimulated waste reduction, recycling, and the buying of recycled goods in all federal agencies</td>
</tr>
<tr>
<td>1993</td>
<td>Two decades after the first oil embargo, 109 nuclear power plants operating in the U.S. provided about one-fifth of the nation's electricity</td>
</tr>
<tr>
<td>1997-98</td>
<td>Asian financial crisis has worldwide economic effects - demand for petroleum products declined and oil prices fell</td>
</tr>
<tr>
<td>1998</td>
<td>Electric utility deregulation began</td>
</tr>
<tr>
<td>1999</td>
<td>First hybrid electric vehicle, powered by both a rechargeable battery and gasoline, became available in the U.S.</td>
</tr>
</tbody>
</table>

### 2000s

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Americans owned 220 million cars</td>
</tr>
<tr>
<td>2000</td>
<td>EPA established a link between global climate change and solid waste management, noting that waste reduction and recycling can help reduce greenhouse gas emissions</td>
</tr>
<tr>
<td>2003</td>
<td>U.S. sponsored a $1 billion, 10-year demonstration project to create the world's first coal-based, zero-emissions electricity and hydrogen power plant</td>
</tr>
<tr>
<td>2003</td>
<td>Invasion of Iraq disrupted crude oil supplies</td>
</tr>
<tr>
<td>2003</td>
<td>Nation's largest-ever power outage left much of the Northeast and parts of Canada without electricity for several days</td>
</tr>
<tr>
<td>2005</td>
<td>Hurricane Katrina (August) and Rita (September) caused massive damage to U.S. petroleum and natural gas infrastructure</td>
</tr>
<tr>
<td>2005</td>
<td>In September, U.S. residential natural gas prices were the highest ever recorded, reaching $16.66 per thousand cubic feet</td>
</tr>
</tbody>
</table>
| 2005 | Congress passed the Energy Policy Act of 2005:  
  • promoted the use of coal through clean coal technologies  
  • required increased use of renewable fuels for transportation and new measures to reduce pollution from gasoline and diesel |
<p>| 2006 | Coal production set a record high with 1.16 billion short tons |
| 2006 | The U.S. ranked among the top 4 countries in the world for hydroelectric generation, along with China, Canada, and Brazil, generating 44% of the world's electricity from hydropower |
| 2007 | Largest consumption of energy in U.S. history |
| 2008 | Oil prices reached new high – over $100 per barrel, gasoline prices broke $4.00 per gallon |
| 2009 | The American Recovery and Investment Act was instituted — the U.S. Department of Energy invested over $31 billion to support clean energy projects and infrastructure updates nationwide |</p>
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>29 miners killed in an underground explosion at the Upper Big Branch Mine in West Virginia, the worst mining accident in the U.S. since 1972</td>
</tr>
<tr>
<td>2010</td>
<td>Explosion and fire occurred on the offshore drilling rig Deepwater Horizon while drilling an exploratory well in the Gulf of Mexico, killing 11 crew members and left oil leaking from the unfinished well into the ocean for months</td>
</tr>
<tr>
<td>2010</td>
<td>Secretary of the Interior Salazar announced a 6-month hold or “moratorium” on deep water drilling</td>
</tr>
<tr>
<td>2010</td>
<td>33 miners trapped half a mile underground in a mine collapse in northern Chile; after 69 days, everyone was rescued</td>
</tr>
<tr>
<td>2010</td>
<td>Tohoku earthquake and subsequent tsunami led to the accident and shutdown at Tokyo Electric Power Company’s Fukushima Daiichi nuclear power plant and subsequent outages at other plants - as a result, LNG consumption at power companies in Japan was up 30% in May 2011 compared to May 2010</td>
</tr>
<tr>
<td>2012</td>
<td>In February, the U.S. Nuclear Regulatory Commission (NRC) issued the first-ever combined licenses to build and operate two new nuclear reactors at the Vogtle Power Plant in Georgia; (the NRC had not issued a license to build a new reactor since 1978); in March, combined licenses were issued to build and operate two new reactors at the Summer Power Plant in South Carolina</td>
</tr>
<tr>
<td>2012</td>
<td>Cobscook Bay Tidal Energy Project, the nation’s first commercial, grid-connected tidal energy project, began operation; the project is located off the coast of Eastport, Maine, and could initially power between 75 and 100 homes</td>
</tr>
<tr>
<td>2012</td>
<td>The Three Gorges Dam on the Yangtze River in China came online; it is the largest hydroelectric facility in the world, generating the electrical equivalent of fifteen nuclear reactors</td>
</tr>
<tr>
<td>2013</td>
<td>World wind energy capacity grew by 144% since 2008; the U.S. is among the largest installers of wind power globally</td>
</tr>
<tr>
<td>2013</td>
<td>Construction began on two new nuclear reactors at the existing Vogtle Nuclear Power Plant in Georgia; these two new reactors are the first to be built in nearly 30 years in the U.S.</td>
</tr>
<tr>
<td>2014</td>
<td>The Ivanpah Solar Electric Generating Station came online as the largest concentrating solar power (CSP) facility in the world of its kind; the facility, located in California’s Mojave Desert, can generate up to 392 MW</td>
</tr>
<tr>
<td>2015</td>
<td>Deepwater Wind Project, off the coast of Rhode Island, began construction and will become the U.S.’s first offshore wind farm</td>
</tr>
</tbody>
</table>
Sample Graphs

U.S. Population vs Energy Consumption

Data: Energy Information Administration

U.S. Energy Production vs Consumption

Data: Energy Information Administration
Sample Graphs

U.S. Production By Energy Source

![Graph showing energy production by energy source from 1950 to 2020. The graph displays data from AER Table 1.1.](image)

Data: Energy Information Administration

U.S. Consumption By Energy Source

![Graph showing energy consumption by energy source from 1950 to 2020. The graph displays data from Energy Information Administration.](image)

Data: Energy Information Administration
U.S. Coal Flow, 2013
Million Short Tons

Data: U.S. Energy Information Administration
U.S. Natural Gas Flow, 2013
Trillion Cubic Feet

From Natural Gas Wells: 13.01
From Crude Oil Wells: 5.08
From Coal Bed Wells: 1.57
From Shale Gas Wells: 10.52

Gross Withdrawals: 30.17
Marketed Production: 25.62
Dry Gas Production: 24.28
Consumption: 26.03

Nonhydrocarbon Gases Removed: 0.82
Repressuring: 3.51
Vented and Flared: 0.23
Exports: 1.57
Additions to Storage: 3.51
Balancing Item: 0.16
Exports: 1.57
Additions to Storage: 3.51
Balancing Item: 0.16

Residential: 4.94
Commercial: 3.29
Industrial: 8.88
Transportation: 0.78
Electric Power: 8.15
Imports: 2.88
Supplemental Gaseous Fuels: 0.06
Withdrawals From Storage: 3.70

Data: U.S. Energy Information Administration
U.S. Petroleum Flow, 2013
Million Barrels Per Day

Data: U.S. Energy Information Administration/Annual Energy Review
U.S. Electricity Flow, 2013
Quadrillion Btu

Energy Analysis

Production → Consumption

Coal 16.54Q
Natural Gas 8.73Q
Petroleum 0.28Q
Other Gases 0.11Q
Nuclear Electric Power 8.27Q
Renewable Energy 5.07Q
Other 0.18Q

Fossil Fuels
Energy Consumed to Generate Electricity
Conversions Losses 24.52Q
Gross Generation of Electricity 14.65Q
Net Generation of Electricity 13.85Q
End Use 13.07Q
Net Imports of Electricity 0.18Q
Net Imports of Electricity 0.18Q
Plant Use 0.80Q
T&D Losses 0.95Q
Residential 4.75Q
Commercial 4.57Q
Industrial 3.26Q
Transportation 0.03Q
Direct Use 0.09Q

Data: Energy Information Administration/Annual Energy Review
Consumption and Impact

Fossil Fuel Consumption

Data: Energy Information Administration

Carbon Dioxide Level

Data: Carbon Dioxide Information Analysis Center
Global Averages

Global Average Temperature

Global Average Mean Sea Level—1880 to 2013

Data: Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Data: NASA Goddard Institute for Space Studies

Global Average Temperature

Global Temperature Anomaly °C

Annual Average

Five Year Average

Year

1880 1900 1920 1940 1960 1980 2000

Global Temperature Change Since 1880

Global Average Temperature

Global Average Mean Sea Level—1880 to 2013

Data: Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Trend based on tide gauges

Satellite measurements

Year

1880 1900 1920 1940 1960 1980 2000 2020

Sea Level Rise (mm) Since 1880

-2 0 2 4 6 8 10 12
Transportation Sector Consumption

Data: Energy Information Administration

Number of Vehicles in Use in the United States

Data: DOE Transportation Energy Data Book Edition 30
Motor Vehicle Mileage

Motor Vehicle Fuel Economy

Data: Energy Information Administration
Municipal Solid Waste Generation and Recycling

Municipal Solid Waste Generation Rates from 1960 to 2012

Municipal Solid Waste Recycling Rates from 1960 to 2012
Municipal Solid Waste Generation and Recycling

Waste Generated by Weight, 2012

- Rubber, Leather, and Textiles
- Other Materials
- Glass
- Wood
- Metals
- Plastics
- Food Scraps
- Yard Trimmings
- Paper & Paperboard

Data: EPA MSW Characterization Report

Percentage of Waste Recovered (Recycled) By Weight, 2012

- Rubber, Leather, and Textiles
- Other Materials
- Glass
- Wood
- Metals
- Plastics
- Food Scraps
- Yard Trimmings
- Paper & Paperboard

Data: EPA MSW Characterization Report
Energy Analysis Evaluation Form

State: ___________ Grade Level: ___________ Number of Students: __________

1. Did you conduct the entire activity?  □ Yes □ No

2. Were the instructions clear and easy to follow?  □ Yes □ No

3. Did the activity meet your academic objectives?  □ Yes □ No

4. Was the activity age appropriate?  □ Yes □ No

5. Were the allotted times sufficient to conduct the activity?  □ Yes □ No

6. Was the activity easy to use?  □ Yes □ No

7. Was the preparation required acceptable for the activity?  □ Yes □ No

8. Were the students interested and motivated?  □ Yes □ No

9. Was the energy knowledge content age appropriate?  □ Yes □ No

10. Would you teach this activity again?  □ Yes □ No

*Please explain any ‘no’ statement below.*

How would you rate the activity overall?  □ excellent □ good □ fair □ poor

How would your students rate the activity overall?  □ excellent □ good □ fair □ poor

What would make the activity more useful to you?

________________________________________

________________________________________

________________________________________

Other Comments:

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

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Manassas, VA 20110
FAX: 1-800-847-1820
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Llano Land and Exploration  
Louisiana State University Cooperative Extension  
Louisville Gas and Electric Company  
Maine Energy Education Project  
Massachusetts Division of Energy Resources  
Michigan Oil and Gas Producers Education Foundation  
Miller Energy  
Mississippi Development Authority–Energy Division  
Mojave Environmental Education Consortium  
Mojave Unified School District  
Montana Energy Education Council  
NASA  
National Association of State Energy Officials  
National Fuel  
National Grid  
National Hydropower Association  
National Ocean Industries Association  
National Renewable Energy Laboratory  
Nebraska Public Power District  
New Mexico Oil Corporation  
New Mexico Landman’s Association  
Nicor Gas – An AGL Resources Company  
Northern Rivers Family Services  
North Shore Gas  
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Offshore Energy Center  
Offshore Technology Conference  
Ohio Energy Project  
Opterra Energy  
Oxnard School District  
Pacific Gas and Electric Company  
Paxton Resources  
PECO  
Pecos Valley Energy Committee  
Peoples Gas  
Petroleum Equipment and Services Association  
Phillips 66  
PNM  
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Read & Stevens, Inc.  
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