Energy Math Challenge

This section has activities to enhance math skills and reinforce energy knowledge.
The answer key is provided on page 40.

Let's review some energy unit terms before we begin.

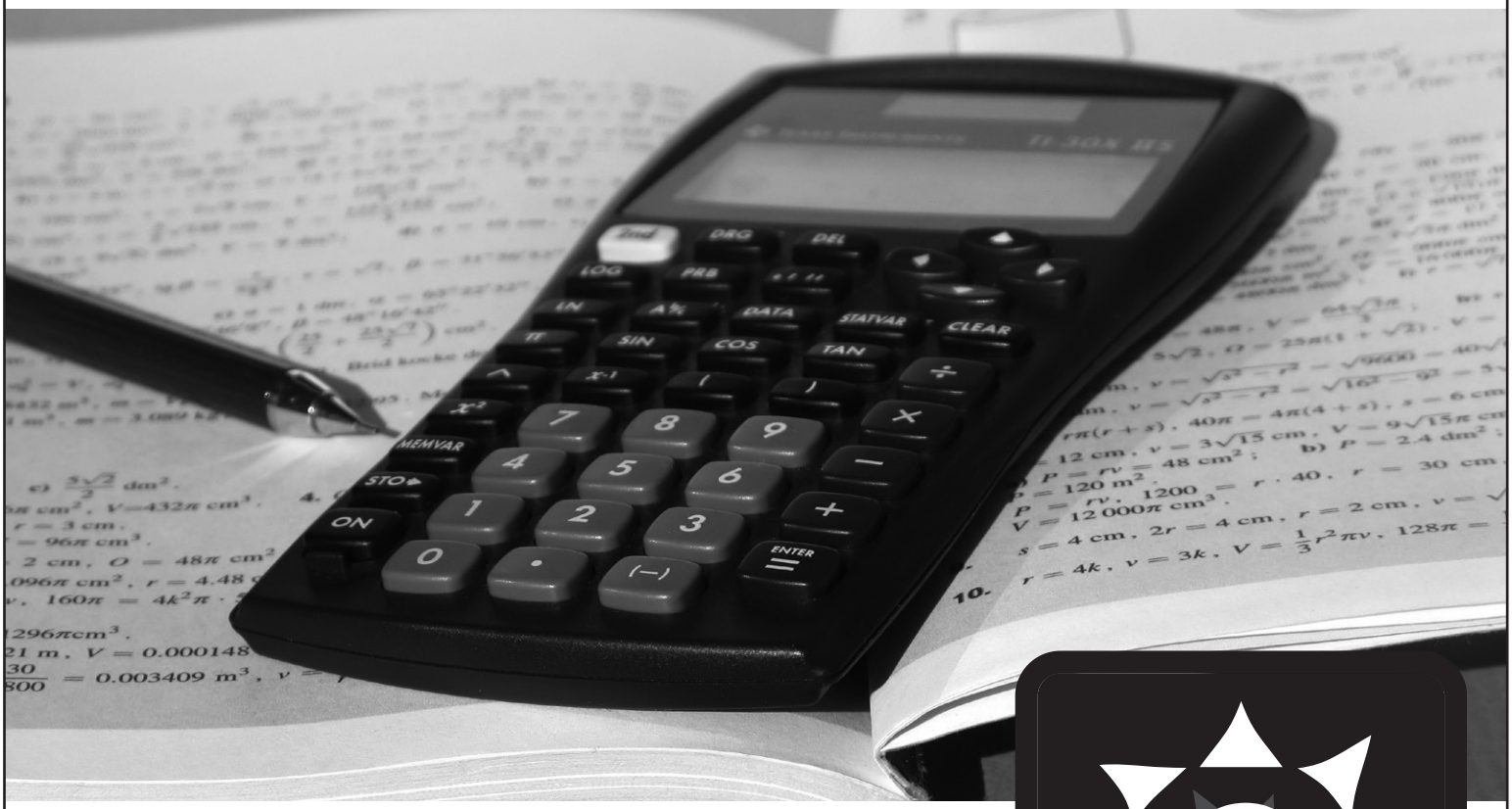
Btu — One British thermal unit is the heat energy needed to raise the temperature of one pound of water one degree Fahrenheit. A single Btu is quite small. A wooden kitchen match, if allowed to burn completely, would give off one Btu of energy. Every day, the average American uses 844,000 Btu to energy.

MBtu — An MBtu is equal to one million (1,000,000) Btu. The average American family consumes 983 MBtu of energy a year.

Quad — Quads are used to measure very large quantities of energy. A quad is equal to one quadrillion (1,000,000,000,000,000) Btu. The United States uses about one quad of energy every 3.75 days.

kWh — A kilowatt-hour is the amount of electricity used in one hour at a rate of 1,000 watts. Just as we buy gasoline in gallons and wood in cords, we buy electricity in kilowatt-hours. Utility companies charge their customers for the kilowatt-hours they use during a month. The average monthly electricity use in the United States is 908 kWh.

bkWh — A bkWh is one billion (1,000,000,000) kilowatt-hours. The U.S. consumes over 4,000 billion kilowatt-hours (bkWh) of electricity a year.



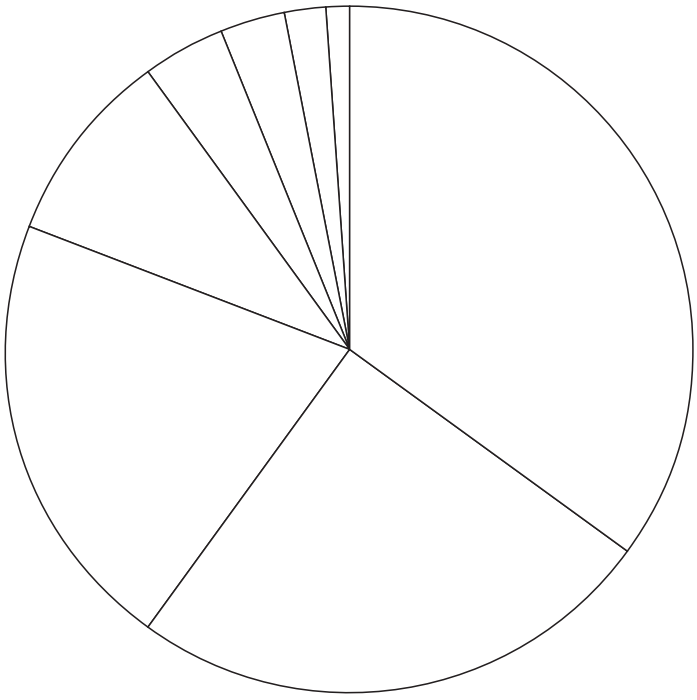
NEED
National Energy Education Development Project

Problem 1: Energy Source Use Circle Graph

Directions

Using the data below, label the sections of the circle graph.

Petroleum	35%
Natural Gas	25%
Coal	21%
Uranium	9%
Biomass	4%
Hydropower	3%
Propane	2%
Other (Solar, Wind, Geothermal)	1%



Directions

Using the graph and what you know about energy sources, answer these questions.

1. Which energy source provides the most energy?

2. What percentage are renewable energy sources?

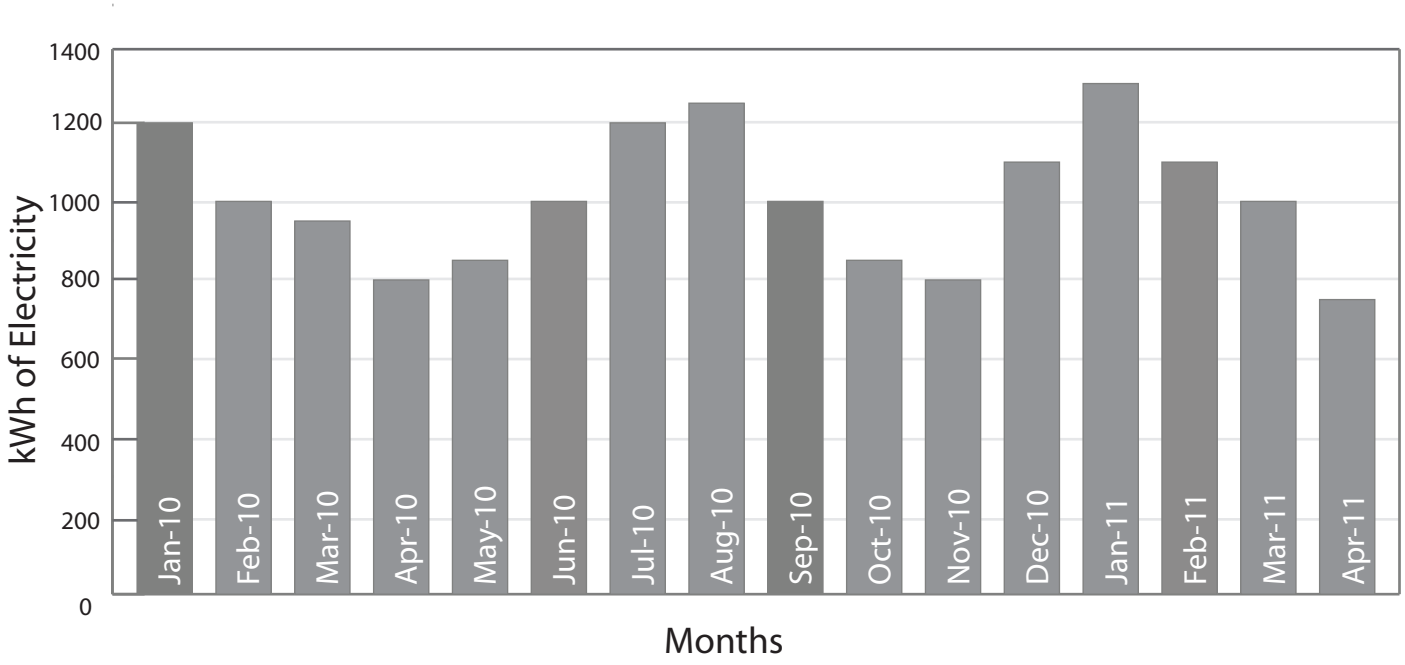
3. What percentage are nonrenewable energy sources?

4. What percentage of the energy sources are fossil fuels?

5. What percentage of the energy sources are found underground?

Problem 2: Electricity Use Chart

This is a graph of the Smith family's monthly electricity use for 2010 and part of 2011. The Smiths have an all-electric house.



Directions

Using the graph, answer these questions.

In what month and year did the family use the most electricity?

1. In what month and year did the family use the least electricity?

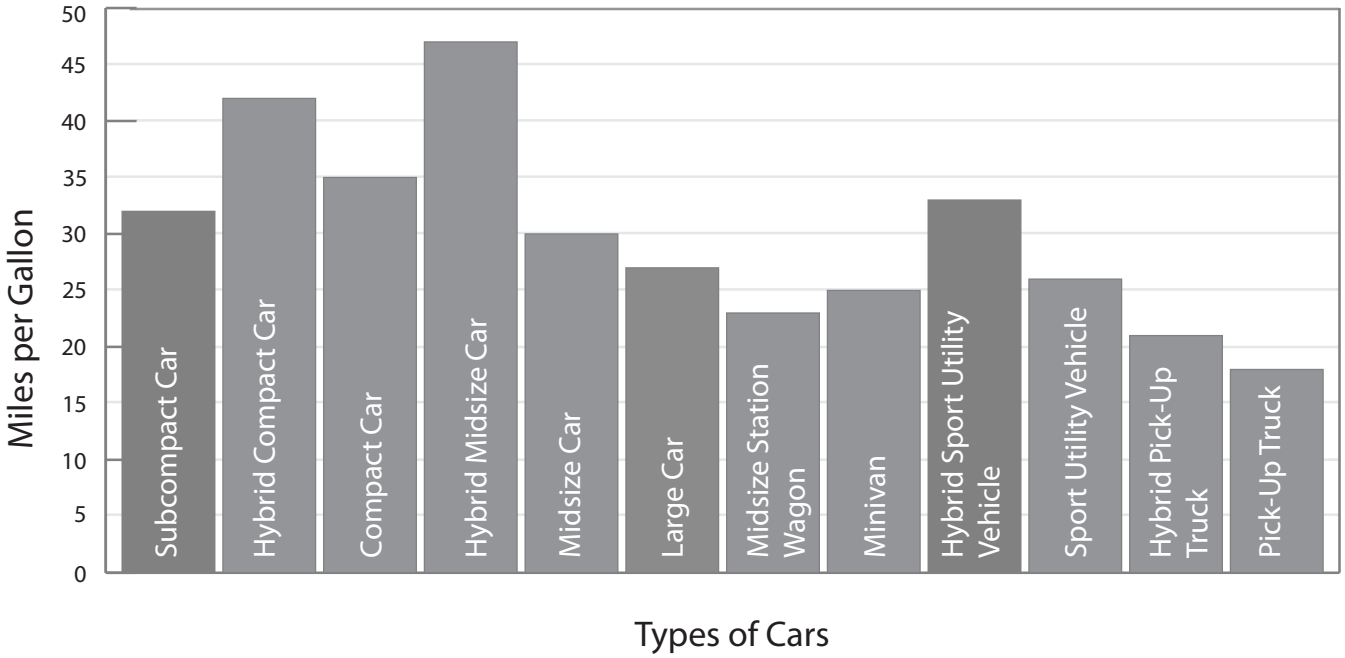
2. What summer month and year do you think was the hottest?

3. How much more electricity did the family use in January 2011 than in January 2010?

4. How many kWh of electricity did the family use in 2010?

Problem 3: Fuel Economy Chart

This is a graph of the best gasoline mileage of different types of cars.



Directions

Using the graph, answer these questions.

1. What type of car gets the most miles per gallon?

2. What type of car gets the fewest miles per gallon?

3. How many miles can a compact car travel on two gallons of gasoline?

4. How many miles can a large car travel on three gallons of gasoline?

5. If a midsize car travels 60 miles, how many gallons of gas will it use?

BONUS: If the gas tank of a minivan can hold 20 gallons of gasoline, how far can it travel on a full tank of gasoline?

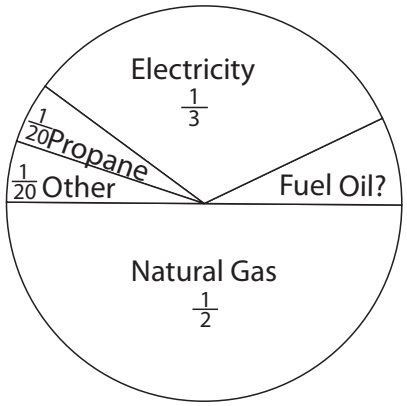
Round 1 Intermediate Math Challenge

1. The average American housing unit uses 45% of the total energy it consumes for heating and cooling rooms. Each month, 35 MBtu of energy are used for maintaining comfortable temperatures in our homes. How many MBtu of energy does the average housing unit consume each year for heating and cooling rooms?

Answer: _____ MBtu

Round 1 Intermediate Math Challenge

2. Natural gas is often used for heating buildings and homes. In fact, natural gas heats half of the nation's housing units. Reduced to the lowest terms, what fraction of the housing units is heated by fuel oil?



Answer: _____

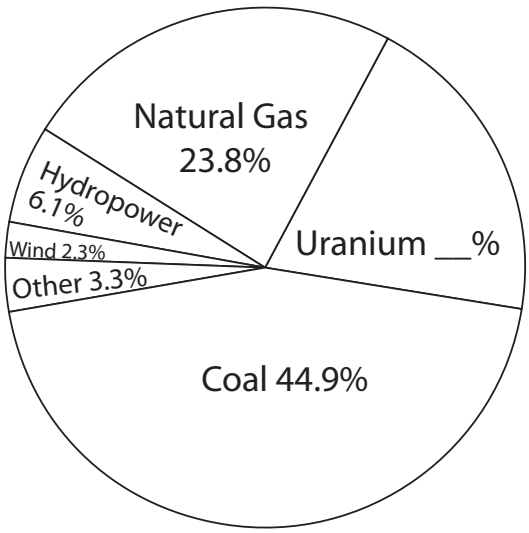
Round 1 Intermediate Math Challenge

3. The United States consumes more petroleum than it can produce. Today, the U.S. consumes 19.1 Million Barrels a Day (MBD) of petroleum – half of the petroleum is supplied by domestic production. To the nearest tenth, how many MBD are imported from other nations to supply America's demand for petroleum?

Answer: _____ MBD

Round 1 Intermediate Math Challenge

4. What percentage of U.S. electricity in 2010 was generated by uranium?



2010 U.S. Electricity Production

Answer: _____ %

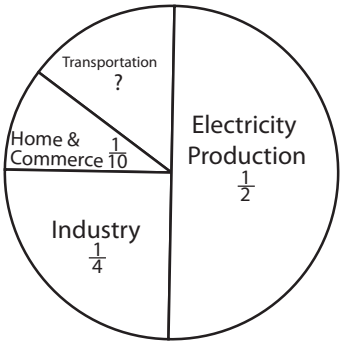
Round 2 Intermediate Math Challenge

1. Hydropower is a renewable source of energy. Hydropower provided 3.3% of the 98 quads of energy we consumed in 2010. Energy experts predict hydropower production will remain relatively constant during the next five years. How many total quads of energy will hydropower provide the nation during the next five years?

Answer: _____ quads

Round 2 Intermediate Math Challenge

2. Renewables provide about 8% of the energy the U.S. consumes. The use of renewable energy sources to generate electricity accounts for half of their use. Reduced to the lowest terms, what fraction of the nation's renewables is used for transportation?



Answer: _____

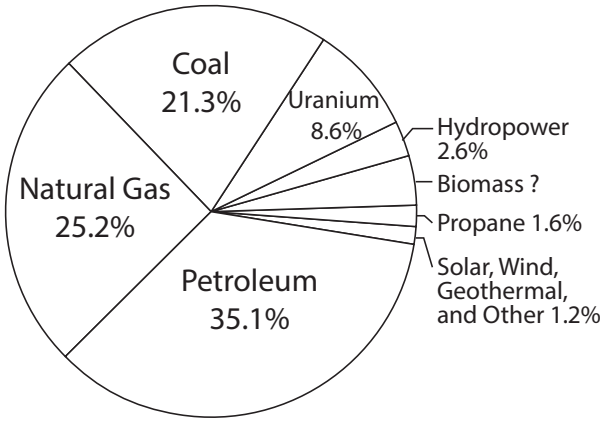
Round 2 Intermediate Math Challenge

3. Propane is 270 times more compact in its liquid state than it is as a gas. This makes propane a very portable source of heat energy. How many liters of propane gas would a three liter pressurized tank hold for your next camping trip?

Answer: _____ liters

Round 2 Intermediate Math Challenge

4. From the graph, what percentage of total energy consumption is provided by biomass?



Answer: _____ %

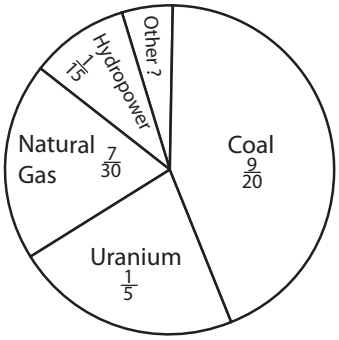
Round 3 Intermediate Math Challenge

1. The United States imports about half of its petroleum from other countries. The average daily import is 11.75 million barrels. How many barrels of petroleum would the nation import during the month of March?

Answer: _____ barrels

Round 3 Intermediate Math Challenge

2. Coal generates almost half the nation's electricity. Uranium, hydropower, and natural gas produce significant amounts, too. Reduced to the lowest terms, what fraction of electricity is provided by the other energy sources?



Answer: _____

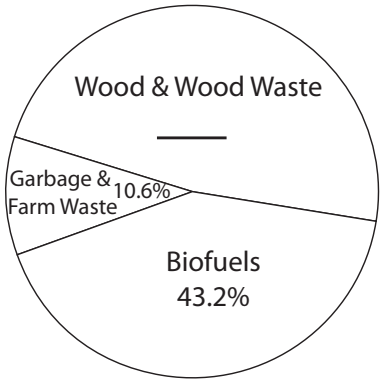
Round 3 Intermediate Math Challenge

3. About 6/7 of the energy given off by the splitting of uranium atoms is due to the motion of the splitting atoms. The other 1/7 of the heat energy is a result of the radiation released. Uranium provides the nation with 8.44 quads of energy a year. How many quads of energy are the result of the **radiation** released by the splitting uranium atoms?

Answer: _____ quads

Round 3 Intermediate Math Challenge

4. From the graph, what percentage of the nation's consumption of biomass energy is provided by wood and wood waste?



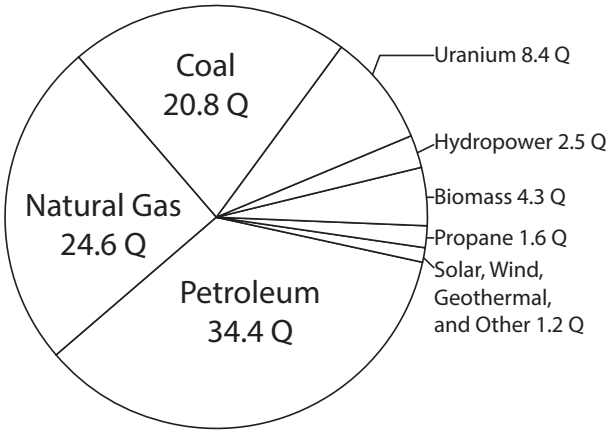
Answer: _____ %

Math Challenge

Mega Question – Intermediate

Almost all the energy we use in the United States comes from nonrenewable energy sources. Using the circle graph below, determine how many total quads (Q) of energy we used in 2010, and how many quads were provided by renewable and nonrenewable sources. Write your answers in the spaces below.

2010 Consumption



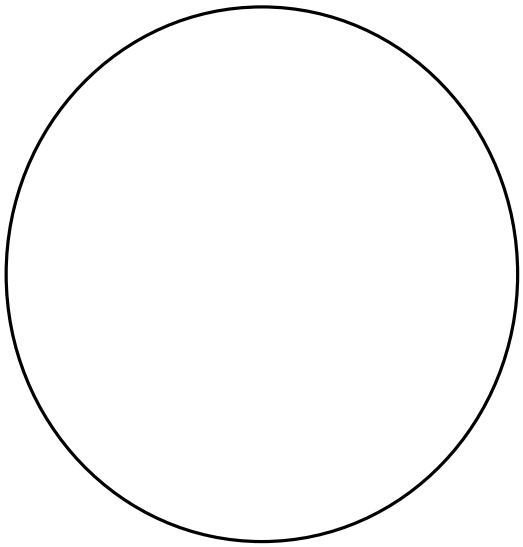
2010

Renewable:	**quads**
Nonrenewable:	**quads**
Total energy use:	**quads**

2035 Consumption

By 2035, experts predict that the United States will use 20% more energy than we did in 2010. Calculate how many total quads of energy the United States will use in 2035 and write it in the space below.

Will we use the same sources to provide that energy or will we use different sources? Fill in the blank circle graph using your predictions. The blank circle graph is 20% larger to show you what this increase looks like.



2035

Renewable:	**quads**
Nonrenewable:	**quads**
Total energy use:	**quads**

Round 1 Secondary Math Challenge

1. The United States consumes about 4,120 billion kilowatt-hours (bkWh) of electricity a year. Uranium fuels about 807 bkWh of this electrical power generation. To the nearest tenth of a percent, calculate the percentage of the nation's electricity that is generated by uranium in nuclear power plants.

Answer: _____ %

Round 1 Secondary Math Challenge

2. Approximately 57% of the nation's 114 million housing units are heated by natural gas. To the nearest million, how many housing units in the nation are heated by natural gas?

Answer: _____ units

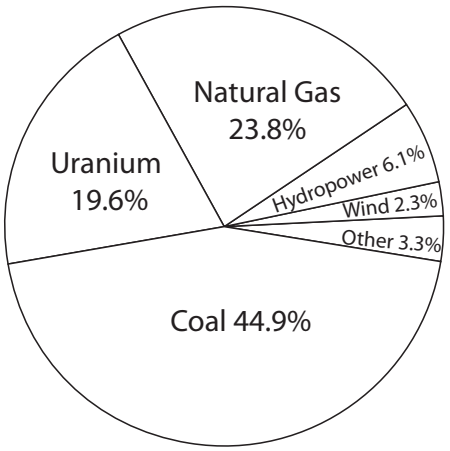
Round 1 Secondary Math Challenge

3. Today's power plants convert about one-third of the energy stored in fuels into electricity. During these conversions, most of the energy is transformed into heat rather than electricity. A certain electric power plant consumes 360 units of energy every day. How many units of electricity would the plant actually generate in a week?

Answer: _____ units

Round 1 Secondary Math Challenge

4. The United States consumes about 4,120 bkWh of electricity a year. To the nearest bkWh, how many bkWh of electricity does natural gas provide?



2010 U.S. Electricity Production

Answer: _____ bkWh

Round 2 Secondary Math Challenge

1. The United States consumes about 19.1 million barrels of petroleum a day. Gasoline, the number one product produced by the refining of petroleum, consumes 8 million barrels of the petroleum. To the nearest percent, calculate the percentage of petroleum that is refined into gasoline.

Answer: _____ %

Round 2 Secondary Math Challenge

2. Hydropower, biomass, wind, and solar energy are all a result of the sun's rays striking the earth. Geothermal energy, which provides 2.6% of the nation's renewable energy, is the only renewable source resulting from energy found below the earth's surface. All five renewable sources of energy provide the nation with about 8 quads of energy. To the nearest tenth of a quad, how many quads of energy are a result of the sun's rays striking the earth's surface?

Answer: _____quads

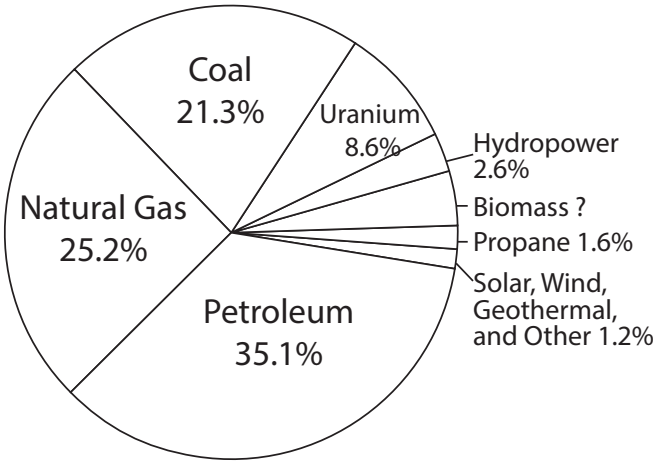
Round 2 Secondary Math Challenge

3. A 42 gallon barrel of petroleum is refined into kerosene, jet fuel, heating oil, and gasoline (the number one product). About 19.4 gallons per barrel are refined into gasoline. A tanker containing 920 million barrels of petroleum has unloaded its cargo at the refinery. To the nearest million, how many barrels of petroleum from the tanker will be refined into gasoline?

Answer: _____ barrels

Round 2 Secondary Math Challenge

4. The United States consumes about 98 quads of energy a year. How many quads of energy does biomass provide?



Answer: _____ quads

Round 3 Secondary Math Challenge

1. To generate electricity, a fossil fuel power plant consumes 72 units of chemical energy stored in the fossil fuel. Only 26 units of electrical energy are actually produced and sent out over the transmission lines. This loss occurs because a large amount of the energy stored in a fossil fuel is changed into thermal (heat) energy during the generation of electrical power. To the nearest whole percent, calculate the efficiency of this power plant at converting chemical energy into electrical energy.

Answer: _____ %

Round 3 Secondary Math Challenge

2. The average American family consumes approximately 983 million Btu (MBtu) of energy a year. Heating and cooling rooms accounts for 54% of total household energy use, operating appliances and lights accounts for 37%, and heating water accounts for 18%. To the nearest MBtu, how many MBtu of energy are consumed by the average household for heating and cooling rooms in one year?

Answer: _____MBtu

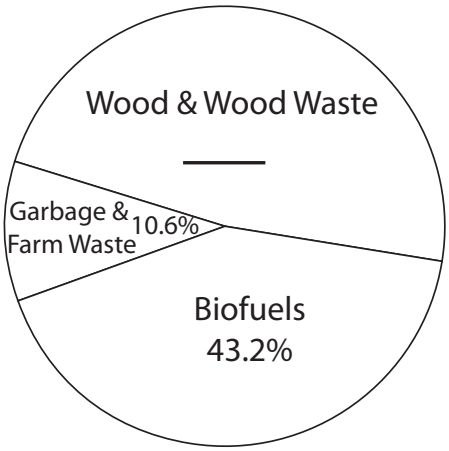
Round 3 Secondary Math Challenge

3. When uranium atoms are split, they give off heat. This heat produces high pressure steam that turns a turbine in a nuclear power plant. Each year, the nation's 104 nuclear reactors generate about 807 bkWh of electricity – 20% of total U.S. electricity production. To the nearest hundredth of a bkWh, how many bkWh of electricity does the average U.S. nuclear reactor generate a month?

Answer: _____ bkWh

Round 3 Secondary Math Challenge

4. Biomass provides the nation with 4.3 quads of energy. How many quads of biomass energy are provided by wood and wood waste?



Answer: _____quads

Electric Connections
U.S. ELECTRIC POWER GENERATION SOURCES

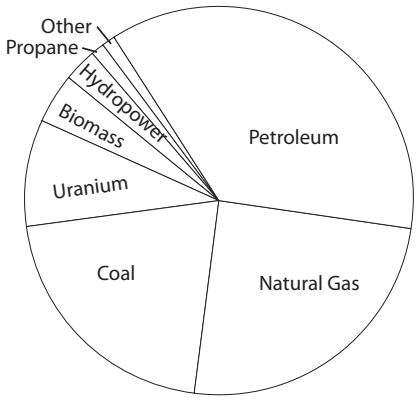
The United States is becoming more dependent on electricity to meet its energy needs. Almost 40% of the nation's energy is used to make electricity and experts predict that this figure will continue to increase. To meet the growing demand, many energy sources are used to generate electricity.

In the "Your Rank" column, place a number for each source from 1 (provides the most amount of electricity) to 10 (provides the least amount of electricity). After you have finished, use the numbers found in the answer key to fill in the "EIA's Rank" column and see how you did!

SOURCE	STATISTICS	YOUR RANK	EIA'S RANK
BIOMASS	In 2017, biomass produced 62.8 billion kilowatt-hours of electricity, 1.6% of the nation's total. Biomass electricity is usually the result of burning wood waste, landfill gas, and solid waste.		
COAL	Over 91% of the nation's coal is consumed by electric utility companies to produce electricity. In 2017, coal produced 1,205.8 billion kilowatt-hours of electricity, which was 30% of the nation's electricity.		
GEOTHERMAL	In 2017, geothermal power plants produced 15.9 billion kilowatt-hours of electricity, mostly from facilities in the western U.S. Geothermal energy produced 0.4% of the nation's electricity.		
HYDROPOWER	Nationwide, there are 2,200 hydro plants that generate 7.3% of U.S. electricity. Hydro plants produced 293.8 billion kilowatt-hours of electricity in 2017. It is the leading renewable energy source used to provide electricity.		
NATURAL GAS	Natural gas produced 1,296.4 billion kilowatt-hours of electricity in 2017, generating 32.2% of the nation's electricity. Natural gas is used by turbines to provide electricity during peak hours of demand.		
PETROLEUM	Petroleum provided 0.5% of U.S. electricity, generating 21.4 billion kilowatt-hours of electric power in 2017.		
PROPANE	There are no statistics available for propane's contribution to electricity generation. Very little propane is used to produce electricity.		
SOLAR	Solar energy provided about 1.3% of U.S. electricity in 2017, amounting to 53.3 billion kilowatt-hours of electricity. Electricity was generated by solar thermal systems or photovoltaic arrays.		
URANIUM	In 2017, 99 nuclear reactors provided the nation with 20% of its electrical energy needs. Nuclear energy produced 805 billion kilowatthours of electricity.		
WIND	Wind energy produced 254.3 billion kilowatt-hours of electricity in 2017, providing 6.3% of the nation's electricity. Most of the windgenerated electricity is produced in Texas, Iowa, and Oklahoma.		

Answer Key

Problem 1, 2, and 3 Answers



	1	2	3	4	5	Bonus
Problem 1	Petroleum	8%	92%	83%	92%	—
Problem 2	Jan 11	Apr 11	Aug 10	100 kWh	12,000 kWh	—
Problem 3	Hybrid Midsize	Pick-Up	70 mi	81 mi	2 gal	500 miles

Intermediate Math Challenge Answers

Round 1:	1. 420 MBtu	2. 1/15
	3. 9.6 MBD	4. 19.6%
Round 2:	1. 16.2 quads	2. 3/20
	3. 810 liters	4. 4.4%
Round 3:	1. 364.25 million barrels	2. 1/20
	3. 1.20 Q	4. 46.2%

Mega Question: The totals for the 2010 list: Renewable – 8 quads, Nonrenewable – 89.8 quads, and Total – 97.8 quads. The total for the 2035 list is 117.5 quads. There are no right or wrong answers for the 2035 pie chart as long as the numbers add up to 117.5 quads.

Secondary Math Challenge Answers

Round 1:	1.19.6%	2. 65 million units
	3. 840 units	4. 981 bkWh
Round 2:	1. 42%	2. 7.8 quads
	3. 425 million barrels	4. 4.4 quads
Round 3:	1. 36%	2. 442 MBtu
	3. 0.65 bkWh	4. 1.99 or 2 quads

Electric Connections – Energy Information Administration's (EIA) Rank

Biomass – 6
Coal – 2
Geothermal – 9
Hydropower – 4
Natural Gas – 1
Petroleum – 8
Propane – 10
Solar – 7
Uranium – 3
Wind – 5

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Louisiana State University – Agricultural Center
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Minneapolis Public Schools
Mississippi Development Authority–Energy Division
Mississippi Gulf Coast Community Foundation
National Fuel
National Grid
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
NC Green Power
Nebraskans for Solar
New Mexico Oil Corporation
New Mexico Landman's Association
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Nicor Gas
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In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

Energy Data Used in NEED Materials

NEED believes in providing teachers and students with the most recently reported, available, and accurate energy data. Most statistics and data contained within this guide are derived from the U.S. Energy Information Administration. Data is compiled and updated annually where available. Where annual updates are not available, the most current, complete data year available at the time of updates is accessed and printed in NEED materials. To further research energy data, visit the EIA website at www.eia.gov.

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