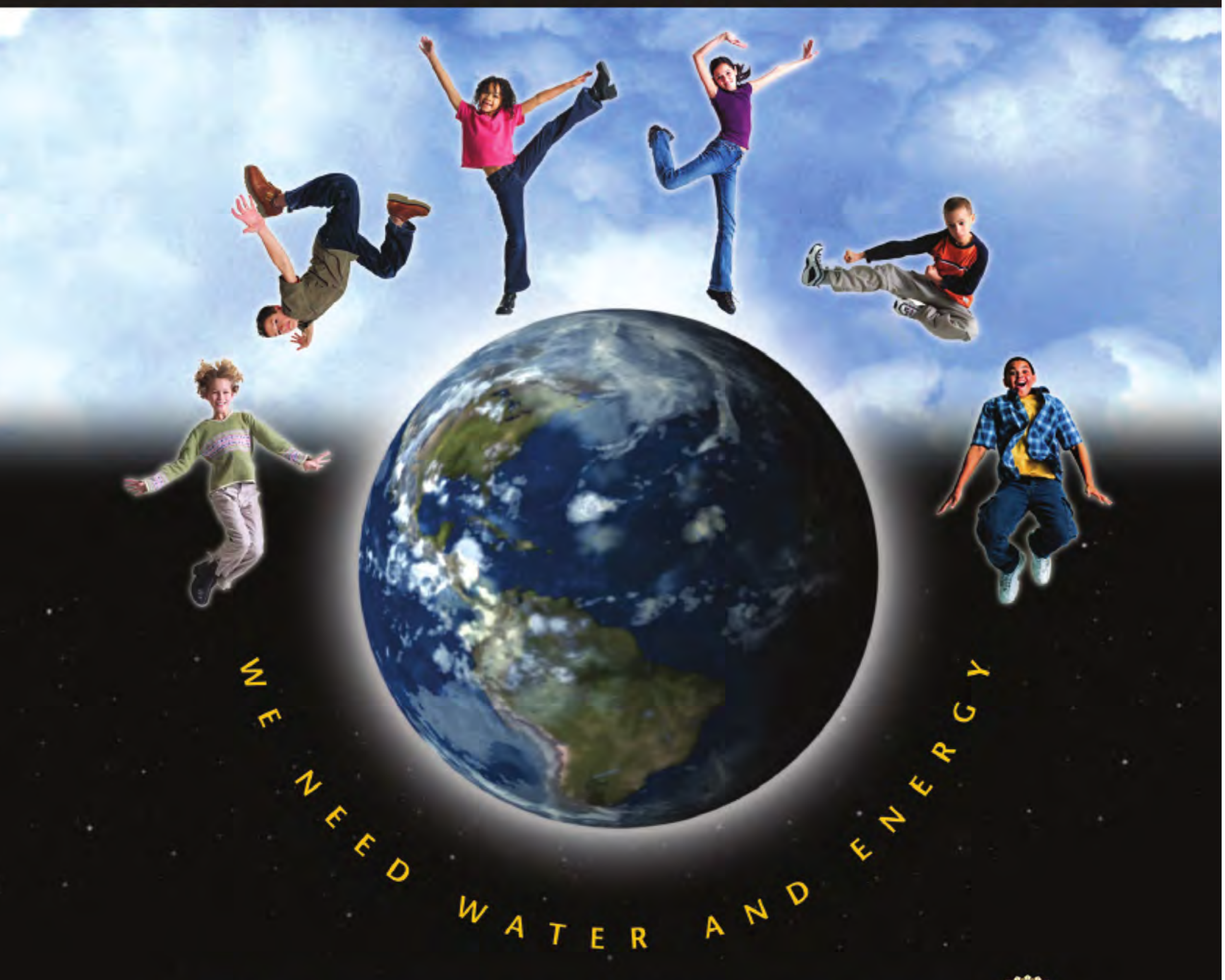
Los Angeles Department of Water & Power

Los Angeles Times | in Education

Conservation Connection: Energy in Southern California



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Conservation Connection: Energy in Southern California

Presented by:

Los Angeles Department of Water & Power

And

Los Angeles Times | IN EDUCATION

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Adapted from:
Conservation Connection: Water & Energy Use in Southern California

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Conservation Connection: Energy in Southern California

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Conservation Connection: Energy in Southern California

	ENERGY SOURCES			ENERGY USE & ENERGY CHALLENGES			ENERGY & THE FUTURE		
STANDARDS	6th	7th	8th	6th	7th	8th	6th	7th	8th
<u>COMMON CORE STANDARDS</u>									
Reading for Informational Text:									
1- Cite textural evidence	•	•	•	•	•	•	•	•	•
2-Determine a central idea	•	•	•						
4-Determine the meaning of words	•	•	•	•	•	•	•	•	•
5-Analyze how text structure contributes to the author's ideas				•	•	•	•	•	•
7-Integrate information presented	•	•					•		
8-Evaluate the argument and specific claims in a text			•				•	•	•
Writing:									
1-Write arguments to support claims	•	•	•	•	•	•	•	•	•
2- Write informative/explanatory texts							•	•	
3-Write narritives to develop real or imagined experiences							•	•	•
5- Develop & strengthen writing by planning, revising, editing							•	•	•
7- Conduct short research projects							•	•	•
8- Gather relevent information from multiple sources								•	•
Speaking and Listening:									
1-Engage in a range of collaborative discussions	•	•	•	•	•	•	•	•	•
4-Present claims and findings	•	•	•	•	•	•	•	•	•
5-Include multimedia components	•	•	•						
Language:									
1-Demonstrate command of the conventions of English grammar and usage.	•	•	•	•	•	•	•	•	•
2- Demonstrate command of the conventions of English Punctuation							•	•	•
3-Use knowlege of language when writing, speaking, reading or listening	•	•	•	•	•	•	•	•	•
<u>NEXT GENERATION SCIENCE STANDARDS</u>									
Energy:									
PS3-3- Apply scientific principles to design, construct, and test a device that either minimizes of maximizes thermal energy transfer	•			•			•		
Earth and Human Activity:									
ESS3-1- Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral energy, and groundwater resources are the result of past and current geoscience processes.					•				
ESS3-3- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.				•					
ESS3-5- Ask questions to clarify evidence of the factors that have cause the rise in global temperatures over the past century.				•			•		

Energy Sources

Lesson Overview

Students will:

- Prepare and give presentations on the various energy sources we currently use
- Compare the advantages and disadvantages of energy sources

Vocabulary

- atom • nuclear power
- biofuel • nucleus
- biomass • petrochemicals
- fission • photovoltaic
- fossil fuels • solar energy
- geothermal • thermal heat
- hydropower • turbine-generator
- neutrons • uranium

Materials and Preparation

- Materials to make posters
- Create and distribute copies of pages 11-16
- Copies of the Los Angeles Times

Approximate Time Requirement

- 2-3 class periods, depending on time to prepare and give presentations

Procedures

I. **Think About Energy Sources**

   A. Have students look at page 11, *Energy Sources*

   B. Read aloud and discuss the questions under *Think About It…*

II. **Prepare Student Presentations**

   A. Have students read the first paragraph on page 11 under *Learn About It…*

   B. Tell students that to learn more about our energy resources, each of them is going to become an "expert" about a certain energy source and will then inform the rest of the class about that source.

   C. Divide the class into 8 groups, one for each of the energy sources described on pages 11-15:

-Fossil fuels	-biomass
-nuclear power	-geothermal
-hydropower	-wind
-solar	-ocean energy

   D. Explain that each group should use the information on those pages and from the Los Angeles Times newspaper (and other information that they gather if teacher desires), to become "experts" about their energy source. Advise the students that the information on those pages is correct, but was written a few years ago so the percentages have changed. Have students go through the LA Times newspaper to locate stories or ads that contain information pertaining to their particular energy source (power rate increase, solar power installation ads, environmental impact articles) -- tell students that each group is to prepare a poster and a brief report about their energy source, and they can also use other methods and other media to present their presentation to the rest of the class.

   E. Inform students how long you are giving them to prepare their presentations, when they will give their presentations, and about how long each presentation should be.

III. **Conduct Presentations**

   A. Ask students to look at page 16 *Compare Energy Sources.* Explain that as they listen to each presentation, they should fill in the worksheet indicating the advantages and disadvantages of each energy source. Tell them to pay particular attention the areas of cost, supply, and environmental effects.

   B. Have each "expert" group present their poster and information about their energy source. After each presentation, as the class if they have any questions to ask the experts.

   C. Display the posters around the room.

VI. **Compare Energy Sources**

A. When all the presentations have been completed, discuss the energy source comparison worksheet using the sample responses below as a guide.

B. Have each "expert" group present their poster and information about their energy source, including any Los Angeles Times articles or ads they found. Include discussion regarding the LA Times information – Does the group believe that this information was valuable in helping society improve the responsible handling of this energy source? After each presentation, ask the class if they have any questions to ask the experts.

C. Ask students what energy sources they think should be developed in the future and why.

SAMPLE RESPONSES

COMPARE ENERGY SOURCES

What are some advantages and disadvantages of each of our energy sources?

Think about: **supply** **cost** **environmental effects**

Energy Source	Advantages	Disadvantages
 fossil fuels	*Fairly easy to obtain and to use* *Systems in place to use them in our cars, homes, factories, and power plants*	*Nonrenewable* *Dependence on other countries for the amount we use* *Becoming more difficult to find and get out of the ground so costs continue to increase* *Contribute to air pollution*
 nuclear power	*Large supply since uranium, the fuel, is a common mineral found around the world* *Not expensive because uranium is common*	*Radioactive waste, which can be harmful to us*
 hydropower	*Renewable* *Don't have to pay for water* *Clean for the environment*	*Only a limited number of places with water that can be used for hydropower*
 solar	*Renewable* *Don't have to pay for sunshine* *Clean for the environment*	*Not reliable since the sun doesn't always shine* *Needs special power plants and special equipment—solar cells and solar collectors*
 biomass	*Renewable* *Inexpensive fuel (trash and plant waste)* *Reduced air emissions from vehicles using biofuels*	*Pollutants released into the air when trash is burned* *Requires a lot of land and water to grow crops for fuel*
 geothermal	*Renewable* *Don't have to pay for fuel* *Clean for the environment*	*Only in areas where heat is close to the surface* *Costs to build special power plants and to reinject water into the ground*
 wind	*Renewable* *Don't have to pay for wind* *Clean for the environment*	*Not reliable since winds must blow at a constant high speed* *Uses large areas of land and may disturb wildlife*
 ocean energy	*Renewable*	*Limited locations* *Possible effects on aquatic plants and animals*

Extension Activities

- **Identify fossil fuel products**. Remind students that fossil fuels are used to make chemicals that are used to produce many products that we use every day. Give students a few examples of fossil fuels products:

  -Plastic—- bags, bottles, balls, toothbrushes, dishes, furniture
  - Fabric —- polyester, nylon, vinyl
  - Medicine —- cough syrup, asprin
  - Cosmetics —- hand lotion, nail polish, shampoo
  - Other products —- floor wax, glue, film, ink, insect spray

  Have students identify various objects around the classroom that are made from fossil fuels.
- **Compare sources.**

In 2005, Los Angeles' primary sources of power were as follows:

Renewable Energy: 6%
Large Hydro 5%
Nuclear Power 9%
Coal 51%
Natural Gas 29%

- The usage percentages have changed since then. Ask students to compare the percentages above to the percentages in your "Water Energy, The Environment and You" guide on page 45, page 11 in your student booklet, and the most recent content labels on the LADWP website at www.ladwp.com/powercontent. Ask students to use their knowledge of the power sources to write about what could have contributed to the change over the past few years. *Answers may vary. Students might include information about increased interest in clean energy including rebates for energy star equipment and tax credits for solar usage. Let students know that the California Legislature has also passed laws signed by the governor mandating increased usage of renewable energy provided by the state's electric utilities. For example: 33% of electricity is required to be derived from renewable re-sources by 2020. We exceeded that percentage and in 2019 were at 34% renewable energy from wind, solar, geothermal, and eligible hydroelectric power. A new law now requires 60% of renewable resources to be provided by 2030, while calling for a "bold path" towards 100% zero-carbon electricity by 2045.("Zero-carbon" sources include nuclear power, which is not renewable.) Mayor Eric Garcetti set a goal for the City of Los Angeles in the Green New Deal to build a zero carbon electricity grid– reaching an accelerated goal of 80% renewable energy supply by 2036 as we lead California toward 100% renewables by 2035.*
- **Demonstrate a turbine.** Use a toy pinwheel (or construct a metal pinwheel out of a can lid) to demonstrate how the blades are turned by steam, falling water, and wind.
- **Make a solar collector.** Gather the following materials: black plastic trash bag, rubber hose (about 2-3 feet long), thick rubber band, string, water. Tell students that they are going to make a solar collector to heat water.
  - Fill the plastic bag about half full with water.
  - Insert one end of the rubber hose into the top of the bag and secure the bag around the hose with the rubber band.
  - Tie the string tightly around the plastic bag just under the end of the hose in the bag.
  - Lay the bag in the sun for at least one hour.
  - Hold the bag upside down. Untie the string around the bag and carefully feel the water that runs through the hose.
- **Measure and compare wind speed.** Find the windiest spot at your school and use an anemometer to measure the wind speed at various heights, times of day, times of year. Is it ever windy enough for a wind machine, which requires an average wind speed of 13 miles per hour?
- **Play "What Am I?"** Divide students into two (or more) teams. Either alternate having the teams answer or pose the questions to all teams and allow the first team that raises a hand (or rings a bell or calls a name) to answer. State various facts, including advantages and disadvantages, about an energy source and have students guess the source. For example: "I'm renewable; I do not create air pollution; I use falling water to create electricity." *(hydropower)*

Energy Uses and Challenges

Lesson Overview

Students will:

- Determine how energy is used in California
- Discuss the problem of energy supply meeting energy demand
- Analyze their personal energy use

Vocabulary

- BTU
- Kilowatt hour (kWh)
- Vampire power

Materials and Preparation

- Students should complete the "Energy Use" column of the Personal Energy Use Log (page 17)
- Create and distribute copies of pages 17-21
- Advise students to login to the Los Angeles Times eNewspaper

Approximate Time Requirement

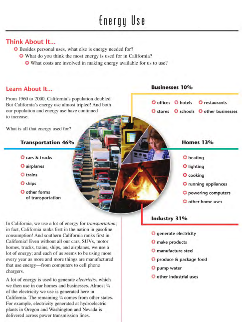
- 1 class period

Procedures

I. **Think About Energy Use**

A. Have students look at page 18

B. Read aloud and discuss the questions under *Think About It…*


Energy Use

Think About It...

- Besides personal uses, what else is energy needed for?
- What do you think the most energy is used for in California?
- What costs are involved in making energy available for us to use?

Learn About It...

From 1960 to 2000, California's population doubled. But California's energy use almost tripled! And both our population and energy use have continued to increase.

What is all that energy used for?

Businesses 10%
- offices
- hotels
- restaurants
- stores
- schools
- other businesses

Transportation 46%
- cars & trucks
- airplanes
- trains
- ships
- other forms of transportation

Homes 13%
- heating
- lighting
- cooking
- running appliances
- powering computers
- other home uses

Industry 31%
- generate electricity
- make products
- manufacture steel
- produce & package food
- pump water
- other industrial uses

In California, we use a lot of energy for *transportation*; in fact, California ranks first in the nation in gasoline consumption! And southern California ranks first in California! Even without all our cars, SUVs, motor homes, trucks, trains, ships, and airplanes, we use a lot of energy; and each of us seems to be using more every year as more and more things are manufactured that use energy—from computers to cell phone chargers.

A lot of energy is used to generate *electricity*, which we then use in our homes and businesses. Almost ¾ of the electricity we use is generated here in California. The remaining ¼ comes from other states. For example, electricity generated at hydroelectric plants in Oregon and Washington and Nevada is delivered across power transmission lines.

II. **Learn About Energy Use**

A. Read aloud the paragraphs under **Learn about it,** ***and also have Los Angeles Times eNewspapers available***….Point out that means that each person is using more energy. Have students access the Los Angeles Times to look for varied reasons WHY each person uses more energy today (articles regarding increased drive travel time, faster daily schedules which require more technology/energy usage, ads that promote bigger cars, larger houses, more appliances, etc). Ask students for feedback regarding agreement/disagreement.

B. Direct Students' attention to the graph on page 18

Ask:

1. In what categories are you responsible for the use of energy?

*All of them. We use energy both **directly** and **indirectly.** We personally use energy in our homes. We attend school and shop in stores. We use products that are made by industry. And we ride in cars, buses, trains, and/or airplanes, as well as use products that are transported by ships, trucks, trains, and planes.*

2. **What provides the energy needed in each sector?**

The transportation sector uses mainly oil, which is made into gasoline and other fuels. Homes, businesses, and industries depend mostly on natural gas and on electricity.

3. What energy sources are used to generate electricity?

(NOTE: Have students go the website shown in their booklets on page 11 to find out -and then perhaps graph- how much electricity each source generates in California.)

In 2017 in California, electricity was generated by:*
Coal– 0%
Natural Gas– 31%
Oil– 9%
Nuclear- 3%
Hydro– 5%
Other Renewables– 12%

**See also page 45 of the "Water, Energy, the Environment and You" for per-centages of electricity sources for the City of Los Angeles supplied by the Los Angeles Department of Water and Power*

III. **Calculate Personal Energy Use**

A. Tell students that they are going to fill in the numbers to show how much energy they used for everything they listed on their *Personal Energy Use Log.*

B. Ask students to look at page 19, 20—*How Much Energy Do You Use?* Point out to students that:

1.The amount of energy used by electric appliances is measured in watts. Our use of electricity is measured by kilowatt hours. One kilowatt hour (kWh) is 1,000 watts of electricity use for one hour. That would be the same as a 1,000 watt hair dryer used for one hour, or a 100 watt incandescent light bulb burning for 10 hours.

*2.*The amount of energy used by appliances that run on natural gas is measured in BTU, which stands for British Thermal Units. One BTU signifies the quantity of heat needed to raise the temperature of one pound of water by 1 degree Fahrenheit; it is a very small unit. ***(Note:*** *These definitions are shown on the bottom of page 17—Personal Energy Use Log.)*

C. Ask students to look at the lists on pages 19 and 20, and determine what the top six energy users are and what they have in common. *(The top six energy users—central air conditioner, clothes dryer, furnace, oven, refrigerator, and water heater—all provide either heat or cooling.)*

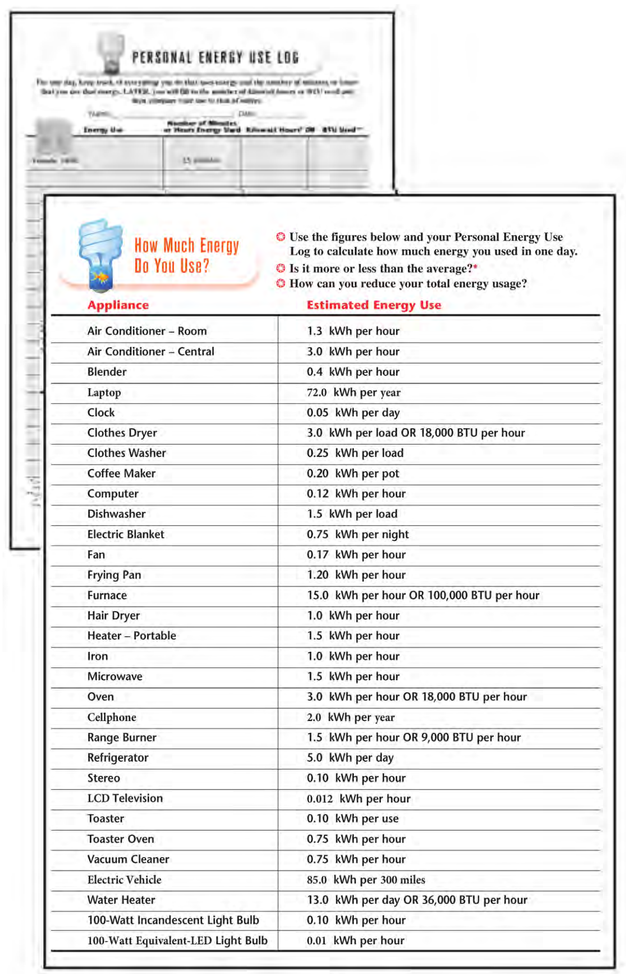
D. Have students use the figures shown on pages 19 and 20 to fill in the number of kWh for each electrical use they listed on their *Personal Energy Use Log* (page 18). Tell them that if any of their appliances— furnace, clothes dryer, water heater, or stove—uses natural gas instead of electricity, they should fill in the BTU figure. *(**NOTE**: If students aren't sure, just have them use the kWh figure.)* For any uses not shown, have students estimate the number based on figures for other uses.

E. Have students figure the total number of kilowatt hours and BTU they used for one day. *(**Note**: You can convert all numbers to kWh using this formula: 3,413 BTU = 1 kWh.)*

F. Add up the total numbers used by the class and divide by the number of students in the class to determine the average amount used per person.

G. Tell students that the average electricity use **per household** is calculated to be about 17 kilowatt hours per day. Explain that in a household, often several people at the same time use the same light, watch the same television, use the same heater, and so on, so individual use varies widely. Remind students that each person is responsible for not only direct energy usage but also indirect usage—the energy needed to make the products and grow the food that each of us uses.

H. Take a quick tally to see what energy uses were most common among students and what the range of use is in the class.



PERSONAL ENERGY USE LOG

How Much Energy Do You Use?

- Use the figures below and your Personal Energy Use Log to calculate how much energy you used in one day.
- Is it more or less than the average?*
- How can you reduce your total energy usage?

Appliance	Estimated Energy Use
Air Conditioner – Room	1.3 kWh per hour
Air Conditioner – Central	3.0 kWh per hour
Blender	0.4 kWh per hour
Laptop	72.0 kWh per year
Clock	0.05 kWh per day
Clothes Dryer	3.0 kWh per load OR 18,000 BTU per hour
Clothes Washer	0.25 kWh per load
Coffee Maker	0.20 kWh per pot
Computer	0.12 kWh per hour
Dishwasher	1.5 kWh per load
Electric Blanket	0.75 kWh per night
Fan	0.17 kWh per hour
Frying Pan	1.20 kWh per hour
Furnace	15.0 kWh per hour OR 100,000 BTU per hour
Hair Dryer	1.0 kWh per hour
Heater – Portable	1.5 kWh per hour
Iron	1.0 kWh per hour
Microwave	1.5 kWh per hour
Oven	3.0 kWh per hour OR 18,000 BTU per hour
Cellphone	2.0 kWh per year
Range Burner	1.5 kWh per hour OR 9,000 BTU per hour
Refrigerator	5.0 kWh per day
Stereo	0.10 kWh per hour
LCD Television	0.012 kWh per hour
Toaster	0.10 kWh per use
Toaster Oven	0.75 kWh per hour
Vacuum Cleaner	0.75 kWh per hour
Electric Vehicle	85.0 kWh per 300 miles
Water Heater	13.0 kWh per day OR 36,000 BTU per hour
100-Watt Incandescent Light Bulb	0.10 kWh per hour
100-Watt Equivalent-LED Light Bulb	0.01 kWh per hour

IV. **Think About Energy Challenges**

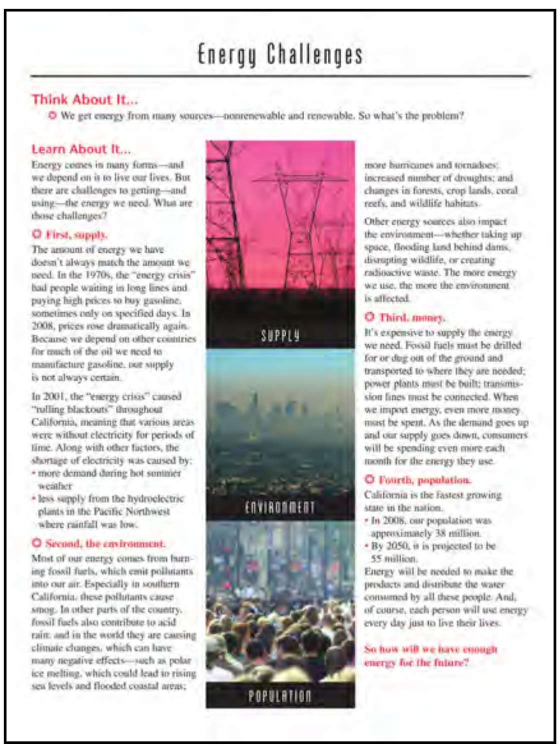
A. Have students look at page 21 - *Energy Challenges.*

B. Read aloud and discuss the question under *Think About It....*

V. Learn About Energy Challenges

A. Have students read the text under **Learn About It....** Then use the following questions to generate a discussion.

1. **What is an "energy crisis"?** *An "energy crisis" happens when our supply doesn't meet our demand for energy—such as when we don't get enough oil from other countries or when we can't generate all the electricity that people want to use.*
2. **How does using energy affect the environment?** *Burning fossil fuels, which supply most of our energy in the U.S. and in southern California, puts pollutants into our air—causing smog. Some of these pollutants also are causing climate changes, which can melt polar ice, increase storms and droughts, and affect plant and animal habitats.*
3. **What are some reasons that energy is expensive?** *We buy a lot of our oil, which we use for transportation, from other countries. And we have to build and maintain power plants and transmission lines and pipelines.*
4. **With our increasing population, how will we have enough energy for the future?**
Allow students to share their ideas.



Energy Challenges

Think About It...

We get energy from many sources—nonrenewable and renewable. So what's the problem?

Learn About It...

Energy comes in many forms—and we depend on it to live our lives. But there are challenges to getting—and using—the energy we need. What are those challenges?

First, supply.

The amount of energy we have doesn't always match the amount we need. In the 1970s, the "energy crisis" had people waiting in long lines and paying high prices to buy gasoline, sometimes only on specified days. In 2008, prices rose dramatically again. Because we depend on other countries for much of the oil we need to manufacture gasoline, our supply is not always certain.

In 2001, the "energy crisis" caused "rolling blackouts" throughout California, meaning that various areas were without electricity for periods of time. Along with other factors, the shortage of electricity was caused by:
- more demand during hot summer weather
- less supply from the hydroelectric plants in the Pacific Northwest where rainfall was low.

Second, the environment.

Most of our energy comes from burning fossil fuels, which emit pollutants into our air. Especially in southern California, these pollutants cause smog. In other parts of the country, fossil fuels also contribute to acid rain; and in the world they are causing climate changes, which can have many negative effects—such as polar ice melting, which could lead to rising sea levels and flooded coastal areas; more hurricanes and tornadoes; increased number of droughts; and changes in forests, crop lands, coral reefs, and wildlife habitats.

Other energy sources also impact the environment—whether taking up space, flooding land behind dams, disrupting wildlife, or creating radioactive waste. The more energy we use, the more the environment is affected.

Third, money.

It's expensive to supply the energy we need. Fossil fuels must be drilled for or dug out of the ground and transported to where they are needed; power plants must be built; transmission lines must be connected. When we import energy, even more money must be spent. As the demand goes up and our supply goes down, consumers will be spending even more each month for the energy they use.

Fourth, population.

California is the fastest growing state in the nation.
- In 2008, our population was approximately 38 million.
- By 2050, it is projected to be 55 million.

Energy will be needed to make the products and distribute the water consumed by all these people. And, of course, each person will use energy every day just to live their lives.

So how will we have enough energy for the future?

Extension Activities

- **Demonstrate air pollution**. Gather the following materials: white porcelain cup or plate, candle, matches. Tell students that you are going to demonstrate how fossil fuels produce pollution.
  -Light the candle. Explain that the candle is made, in part, from oil, a fossil fuel.
  - Ask students what they think will happen if the cup or plate is placed over the flame.
  - Briefly place the cup or plate near the top of the flame until a black smudge appears; then remove the cup from the flame.
  - Wipe off part of the black soot with a tissue to show that the cup was not burned or scorched. Ask students why they think the cup turned black.
  - Tell students that burning the candle releases hot gases and tiny particles—air emissions—which rise quickly up into the air. Explain that some of the emissions are invisible and some can be seen as smoke and that when the smoke settles on a surface, it produces soot.
  - Tell students that burning a candle produces very few air emissions; but burning fossil fuels in cars, power plants, factories, and other buildings produces a lot of air emissions that can cause air pollution.
- **Read electric and natural gas bills.** Show students an electricity bill and a natural gas bill and determine the cost per kilowatt hour of electricity and cost per unit of natural gas. Point out that natural gas is usually billed in therms and that one therm equals 100,000 BTU.
- **Determine costs.** Use the following formula to figure the cost of using various electrical appliances: *Watts x Hours Used x Cost per kWh =Operating Cost*

Energy and the Future

Lesson Overview

Students will:

- Learn about ways to meet our energy demand in the future, including energy efficient products, renewables, fuel cells, and conservation
- Solve math problems related to energy use

Vocabulary

- Energy efficiency
- Fuel cell
- sustainable

Materials and Preparation

- Create and distribute copies of pages 22
- Advise students to login to the Los Angeles Times eNewspaper

Approximate Time Requirement

- 1 class period

Procedures

I. **Think About Energy & the Future**

  A. Have students look at page 22- *Energy & the Future*

  B. Read aloud and discuss the questions under *Think About It…*

Energy & the Future

Think About It...

- What can we do to have enough energy for the future?
- Do you waste any energy?

Learn About It...

There is probably not one solution to the problems we face supplying energy. Rather the key is likely to find a mix of new technologies and practices that will help us have enough energy for the future.

Technology

Efficiency

Increasing energy efficiency—that is, using less energy to do more—is an important part of our energy future.

The appliances we use every day eat up a lot of electricity, but they can be—and many have been—designed to consume less. Since 1980, appliances have improved in energy efficiency by 30 to 90%. Today, products that meet strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the Department of Energy earn the Energy Star label. These products have advanced technologies that use 10 to 50% less energy than standard models. Energy Star products include big appliances such as refrigerators, clothes washers, dishwashers, and air conditioners, as well as table lamps and windows.

Other improvements in technology include:

- Smarter thermostats that can cut heating and air conditioning costs up to 33%. Using a microcomputer, these thermostats allow you to divide the day into periods and to program each period with a specific temperature. For example, at 6 a.m., a half hour before you get up on a cold day, the thermostat can increase the heat to a comfortable temperature. When everyone leaves the house at 8 a.m., the thermostat goes back down. Then at 5 p.m., just before people come home, the heat comes back on, until 10 p.m. when everyone goes to bed.
- Light emitting diode (LED) light bulbs can last up to 20,000 hours-20 times longer than a standard light bulb. To get the same light, the LED bulb needs to be just one-sixth the wattage of the standard incandescent bulb, thus using 85% less electricity. These bulbs can replace standard bulbs in table lamps, desk lamps, and ceiling or wall fixtures. They are particularly efficient in lights that will be left on for 3 to 4 hours at a time. LEDs also produce less "waste heat," thus reducing air-conditioning use in warmer weather..

ENERGY EFFICIENCY

Entire buildings can be made more energy efficient by using these improved technologies and by installing:

- solar roof panels
- skylights
- light sensors that naturally reduce lighting
- separate climate control zones
- low-emission windows that allow in maximum light but minimum heat

The U.S. Green Building Council has established a system to rate the environmental and economic impact of buildings. This Leadership in Energy and Environmental Design (LEED) Green Building Rating System certifies buildings as Silver, Gold, or Platinum. The rating is based on the number of points achieved in areas such as energy efficiency, water savings, content of building materials, and indoor environmental quality. In Southern California, LEED certified buildings include LADWP headquarters John Ferraro Building, the Audubon Center, The Getty Center, the Los Angeles Convention Center, and Metropolitan Water District's Diamond Valley Lake Visitor Center. What other LEED certified buildings can you find?

22

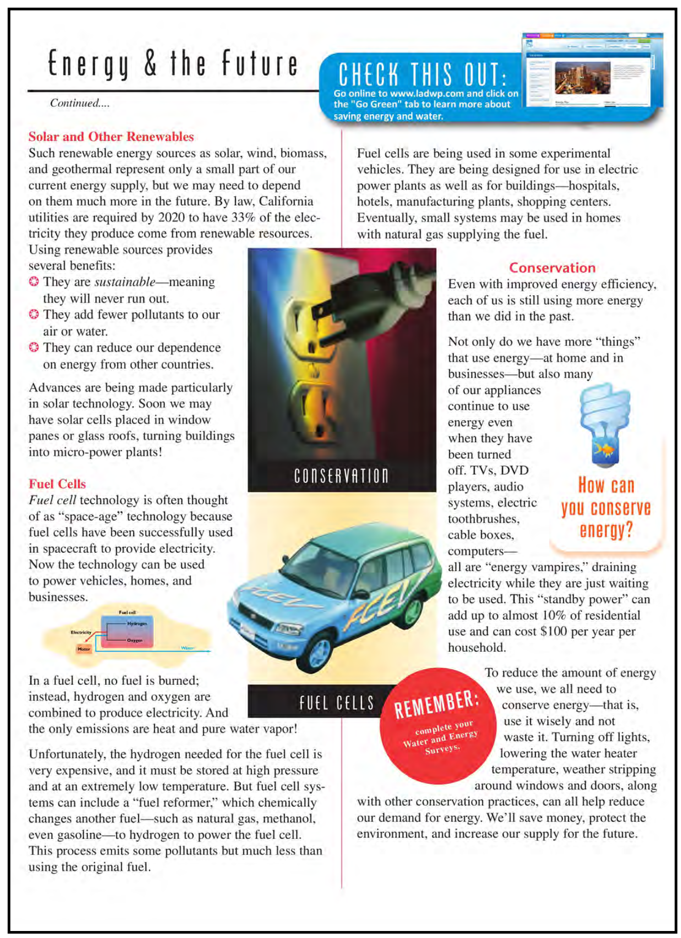
II. **Learn About Energy Technology and Conservation**

  A. Read aloud the paragraphs under *Learn about it* on page 22

  B. Have students read the text on pages 22 and 23. Then use the questions below to discuss what they read.

   1. **What does it mean to increase energy efficiency?**
   It means using less energy to do the same or more work.

   2. **Are appliances today more or less efficient than in the past?**
   Appliances today are more efficient. Since 1980, appliances—such as refrigerators, dishwashers, clothes dryers—have improved in energy efficiency by 30 to 90%, depending on the product. Today, Energy Star rated products have advanced technologies that use 10 to 15% less energy than standard models.



Energy & the Future

Continued....

CHECK THIS OUT: Go online to www.ladwp.com and click on the "Go Green" tab to learn more about saving energy and water.

Solar and Other Renewables

Such renewable energy sources as solar, wind, biomass, and geothermal represent only a small part of our current energy supply, but we may need to depend on them much more in the future. By law, California utilities are required by 2020 to have 33% of the electricity they produce come from renewable resources. Using renewable sources provides several benefits:

- They are *sustainable*—meaning they will never run out.
- They add fewer pollutants to our air or water.
- They can reduce our dependence on energy from other countries.

Advances are being made particularly in solar technology. Soon we may have solar cells placed in window panes or glass roofs, turning buildings into micro-power plants!

Fuel Cells

Fuel cell technology is often thought of as "space-age" technology because fuel cells have been successfully used in spacecraft to provide electricity. Now the technology can be used to power vehicles, homes, and businesses.

In a fuel cell, no fuel is burned; instead, hydrogen and oxygen are combined to produce electricity. And the only emissions are heat and pure water vapor!

Unfortunately, the hydrogen needed for the fuel cell is very expensive, and it must be stored at high pressure and at an extremely low temperature. But fuel cell systems can include a "fuel reformer," which chemically changes another fuel—such as natural gas, methanol, even gasoline—to hydrogen to power the fuel cell. This process emits some pollutants but much less than using the original fuel.

Fuel cells are being used in some experimental vehicles. They are being designed for use in electric power plants as well as for buildings—hospitals, hotels, manufacturing plants, shopping centers. Eventually, small systems may be used in homes with natural gas supplying the fuel.

CONSERVATION

FUEL CELLS

Conservation

Even with improved energy efficiency, each of us is still using more energy than we did in the past.

Not only do we have more "things" that use energy—at home and in businesses—but also many of our appliances continue to use energy even when they have been turned off. TVs, DVD players, audio systems, electric toothbrushes, cable boxes, computers—all are "energy vampires," draining electricity while they are just waiting to be used. This "standby power" can add up to almost 10% of residential use and can cost $100 per year per household.

How can you conserve energy?

REMEMBER: complete your Water and Energy Surveys.

To reduce the amount of energy we use, we all need to conserve energy—that is, use it wisely and not waste it. Turning off lights, lowering the water heater temperature, weather stripping around windows and doors, along with other conservation practices, can all help reduce our demand for energy. We'll save money, protect the environment, and increase our supply for the future.

3. **How can a thermostat help us use less energy?**
   Some thermostats can be programmed to automatically change the setting at various times of the day. That means that the heat or the air conditioning can be programmed to go up or down or off so that the heat or AC is not accidentally left on when it isn't needed.
4. **How much less energy does a compact fluorescent light bulb use than a standard incandescent bulb?**
   A compact fluorescent light bulb uses 75% less electricity than a standard light bulb, and it can last up to 10 times longer. So even though it is more expensive to buy, it will save money over time in energy costs.

   Note: LED lights are even more energy efficient than compact fluorescent lights.
3. **What is a LEED building?**
   A LEED (Leadership in Energy and Environmental Design) building is certified to be energy and water efficient.
4. **Why don't we use more renewable energy sources now?**
   Compared to fossil fuels, renewable energy sources have been expensive, less efficient and more difficult to see.
5. **What are the benefits of using more renewable energy sources?**
   Renewable energy sources are:
   -sustainable, meaning that they will never run out
   -non-polluting for our air and water
   -available in the United States, which means we do not have to depend on other countries for them
6. **How does a fuel cell work?**
   In a fuel cell, hydrogen and oxygen are combined to produce electricity; no fuel is burned.
7. **What are the advantages and disadvantages of using fuel cells?**
   An advantage to using fuel cells is that they produce no pollution; the only emissions from a fuel cell are heat and pure water vapor. The disadvantages are that hydrogen is very expensive and is difficult to store.
8. **Why do each of use more energy today than we did in the past?**
   Although energy efficiency of appliances has improved, we have more "things" that use energy. Also, many of our appliances have a "stand-by" mode, which continues to use energy even when the appliance is turned off.
9. **What are the benefits of conserving energy?**
   By conserving energy, which means using it wisely and not wasting it, we can:
   -save money
   -put fewer pollutants into the environment
   -have more energy available for the future.
10. a. **How can you conserve energy?**
   Allow students to share their ideas.

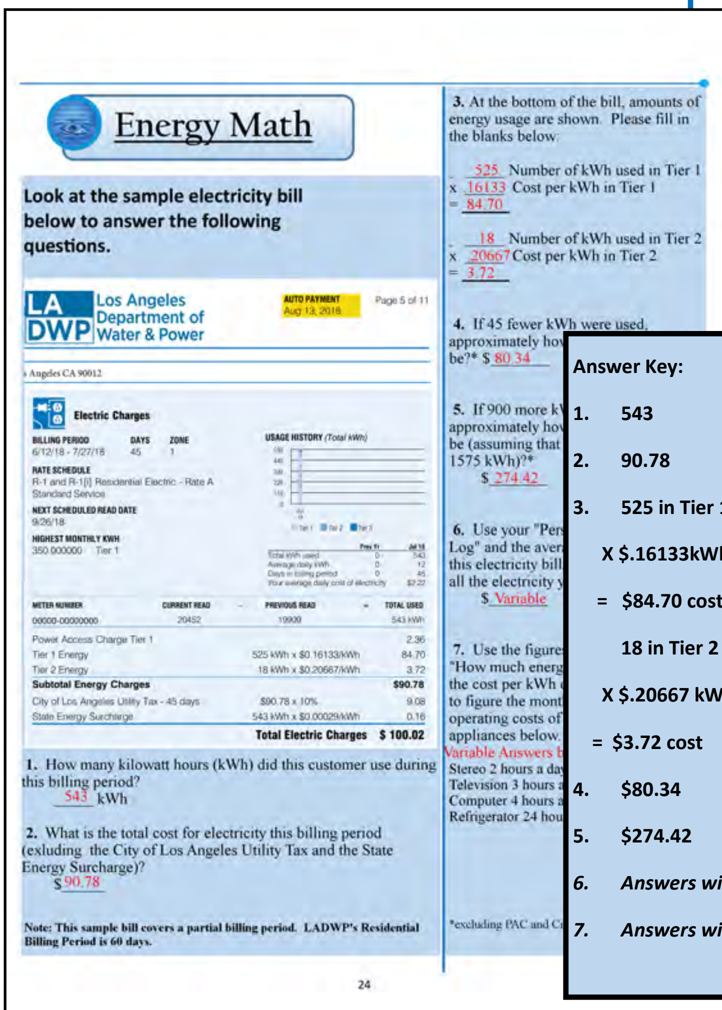
   b. **How can the media and newspaper like the Los Angeles Times help society conserve energy?**
   Encourage ideas along the lines that newspaper and other media are responsible for providing information on energy usage, environmental impact, and should editorialize on society's issues pertaining to environmental protection and energy needs for our future.

C. Have students look at *A Water and Energy Efficient Home* on page 25 Explain that this *Conservation Home* depicts many ways to save energy. Ask students to point out energy conservation practices that they see and ones that they think could be in practice around the home.

III. Solve Math Problems

A. Have students look at page 24— *Energy Math.* Tell students that they are to use the sample electricity bill to answer the questions.
Have students work either:
-individually
-in pairs or groups
-together as a class.

B. Correct the exercise with the class, working through the problems and discussing the answers.



Energy Math

Look at the sample electricity bill below to answer the following questions.

LA DWP Los Angeles Department of Water & Power — AUTO PAYMENT Aug 13, 2018 — Page 5 of 11

Electric Charges

BILLING PERIOD 6/12/18 - 7/27/18 DAYS 45 ZONE 1

RATE SCHEDULE R-1 and R-1[i] Residential Electric - Rate A Standard Service

NEXT SCHEDULED READ DATE 9/26/18

HIGHEST MONTHLY KWH 350.000000 Tier 1

METER NUMBER	CURRENT READ	PREVIOUS READ	TOTAL USED
00000-00000000	20452	19909	543 kWh

Power Access Charge Tier 1		2.36
Tier 1 Energy	525 kWh x $0.16133/kWh	84.70
Tier 2 Energy	18 kWh x $0.20667/kWh	3.72
Subtotal Energy Charges		$90.78
City of Los Angeles Utility Tax - 45 days	$90.78 x 10%	9.08
State Energy Surcharge	543 kWh x $0.00029/kWh	0.16
Total Electric Charges		$ 100.02

1. How many kilowatt hours (kWh) did this customer use during this billing period? 543 kWh

2. What is the total cost for electricity this billing period (exluding the City of Los Angeles Utility Tax and the State Energy Surcharge)? $ 90.78

Note: This sample bill covers a partial billing period. LADWP's Residential Billing Period is 60 days.

3. At the bottom of the bill, amounts of energy usage are shown. Please fill in the blanks below:

525 Number of kWh used in Tier 1
x .16133 Cost per kWh in Tier 1
= 84.70

18 Number of kWh used in Tier 2
x .20667 Cost per kWh in Tier 2
= 3.72

4. If 45 fewer kWh were used, approximately ho[w] ... be?* $ 80.34

5. If 900 more k[Wh] ... approximately ho[w] ... be (assuming that ... 1575 kWh)?* $ 274.42

6. Use your "Per[sonal] ... Log" and the aver[age] ... this electricity bill ... all the electricity ... $ Variable

7. Use the figure[s] ... "How much energ[y] ... the cost per kWh ... to figure the mont[hly] ... operating costs of ... appliances below. Variable Answers ...
Stereo 2 hours a da[y]
Television 3 hours ...
Computer 4 hours ...
Refrigerator 24 hou[rs]

*excluding PAC and C...

24

Answer Key:

1. 543
2. 90.78
3. 525 in Tier 1
   X $.16133kWh
   = $84.70 cost
   18 in Tier 2
   X $.20667 kWh
   = $3.72 cost
4. $80.34
5. $274.42
6. *Answers will vary*
7. *Answers will Vary*

Extension Activities

- **Research conservation products and report on savings.** Determine an average cost for various new energy-saving products (e.g. Energy Star refrigerator, programmable thermostat, low-emission windows) and calculate how much energy is saved and how long the product will take to "pay for itself"—that is, even though a new energy-efficient product may be more expensive to buy, it costs less to operate, so how long will it take to make up the extra cost to purchase the product?
- **Demonstrate efficiency**. Gather the following materials: pots or pans of the same shape and size but of different materials (e.g. glass, steel, copper), hot plate, water, stopwatch. Heat equal amounts of the same temperature water in each pan until the water boils. Record the times and determine which material had the best heating efficiency.
- **Experiment with lighting.** Gather the following materials: photographer's light meter, fluorescent and incandescent light bulbs of equal wattage, a lamp that can use either bulb. In a darkened room, turn on the incandescent light. Use the light meter to measure the amount of light given off at distances of 3 and 10 feet from the light. Record the findings. Carefully touch the bulb after it has been on for a few minutes to determine how hot it is. Follow the same procedures using the fluorescent bulb. Determine which is more efficient and why.
- **Test low-emission windows.** Gather the following materials: sheet of ordinary glass, sheet of low-emission glass, two identical boxes, two thermometers. Put a thermometer inside each box and place a sheet of glass on top of each box. Put the boxes next to each other outside the sun. Measure and record the temperatures inside each box every 15 minutes. Expose the boxes to different conditions (e.g. sunny day, overcast day, tree-shaded) and compare the differences.

Energy Sources

Think About It...

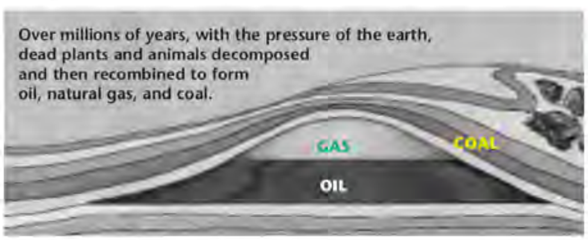
- Where does the energy you use every day come from?
    - Are the energy sources we depend on the same as those in the past?

Learn About It...

Over the years, Americans have used several energy sources to meet our energy needs. Before 1900, wood was burned to provide most of our energy. Then people began to depend on coal—to power trains, steamboats, factories, and furnaces, and eventually to generate electricity. Today, the United States—and California—rely on a variety of energy sources. In California, all of our energy sources—except oil—are used at least in part to help generate electricity.

Fossil Fuels

Petroleum (oil), natural gas, and coal are *fossil fuels*. Millions of years ago, when the plants and animals that lived on Earth died, they were covered with water, mud, and rock.

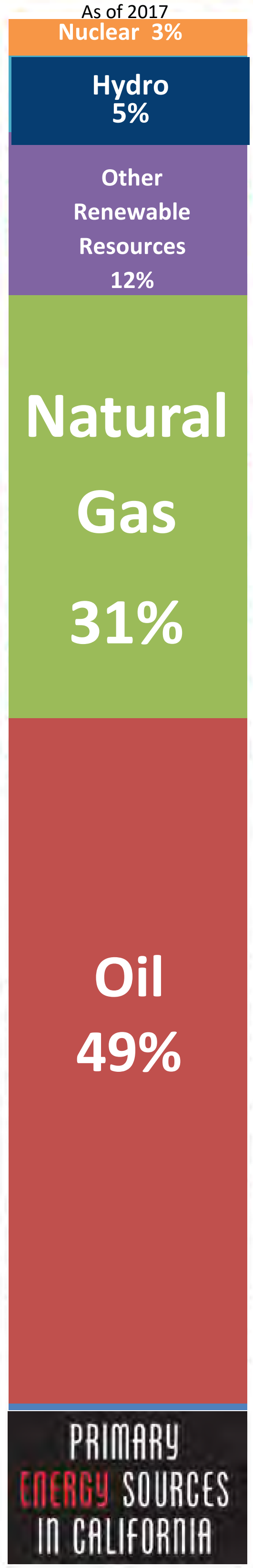


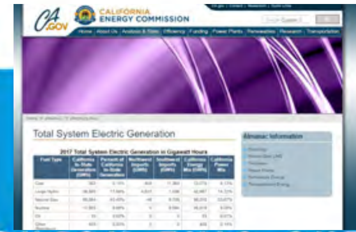
Over millions of years, under pressure, the dead plants and animals decomposed and then recombined to form oil, natural gas, and coal. These fuels are rich in stored up energy. When we burn fossil fuels, the stored energy is released as heat.

Oil, a thick, brown liquid, is found under land and water. We drill holes to find the oil and then pump it out of the ground.

Most oil is used to make gasoline and other vehicle fuels. It is also used to make heating oil to burn in furnaces and to make *petrochemicals*, which are used to make such products as plastic, fabrics, and cosmetics.

As of 2017





CHECK THIS OUT:

Go online to http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html to see the percentage of electricity generated by each energy source.

Natural gas is an invisible, odorless gas that is sometimes found along with oil. Drills are used to reach the natural gas, which then rises through pipes to the surface.

Most natural gas is delivered to homes and businesses through underground pipes and is used in furnaces and stoves. Natural gas is also used in power plants to generate electricity and, like oil, used to make chemicals used in such products as ink, glue, and nylon.

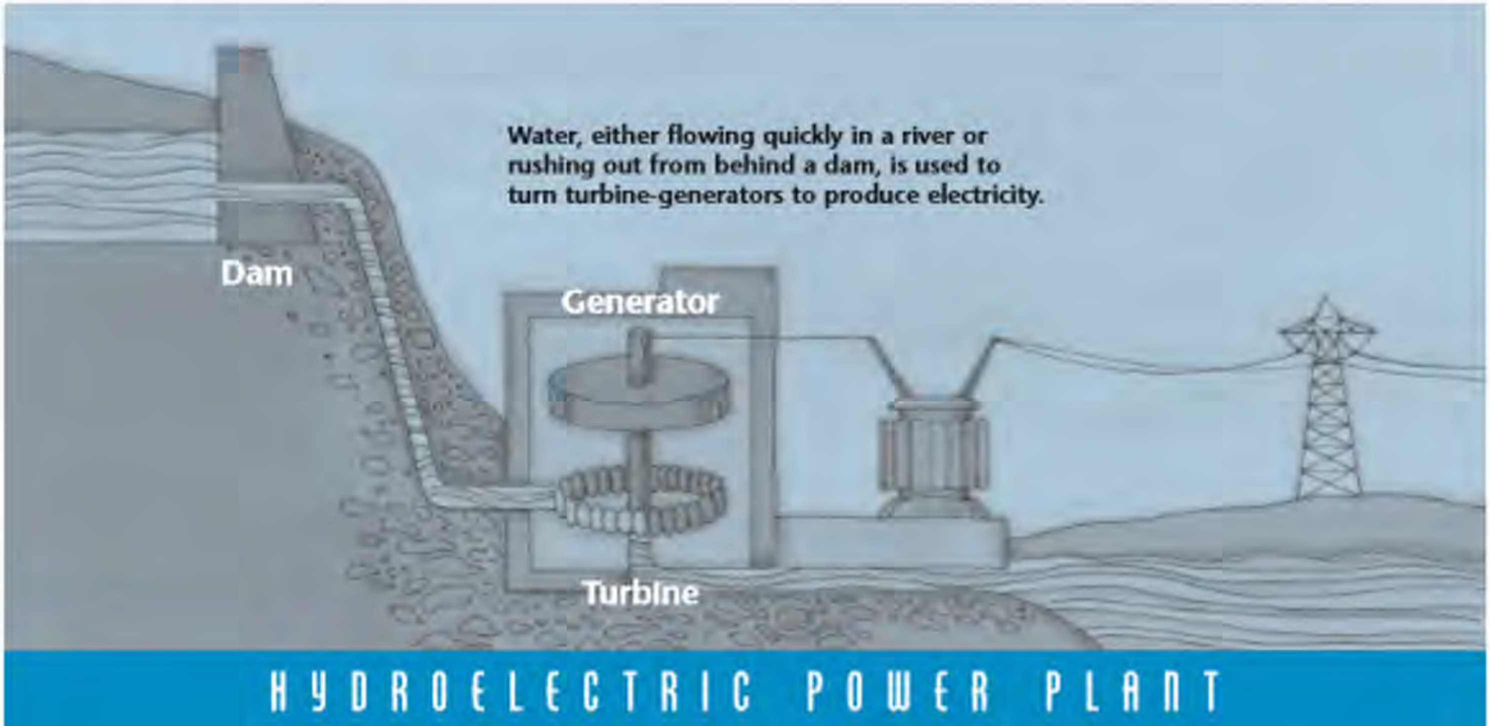
Coal, which looks like rough black rocks, must be dug out of the ground. The primary use of coal is to generate electricity in power plants, though it is also burned in some buildings and factories to provide heat.

Fossil fuels have been fairly easy to obtain and to use. We have established systems for using them in our cars, homes, factories, and power plants. In California, fossil fuels provide more than 80% of our total energy, and they generate more than 50% of our electricity.

But there are disadvantages to using fossil fuels.

- First, fossil fuels are nonrenewable. They are becoming more difficult to find and recover, and once they are used up, they cannot be replaced.
- Second, the use of fossil fuels causes environmental problems. Whether they are burned in power plants or in our cars, fossil fuels release harmful pollutants into the air, causing smog and other air pollution problems.

Continued....



Nuclear Power

Nuclear energy comes from the tiny dense core of the *atom*—the *nucleus*. In a nuclear power plant, the nuclei of atoms of *uranium*, a heavy mineral, are split apart. As each one splits, it releases *neutrons*, which travel at high speed, hitting other atoms, splitting them apart, causing a chain reaction. This splitting of millions of atoms—called *fission*—creates a lot of heat, which is then used to make steam to turn *turbine-generators* in a nuclear power plant.

The one nuclear power plant in California, Diablo Canyon near San Luis Obispo between Los Angeles and San Diego, will soon begin shutdown operations. There was one other in San Onofre that is now shutdown.

Uranium, the fuel for nuclear fission is nonrenewable; however, it is a common, inexpensive mineral found worldwide. The primary problem with nuclear energy is that the material left over after the atoms are split aart is radioactive, which means that it gives off radiation that can be harmful to us. This, the waste material must be stored carefully since it remains radioactive for hundreds of years.

Hydropower

Hydro means water. So *hydropower* means, "water power." Water, either flowing quickly in a river or rushing out from behind a dam, is used to turn turbine-generators to produce electricity. Hydropower is an important source of electricity for the nation and for California. About 12% of the total electricity in California comes from nearly 400 hydro plants.

Some hydroelectric power plants are both producers and consumers of electricity. Here's how it works. During times when a lot of electricity is being used—such as on hot summer days—water is released from a dam at a high elevation to generate electricity. The water ends up in a reservoir at a lower elevation. Then at night, when less electricity is needed, the water is pumped from the lower reservoir back to the higher reservoir to be used again.

Hydropower is a renewable energy source as long as rivers and streams continue to flow. But there are only so many places with water that we can use for hydropower.

Continued....

Solar

Solar energy—energy from the sun—is the principal source of all the Earth's energy. Sunlight heats the land and warms the water. It causes the winds to blow and the rains to fall. It allows plants to grow, providing the stored energy on which all animals live. Even fossil fuels are "stored sunshine." Without the sun, the Earth as we know it could not exist. But the energy source that powers the planet can also power the many machines that have become a part of our lifestyle.

There are basically two different ways in which we can capture and use the sun's energy.

- *Thermal heat* – The sun's heat can be used to heat water, which can be used directly or used to generate electricity.
- *Photovoltaic cells* – These devices actually convert sunlight into electric current.

SOLAR POWER PLANT

SOLAR CELL PANELS

Thermal Heat

The intense energy of the sun has long been used to heat water. Pioneer families had homes equipped with solar water heaters. Today, homes across the nation have solar hot water heaters installed. In these systems, cold water from the home's regular water line is pumped to a thermal collector on the roof, where the sun's heat warms the water. The heated water then flows into the regular hot water tank. These systems are used to heat water for homes and businesses and for swimming pools.

Solar heat can also be used to heat water in power plants. At a solar thermal power plant, huge mirrors—solar collectors—are used to focus sunlight onto a tank filled with water or other fluids. The sun heats the fluid to a very high temperature, creating steam to power turbine-generators to produce electricity. California's Beacon Solar Energy Project covers about 2,000 acres in Kern County.

Photovoltaic Cells

Photovoltaic cells—or PVs or, more commonly, solar cells—are composed of thin layers of silicon and other materials. When sunlight strikes a solar cell, chemical reactions release electrons, generating a little electric current. We find solar cells in calculators, camera light meters, sidewalk lighting systems, and freeway phones for stranded motorists.

Solar cells can also be put together into solar panels or modules to provide electricity for homes and businesses.

The panels are usually placed on rooftops of individual homes and businesses that have clear access to the sun for most of the day. They might be simply attached to the roof or actually part of the roofing material. In some cases, a PV system can be connected to the electric utility's system. Then, if the solar panels are providing more power than the home or business uses, the extra electricity goes to the utility, and the home or business's electricity meter actually spins backwards!

Electric utilities can use their own PV systems to supplement the electricity they provide. Los Angeles Department of Water and Power has several rooftop installations on municipal buildings throughout the city. Besides using conventional PV technology, LADWP is planning to feature building-integrated photovoltaic (BIPV) systems at several area libraries.

Southern California Edison has begun installing the nation's largest solar cell system on the unused roofs of commercial buildings. Over the next few years, Edison will install solar cell panels on approximately 65 million square feet—about 2 square miles—of roofs. Eventually, these solar units could provide enough electricity for about 160,000 homes.

Continued....

Biomass

Biomass is organic matter from plants and animals. Some examples of biomass fuels are:

- wood, especially lumber waste
- crops, such as corn and sugar cane
- trash and garbage from our homes and businesses

To get energy out of biomass, we can burn it or convert it into *biofuel*.

Burning biomass releases heat. Wood, along with wood waste (bark, sawdust, wood chips, wood scraps), is the most common form of biomass. It is burned in homes, industries, and businesses, and by electric power companies, who use the heat to create steam to turn turbine-generators to generate electricity.

Trash that comes from plant or animal products is also biomass—food scraps, lawn clippings, paper packaging, leaves. Californians create about 85 million tons of household garbage and industrial waste each year—nearly 3,000 pounds each second! About half can be recycled, but that leaves a lot of garbage that could be burned to produce electricity.

In California, there are about 30 biomass power plants. Two plants that burn municipal solid waste—trash and garbage—are located in Los Angeles County—one in Long Beach and one in the city of Commerce. Biomass produces about 3% of the total electricity in California.

BIOMASS

GEOTHERMAL POWER PLANT

Converting biomass creates biofuels, which are used to power cars and trucks. Crops like corn and sugar can be fermented to produce ethanol, which can be mixed in with gasoline. Biodiesel, which can run diesel engines, can be produced from leftover vegetable oil—like french-fry oil! Biofuel is even starting to be made from algae. Several companies—some in California—are growing algae either in open ponds or in tanks and converting it to fuel.

Biomass is a renewable energy source; we can always grow more crops, and waste will always exist. Using biomass to generate electricity helps keep waste out of rapidly filling landfills, and using biofuels does reduce air emissions from vehicles. But burning biomass in power plants does release some pollutants into the air, and growing crops for fuel requires a lot of land.

Geothermal

Geothermal energy comes from heat inside the Earth. We can see the results of that heat in volcanoes, geysers, and hot springs. The heat underground often heats water or creates steam that we can tap to generate electricity in power plants. The hot water can also be used directly by piping it through buildings to heat them.

The city of San Bernardino has one of the largest direct-use geothermal projects in North America. Hot water from below ground is used to heat public buildings. After being pumped up, the hot water runs through about 15 miles of insulated pipelines to about 40 buildings—from City Hall to retirement homes and animal shelters.

California has more than 40 geothermal power plants that produce almost 6% of the state's total electricity—a little more in southern California. Geothermal energy is considered to be renewable since heat from the core of the Earth is expected to last indefinitely. However, geothermal energy can be tapped only in areas where the heat is close enough to the surface. Also water that is removed must be reinjected into the ground so that the land doesn't sink and the source doesn't "dry up."

Energy Sources

As of 2001

Continued....

Wind

People have been using wind for energy for thousands of years. Wind has powered sailboats, pumped water from wells, and turned grinding stones to mill wheat or corn.

Today, wind also turns wind turbines to make electricity. A wind turbine is similar to a child's pinwheel or the propeller of an airplane. The giant blades are connected to a shaft, which in turn is connected to a generator that produces electricity. Often, hundreds of wind machines are grouped together in wind farms in particularly windy areas—areas with average wind speeds of at least 13 miles per hour.

California has 5 major areas producing wind power. Two of those areas are in southern California—Tehachapi, which is southeast of Bakersfield, and San Gorgonio, which is east of Los Angeles near Palm Springs. Approximately 14,000 wind turbines in California produce about 2% of our electricity.

Where does your city get its energy?*

Wind is, of course, a renewable energy source—but it's not reliable. Winds must blow at a constant high speed to generate electricity, and that condition is not found in very many places and never all year long. In California, ¾ of our wind energy is produced during the spring and summer. Wind farms also use large areas of land and may disturb the area's wildlife, including birds.

Ocean Energy

There is tremendous energy in **ocean tides and waves.**

Caused by the gravitational pull of the moon and sun, **ocean tides** flowing on and off shore or between ocean and rivers can be a source of electricity. Tidal turbines basically resemble and function like sturdier wind turbines. Placed where there are strong tidal currents, the turbines turn as the water flows in during high tide, and then reverse as the water flows out to sea during low tide. Currently, only two tidal plants are in operation—one in Canada and one in France.

The energy in **ocean waves** comes from the movement of the ocean and the changing heights and speed of the swells as the wind blows across the sea. But it's not easy to harness this energy and convert it into electricity in large amounts. There are several methods of getting energy from waves. Most all of them involve wave machines outfitted with turbines and/or pistons to capture the energy of ocean waves and turn it into electricity.

Currently, installations have been built or are under construction in a number of countries—Scotland, Portugal, Norway, China, Japan, Australia, and India. The west coast of the United States, including California, has many areas with the necessary wave patterns or strength. Two wave farms are under construction in northern California.

Ocean energy is renewable. Waves continue to break, and the daily movement of tides is predictable. But only limited locations have the needed tidal currents or strong ocean waves to produce energy economically. And the effects on the aquatic plants and animals must also be considered.

*For the city of Los Angeles, go to page 45 in "Water, Energy, the Environment and You" teacher's guide.

COMPARE ENERGY SOURCES

What are some advantages and disadvantages of each of our energy sources?

Think about: supply cost environmental effects

Energy Source	Advantages	Disadvantages
 fossil fuels		
 nuclear power		
 hydropower		
 solar		
 biomass		
 geothermal		
 wind		
 ocean energy		

PERSONAL ENERGY USE LOG

For one day, keep track of everything you do that uses energy and the number of minutes or hours that you use that energy. LATER, you will fill in the number of kilowatt hours or BTU used and then compare your use to that of others.

Name:______________________________ Date:____________

Energy Use	Number of Minutes or Hours Energy Used	Kilowatt Hours* OR	BTU Used**
Example: radio	25 minutes		

TOTAL ______ **kWh** ______ **BTU**

*One kilowatt-hour (kWh) is 1,000 watts of electricity use for one hour—e.g., a 1,000 watt hair dryer used for one hour, or a 100 watt light bulb burning for 10 hours.

**One BTU, which stands for British Thermal Units, signifies the quantity of heat needed to raise the temperature of one pound of water by one degree Fahrenheit; it is a very small unit.

Energy Use

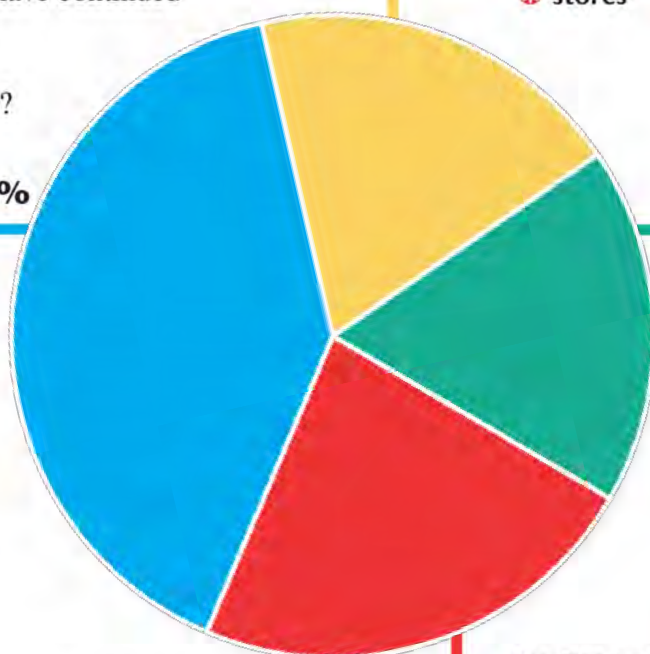
Think About It...

- Besides personal uses, what else is energy needed for?
- What do you think the most energy is used for in California?
- What costs are involved in making energy available for us to use?

Learn About It...

From 1960 to 2000, California's population doubled. But California's energy use almost tripled! And both our population and energy use have continued to increase.

What is all that energy used for?



Transportation 40%

- cars & trucks
- airplanes
- trains
- ships
- other forms of transportation

Businesses 19%

- offices
- hotels
- restaurants
- stores
- schools
- other businesses

Homes 18%

- heating
- lighting
- cooking
- running appliances
- powering computers
- other home uses

Industry 23%

- generate electricity
- make products
- manufacture steel
- produce & package food
- pump water
- other industrial uses

In California, we use a lot of energy for *transportation*; in fact, California ranks first in the nation in gasoline consumption! And southern California ranks first in California! Even without all our cars, SUVs, motor homes, trucks, trains, ships, and airplanes, we use a lot of energy; and each of us seems to be using more every year as more and more things are manufactured that use energy—from computers to cell phone chargers.

A lot of energy is used to generate *electricity*, which we then use in our homes and businesses. Almost ¾ of the electricity we use is generated here in California. The remaining ¼ comes from other states. For example, electricity generated at hydroelectric plants in Oregon and Washington and Nevada is delivered across power transmission lines.

How Much Energy Do You Use?

- Use the figures below and your Personal Energy Use Log to calculate how much energy you used in one day.
- Is it more or less than the average?*
- How can you reduce your total energy usage?

Appliance	Estimated Energy Use
Air Conditioner – Room	1.3 kWh per hour
Air Conditioner – Central	3.0 kWh per hour
Blender	0.4 kWh per hour
Laptop	72.0 kWh per year
Clock	0.05 kWh per day
Clothes Dryer	3.0 kWh per load OR 18,000 BTU per hour
Clothes Washer	0.25 kWh per load
Coffee Maker	0.20 kWh per pot
Computer	0.12 kWh per hour
Dishwasher	1.5 kWh per load
Electric Blanket	0.75 kWh per night
Fan	0.17 kWh per hour
Frying Pan	1.20 kWh per hour
Furnace	15.0 kWh per hour OR 100,000 BTU per hour
Hair Dryer	1.0 kWh per hour
Heater – Portable	1.5 kWh per hour
Iron	1.0 kWh per hour
Microwave	1.5 kWh per hour
Oven	3.0 kWh per hour OR 18,000 BTU per hour
Cellphone	2.0 kWh per year
Range Burner	1.5 kWh per hour OR 9,000 BTU per hour
Refrigerator	5.0 kWh per day
Stereo	0.10 kWh per hour
LCD Television	0.012 kWh per hour
Toaster	0.10 kWh per use
Toaster Oven	0.75 kWh per hour
Vacuum Cleaner	0.75 kWh per hour
Electric Vehicle	85.0 kWh per 300 miles
Water Heater	13.0 kWh per day OR 36,000 BTU per hour
100-Watt Incandescent Light Bulb	0.10 kWh per hour
100-Watt Equivalent-LED Light Bulb	0.01 kWh per hour

*Average electricity use per household is about 17 kilowatt hours per day.

How Much Energy Do You Use?

Vampire power refers to electricity that is still consumed when an appliance is turned off, in sleep mode, or in standby mode. Generally vampire power is used mainly by devices that involve remote controls, continuous displays, or power adapters.

Below is a list of a few appliances and how much electricity is used in Vampire mode. Note that advance power strips can be purchased that help fully turn off appliances so vampire power use is avoided.

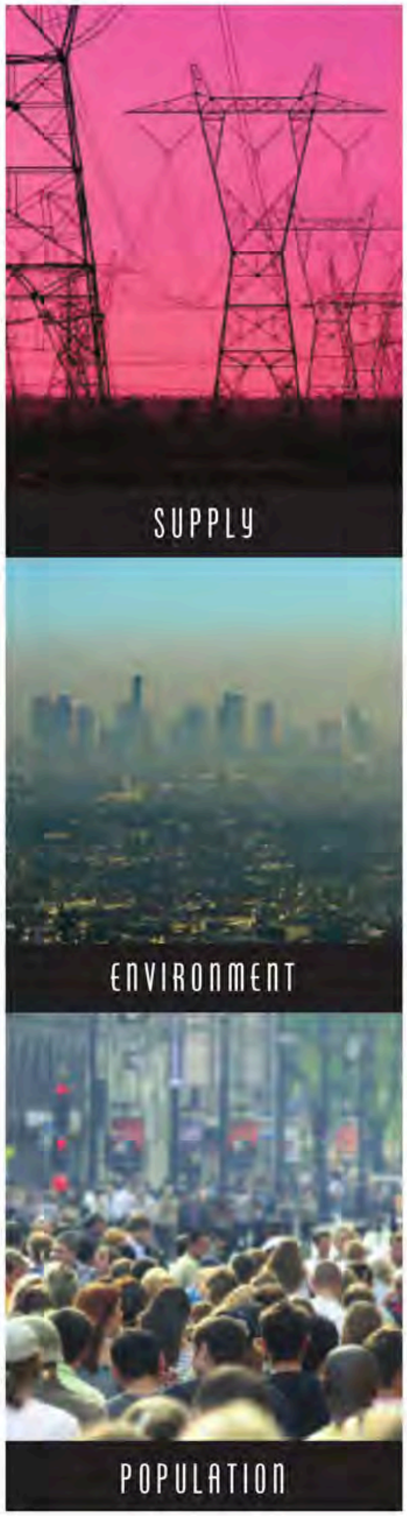
Appliance	Estimated Energy Use
Cell Phone Charger	4 watts
Dvd player	13 watts
Desktop computer	181 watts
CD player	18 watts
DVR set-up	43 watts
Video game console	64 watts
Ink jet printer	4 watts
Cordless phone	5 watts
Laptop computer	55 watts
Copier	14 watts
Microwave	5 watts

Energy Challenges

Think About It...

- We get energy from many sources—nonrenewable and renewable. So what's the problem?

Learn About It...



Energy comes in many forms—and we depend on it to live our lives. But these are challenges to getting – and using—the energy we need.

What are those challenges?

First, supply.

The amount of energy we have doesn't always match the amount we need. In the 1970s, the "energy crisis" had people waiting in long lines and paying high prices to buy gasoline, sometimes only on specified days. In 2008, prices rose dramatically again. Because we depend on other countries for much of the oil we need to manufacture gasoline, our supply is not always certain.

In 2001, the "energy crisis" caused "rolling blackouts" throughout California, meaning that various areas were without electricity for periods of time. Along with other factors, the shortage of electricity was caused by:

- more demand during hot summer weather.
- Less supply from the hydroelectric plants in the Pacific Northwest where rainfall was low.

Second, the environment.

Most of our energy comes from burning fossil fuels, which emit pollutants into our air. Especially in southern California, these pollutants cause smog. In other parts of the country, fossil fuels also contribute to acid rain; and in the world they are causing climate changes, which have many negative effects, such as polar ice melting, which could lead to rising sea levels and flooded coastal areas; more hurricanes and tornadoes; increased number of droughts; wildfires; flooding; and changes in forests, crop lands, coral reefs and wildlife habitats.

Other energy sources also impact the environment – whether taking up space, flooding land behind dams, disrupting wildlife, or creating radioactive waste. The more energy we use, the more the environment is affected.

Third, money.

It's expensive to supply the energy we need. Fossil fuels must be drilled for or dug out oof the ground and transported to where they are needed; power plants must be built; transmission lines must be connected. When we import energy, even more money must be spent. As the demand goes up and our supply goes down, consumers will be spending even more each month for the energy they use.

Fourth, population.

California is growing fast.

- In 2018, our population was approximately 40 million.
- By 2050, it is projected to be 60 million.

Energy will be needed to make the products and distribute the water consumed by all these people. And, of course, each person will use energy every day just to live their lives.

So how will we have enough energy for the future?

Think About It...

- What can we do to have enough energy for the future?
- Do you waste any energy?

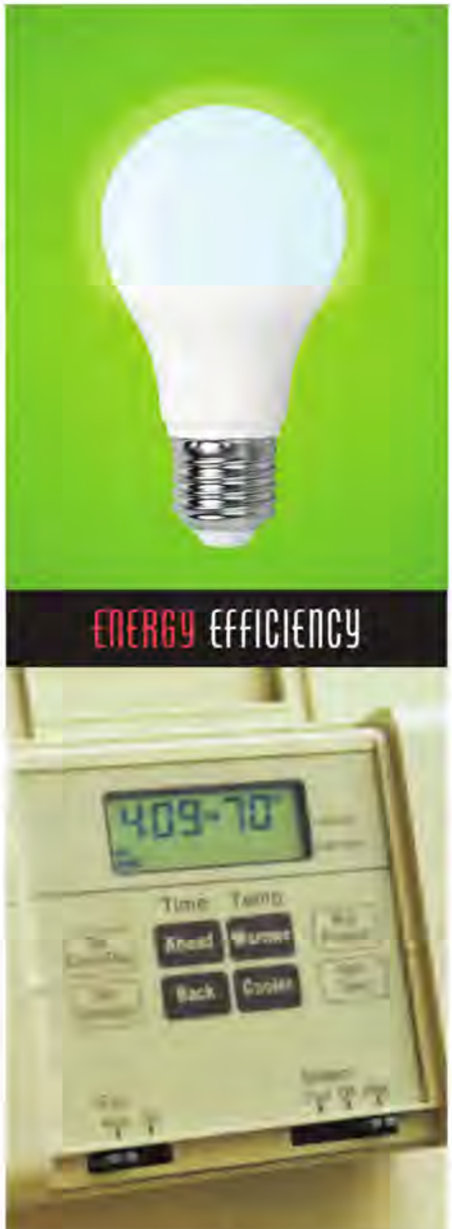
Learn About It...

There is probably not one solution to the problems we face supplying energy. Rather the key is likely to find a mix of new technologies and practices that will help us have enough energy for the future.

Technology

Efficiency

Increasing energy efficiency—that is, using less energy to do more—is an important part of our energy future.



The appliances we use every day eat up a lot of electricity, but they can be—and many have been—designed to consume less. Since 1980, appliances have improved in energy efficiency by 30 to 90%. Today, products that meet strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the Department of Energy earn the Energy Star label. These products have advanced technologies that use 10 to 50% less energy than standard models. Energy Star products include big appliances such as refrigerators, clothes washers, dishwashers, and air conditioners, as well as table lamps and windows.

Other improvements in technology include:

- Smarter thermostats that can cut heating and air conditioning costs up to 33%. Using a microcomputer, these thermostats allow you to divide the day into periods and to program each period with a specific temperature. For example, at 6 a.m., a half hour before you get up on a cold day, the thermostat can increase the heat to a comfortable temperature. When everyone leaves the house at 8 a.m., the thermostat goes back down. Then at 5 p.m., just before people come home, the heat comes back on, until 10 p.m. when everyone goes to bed.
- Light emitting diode (LED) light bulbs can last up to 20,000 hours-20 times longer than a standard light bulb. To get the same light, the LED bulb needs to be just one-sixth the wattage of the standard incandescent bulb, thus using 85% less electricity. These bulbs can replace standard bulbs in table lamps, desk lamps, and ceiling or wall fixtures. They are particularly efficient in lights that will be left on for 3 to 4 hours at a time. LEDs also produce less "waste heat," thus reducing air-conditioning use in warmer weather..

Entire buildings can be made more energy efficient by using these improved technologies and by installing:

- solar roof panels
- skylights
- light sensors that naturally reduce lighting
- separate climate control zones
- low-emission windows that allow in maximum light but minimum heat

The U.S. Green Building Council has established a system to rate the environmental and economic impact of buildings. This Leadership in Energy and Environmental Design (LEED) Green Building Rating System certifies buildings as Silver, Gold, or Platinum. The rating is based on the number of points achieved in areas such as energy efficiency, water savings, content of building materials, and indoor environmental quality. In Southern California, LEED certified buildings include LADWP headquarters John Ferraro Building, the Audubon Center, The Getty Center, the Los Angeles Convention Center, and Metropolitan Water District's Diamond Valley Lake Visitor Center. What other LEED certified buildings can you find?

Energy & the Future

Continued....

CHECK THIS OUT:

Go online to www.ladwp.com and click on the "Go Green" tab to learn more about saving energy and water.

Solar and Other Renewables

Such renewable energy sources as solar, wind, biomass, and geothermal represent only a small part of our current energy supply, but we may need to depend on them much more in the future. By law, California utilities are required by 2020 to have 33% of the electricity they produce come from renewable resources.*

Using renewable sources provides several benefits:

- They are *sustainable*—meaning they will never run out.
- They add fewer pollutants to our air or water.
- They can reduce our dependence on energy from other countries.

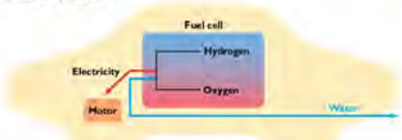
Advances are being made particularly in solar technology. Soon we may have solar cells placed in window panes or glass roofs, turning buildings into micro-power plants!

CONSERVATION

FUEL CELLS

Fuel Cells

Fuel cell technology is often thought of as "space-age" technology because fuel cells have been successfully used in spacecraft to provide electricity. Now the technology can be used to power vehicles, homes, and businesses.



In a fuel cell, no fuel is burned; instead, hydrogen and oxygen are combined to produce electricity. And the only emissions are heat and pure water vapor!

Unfortunately, the hydrogen needed for the fuel cell is very expensive, and it must be stored at high pressure and at an extremely low temperature. But fuel cell systems can include a "fuel reformer," which chemically changes another fuel—such as natural gas, methanol, even gasoline—to hydrogen to power the fuel cell. This process emits some pollutants but much less than using the original fuel.

Fuel cells are being used in some experimental vehicles. They are being designed for use in electric power plants as well as for buildings—hospitals, hotels, manufacturing plants, shopping centers. Eventually, small systems may be used in homes with natural gas supplying the fuel.

Conservation

Even with improved energy efficiency, each of us is still using more energy than we did in the past.

Not only do we have more "things" that use energy—at home and in businesses—but also many of our appliances continue to use energy even when they have been turned off. TVs, DVD players, audio systems, electric toothbrushes, cable boxes, computers—all are "energy vampires," draining electricity while they are just waiting to be used. This "standby power" can add up to almost 10% of residential use and can cost $100 per year per household.

How can you conserve energy?

REMEMBER: complete your Water and Energy Surveys.

To reduce the amount of energy we use, we all need to conserve energy—that is, use it wisely and not waste it. Turning off lights, lowering the water heater temperature, weather stripping around windows and doors, along with other conservation practices, can all help reduce our demand for energy. We'll save money, protect the environment, and increase our supply for the future.

* By 2030, utilities are required to have 60% of the electricity they produce come from renewable resources and 100% by 2045.

Energy Math

Look at the sample electricity bill below to answer the following questions.

LA DWP Los Angeles Department of Water & Power

AUTO PAYMENT
Aug 13, 2018

Page 5 of 11

s Angeles CA 90012

Electric Charges

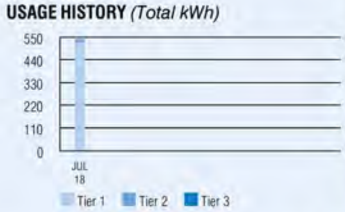
BILLING PERIOD 6/12/18 - 7/27/18 **DAYS** 45 **ZONE** 1

RATE SCHEDULE
R-1 and R-1[i] Residential Electric - Rate A
Standard Service

NEXT SCHEDULED READ DATE
9/26/18

HIGHEST MONTHLY KWH
350.000000 Tier 1

USAGE HISTORY *(Total kWh)*



	Prev Yr	Jul 18
Total kWh used	0	543
Average daily kWh	0	12
Days in billing period	0	45
Your average daily cost of electricity		$2.22

METER NUMBER	CURRENT READ	–	PREVIOUS READ	=	TOTAL USED
00000-00000000	20452		19909		543 kWh

Power Access Charge Tier 1		2.36
Tier 1 Energy	525 kWh x $0.16133/kWh	84.70
Tier 2 Energy	18 kWh x $0.20667/kWh	3.72
Subtotal Energy Charges		**$90.78**
City of Los Angeles Utility Tax - 45 days	$90.78 x 10%	9.08
State Energy Surcharge	543 kWh x $0.00029/kWh	0.16
	Total Electric Charges	**$ 100.02**

1. How many kilowatt hours (kWh) did this customer use during this billing period?
_____ kWh

2. What is the total cost for electricity this billing period (exluding the City of Los Angeles Utility Tax and the State Energy Surcharge)?
$_____

Note: This sample bill covers a partial billing period. LADWP's Residential Billing Period is 60 days.

3. At the bottom of the bill, amounts of energy usage are shown. Please fill in the blanks below:

_____ Number of kWh used in Tier 1
x _____ Cost per kWh in Tier 1
= ______

_____ Number of kWh used in Tier 2
x _____ Cost per kWh in Tier 2
= ______

4. If 45 fewer kWh were used, approximately how much would the bill be?* $_______

5. If 900 more kWh were used, approximately how much would the bill be (assuming that Tier 2 is from 525 to 1575 kWh)?*
$_______

6. Use your "Personal Energy Use Log" and the average cost per kWh on this electricity bill, to figure the cost of all the electricity you used in one day.
$_______

7. Use the figures on the page titled "How much energy do you use?" and the cost per kWh on this electricity bill to figure the monthly (30 days) operating costs of the electrical appliances below.

Stereo 2 hours a day $____per mo.
Television 3 hours a day $____per mo.
Computer 4 hours a day $____per mo.
Refrigerator 24 hours a day $____ per mo.

*excluding PAC and City Tax

A WATER AND ENERGY EFFICIENT HOME

With improved technology and non-wasteful practices that conserve water and conserve energy, you can help

- **protect the environment,**
- **stretch our supply of water and energy,**
- **and save money.**

LA DWP Los Angeles Department of Water & Power

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA