ENERGY ALTERNATIVES

Adapted from the California Department of Education

Overview: Students research and evaluate various energy resources, and participate in a cooperative problem solving activity.

Objectives: Students will be able to…

1. Distinguish between renewable and nonrenewable resources
2. Compare various energy resources
3. Determine which renewable resources show promise in meeting our energy needs
4. Use cooperative skills to determine the energy resources of a hypothetical town

Time: 3 – 5 class periods

Grouping: Whole class and small groups

Subjects: Mathematics, Language Arts

Suggested Grade Level: 6 – 10

Vocabulary: Biomass, fossil fuels, geothermal, hydropower, non renewable resources, nuclear energy, nuclear fission, nuclear fusion, pollution, renewable resource, solar energy.

Materials: Poster board (or butcher paper), paper, pencils, and the following

TRANSPARENCIES:

- A – Energy Resources Classification
- B – Energy Resources used for Electric Generation (in the United States and in California)

STUDENT WORKSHEETS:

- #1 – Energy Resources Study Guide
- #2 – Energy Resources Chart

STUDENT HANDOUTS:

- Energy Source Fact Sheets
- Energy Bits Cards

Advance Preparation: Duplicate appropriate materials.

BACKGROUND INFORMATION

Non-Renewable and Renewable Energy

Energy resources can be classified as nonrenewable or renewable resources. Renewable resources are derived from natural processes that can replenish themselves within a human life span.

Fossil Fuels

Fossil fuels such as petroleum, coal, and natural gas are considered non-renewable because they are consumed at a much faster rate than they are formed. They are called fossil fuels because they were formed from plant and animal life that lived on Earth millions of years ago. Fossil fuels supply most of our current energy needs, especially for transportation, power generation, and home hearing. At the present time, they seem abundant, dependable, and are easily transported. However, their supply is finite, reserves are limited and they contribute to air pollution problems. Also, much of the oil used in the United States is imported. Our dependence on foreign oil can create economic and political problems for our country.

Nuclear Power: Fission and Fusion

Nuclear fuel is also a non-renewable resource. However, very little fuel is needed to generate electricity. Controlled nuclear fission has been used to produce electricity for about three decades. Fission is the process of splitting a heavy atom such as Uranium 235 into smaller fragments. The great quantity heat energy released in this process is used to generate electricity. Problems with radioactive waste disposal and possible radioactive leaks in power plants make this process controversial. Scientists are attempting to create a controlled nuclear fusion reaction which generates similar amounts of energy when light nuclei and combined with heavier ones. Nuclear fusion may use the highly abundant deuterium isotope for fuel and will not produce radioactive waste. However, commercial production of fusion energy is not expected to be developed until well into the future.

Renewable Energy Resources

Power derived from renewable resources includes solar, geothermal, water (hydropower), ocean, wind, and biomass. Some of the technology used to harness the power from these resources is expensive and not fully developed. Their supply in certain areas is unlimited and some are much less polluting than fossil fuels. But in certain cases, they are less dependable. Many are difficult, if not impossible, to transport to areas away from their sources. Some harnessing techniques, like solar collectors or windmills, require large areas to generate adequate amounts of electricity. This affects the aesthetic quality of the environment.

A Balanced Energy System

Planning for adequate energy supplies includes considering factors such as cost, uncertainty of fuel supply, power plant reliability, and environmental impact. A balanced utility system should have a variety of electrical generating technologies that require different fuel, thus preventing vulnerability to shortages of any one particular fuel.

SETTING THE STAGE

1. Display Transparency A. Discuss renewable and non-renewable resources and how they are used.

2. Display Transparency B. Discuss what resources the United States depends on most for the generation of electricity. Discuss what resources California depends on most for its supply of electric power.

3. Ask students how long they think it takes to replace various energy resources. Share the information below. Discuss the significance of energy resources replacement times to our society.

Energy Resources	Replacement Time
Coal	Millions of years
Nuclear (Uranium 235)	Billions of years
Natural gas	Millions of years
Oil	Millions of years
Geothermal steam	Brief
Solar energy (photon)	Brief
Wood (Oak tree)	80 years

NOTE: *Scientists estimate the earth's age to be 41/2 billion years. To help students appreciate the magnitude of resource replacement time, use the following example to convey the quantity "billion." Ask student "How many times do you think one billion pennies, placed side by side, would cross the continental United States?" One billion pennies would crisis-cross the United States approximately four times (16 pennies=1 foot)!*

PROCEDURE

1. Divide the class into groups. Display Transparency A. Each group is to select one or more of the following resources or processes to investigate: geothermal, wind, solar, ocean, biomass, hydropower, wood, petroleum, coal, natural gas, nuclear fission, and nuclear fusion. One group will research "conservation" as an alternative to a resource.

2. Distribute Fact Sheets and Student Worksheet # 1. Encourage students to do additional research in a library or call their local utility company for brochures and information.

3. Groups should be prepared to make oral presentation to the class and illustrate their findings in some way (drawings, photographs, models).

4. Distribute Student Worksheet # 2. Have students fill out the worksheet as groups present their reports.

5. Using information from the class presentations have students answer the following questions:
   - What is the difference between renewable and non-renewable resources?
   - Which resource is the most polluting and least polluting?
   - Which renewable energy resources show promise for the future? Why?
   - Which one could be the most "Valuable" given advances in technology? Why?
   - What would have to happen for it to achieve widespread use?

- Are any renewable energy sources providing significant amounts of energy in their community or state at this time? If so, which ones?

6. Cooperative problem solving: Powersville. Divide class into groups of 6 and distribute one sheet of paper, one pencil, and one set of Energy Bits cards to each group (make sure that each group member receives one card).
   a. Tell groups that they have a problem to solve. Clues on the cards will help them determine the problem and solutions. In order to solve the problem each group member must contribute information from his/her card. They may read their cards out loud, but they cannot show the cards to other group members.
   b. As the groups begin to discuss the problem ask to record process they are using to solve the problem.
   c. When all groups have solved the problem, discuss the questions and answers, (Question: What three energy sources provide power for Powersville? Answer wind, biomass, and oil.)
   d. Ask groups to share the steps they used to reach a conclusion. Discuss how the involvement of each person affected the group's ability to solve the problem.

FOR DISCUSSION

Discuss with students: What considerations (e.g., resources availability) might enter into deciding the resources or combination of resources we should use to produce energy?

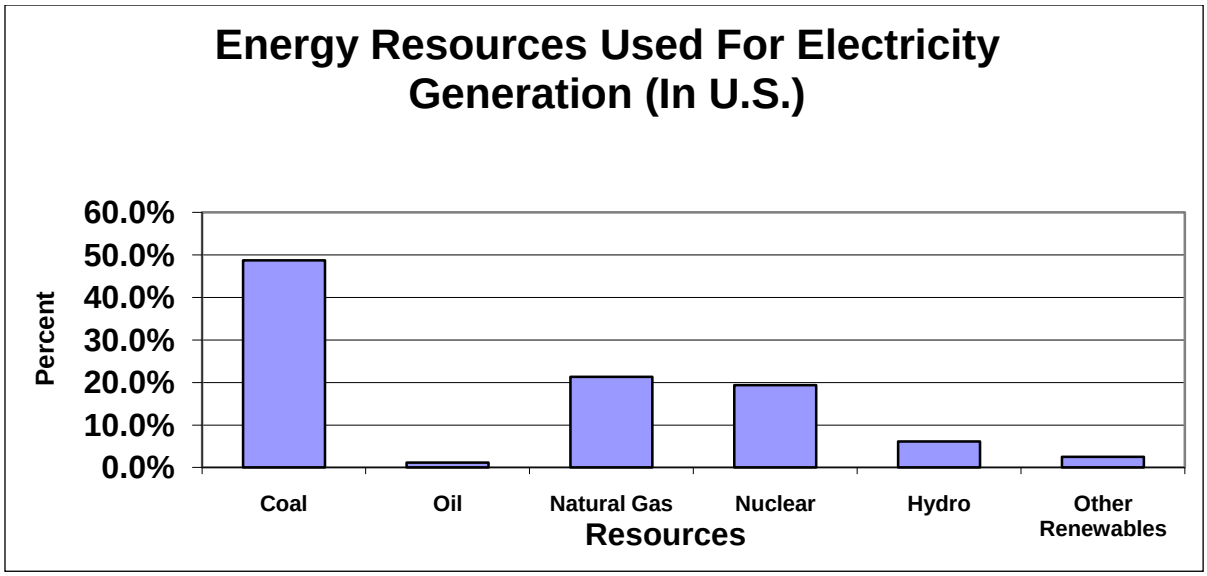
EXTENSION

Have students calculate equivalent measures of each resource and them figure the relative costs of producing equivalent amounts of energy from each resource (see research project at the end of this unit: Energy Equivalence Conversion). For example, one ft3 of natural gas produces 1.020 BTU's. A barrel of crude oil produces 5,800.000 BTU's. It will take roughly 5,686 ft3 of natural gas to produce the same amount of energy as a barrel of crude oil produces. In your area, would a barrel of crude oil cost more than 5,686 ft3 of natural gas?

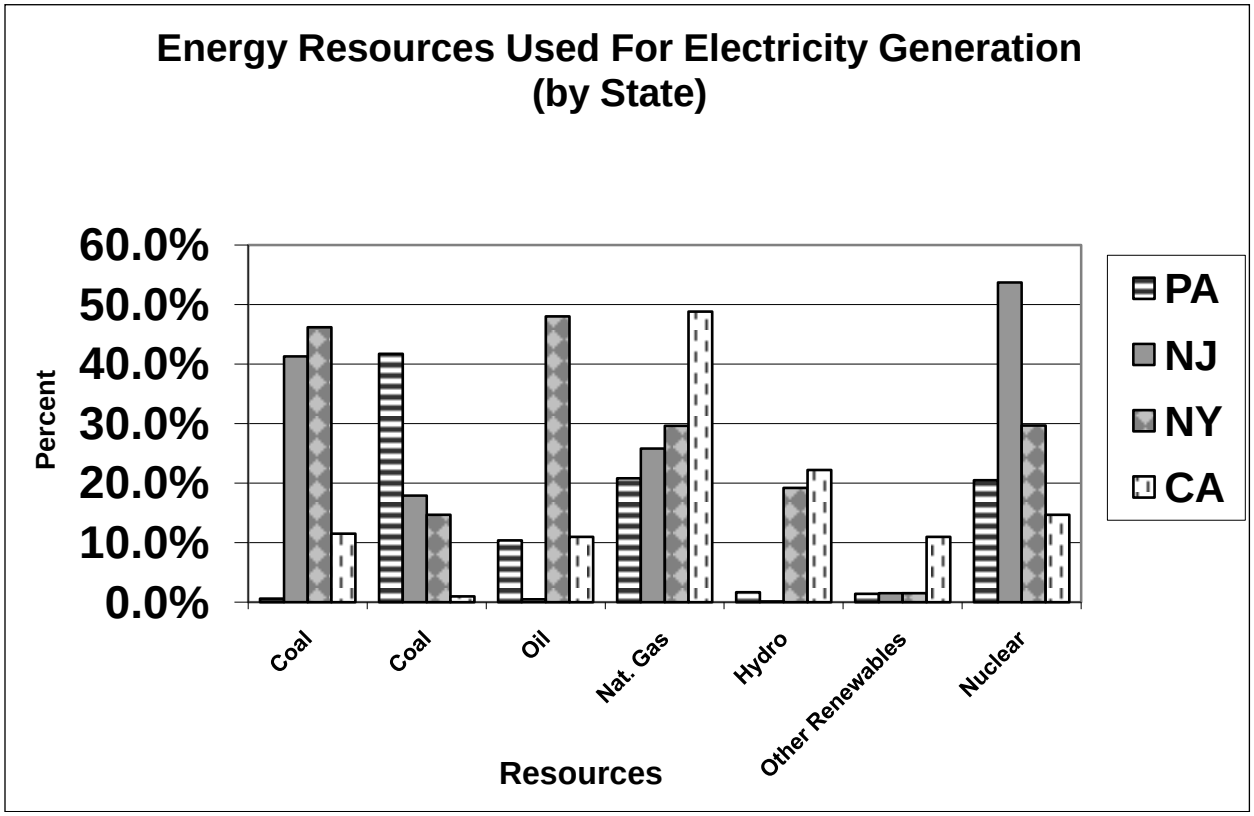
NOTE: *Cost per unit of energy resource will vary, not only geographically, but even from distributor to distributor. BTU's per unit will vary too, depending on the quality of the resource.*

Energy Resource Classifications

RENEWABLE		NON-RENEWABLE	
Geothermal		Fossil Fuels: - Petroleum (oil) - Coal - Natural Gas	
Wind			
Solar		Nuclear Fission	
Ocean Tidal Wave Thermal		Nuclear Fusion	
Biomass Organic Waste (urban and agricultural)			
Hydropower			
Wood			



Source: From Energy Information Administration (2003)
http://www.eia.doe.gov/cneaf/electricity/epm/table1_1.html



Source: From Energy Information Administration (2002)
http://www.eia.doe.gov/cneaf/electricity/st_profiles/pennsylvania.pdf
http://www.eia.doe.gov/cneaf/electricity/st_profiles/new_york.pdf
http://www.eia.doe.gov/cneaf/electricity/st_profiles/maryland.pdf
http://www.eia.doe.gov/cneaf/electricity/st_profiles/california.pdf

Worksheet #1: Energy Resource Study Guide

GROUP MEMBERS _____

DIRECTIONS: Select an energy resource to study, Read the energy source fact sheet, do library research and/or call local power companies to help you answer the following questions:

1. What energy resource are you studying? _____
2. Where does this resource originate? _____
3. How is your energy resource used to produce power? _____
   _____
   _____
4. How is your resource collected, transported, and stored? _____
5. Is this type of energy useful NOW, or is new technology required before it can be used either more effectively and/or more efficiently? _____
6. What are the advantages of using this resource? _____
7. What possible consequences could occur by using this resource? _____
   _____
8. How expensive is it to use? _____
9. How much longer will this resource be available as an energy source? _____
   _____
10. If your energy resource is not commonly used, when might it be both energy-efficient and cost-effective? (approximate year) _____
11. What type of energy resource does your community use to produce electricity and to heat homes?
12. Describe two interesting facts you learned about your resource:
    _____
    _____

Worksheet #2: Energy Resources Chart

Name _____ Date _____

SOURCE AVAILABLE?	HOW IS THE ENERGY PRODUCED	IS IT: EXPENSIVE? INEXPENSIVE?	LIST ANY POSITIVE ASPECTS	LIST ANY NEGATIVE ASPECTS
1. Geothermal				
2. Wind				
3. Solar				
4. Ocean				
5. Biomass				
6. Hydropower				
7. Petroleum				
8. Coal				
9. Natural Gas				
10. Nuclear Fission				
11. Nuclear Fusion				
12. Conservation				

Energy Source Fact Sheet

GEOTHERMAL ENERGY

Geothermal energy is heat from the earth. Scientists believe that the mantle of our planet is a large mass of molten material, called magma. It may have a temperature of 8000° F. In most places on earth, the magma is many miles below the ground, but at some locations, it comes close to the surface, and it creates hot spots. When ground water comes in contact with these hot spots, the water turns to steam. The geysers and hot springs in Yellowstone
National Park are examples of geothermal energy.

Geothermal steam, or hot water, provides power to generate electricity. The steam is collected and transported through pipes to power plants. The steam can also be piped to buildings for heat. Geothermal fields in Northern California generate enough electricity to serve a city approximately the size of San Francisco.

There are some concerns about using geothermal energy when steam is taken from the ground, as large amounts of water are often taken with it. If the water has a high mineral content, it corrodes and clog pipes and turbines. The water removed must be injected back into the water table to avoid causing sinking of the surrounding land. Some people fear that the injection and withdrawal of water may cause earthquakes.

Geothermal energy contaminates the waste water, making it more difficult for disposal. The release of steam and hot water under pressure also causes noise (similar to a jet plane taking off).

Geothermal energy is renewable. It does not affect the land the way mining does, nor does it have the waste problems of fossil or nuclear fuels. The United States has 1.8 million acres of land where geothermal energy is known to exist in various forms. This leads to the belief that geothermal energy may eventually become an important source of electricity. Geothermal output, all located in the West, is projected to increase from 13 billion kilowatt-hours in 2002 (0.3 percent of generation) to 47 billion in 2025 (0.8 percent). Source: Energy Information Administration
(http://www.eia.doe.gov/oiaf/aeo/electricity.html#elerene)

Energy Source Fact Sheet

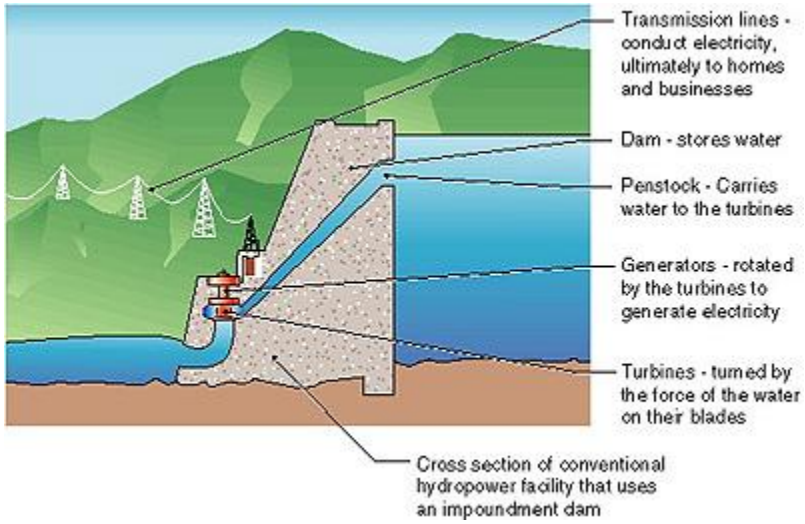
HYDROPOWER

Hydropower uses falling water to turn a turbine to make electricity. The water can be collected by constructing a dam or by using natural waterfalls, lakes, streams, and rivers. Water is channeled through canals, flumes, chutes, aqueducts, pipelines, or rivers. It is stored in reservoirs.

Water is a renewable resource, and hydropower does not create air pollution. If natural waterfalls (no dams) are used, very little environmental damage is created. Where water is available, generating hydroelectric power is fairly inexpensive.

There are several disadvantages to using hydropower. Damming buries large amounts of agricultural land and destroys animal habitats. Often, the lake behind a hydroelectric power dam starts filling with sediment and is slowly rendered useless. It reduces the natural flow of sediment to the oceans, thus reducing the amount of sand for beaches. In addition construction of dams is expensive and there is a possibility of hazard to life and property if a dam breaks.
Finally, damming significantly effects fish by blocking upstream fish movements and prevents anadromous fish (e.g. salmon), and some resident fish, from returning to their spawning areas.

There are additional forms of hydropower that do not use large dams and have a less profound environmental impact. One additional form is a diversion facility, sometimes called *run-of-river*, which channels a portion of a river through a canal or penstock. Another form, called micro-hydro, can produce enough energy for a home, farm, or village. For more information on hydropower: http://www.eere.energy.gov/windandhydro/hydro_plant_types.html .



Energy Source Fact Sheet

OCEAN POWER (TIDAL WAVES AND THERMAL)

Tidal ocean power is possible along a coast where there is significant difference in the high and low tide. Incoming and outgoing ocean currents turn turbines to generate electricity. At high tide, water flows through turbines into a bay, and during low tide, it flows back out. Only a few places in the world have enough variation in tides to generate electricity efficiently. Conversion to energy is possible only during tidal flow (about three hours, twice a day, along the Pacific coast).

Waves can generate electricity by forcing water through valves in pipes into a tank above sea level. This water turns a turbine on its way back to the sea. Floats can be mounted along the shoreline, and connected to the shore by a long boom. The up-and-down motion of each boom turns a generator. The power created by wave action can be stored as hydrogen gas, in tanks, and in batteries for electrical storage.

Temperature differences can be a source of ocean power. Sunlight warms the tops layer of water in the ocean. In some parts of the world, surface water temperature is 80° F or higher. But the deep lower layers of water usually have a temperature of about 40° F. This difference in temperature can be used to drive a turbine generator power plant. An example of how this works is as follows:

1) The process begins with the ammonia in liquid form, at a temperature of 40° F. Warm seawater at the surface heats the liquid ammonia to a temperature of 80°F. This heating turns the ammonia into an expanding gas.

2) The expanding gas rushes through the turbine, making it spin. The turbine is connected to an electric generator. As the turbine spins, so does the generator, thus producing electricity.

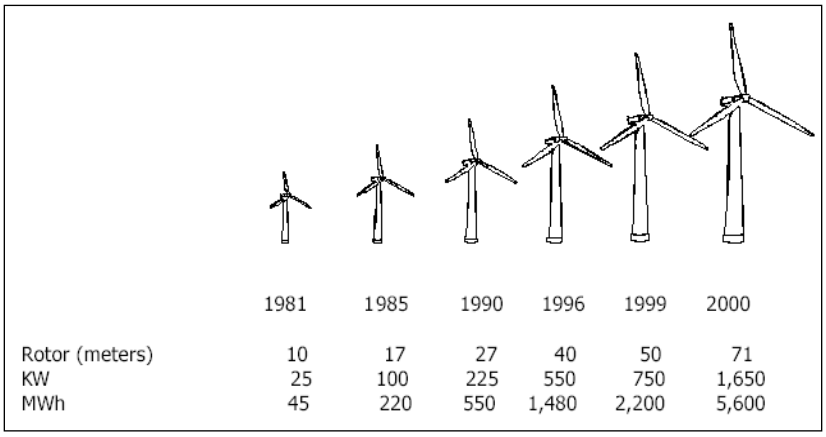
3) Cool seawater, from the deep, chills the ammonia gas and turns it back into a liquid. The cycle then repeats once again.

Ocean power produces little or no air pollution and has little negative effect on the environment. However, since generating plants are built on beach areas, restrictions on recreation and fishing are necessary near the plants. Transmission of power from ocean sites is difficult. In addition, the present costs for ocean power are almost twice as much as conventional power plants.

Energy Source Fact Sheet

WIND POWER

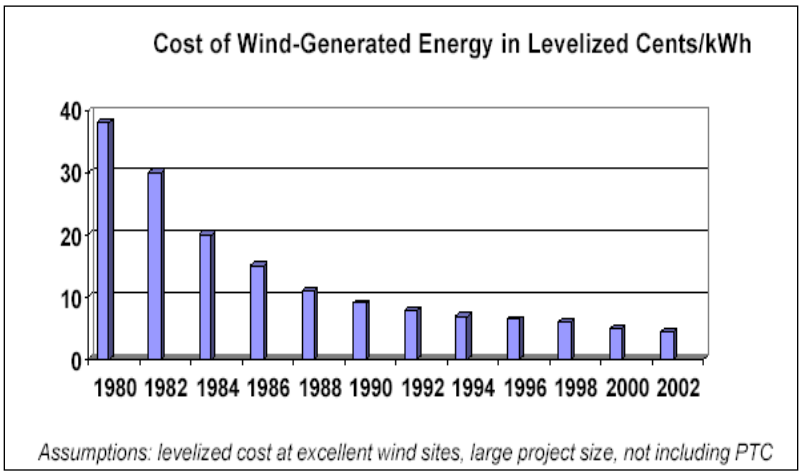
For over 4,000 years, wind has been used to produce power for pumping water, milling grain, and moving vehicles such as boats. Wind is produced by daytime heating and nighttime cooling of the atmosphere. Windmills, sails, and wind turbines are used to harness wind power. This is transported by wire, (when used to produce electricity) and by pipe, truck, or ship (when used to produce hydrogen).



	1981	1985	1990	1996	1999	2000
Rotor (meters)	10	17	27	40	50	71
KW	25	100	225	550	750	1,650
MWh	45	220	550	1,480	2,200	5,600

Wind turbines vary in size. The following chart depicts a variety of turbine sizes and the amount of electricity they are each capable of generating (the turbine's capacity, or power rating).

Over the last 20 years, the cost of electricity from utility-scale wind systems has dropped by more than 80%. In the early 1980s, when the first utility-scale turbines were installed, wind-generated electricity cost as much as 30 cents per kilowatt-hour. Now, state-of-the-art wind power plants can generate electricity for less than 5 cents/kWh in many parts of the U.S., a price that is in a competitive range with many conventional energy technologies.



Wind energy could supply about 20% of the nation's electricity, according to Battelle Pacific Northwest Laboratory, a federal research lab. U.S. wind resources are vast -- wind energy resources useful for generating electricity can be found in nearly every state. North Dakota alone is theoretically capable (if there were enough transmission capacity, storage capability, etc.) of producing enough wind-generated power to meet more than one-third of U.S. electricity demand.

Wind energy system operations do not generate air or water emissions and do not produce hazardous waste. Nor do they deplete natural resources such as coal, oil, or gas, or cause environmental damage through resource extraction and transportation. Wind's pollution free electricity can help reduce the environmental damage caused by power generation in the U.S. and worldwide.

Energy Source Fact Sheet

BIOMASS OR ORGANIC WASTE AND REFUSE POWER

The people of American throw away about 94 million tons of solid waste each year. If you add the solid waste produced by farming, farm animals, and industries, such as logging and paper making, the total climbs 850 million tons.

This trash can be converted to energy. For example, burning trash can produce heat, but flammable materials are only part of the story. Organic waste (such as food scraps) can be transformed into methane gas, the chief component of natural gas. In this way, garbage can help supplement the nation's dwindling natural gas supply.

Urban and agricultural waste can be transported by trucks and sewer systems. The organic waste can be stored in dumps, produced in sewer treatment plants, and burned in municipal garbage incinerators.

Disadvantages of this energy source include controlling air pollution from burning the waste products. Use of trash also requires large areas of land, and the initial equipment cost is high. The conversion of refuse to fuel is more expensive than present waste disposal techniques and offshore exploration for natural gas. However, the cost of building municipal methane plants and family-size converters would be offset by the production of a usable fuel.

Since "trash" fuel is abundant, the energy potential from waste could be expected to provide up to 10% of our electrical needs. Ideally, every city sanitation operation in the country could include a methane converter facility. A family-size garbage converter attached to the house could provide much of the fuel needed for home use (cooking and heating).

Production of methane gas from organic waste and refuse could provide needed energy and would help to dispose of waste materials. For both of these reasons, many experts predict that waste conversion will become very popular in the years ahead. Methane can be used as an energy source in many ways. Most facilities burn it in a boiler to produce steam for electricity generation or for industrial processes. Two new ways include the use of microturbines and fuel cells. Microturbines have outputs of 25 to 500 kilowatts. About the size of a refrigerator, they can be used where there are space limitations for power production. Methane can also be used as the "fuel" in a fuel cell. Fuel cells work much like batteries but never need recharging, producing electricity as long as there's fuel.

Energy Source Fact Sheet

COAL

Coal is a fossil fuel. Scientists believe that coal was formed from dead plants and animals whose organic material was converted to coal by heat and pressure. (It takes about 25 million years for coal to be formed).

Coal is found throughout the world. It is mined underground and in open pits (surface mining) where the soil is stripped (like peeling an orange). A federal law passed in 1977 requires the restoration of all surface-mined land. Once mined, coal is transported by railroad, truck, barge, or freighter, and is more difficult and costly to transport than oil or gas.

Coal has long been used as a fuel for electric power plants. Many years ago, coal was a popular fuel for heating homes. But coal is not as convenient a fuel as oil or natural gas for the following reasons:

1) The furnaces needed to burn coal are more complicated.
2) Strip mining destroys surface environments. The acids formed from leftover sulfur pollutes streams and ground water.
3) Pollution from ashes, sulfur dioxide, carbon dioxide, and carbon monoxide contribute to smog and acid rain.
4) A large majority of the world's scientists think that increased amounts of carbon dioxide and other greenhouse gases in the atmosphere are contributing to a warming of the Earth's surface temperature, commonly referred to as "global warming," but to what extent is difficult to determine at the present time.
5) Present pollution control methods are very expensive.

For these reasons, scientists are searching for practical ways to convert coal into liquid fuel and gas. Liquid fuel made from coal could be used in place of heating oil. It could also be made into gasoline for cars and coal could be also be made into gasoline for cars and kerosene for jet planes. Gas produced from coal could mixed with natural gas for home heating and industrial use.

Energy Source Fact Sheet

SOLAR ENERGY

The sun provides the energy for plants to photosynthesize, thus providing animals with food and oxygen. It also heats the land and waters and causes winds, rains, and ocean currents. This energy source can also be used to provide heating for homes or used to generate electricity.

Scientists estimate that the sunlight falling on the United States during a single summer day contains twice as much energy as the nation uses in an entire year! Energy from the sun can be used directly or indirectly. For example, sunlight can be transformed into heat and electricity, or the effects of sunlight (i.e. wind and warm water) can be used as energy sources.

Solar energy has many advantages:

- It is an inexhaustible source of energy that will last as long as the sun itself.
- It is available in the United States: it does not have to be "imported."
- It is a clean source of energy: it does not create air or water pollution.

But solar energy also has serious disadvantages:

- Solar energy "turns off" at night and during cloudy weather.
- Solar energy is at its weakest during the winter months, the time of year when homes and factories need energy the most.
- It is cumbersome. Solar cells can directly convert sunlight into electricity. But, since a single cell produces only a small amount of electricity, many cells must be linked together in large panels. In addition, in order to gat her sufficient amounts of solar energy, large collectors must be built which occupy large areas of land.
- The equipment needed to collect solar energy is quite expensive. Using active solar heating on a small scale for individual homes is relatively inexpensive, but using solar cells to generate electricity on a large scale (based upon present technology) is still "significantly" more expensive than using conventional nuclear-fueled plants. However, the potential benefits of solar energy outweigh its shortcomings. Major research programs are presently being conducted, worldwide, to make solar energy practical.

Energy Source Fact Sheet

NATURAL GAS

Natural gas, a fossil fuel, is colorless and odorless, and has a high concentration of methane. It is located in underground deposits, and is often found when drilling for crude oil. Usually, natural gas does not need to be pumped because the gas rises to the surface of the earth naturally. It is transported in pipelines or by gas tankers (trucks, railroad, ships). It is stored as a gas or liquid in above the ground storage tanks or in underground wells.

Natural gas is used as fuel to heat homes and industries and to generate electricity. Some detergents, drugs, and plastics are made from natural gas.

As a fuel, natural gas is comparatively clean and in expensive. It has the least environmental impact of any fossil fuel. A field can yield about 90% useable natural gas and little processing is necessary after it comes out of the ground. Estimates suggest that supplies may be expected to last from 60to 200 years at current world production and use rates.

Natural gas is dangerous to breathe in heavy concentrations and it is also very flammable. When used in large electrical power plants, it causes some air pollution which includes the production of nitrogen oxides and carbon dioxide. A majority of the world's scientists think that increased amounts of carbon dioxide and other greenhouse gases in the atmosphere are contributing to a warming of the Earth's surface temperature, commonly referred to as "global warming," but to what extent is difficult to determine at the present time.

There are several alternative methods for obtaining natural gas. For example, liquefied natural gas can be imported from foreign sources. However, this would mean building expensive tankers which would increase the price of gas. Gasifying coal (changing coal into gas) can produce gas, but the cost of this conversion is very high. Scientists can also produce usable methane gas from organic trash and garbage.

Energy Source Fact Sheet

NUCLEAR FISSION

Nuclear fission is a process whereby an atomic nucleus is split into two or more fragments to release energy in the form of heat. In the U.S. nuclear power plants, uranium 235, thorium, and plutonium are used in controlled nuclear reactions. Uranium and thorium are mined from the ground, then processed and enriched. Plutonium is produced as a by-product in nuclear reactors.

Nuclear fission produces heat energy. This is used to boil water, making steam to run turbines, which turns generators to make electricity. Other uses of nuclear power include desalting seawater, making hydrogen, coal gasification, and functioning as power plants for ships and spacecraft.

Nuclear fission is an efficient energy source. The cost to produce electricity by nuclear power plants is about the same as coal and lower than oil and natural gas. A single ounce of uranium in a nuclear reactor produces more energy than 90 tons of coal. In addition, a special type of reactor, called a breeder reactor, produces more fuel than it consumes. It actually converts non-fissionable uranium atoms into fissionable plutonium. Relatively small areas of land are needed for nuclear power plants. Under normal conditions, nuclear plants release only a small amount of air pollution.

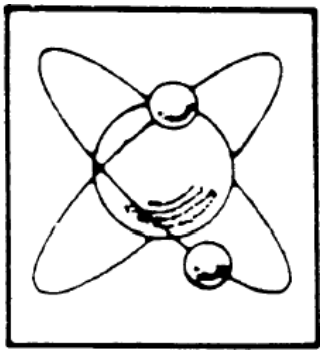
There are disadvantages to using nuclear power. The material which remains after fission is radioactive (it releases radiation). This waste product must be kept away from living things for thousands of years (depending on the treatment of the waste before storage). If the nuclear reactor core overheats, it could melt, releasing radioactive material. The water intended to cool the core, could change to steam causing the protective shell to break and spread radioactive material into the environment over a wide area. Safe transportation and storage of radioactive material is an important issue.

Currently, nuclear power plants produce approximately 10% of our electricity needs. The U.S. has nearly 30% of the world's uranium reserves and thus has control of a large percentage of this resource. It is estimated that worldwide uranium resources should last to the year 2030. This could be extended for hundreds of years by using breeder reactors.

Energy Source Fact Sheet

NUCLEAR FUSION

In a fusion reaction, light atoms (such as two types of hydrogen isotopes; deuterium and tritium) are forced together under great pressure. During this change, large amounts of energy are released. This energy could then be used to generate electricity. Unfortunately, present day technology has not allowed scientists to develop fusion reactions because of the extremely hot temperature required. (No container can withstand 50 million degrees centigrade, the same temperature as the inside of the sun.)



The hydrogen isotopes needed as fuel are separated from water or sea water. Therefore, the supply is almost limitless. Thus, if fusion techniques can be developed, there would be enough fuel on earth to produce energy for millions of years. This power would be generated almost pollution free with no threat of nuclear explosion and only a small amount of radioactivity. Nuclear fusion releases approximately 10 million times as much energy per gram as the burning of fossil fuels.

Nuclear fusion is still in the research stage. Because of many technical problems, nuclear fusion is not a solution to the energy needs the immediate future.

Energy Source Fact Sheet

PETROLEUM (OIL)

Petroleum (crude oil) is known as a fossil fuel because it is composed of the remains of plants and animals which lived millions of years ago.

Oil is found in underground deposits through out the world and in some locations under the sea floor. The oil is brought to the surface by drilling and pumping. Once out of the ground, oil is easy to transport to processing plants by pipelines and oil tankers, and is stored in special storage tanks.

Petroleum is burned to release its energy. It can be used to generate electricity, to produce mechanical energy, and to provide fuel for transportation and heating. Although petroleum is relatively expensive, it is a favored source of energy because it is easy to remove and transport.

There are many disadvantages to using petroleum as a major energy source:

- There is a danger of oil spills (in oceans, lakes, streams, and on land) when drilling for oil or during its transportation.
- Burning oil produces air pollution. Motor vehicles account for almost half of the country's air pollutants by emission of carbon monoxide, hydrocarbons, and nitrogen oxides. Oil burning power plants and industry produce almost 20% of the air pollution.)
- It is a non-renewable resource. If we rely on the available resources in the United States, we only have enough oil to last 35–40 years. The current American use of oil requires increasing imports from the Middle East and Central and South America. Importing oil causes American dollars to be spent out of the country and requires construction of oil supertankers with offshore ocean terminals.

Oil shale (a limestone-like rock that is heated to release its oil) could be used to increase petroleum supplies. However, mining the oil shale has negative effects on the land near the mine sites and requires large quantities of water in the process.

CONSERVATION

Conservation is an alternative source of energy that is free and easy to implement. In order for conservation to be successful, people must learn to use less energy and use it more efficiently. Each person must recognize that supplies of fossil fuels are limited, and there major disadvantages (including the serious environmental effects) of other energy sources.

There are no negative consequences of energy conservation except the possible initial cost of home improvements. An example would be the insulation of homes and buildings. However conservation usually saves money in the long run. "Saved energy" which, can be used in the future, is cheaper than producing new energy. Because conservation is an individual act, there is no danger of this energy supply being cut off by foreign governments or by changes made in federal rules.
Conservation will only work if everyone committed to the cause of using our resource efficiently.

Energy Bits

YOU MAY READ THIS CARD TO YOUR GROUP, BUT DO NOT SHOW IT. **1** • The town of Powersville is located on the windy north coast California. • A large city, San Ninos, is located 100 miles south of Powersville. • Some beaches by Powersville were blackened by an oil spill.	YOU MAY READ THIS CARD TO YOUR GROUP, BUT DO NOT SHOW IT. **2** • The City of San Ninos sends it garbage 100 miles up the coast. • Powersville does not have geothermal fields. • All appliances in Powersville homes are electric. There are no gas stoves or water heaters.
YOU MAY READ THIS CARD TO YOUR GROUP, BUT DO NOT SHOW IT. **3** • A large area of land is needed for one of the energy generating plants. • Last year, the citizens of Powersville voted against the building of a nuclear power plant in their area. • There is a large plant in Powersville that manufacturers rubber, plastics, and polyester fabrics.	YOU MAY READ THIS CARD TO YOUR GROUP, BUT DO NOT SHOW IT. **4** • Many people in Powersville own sailboats. • No major rivers are located near Powersville. • The problem to solve is: What 3 energy sources provide power for Powersville?
YOU MAY READ THIS CARD TO YOUR GROUP, BUT DO NOT SHOW IT. **5** • A large cattle yard is located close to the town of Powersville. • Powersville is covered by fog most of the year. • Some Powersville citizens are complaining about the destruction of the aesthetic quality of nearby hills.	YOU MAY READ THIS CARD TO YOUR GROUP, BUT DO NOT SHOW IT. **6** • There is not a large difference between high and low tides in Powersville's coastal area. • Powersville is surrounded by land that a used for grazing. • The town of Powersville does not have a refuse dump.