Energy is defined as "the ability to do work"

It is extremely important to understand energy, where it comes from and how we use it. Without it we would be unable to run our lights, watch television, play a CD, or heat our homes. It is mind boggling to think of how many things in our society depend on energy to function. Let's take a look at different sources of energy and where they come from.
The 6 sources of energy are solar, fossil fuel, wind, hydropower, geothermal, biomass, and nuclear.

Fossil Fuels
Oil and natural gas were formed from the remains of marine animals & plants that lived in the seas some 100 to 300 million years ago. Gradually, the layers of decayed plants and animals trapped between the layers of sedimentary rock changed chemically. Bacteria, heat and pressure transformed the decayed material into natural gas or oil. Coal was formed when seeping water cut off the oxygen supply to the plants trapped in layers. The plant matter remained undecayed and eventually built up into a spongy substance called peat. Over time, the peat was buried deeper and changed by heat and pressure into a hard black material (coal). These changes all took place over millions of years.
Oil and gas seeped through the holes in the porous rocks (sandstone and limestone) and became trapped when it reached the layer of nonporous rock (shale) far beneath the ground. Coal occurs in seams between sedimentary layers at various depths. The coal seams are generally mined from a thickness of two and a half to six feet.

Oil
Oil is found in many parts of the world. The largest reserves are in Saudi Arabia. Other major reserves are found in the North Sea, the Alaskan North Slope, the lower forty eight states, Venezuela, Mexico, the Persian Gulf, and the former Soviet Union. The United States has become very dependent on imported oil.

Besides gasoline for our cars, many other products are also made from oil.
Oil and natural gas are prospected and drilled for in basically the same ways.
After a site is chosen, steel tower, called a derrick is erected. A bit on the end of drill pipe digs into the earth through layers of rock. As the bit drills deeper, more pipe is added. A special mixture of clay, chemicals and water (drilling mud) is pumped down the well that has been drilled, cooling the drill bit and washing away rock fragments. The rock chips are collected and analyzed to tell what is happening at the bottom of the well. Steel pipe, called casing, is used to line the well so the sides won't cave in. Tubing is run through the casing so the oil will have a way to get to the surface. Wells on an average, are about 6,000 feet deep. It can cost millions of dollars to drill a well.

Meters and valves control and measure the flow of oil. Sometime, pumps must be used to bring oil to the surface if the natural pressure is not strong enough. The oil passes through a separator which removes gas and water before it is pumped into gathering tanks where it

is stored until it is transported to a refinery.

Pipelines, trucks, trains, or ships are used to transport oil to a refinery where it is heated until most of it turns vapor. In a fractionating tower the hot vapor is separated and converted from crude oil into consumer products. Oil is measured in barrels (one barrel is 42 gallons).

There are many regulations and safeguards to make the petroleum industry more environmentally sound. Emissions allowed into the atmosphere and pollutants discharged into waters are monitored. Lands are restored after drilling, an precautions are taken in transporting crude oil. Still accidents happen. New technology and stricter standards could reduce environmental risks. Automobiles, the primary oil consumers, as well as homes and industries, spew carbon monoxide and carbon dioxide and sulfur into the atmosphere when petroleum is combusted. Conservation, here, is the key - reducing use, thereby, reducing emissions.

Natural Gas
Natural gas consists primarily of methane, a colorless, odorless, flammable gas. Mercaptan, an unpleasant odor, is added during production for safety so natural gas can be detected in the atmosphere. Methane is the simplest of the hydrocarbons. Natural gas contains small amounts of other gases also, including ethane (used as a refrigerant and fuel), propane (used as a fuel, refrigerant and solvent), butane (used as a fuel), and pentane (used as a solvent).

Natural gas is found with oil about 18% of the time. Some of the largest concentrations of natural gas are found in older, deeper geologic formations at higher temperatures than are suitable for oil. Natural gas is also found in coal seams.
Natural gas is most commonly used to heat homes, offices and provide power to industries. Natural gas is also burned to generate electricity. A more recent use is as a non-polluting transportation fuel (instead of gasoline).

Geologic areas are assessed in different ways to determine favorable sites for finding natural gas. Magnetic measurement, satellite imagery, gravity mapping and reflection seismology are all methods of evaluating surface structures and patterns that indicate the presence of sedimentary rock layers.

Coal

Deep mines with tunnels have been dug over time. There are many dangers, even today with modern technology and safety precautions. Many coal mines are more than one half mile deep. In early days, miners carried coal out of the mine on their backs. Today, coal is put on conveyor belts or carried on mine trains to the mine shaft. Electric powered skips take as much as 22 tons of coal at a time to the surface.

Most of the coal mined, transported by rail car, is used by power plants to make electricity. The coal is used to heat water to make steam. The steam is forced through turbines to make electricity.

Coal is used to make a number of other products as well. Adhesives, explosives, fertilizers, cleaners, road tar, detergents, and cosmetics are some. Gasoline can even be made from coal. The waste products from coal are used in making brick and filling holes in roads.

Coal contains a substance called sulfur that makes a gas called sulfur dioxide when burned. This gas is harmful to breathe. Tall chimneys on power plants send the harmful fumes high into the air away from people. The amount of carbon dioxide in the upper atmosphere increases with the burning of wood or coal. These increases contribute to the greenhouse effect. Conservation, again, is essential in reducing the pollution associated with burning coal.

Some coal is strip mined when it is near the surface. Miners strip away the earth on top and dig away the coal underneath. Top soil can be returned to the site which can then be farmed or restored to its natural state. Strip mining is safer and less expensive but there are some environmental drawbacks.

When we burn fossil fuels, we are burning fuels that cannot be replaced, they are nonrenewable. If used at the same rate as today, it is estimated by some that oil and gas supplies will only last another hundred years. The coal supply is much larger and will last longer if used wisely.

Nuclear Energy

Nuclear energy comes from atoms. When the nucleus of an atom is split apart (fission) it releases a great amount of heat and light energy. When let out slowly, this energy can be harnessed to produce electricity. When let out all at once it causes an explosion or bomb.

Nuclear power plants use a rare metal dug out of the ground, uranium, to produce energy. In the production of this energy nuclear radiation is produced which is deadly to people. Nuclear power plants are easily identified by the thick concrete buildings used to prevent a dangerous radiation leak.

In 1942, Dr. Enrico Fermi assembled enough uranium to cause a nuclear fission reaction. Nine years later, in 1951, the first electric power was produced from the atom, when an experimental reactor lit up four light bulbs in laboratory experiment.

Some anti-nuclear groups continue to advocate shutting down the nuclear plants immediately. They argue the move would save money for ratepayers over the long term because nuclear plants pose safety problems that could be very expensive to resolve. For instance, an accident like the one that occurred at the Chernobyl plant in the former Soviet Union could cost hundreds of millions of dollars. In addition, they say the long-term storage costs of radioactive waste are too expensive.

Nuclear power proponents point out that when operated correctly, nuclear plants emit little or no carbon dioxide. And they say that the plants will save ratepayers money over the long term because the fuel costs for nuclear power plants are far less than fuel costs for conventional fossil fuel plants.

Geothermal Energy

The earth's core is very hot -7,000 - 8,000 degrees Fahrenheit. Geothermal energy is the internal heat of the earth. "Geo" means earth and "thermal" refers to heat. That heat is the result of radioactive decay, chemical reactions, friction from the movement of the earth's crustal plates and heat leftover from the formation of the earth.

Heat from the molten rock (magna) deep beneath the earth's surface produces hot water and steam when pressure builds up and is brought to the surface through heated, permeable rock. Volcanic eruptions and geysers are examples of geothermal energy.

There are three basic forms of geothermal energy:

1.Hydorthermal - composed of naturally circulating hot water and steam trapped in porous rock near the earth's surface.
2.Geopressurized - a mixture of hot water and methane trapped in sedimentary rock far beneath the earth's surface.
3.Hot Dry Rock - formations containing very hot rock and little water.

Since prehistoric times geothermal energy has been used directly for cooking and bathing. Today, hydrothermal resources supply millions of people with clean, low cost electricity. Most of the country's geothermal resources are located in the western United States. It is a very important source of energy in Iceland and New Zealand.

Geothermal Power Plants

In some places hot water reaches the surface naturally and power stations are established there. But, large deposits trapped and can only be obtained by drilling into the porous rock.

Hydrothermal power plants are built in places where hot water is located near the Earth's surface. A pipe is drilled into the rocks to allow steam to escape to the surface, where it is used to drive and generate electricity. Waste water is pumped back down into the ground. With current technology, hydrothermal reservoirs are the most desirable type.

The Future

Our present knowledge of promising geothermal sites depends on visual evidence like geysers and hot springs. Current technology is not very sophisticated and drilling is complicated and expensive. There are promising geothermal "hot spots" world wide that require further technological developments, commitment and money.

Biomass

Organic materials, in the process of being eaten, burned or decayed, transfer their energy.

Crops like corn and sugar are grown and converted into ethanol (ethyl alcohol - made by the fermentation of grain). 10% Ethanol combined with 90% gasoline makes gasohol - one way to help stretch fossil fuel supplies. Fuel can be produced by converting wood into a methane rich gas.

Garbage, or organic waste, has potential as an energy source. As waste in landfills breaks down, it releases a gas called methane into the air. When collected and burned, methane can be used to heat water and make electricity. About 16% of the 870 million tons of refuse produced in the United States each year could easily be converted into fuel providing the equivalent of 150 million barrels of oil. Garbage can also be converted into fertilizer and soil conditioner through composting.

While biomass is an exciting alternative energy source, it takes energy to produce the things that become our waste. Conservation still saves more energy than recycling or converting waste to energy.

Wind Energy

About 12,000 years ago Egyptians figured out how to use the wind's power and patterns to move sailing boats. The first windmills were used by Persians about 1,300 years ago. Windmills have been used to pump and drain water, grind grain, and saw wood. Wind energy is now used to make electricity.

Today's windmills have evolved into sophisticated machines. Some look like huge fans with two or three blades. Each blade can weigh up to 4,500 pounds range from 20 to 70 across and 80 to 140 feet tall. The "Darrieus" wind machine looks like a giant egg beater. It stands 100 feet tall and is about 50 feet wide.

Whatever their shape or size all wind machines work essentially the same. Wind spins the blades on a wind turbine. The blades are attached to a hub that is mounted on a turning shaft. The shaft goes through a gear transmission box where the turning speed is increased. The transmission box is attached to a high speed shaft which turns a generator that makes electricity.

Wind speeds must be above 12-14 miles per hour to turn turbines fast enough to make electricity. If the wind is blowing too high, the turbine has a brake that will keep the blades from turning and being damaged. As of 1994, there were 14,577 wind turbines in California. Grouped in wind farms in 3 areas of the state, they made enough electricity to supply a city the size of San Francisco with power. Texas has a very high wind energy potential - enough to meat roughly 10% of the nations 1990 electric power needs. Ultimately, West Texas could be the largest center of renewable energy in North America.

Hydropower

Moving water is an important source of energy. Centuries ago the Greeks built watermills by rivers and used them to grind wheat into flour. The power of water was one of the first methods used to generate electricity. The first hydroelectric plant was built at Niagara Falls in 1879. In the following decades, many more hydroelectric plants were built. At one time up to 33% of this country's electricity was provided hydrogeneration. By the late 1940's most of the best hydropower sights had been developed and fossil fuels were being used to generate electricity - much more cheaply than hydropower. With the oil crisis of the 1970's and concern for the environment came a renewed interest in hydropower.

Hydroelectric dams are built on rivers to control the flow of water and to provide a reservoir. Water in a reservoir is stored energy. A hydro plant uses the force of falling water to make electricity. The greater the water pressure, the greater the power of the water.

To make electricity, the gates of a dam are opened. Water flows through the gates into pipes called penstocks. The water spins a wheel with blades called a turbine, which drives a generator producing electricity.

The biggest advantage of hydroelectricity is the low cost - once equipment costs are recovered. It is also nonpolluting and can be stored. The water can be held behind the dam and released as needed. Reservoirs created for hydroelectric facilities can create opportunities for recreation and may provide habitats for some animals.
Objections to hydroelectricity are the building of dams and creating reservoirs - large areas of land are flooded, flow into bays and estuaries are affected and some animal habitats are eliminated.

Ocean waves and tides are now being explored as a source of energy. Tidal power generated electricity is similar in concept to hydroelectric generation on a river. Massive gates close after an incoming tide hits its highest point creating a tidal bay. Just before low tide, when the head is at its maximum, water is released through turbines. Once it has spilled out, the gates reopen and the process begins again.

Wave power converts the up and down motion of waves into electricity. Waves are funneled up a special ramp, forcing air through turbines. This system can be used on a small scale, but larger systems are experimental and not yet feasible.

Solar
Solar energy is our most important resource. It has given rise to all fossil fuels (the dead animals and plants that created petroleum, for example, got their energy from sunlight). People have been utilizing energy from the sun throughout history. Over 3,000 years ago a king in Turkey used heat from the sun to warm water. The first solar furnace was built in France in 1714. In the later eighteen hundreds solar heaters were used in California. As the technology improved, solar equipment made its way across the areas of the US that received a lot of sun.

In the United States solar energy machines date from about 1883. During this time a Swedish American name John Ericsson built a machine that produced 2 1/2 horsepower of energy. In 1913, an American inventor named Frank Shuman, in collaboration with physicist C.V. Boys, designed and built a solar powered irrigation pump from Cairo, Egypt that produced 50 horsepower. In the 1940's and 1950's a furnace was built by Dr. Felix Thrombe that could produce 70,000 watts of power and temperatures of over 5,000 degrees Fahrenheit. In the 1960's and even larger furnace was built under the direction of the French government.

In more recent years our increasing energy needs and concern about energy crises have prompted interest in the use of solar energy, new possibilities in solar technology and new ideas in energy conservation.

Photovoltaic (PV) energy systems are made of "solar cells" that use sunlight to generate electricity. PV cells are found on many small appliances we use everyday, like calculators and gate openers. They were first developed in the 1950's for use on U.S. space satellites.
Photovoltaics are used to provide electricity for everything from hand held calculators to homes and schools.

Energy Conservation
As our energy needs increase and we use more and more of our available resources, the need for energy efficiency and developing better ways of using our renewable and nonrenewable energy sources becomes more important.

Energy efficiency at all levels is the best way to conserve our renewable resources: water, the sun and wind. New methods are being explored that will be able to reach previously unattainable oil and coal.