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Introduction to Wind Energy

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Electricity Basics

What is electricity?

Electricity is the flow of electric charge. Electricity is created when electrons from atoms are loosened and begin to move from one atom to another. Scientific advancements have allowed us to control and distribute electricity to our homes, schools, and businesses. Every day, we use electrical energy to do a lot of work: Lighting light bulbs, powering our televisions and computers, running our refrigerators, heaters, and air conditioners, and more.

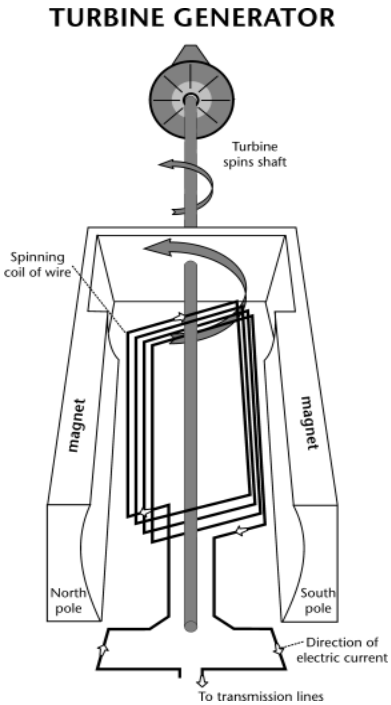
Electricity is known as a secondary energy source. This means that we get electricity by converting other sources of energy – like the thermal energy of burning coal, oil, or natural gas or the kinetic energy of moving air molecules in the wind! Wind, sunlight, and fossil fuels are called primary energy sources. Normally, we convert these primary energy sources into electricity by using an electric generator.

How electricity is generated

A generator is a device that converts mechanical energy into electrical energy. In 1831, Michael Faraday discovered that when a magnet is moved inside a coil of wire, electrical current flows in the wire. This discovery, known as Faraday's Law, proves that there is a relationship between electricity and magnetism.

A typical generator uses powerful magnets and many coils of wire. Faraday's Law tells us that the magnet must be moved inside the coil of wire to cause electrons to flow. You can also move the coil of wire inside the magnetic field to make electricity. A generator does this by having a rotating shaft with coils or magnets attached. On a wind turbine, the rotating blades are attached to a driveshaft which spins inside the generator.

By using a generator, we are able to take mechanical energy (rotating blades) and convert it into electrical energy that we can use in our homes and schools.



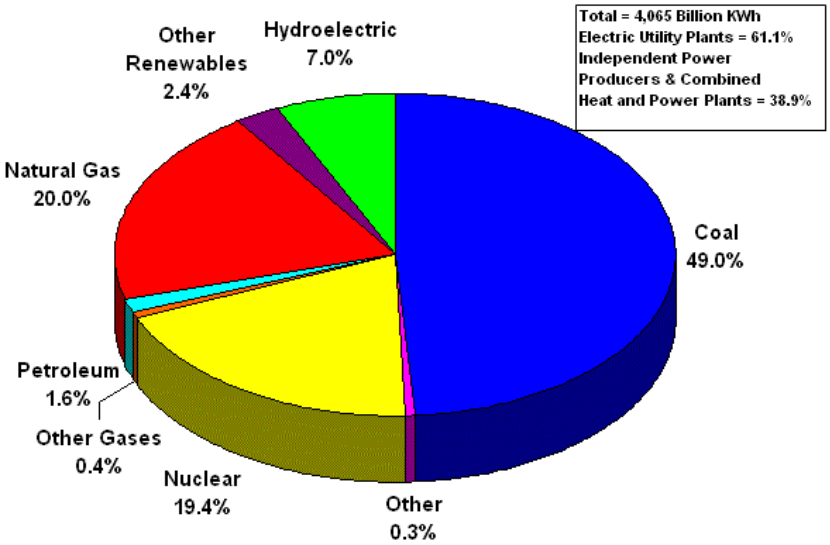
source: www.need.org

Measuring Electricity

Electricity is measured in units of power called *"Watts."* One watt is a fairly small amount of power. An average incandescent lightbulb in your house may use 60-100 watts when it is on. A *kilowatt* represents 1,000 watts. A *kilowatt-hour (kWh)* is equal to the energy of 1,000 watts working for one hour. Kilowatts and kilowatt-hours are useful for measuring amounts of energy used by large appliances or households. One *Megawatt* is equal to 1,000 kilowatts, or 1,000,000 watts. The average modern utility scale wind turbine produces 1.5-2 megawatts of electricity, but the largest ones can produce 5 megawatts! One megawatt is enough electricity for about 300+ average households here in the US.

At the beginning of 2008, wind energy alone was producing 93,881 megawatts of electricity throughout the world. How many watts is that? Can you figure out how many average American households could be powered with that much electricity?

Where does electricity come from?

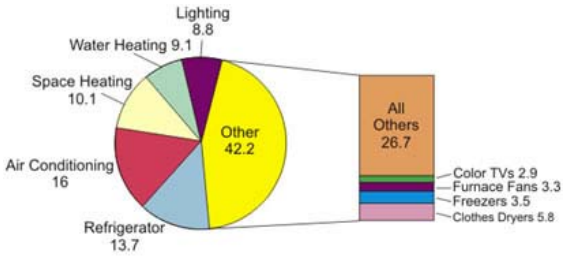


source: www.eia.doe.gov

The chart above shows the fuel sources that are used to generate electricity in the United States. These are nationwide totals, but there are a lot of regional differences in fuel sources used to generate electricity. In the Northeast they use more natural gas and much less coal, in the Midwest they use less natural gas and more coal. Worldwide, the vast majority of electricity is created by burning fossil fuels to make steam to drive turbines.

What do we use electricity for?

These are the common uses for electricity in the US. Air conditioners, refrigerators and lighting for homes and businesses make up the bulk of electric demand. If we could build more efficient refrigerators and air conditioners we could save quite a bit of electricity. This is why many people think we need to focus on energy efficiency and not increasing electric generation.



Source: Energy Information Administration, Form EIA-457A, B, C, E, and H of the 2001 Residential Energy Consumption Survey.

Sources:

- The National Energy Education Development Project, *Intermediate Energy Infobook*, 2006.
- Energy Information Administration. *Energy Kids Page.* http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html
- Windpower Monthly - *Wind Energy Facts and Figures.* http://www.wpm.co.nz/WPM:WINDICATOR::

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