Energy 101

What is energy?

Everything requires energy to respire, move, grow and reproduce. Most energy on Earth is originally derived from the Sun, the only input into an otherwise closed and self-sustaining system. In physics, energy is defined as the "ability to do work," and can take on multiple forms. Energy can be converted from one form to another, but there are always losses associated with the conversion (according to the second law of thermodynamics). These forms of energy include:

- Potential energy
- Kinetic energy
- Thermal or heat energy
- Chemical energy
- Electric energy
- Electromagnetic energy
- Electrochemical energy
- Sound energy
- Nuclear or atomic energy

The most recognizable renewable energy technologies, such as solar panels or wind turbines, work by harvesting naturally available forms of energy and converting them into electric energy.

What's the difference between (electric) power and energy?

"Power" or "capacity" is the rate at which energy is produced or consumed. It is measured in watts (W) or kilowatts (1 KW = 1,000 W). When you screw in a new 60W light bulb, it will require 60 watts of power during every moment it is on. Think of this as analogous to the width of your water faucet, which determines how much water can flow through at any given moment.

"Energy" is power consumed over a period of time and is usually measured in kilowatt-hours (1,000 watt-hours). If you leave a 60W bulb on for 1,000 hours, it will consume 60 watts x 1,000 hours = 60,000 watt hours = 60 kWh. In the sink analogy, "energy" would be equivalent to the amount of water in the sink after you have left the water running for a defined period of time.

The distinction between power and energy is important to understand in conversations about electricity and electrical generation. For example, 1 kW of solar power is very different from 1 kWh of solar-powered energy – be careful not to confuse units.

When talking about other forms of energy, such as heat energy produced from direct combustion of a fuel source, it is more common to use units such as **kilocalories (kcals), joules, or British Thermal Units (BTUs).** The U.S. Energy Information Administration offers an easy energy conversion calculator.

What are the main sources of energy used in the U.S.?

Most energy used today comes from non-renewable energy sources. In order of the most use to the least, they are:

1. Petroleum
2. Natural gas
3. Coal
4. Nuclear electric power

The first three categories are also known as "fossil fuels," because they were created as a result of biomass being compressed and "fossilized" under the Earth's surface over the course of millions of years. Fossil fuels have an extremely high energy content (unit of useful energy produced per unit of fuel consumed) and have historically served as the driving force behind industrialization, population growth, and economic development. However, there are a number of problems associated with the conversion technologies (e.g., combustion) used to turn the stored chemical energy in fossil fuels into active thermal energy. Burning fossil fuels creates pollutants, including greenhouse gases that contribute to global warming. Limited petroleum resources and the political conflicts associated with their ownership could have serious repercussions in terms of economic and national security.

What are the main categories of energy consumption?

Most analyses of energy consumption break it down into the following categories:

- Residential – household energy use
- Commercial – "everything else" (includes public and institutional uses)
- Industrial – energy used in manufacturing processes
- Transportation – energy used to move people or products around
- Agriculture – energy used in food production

References

- "Energy Explained." U.S. Energy Information Administration. http://www.eia.gov/energyexplained