SCI – ELECTRICAL POWER PRODUCTION

A considerable portion of the total energy used generates electrical power, defined as the amount of work done by an electric current over a given time. The electricity itself is an energy carrier—it transfers energy from a primary energy source (coal or waterpower, for instance) to its point of use. Electricity now defines our modern technological society, powering appliances and computers in our homes, lighting up the night, and enabling the global Internet and countless other vital processes in business and industry to operate.

Generators

Electric generators were invented in the 19th century. In 1831, the English scientist, Michael Faraday discovered that passing a coil of wire through a magnet field causes a flow of electrons—an electrical current—in the wire. An electric generator is basically a coil of wire that rotates in a magnetic field or that remains stationery while a magnetic field is rotated around it. The process converts mechanical energy into electrical energy. If you do just the reverse—supply electric power to a generator—it becomes a motor. Anytime energy is converted from one form to another, some is lost through resistance and heat (in accordance with the second law of thermodynamics). In a generator, as the current flows in the wire, it creates a new magnetic field that is opposition to the first and thus resist the flow of current. Some energy is lost in transmitting the electricity over wires from the generating plants to the end users. In the end, it takes three units of primary energy to create one unit of electrical power that actually is put to use. This energy-losing proposition is justified because electrical power is so useful and now indispensable.

Turbogenerators

In the most widely used technique for generating electrical power, a primary energy source is employed to boil water, creating high-pressure steam, that drives a turbine—a sophisticated paddle wheel—coupled to the generator. The combined turbine and generator are called a turbogenerator. Any primary energy source can be harnessed for boiling the water. Coal, oil and nuclear energy are most commonly used at present, but burning refuse, solar energy, and geothermal energy (heat from Earth's interior) may be more widely used in the future.

In addition to steam-driven turbines, gas- and water- (hydro-) driven turbines are also used. In a gas turbogenerator, the high pressure gases produced by the combustion of a fuel (usually natural gas) drive the turbine directly. For hydroelectric power, water under high pressure—at the base of a dam or at the bottom of a pipeline beginning at the top of a waterfall—is used to drive a hydroturbogenerator. Wind turbines are also coming into use.