**University of Bejaia**

**2nd year Technology**

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**Lecture one:**

**WHAT IS ELECTRICITY?**

Electricity is a form of energy. Electricity is the flow of electrons. All matter is made up of atoms, and an atom has a centre, called a nucleus. The nucleus contains positively charged particles called protons and uncharged particles called neutrons. The nucleus of an atom is surrounded by negatively charged particles called electrons. The negative charge of an electron is equal to the positive charge of a proton, and the number of electrons in an atom is usually equal to the number of protons. When the balancing force between protons and electrons is upset by an outside force, an atom may gain or lose an electron. When electrons are "lost" from an atom, the free movement of these electrons constitutes an electric current.

**HOW IS ELECTRICITY GENERATED?**

**Electricity generation** is the process of generating [electric power](http://en.wikipedia.org/wiki/Electric_power) from [sources of energy](http://en.wikipedia.org/wiki/Forms_of_energy). The fundamental principles of electricity generation were discovered by the British scientist [Michael Faraday](http://en.wikipedia.org/wiki/Michael_Faraday). His basic method is still used today: electricity is generated by the movement of a loop of wire, or disc of copper between the poles of a [magnet](http://en.wikipedia.org/wiki/Magnet).

Electricity is most often generated at a [power station](http://en.wikipedia.org/wiki/Power_station) by electromechanical [generators](http://en.wikipedia.org/wiki/Electrical_generator), primarily driven by [heat engines](http://en.wikipedia.org/wiki/Heat_engine) fueled by chemical [combustion](http://en.wikipedia.org/wiki/Combustion) or [nuclear fission](http://en.wikipedia.org/wiki/Nuclear_fission) but also by other means such as the [kinetic energy](http://en.wikipedia.org/wiki/Kinetic_energy) of flowing water and wind. Other energy sources include solar [photovoltaic](http://en.wikipedia.org/wiki/Photovoltaics) and [geothermal power](http://en.wikipedia.org/wiki/Geothermal_power).

## Methods of generating electricity

An electric utility power station uses a turbine, engine, water wheel, or other similar machine to drive an electric generator or a device that converts mechanical or chemical energy to electricity. Steam turbines, internal-combustion engines, gas combustion turbines, water turbines, and wind turbines are the most common methods to generate electricity.

1. [***Steam turbines***](http://inventors.about.com/library/inventors/blsteamengine.htm#turbines)**:** A turbine converts the kinetic energy of a moving fluid (liquid or gas) to mechanical energy. Steam turbines have a series of blades mounted on a shaft against which steam is forced, thus rotating the shaft connected to the generator. In a fossil-fuelled steam turbine, the fuel is burned in a furnace to heat water in a boiler to produce steam.
2. **Coal, petroleum (oil), and natural gas** are burned in large furnaces to heat water to make steam that in turn pushes on the blades of a turbine.
3. **Natural gas**, in addition to being burned to heat water for steam, can also be burned to produce hot combustion gases that pass directly through a turbine, spinning the blades of the turbine to generate electricity. Gas turbines are commonly used when electricity utility usage is in high demand.
4. Petroleum can also be used to make steam to turn a turbine. Residual fuel oil, a product refined from crude oil, is often the petroleum product used in electric plants that use petroleum to make steam.
5. **Nuclear power** is a method in which steam is produced by heating water through a process called nuclear fission. In a nuclear power plant, a reactor contains a core of nuclear fuel, primarily enriched uranium. When atoms of uranium fuel are hit by neutrons they fission (split), releasing heat and more neutrons. Under controlled conditions, these other neutrons can strike more uranium atoms, splitting more atoms, and so on. Thereby, continuous fission can take place, forming a chain reaction releasing heat. The heat is used to turn water into steam that, in turn, spins a turbine that generates electricity.

**OTHER GENERATING SOURCES**

**Solar power** is derived from the energy of the sun. However, the sun's energy is not available full-time and it is widely scattered. The processes used to produce electricity using the sun's energy have historically been more expensive than using conventional fossil fuels. Photovoltaic conversion generates electric power directly from the light of the sun in a photovoltaic (solar) cell. Solar-thermal electric generators use the radiant energy from the sun to produce steam to drive turbines. Less than 1% of the nation's electricity is based on solar power.

**Wind power** is derived from the conversion of the energy contained in wind into electricity. Wind power like the sun, is usually an expensive source of producing electricity, and is used for less than 1% of the nation's electricity. A wind turbine is similar to a typical wind mill.

**Biomass** (wood, municipal solid waste (garbage), and agricultural waste, such as corn cobs and wheat straw, are some other energy sources for producing electricity. These sources replace fossil fuels in the boiler. The combustion of wood and waste creates steam that is typically used in conventional steam-electric plants.

**Transporting electricity**

The electricity produced by a generator travels along cables to a transformer, which changes electricity from low voltage to high voltage. Electricity can be moved long distances more efficiently using high voltage. Transmission lines are used to carry the electricity to a substation. Substations have transformers that change the high voltage electricity into lower voltage electricity. From the substation, distribution lines carry the electricity to homes, offices and factories, which require low voltage electricity.

**HOW IS ELECTRICITY MEASURED?**

Electricity is measured in units of power called watts. A kilowatt represents 1,000 watts. A kilowatt-hour (kWh) is equal to the energy of 1,000 watts working for one hour. The amount of electricity a power plant generates or a customer uses over a period of time is measured in kilowatthours (kWh). Kilowatthours are determined by multiplying the number of kW's required by the number of hours of use.