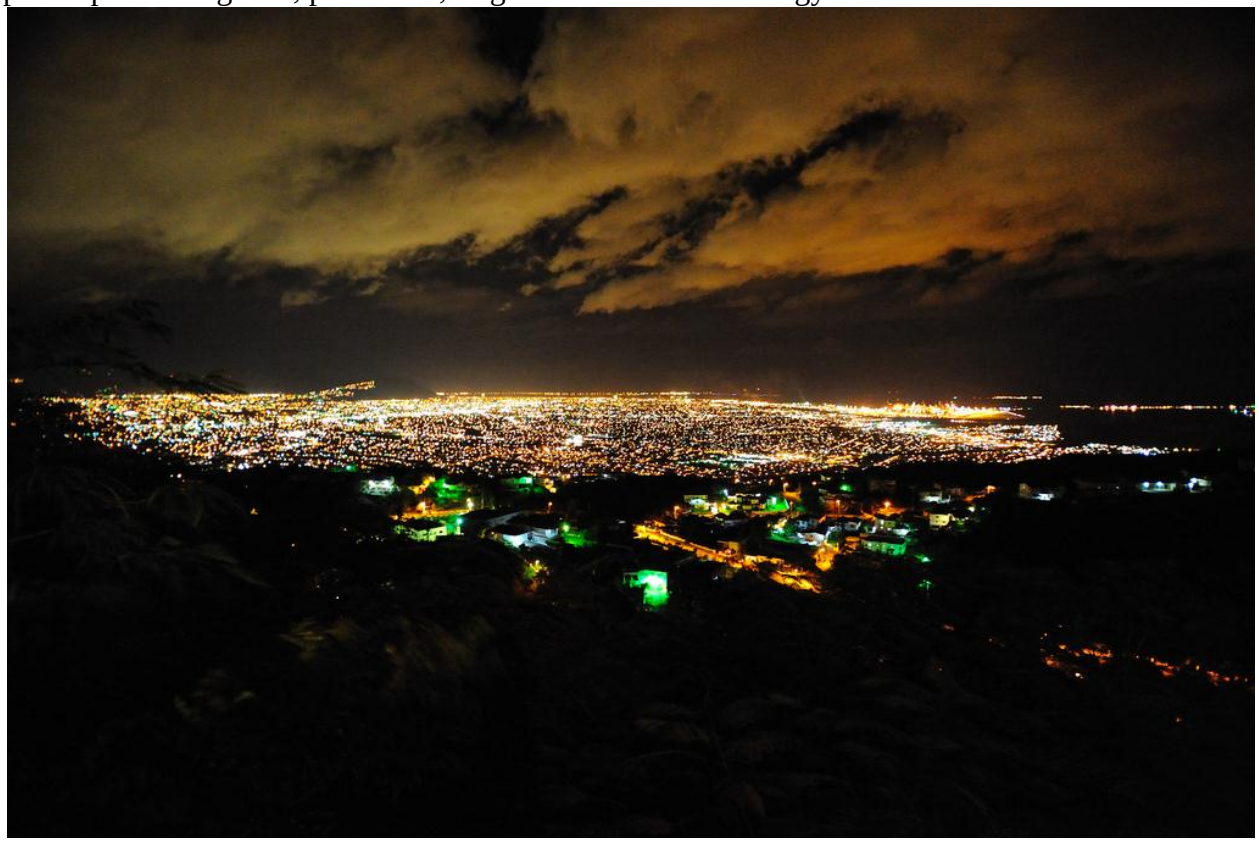
**In 2010, "most candidates did not demonstrate a clear understanding of the term- 'conventional electricity generation facility'."- Statement from the Environment Science Report on Candidate's work in the Advanced Proficiency Examination May/ June 2010.**

# Conventional thermal electricity generation

**Conventional thermal electricity generation** is pertaining to electricity generated by an electric power plant using coal, petroleum, or gas as its source of energy.



The City of Kingston, Jamaica at night

The fundamental principles of electricity generation were discovered during the 1820s and early 1830s by the British scientist 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.

For electric utilities, it is the first process in the delivery of electricity to consumers. The other processes, electricity transmission, distribution, and electrical power storage and recovery using pumped storage methods are normally carried out by the electric power industry.

Electricity is most often generated at a power station by electromechanical generators, primarily driven by heat engines fueled by chemical combustion or nuclear fission but also by other means such as the kinetic energy of flowing water and wind. There are many other technologies that can be and are used to generate electricity such as solar photovoltaics and geothermal power.

There are seven fundamental methods of directly transforming other forms of energy into electrical energy:

1. **Static electricity**, from the physical separation and transport of charge (examples: triboelectric effect and lightning)

2. **Electromagnetic induction**, where an electrical generator, dynamo or alternator transforms kinetic energy (energy of motion) into electricity
3. **Electrochemistry**, the direct transformation of chemical energy into electricity, as in a battery, fuel cell or nerve impulse
4. **Photoelectric effect**, the transformation of light into electrical energy, as in solar cells
5. **Thermoelectric effect**, direct conversion of temperature differences to electricity, as in thermocouples, thermopiles, and Thermionic converters.
6. **Piezoelectric effect**, from the mechanical strain of electrically anisotropic molecules or crystals
7. **Nuclear transformation**, the creation and acceleration of charged particles (examples: betavoltaics or alpha particle emission)

TURBINES

All turbines are driven by a fluid acting as an intermediate energy carrier. Many of the heat engines just mentioned are turbines. Other types of turbines can be driven by wind or falling water. Sources include steam, water and wind.

- **Steam** - Water is boiled by:
    - Nuclear fission,
    - The burning of fossil fuels (coal, natural gas, or petroleum). In hot gas (gas turbine), turbines are driven directly by gases produced by the combustion of natural gas or oil. Combined cycle gas turbine plants are driven by both steam and natural gas. They generate power by burning natural gas in a gas turbine and use residual heat to generate additional electricity from steam. These plants offer efficiencies of up to 60%.
    - Renewables. The steam generated by:
        - Biomass
        - The sun as the heat source: solar parabolic troughs and solar power towers concentrate sunlight to heat a heat transfer fluid, which is then used to produce steam.
        - Geothermal power. Either steam under pressure emerges from the ground and drives a turbine or hot water evaporates a low boiling liquid to create vapour to drive a turbine.
        - Ocean thermal energy conversion (OTEC ): uses the small difference between cooler deep and warmer surface ocean waters to run a heat engine usually a turbine.
- Other renewable sources:

- **Water** (hydroelectric) - Turbine blades are acted upon by flowing water, produced by hydroelectric dams or tidal forces.

- **Wind** - Most wind turbines generate electricity from naturally occurring wind. Solar updraft towers use wind that is artificially produced inside the chimney by heating it with sunlight, and are more properly seen as forms of solar thermal energy.

Photovoltaic Panels

Unlike the solar heat concentrators mentioned above, photovoltaic panels convert sunlight directly to electricity. Although sunlight is free and abundant, solar electricity is still usually more expensive to produce than large-scale mechanically generated power due to the cost of the panels. Low-efficiency silicon solar cells have been decreasing in cost and multijunction cells with close to 30% conversion efficiency are now commercially available. Over 40% efficiency has been demonstrated in experimental systems. Until recently, photovoltaics were most commonly used in remote sites where there is no access to a commercial power grid, or as a supplemental electricity source for individual homes and businesses. Recent advances in manufacturing efficiency and photovoltaic technology, combined with subsidies driven by environmental concerns, have dramatically accelerated the deployment of solar panels. Installed capacity is growing by 40% per year led by increases in Germany, Japan, California and New Jersey.

OTHER GENERATION METHODS

Various other technologies have been studied and developed for power generation. Solid-state generation (without moving parts) is of particular interest in portable applications. This area is largely dominated by thermoelectric (TE) devices, though thermionic (TI) and thermophotovoltaic (TPV) systems have been developed as well. Typically, TE devices are used at lower temperatures than TI and TPV systems. Piezoelectric devices are used for power generation from mechanical strain, particularly in power harvesting. Betavoltaics are another type of solid-state power generator which produces electricity from radioactive decay. Fluid-based magnetohydrodynamic (MHD) power generation has been studied as a method for extracting electrical power from nuclear reactors and also from more conventional fuel combustion systems.

Electrochemical electricity generation is also important in portable and mobile applications. Currently, most electrochemical power comes from closed electrochemical cells ("batteries"),[8] which are arguably utilized more as storage systems than generation systems, but open electrochemical systems, known as fuel cells, have been undergoing a great deal of research and development in the last few years. Fuel cells can be used to extract power either from natural fuels or from synthesized fuels (mainly electrolytic hydrogen) and so can be viewed as either generation systems or storage systems depending on their use

Source: http://en.wikipedia.org/wiki/Electricity_generation