Generating electricity

Electricity is made by generators.

But the generators don't exactly generate electricity, they have to use something in order to get it, it doesn't come from nowhere.

Generators simply change one form of natural into another form of energy called electricity, a form of energy, which is very helpful to us.

We generate electricity because although there is a lot of energy in moving water, or in wind, we cannot use that form of energy to power a light bulb or run a computer hundreds or thousands of kilometres away.

Benmore Dam with the HVDC switchyard on the left

Generators, which come in many sizes, work on a principle that was discovered by Michael Faraday, in 1831. Faraday discovered that electricity could be produced in a coil of copper wire by moving it near a magnet.

How a generator works

Modern generators have magnets and wires that spin very close to one another. One set of magnets spin inside a set of stationary magnets. The fast moving magnets and wires make an electromotive force, or the process of exciting electrons to jump from atom to atom.

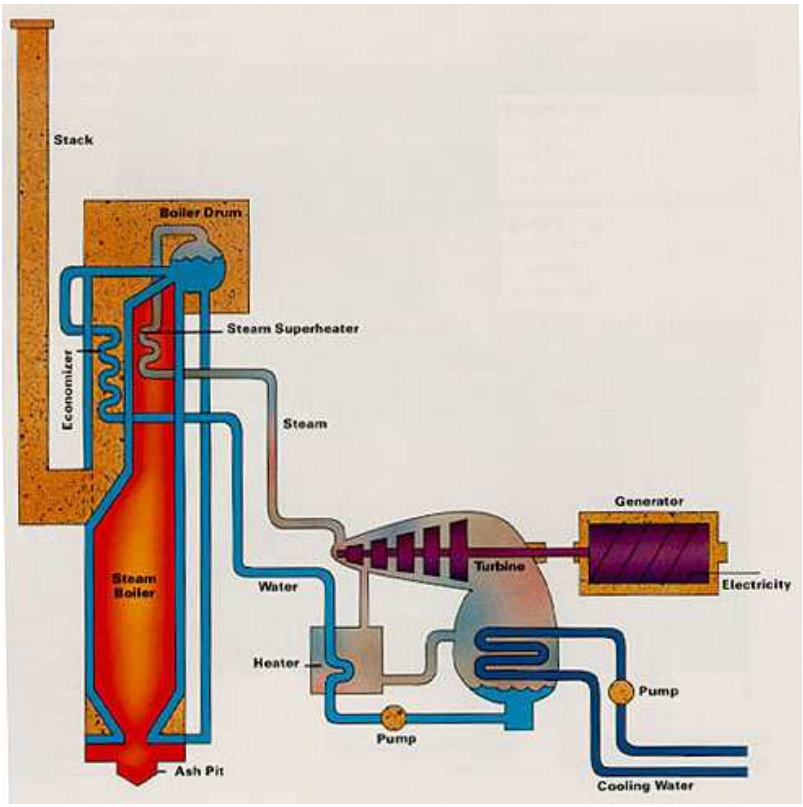
Electron jumping is electricity.

Generators use a source of natural energy - hydro power plants use the motion of water or steam - to move the big fan-like blades in a turbine. The turbine spins the generator.

Thermal Generating Plants

Thermal plants use the energy of heat to make electricity. Water is heated in a boiler until it becomes high-temperature steam. This steam is then channelled through a turbine, which has many fan-blades attached to a shaft. As the steam moves over the blades, it causes the shaft to spin. This spinning shaft is connected to the rotor of a generator, and the generator produces electricity.

The diagram below shows this process



Fossil-fuelled plants

Fossil fuels are what are left of plant and animal life that existed millions of years ago. For millions of years, they have been exposed to high temperatures underground, these remains have been transformed into forms of carbon: coal, oil, and natural gas. Fossil fuels can be stored in large quantities. After 100 years of research and development, fossil-fuelled plants are generally reliable, and problems that do occur are usually confined to a local area. Many electric utilities have operated fossil-fuel plants for decades, and these plants (now fully paid for) are very profitable to run. This not only increases profits to the utility, but also keeps down the direct cost to users.

However, fossil-fuel plants can be big environmental problems. Burning these fuels produces sulphur-dioxide and nitric oxide air-pollution, which mean they need expensive scrubbers. Even with great big pollution controls, there is still waste material made. Carbon-dioxide gas, and ash are the big concerns.

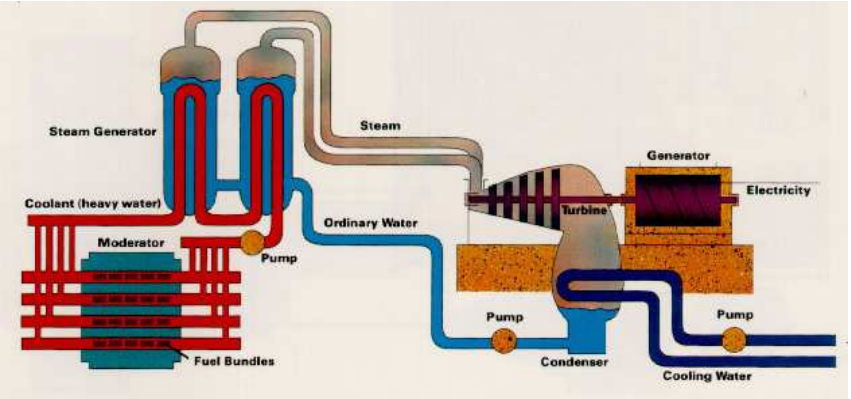
Also, fossil fuels are not renewable. They took millions of years to make, and at some point they will run out. Extracting them and using them had made environmental problems. Strip-mining of coal and oil-spills at sea can have big affects on the environment.

Combined-Cycle and Biomass Plants

Some natural gas plants can produce electricity without steam. They use turbines like those on jet-aircraft. Instead of burning jet-fuel and producing thrust, however, these units burn natural gas and power a generator. Gas-turbine generators have been popular for many years because they can be started quickly in response to temporary demand surges for electricity. A newer twist is the "Combined-Cycle" plant, which uses gas turbines in this fashion, but then channels the hot exhaust gas to a boiler, which makes steam to turn another rotor. This improves the overall efficiency of the generating plant.

Nuclear Plants

Although there are some important differences, nuclear power stations are thermal plants that make electricity in mostly the same way as fossil-fuel plants. The difference is that they generate steam by using the heat of atomic fission rather than by burning coal, oil, or gas. The steam then turns a generator as in other thermal plants.



Nuclear plants don't use large amounts of fuel and do not refuel often, unlike a coal plant which must have heaps of fuel shipped in regularly. The fact that there aren't many greenhouse gasses and air-borne particulates during the operation makes nuclear power attractive to many who care about air-quality. Wastewater is hotter than that from a fossil plant, and large cooling towers are designed to manage this problem.

So far, one problem that has not been solved is that of disposing of spent fuel cores and contaminated accessories, which will dangerous for thousands of years. At the moment, they are being buried in places safe to bury them in, but this still creates controversy.

Hydro-electric Plants

Two basic types of hydroelectric plants are in service. One is a run-of-river plant, which takes energy from a fast moving current to spin the turbine. The flow of water in most rivers can vary depending on the amount of rainfall in that river. Hence, there are few suitable sites for run-of-river plants.

Most hydroelectric plants use a reservoir to compensate for drought, and to boost water-pressure in the turbines. These man-made lakes cover large areas, often creating picturesque sport and recreational facilities. The massive dams required are also good at controlling floods.

Dams have displaced people, and destroyed wildlife habitat and archaeological sites; this has meant that there have been people opposing these actions. A dam-burst can be disastrous. Some environmental costs can be avoided by thoughtful design; using fish ladders to permit fish to travel around a dam is one good example. However, other costs remain, and protests against some recent hydropower projects have become as angry as anti-nuclear protests.

A special type of hydropower is called Pumped Storage. Some non-hydro plants can take advantage of periods of low demand by pumping water into a reservoir. When demand rises, some of this water is channelled through a hydro-turbine to generate electricity. Since "peak-load" generating units (used to meet temporary demand surges), are generally more expensive to run than "base-load" units (which run most of the time), pumped storage is one way to boost system efficiency.

Wind Power

Wind-farms do not need reservoirs and create no air pollution. Small windmills can provide power to individual homes. Air carries much less energy than water but it needs a lot of energy to move the turbines. One needs either a few very large windmills or many small ones to operate a commercial wind-farm. In either case, construction costs can be high; this means that there isn't many wind farms currently in use.

Like run-of-river hydro-plants, there aren't many places suitable, like where the wind blows predictably. Even in good places, turbines often have to be designed with special gearing so that the rotor will turn at

a constant speed never mind what the wind speed is. Some people are against these places though, as they aren't very nice to look at.

Sam Knight 11S