

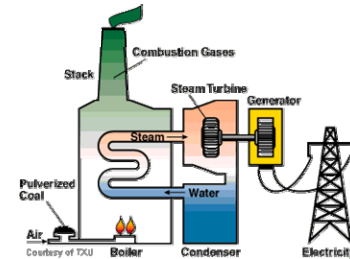
Topic 8 - Electricity Production and the Environment

Electrical energy consumption in Canada is 2×10^{18} J every year. To generate this amount of electricity is a massive undertaking and can effect the environment.

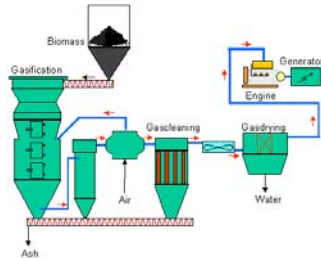
Energy from Burning Fuels

Fuel oil, natural gas, and coal are used in large **thermo-electric** generating plants to produce roughly 25% of Canada's electrical energy needs.

Coal is mined, crushed into a powder, blown into a combustion chamber and burned to release heat. This heat boils water and superheats the resulting steam to a high temperature and pressure, which then turns a turbine. The turbine shaft rotates large electromagnetic coils in the generator to produce electricity.



These fossil fuels are **non-renewable** resources – eventually they will be gone.



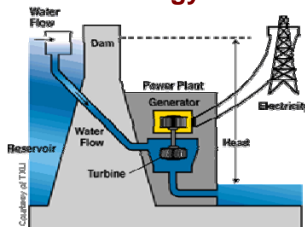
Biomass, solid material from living things, is also burned to power these thermo-electric generators.

Biomass is a **renewable** resource.

Fossil Fuels Affect Land and Air

Coal is mined in Alberta in **open pits**, which are an eyesore, and disturb topsoil and vegetation. Underground mines produce 'tailings' which accumulate near the mine. Water seeps through these tailings and becomes acidic and contaminated. Fossil fuel reserves are decreasing, but with less reliance on these fuels we will be able to see a decrease in pollution. The burning of these fuels creates contaminants such as visible particles and invisible gases (SO_2 is one such gas). **Electrostatic precipitators** can remove most of the solid particles, but not the gases. Sulfur dioxide can be reduced by using **scrubbers** – which spray a water solution through the gas, making sulfuric acid, which is then collected and sold. Another gas produced is carbon dioxide CO_2 which is a greenhouse gas. Producing more of this naturally occurring gas helps the atmosphere trap more heat, leading to global warming. Some generating plants are switching to natural gas which burns a little cleaner. Finding ways to lower our dependence on fossil fuels and finding alternative fuel sources is a decision that will determine much of what our future environment will be like.

Electric Energy from Flowing Rivers



Hydro-electric plants use falling water (gravity), and pressure to generate electricity. Large dams raise the water above the power plant (which is usually built inside the dam), near the base.

A channel, called a **penstock**, directs the water (at high pressure) to a **turbine**. The turbine then converts mechanical energy to electrical energy.

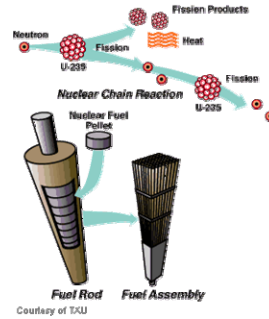
Although these hydro-electric plants appear to be doing no harm to the environment, the reservoir they have to create behind the dam, destroys habitat and displaces whoever lived in the area prior to the reservoir being created. When the submerged vegetation is decomposed, bacteria take up the oxygen supply in the water, methane gas can be produced, and aquatic species – such as fish, are affected when the oxygen levels drop. Other species take over and a new ecosystem can be created.

Energy from Atomic Reactions

Bombarding uranium atoms with tiny particles, called neutrons cause the uranium to split into two smaller atoms.

This is called **nuclear fission**.

The process creates a huge amount of energy which is used to generate electricity in a **thermonuclear** plant.



Heating the Environment

All thermonuclear and thermo-electric-generating plants release thermal energy into the environment. 43% of the water used in the cooling process enters the environment. **Thermal pollution** occurs when this heated water is not cooled before it re-enters the water system. This overheated water can upset the life cycles of organisms in the water and be fatal because they cannot tolerate the sudden temperature change. The heated water also contains less oxygen. To reduce this type of pollution, plants are required to have holding ponds or towers which hold the water until it returns to normal levels.

Cogeneration

Cogeneration is the dual generation of electrical and thermal energy. The cogeneration systems usually are associated with industries, or commercial complexes. The cogeneration plant (like Poplar Creek Power Plant in Fort McMurray) provides electricity and heat or steam to the industry and may even sell excess electricity to the provincial power grid.

Alternative Energy Sources



Wind - this energy is harnessed by large propeller-type blades, which turn a shaft - connected to a generator.



Sunlight - Solar cells (made from silicon) enable the energy from the sun to be transformed (photoelectric effect) into electricity.



Geothermal - Heat from the Earth's core can also be used to generate electricity. This geothermal energy (hot water and steam) is channeled through pipes to drive turbines - connected to generators, which produce the electricity.



Tides - moving water can power turbines, which then run generators. When the tide comes in, the water is trapped in large reservoirs and then allowed to flow out past turbines.

Renewable resources like these alternative sources of energy can be replenished over and over again. Tree harvesting can also be renewed, but it takes a much longer period of time to renew this resource. They can also negatively affect the environment: Dams, wind farms and solar cell arrays can destroy large areas of ecological habitat; Tidal power plants can disrupt the habitat of fish and other marine life.