

Energy

Our future primary resource?



Thinking about energy

- What do you think your total energy consumption has been since you woke up this morning to when you got to school? Write down all the things you've used that required energy (ex. alarm clock, transportation, etc.)
- How do you think the electrical energy you've used today was produced?

Canada + Energy Use = Waste?

- Canada is either the largest or second largest users of energy (per capita) in the world.



WHY?

- Live in a Northern climate = colder temperatures
- Small population over large land mass = energy for transportation
- Have advanced industrial economy = great deal of energy use
- Energy relatively cheap here = wasteful

How is Energy Used in Canada?

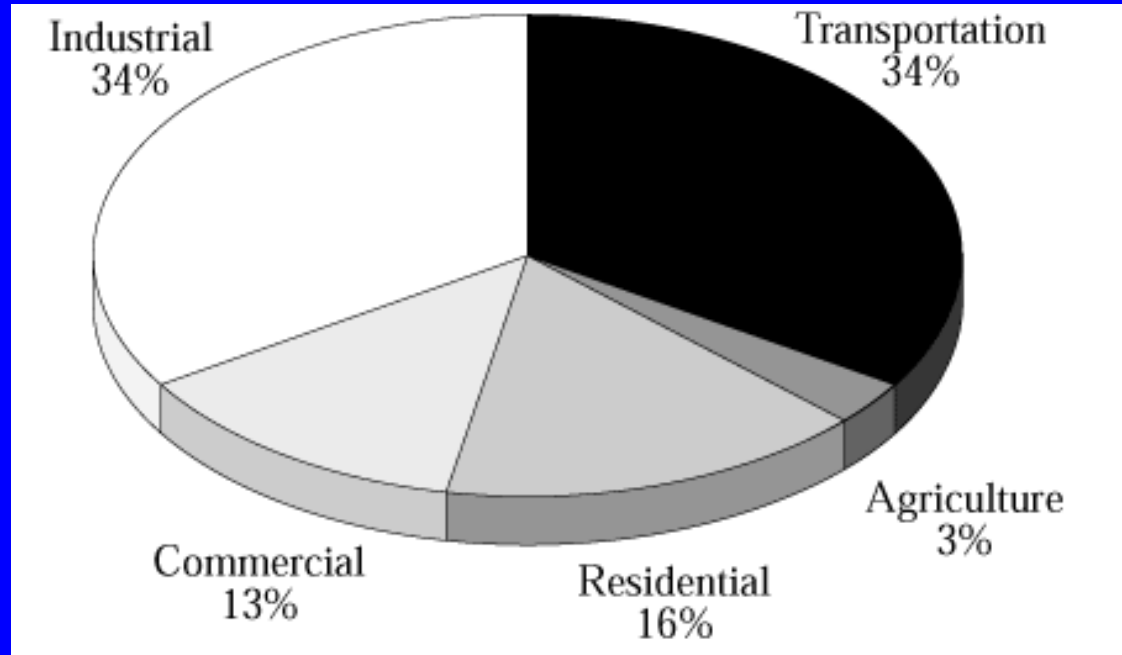
We first need to understand the unit energy is measured in:

Joule (J)

But 1 joule is a very small amount of energy

Gigajoule (GJ) → 1 billion J

Petajoule (PJ) → 1 million GJ



Every year, Canada's total supply of energy is roughly 10 000 PJ

- 20% (2 000) of that is used as raw material and by energy producers to get products to market
- Leaves approximately 8 000 PJ used as energy by businesses and consumers



Canada + Energy Use

Is it possible that the primary resource that takes the longest to form could be Canada's future primary industry "black gold" mine?

Canada's energy sources can be divided into 2 categories:

Conventional (often non-renewable)

- well-established sources;
- oil, natural gas, coal, hydro and nuclear

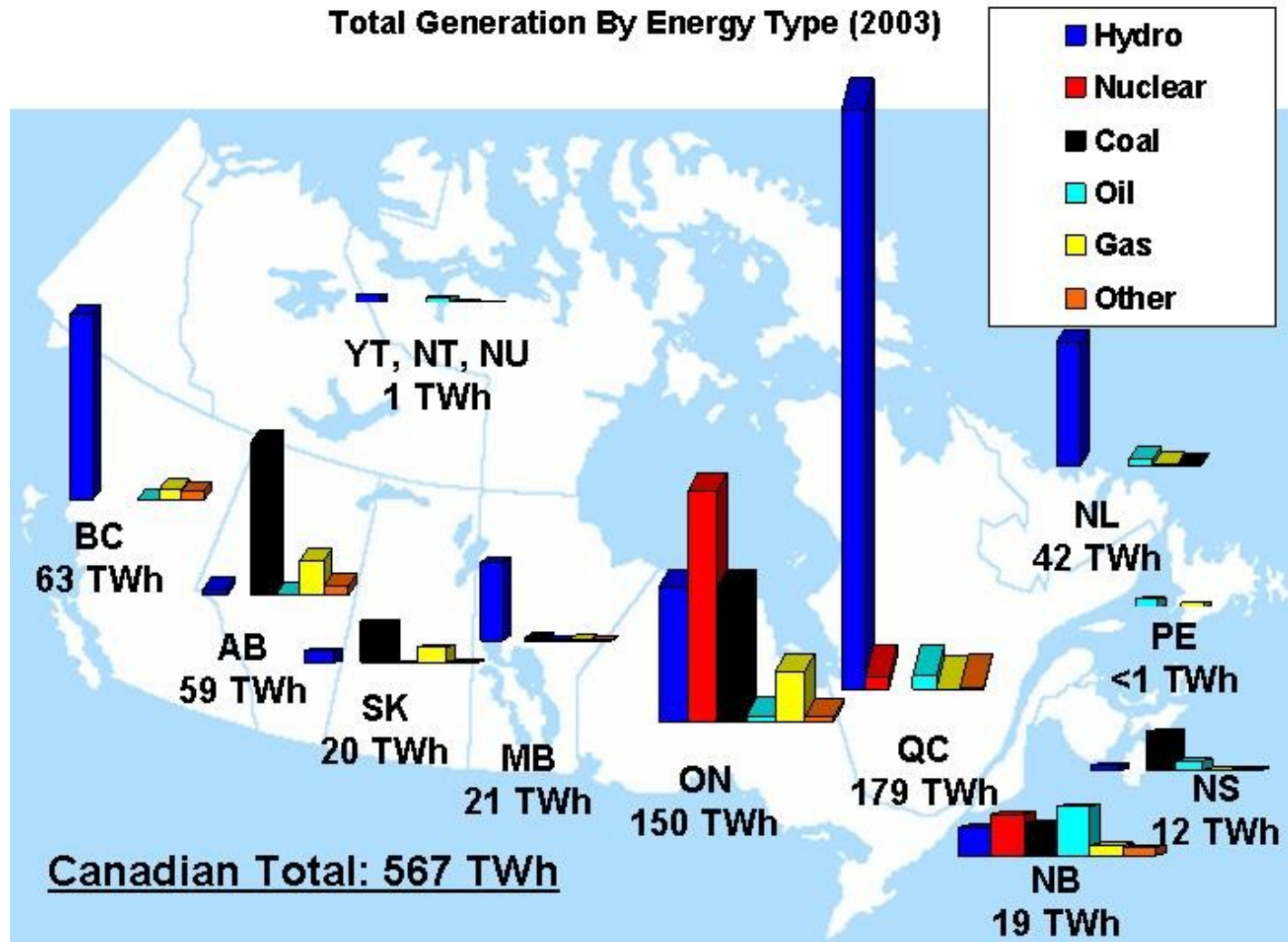
• Alternative (renewable)

- growing newly harnessed;
- solar, wind, biomass, geothermal



Production of Electrical Power

Total Generation By Energy Type (2003)



Conventional Energy

We are first going to look at the original forms of energy Canada produced on a mass scale

Coal



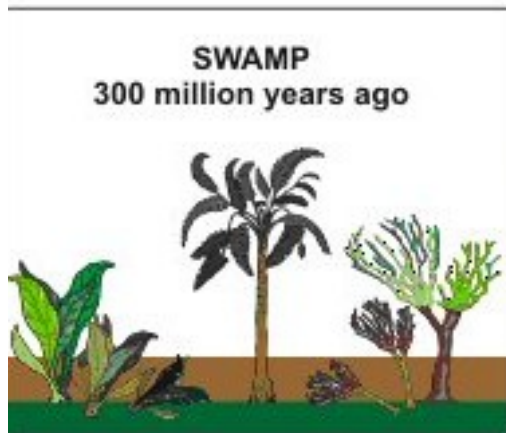
Oil and Gas



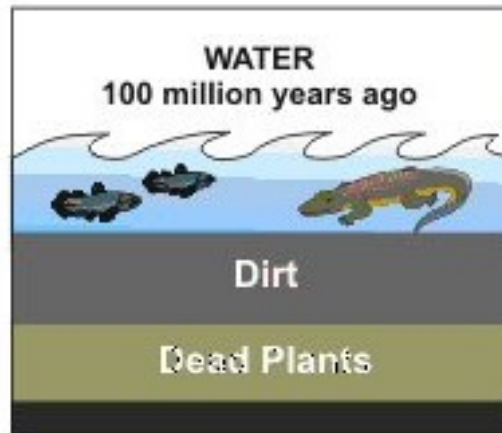
Coal

- formed from the remains of trees and plants 300-360 million years ago
- Layers upon layers of sediments compressing over millions of years turned this matter into coal
 - Different amounts of compression formed 3 different types
 1. *Anthracite – great pressure; shiny and hard*
 2. *Bituminous – less pressure; softer with more impurities*
 3. *Lignite – low pressure; formed near surface of Earth*

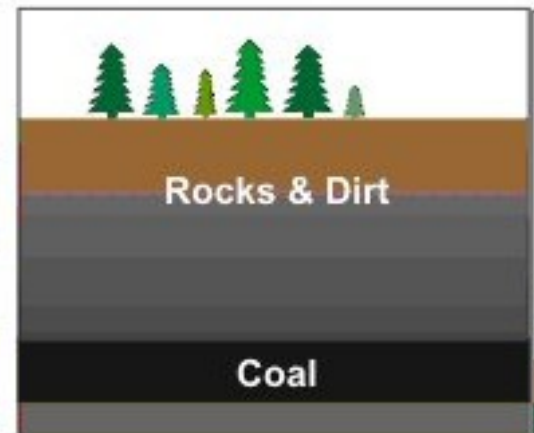
HOW COAL WAS FORMED



Before the dinosaurs, many giant plants died in swamps.



Over millions of years, the plants were buried under water and dirt.



Heat and pressure turned the dead plants into coal.

Coal

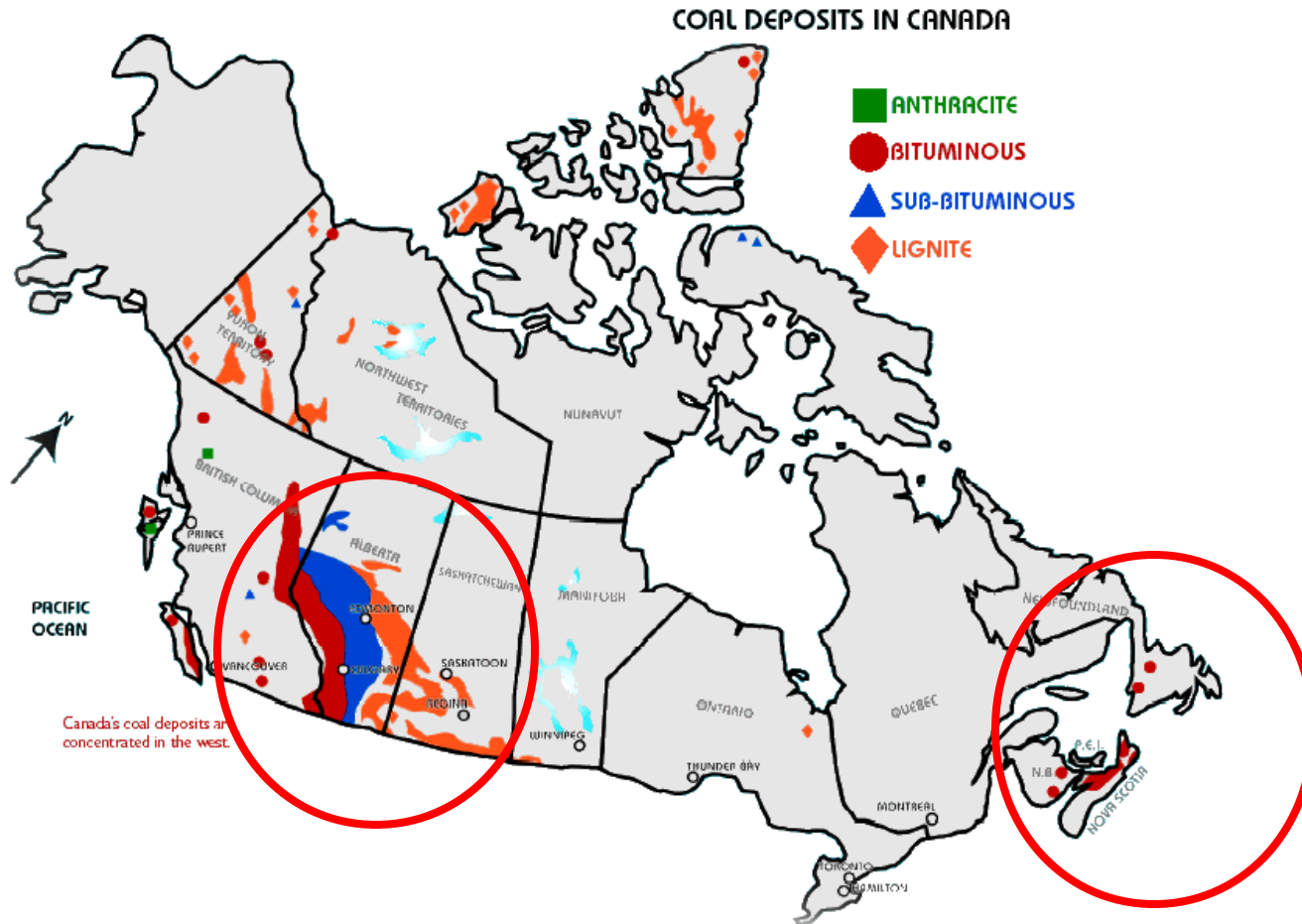
- significant role in CDN economy
 - \$4.5 billion annually to GDP, 55 000 jobs
- half of coal mined is exported (\$1.9 billion, 2004)
 - Mainly to China, South Korea and Japan
- The two other uses of coal in Canada is for steel production and in industry.



of remaining, 93% used in electrical power generation in the provinces of Alberta, New Brunswick, Nova Scotia, Manitoba, Ontario, and Saskatchewan.



Where is the coal mined in Canada?



Saskatchewan, Alberta and British Columbia

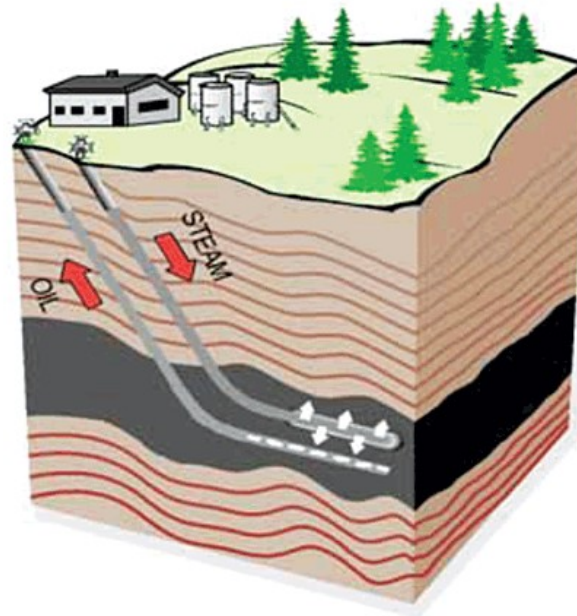
Oil and Gas

- usually found together, oil and gas formed hundreds of million years ago
 - covered by shallow oceans, marine animals fell to sea floor, building up thick layers
 - layers upon layers of sand created immense heat and pressure, converting the remains into oil and gas



Oil and Gas

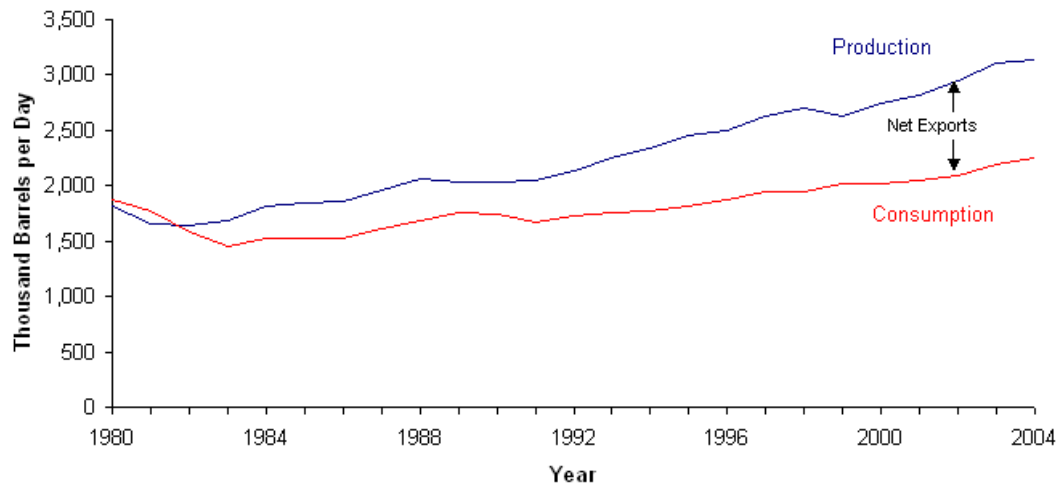
- Oil and gas deposits are found in Anticlinal traps (two layers of non-porous rocks) and are removed in one of 2 ways:
 - Flowing wells → enough natural pressure to move oil/gas
 - Non-flowing wells → not enough pressure, pumps used to move oil/gas
- Even with the best technology, only about 60% of oil deposits can be recovered



Where do we find oil and gas in Canada?

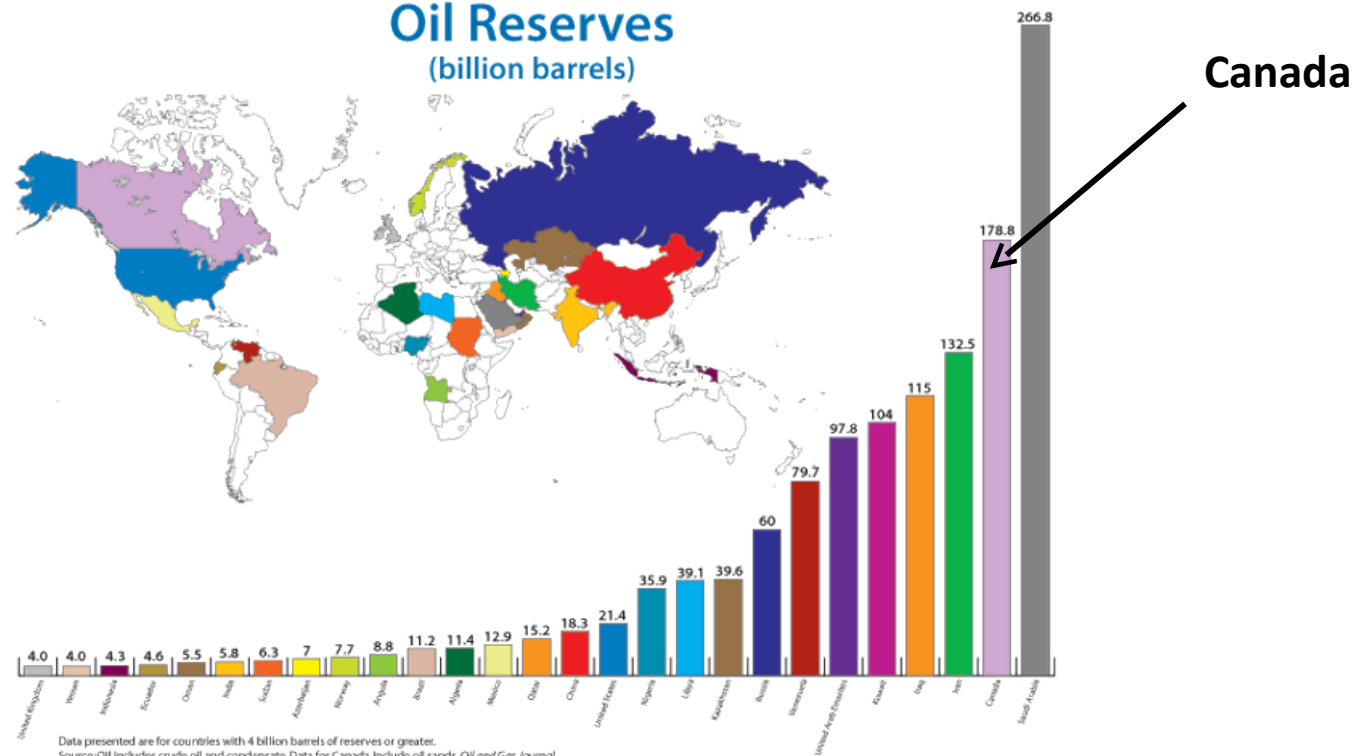


Canada's Oil Production and Consumption 1980-2004



Source: EIA

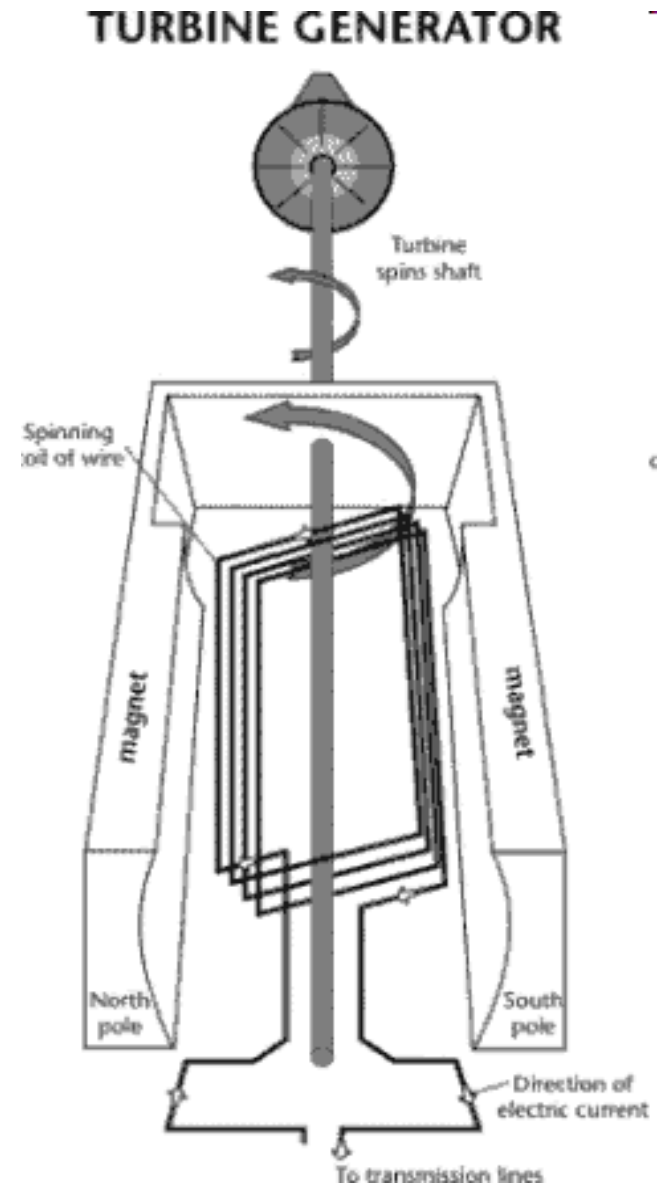
Oil Reserves (billion barrels)



Data presented are for countries with 4 billion barrels of reserves or greater.
Source: Oil includes crude oil and condensate. Data for Canada include oil sands. *Oil and Gas Journal*,
December 19, 2005. Data for the United States are from the Energy Information Agency, November 2005.

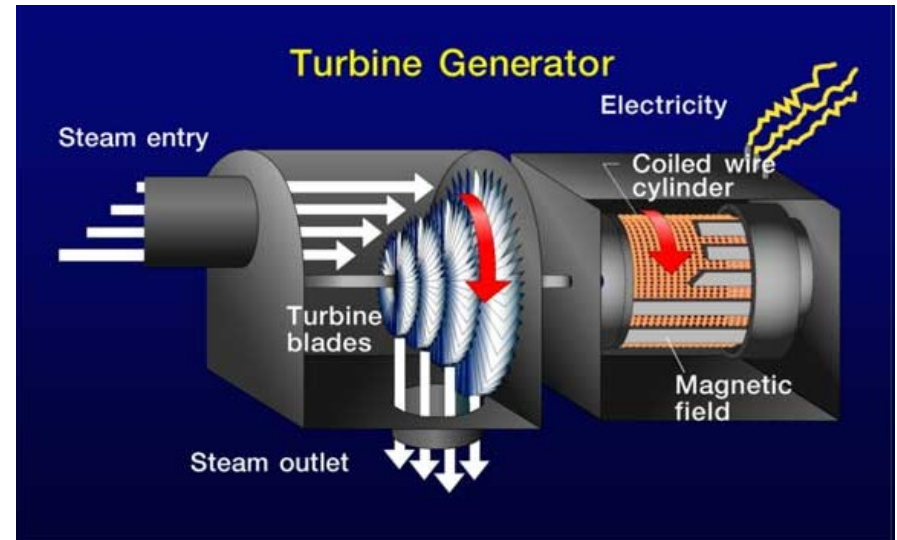
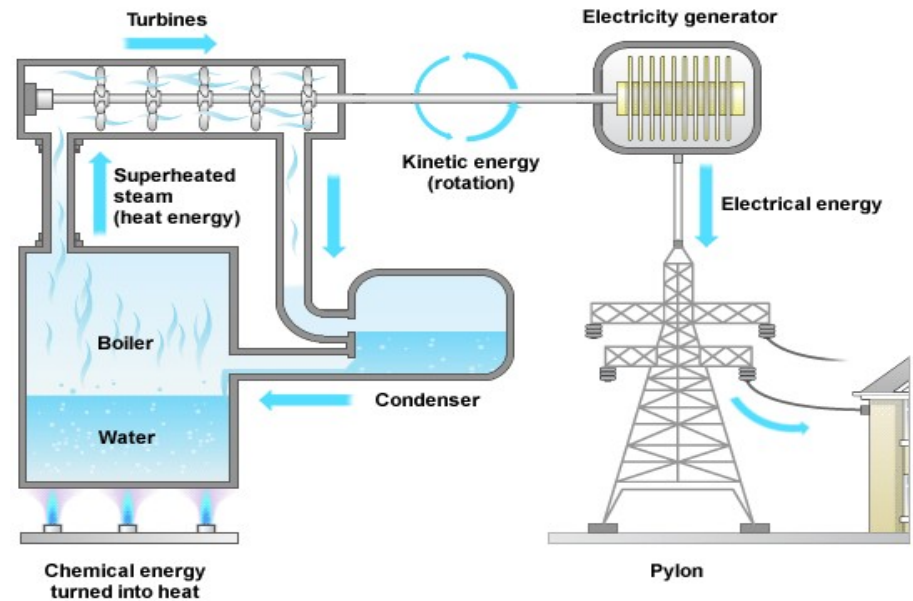
Electricity

- Most electrical power is produced in turbines,
- Turbine shafts are turned by mechanical energy created through:
 - thermal steam
 - water
 - wind

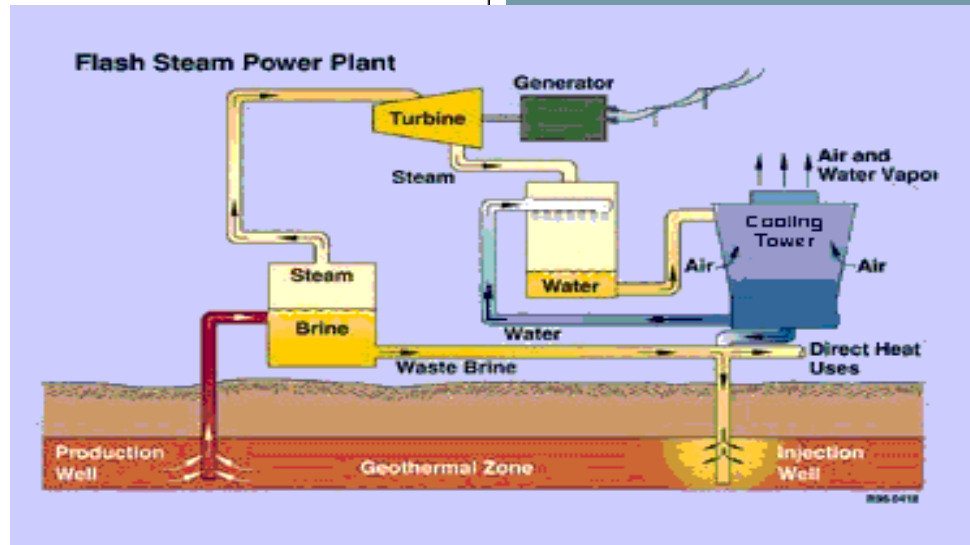
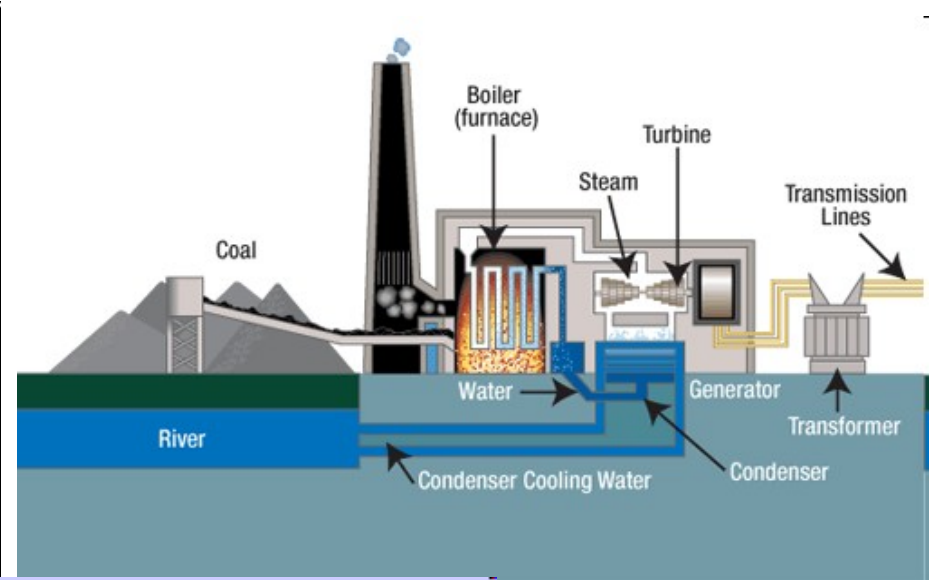
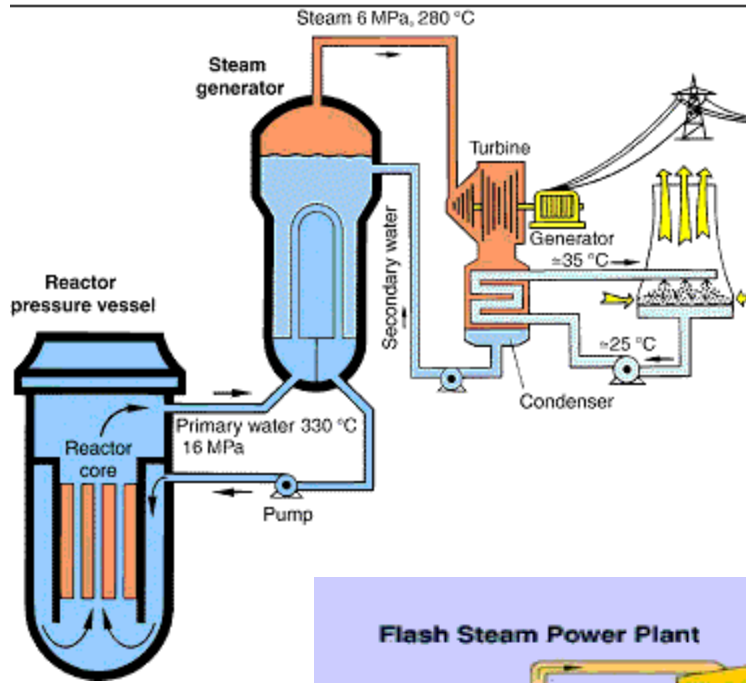


Thermal Generation

- Nuclear, oil, gas, coal & geothermal electrical generation all works on the same principal
- Heat in boiler produces steam, which turns the turbine blades, rotating the turbine shaft



Thermal Generation

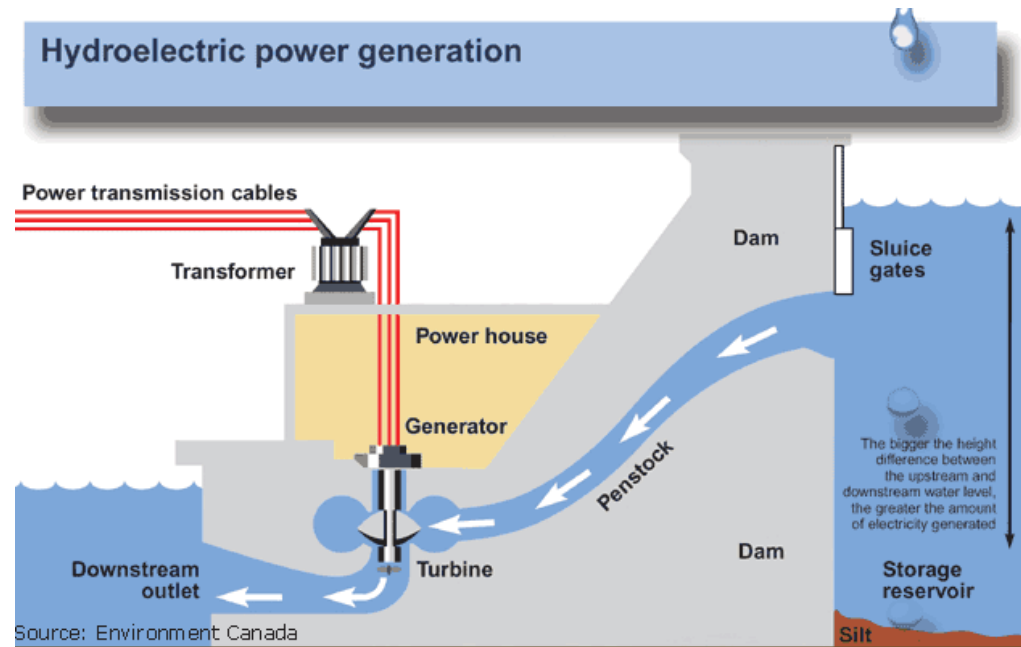




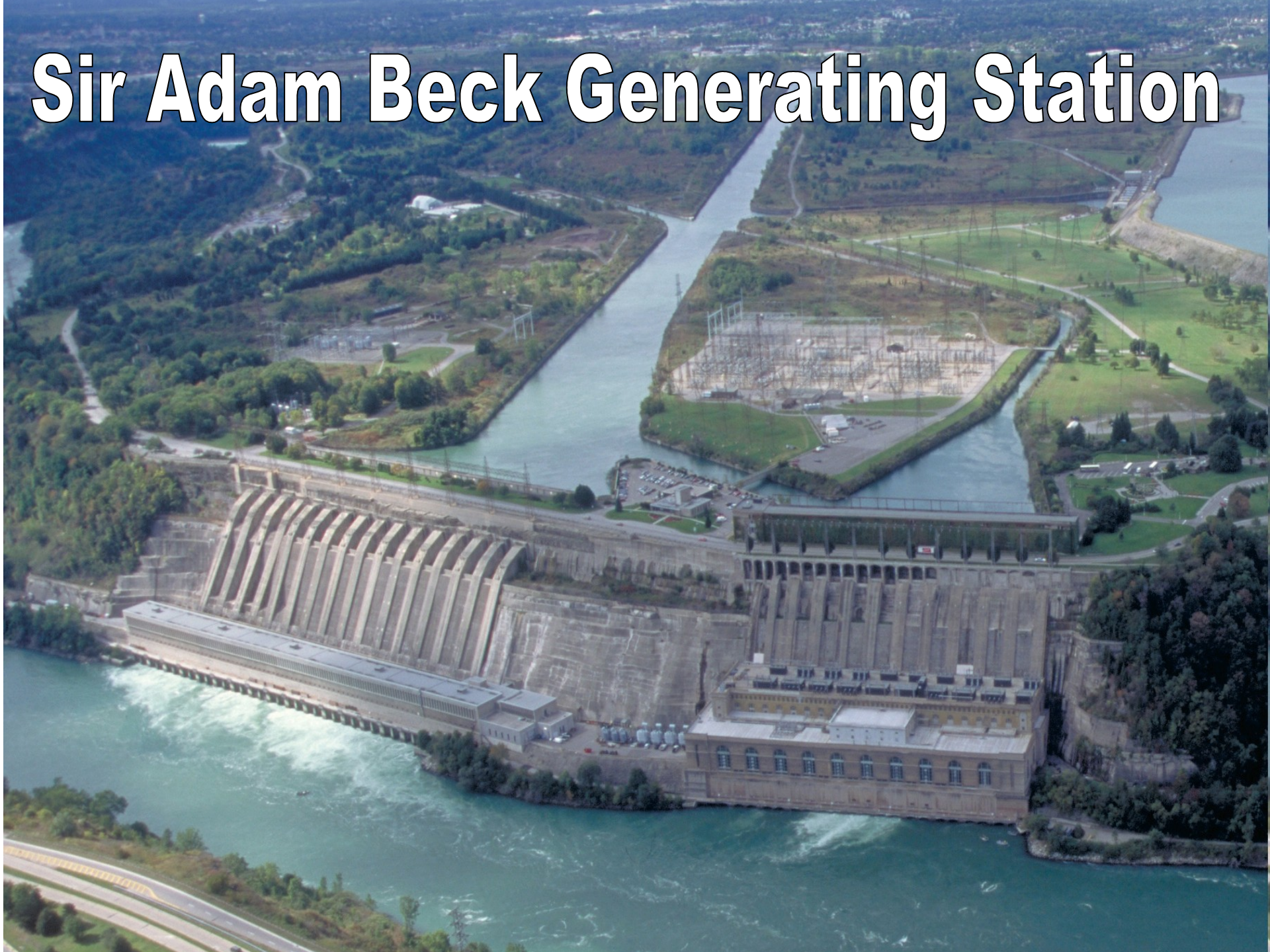
Darlington Nuclear Power Plant

Hydroelectricity

- Electricity is produced through the kinetic energy of the water falling down through the penstock and turning the turbine blades.



Sir Adam Beck Generating Station



Wind Energy

- Electrical power can also be produced by wind energy.
- Wind turns turbine blades, which then turns the turbine shaft, creating electricity in the generator.

