Hydro-Electric Generation System

* Moving water to produce mechanical/electrical energy
* BC Hydro – 43 000 gigawatt hours annually to 1.6 million residents
* 73 000 km of transmission and distribution lines
* Hydroelectric dams
  + Potential energy is stored in a reservoir behind the dam
  + Potential energy is transformed into kinetic energy when the water starts moving
  + The kinetic energy is used to spin a turbine
* Generator
  + The kinetic energy is turned into mechanical energy when the water hits a series of blades
  + The turbine, which is connected to a generator, rotates, turning the mechanical energy into electrical energy
* Step-up Transformer
  + Generators use a low voltage to produce electricity
  + However, it takes a high voltage to transport the electricity
  + The transformer ups the low voltage of the generator
* Grid High Voltage Transmission Lines
  + Transport the electricity from the step-up transformer over long distances
* Terminal Stations
  + Control the power flow
  + Reduce the voltage to “sub transmission voltage”
* Sub-transmission Lines
  + Take power from the terminal stations to distribution centres
* Use of the Customer
  + Most take the power and put into a transformer for their household
  + Some take the energy at transmission voltage level, like large companies
* Distribution Substation
  + Transformers, meters, control and protective devices
  + Transmission voltage is reduced to proper levels for residential and small companies
* <https://www.bchydro.com/energy-in-bc/our_system/generation/electric_generation.html>
* Efficiency is an average of 90%

Hydropower Plants Work

* 675 000 megawatts (the total world output) = 3.6 billion barrels of oil
* Largest source of renewable energy in the United States of America
* Pumped storage plants
  + Upper Reservoir
    - Flows through the plant to create electricity
  + Lower Reservoir
    - Keeps the water from entering back into the lake/river
  + Reversible turbine
    - Pump the water BACK into the upper reservoir
    - Gives the plant more water to make electricity during peak season
  + Generator
    - Heart of the plant
    - Generates the electricity
    - Rotate magnets inside coils of wire
      * Moves electrons to produce electricity
  + Excitor
    - Send electrical currents to the rotor
  + Rotor
    - Large electromagnets that spin inside the stator (tightly-wound coils of copper wire)
* <http://science.howstuffworks.com/environmental/energy/hydropower-plant3.htm>

Thermal Power Stations

* Fuel (coal, oil, gas, etc…) is burned into a furnace to produce heat or chemicals to produce heat
* The heat changes the water in the boiler into steam
  + The steam turns the turbine
  + The turbine powers a generator that turns kinetic energy into electrical energy
* <http://www.bbc.co.uk/bitesize/standard/physics/energy_matters/generation_of_electricity/revision/1/>
* The steam is condensed and recycled to where it was heated
* Efficiency is normally between 33-48%
* Typically found in desert countries where natural gas is plentiful
* Cost is quite large due to need for workers and proper disposal
* If plant produces more than 200MW, fans must be included
* Plants can range from 60MW – 5500MW
* <https://en.wikipedia.org/wiki/Thermal_power_station>