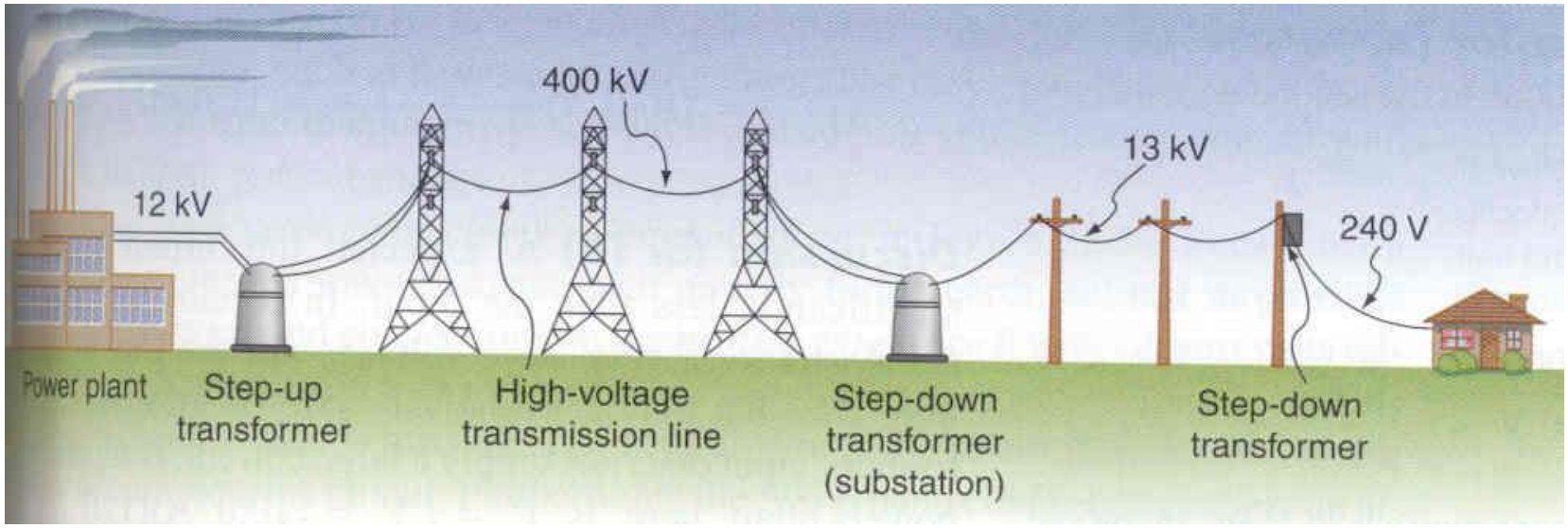
Lecture 7

Electrical Power Generation

Electricity?

Electricity by definition is electric current that is used as a power source!

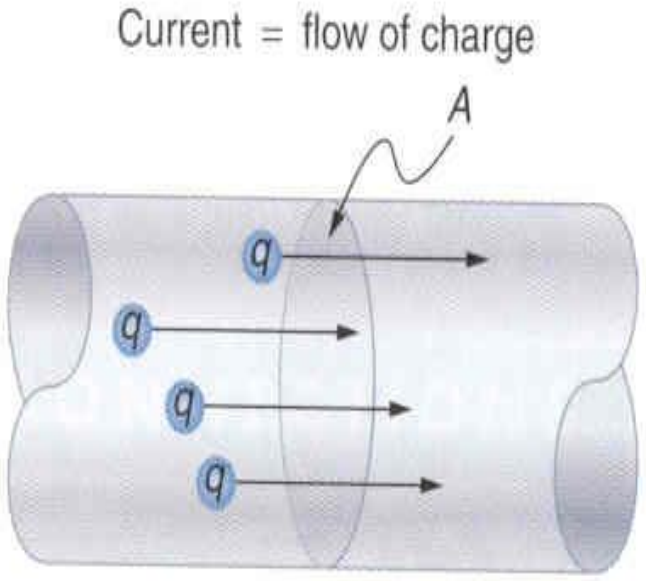
This electric current is generated in a power plant, and then sent out over a power grid to your homes, and ultimately to your power outlets.



What is Electric Current?

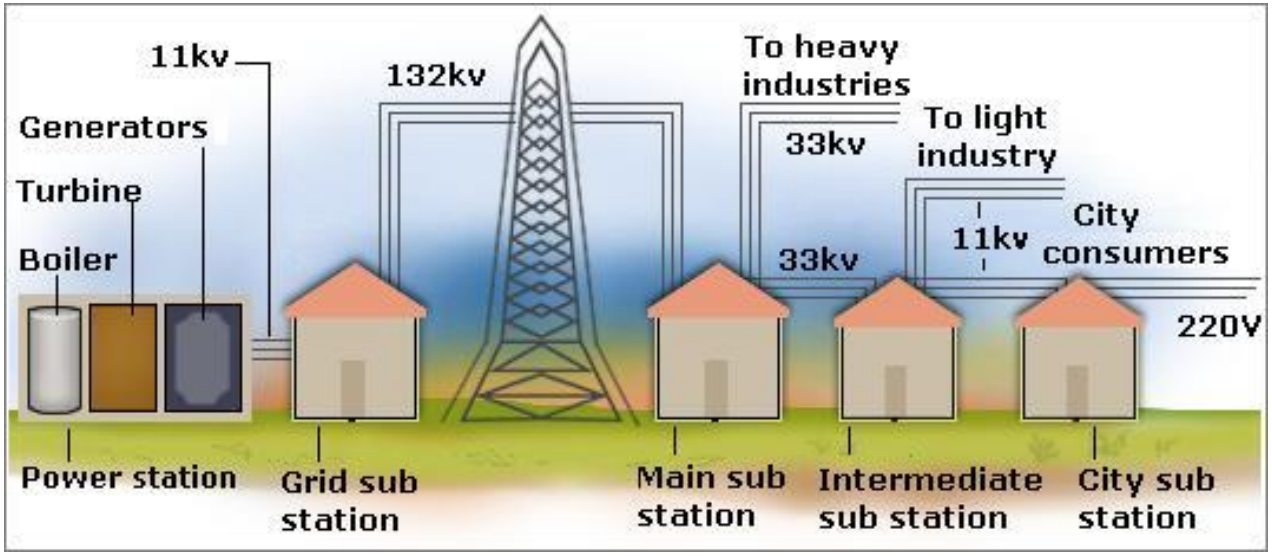
The movement of charges such as electrons is called current, and this electrical current is what powers household appliances.

$$\text{Electric Current} = \frac{\text{Charge Passing Through A Given Area}}{\text{Time}}$$



Power Delivery

Resistance losses are smallest at ***high voltages*** and ***low currents***

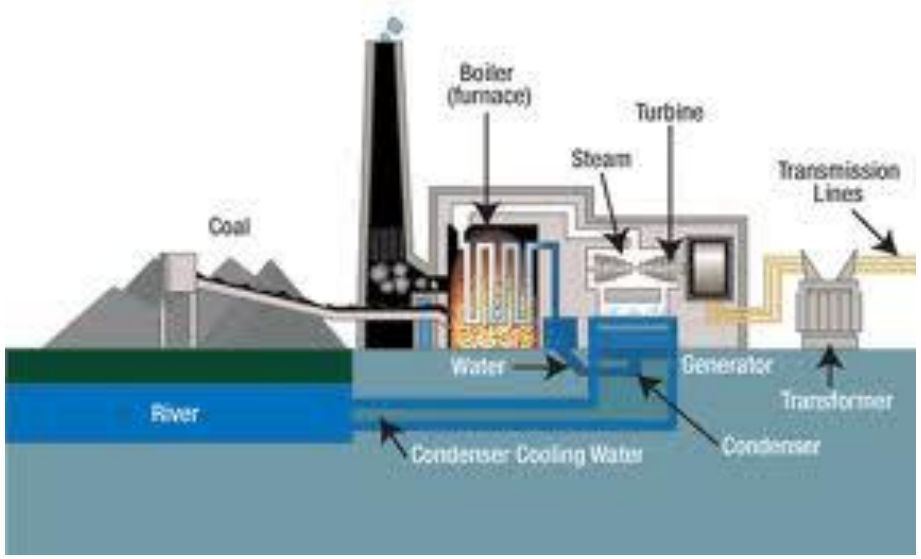


Electrical Power Generation Methods

- Electromagnetic induction – conventional method
  - Fossil fuel based generation (coal-fired, natural gas,…)
  - Hydroelectric
  - Nuclear
  - Wind
  - Geothermal
  - Tidal
  - …
- *Electrochemistry*
  - Fuel cells
- *Photoelectric Effect*
  - *PV solar*

Coal-fired electricity

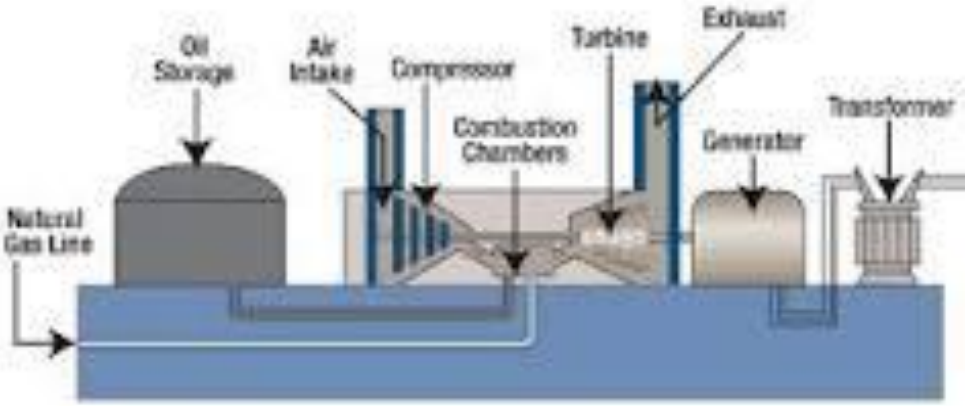
- **Pros**
  - Cheap
  - Abundant



- **Cons**
  - Resource finite
  - Emissions
    - Carbon
    - SO_x
    - NO_x
    - Particulate Matter
    - Mercury
  - Mining
    - Health & environment
  - Transportation

Natural Gas

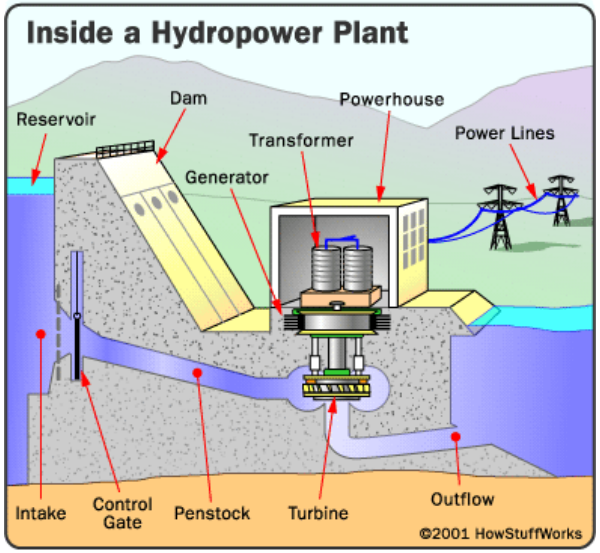
- **Pros**
  - Cleaner than coal
  - Dispatchable
  - "Combined cycle" makes plants more efficient
- **Cons**
  - Costs variability & uncertainty
  - Emissions
  - Supply questionable



Hydroelectric

- **Pros**
  - Emissions very low
  - Opportunity for storage
  - Cheap
  - Flood control
  - Water supply

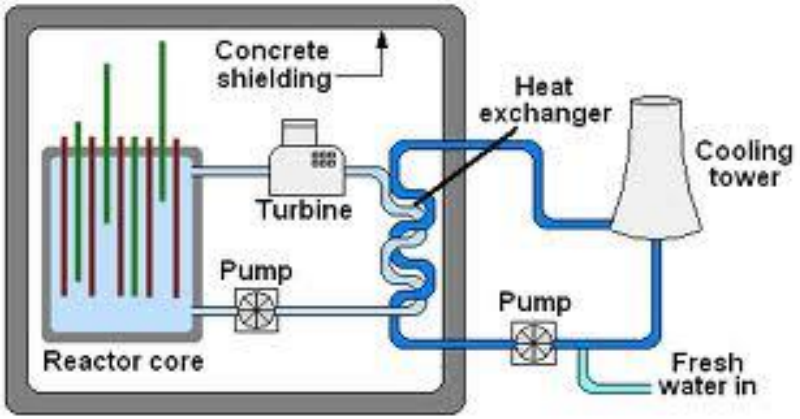
- **Cons**
  - Devastating to wildlife and surrounding area
  - Dependent on weather



Nuclear

- **Pros**
  - No CO2 emissions
  - Cheap?
  - Abundant fuel

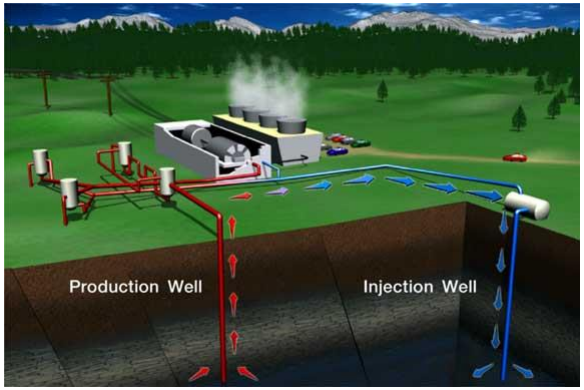
    3% of all topsoil is U235



- **Cons**
  - Cheap?
  - Waste issue
  - Security

Renewables (wind, geothermal, tidal, PV solar)

- **Pros**
  - Low emissions
  - Resource requirements low
  - Energy independence
- **Cons**
  - Costs
  - Intermittency
  - Location



Fuel Cells

- **Pros**
  - Very clean
- **Cons**
  - Costs