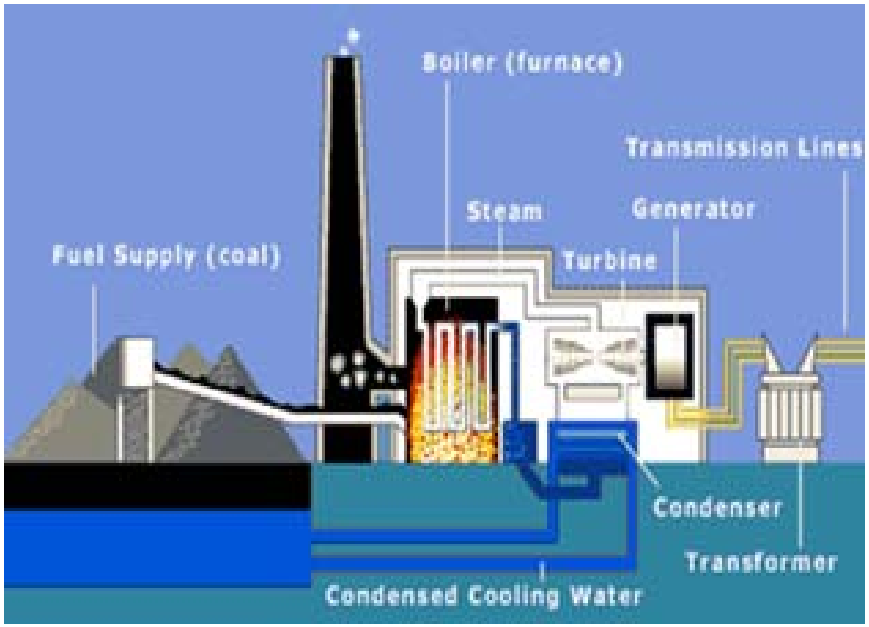
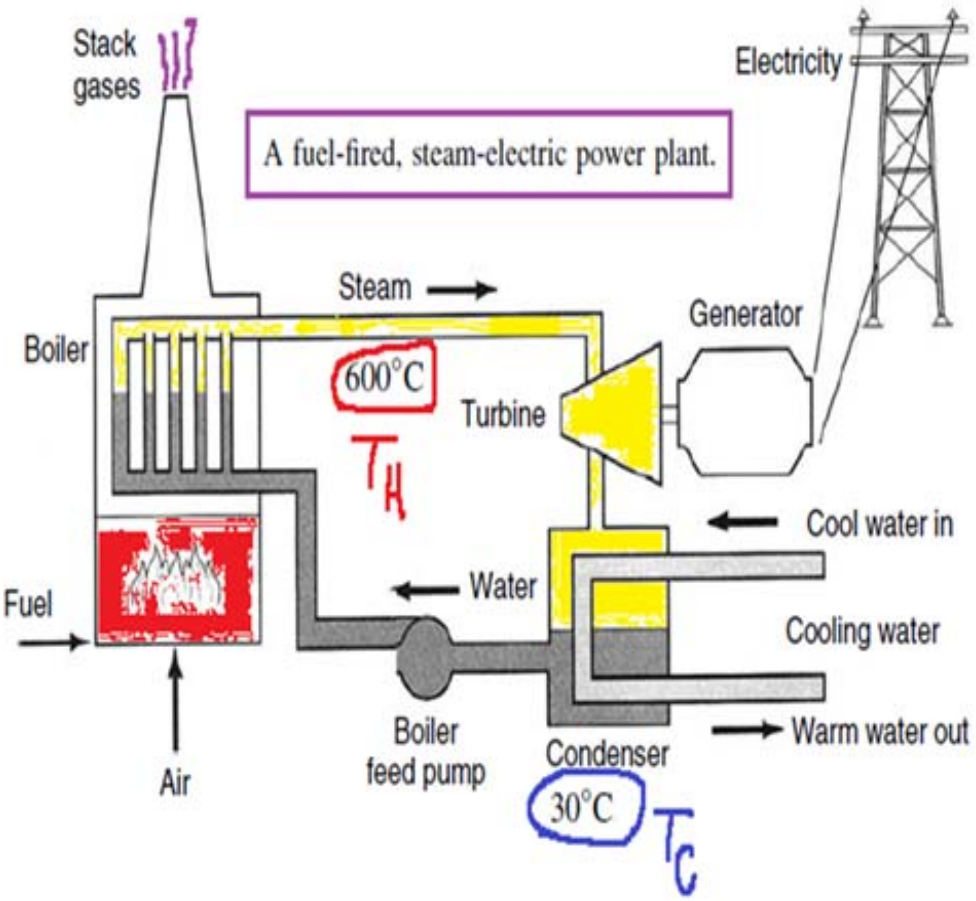
Material Balance



- 1 kWh= 3412 Btu
- 1 kWh = 3600 kJ

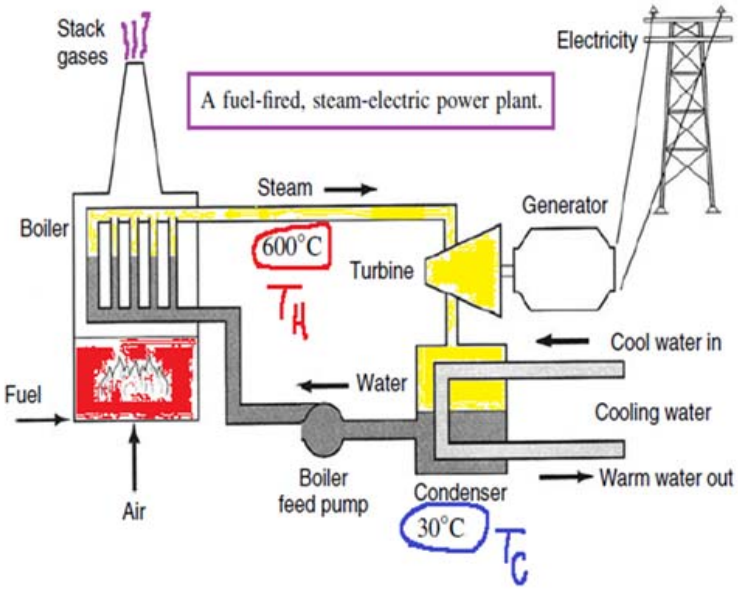
- "Heat Rate" = how much "Thermal Input (Btu or kJ) required to deliver 1kWh of Electrical Output"



Material Balance - Big Picture

- **Subject -** A steam-cycle power plant
  - **How much fuel we need for 1kWh**
  - **How much emission is produced from the fuel**
  - **How the steam was cooled – how much water**

- **Players**



Heat Rate, Heating Value, Fuel Rate

Material Balance - Example/Handout

example problem solving

- A power plant with a heat rate of 10,800 kJ/kWh
- Fuel: Bituminous Coal with 75% Carbon and a heating value (energy released when it is burned) of 27,300 kJ/kg.
- 15% of thermal losses are up the stack, and the remaining 85% are taken away by cooling water
- Q1: Find the efficiency of the plant
- Q2: Find the mass of coal that must be provided per kWh delivered
- Q3: Find the rate of carbon and CO2 emission from the plant in kg/kWh
- Q4: Find the minimum flow of cooling water per kWh if its temperature is only allowed to increase by 10 °C.