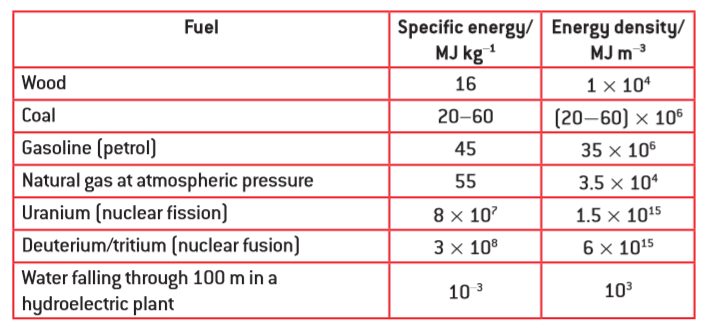
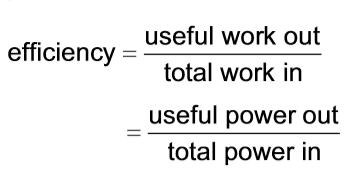
**Videos 15F1 – Energy Production Name**

**Energy Density:**

**0. Energy Density:** How many grams of petrol must you burn to release 100 kJ of energy?

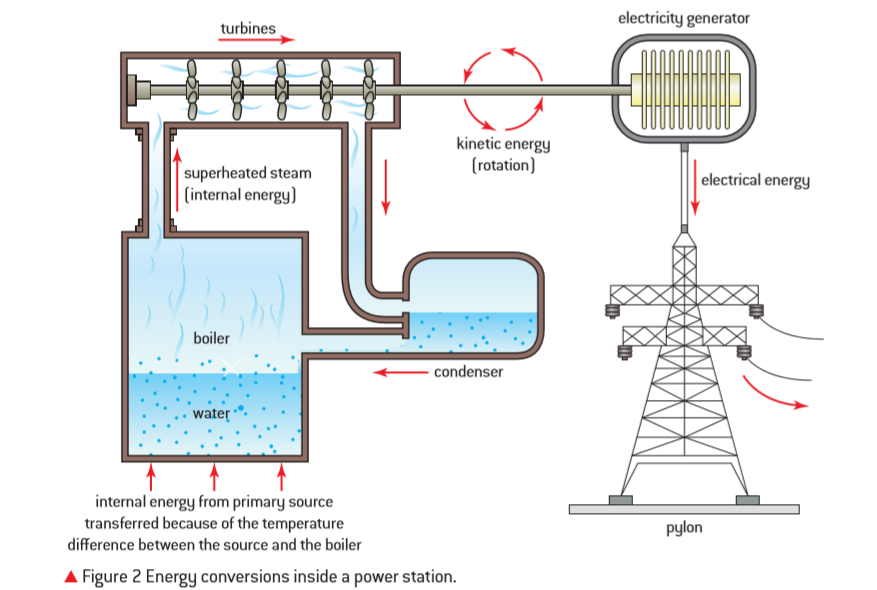
(2.22 grams)



**1. Heating Water:** A water heater uses natural gas to heat 195 liters of water from 15.0 oC to 59.0 oC. What mass of natural gas would this take for a 100% efficient heater? What if the efficiency is 56.0%

(cwater = 4186 J kg-1 oC-1) (0.653 kg, 1.17 kg)

**2. Thermal Power Stations:**



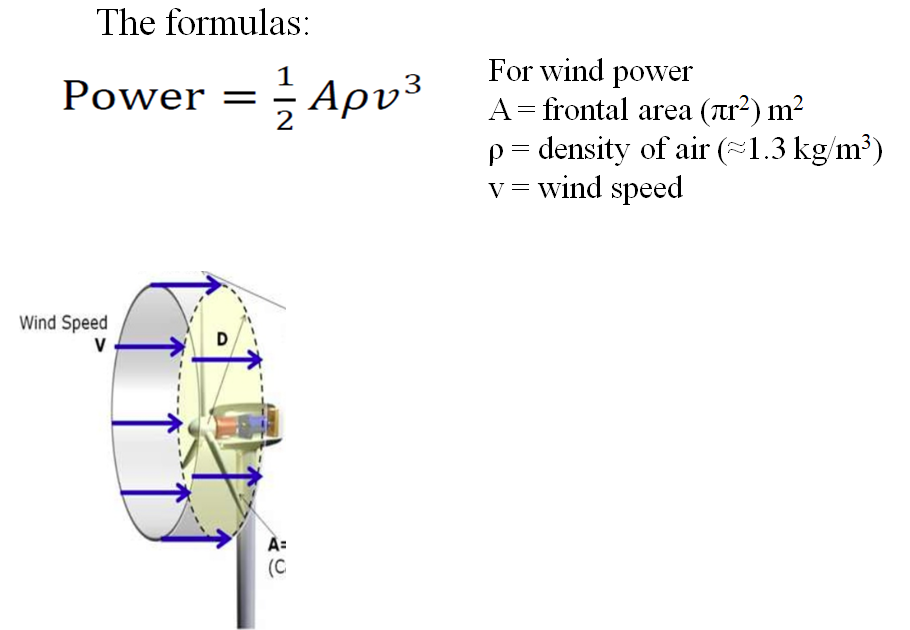
A coal fired electrical generation plant has an overall efficiency of 34.0% and generates an average of 180. MW of electrical power. What quantity of a coal with a specific energy of 47.0 MJ kg-1 would this plant use in one week? (6.81x106 kg)

Whiteboard 1: A water heater uses natural gas to heat 180. liters of water initially at 20.0 oC. If the heater has an efficiency of 54.0%, what is the final temperature of the water after it has burned 0.500 kg of natural gas?

(cwater = 4186 J kg-1 oC-1) (39.7 oC)

Whiteboard 2: A natural gas electrical generation plant puts out an average of 312 MW of power for a year, and in the process, uses 4.36x108 kg of natural gas. What is its overall efficiency? (41.0%)

**3. Wind Turbines:**



Ex1 – What max power can you get from a wind turbine with 8.2 m long blades when the wind speed is about 5.4 m/s on the average? Use the density of air to be 1.2 kg/m3 (2.0x104 W)

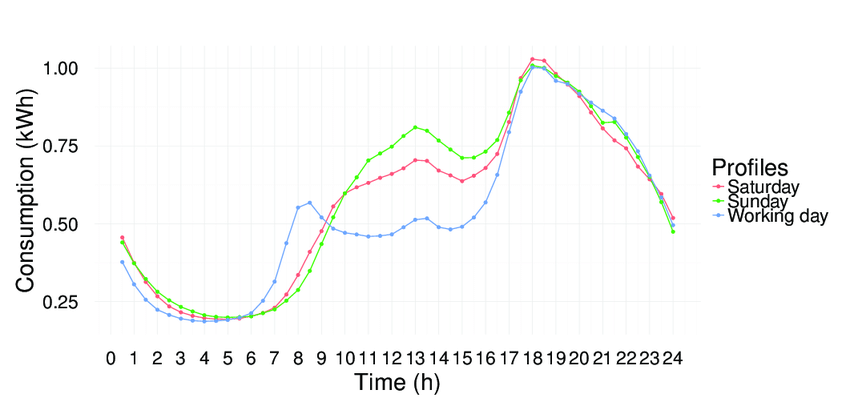
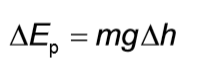
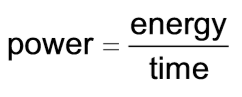
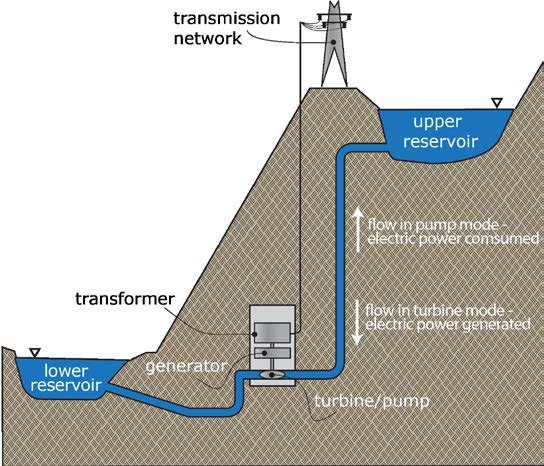
Ex2 – What max power can you get from a wind turbine with 8.5 m long blades when the wind speed is about 7.3 m/s incident on the front of the blades, and is slowed to 6.5 m/s after the blades. Use the density of air to be 1.3 kg/m3 (1.7x104 W)

Whiteboard: Your wind turbines have a radius of 9.70 m. They operate where the wind speed is 8.50 m/s, and they slow the wind to 7.60 m/s on their downwind side. Use the density of air to be 1.3 kgm-3

* What is the power output per turbine?
* How many turbines do you need to generate a megawatt of power? (1.00x106 W)

(33652.26963 W ≈ 3.37x104 W, 30 turbines)

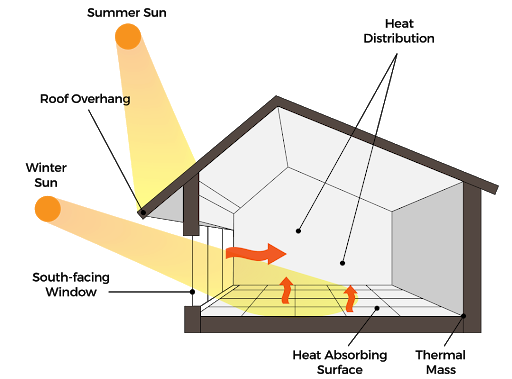
**4. Pumped Energy Storage:**

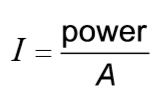
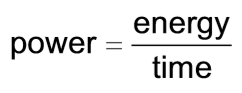
 

Example: A 65.0% efficient pumped storage plant uses a reservoir that is 196 m higher than the generation site. What is its electrical power output if it is draining water from the reservoir a a rate of 1250 kg s-1? (1.56 MW)

Whiteboard: A pumped electrical storage facility generates 1.66 MW of power. It has a reservoir height of 130. m, and releases 2240 kg of water per second. What is its overall efficiency? (58.1%)

**5. Solar:**



Example: A photovoltaic panel measures 1.75 m by 1.10 m, and is 23.0% efficient. How much total electrical power can it put out if the solar intensity is 890 W m-2? How many Joules of electrical energy can it produce in a 6.00 hour period when the sun is hitting the panels? How many kWh of electricity? (394 W, 8.51x106 J, 2.36 kWh)

Whiteboard: A house has a total of 12.8 m2 of solar panels that generate a power of 2045 Watts when the solar intensity is 750. W m-2. What is the efficiency of the panels? (21.3 %)