

BTU Problem Set - Show ALL work

BACKGROUND:

BTU (British thermal unit) is the amount of energy required to raise the temperature of 1 lb of water by 1 °F.

cal (calorie) - the amount of energy required to raise the temperature of 1 g of water by 1 °C.

Commonly, kilocalorie (kcal or Calorie) is used, which is 1,000 calories

Conversions: 1 Btu = 252 cal = 0.252 kcal
 1 cal = 4.184 J
 42 gallons = 1 barrel

1 Btu = 1055 J (joule) = 1.055 kJ
 3.41×10^6 BTU = 1,000 kWh

Two other units that are often seen are the horsepower and the watt. These are not units of energy, but are units of **power**.

Conversions: 1 watt (W) = 3.412 Btu / hour 1 horsepower (hp) = 746 W

Watt-hour - Another unit of energy used only to describe electrical energy.

Usually we use kilowatt-hour (kW-h) since it is larger. **1 MWH = 1000 kWh**

quad (Q) - used for describing very large quantities of energy. 1 Q = 10^{15} Btu

percent efficiency - (Power out) / (Power in) See page 350-351 for **clarification**

<i>Part 1: Calculate the BTU/degree day/ft² for each school's power plant. This is a value that represents how much heat energy is used, normalized for the amount of heating that is needed and the area of the campus.</i>	<i>Part 2: Calculate the efficiency of each Power Plant.</i>
<p><u>Dartmouth Power Plant, Average Year</u> Oil=3,919,419 gallons Electricity= 27,043,809 kwh Space=3,500,000 square feet Degree Days=7385 DD Costs: Oil=\$19/barrel Electricity 7.5 cents/kwh</p> <p><u>Hotchkiss Power Plant, Average Year</u> Oil= 273,704 gallons Electricity=1,071,312 kwh Space=348,335 square feet Degree days= 6870 DD Costs: Oil=\$22.60/barrel Electricity=8.5 cents/kwh</p> <p><u>Taft Power Plant, Average Year</u> Oil=4825 barrels Electricity=965,000 kwh Space = 250,300 square feet Degree Days= 6500 DD Costs: Oil=\$24.05/barrel Electricity= 9.5 cents/barrel</p>	<p><u>Ryegate Wood Chip Electrical Generating Plant, Average Month</u> Electricity Generated= 16128 MWH (megawatthours) Wood chips consumed = 22579 tons BTU value of the wood chips = 4700 BTU/lb (2000lb=1 ton)</p> <p><u>Grayling Generating Station (burns wood chips), Average Year</u> Electricity Generated = 155,000,000 kwh Wood chips consumed = 250,000 tons BTU value of the wood = 4500 BTU/lb</p> <p><u>Wheelabrator Frackville Culm Burning Plant, Average Year</u> Electricity generated = 395,478 MWH Culm burned = 491,629 tons Coal burned = 250 tons Oil burned = 212,622 gallons BTU value of culm = 5000 BTU/lb BTU value of coal = 8000 BTU/lb BTU value of oil = 138,000 BTU/gallon</p> <p><u>Waste Management, Inc (burns waste methane), Average Month</u> Methane consumed = 26,000,000 cubic yards Electricity generated = 25,834,200 KWH BTU value of methane = 560 BTU/cubic foot BTU value of electricity = 3413 BTU/kwh</p>

Selected Solution: Dartmouth= 26.4 BTU/DD-ft²

Selected Solution: Ryegate 25.9%