More Thermal Energy & Efficiencies

Physics and Mathematics of Sustainable Energy

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1. A home electric generator works by converting the the thermal energy obtained by burning gasoline into electrical energy. The Westinghouse WGen7500 has a fuel capacity of 6.6 gallons of gasoline, which produces 233 kWh of thermal energy when burned. The generator's efficiency is 18%.

   (a) How much thermal energy is produced from burning 6.6 gallons of gasoline (petrol)?

   (b) What are the emissions associated with this?

   (c) How much electrical energy can the generator generate from 6.6 gallons of gasoline?

   (d) What are the emissions (in grams per kWh) associated with this electricity?

2. Suppose you wish to use a propane heater to heat the first floor of your house. You estimate that on a cold winter day your heater will need to supply 400,000 BTUs of thermal energy to keep things at a comfortable temperature. The efficiency of this heater is 0.8. How much propane will you burn per day? Burning one gallon of propane releases roughly 90,000 BTUs of thermal energy.

- 1 kWh = 3.6 MJ = 3412 BTU
- 1 MMBTU = 1,000,000 BTU
- Calorific value of heating oil: 12.8 kWh/kg, 37.3 MJ/L, 139,000 BTU/gallon
- Carbon intensity of heating oil: 260 g of CO_2 per kWh of thermal energy. 10.2 kg CO_2 per gallon of fuel. 74.1 kg CO_2 per MMBTU of thermal energy.
- Calorific value of petrol: 33 kWh/gal.
- Carbon intensity of petrol: approx 10.5 kg/gal.
- 1 gallon = 3.8 liters
- Current average cost of heating oil in Maine: $4.90/gallon.