

More Thermal Energy

Physics and Mathematics of Sustainable Energy

College of the Atlantic. October 15, 2024

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%. How much electrical energy can the generator generate from 6.6 gallons of gasoline?
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.
3. In 2015–16 the Seafox Dormitory used 3185 gallons of heating oil.
 - (a) How much would this fuel cost?
 - (b) How much energy thermal energy is this? Answer in BTUs, MMBTUs, and kWh. Put this number into context.
 - (c) How much carbon dioxide is released into the atmosphere as a result of burning this fuel? Put this number into context.
4. Suppose the Seafox furnace is 70% efficient. In that case, how much of the thermal energy from burning the oil ends up inside Seafox? This quantity is known as the *heating load*.
5. Suppose we replaced the Seafox furnace with one that is 90% efficient.
 - (a) How much fuel would we need to heat Seafox with this more efficient furnace?
 - (b) How much money would you save in one year?
 - (c) How much less CO₂ would be emitted in one year?

- 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 CO₂ per kWh of thermal energy. 10.2 kg CO₂ per gallon of fuel. 74.1 kg CO₂ per MMBTU of thermal energy.
- 1 gallon = 3.8 liters
- Current average cost of heating oil in Maine: \$4.90/gallon.