

More Thermal Energy

Physics and Mathematics of Sustainable Energy

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- In 2015–16 the Seafox Dormitory used 3185 gallons of heating oil.
 - How much would this fuel cost?
 - How much energy thermal energy is this? Answer in BTUs, MMBTUs, and kWh. Put this number into context.
 - How much carbon dioxide is released into the atmosphere as a result of burning this fuel? Put this number into context.
 - 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*.
 - Suppose we replaced the Seafox furnace with one that is 90% efficient.
 - How much fuel would we need to heat Seafox with this more efficient furnace?
 - How much money would you save in one year?
 - How much less CO₂ would be emitted in one year?
 - Suppose you want 100 kWh of heat to keep your house warm on a cold Maine day. If you generate this heat with a traditional electric heater:
 - How much CO₂ is released as a result? (Assume a carbon intensity for electricity generation of 350g/kWh.)
 - How much would this cost in Maine?
 - If you generate this heat with a furnace burning heating oil and the efficiency of the furnace is 80%:
 - How much CO₂ would be released as a result?
 - How much would this cost in Maine?
 - If you generate this heat with a heat pump with a COP of 3:
 - How much CO₂ would be released as a result?
 - How much would this cost in Maine?
- 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.
 - 1 gallon = 3.8 liters
 - Current average cost of heating oil in Maine: \$2.80/gallon.