

Thermal Energy: Different Forms of Home Heating

Physics and Mathematics of Sustainable Energy

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1. 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:
 - (a) How much CO₂ is released as a result? (Assume a carbon intensity for electricity generation of 350g/kWh.)
 - (b) How much would this cost in Maine?
 2. If you generate this heat with a furnace burning heating oil and the efficiency of the furnace is 80%:
 - (a) How much CO₂ would be released as a result?
 - (b) How much would this cost in Maine?
 3. If you generate this heat with a heat pump with a COP of 3:
 - (a) How much CO₂ would be released as a result?
 - (b) How much would this cost in Maine?
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- 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: \$4.40/gallon.
 - Cost of electricity in Maine \$0.23/kWh.