# More Thermal Energy

Physics and Mathematics of Sustainable Energy

College of the Atlantic.

1. In 2010-11 the Seafox Dormitory used 4120 gallons of heating oil. Last class you calculated that burning this amount of fuel oil would generate 570 MMBTU (or 170,000 kWh) of thermal energy and would release 44 tons of $CO_2$. 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*.

2. 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 less $CO_2$ would be emitted in one year?

3. 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 $CO_2$ is released as a result? (Assume a carbon intensity for electricity generation of 400g/kWh.)

   (b) How much would this cost in Maine?

4. If you generate this heat with a furnace burning heating oil and the efficiency of the furnace is 80%:

   (a) How much $CO_2$ would be released as a result?

   (b) 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 $CO_2$ per kWh of thermal energy
- 1 gallon = 3.8 liters
- Current average cost of heating oil in Maine: \$2.30/gallon.
- Cost of electricity in Maine \$0.168/kWh.