

Chapter 19 Problem 37 †

Given

Oil – 30.0 kWh/gal

Oil – \$1.75/gal

Electricity – \$0.165 /kWh

Solution

What COP is needed for a heat pump to replace a fuel oil heating system.

First calculate how much energy you get per dollar for the two systems. For the electricity you get

$$energy_{electricity} = \$1.00 \left(\frac{1 \text{ kWh}}{\$0.165} \right) = 6.06 \text{ kWh}$$

For the fuel oil you get

$$energy_{oil} = \$1.00 \left(\frac{1 \text{ gal}}{\$1.75} \right) \left(\frac{30 \text{ kWh}}{1 \text{ gal}} \right) = 17.14 \text{ kWh}$$

Now the COP for a fuel pump is

$$COP = \frac{Q_h}{W}$$

If a dollar's worth of electricity does work on the heat pump and it is desired to have the same amount of heat generated as burning the fuel oil, then

$$COP = \frac{17.17 \text{ kWh}}{6.06 \text{ kWh}} = 2.83$$

This is the break even point. You would want to have a higher COP in order to recover the cost of installing the heat pump.

†Problem from Essential University Physics, Wolfson