Given: $therm := 29.3\ kW\ hr$ $USD := 1$

The efficiency of cooking appliances affects the internal heat gain from them since an inefficient appliance consumes a greater amount of energy for the same task, and the excess energy consumed shows up as heat in the living space. The efficiency of open burners is determined to be 73 percent for electric units and 38 percent for gas units. Consider a 2-kW electric burner at a location where the unit costs of electricity and natural gas are $0.09/kWh and $1.20/therm, respectively.

Note: 1 therm = 29.3 kWh

Required:

Determine the rate of energy consumption by the burner and the unit cost of utilized energy for both electric and gas burners.

Solution:

The efficiency of the two burners are defined as

$$\eta_{elec} := 73\ \% \qquad \eta_{gas} := 38\ \%$$

The heat provided by the burner is defined as

$$\dot{Q}'_{out} := 2\ kW$$

The rate cost of the electricity and gas are given as

$$R_{elec} := 0.09 \cdot \frac{USD}{kW\ hr} \qquad R_{gas} := 1.20 \cdot \frac{USD}{therm}$$

The energy rate consumed by the electric burner is

$$\dot{E}'_{elec} := \frac{\dot{Q}'_{out}}{\eta_{elec}} = 2.74\ kW$$

The unit cost associated with the electric burner is then

$$C_{elec} := \frac{R_{elec} \cdot \dot{E}'_{elec}}{kW} = 0.2466\ \frac{USD}{kW\ hr}$$

Assuming the gas burner produces the same amount of heat, the energy rate consumed by the gas burner is

$$\dot{E}'_{gas} := \frac{\dot{Q}'_{out}}{\eta_{gas}} = 5.263\ kW$$

The unit cost associated with the gas burner is then

$$C_{gas} := \frac{R_{gas} \cdot \dot{E}'_{gas}}{kW} = 0.2156\ \frac{USD}{kW\ hr}$$

Discussion:

These answers are reasonable. It is expected that the gas burner would cost less by comparing the rate cost of the electric and gas. While this is not the only factor involved, it is a quick check that may be performed.

$$R_{elec} = 0.09\ \frac{USD}{kW\ hr} \qquad R_{gas} = 0.041\ \frac{USD}{kW\ hr}$$