Enthalpy of combustion of CO

Approximately one billion tons of CO is lost each due to incomplete combustion of fuels. First compare the enthalpy of combustion of CO to that of H_2. Is CO a potential fuel? Then determine how many Joules of energy is lost every year.

You will need the following data.

$$\Delta_f H^o(CO_2) = -393.5\ kJ/mol$$

$$\Delta_f H^o(CO) = -110.5\ kJ/mol$$

$$\Delta_f H^o(H_2O) = -286\ kJ/mol$$

Enthalpy of combustion of CO

Step 1: Write down the balanced equations for the combustion of CO and H_2.

$$CO + \frac{1}{2}O_2 \rightarrow CO_2$$

$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$$

Step 2: Calculate the enthalpies of combustion.

$$\Delta_{rxn}H^o = \Delta_f H^o(CO_2) - \Delta_f H^o(CO)$$

$$\Delta_{comb}H^o(CO) = -393.5 - (-110.5) = -283\,\frac{kJ}{mol}$$

$$\Delta_{comb}H^o(H_2) = -286\;kJ/mol$$

Enthalpy of combustion of CO

We see that CO has almost as much heat released as H_2 on a per mole basis. Clearly there is a significant waste. To see how large the waste is we calculate the number of moles in 1 billion tons of CO.

$$n_{CO} = \frac{m_{CO}}{M_{m,CO}} = \frac{10^{15}\ gm}{28\ gm/mol} = 3.57\ x\ 10^{13}\ moles$$

and then calculate the number of Joules of energy

$$q = n_{CO}\Delta_{comb}H^{o}(CO)$$

$$q = (3.57\ x\ 10^{13}\ moles)(-283\ kJ/mol)$$

$$q = 10^{16}\ Joules$$