

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 H₂. Is CO a potential fuel? Then determine how many Joules of energy is lost every year.

You will need the following data.

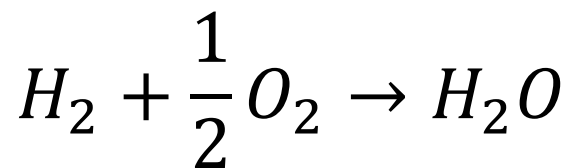
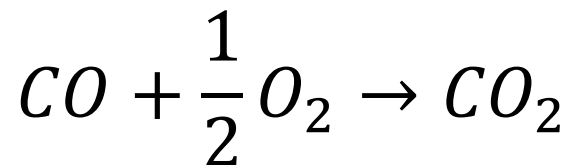
$$\Delta_f H^\circ(\text{CO}_2) = -393.5 \text{ kJ/mol}$$

$$\Delta_f H^\circ(\text{CO}) = -110.5 \text{ kJ/mol}$$

$$\Delta_f H^\circ(\text{H}_2\text{O}) = -286 \text{ kJ/mol}$$

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Step 1: Write down the balanced equations for the combustion of CO and H₂.



Step 2: Calculate the enthalpies of combustion.

$$\Delta_{rxn}H^\circ = \Delta_fH^\circ(CO_2) - \Delta_fH^\circ(CO)$$

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

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

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We see that CO has almost as much heat released as H₂ 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.

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

and then calculate the number of Joules of energy

$$\begin{aligned} q &= n_{CO} \Delta_{comb} H^{\circ}(CO) \\ q &= (3.57 \times 10^{13} \text{ moles})(-283 \text{ kJ/mol}) \\ q &= 10^{16} \text{ Joules} \end{aligned}$$