Elementary Introduction to Entropy as a State Function

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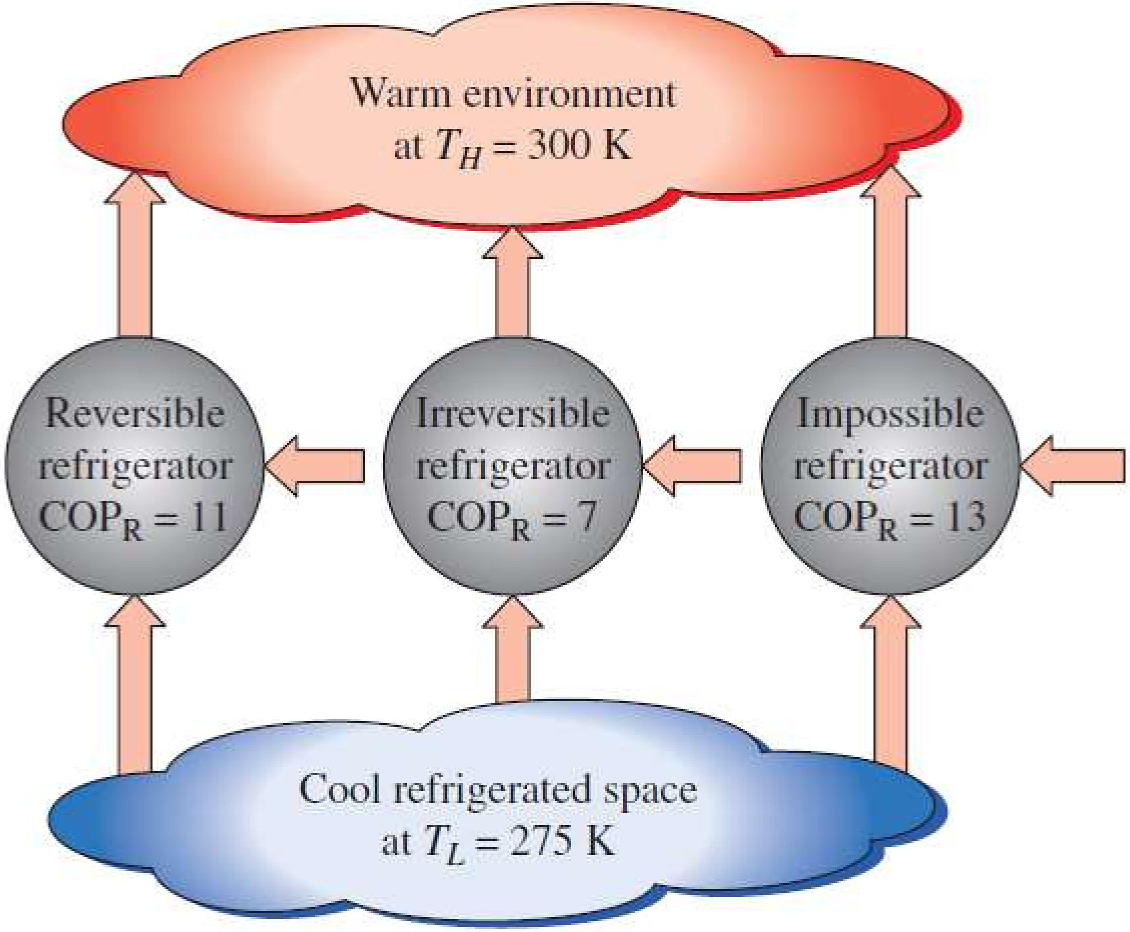
Previous Lecture: Carnot Refrigerator & Heat Pump



$$COP_R = \frac{1}{Q_H/Q_L - 1}$$

$$COP_{HP} = \frac{1}{1 - Q_L/Q_H}$$

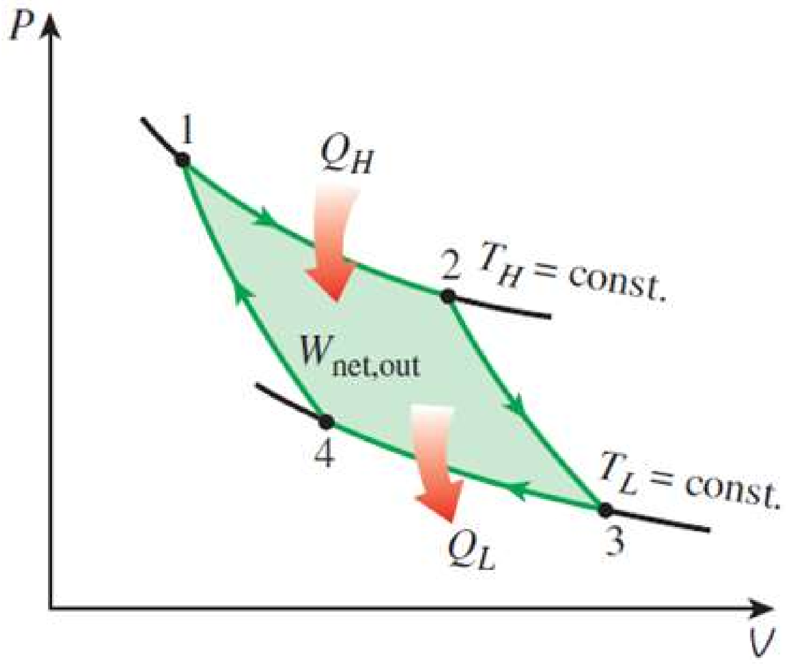
$$COP_{R,rev} = \frac{1}{T_H/T_L - 1}$$

$$COP_{HP,rev} = \frac{1}{1 - T_L/T_H}$$

$$COP_R \begin{cases} < COP_{R,rev} & \text{irreversible refrigerator} \\ = COP_{R,rev} & \text{reversible refrigerator} \\ > COP_{R,rev} & \text{impossible refrigerator} \end{cases}$$

TD: Cengel & Boles

Entropy: A State Function!



$$\frac{Q_H}{T_H} + 0 - \frac{Q_L}{T_L} + 0 = 0$$

$$\sum_i \frac{Q_i}{T_i} = 0$$

$$\sum_i U_i = 0;\ \oint U = 0;\ U\ is\ a\ State\ Function$$

$$\left(\frac{Q_H}{Q_L}\right)_{\text{rev}} = \frac{T_H}{T_L}$$

$$\textstyle\sum_i \frac{Q_i}{T_i} = 0;\ S_i = \frac{Q_i}{T_i};\ \sum_i S_i = 0;\ \oint S = 0;\ S\ is\ a\ State\ Function!!!$$

Fig: TD-Cengel & Boles

What's next?

- Clausius Inequality