Carnot Heat Engine

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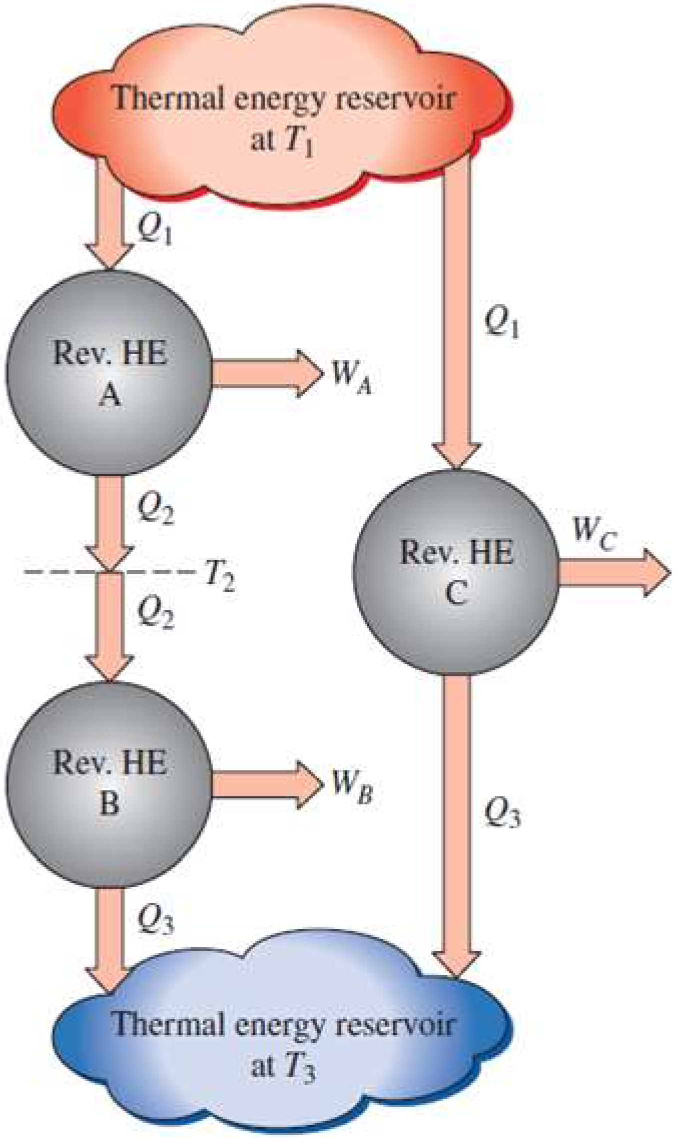
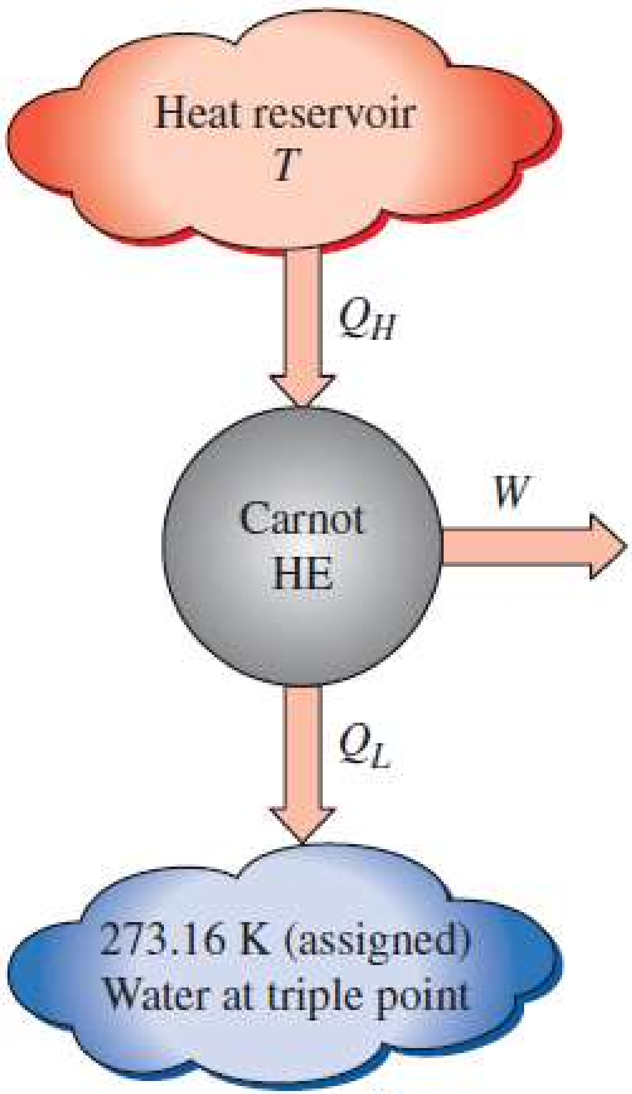
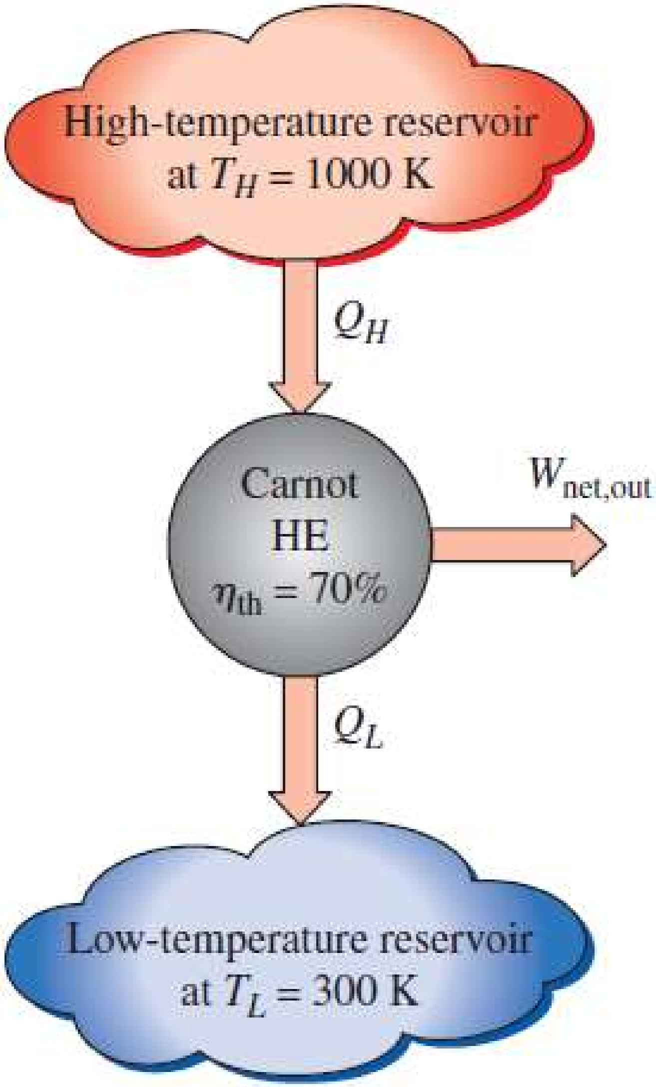
Previous lecture: Kelvin and Absolute T





$$T = 273.16\,\frac{Q_H}{Q_L}$$

Carnot Heat Engine

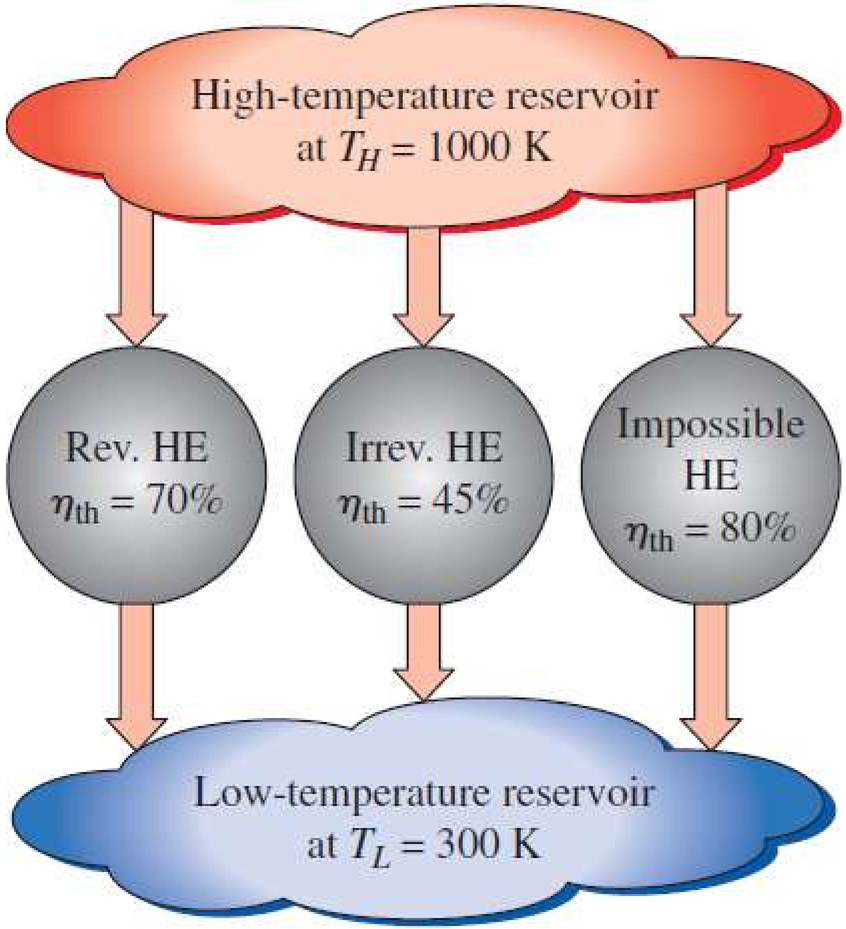


$$\eta_{th} = 1 - \frac{Q_L}{Q_H}$$

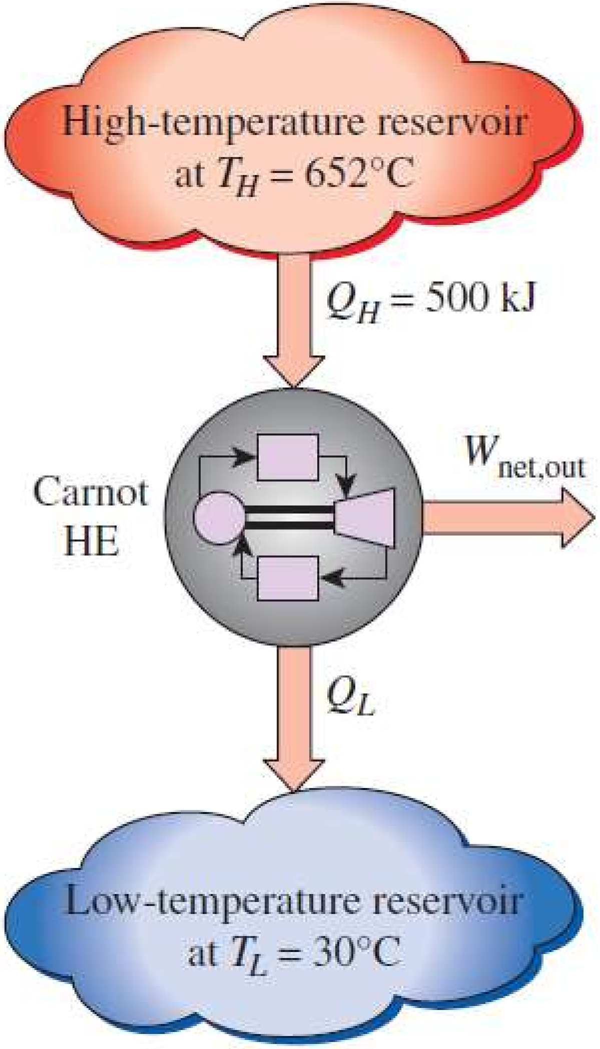
$$\eta_{th,rev} = 1 - \frac{T_L}{T_H}$$

$$\eta_{th} \begin{cases} < & \eta_{th,rev} \quad \text{irreversible heat engine} \\ = & \eta_{th,rev} \quad \text{reversible heat engine} \\ > & \eta_{th,rev} \quad \text{impossible heat engine} \end{cases}$$

Comparing efficiencies of Heat Engine



Analysis of a Carnot Heat Engine

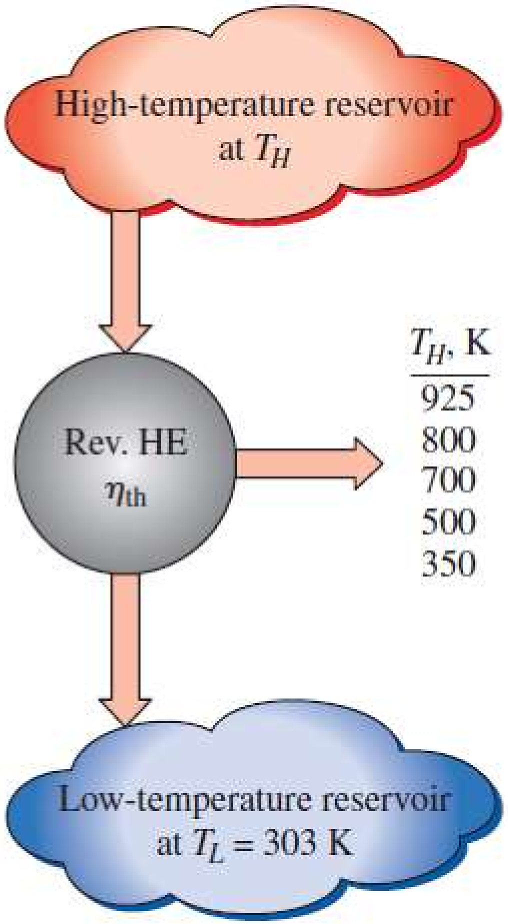


$$\eta_{th,rev} = 1 - \frac{T_L}{T_H} = 1 - \frac{(30 + 273)\text{ K}}{(652 + 273)\text{ K}} = \mathbf{0.672}$$

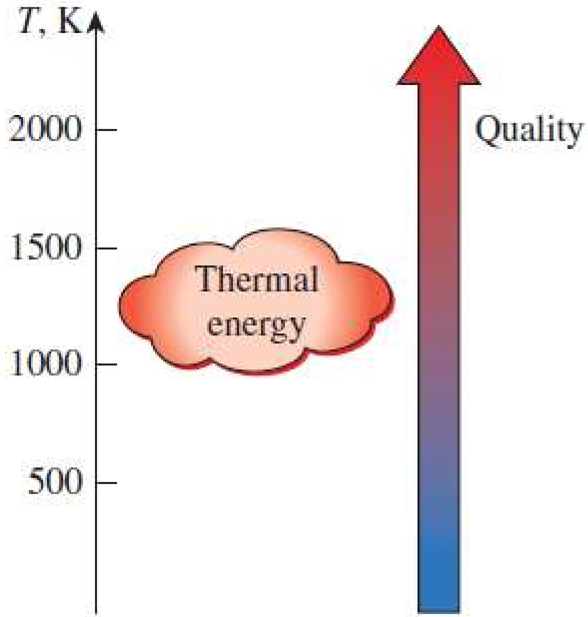
$$Q_{L,rev} = \frac{T_L}{T_H} Q_{H,rev} = \frac{(30 + 273)\text{ K}}{(652 + 273)\text{ K}}(500\text{ kJ}) = \mathbf{164\ kJ}$$

Quality of Energy

$$\eta_{th,rev} = 1 - \frac{T_L}{T_H}$$



T_H, K	η_{th}, %
925	67.2
800	62.1
700	56.7
500	39.4
350	13.4



What's next?

- Carnot refrigerator and heat pump