

Engines and the 2nd Law

The objective: turn heat from hot reservoir into work

The cost: "waste heat"

1st Law: $Q_H - Q_C = W$

efficiency $e \equiv W/Q_H = W/Q_H = 1 - Q_C/Q_H$

$$\Delta S = Q_C/T_C - Q_H/T_H \geq 0$$

$\Delta S = 0$ for Carnot

Therefore, $Q_C/Q_H \geq T_C/T_H$

$Q_C/Q_H = T_C/T_H$ for Carnot

Therefore $e = 1 - Q_C/Q_H \leq 1 - T_C/T_H$

$e = 1 - T_C/T_H$ for Carnot

$e = 1$ is forbidden!

e largest if $T_C \ll T_H$

HEAT ENGINE

