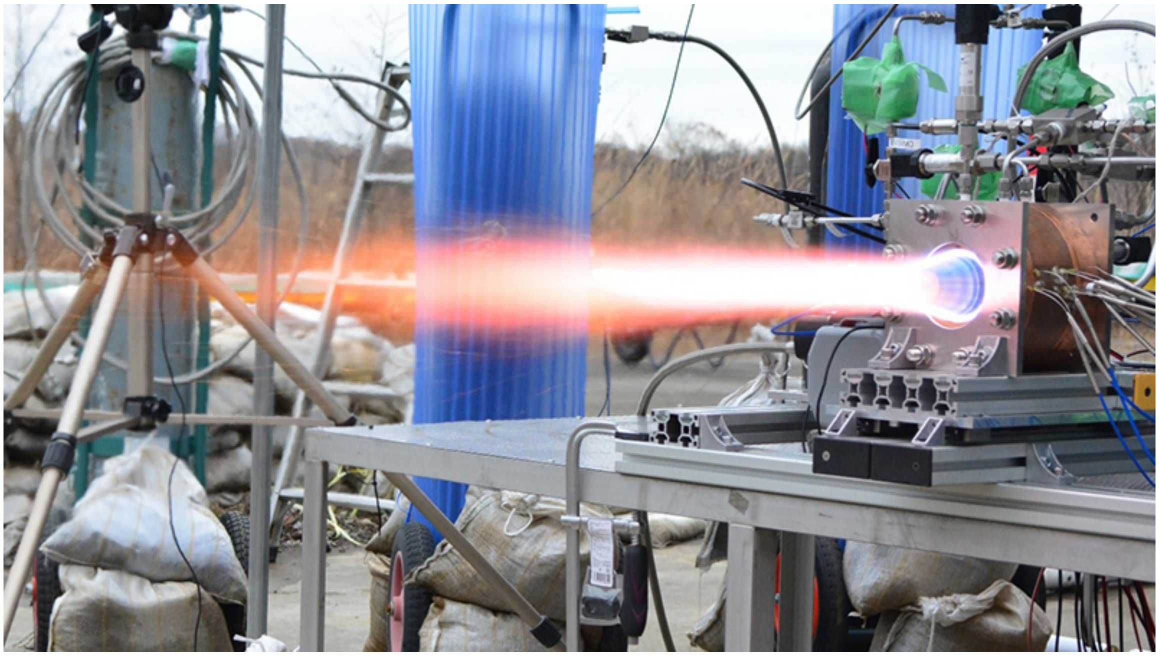
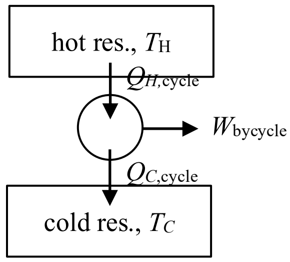


(Image from: https://aerospaceamerica.aiaa.org/year-in-review/advances-made-toward-rotating-detonation-engines/)

Explanation of a RDE, with thermodynamics starting at 6m 27s: https://www.youtube.com/watch?v=rG_Eh0J_4_s

The Carnot Cycle



For a reversible cycle,

$$\eta_{rev} = 1 - \frac{Q_{C,rev}}{Q_{H,rev}} = 1 - \frac{T_C}{T_H} = \frac{T_H - T_C}{T_H},$$

$$COP_{ref,rev} = \frac{1}{Q_{H,rev}/Q_{C,rev} - 1} = \frac{1}{T_H/T_C - 1} = \frac{T_C}{T_H - T_C},$$

$$COP_{hp,rev} = \frac{1}{1 - Q_{C,rev}/Q_{H,rev}} = \frac{1}{1 - T_C/T_H} = \frac{T_H}{T_H - T_C},$$

The Carnot Cycle

A Carnot cycle is a particular type of internally reversible cycle (can be a power, refrigeration, or heat pump cycle).

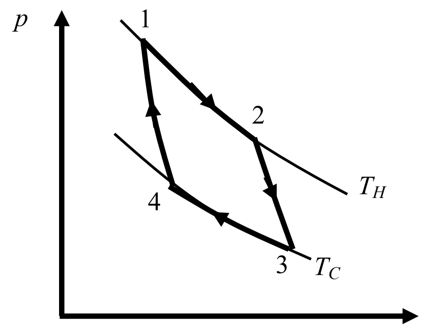
Each of the process steps is assumed to be internally reversible, e.g.,

- frictionless and no viscosity
- quasi-equilibrium
- expansions/compressions occur very slowly
- heat addition/removal occur over a negligible temperature difference

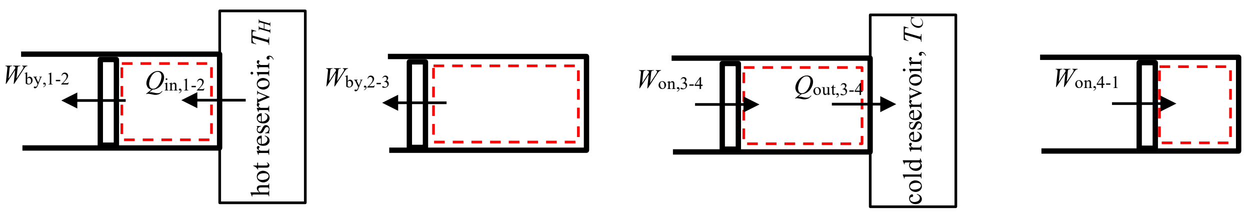
Real cycles have irreversibilities that make them less efficient than a Carnot cycle.

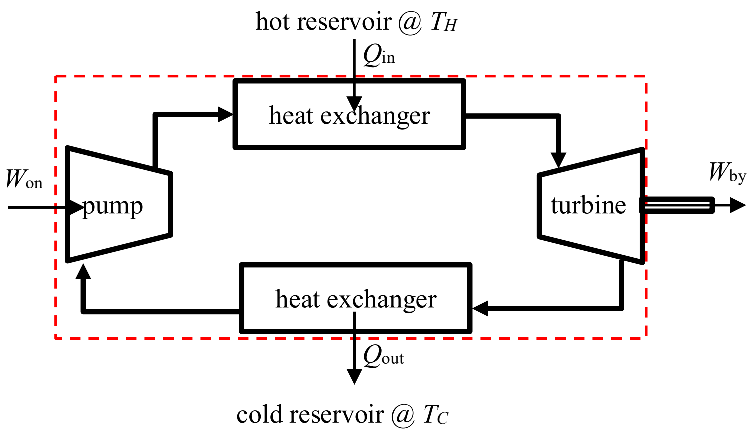
Carnot Power Cycle

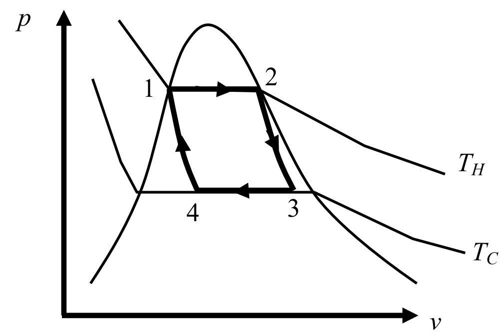
1 – 2: isothermal expansion at T_H
2 – 3: adiabatic expansion to T_C
3 – 4: isothermal compression at T_C
4 – 1: adiabatic compression to T_H



Carnot Power Cycle shown for a substance that remains a vapor







Carnot Power Cycle shown for a substance that is a SLVM