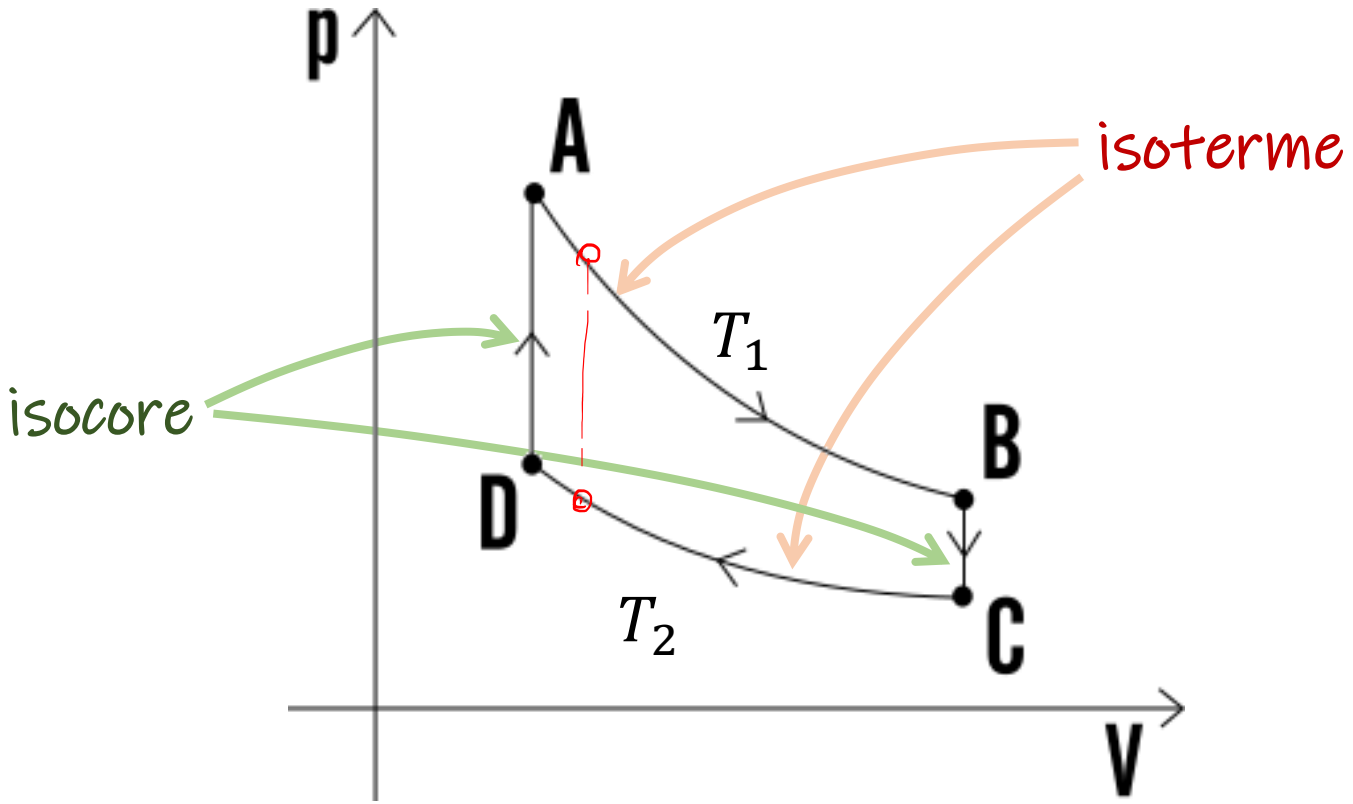
Fisica Generale 1

Termodinamica

Wooclap

$pV = nRT$

Qual è la relazione tra T1 e T2?



Wooclap

Durante quale/i trasformazione/i il sistema riceve calore dall'ambiente?

$Q_{AB} = \int_{V_A}^{V_B} p\,dV$

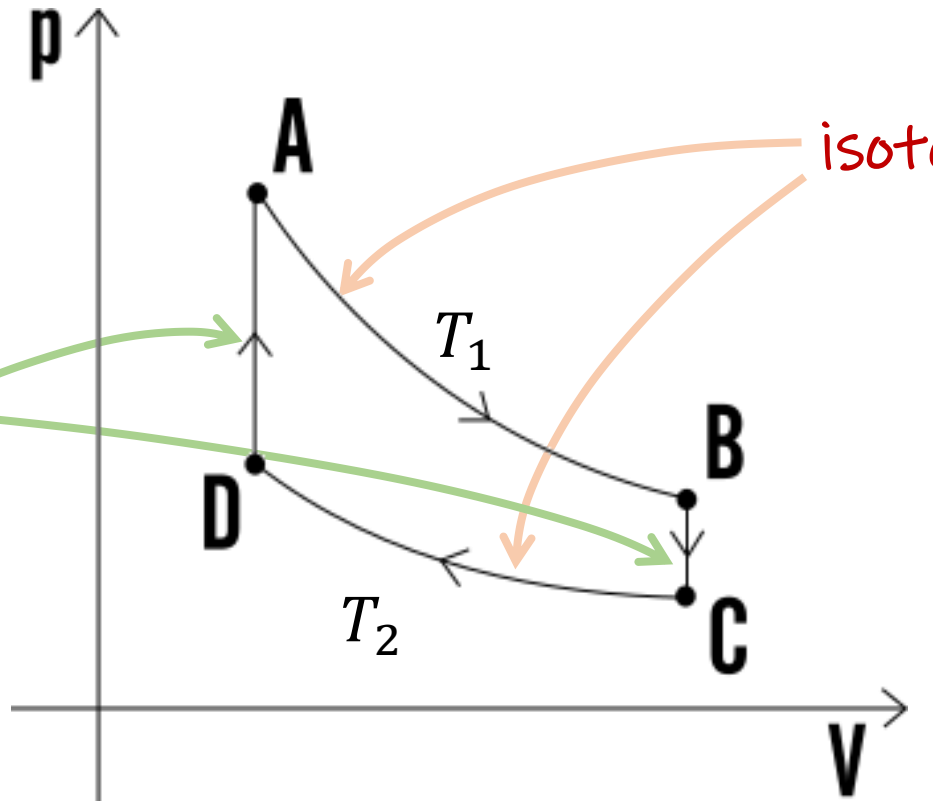
$= \int_{V_A}^{V_B} \frac{nRT_1}{V}\,dV$

$= nRT_1 \int_{V_A}^{V_B} \frac{dV}{V}$

$= nRT_1 \ln\left(\frac{V_B}{V_A}\right) > 0$ isocore

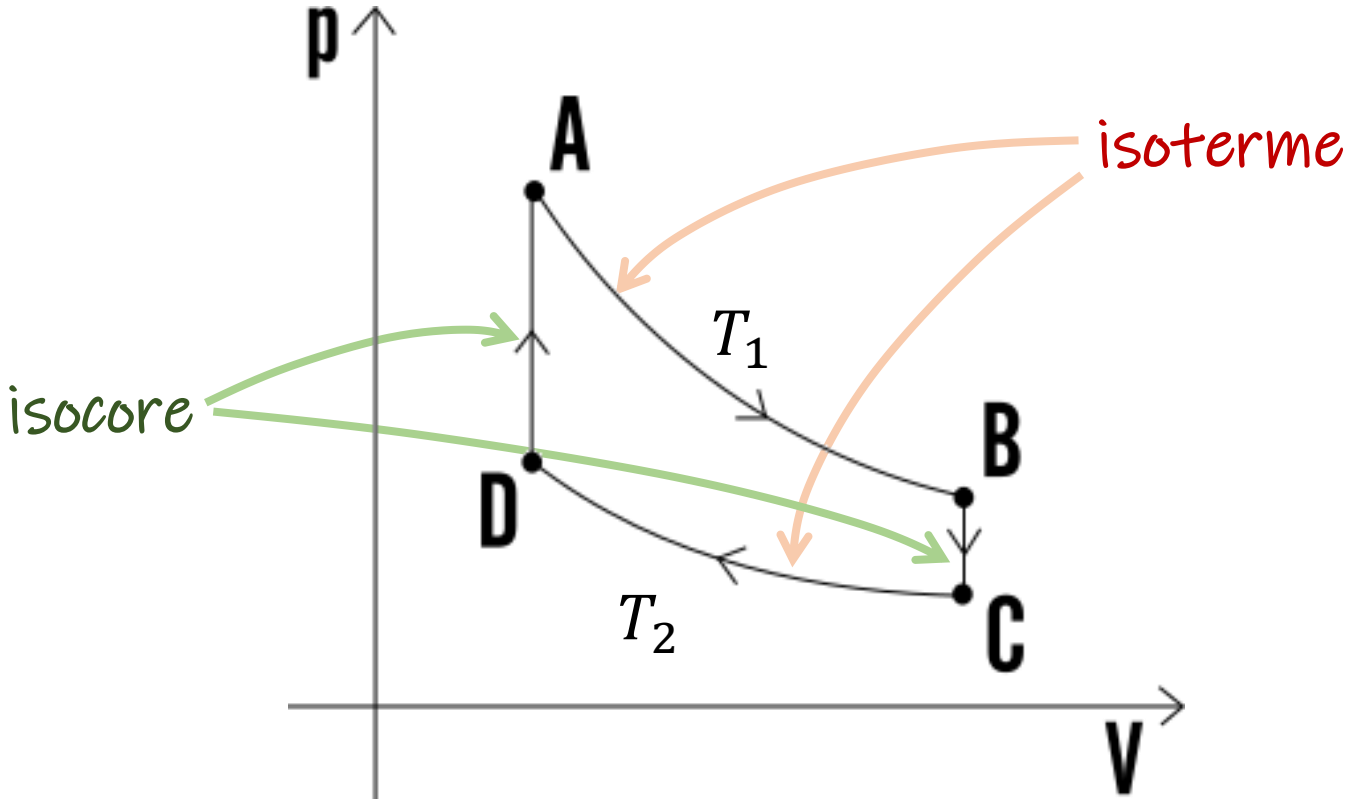
$Q_{CD} = nRT_2 \ln\left(\frac{V_D}{V_C}\right) < 0$

$nC_V\Delta T$



Wooclap

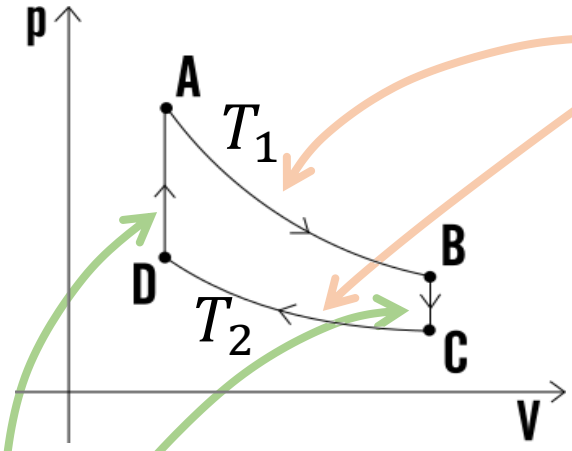
Durante quale/i trasformazione/i l'ambiente compie lavoro sul sistema?



Wooclap

Si calcoli il rendimento del ciclo, sapendo che $T_A = 380\ K$ $T_D = 280\ K$

$V_A = 1\ L$ $V_B = 3\ L$



isoterme

isocore

$$\eta = \frac{W}{Q_c} = 1 - \frac{|Q_F|}{Q_c}$$

$$Q_c \begin{cases} Q_{DA} = nC_v(T_1 - T_2) = 1246\ J \\ Q_{AB} = nRT_1 \ln\left(\frac{V_B}{V_A}\right) = 3469\ J \end{cases}$$

$$Q_F \begin{cases} Q_{BC} = nC_v(T_2 - T_1) = -1246\ J \\ Q_{CD} = nRT_2 \ln\left(\frac{V_D}{V_C}\right) = -2556\ J \end{cases}$$

$W < 0$

$W = |Q_{AB} + Q_{CD}|$

W

$$\eta = \frac{Q_{AB} + Q_{CD}}{Q_{DA} + Q_{AB}}$$

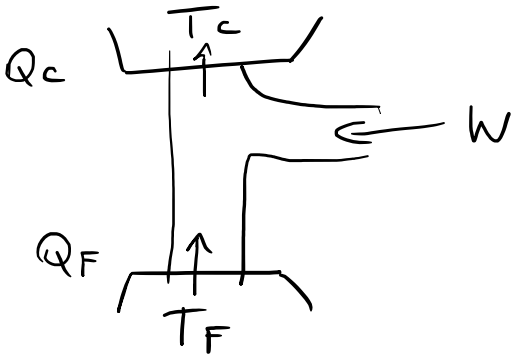
$$\eta = 1 - \frac{|Q_F|}{Q_c} = 1 - \frac{|Q_{BC} + Q_{CD}|}{Q_{DA} + Q_{AB}} = 0{,}19$$

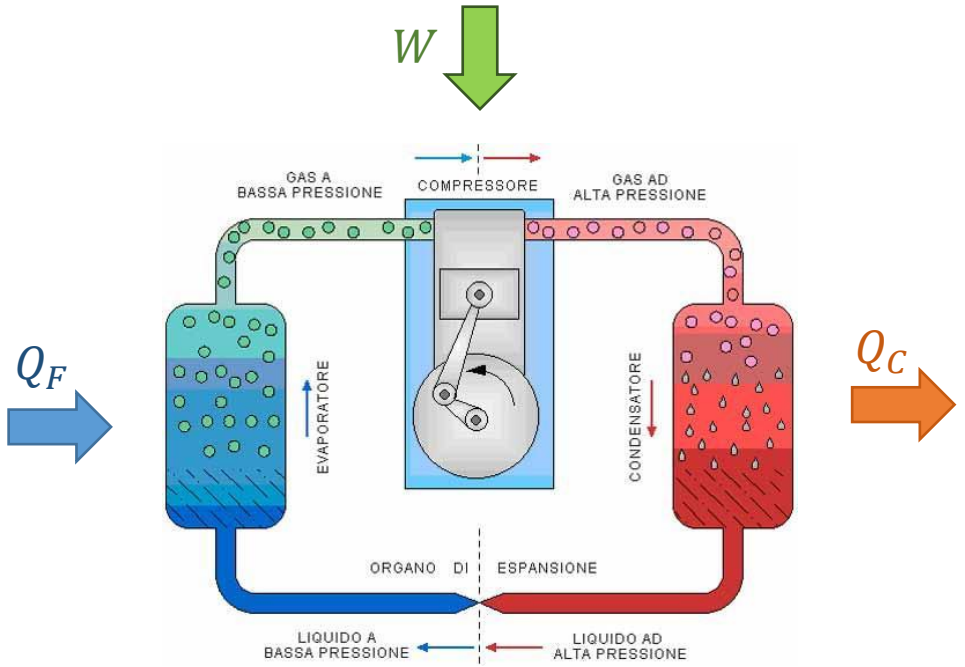
Macchine Frigorifere

Coefficiente di prestazione

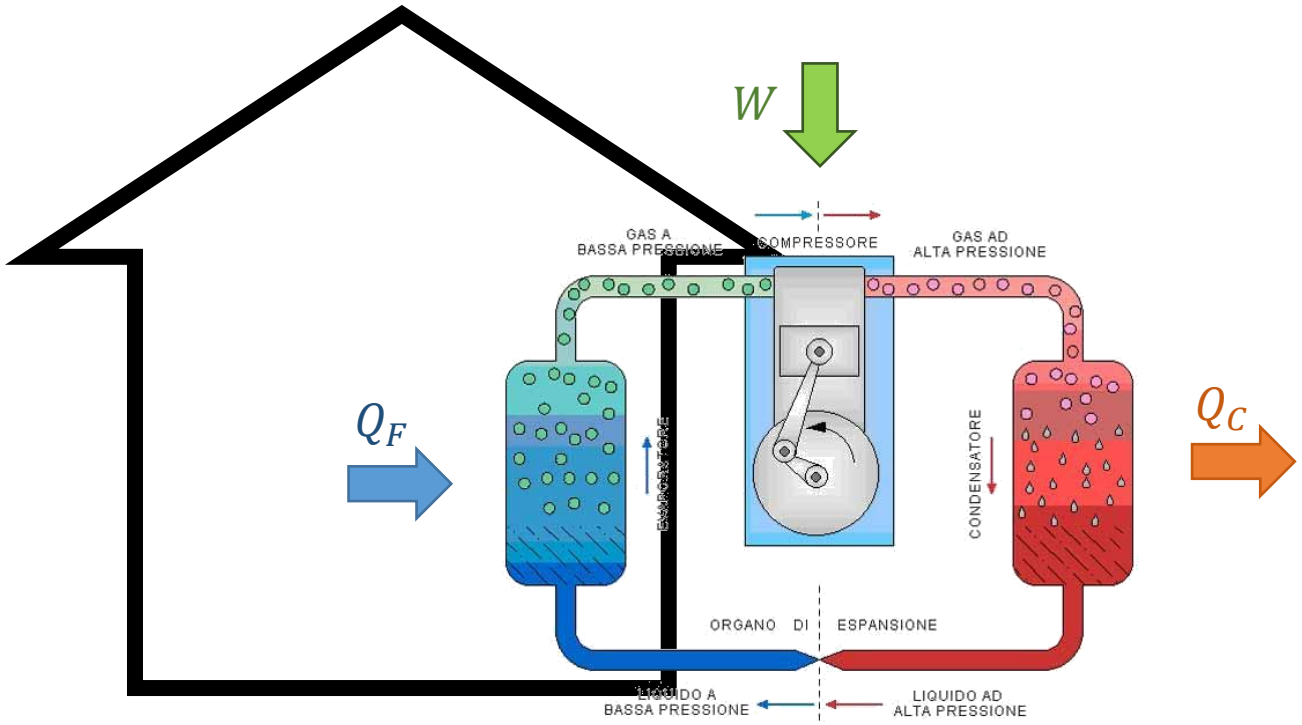
$$\left(\eta = \frac{W}{Q_c} \quad \text{macch. termiche}\right)$$

$$K = \frac{Q_F}{W}$$





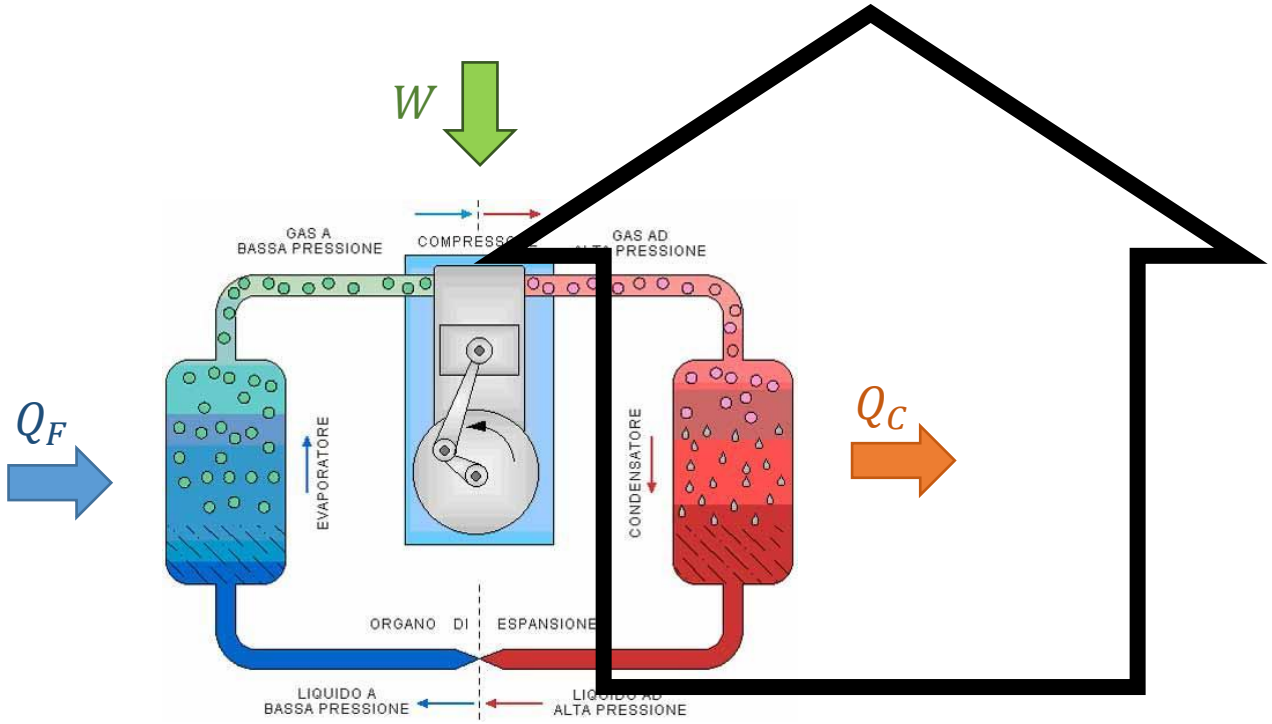
Macchine Frigorifere



Pompa di Calore

η

$$K_{PC} = \frac{|Q_C|}{|W|}$$



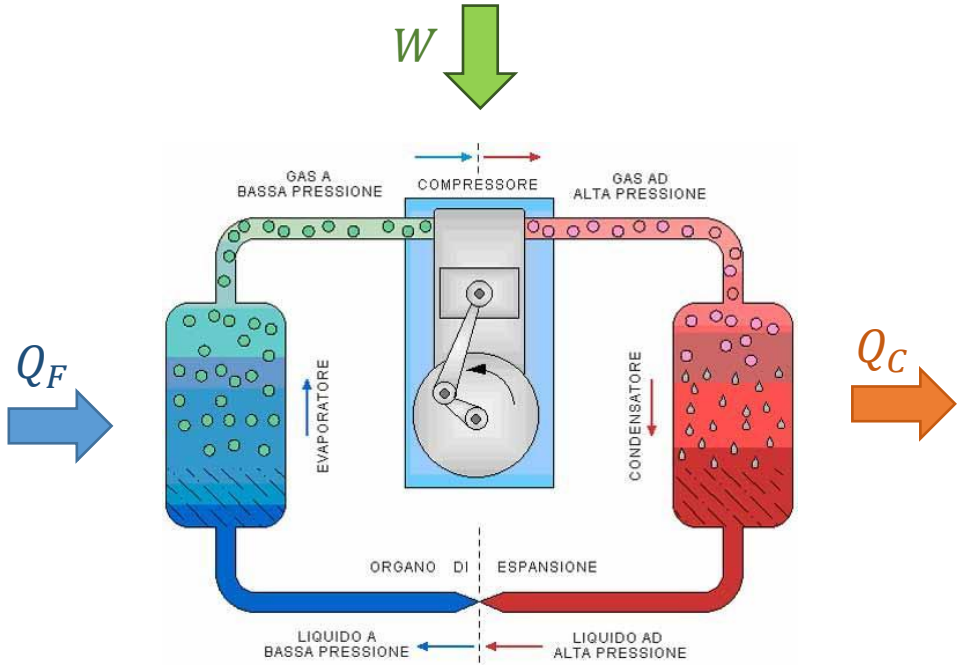
Enunciato di Clausius

$$K = \frac{Q_F}{|W|}$$

Coeff. di prestazione per Macchine Frigorifere

$$K_{PC} = \frac{|Q_C|}{|W|}$$

Efficienza per Pompe di Calore



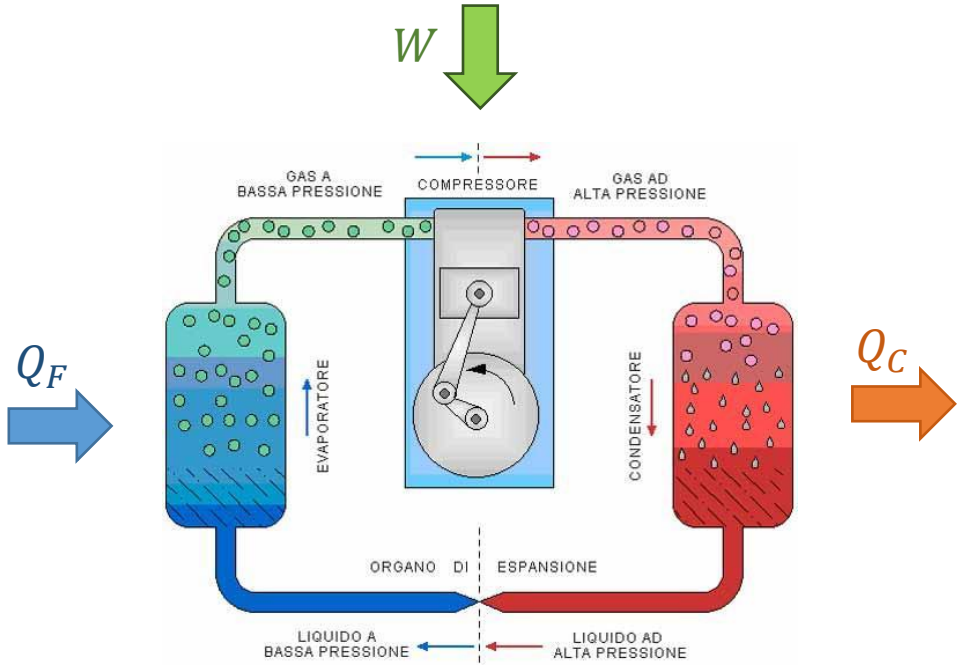
Enunciato di Clausius

$$K = \frac{Q_F}{|W|}$$

Coeff. di prestazione per Macchine Frigorifere

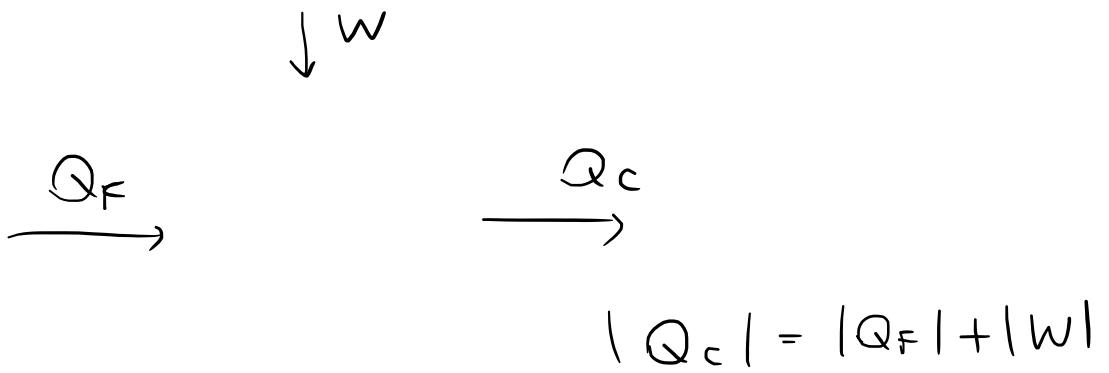
$$K_{PC} = \frac{|Q_C|}{|W|}$$

Efficienza per Pompe di Calore

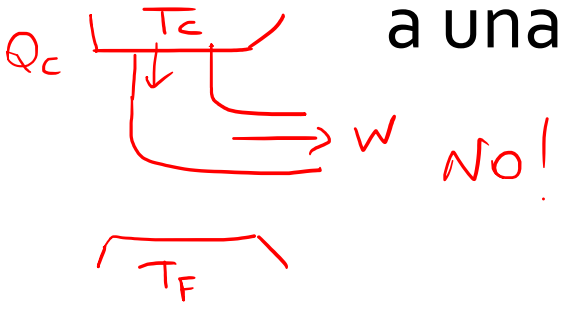


Non è possibile realizzare una trasformazione il cui unico risultato sia il trasferimento di calore da una temperatura inferiore ad una superiore

Posso raffreddare una stanza con un frigorifero?

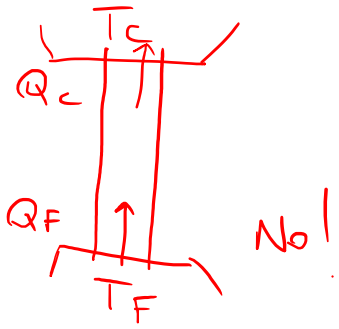


Enunciati Secondo Principio



Non è possibile realizzare un ciclo che sottragga calore a una sorgente a temperatura uniforme e lo converta completamente in lavoro

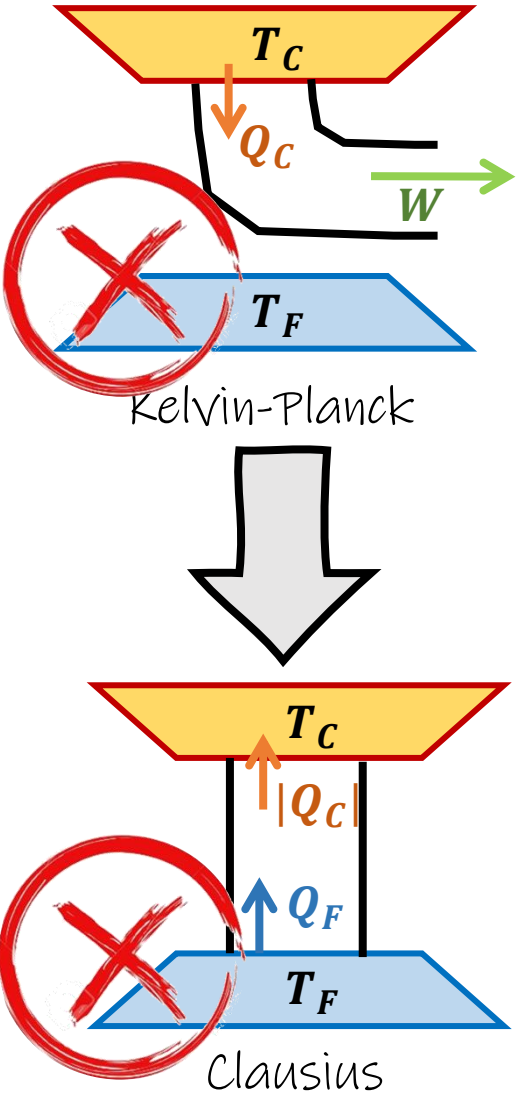
Kelvin-Planck

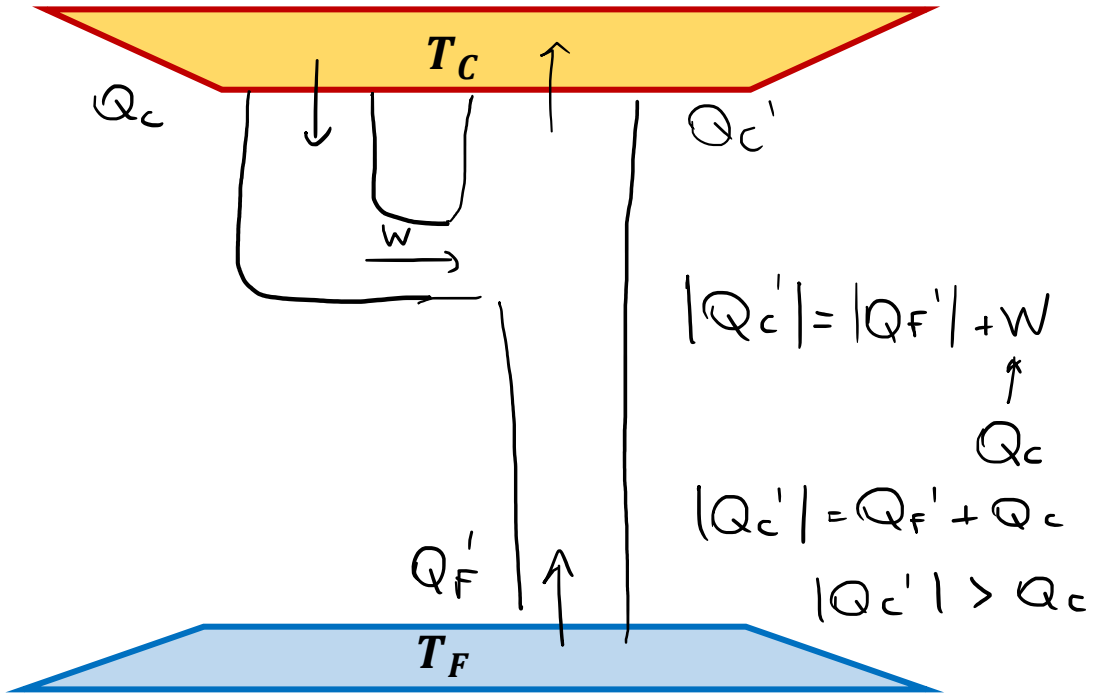


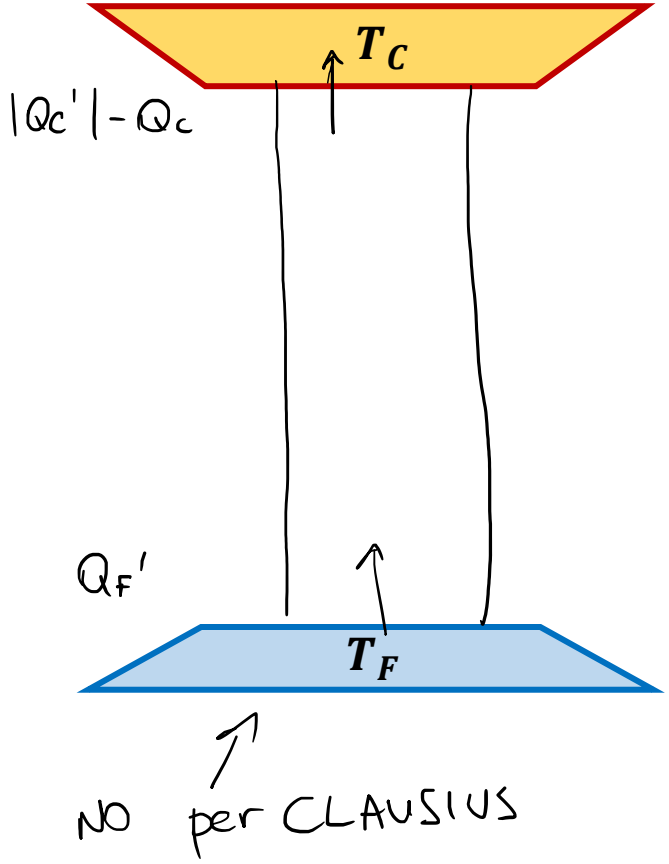
Non è possibile realizzare una trasformazione il cui unico risultato sia il trasferimento di calore da una temperatura inferiore ad una superiore

Clausius

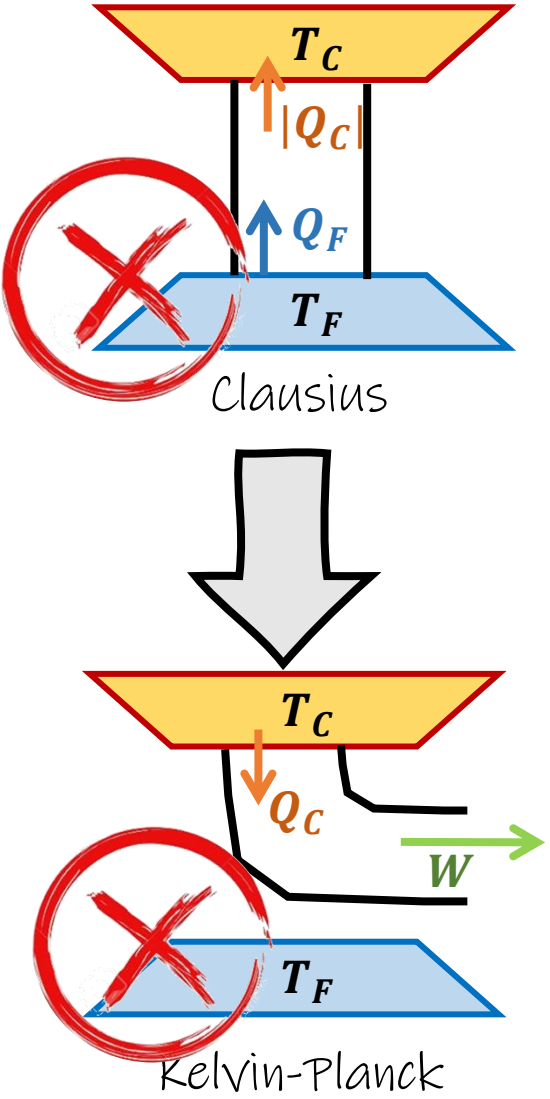
Equivalenza Enunciati

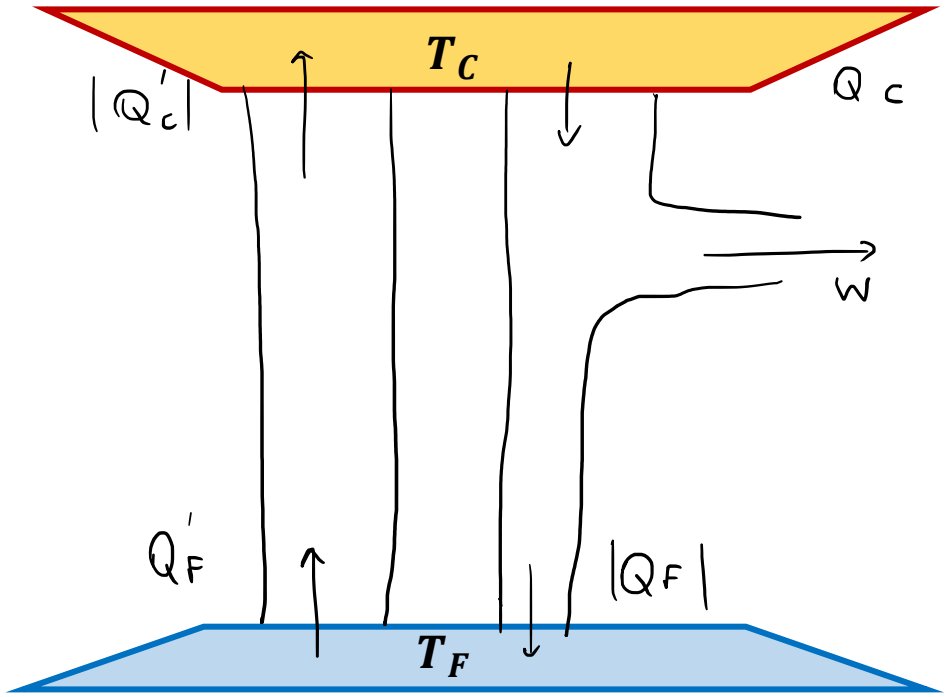


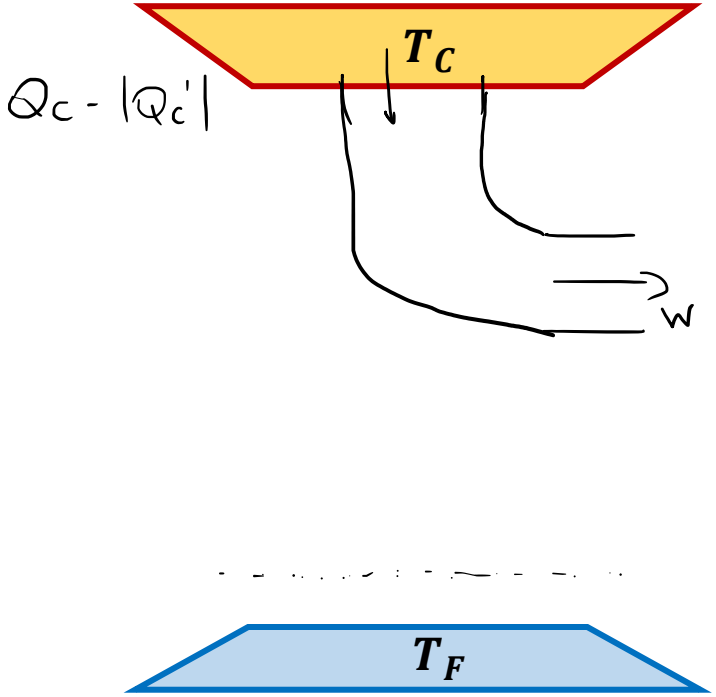




Equivalenza Enunciati







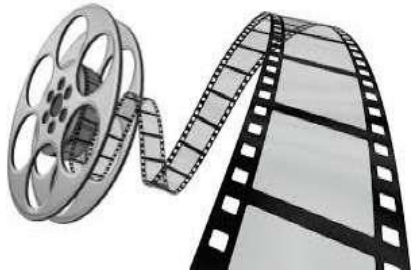
$Q_F' = |Q_F|$

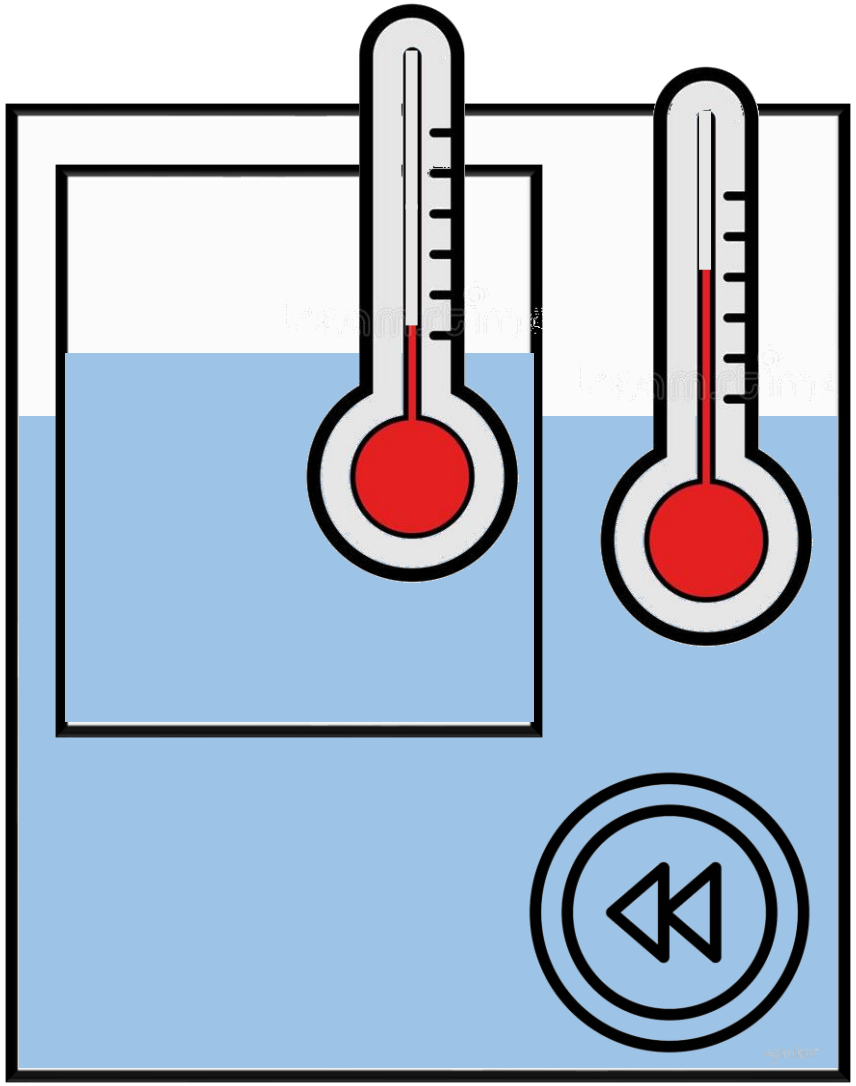
$|Q_c'| = Q_F' = |Q_F|$

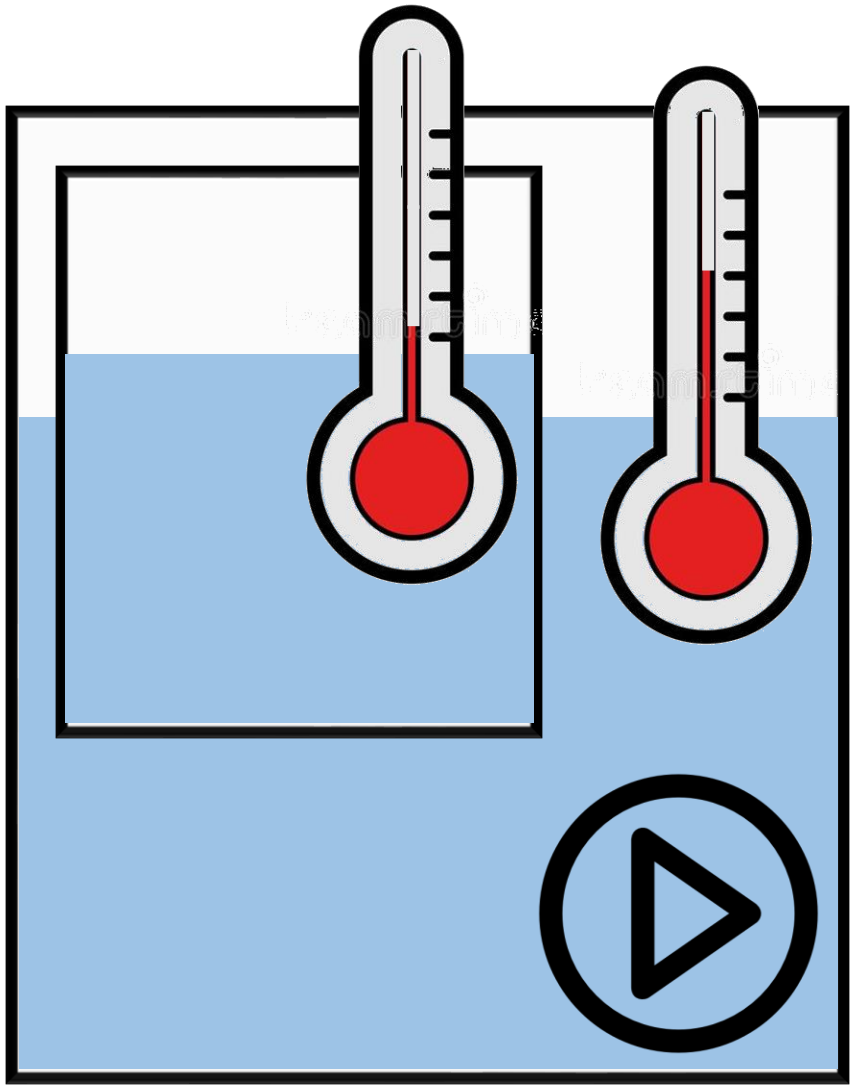
$Q_c = W + \underbrace{|Q_F|}_{Q_c'}$

$Q_c > |Q_c'|$

Reversibilità







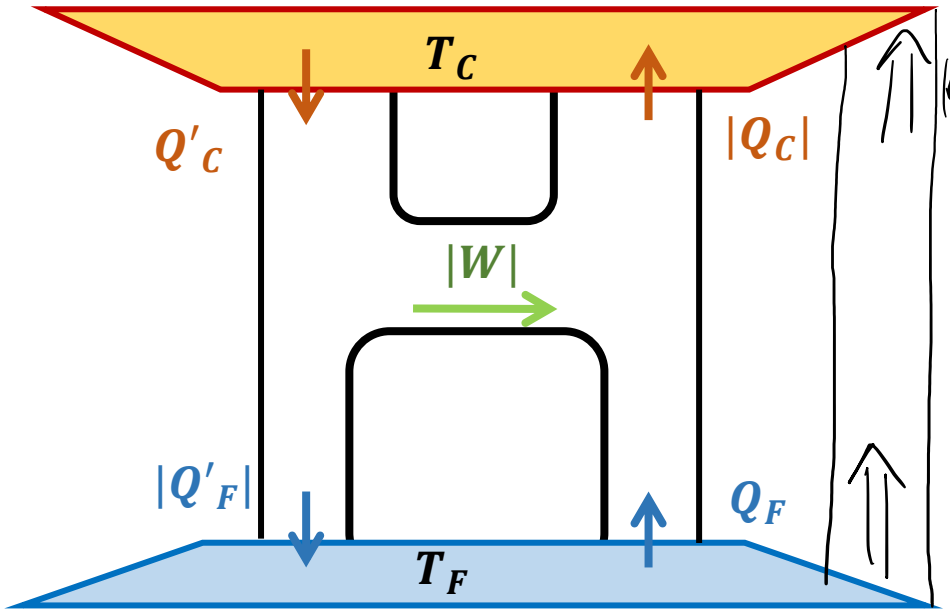
Macchine reversibili

Teorema di Carnot

Tutte le macchine reversibili che operano tra le temperature T_C e T_F hanno il medesimo rendimento e nessuna macchina che funzioni tra queste due temperature può avere rendimento maggiore.

Macchine reversibili

Teorema di Carnot



$\eta = \eta'$

per assurdo: $\eta \neq \eta'$ $\quad \eta' > \eta$

$\eta' = \dfrac{|W|}{|Q_C'|}$ $\quad \eta = \dfrac{|W|}{|Q_C|}$

$\dfrac{|W|}{|Q_C'|} > \dfrac{|W|}{|Q_C|} \Rightarrow |Q_C| > |Q_C'|$

$|Q_C| - |Q_C'| > 0$

$$\begin{cases} W = |Q_C'| - |Q_F'| \\ W = |Q_C| - |Q_F| \end{cases}$$

$|Q_C'| - |Q_F'| = |Q_C| - |Q_F|$

$|Q_F| - |Q_F'| = |Q_C| - |Q_C'| > 0$

$|Q_F| - |Q_F'| > 0$