

Hydrid wheel loader

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a 'hybrid' cooperation

Volvo



Innas

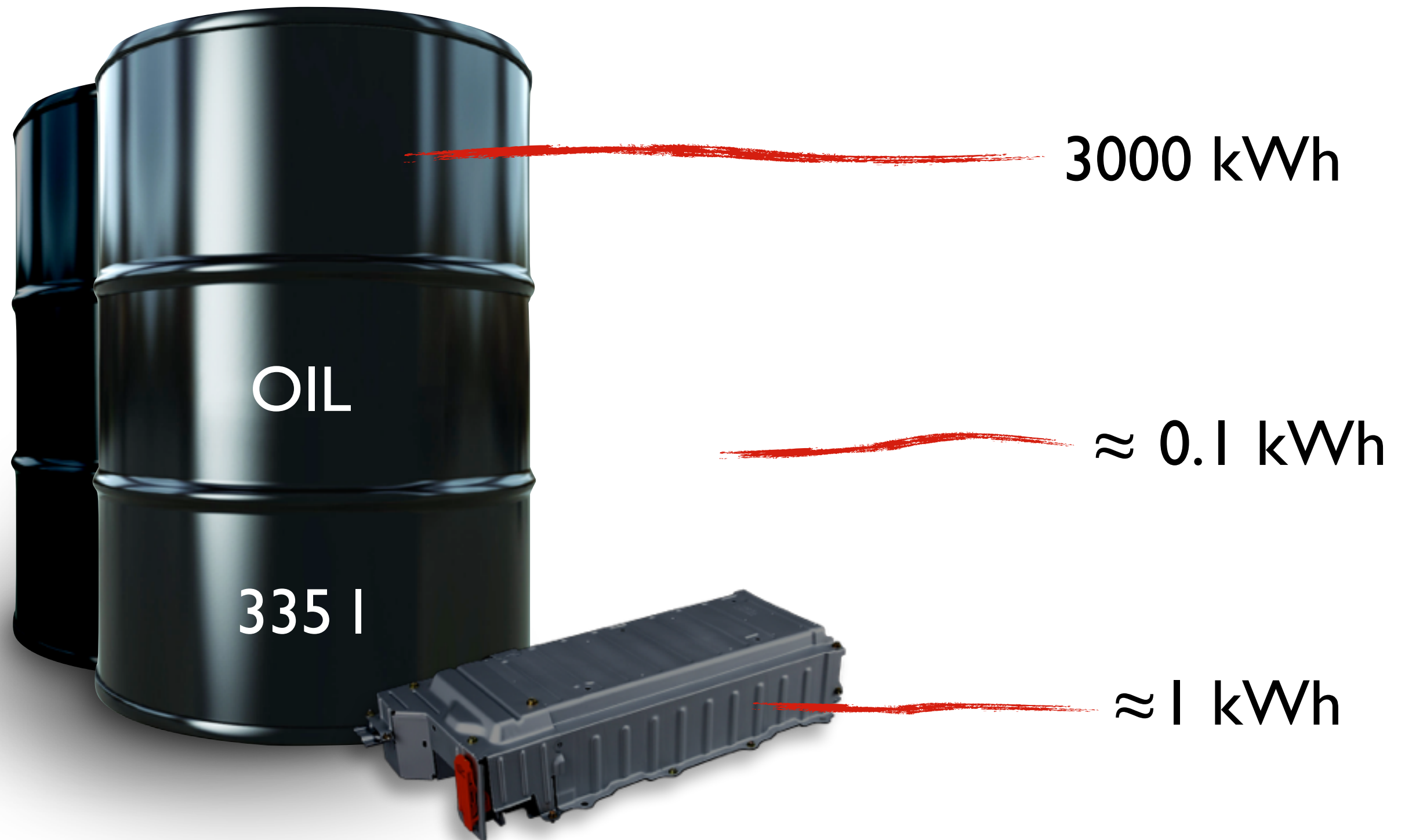


maximum traction 240 kN

maximum speed 45 km/h

engine power 274 kW

fuel tank 335 l



Hybrid?



Hydraulic + Hybrid = Hydrid

simulation study

starting points

- ❖ 30 metric tonnes wheel loader
- ❖ short loading cycle (Y-cycle)



Hydrid wheel loader

same engine

same performance

<50% fuel consumption



Hydrid wheel loader

decoupling the engine

hydraulic accumulators

efficient 'floating cup' pumps & motors

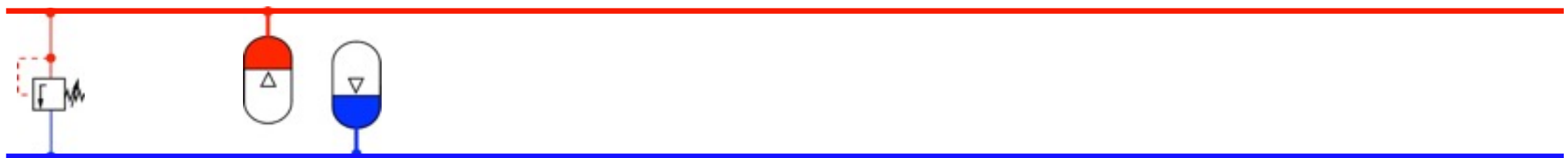
hydraulic transformers



new hydraulic circuit

hydraulic circuit

common pressure rail (CPR)

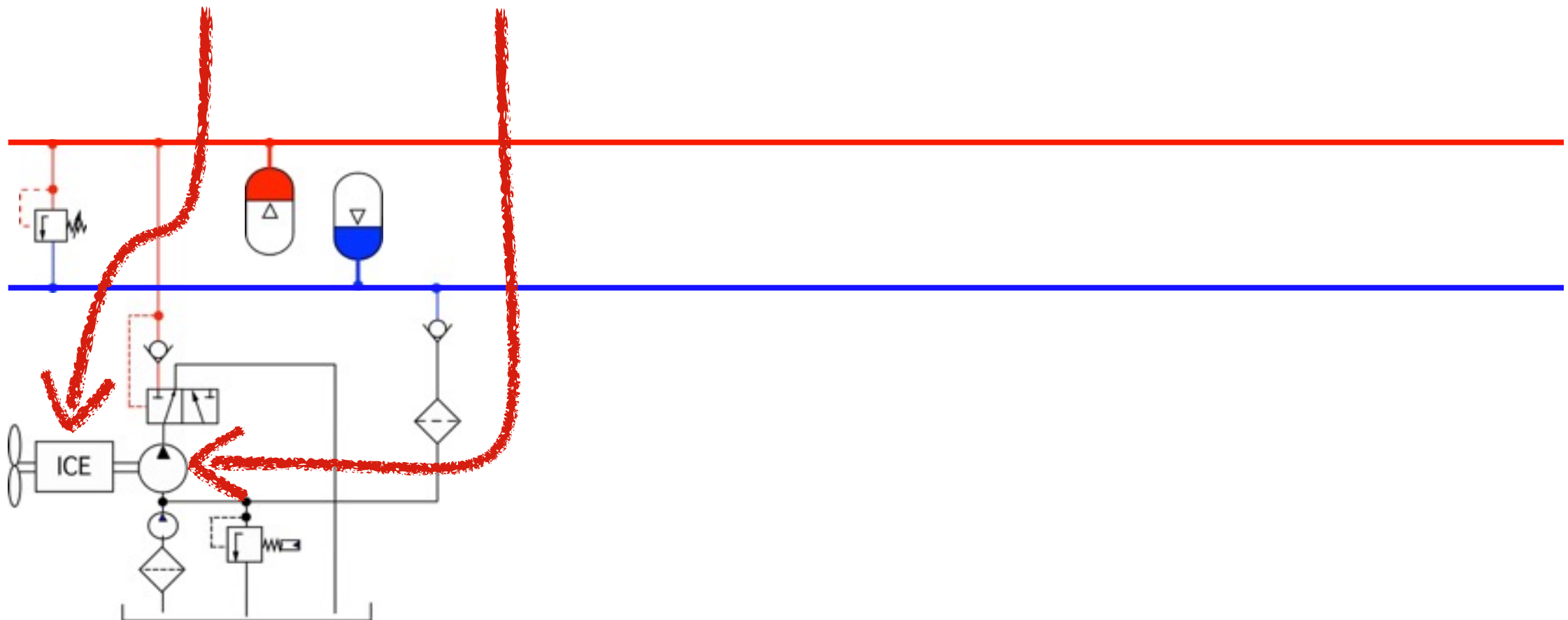


hydraulic circuit

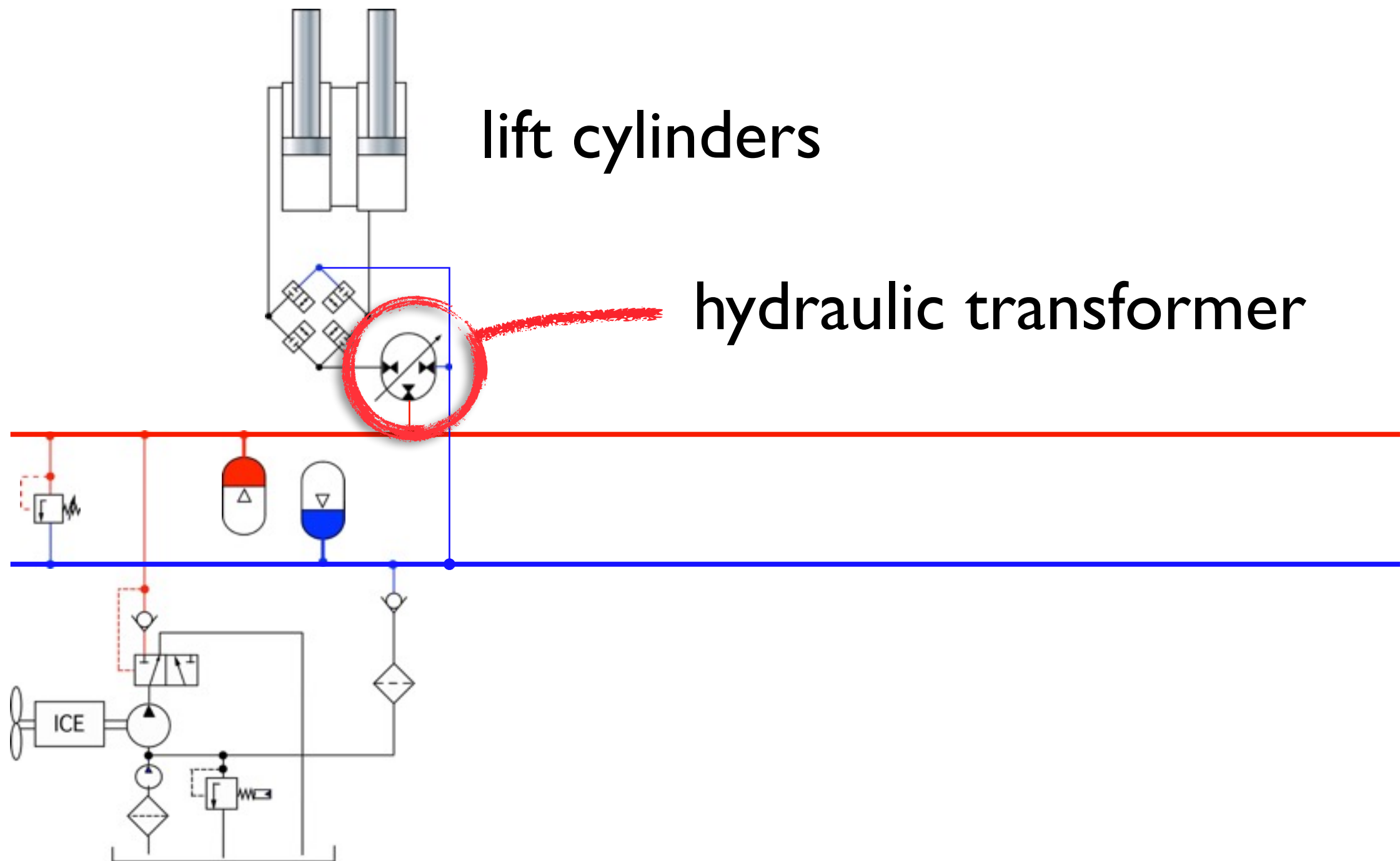
“power plant”

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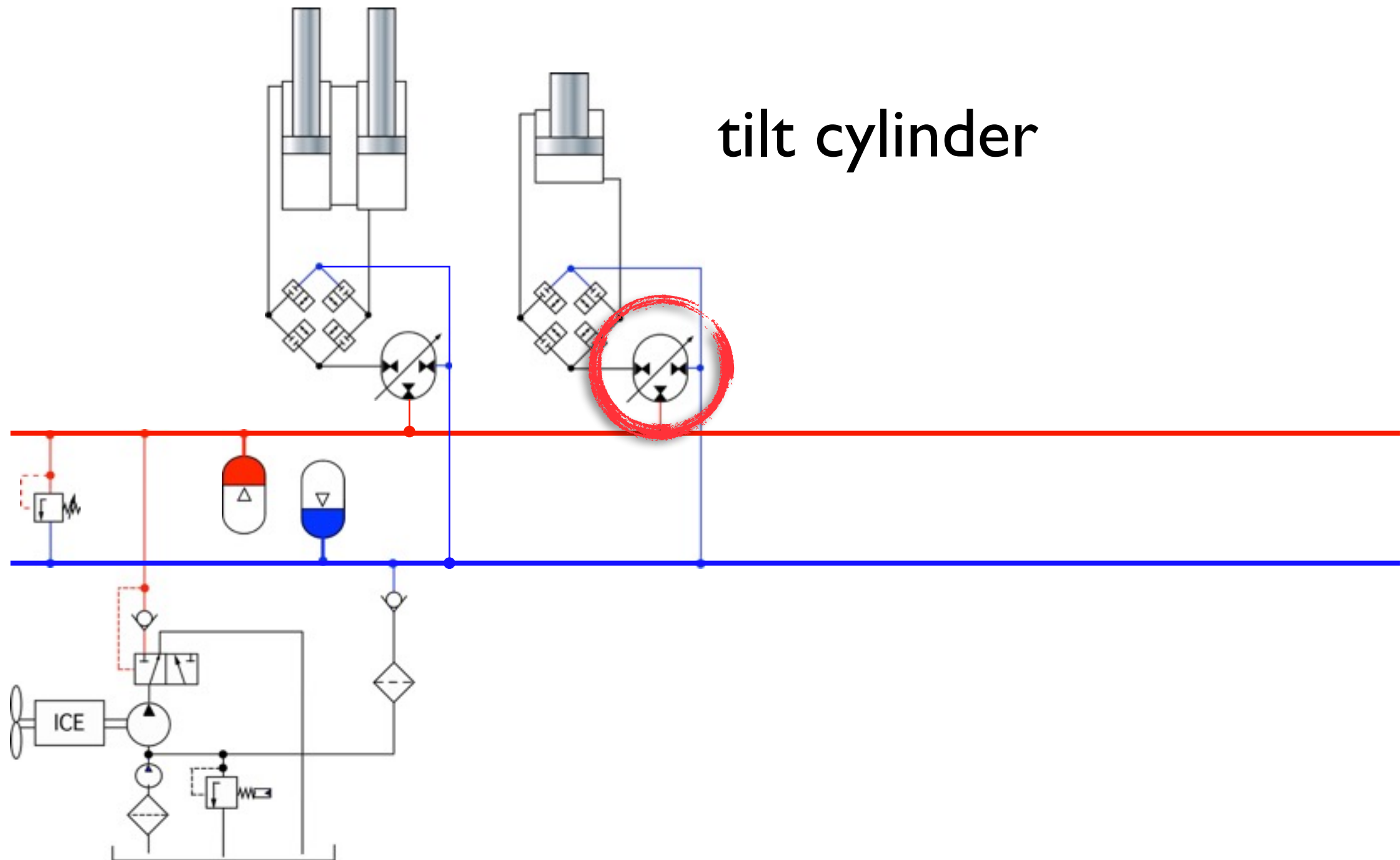
engine + pump



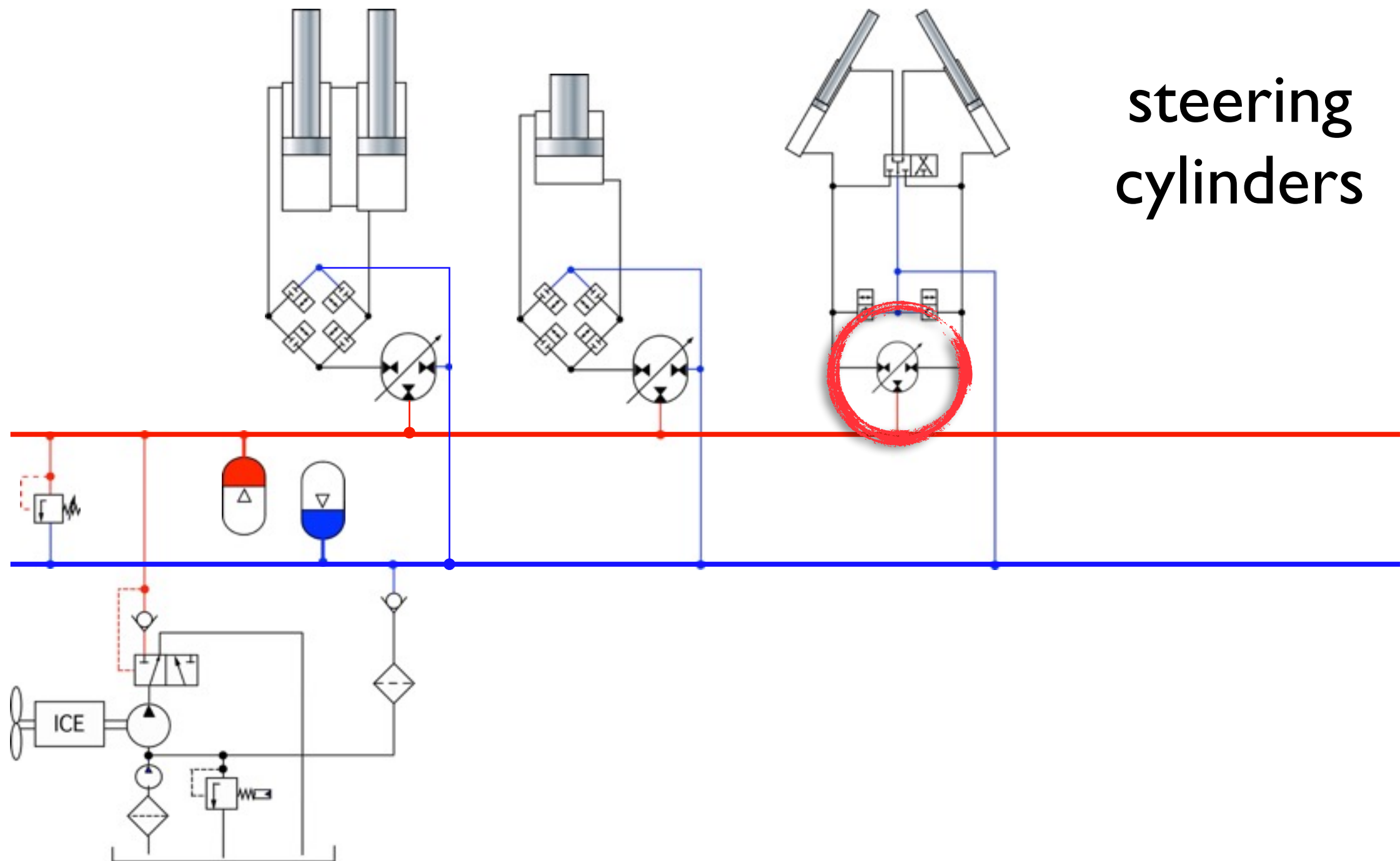
hydraulic circuit



hydraulic circuit

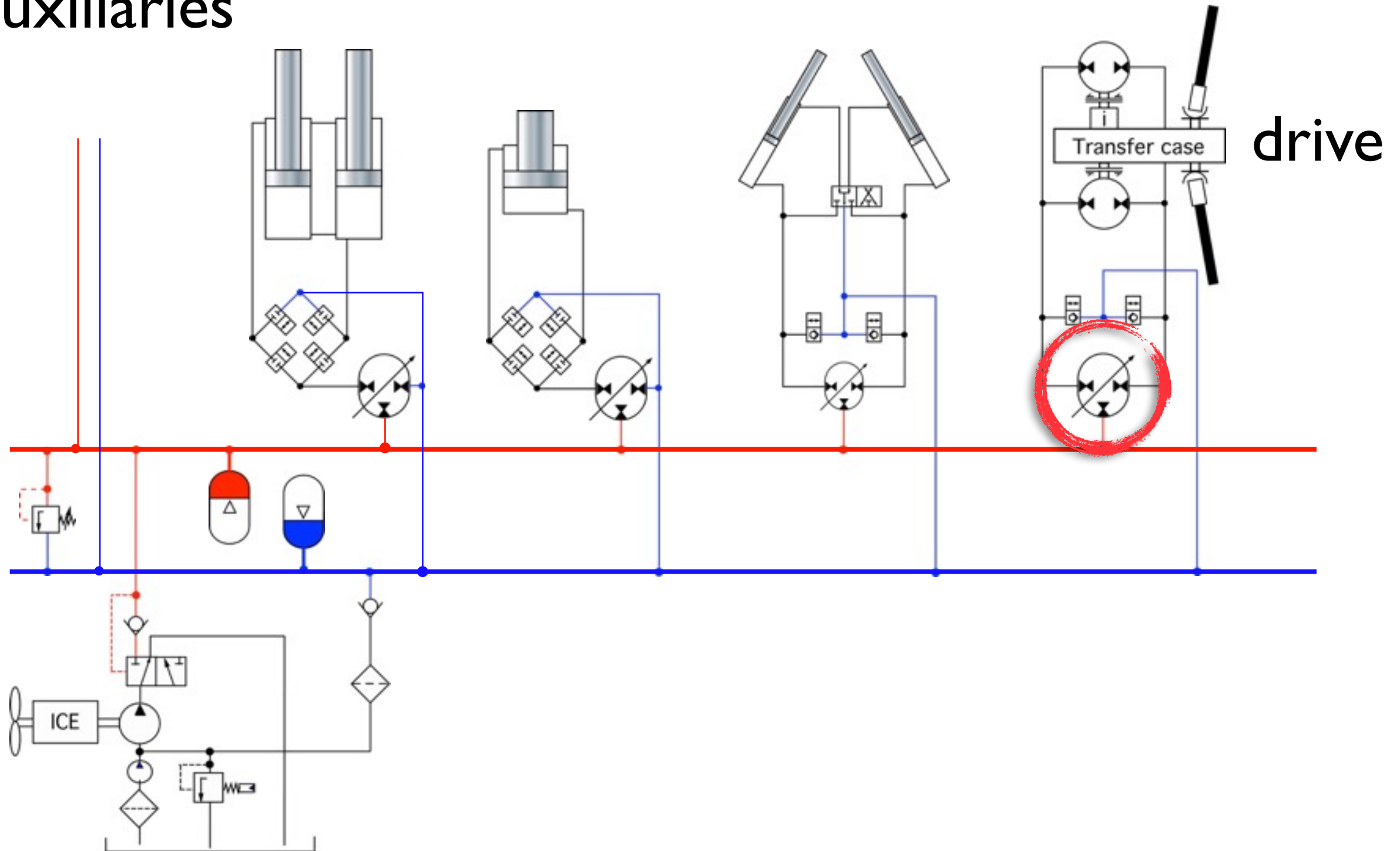


hydraulic circuit



hydraulic circuit

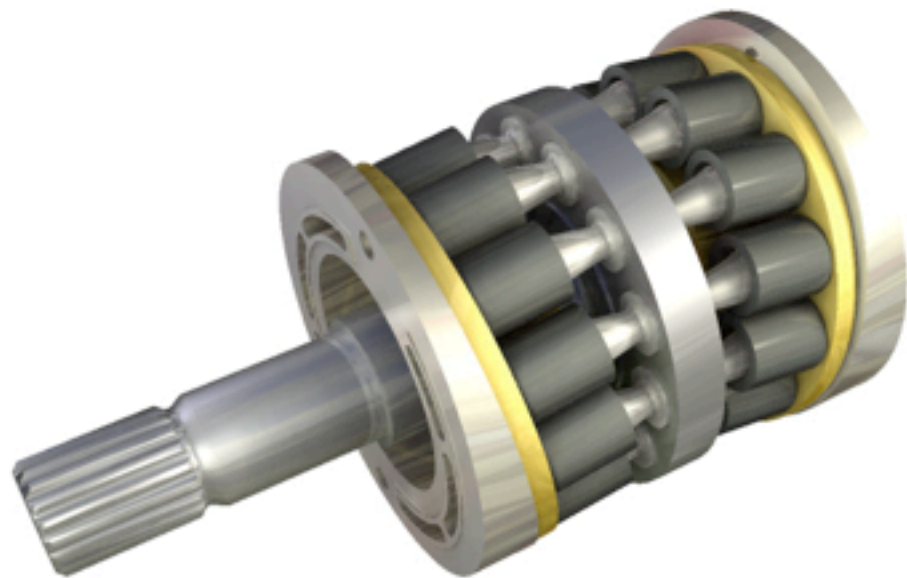
auxiliaries



new technologies

two new technologies

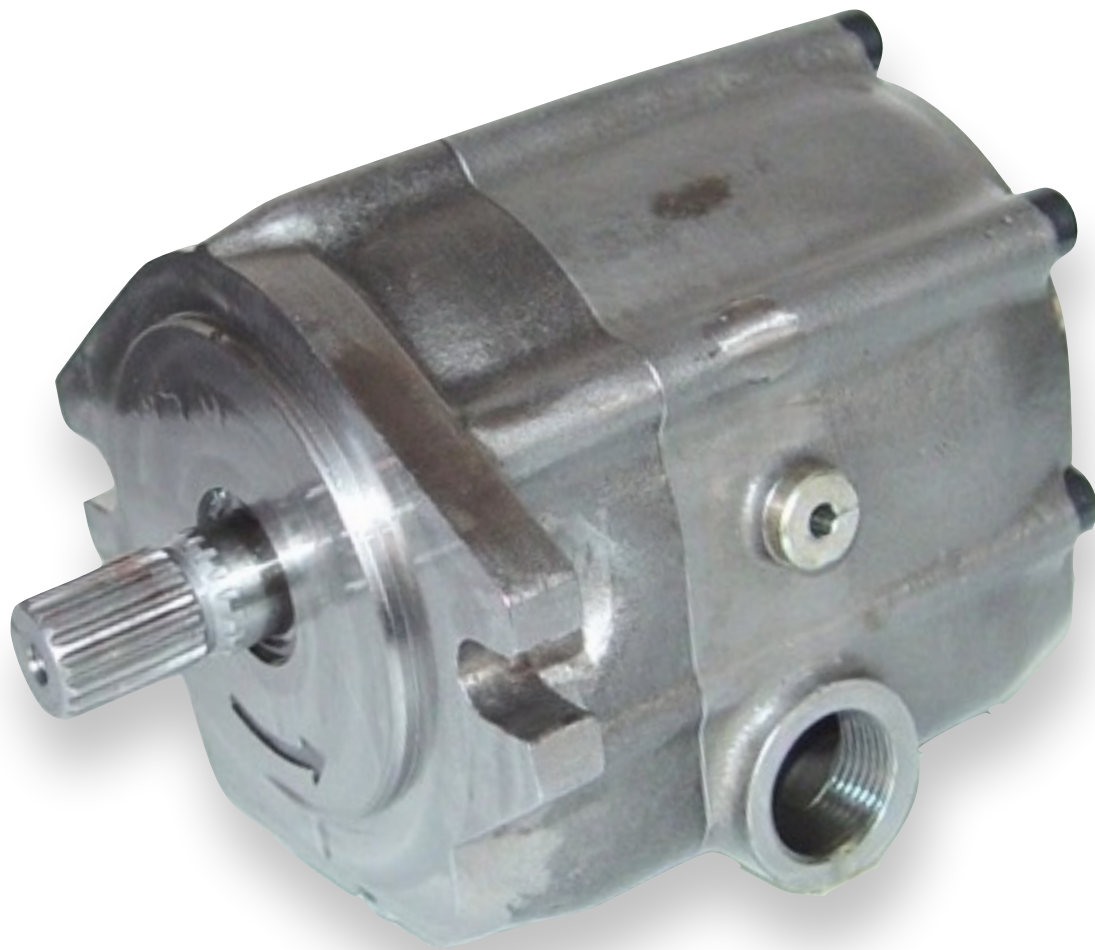
floating cup
principle



hydraulic
transformer

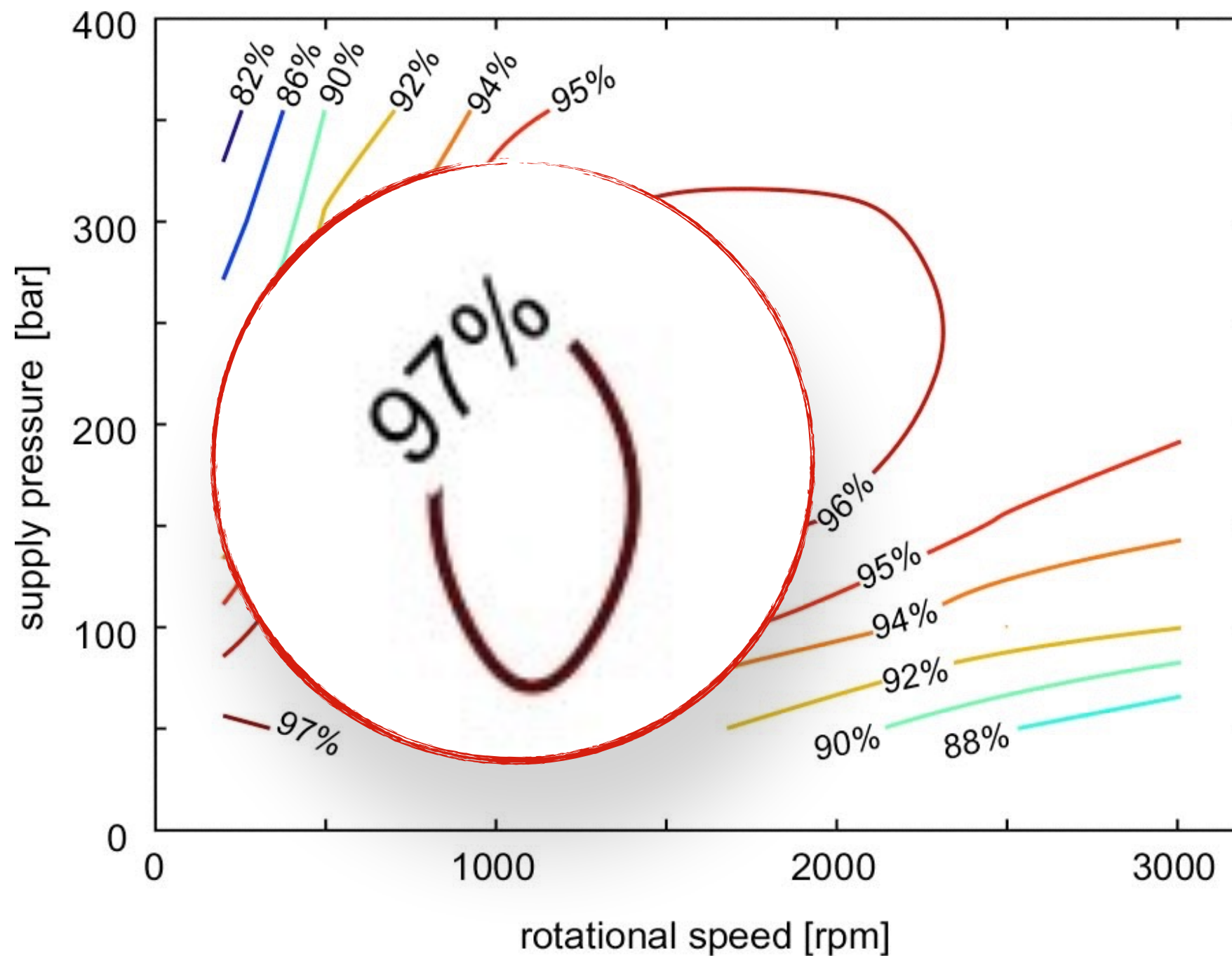


floating cup



- ❖ compact
- ❖ low torque ripple
- ❖ high starting torque
- ❖ low noise
- ❖ low cost
- ❖ efficient

floating cup principle



transformers

mechanical



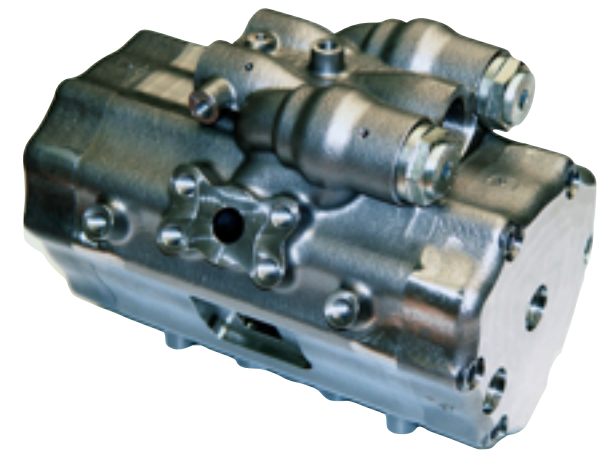
$$(T \cdot \omega)_{in} = (T \cdot \omega)_{out}$$

electrical



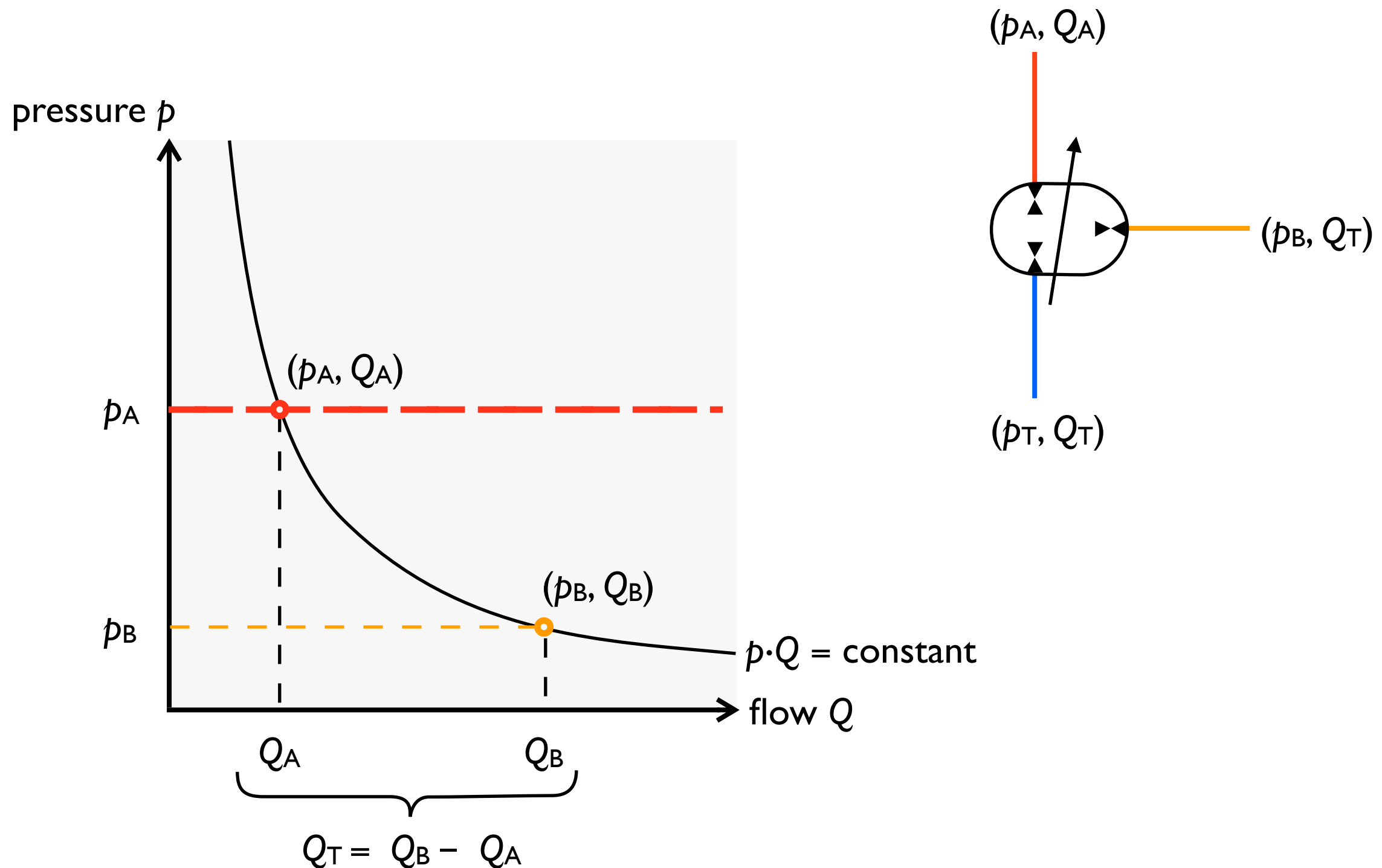
$$(V \cdot I)_{in} = (V \cdot I)_{out}$$

hydraulic

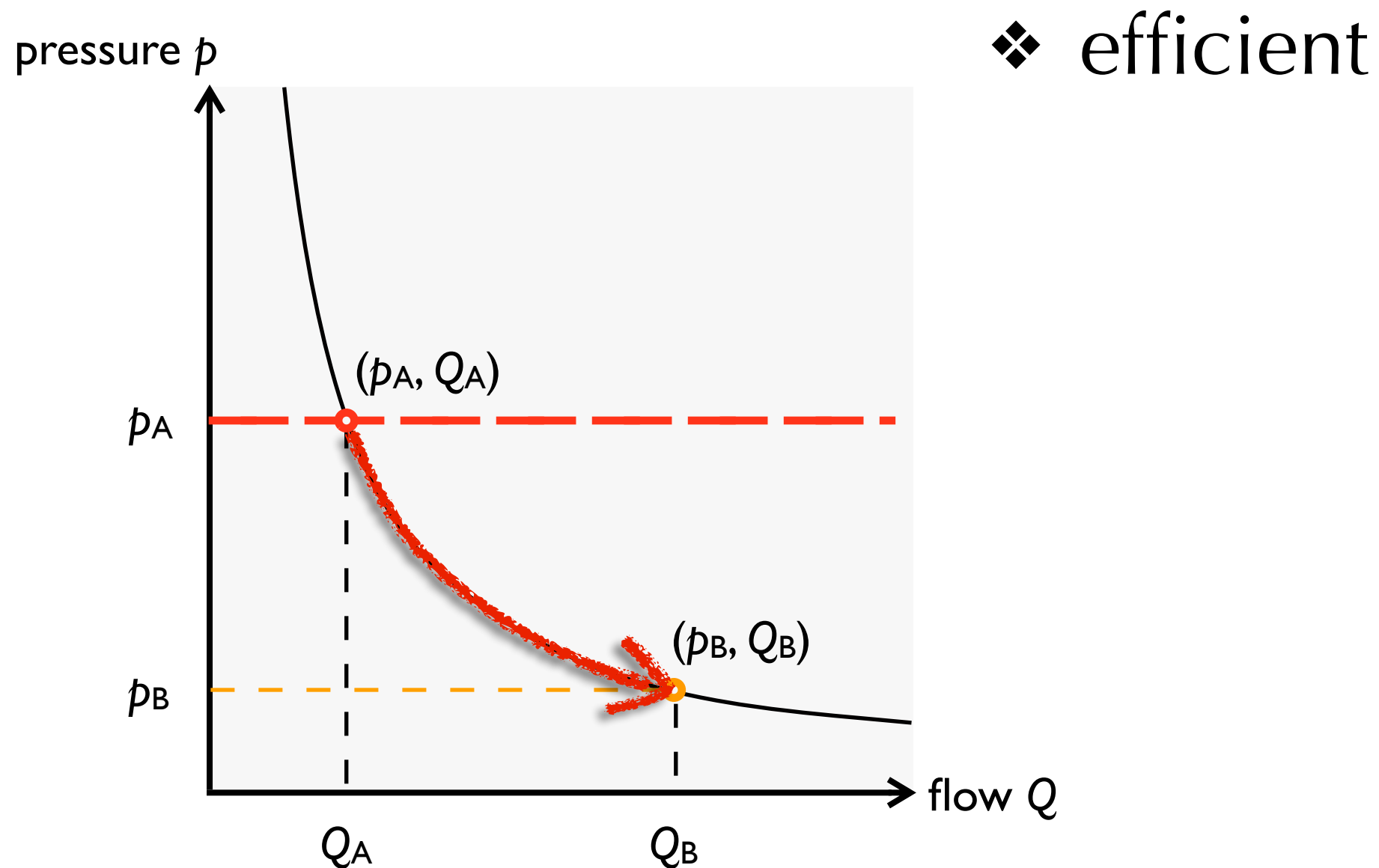


$$(p \cdot Q)_{in} = (p \cdot Q)_{out}$$

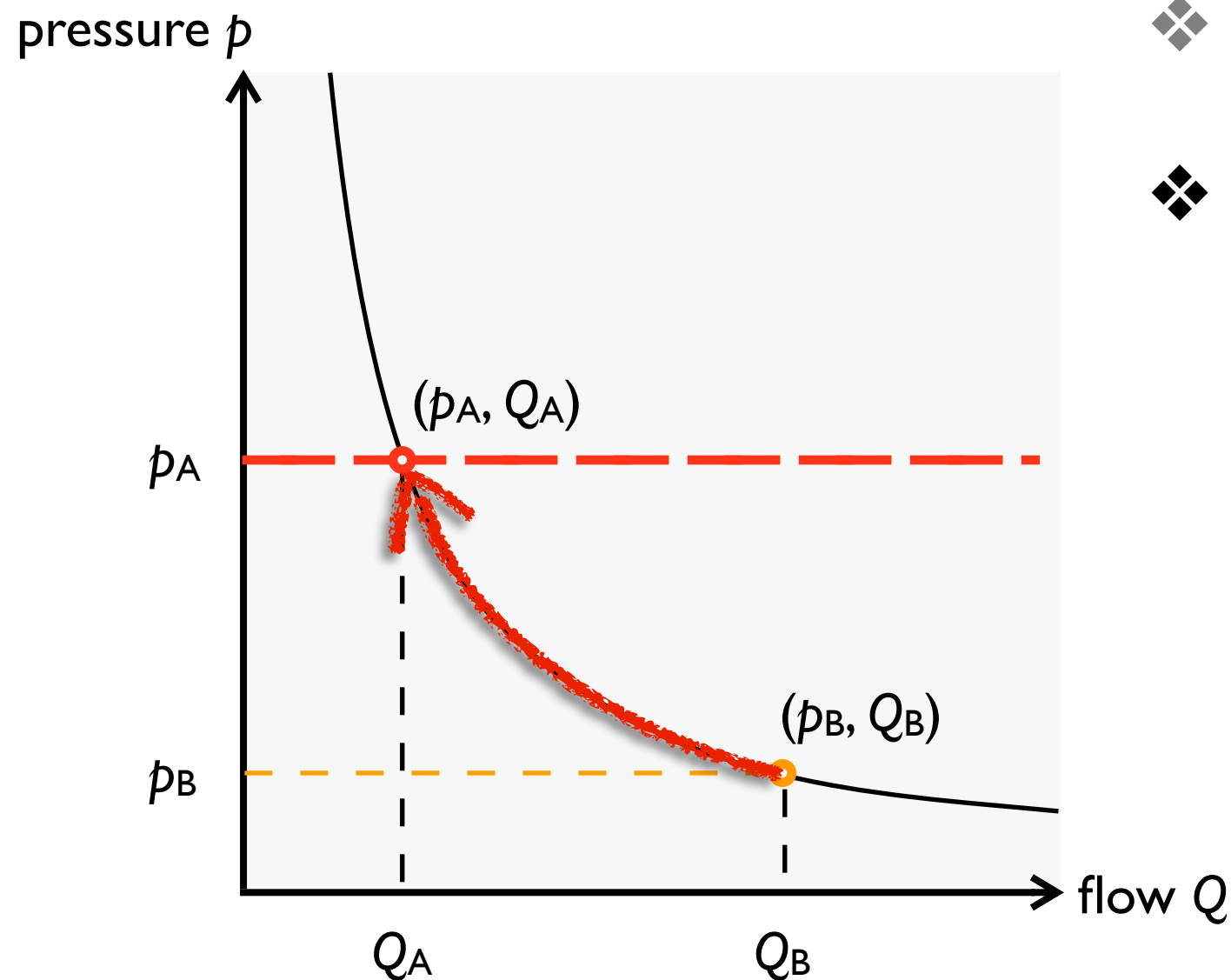
Hydraulic transformation



Hydraulic transformation



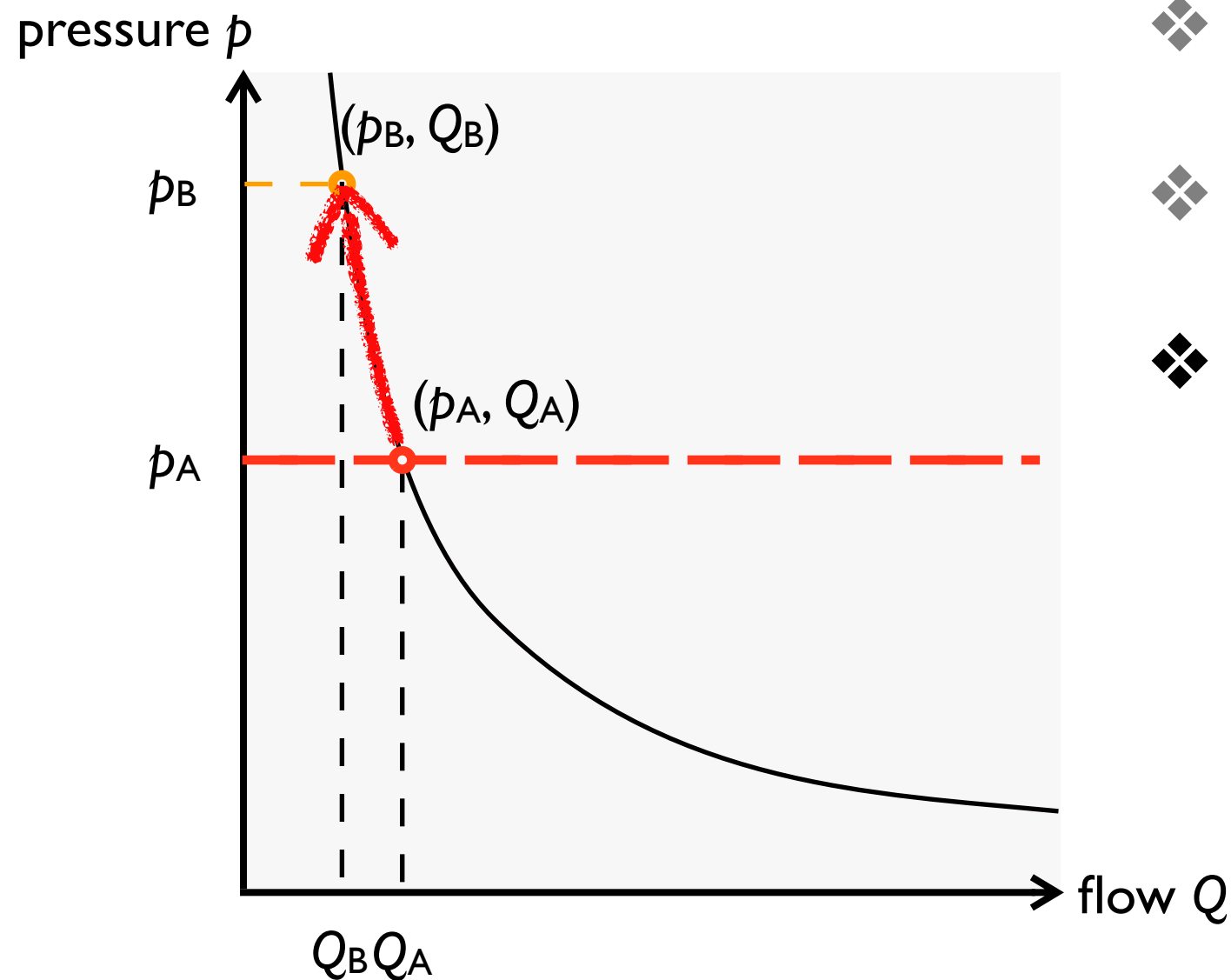
Hydraulic transformation



❖ efficient

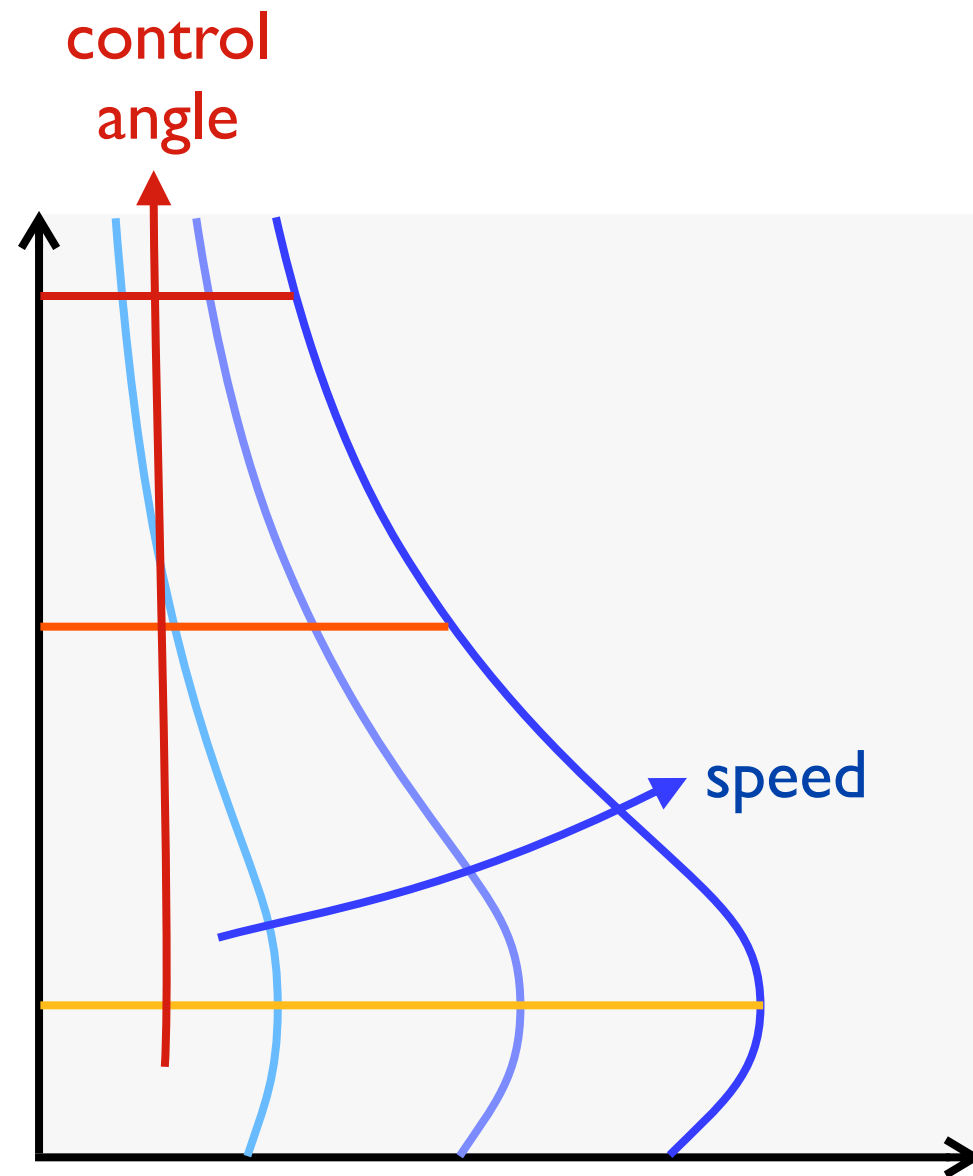
❖ recuperative

Hydraulic transformation



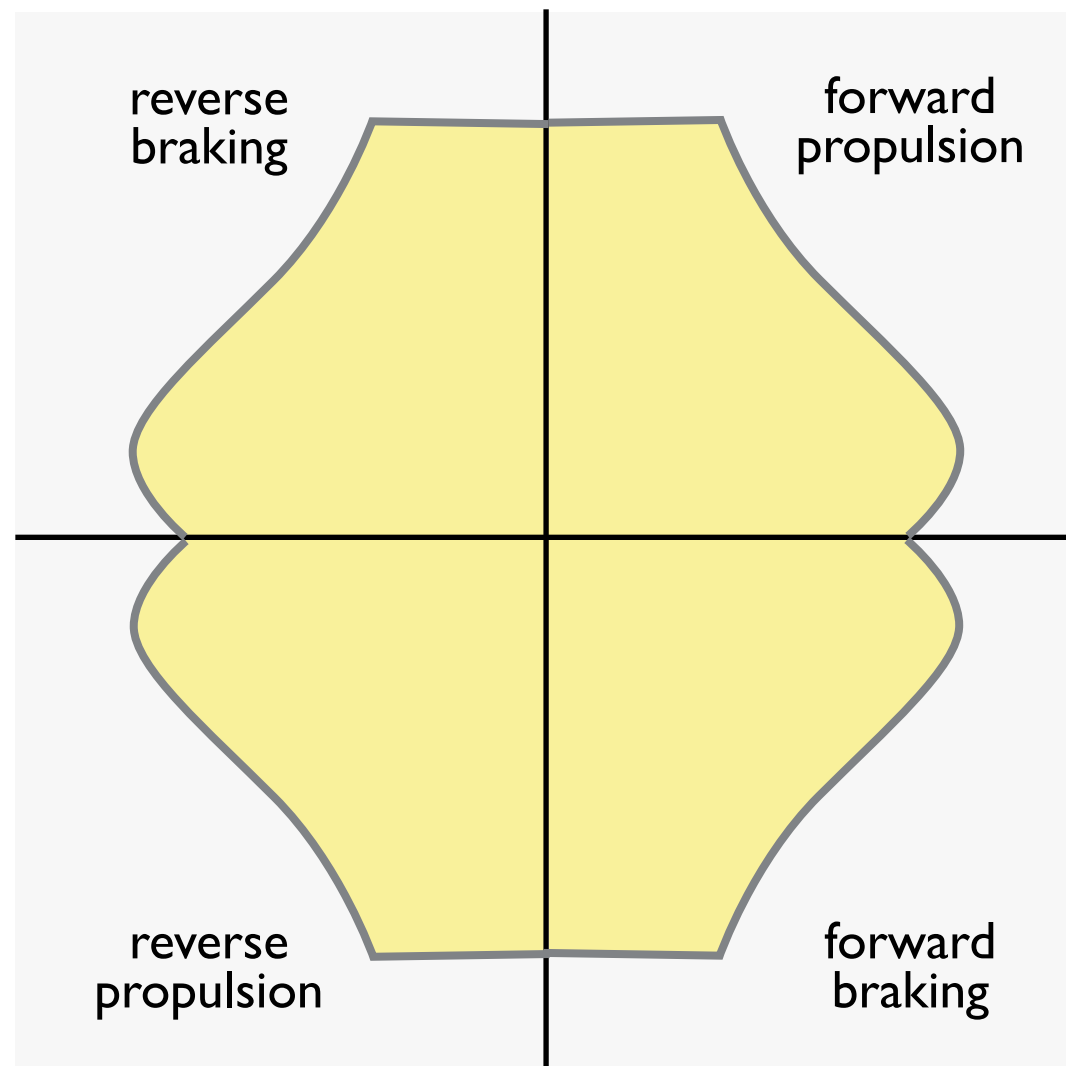
- ❖ efficient
- ❖ recuperative
- ❖ amplification

Hydraulic transformation



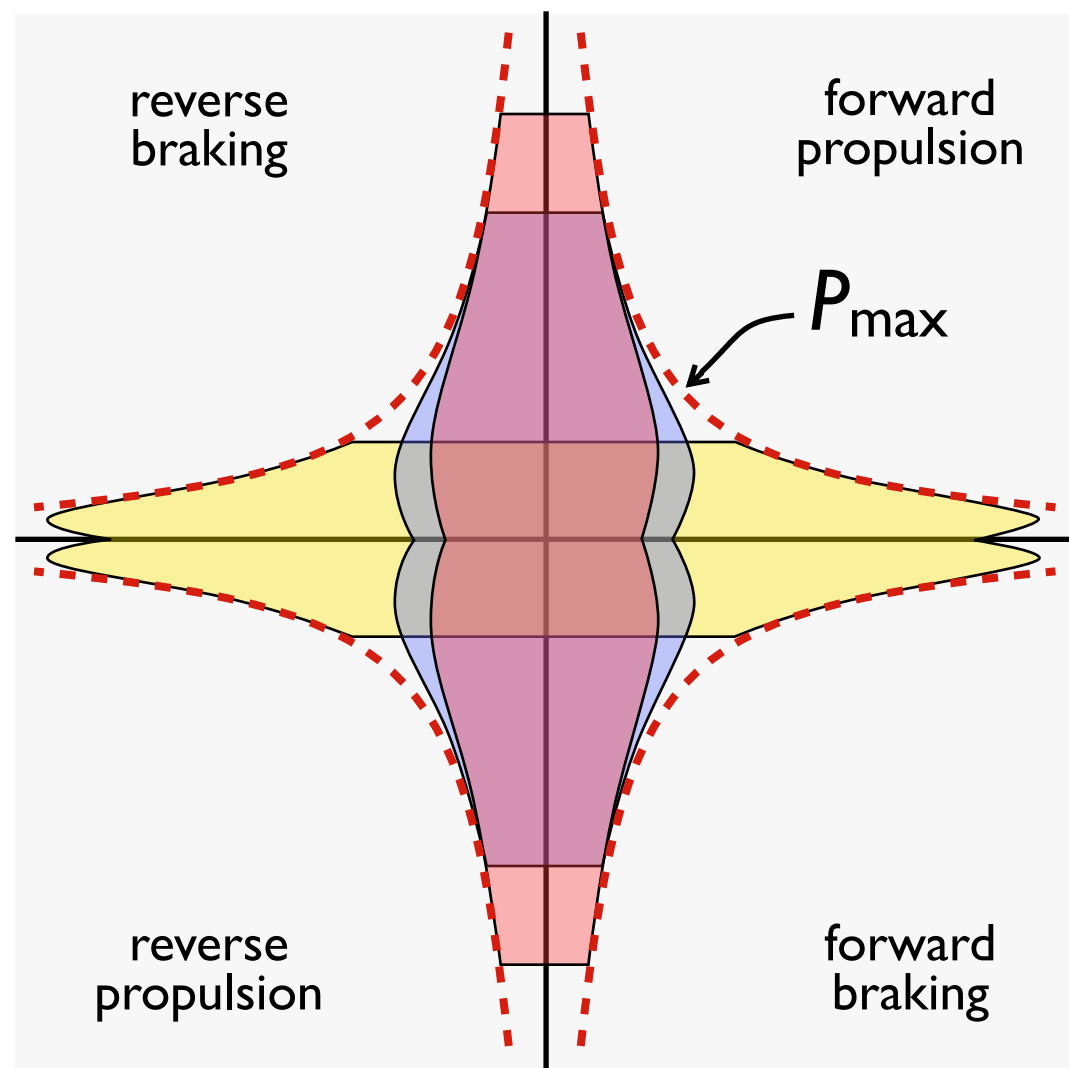
- ❖ efficient
- ❖ recuperative
- ❖ amplification
- ❖ dynamic

Hydraulic transformation



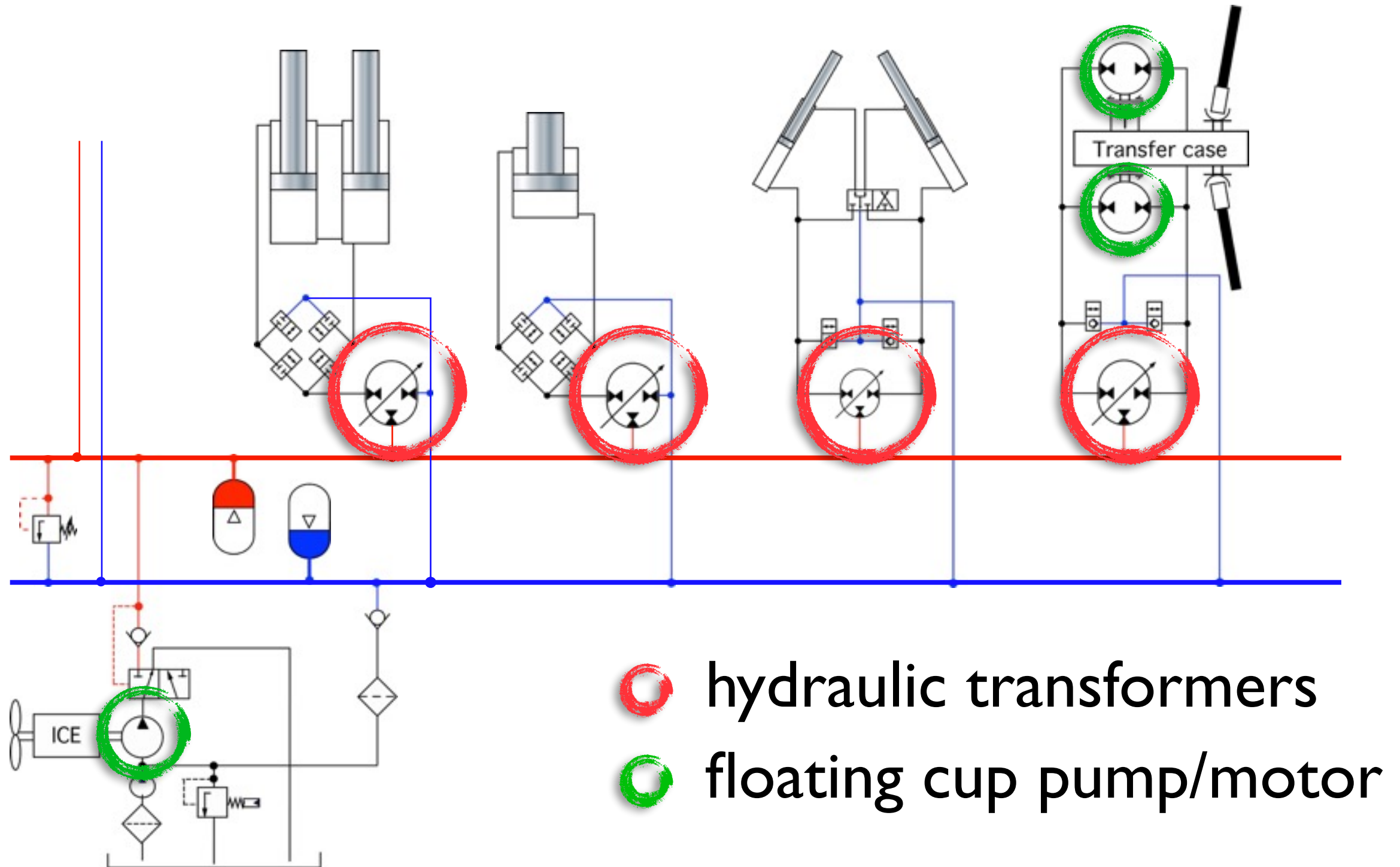
- ❖ efficient
- ❖ recuperative
- ❖ amplification
- ❖ dynamic
- ❖ 4-quadrants

Hydraulic transformation



- ❖ efficient
- ❖ recuperative
- ❖ amplification
- ❖ dynamic
- ❖ 4-quadrants
- ❖ wide operating range

new technologies



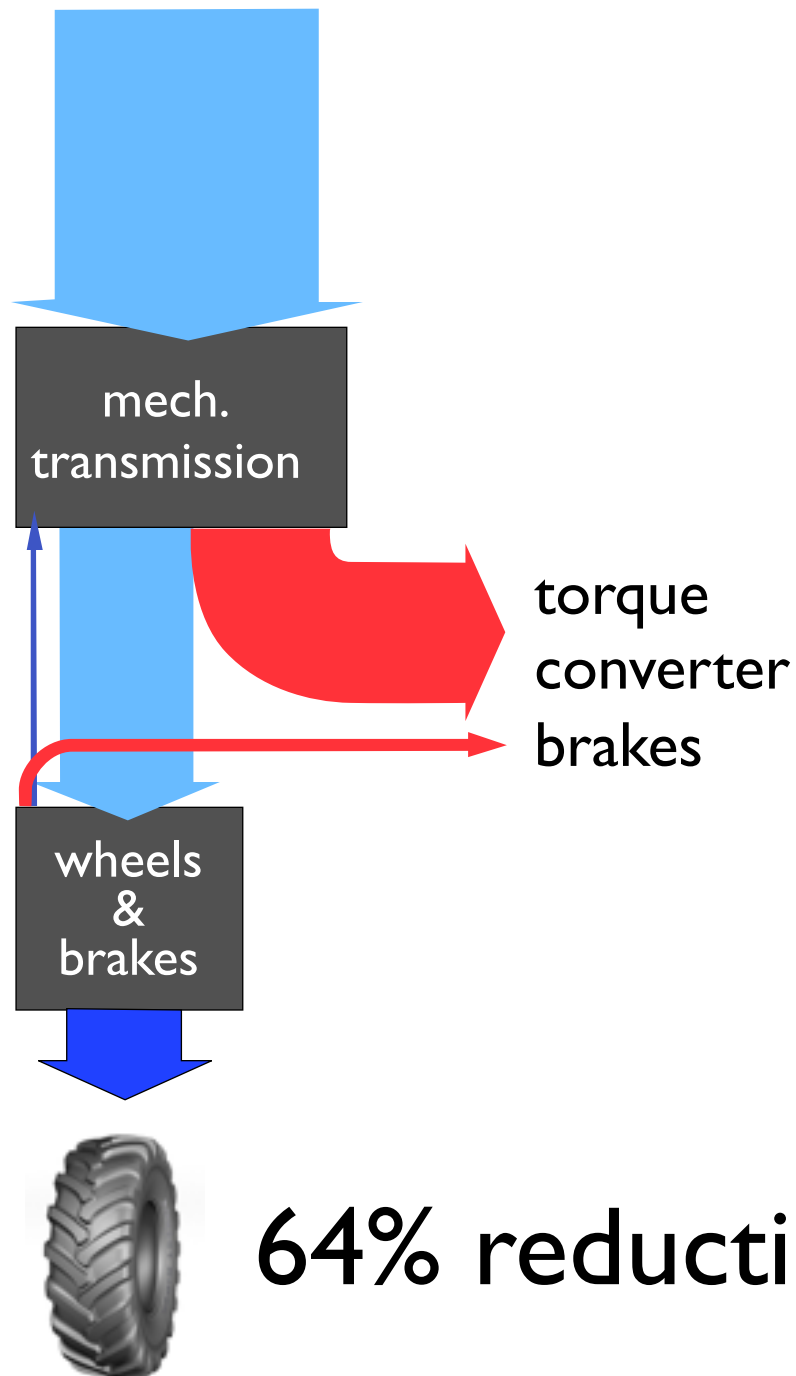
50% fuel
consumption?

most important reasons

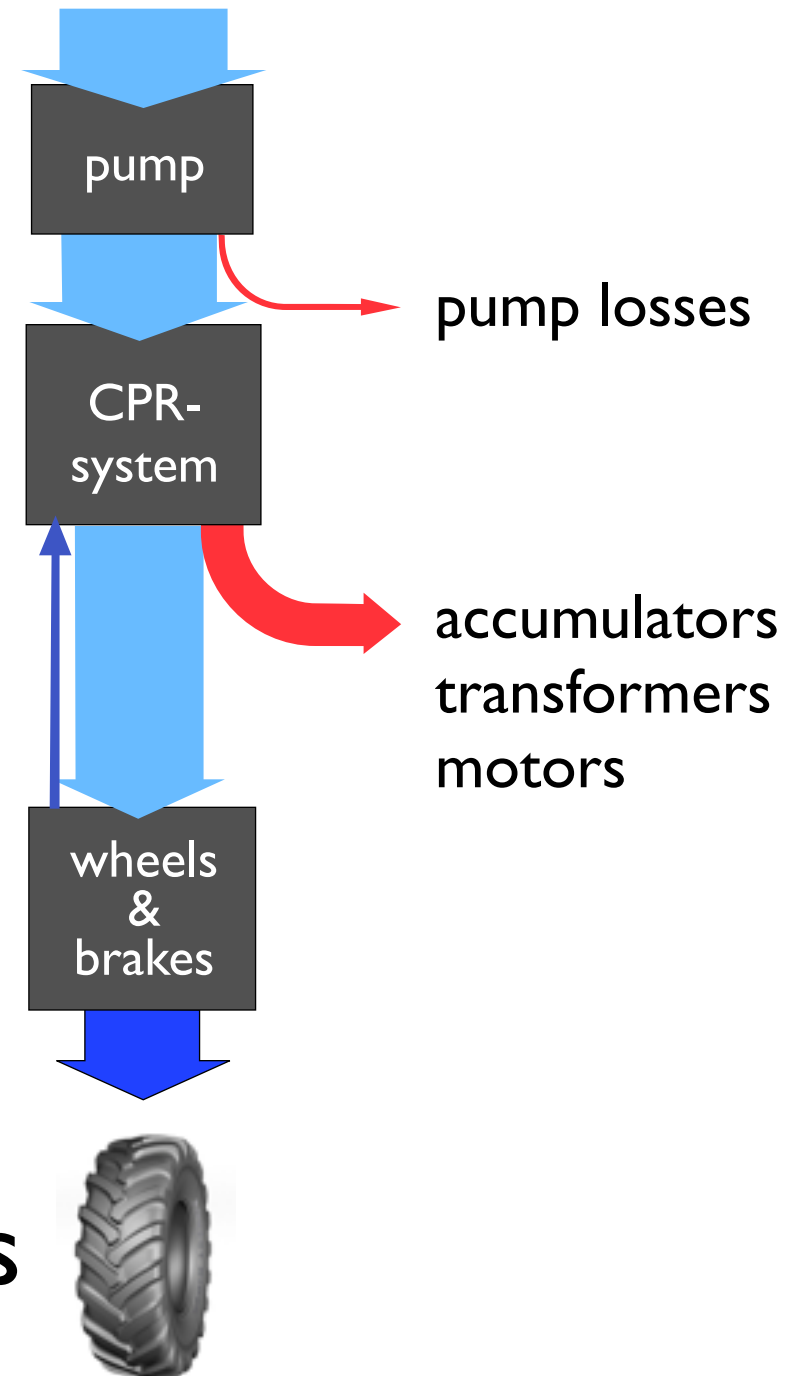
- ❖ high component efficiency
- ❖ energy recuperation
- ❖ avoiding throttle losses
- ❖ eliminating the torque converter

propulsion (excl. engine)

conventional



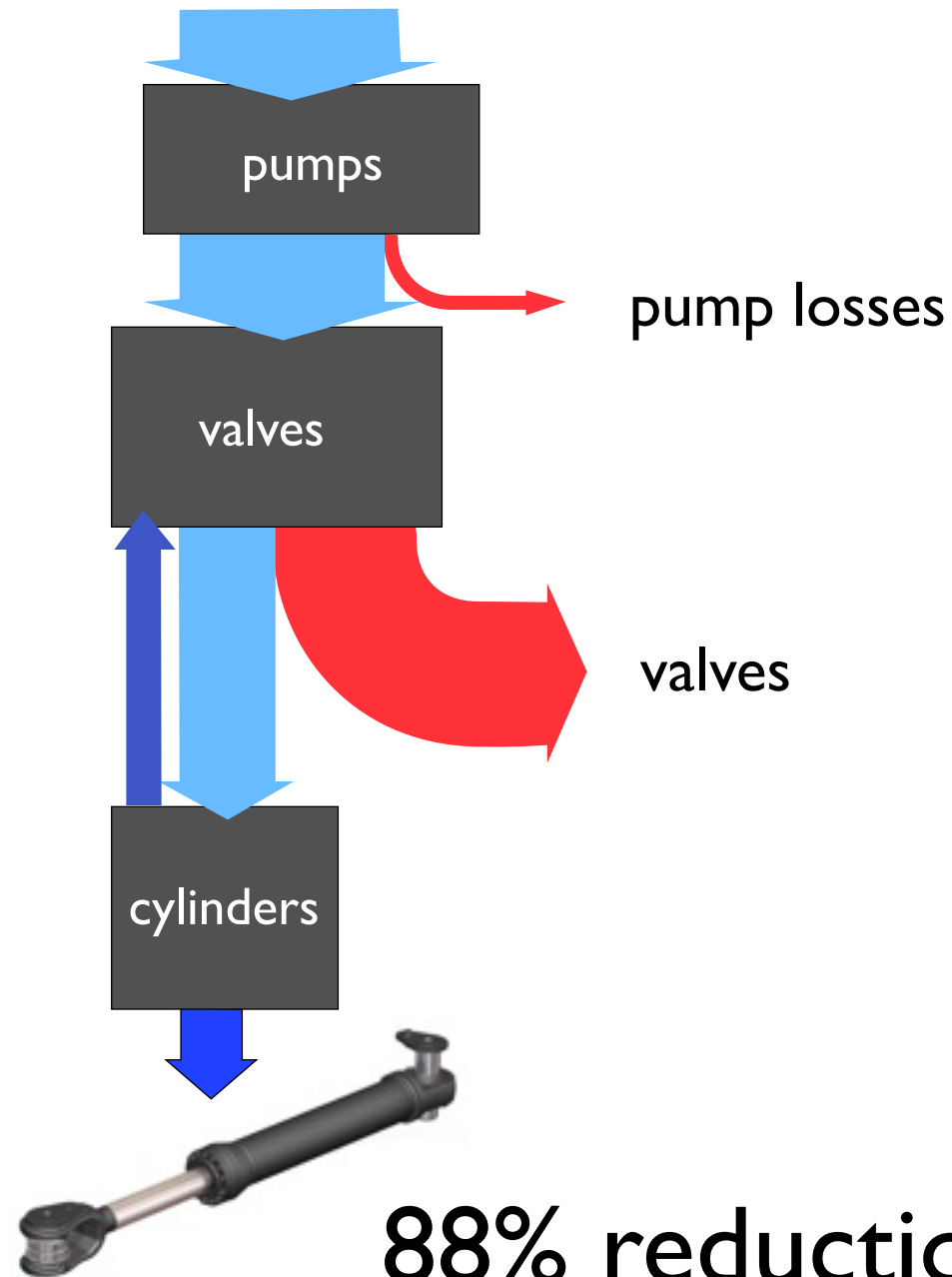
Hydrid



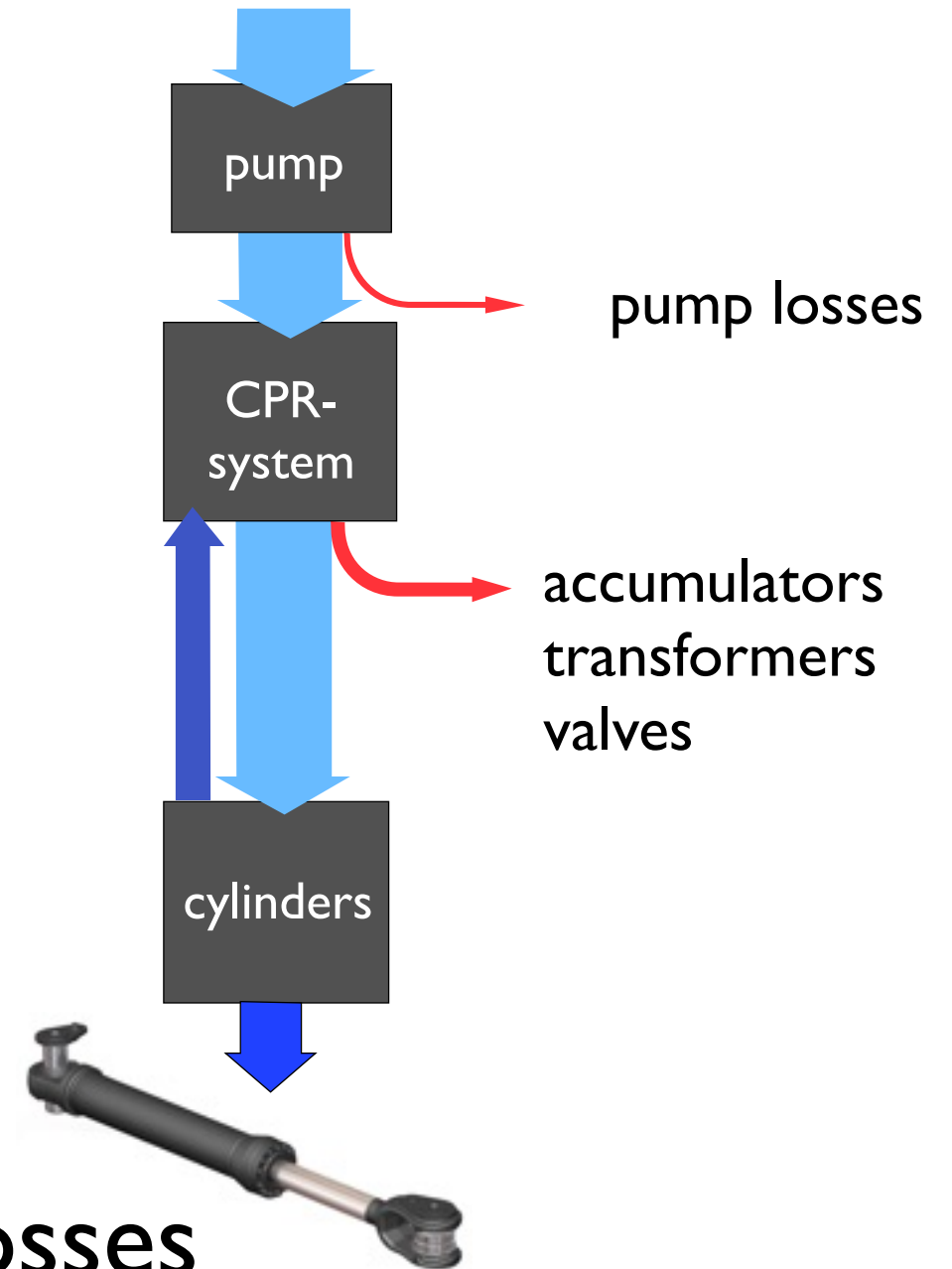
64% reduction of losses

cylinders (excl. engine)

conventional



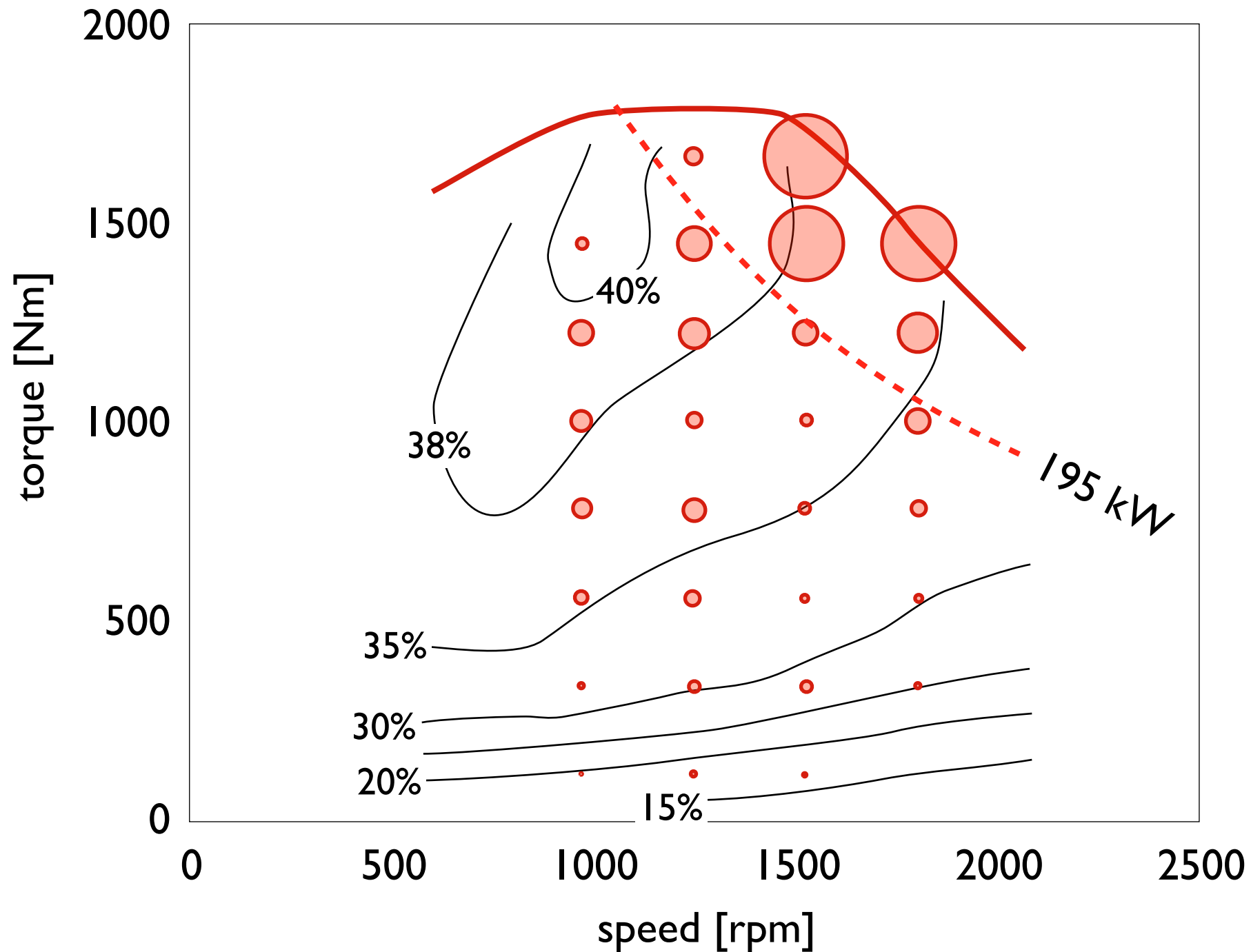
Hydrid



88% reduction of losses

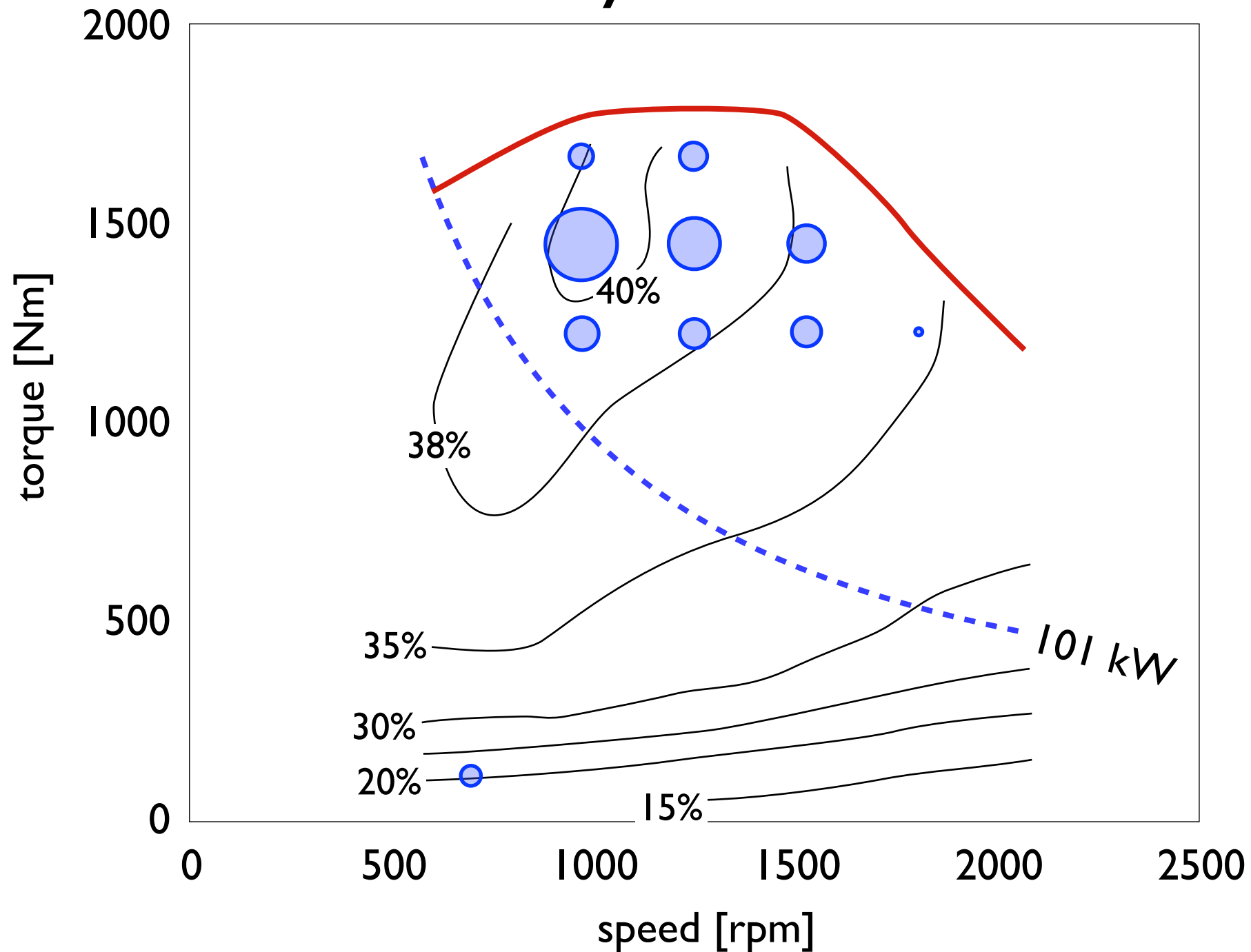
engine efficiency

conventional



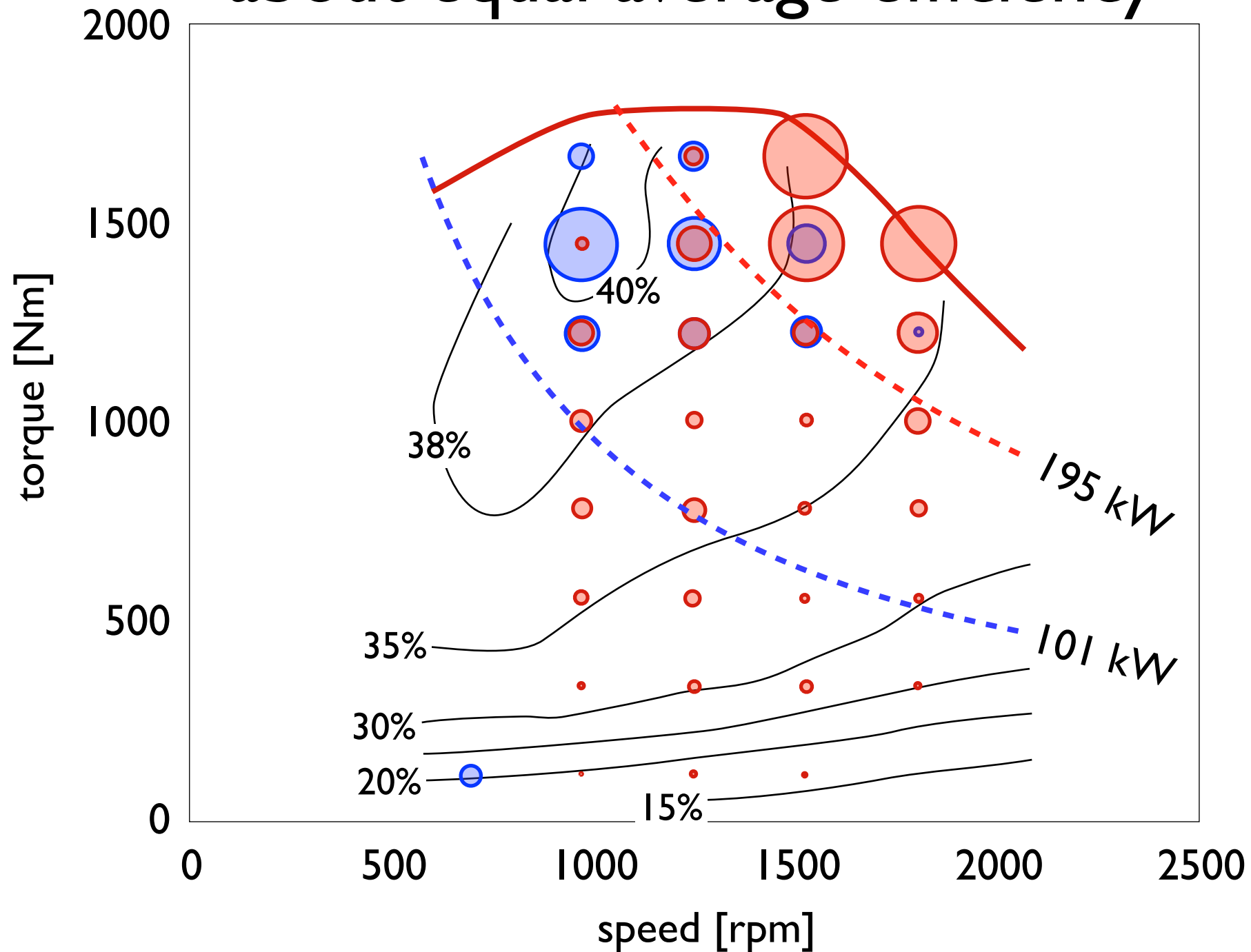
engine efficiency

Hydrid



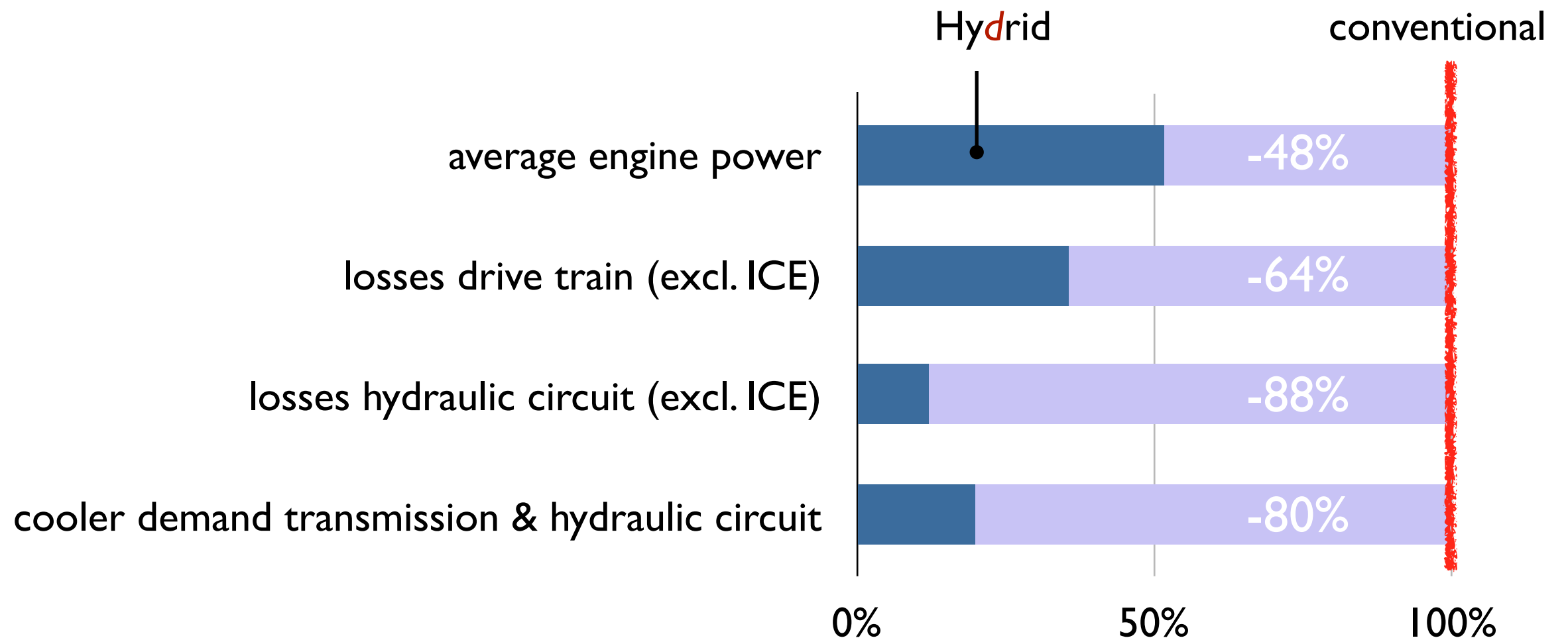
engine efficiency

about equal average efficiency



Results

Results



Y-cycle only!



