

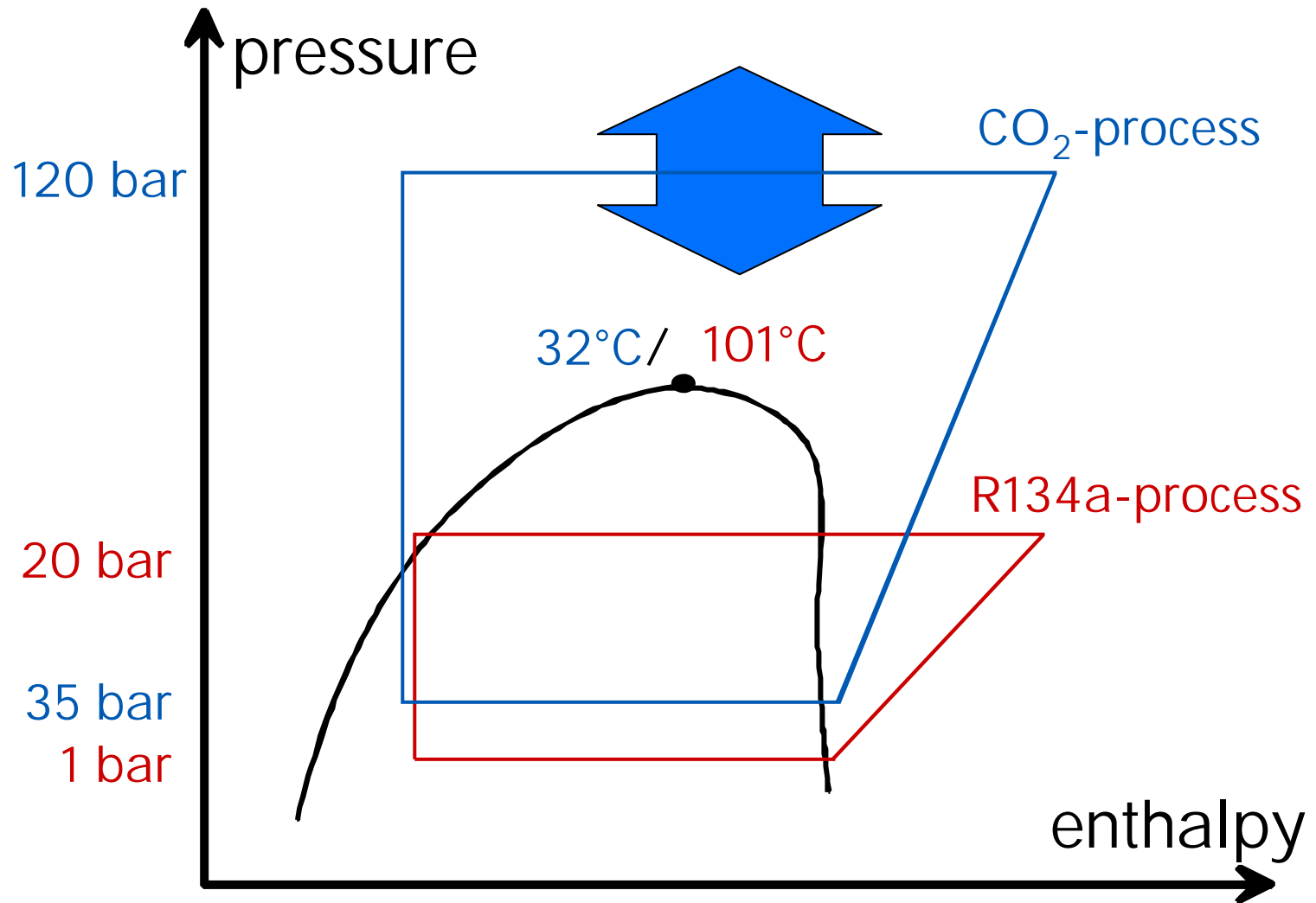
CO₂-A/C-system

COP comparison R134a vs. CO₂

- Characteristic of the CO₂- cooling cycle
- Test bench investigation R134a vs. CO₂
- Calculation of Power Consumption in NEFZ-Driving Cycle
- Summary

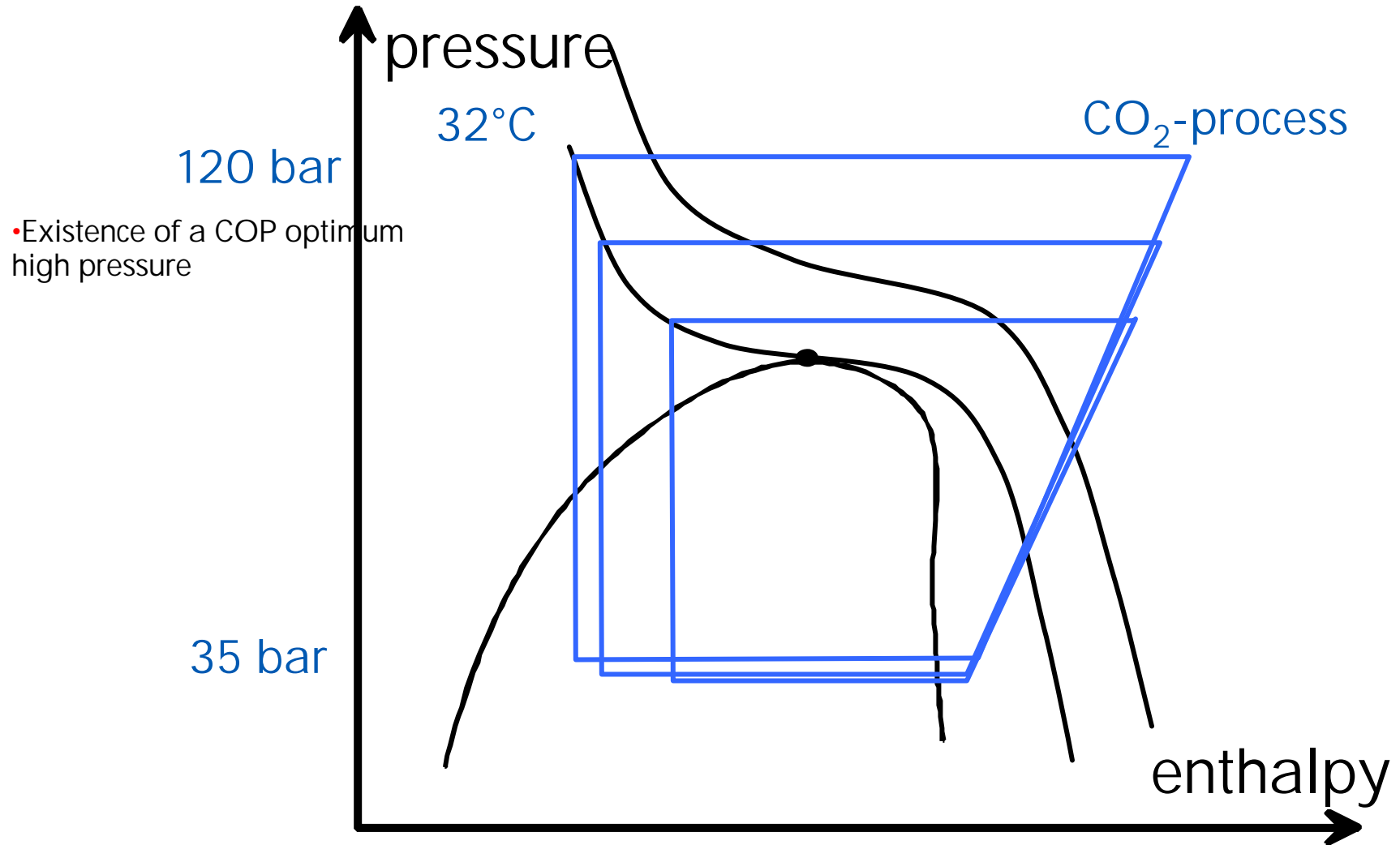
CO₂-A/C-system

Thermodynamic process



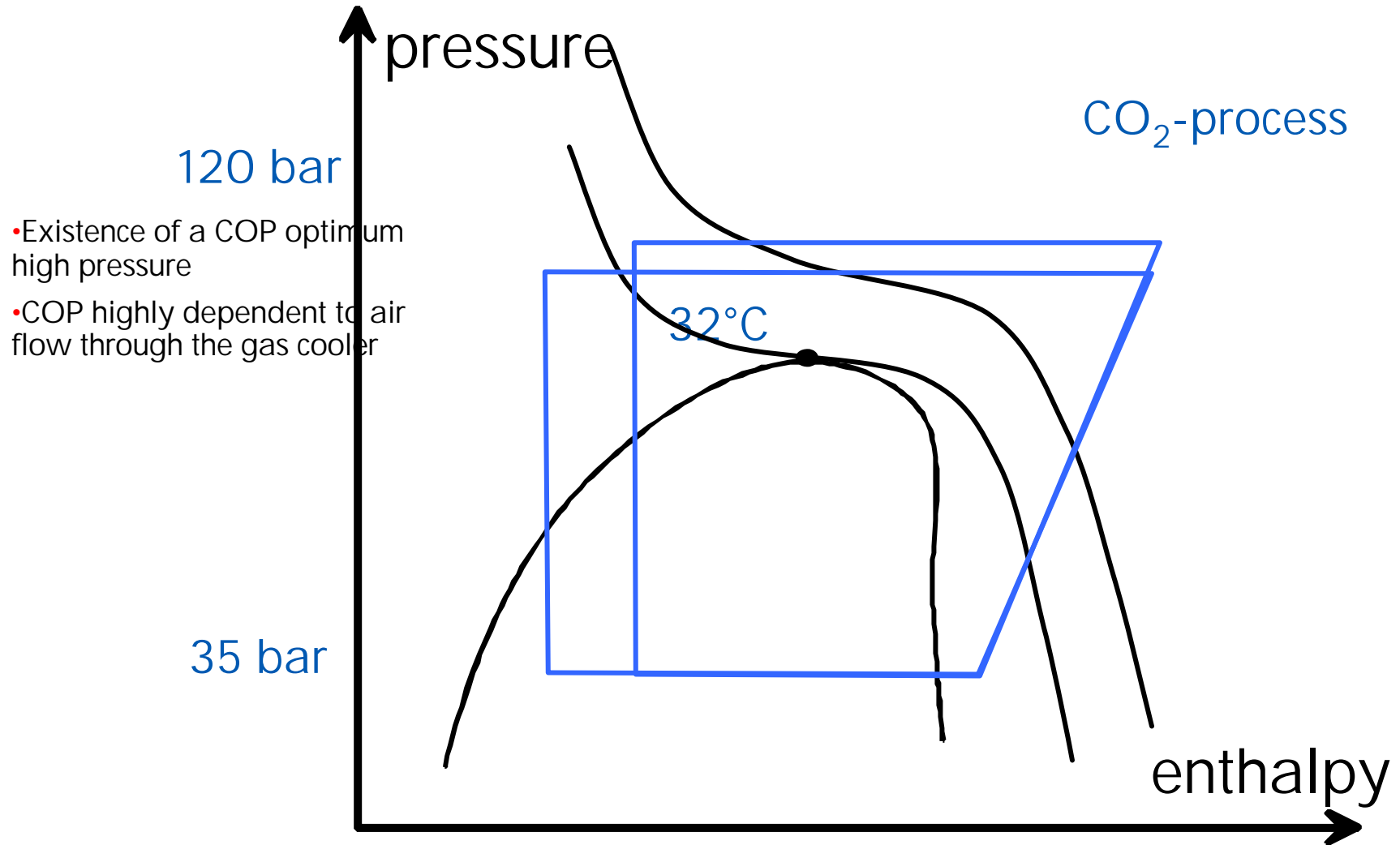
CO₂-A/C-system

Thermodynamic process



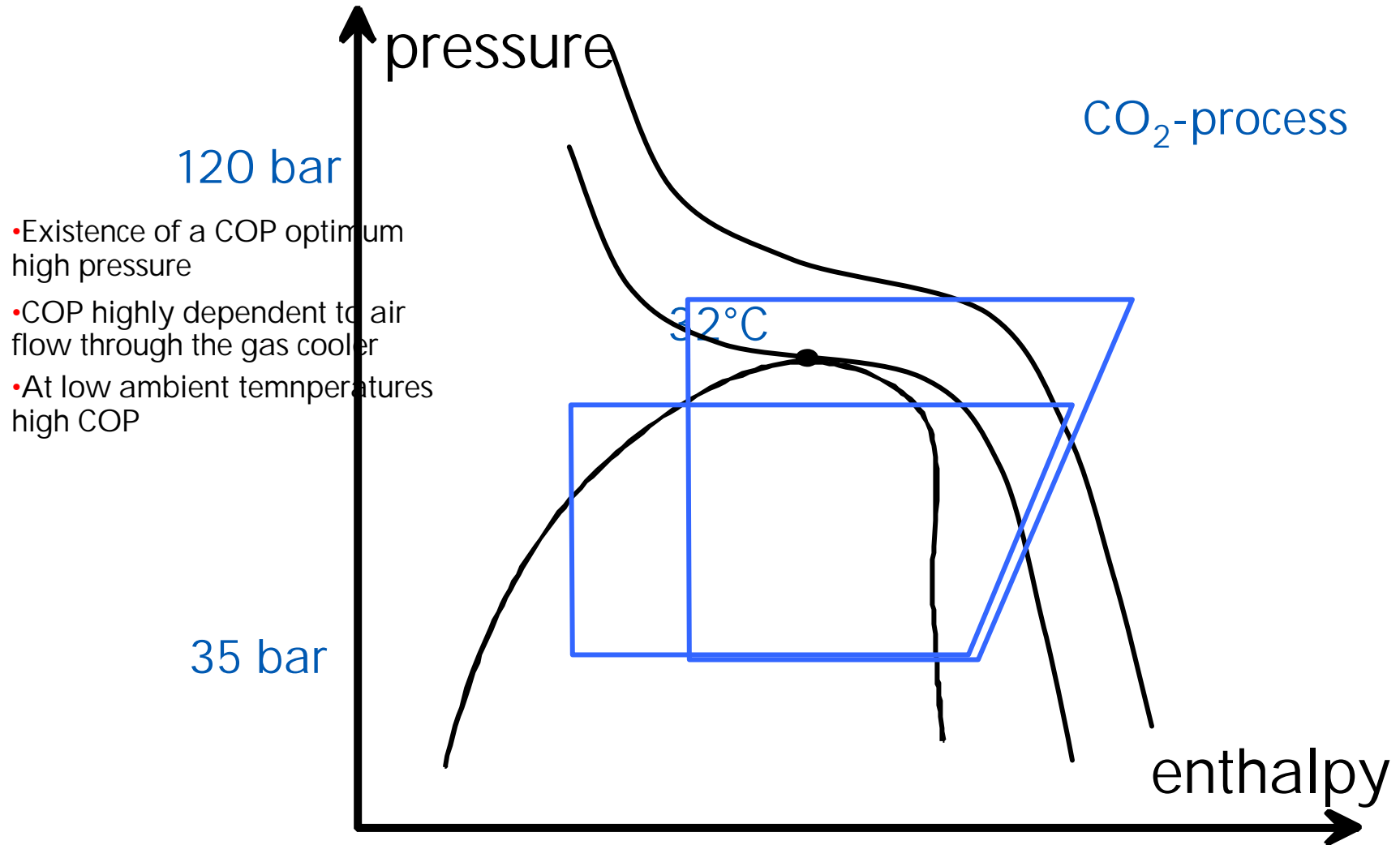
CO₂-A/C-system

Thermodynamic process



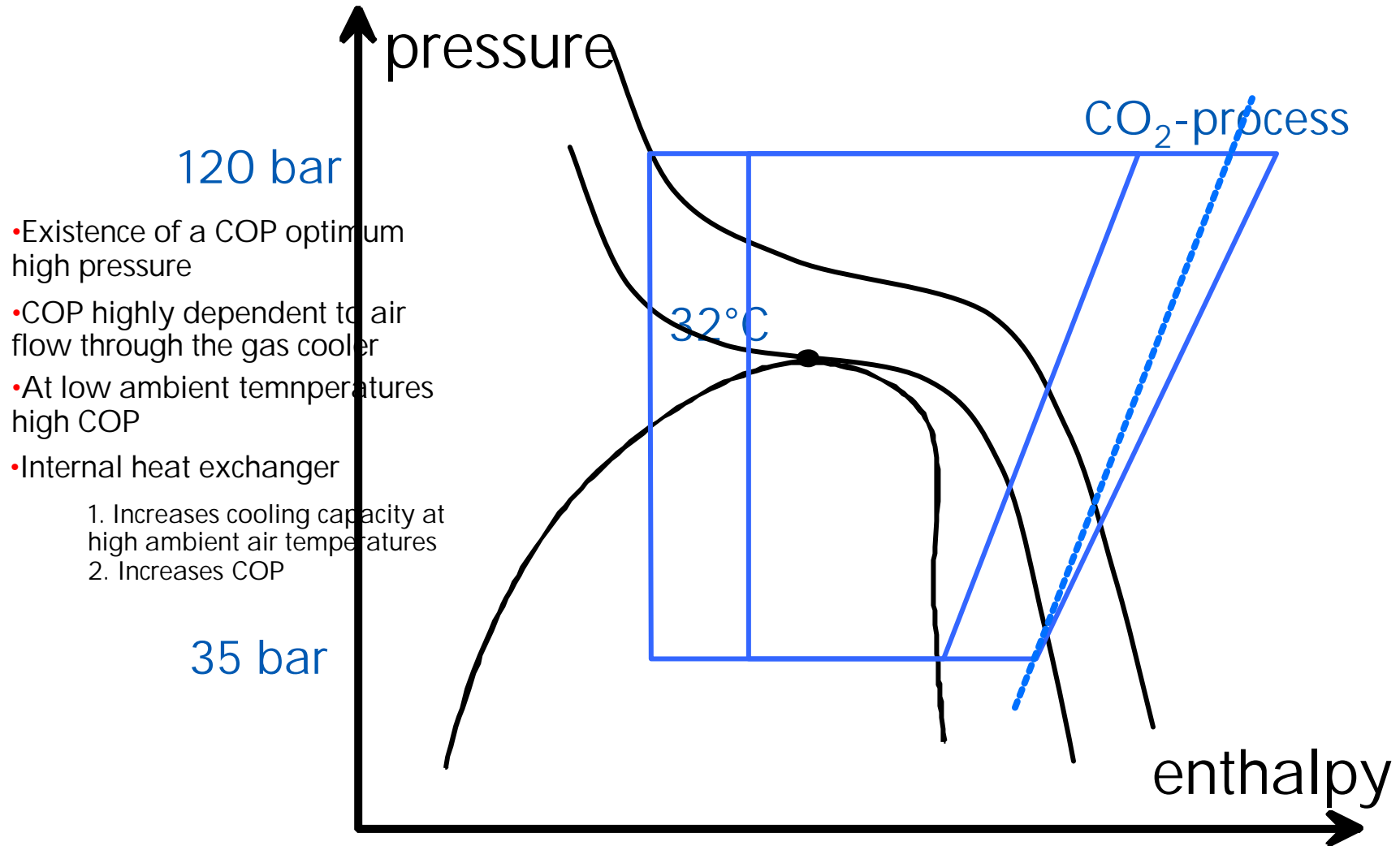
CO₂-A/C-system

Thermodynamic process

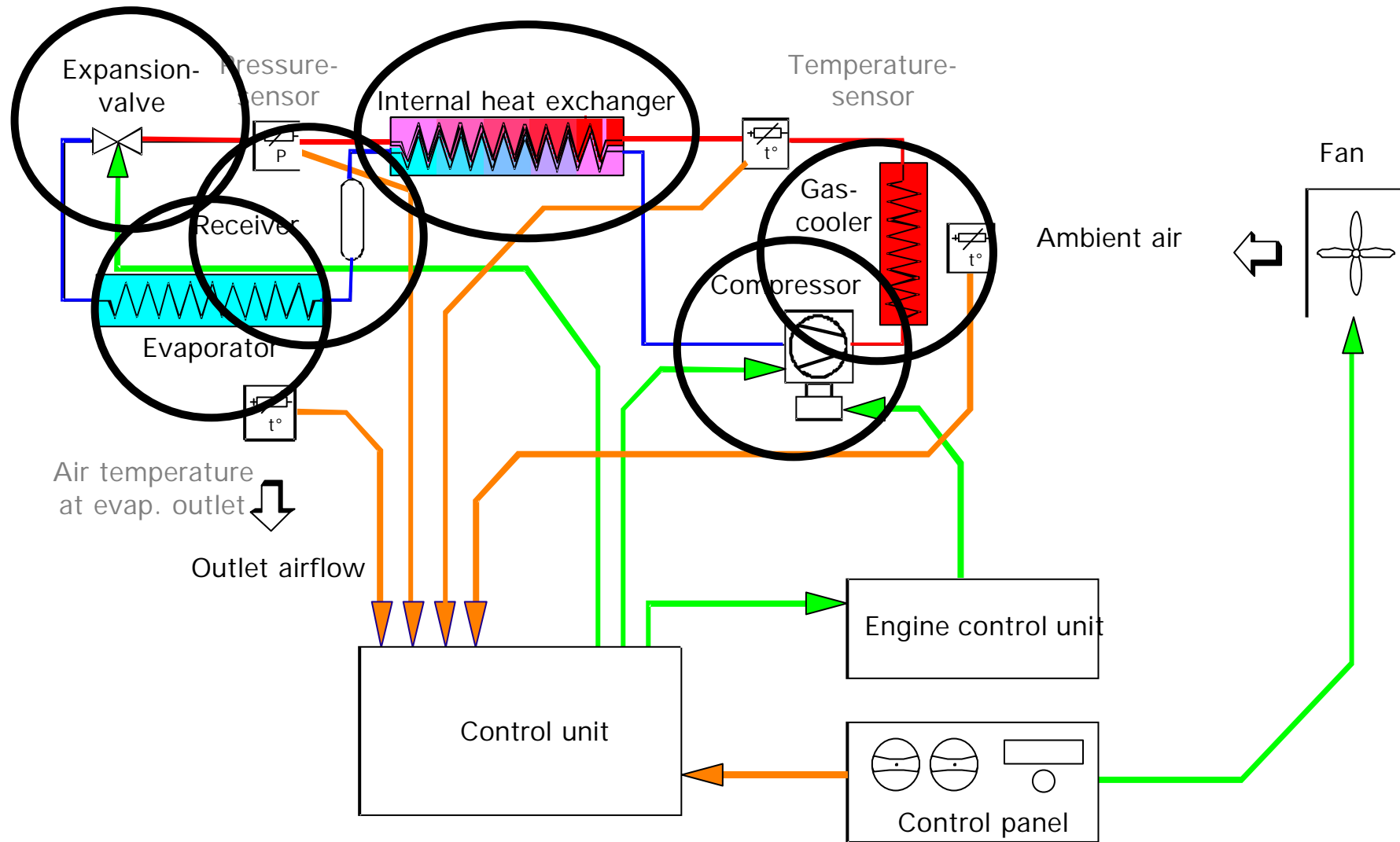


CO₂-A/C-system

Thermodynamic process



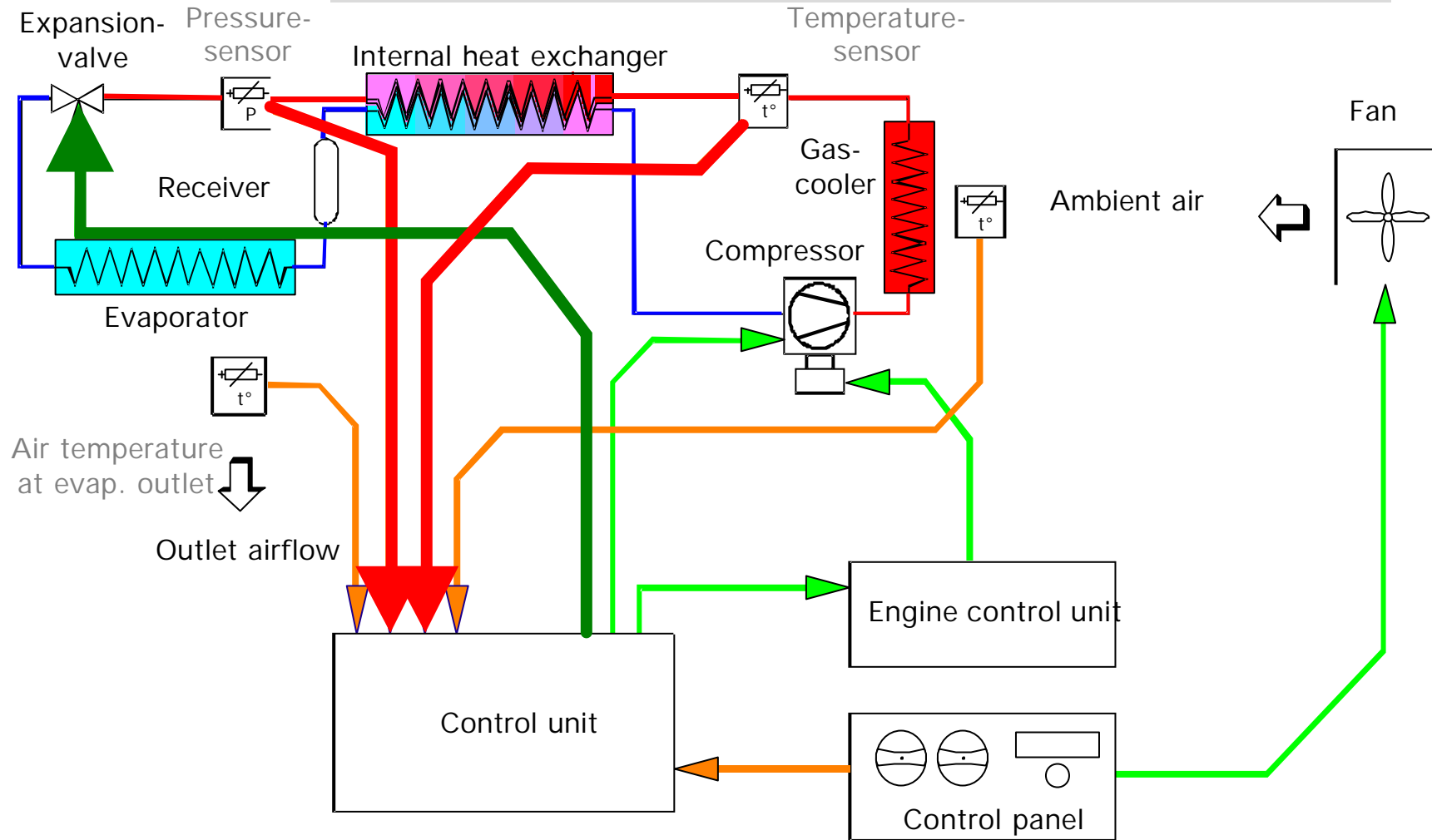
CO₂-A/C-system System layout



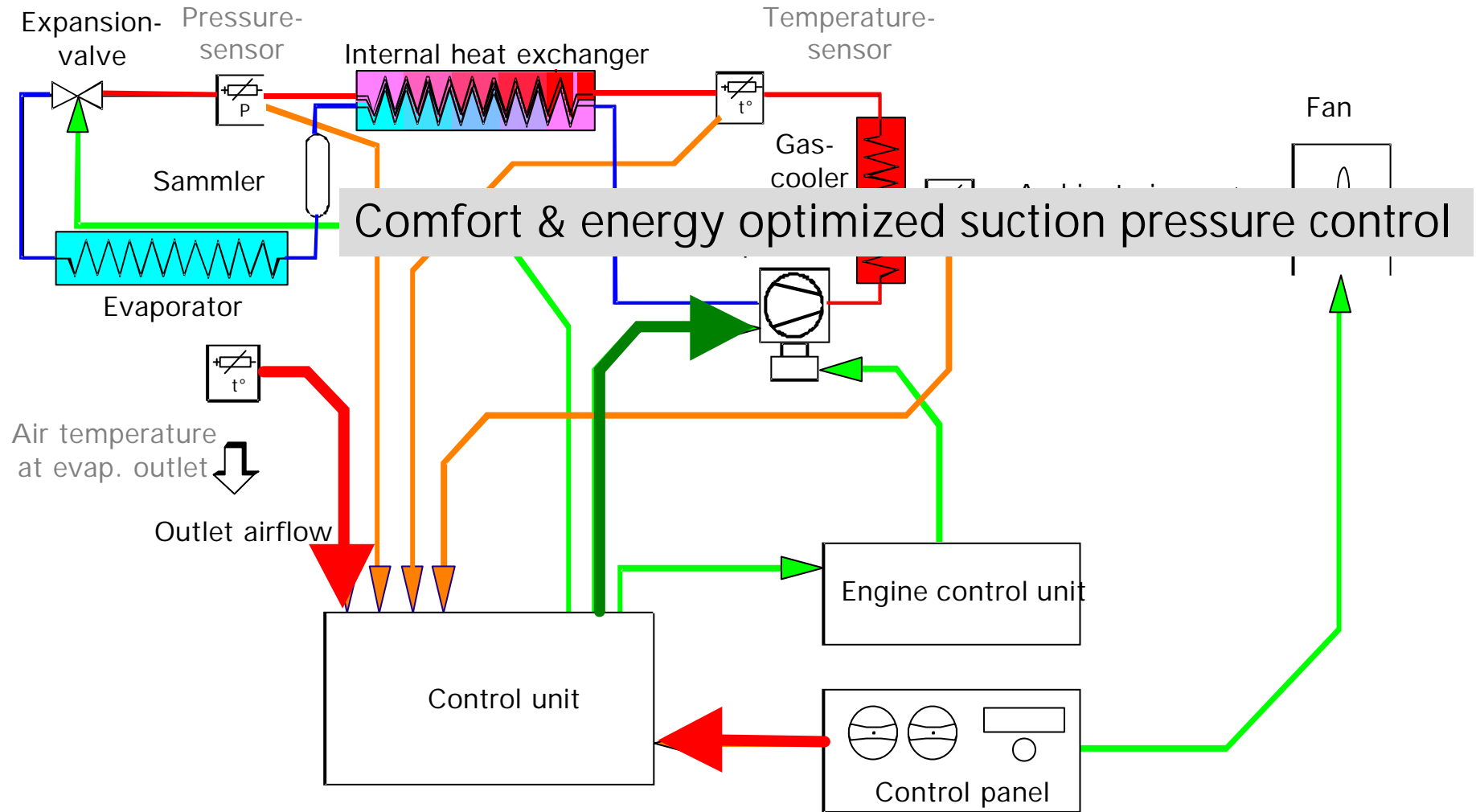
CO₂-A/C-system

System layout

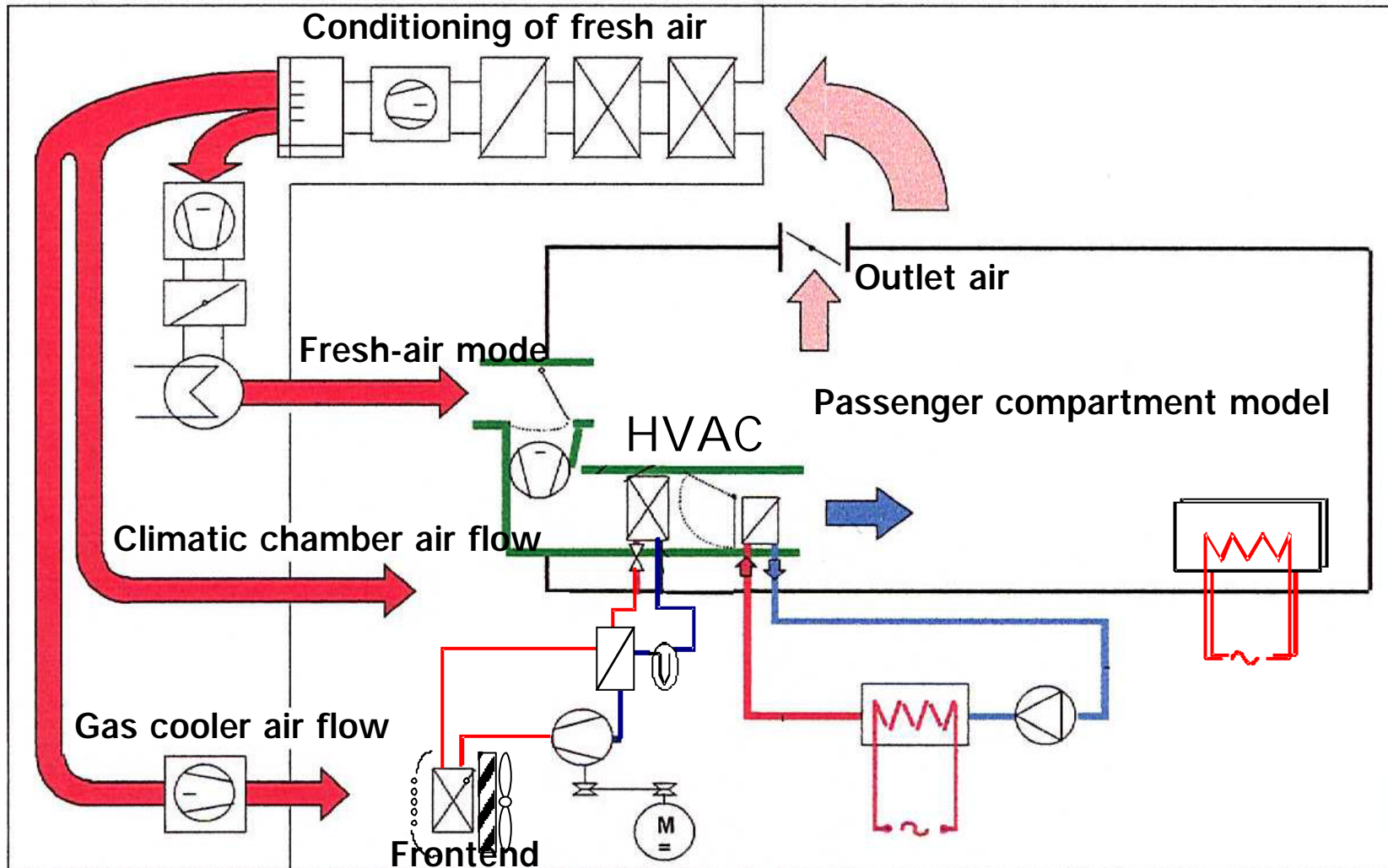
COP optimized high pressure control



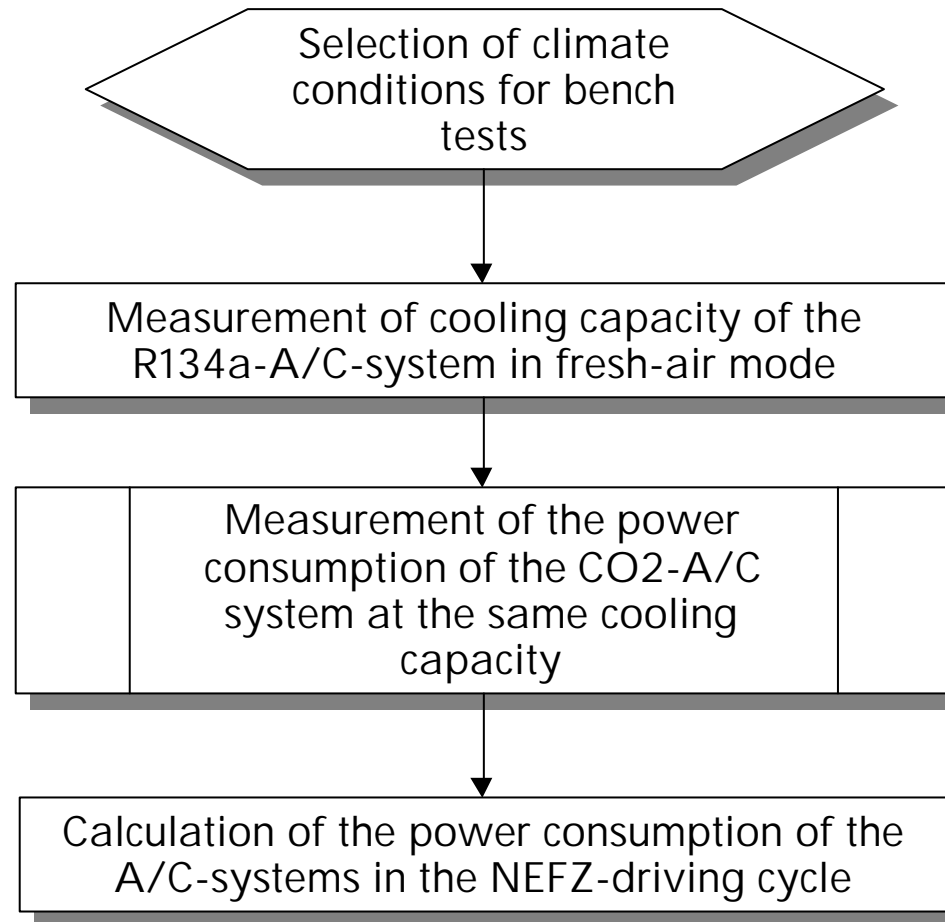
CO₂-A/C-system System layout



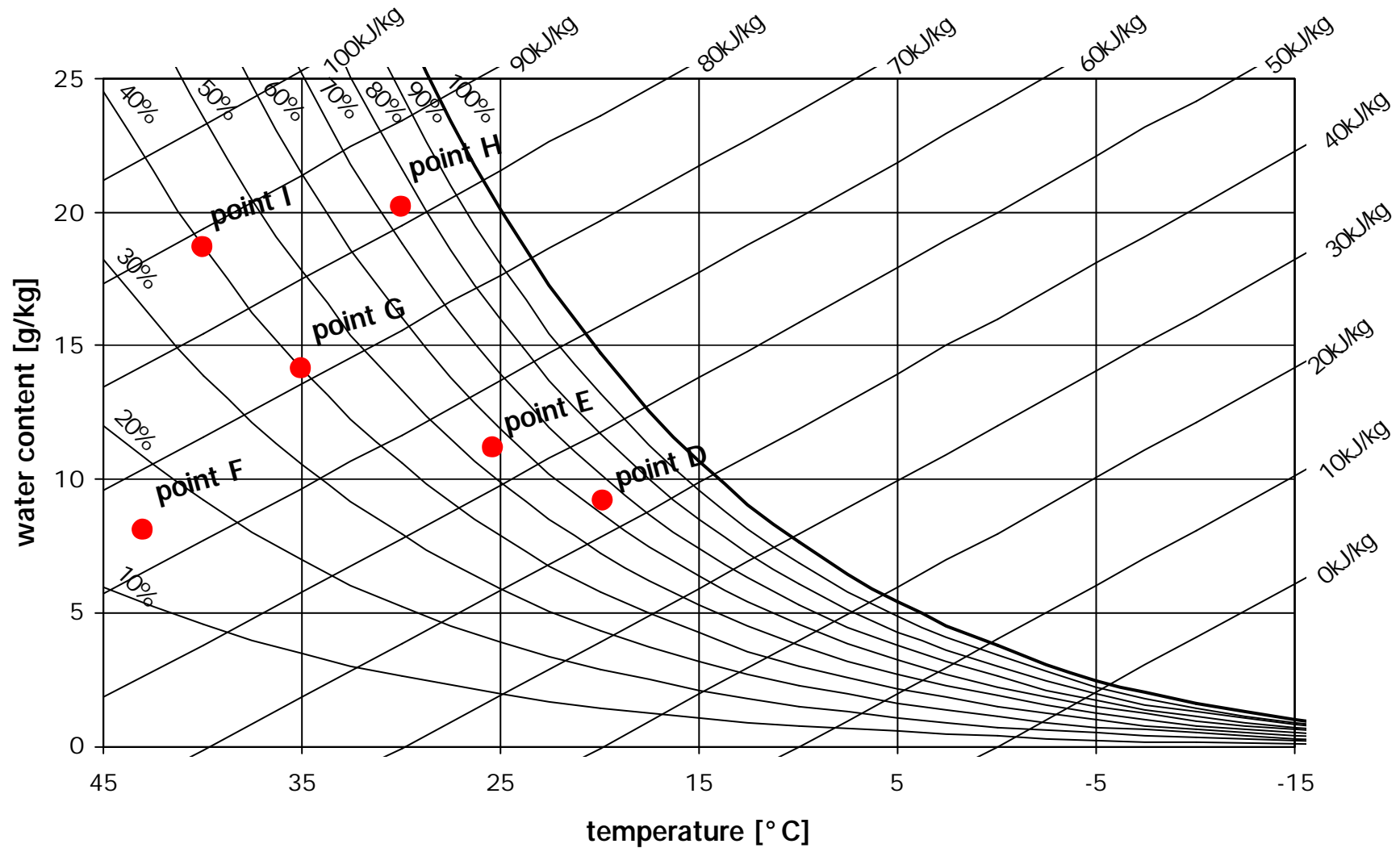
CO₂-A/C-system Test bench



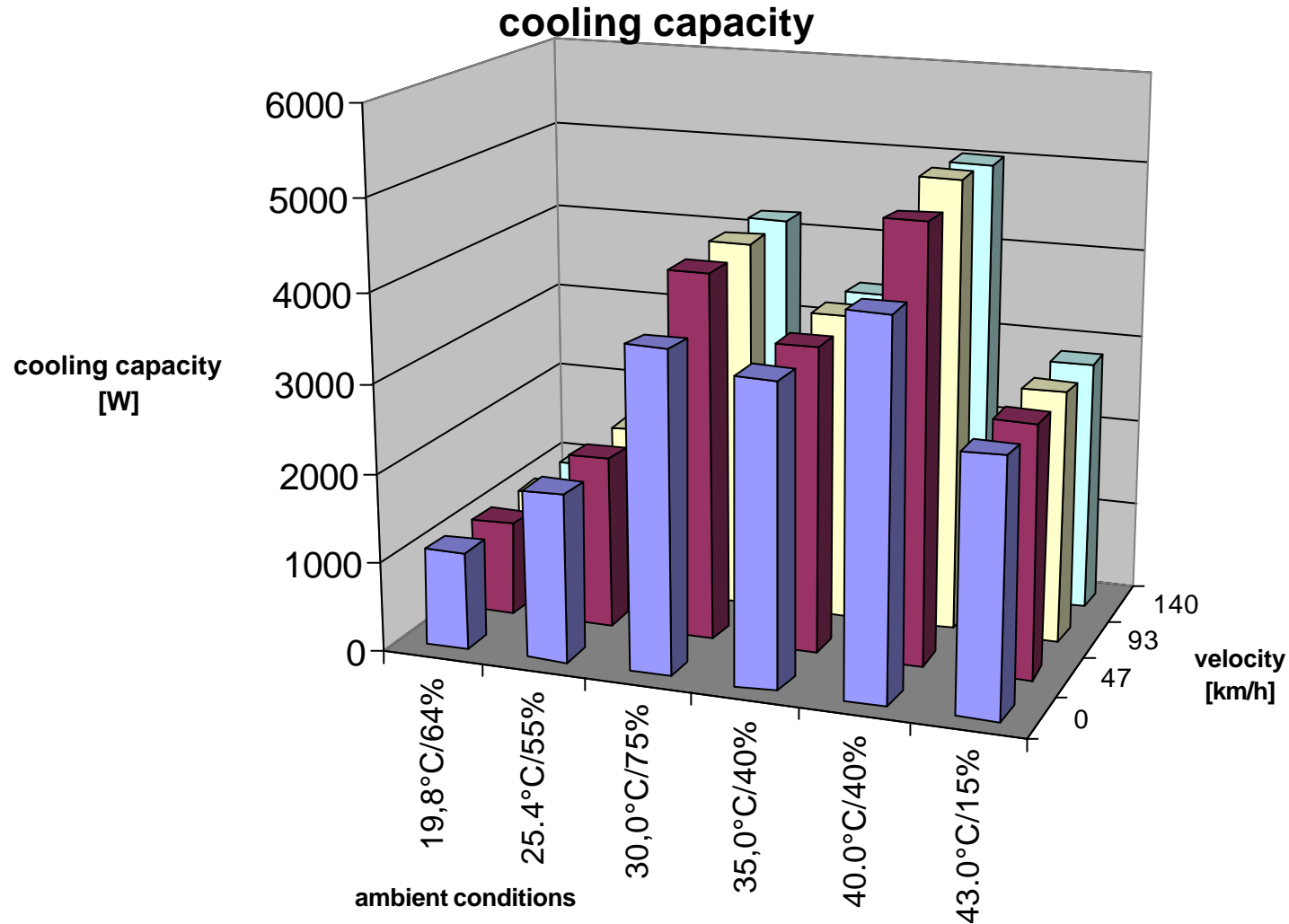
CO₂-A/C-system comparison CO₂- vs. R134a-A/C-system



CO₂-A/C-system comparison CO₂- vs. R134a-A/C-system

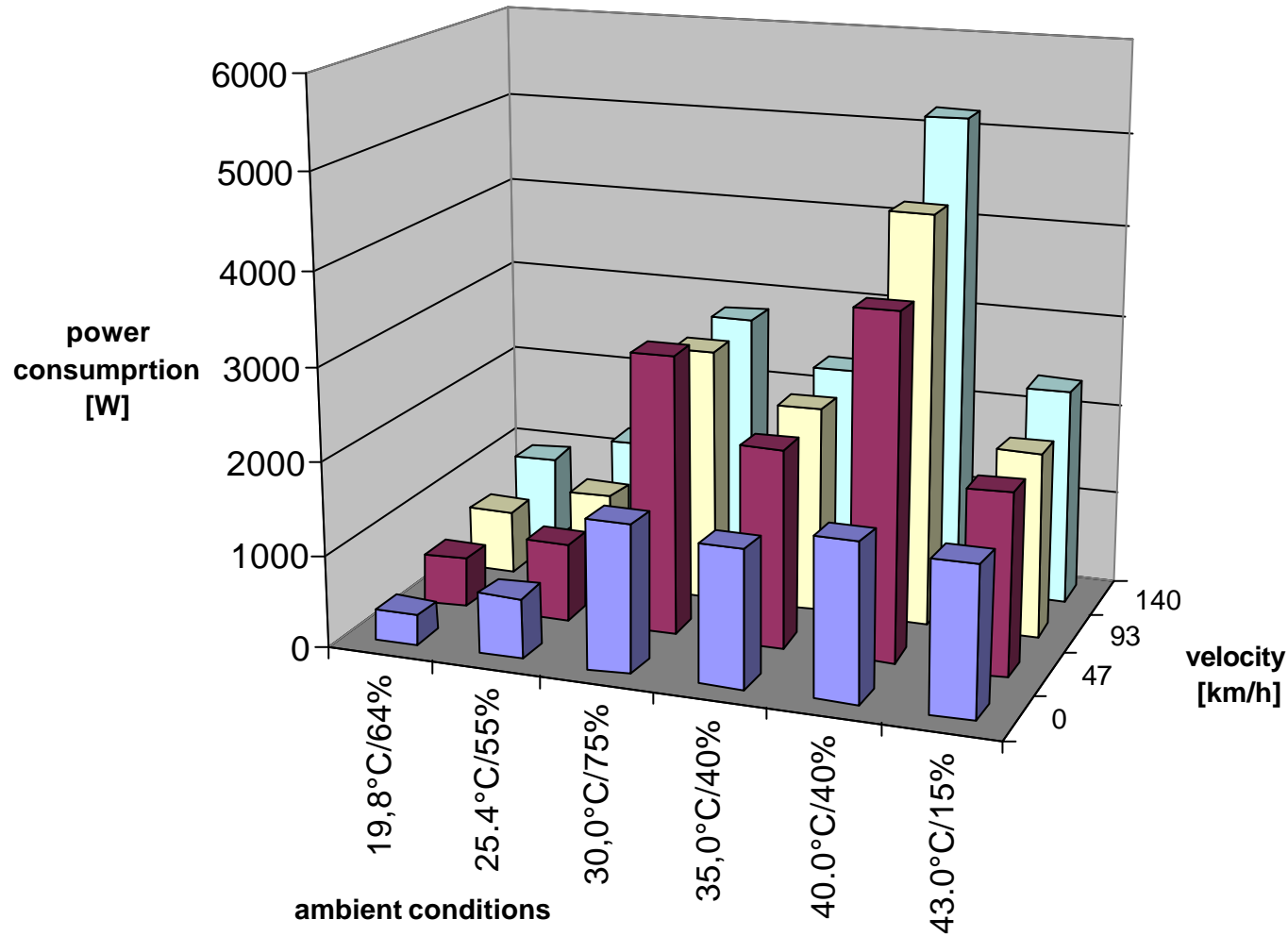


CO₂-A/C-system comparison CO₂- vs. R134a-A/C-system

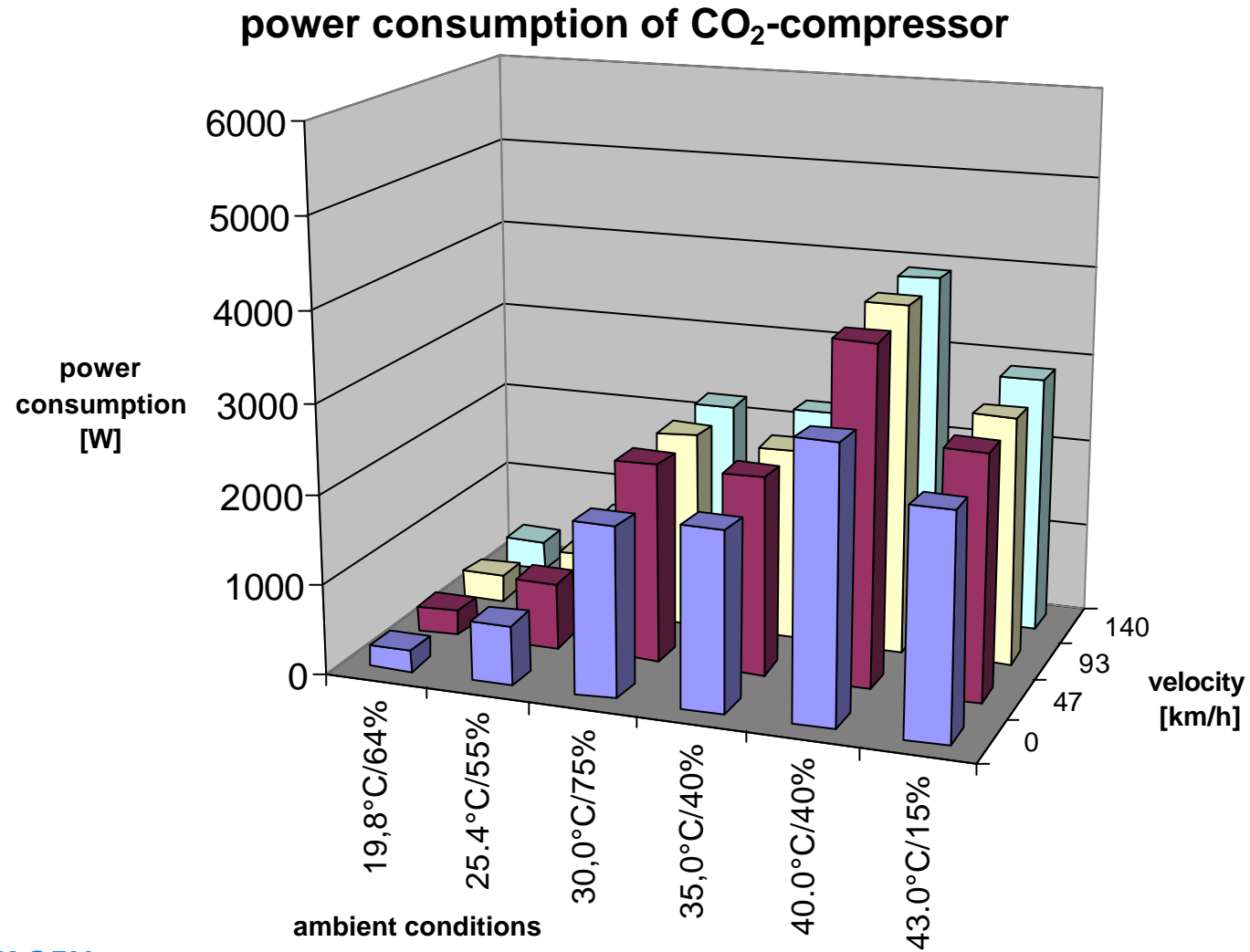


CO₂-A/C-system comparison CO₂- vs. R134a-A/C-system

power consumption of R134a-compressor

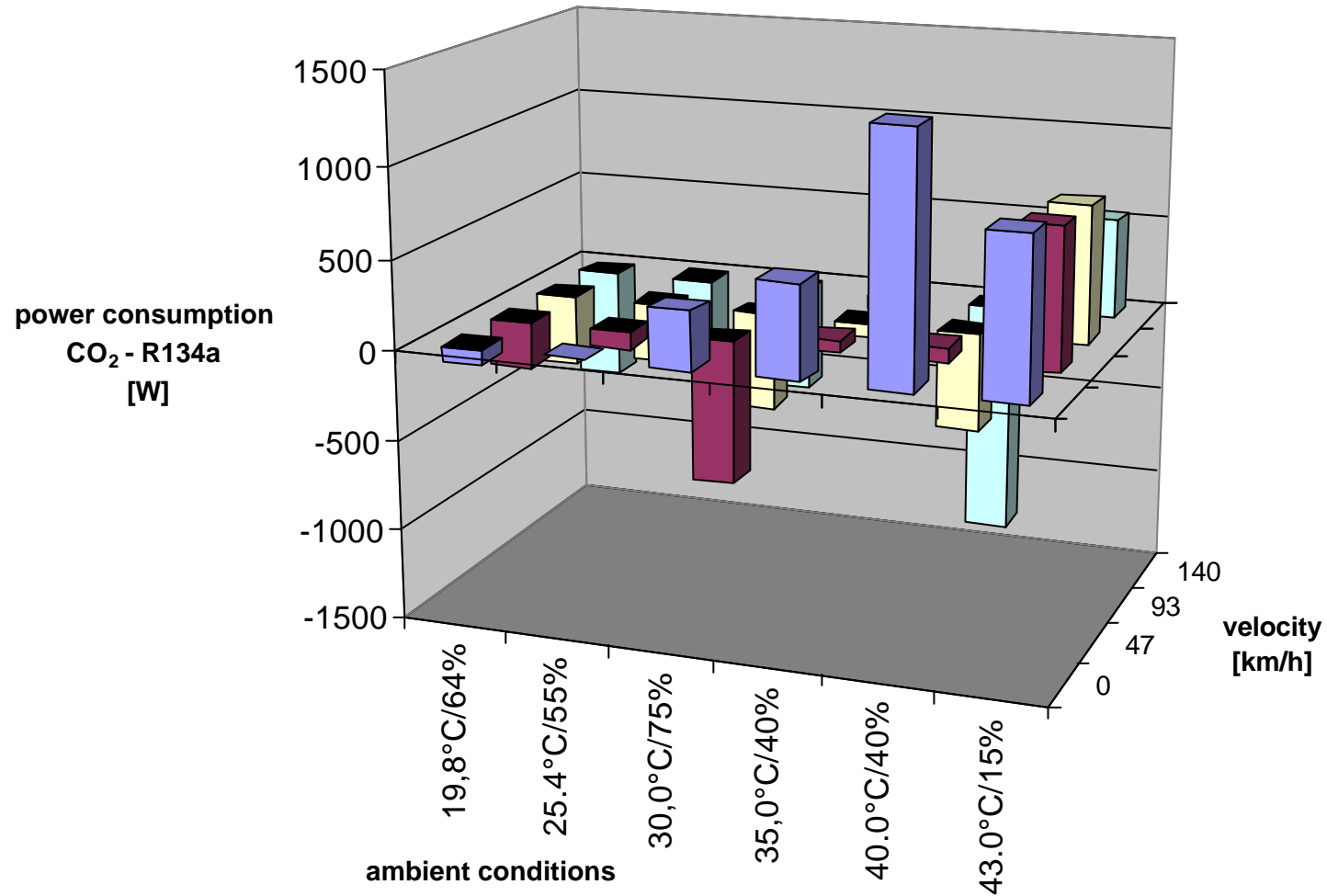


CO₂-A/C-system comparison CO₂- vs. R134a-A/C-system



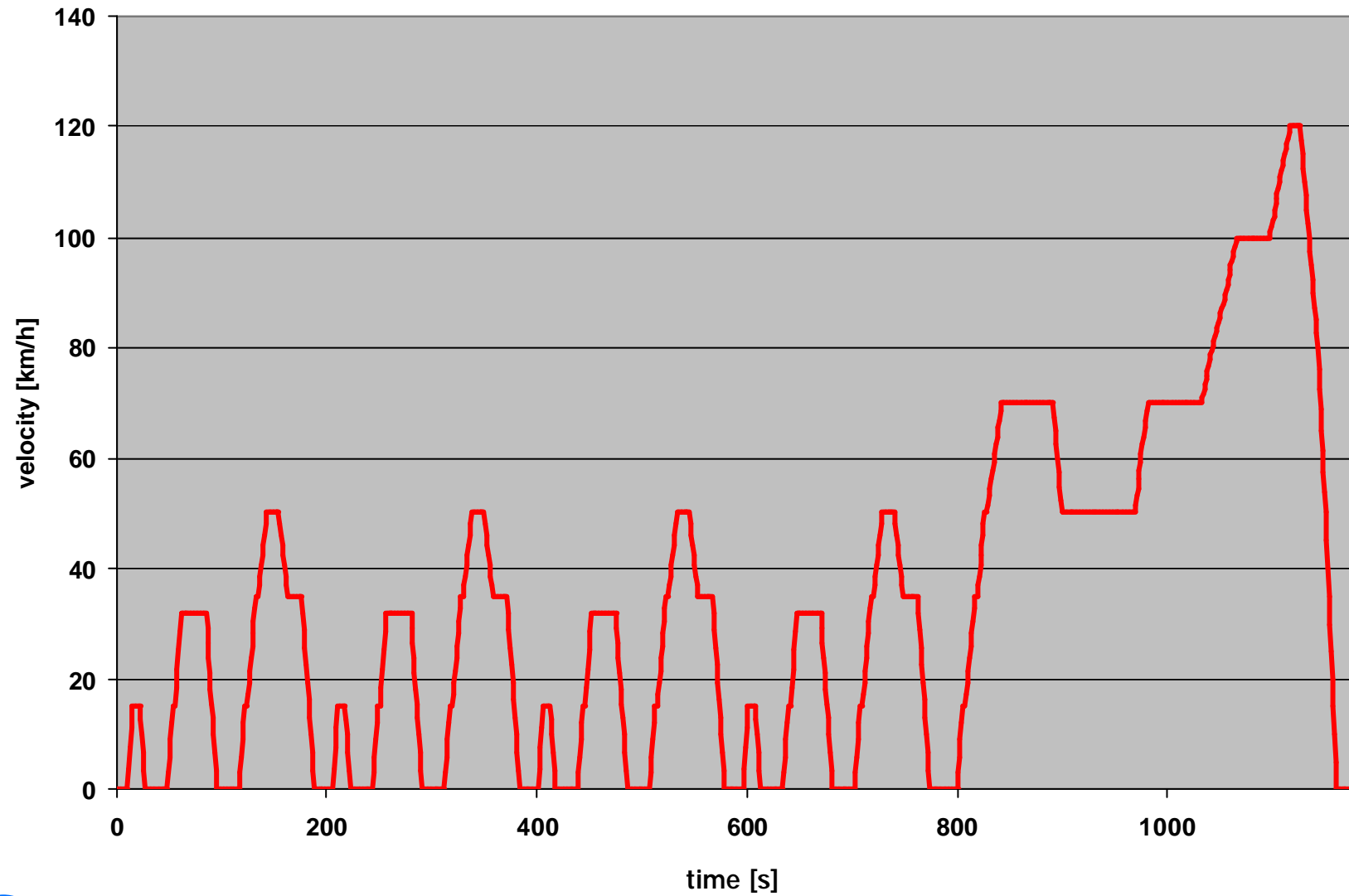
CO₂-A/C-system comparison CO₂- vs. R134a-A/C-system

comparison of power consumption



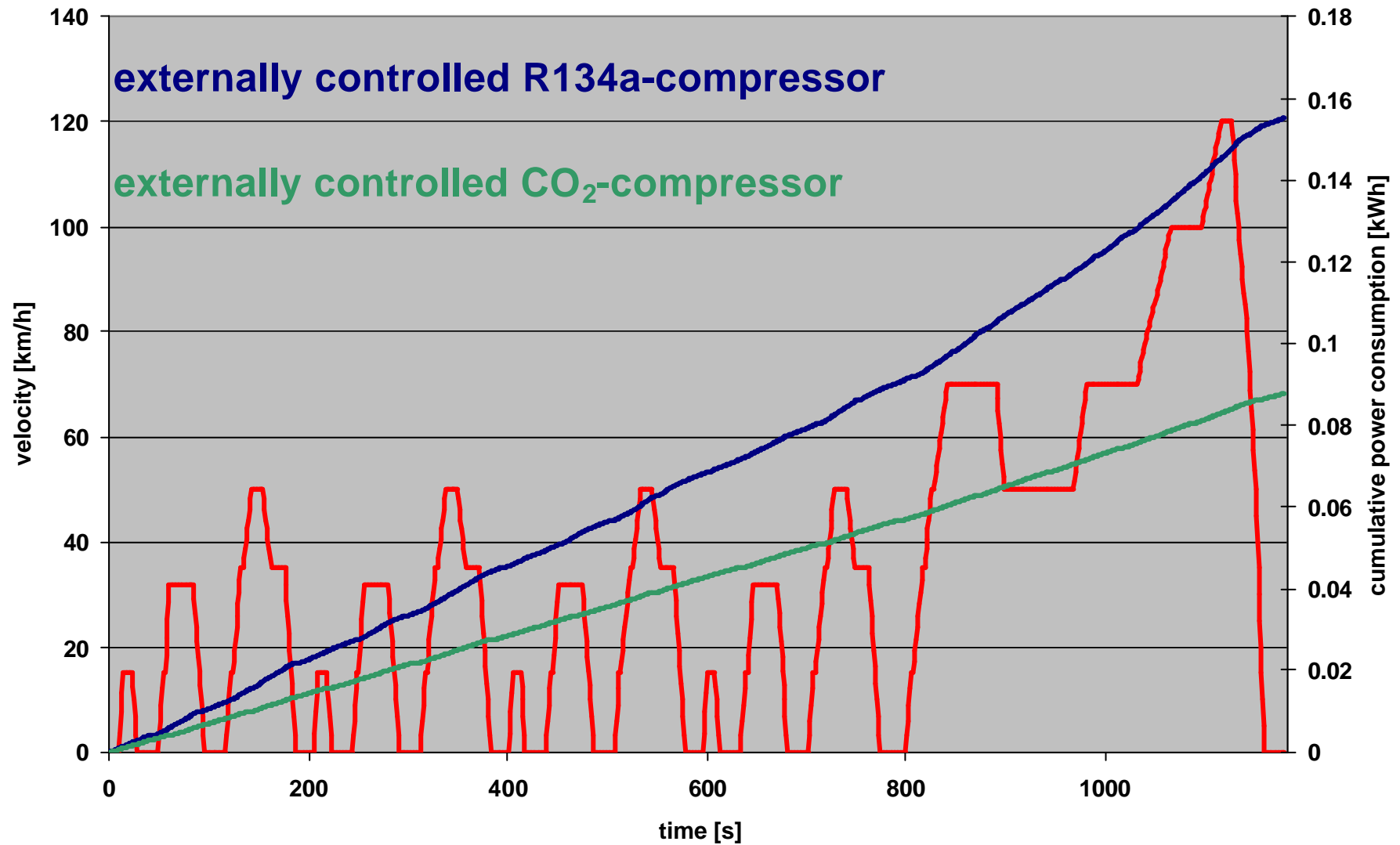
CO₂-A/C-system

NEFZ-driving cycle



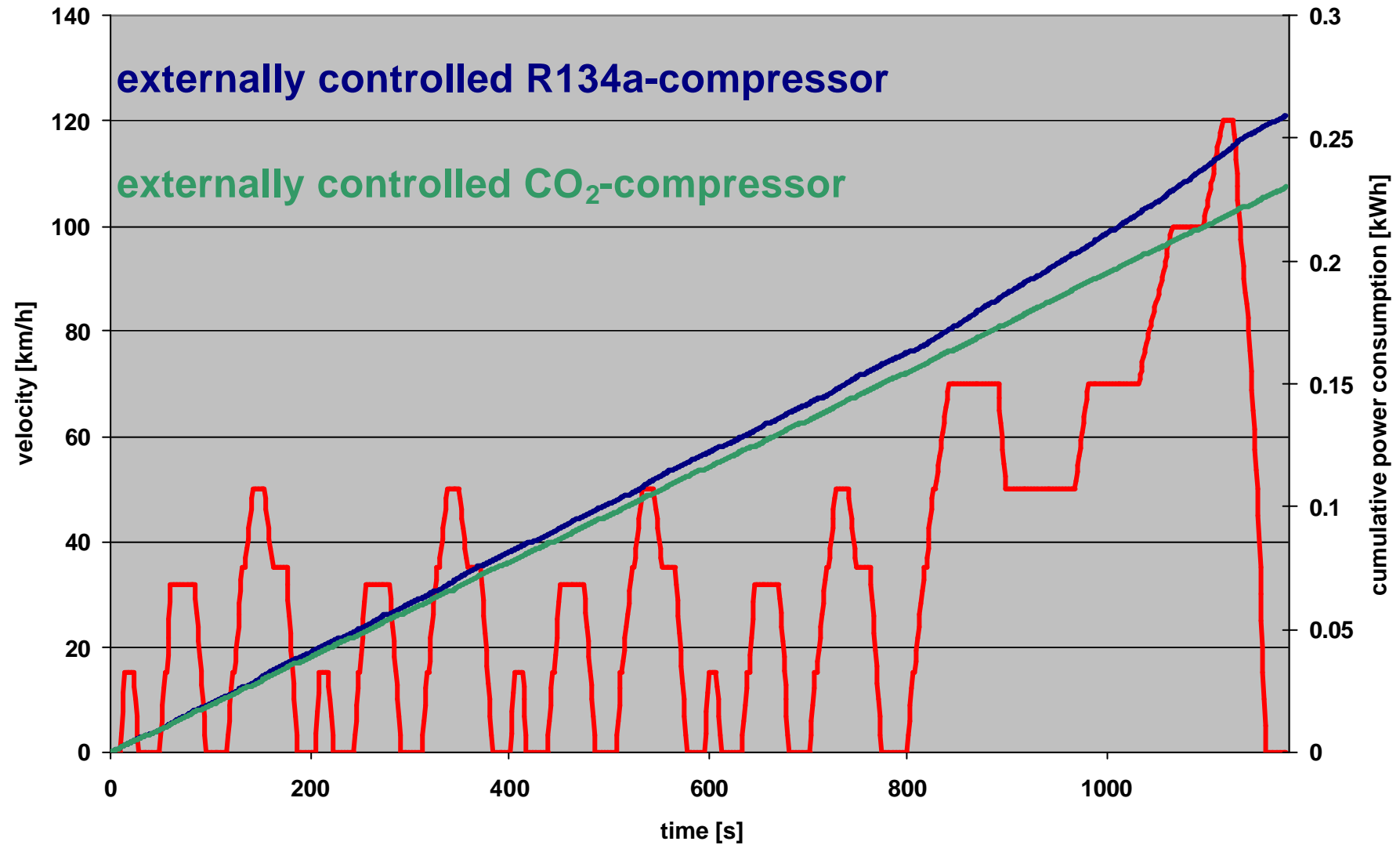
CO₂-A/C-system

NEFZ-driving cycle at 19.8°C, 64% r.h.



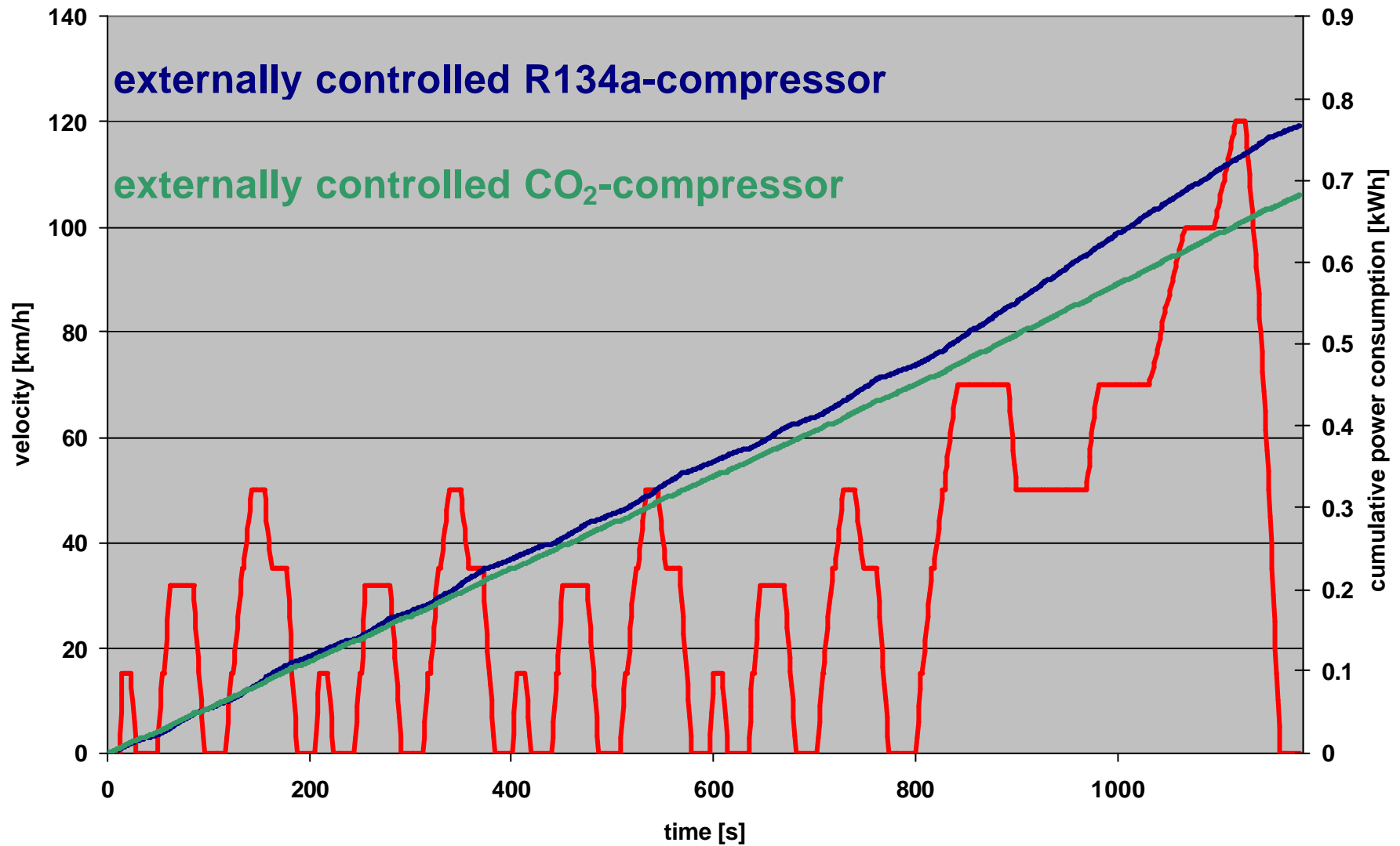
CO₂-A/C-system

NEFZ-driving cycle at 25.4°C, 55% r.h.



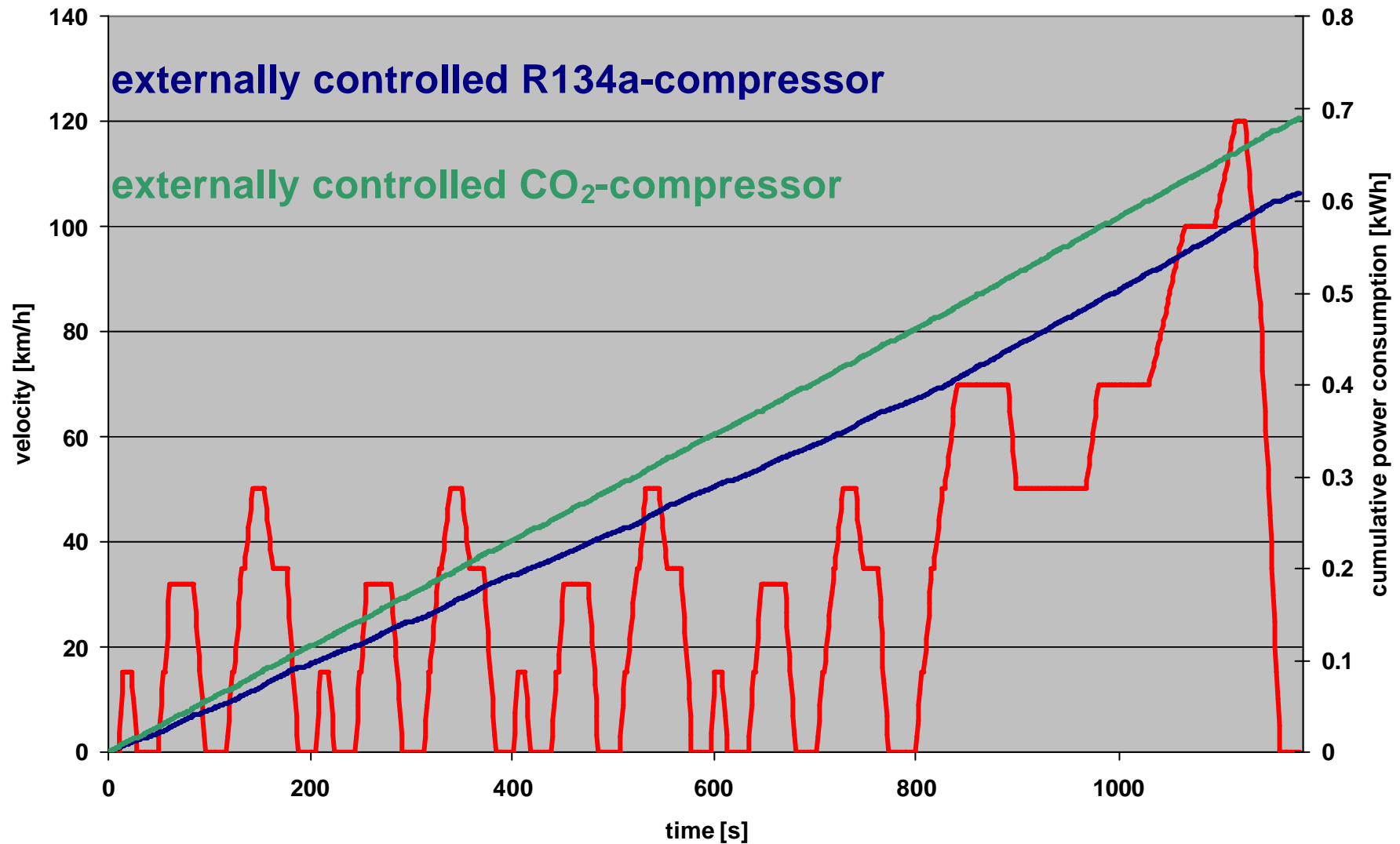
CO₂-A/C-system

NEFZ-driving cycle at 30.0°C, 75% r.h.



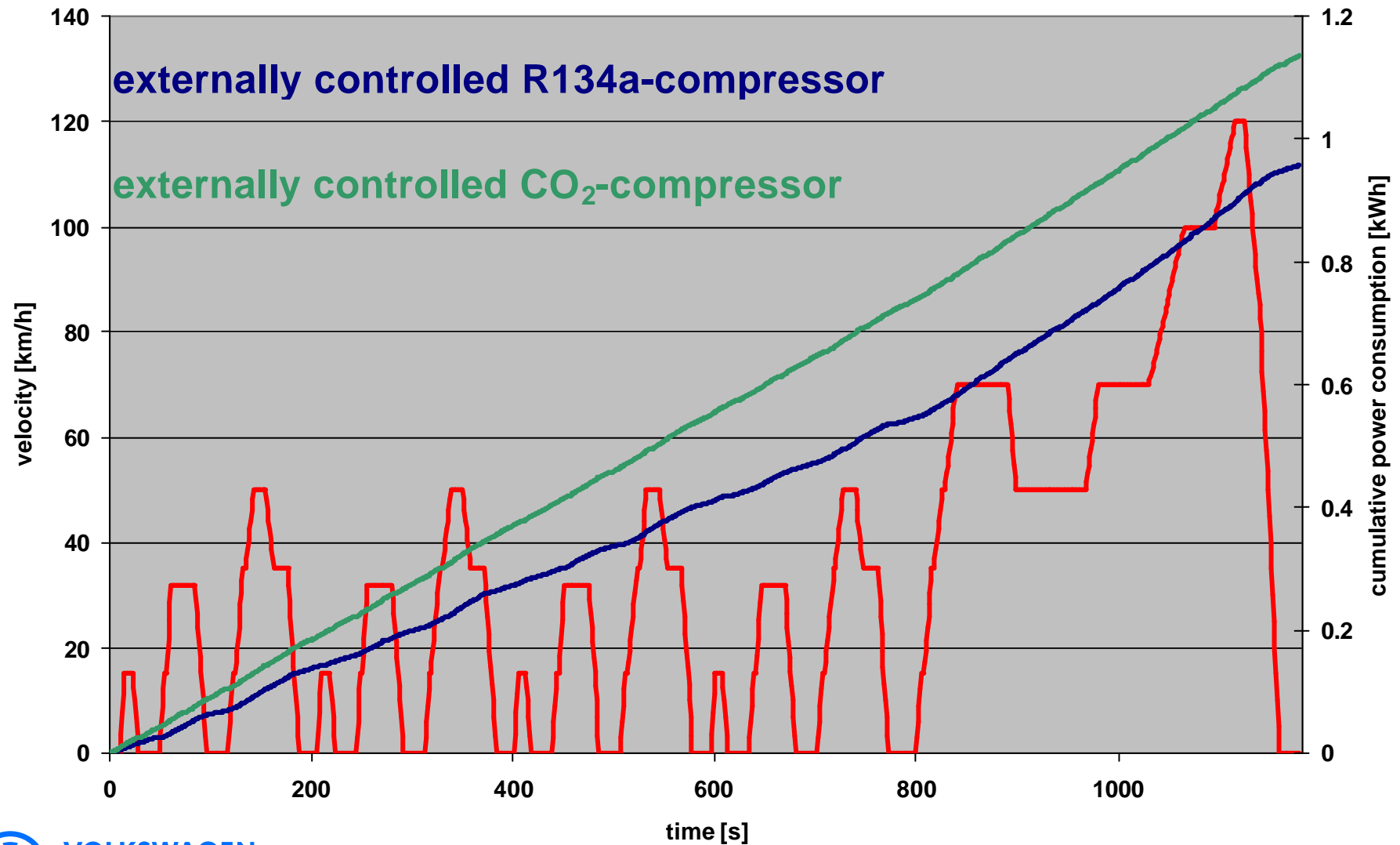
CO₂-A/C-system

NEFZ-driving cycle at 35.0°C, 40% r.h.



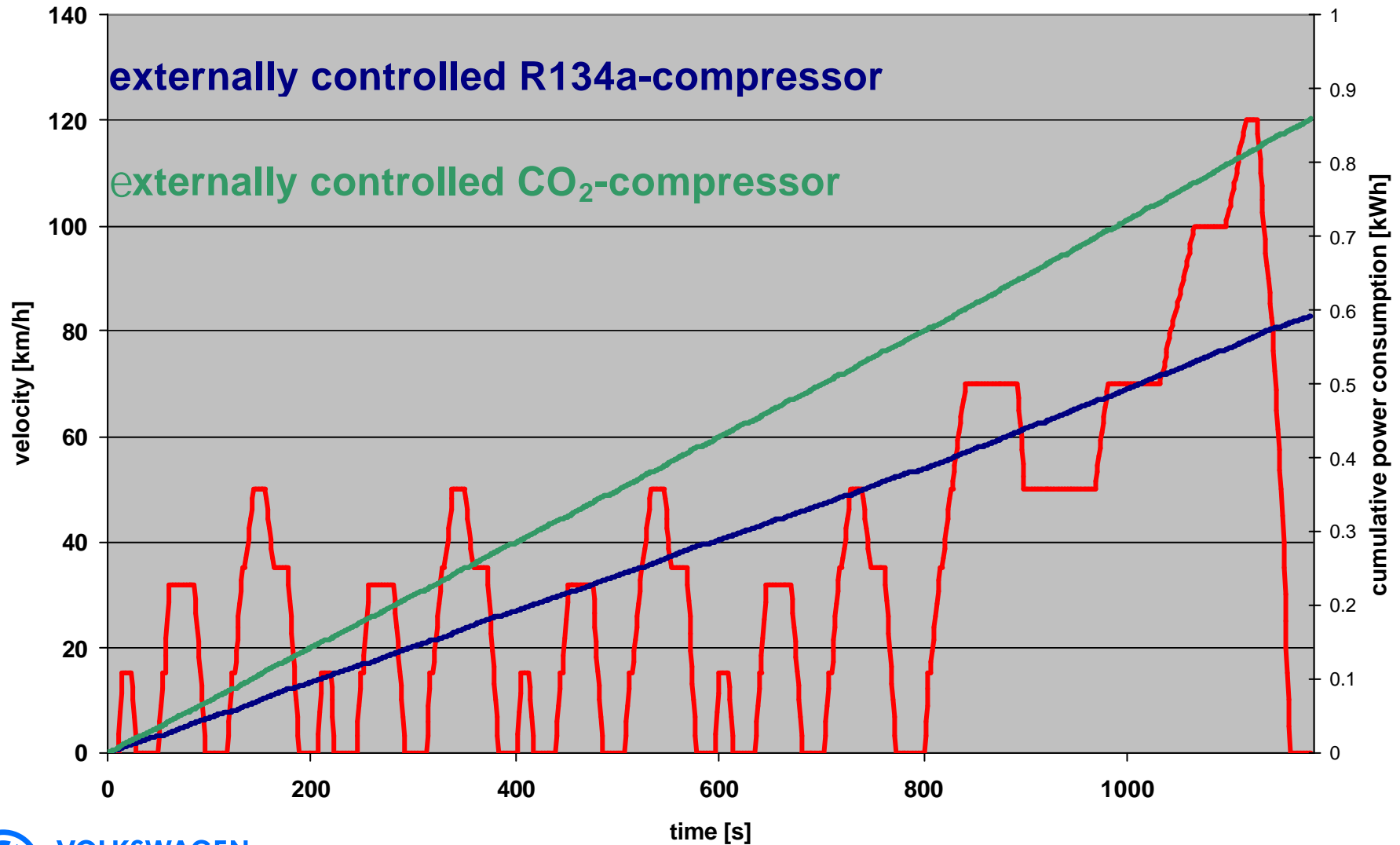
CO₂-A/C-system

NEFZ-driving cycle at 40.0°C, 40% r.h.



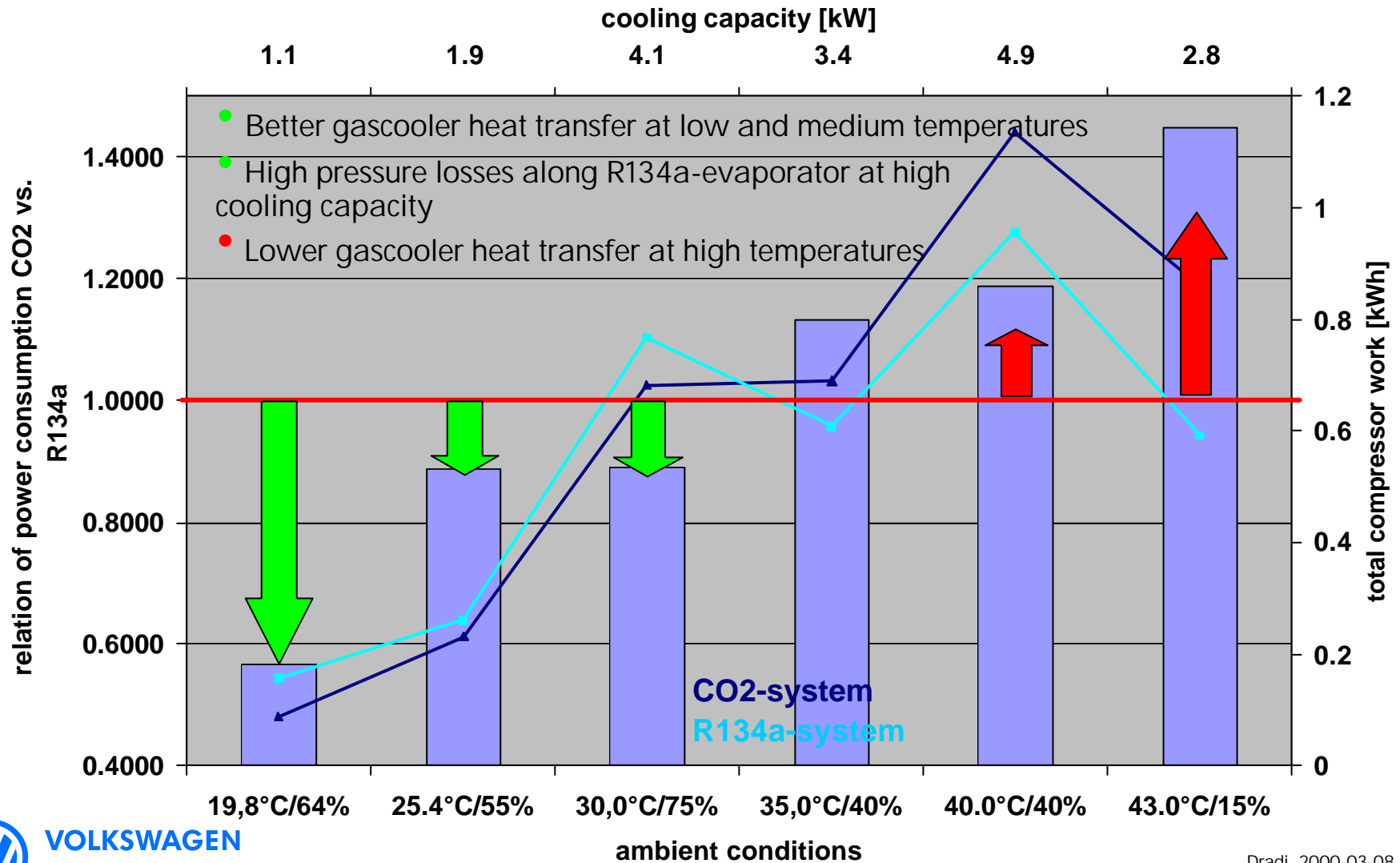
CO₂-A/C-system

NEFZ-driving cycle at 43.0°C, 15% r.h.



CO₂-A/C-system

Comparison power consumption at NEFZ-driving cycle



CO₂-A/C-system

Summary

- Power consumption dependent on annual climate condition
- Advantages at
 - Medium temperatures ($< \sim 33^{\circ}\text{C}$)
 - High cooling capacities due to high humidity
- Disadvantages at
 - High temperatures ($> \sim 33^{\circ}\text{C}$)
 - Idle speed

CO₂-A/C-system

Outlook

- CO₂-system to be further developed in regard to efficiency
- Optimizing the HVAC unit for CO₂-heat exchanger
- Adaptation of the refrigerant passes in the gas cooler to the realistic airflow in the frontend

- Open point: Small car A/C-system,
Power consumption/cooling capacity/drivability at idle speed and high ambient air temperatures