High
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CAREL

Integrated CO_2 systems for warm climates

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ATMOsphere EU
solutions for europe
natural refrigerants
15-16 October 2013, Brussels

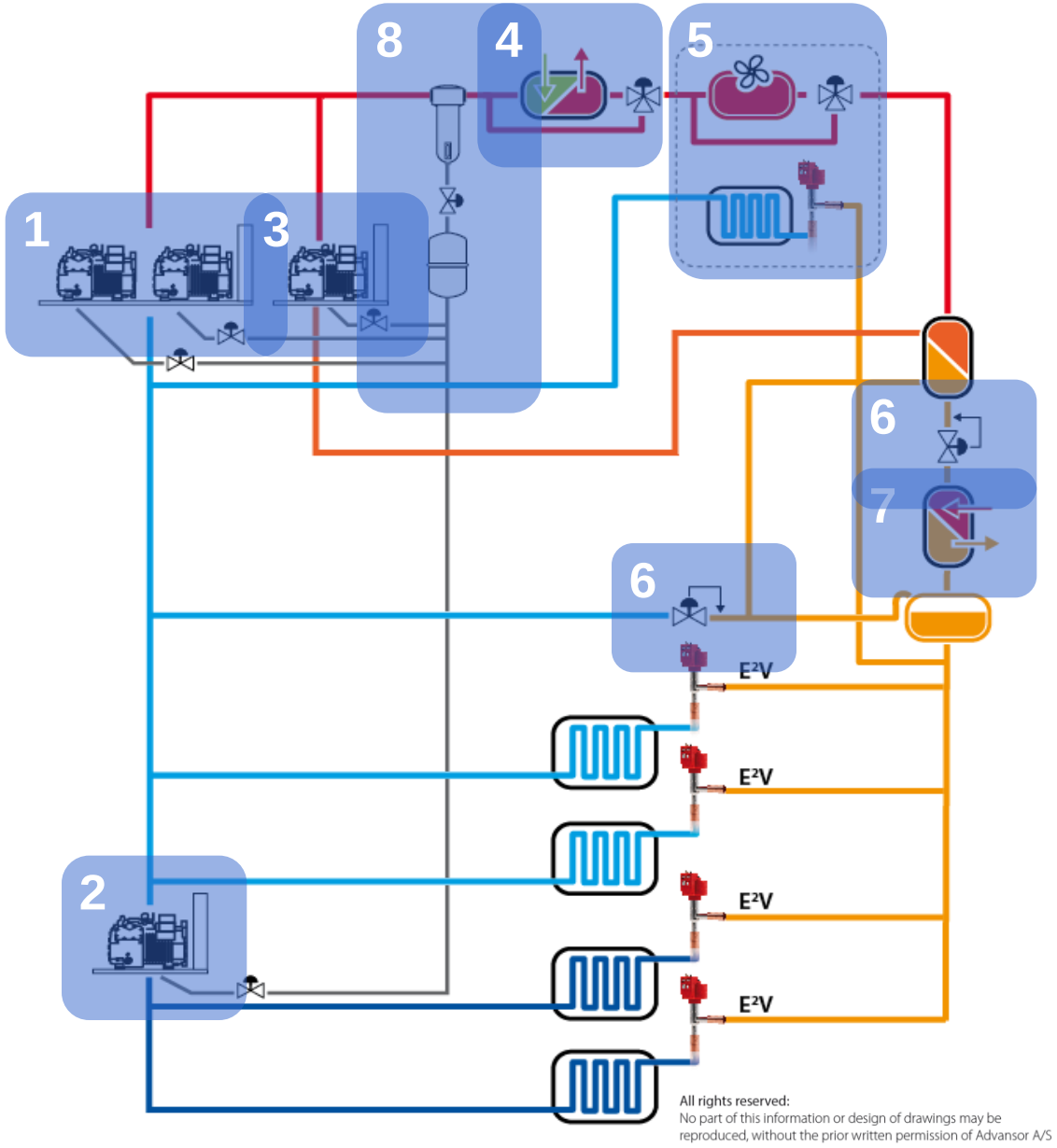
Field experience

Integrated compressor rack for medium-sized supermarket in southern Germany
Refrigeration, air conditioning & heat recovery loads

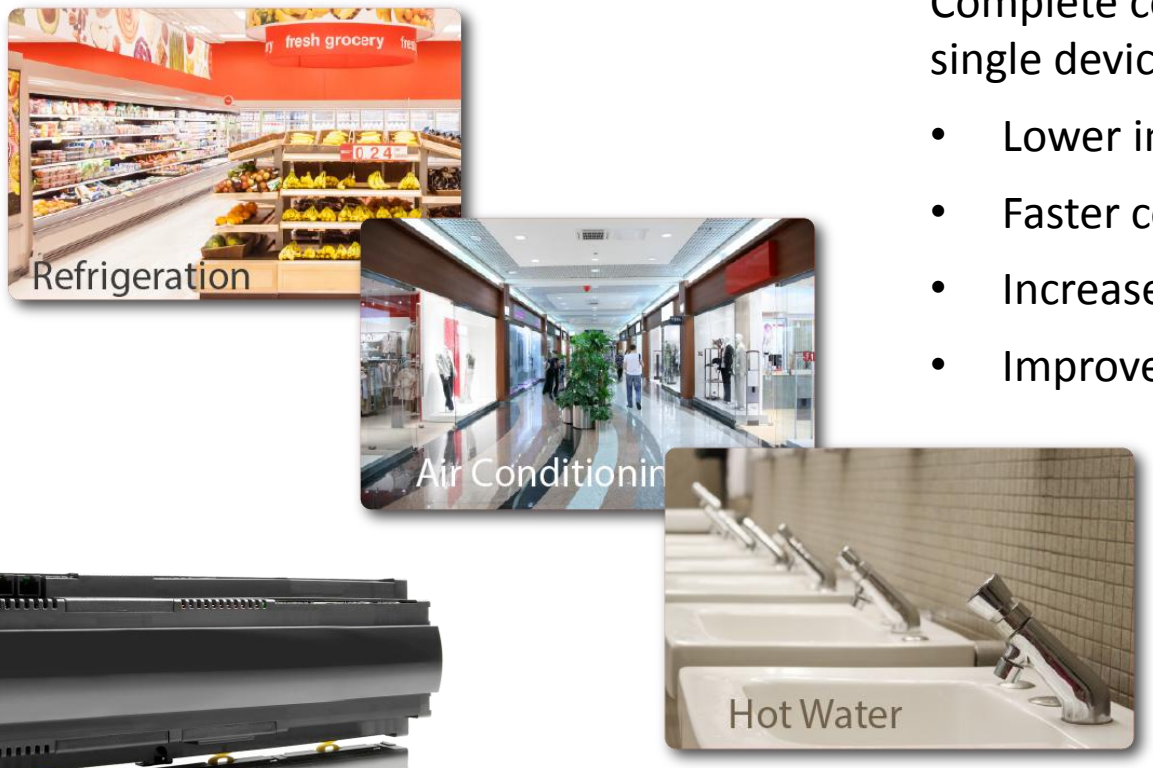
2 - MT : 60 kW
1 - LT : 8 kW
1 - Par : 12 m^3/h
1 - H/R : 75 kW
1 - AC : 30 kW

Field experience

1. MT Compressors
2. LT Compressor
3. Parallel Compressor
4. Heat recovery heat ex.
5. Gas Cooler & “false load”
6. Transcritical & flash gas valves
7. Air conditioning heat ex.
8. Oil return



Integration



Complete control of the entire unit on one single device

- Lower installation costs/ space
- Faster commissioning
- Increased usability (one point of access)
- Improved efficiency

Integration

How to divide total energy consumption between REF – AC – HR?

One unit providing REF+AC+HR

Compressor power consumption [kW]

- P_{MT} : Medium temperature compressors
- P_{LT} : Low temperature compressors
- P_{PC} : Parallel compressors
- P_{GC} : Gas cooler

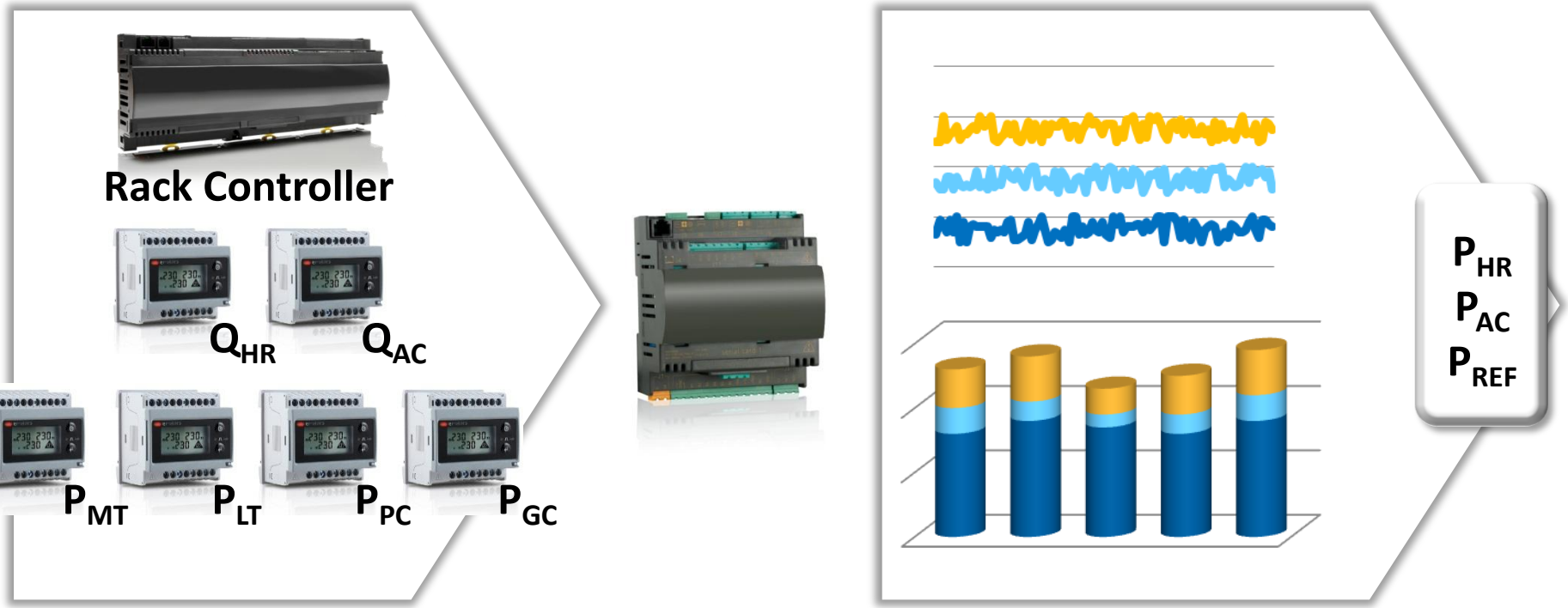
Heat transfer

- Q_{AC} : Air conditioning heat
- Q_{HR} : Heat recovery heat

Integration

How to divide total energy consumption between REF – AC – HR?

Site status reading: main variables, energy consumption, heat transfer
Real time COP calculation, division of power consumption



Integration

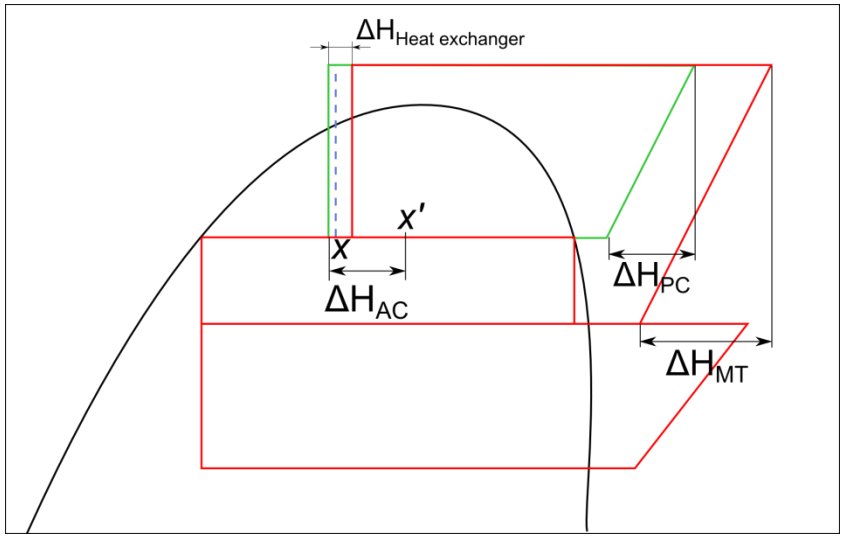
Temperatures
Pressures
Comps data

Entalpies
Qualities

COP_{HR}
COP_{AC}
COP_{REF}

P_{HR} **P_{AC}**
P_{REF}

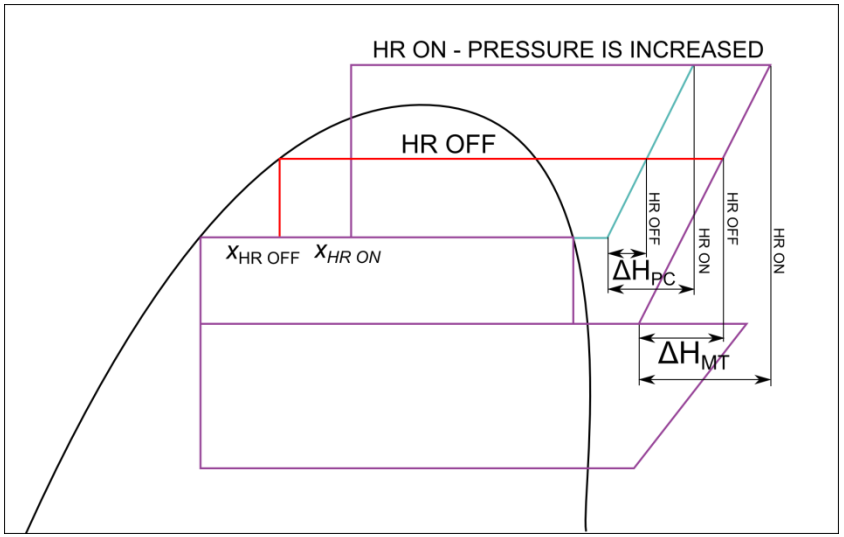
Air conditioning mode



Higher quality of vapour

Mass refrigerant flow $\dot{m}_{AC}$

Heat Reclaim mode



Higher gas cooler pressure

Higher quality of vapour

$$\frac{COP_{HR\ ON}}{COP_{HR\ OFF\ [T]}} = \frac{P_{HR\ ON}}{P_{HR\ OFF}}$$

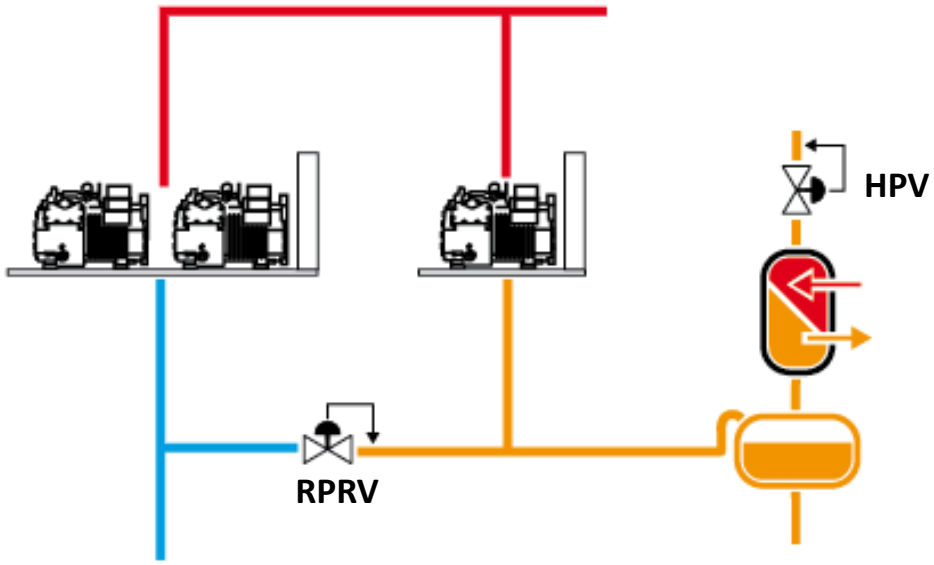
Warm Climates

PARALLEL COMPRESSOR

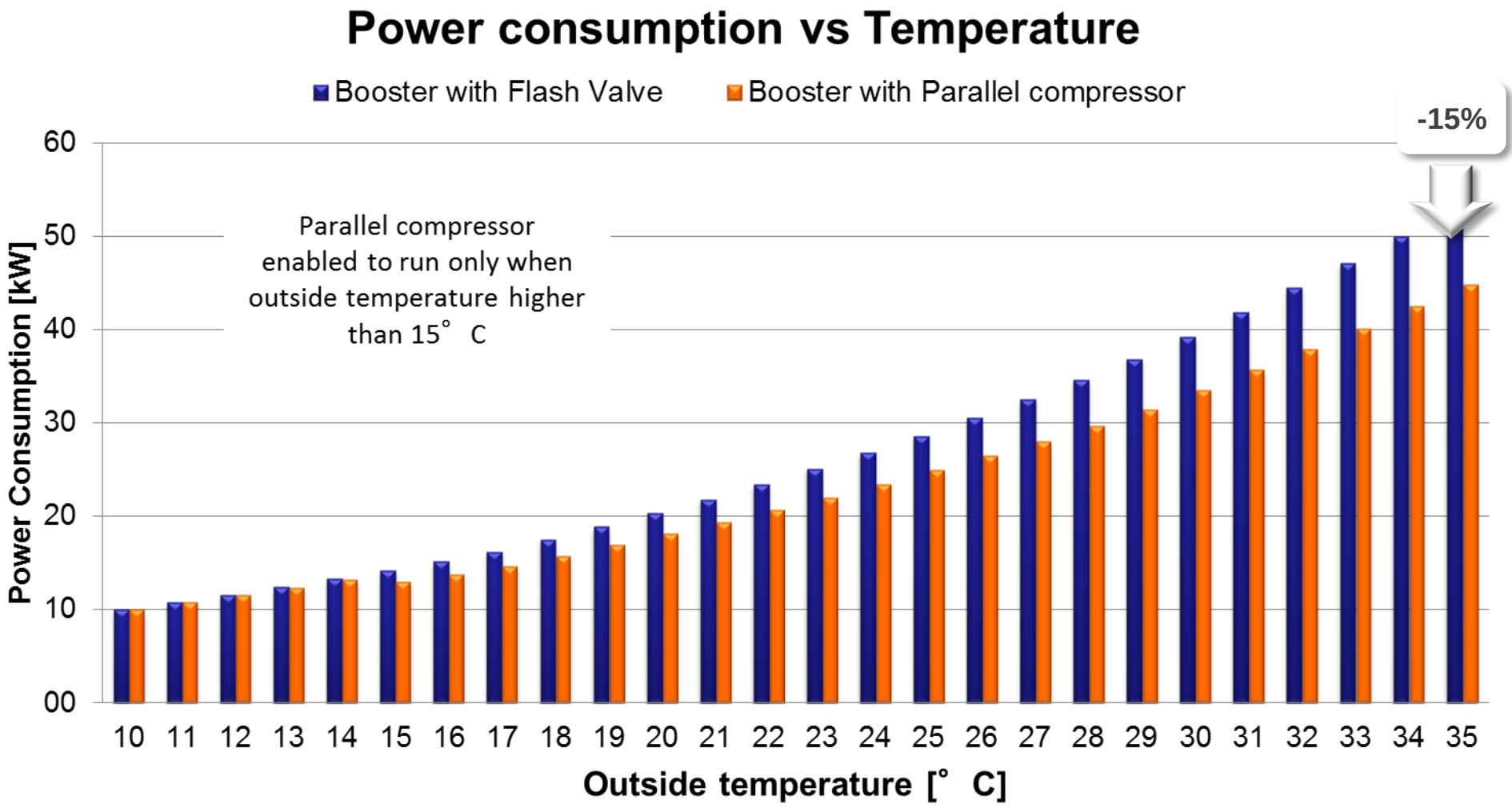
Receiver pressure control
Activated with sufficient flash gas
Flash gas valve synchronisation

Higher efficiency
- High gas cooler pressure
- AC load
- Heat recovery

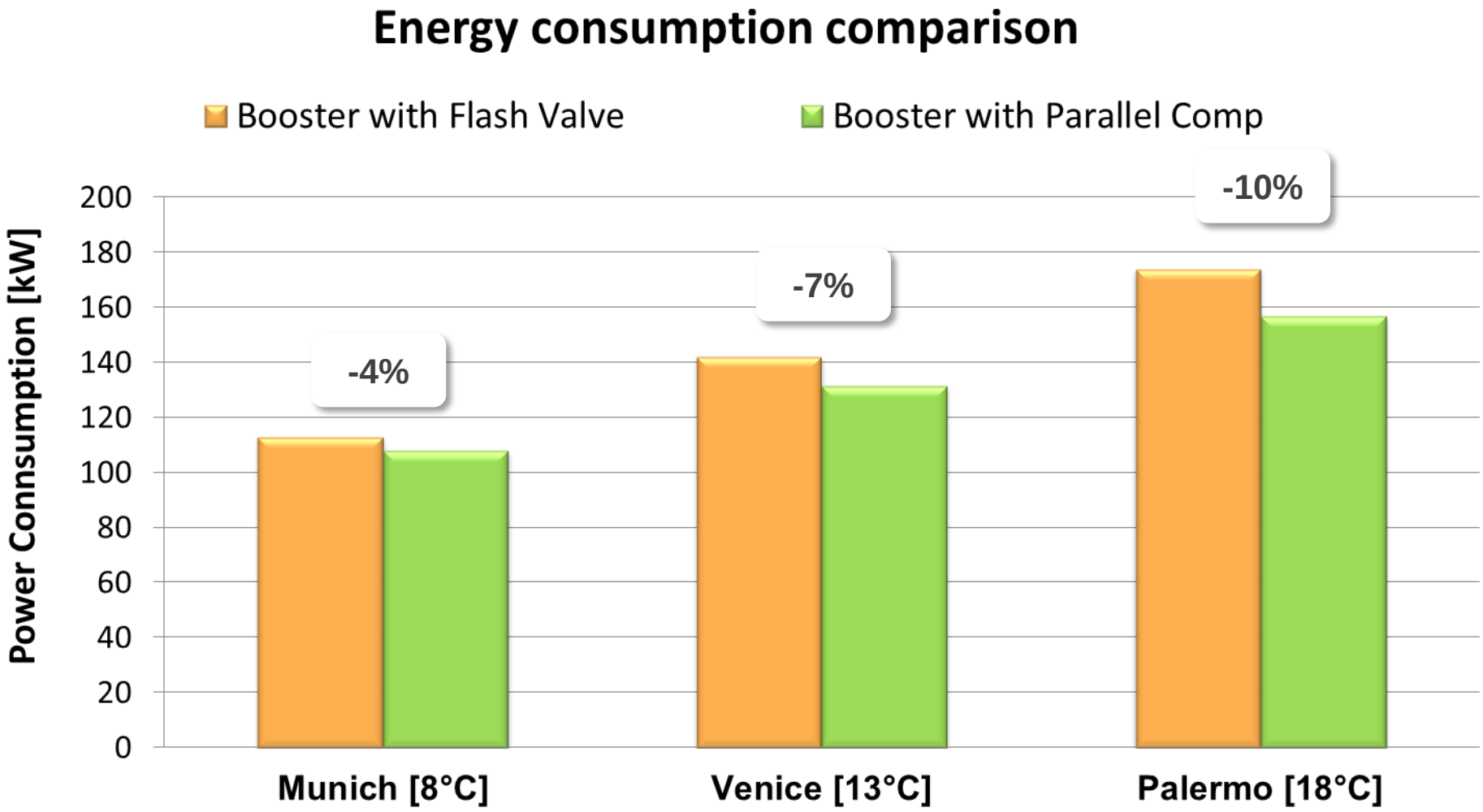
Higher efficiency at higher outside temperature



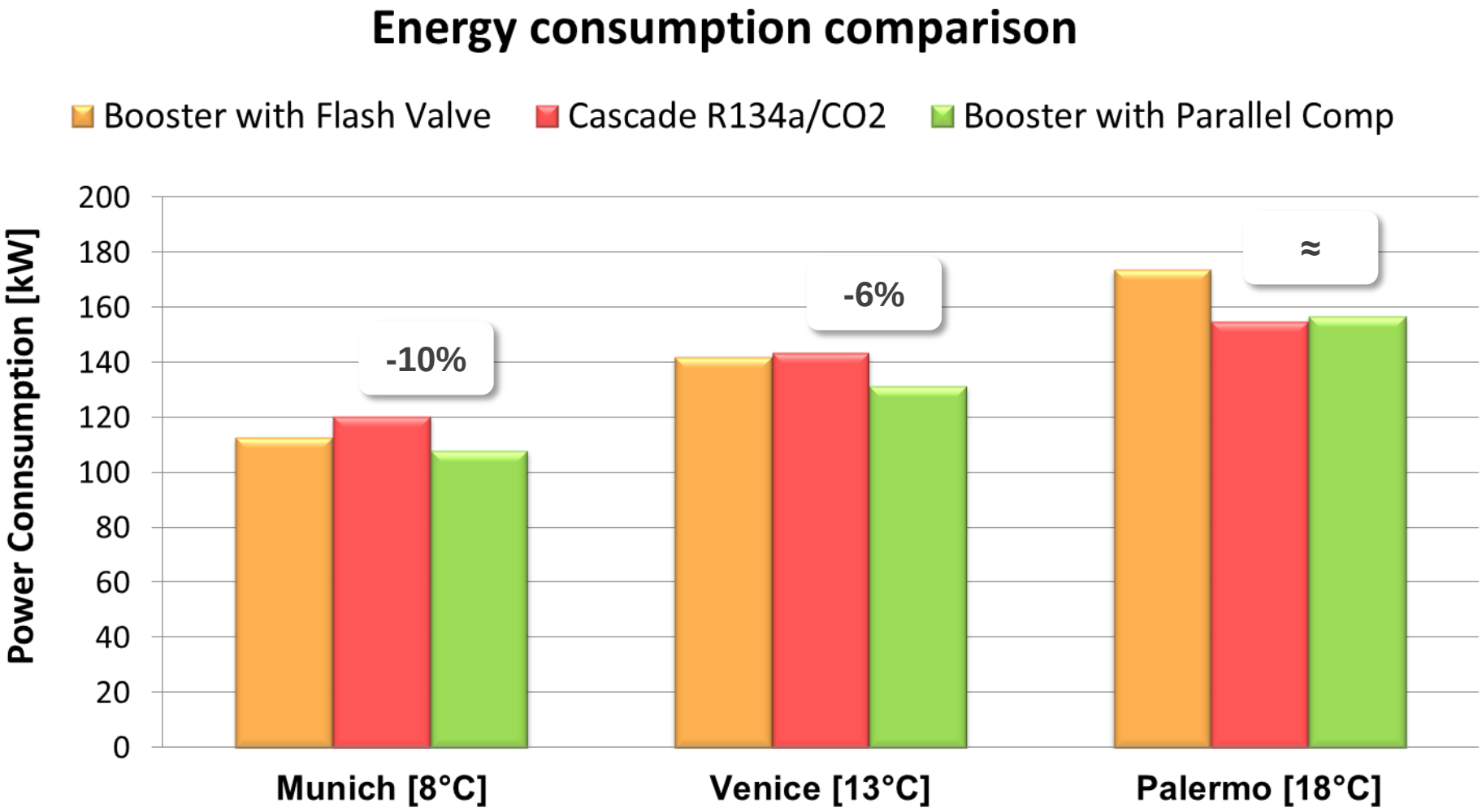
Warm Climates



Warm Climates

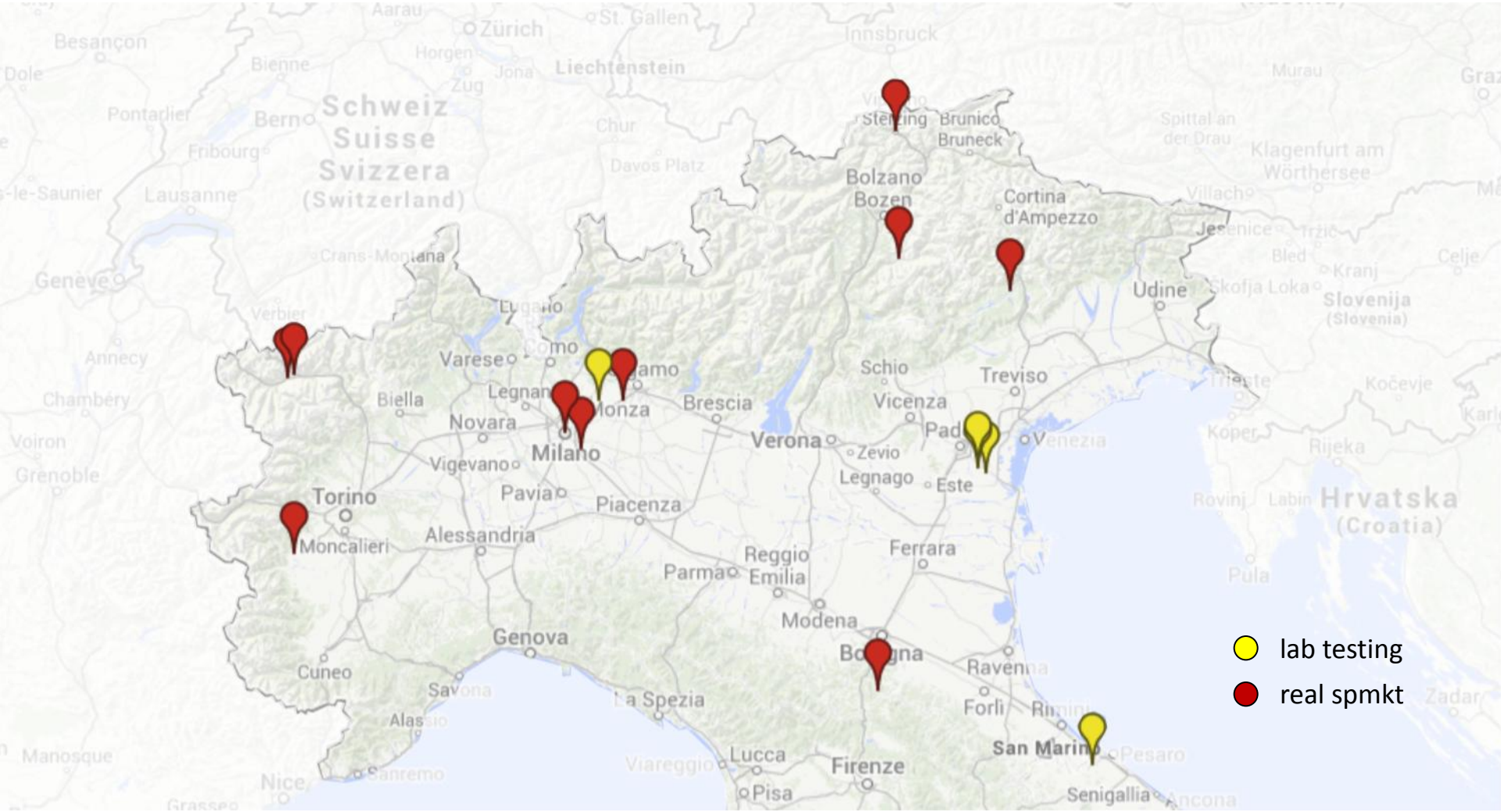


Warm Climates



Warm Climates

italian transcritical CO_2 systems (Carel 2013)



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