ATMOsphere Europe 2011

waste heat recovery of a transcritical CO_2 system with adsorption technology

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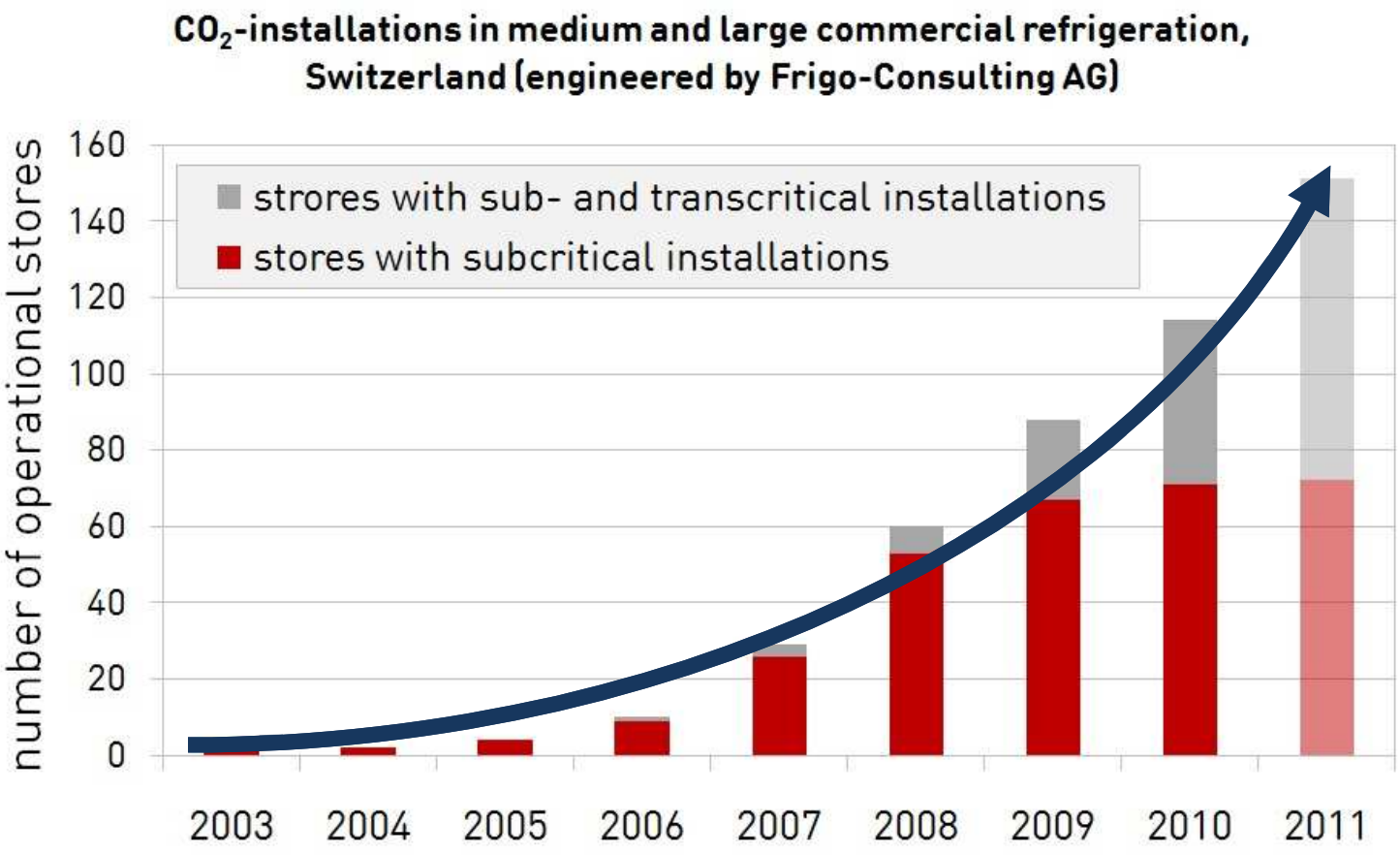
Raphael Gerber

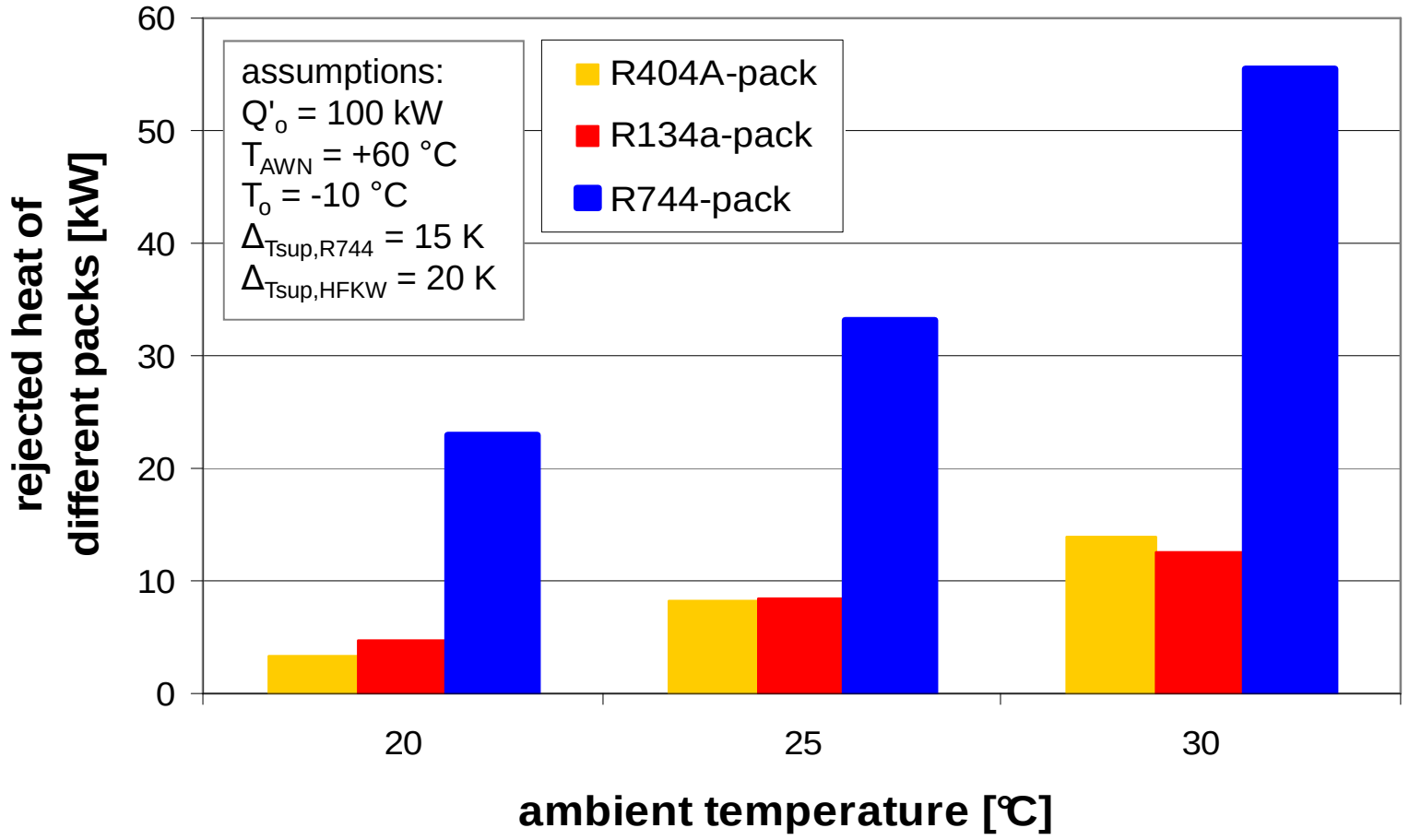
Content

- Why using CO_2
- Adsorption technology
- Combining two technologies
- Efficiency analysis
- Barriers & solutions
- Lessons learned and outlook
- Summary

CO_2 commercial references

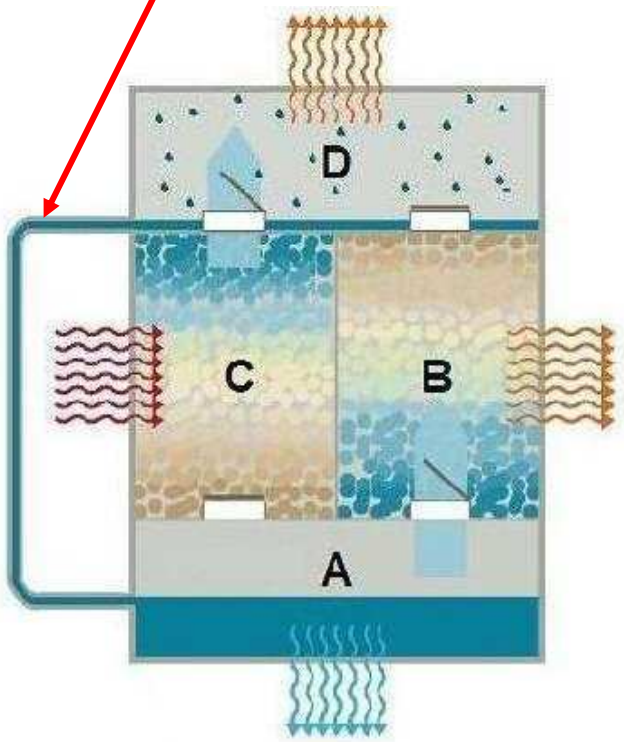


Useful rejected heat of different packs



adsorption technology

Water as natural refrigerant



A: H_2O evaporates and rises into chamber B

B: H_2O deposes on the surface of the silica gel and heat is rejected (dry cooler)

C: (waste) heat drives out H_2O in chamber C, which rises to chamber D

D: H_2O condensates and heat is rejected to the dry cooler

E: The function of chamber B and C is switched periodically

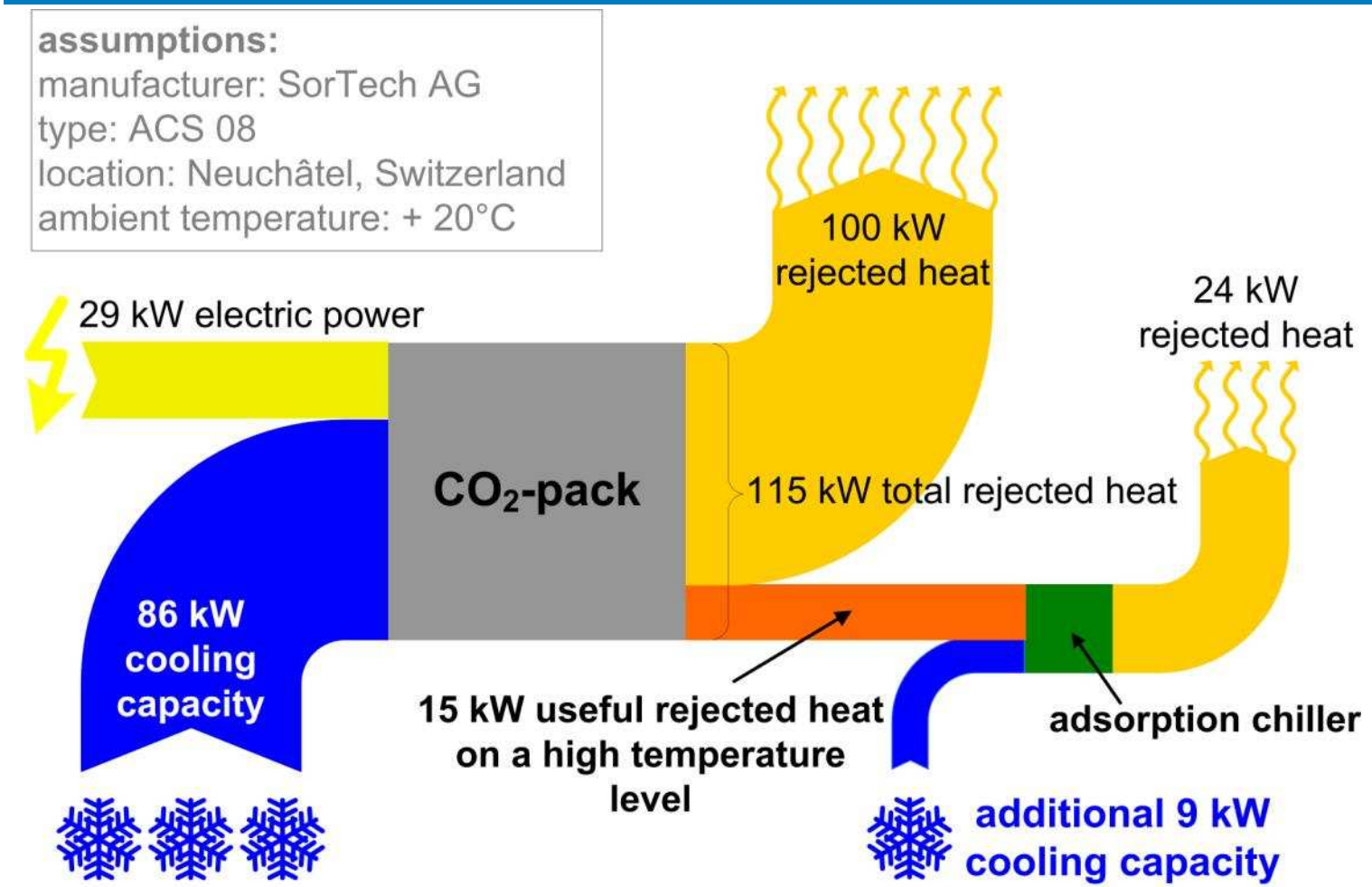
Place of installation

- Prodega St-Blaise, Switzerland
- Cash & Carry Market
- Medium temperature refrigerated area: 400 m^2
- Total refrigerated area: 1’150 m^2
- Transcritical CO_2-pack
  - cooling capacity: 86 kW
  - evaporation temperature: -10 °C

Place of installation

- Prodega St-Blaise, Switzerland
- Cash & Carry Market
- Medium temperature refrigerated area: 400 m^2

Energy flow


assumptions:
manufacturer: SorTech AG
type: ACS 08
location: Neuchâtel, Switzerland
ambient temperature: + 20°C
100 kW
rejected heat
24 kW
rejected heat
29 kW electric power
CO2-pack
115 kW total rejected heat
86 kW
cooling
capacity
15 kW useful rejected heat
on a high temperature
level
adsorption chiller
additional 9 kW
cooling capacity

Potential application for cooling energy

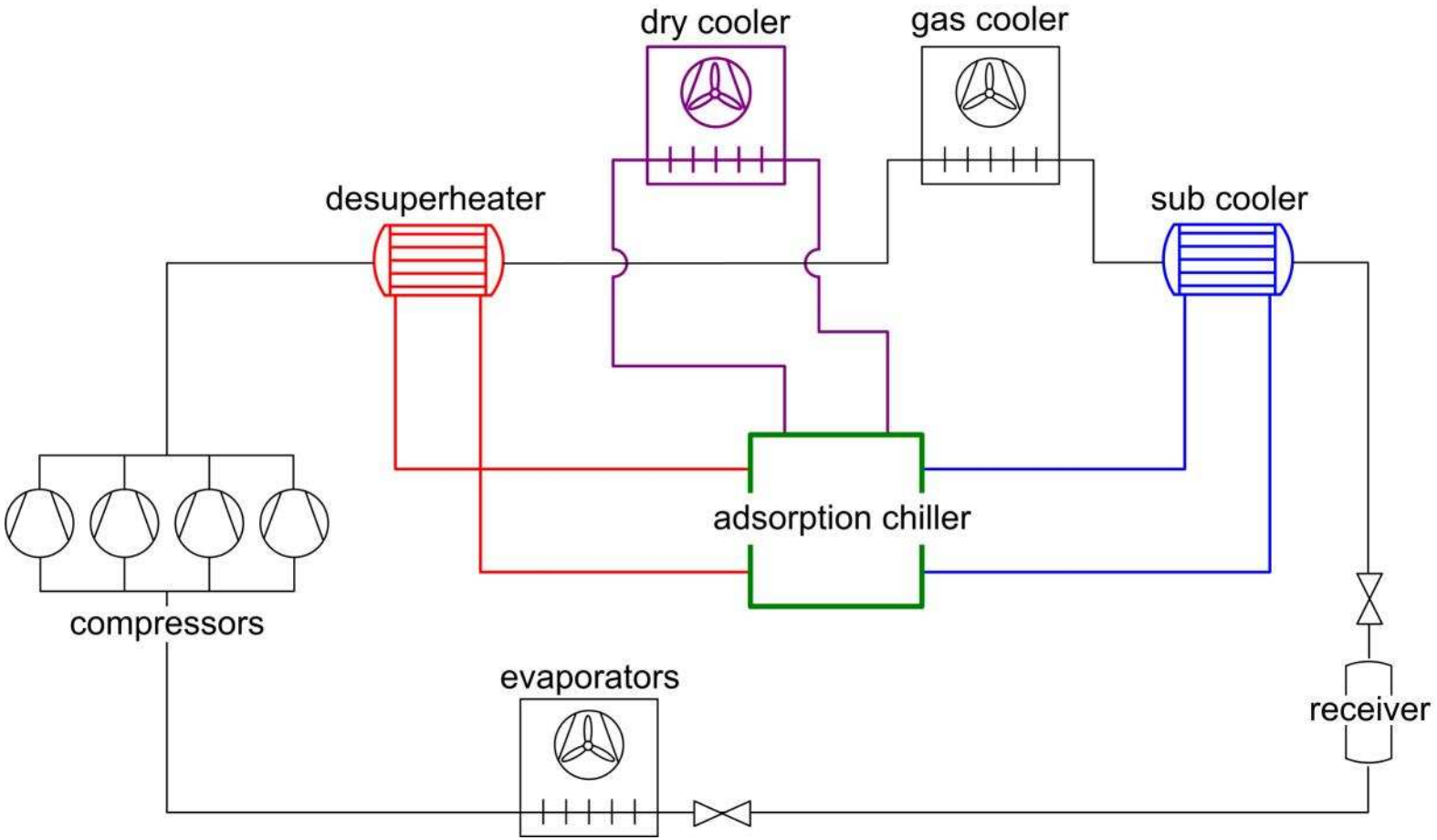
10‘000 kWh

cooling energy per year

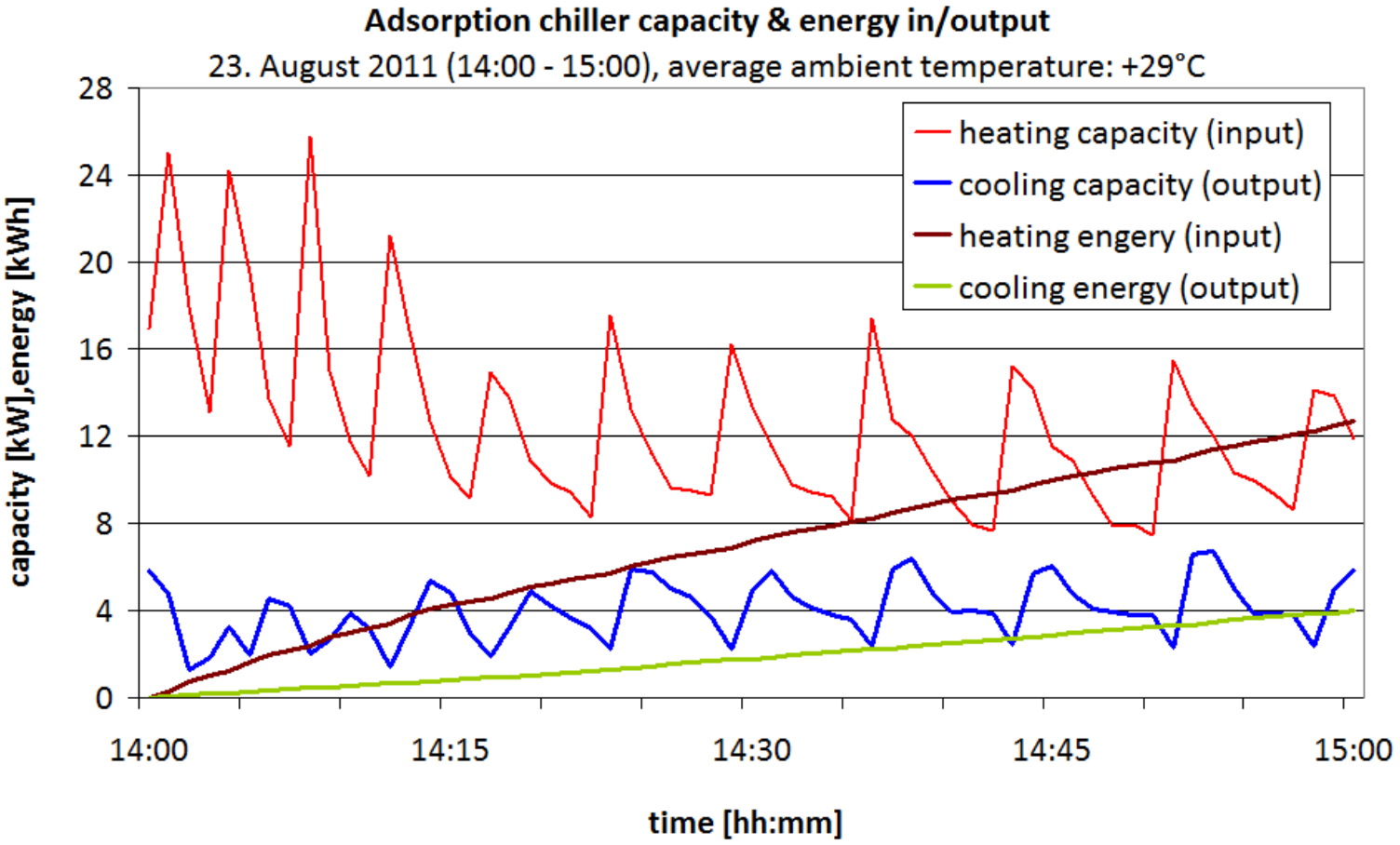
assumptions:
manufacturer: SorTech AG
type: ACS 08
location: Neuchatel, Switzerland
temperature range: $T_{amb,min}$ = +14°C
$T_{amb,max}$ = +34°C

- air conditioning
  - ➔ support air conditioning
- sub cool CO_2-pack
  - ➔ support CO_2-refrigeration-system
  - ➔ process optimization of CO_2-refregeration-system

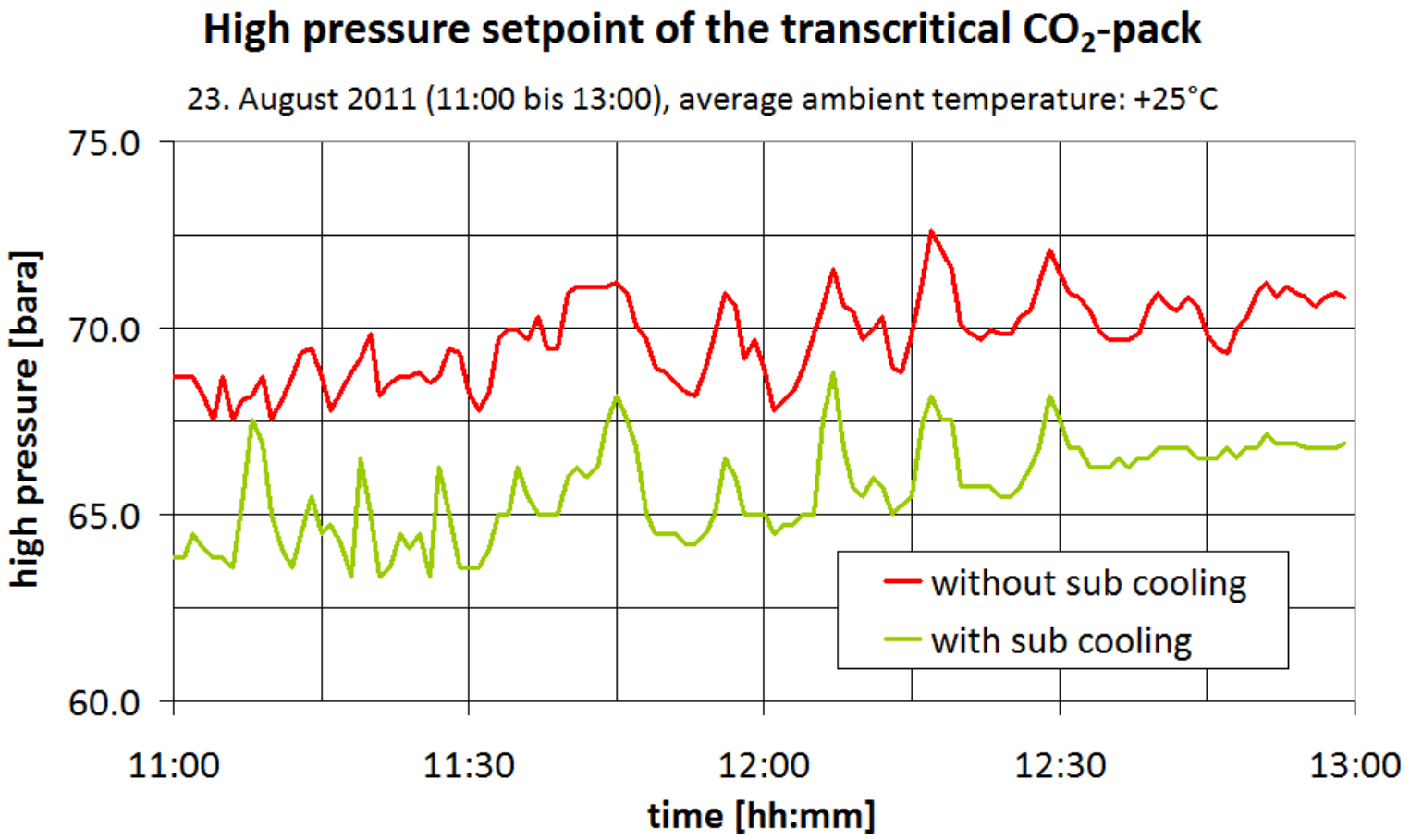
Integration of adsorption chiller



Efficiency analysis of refrigeration system



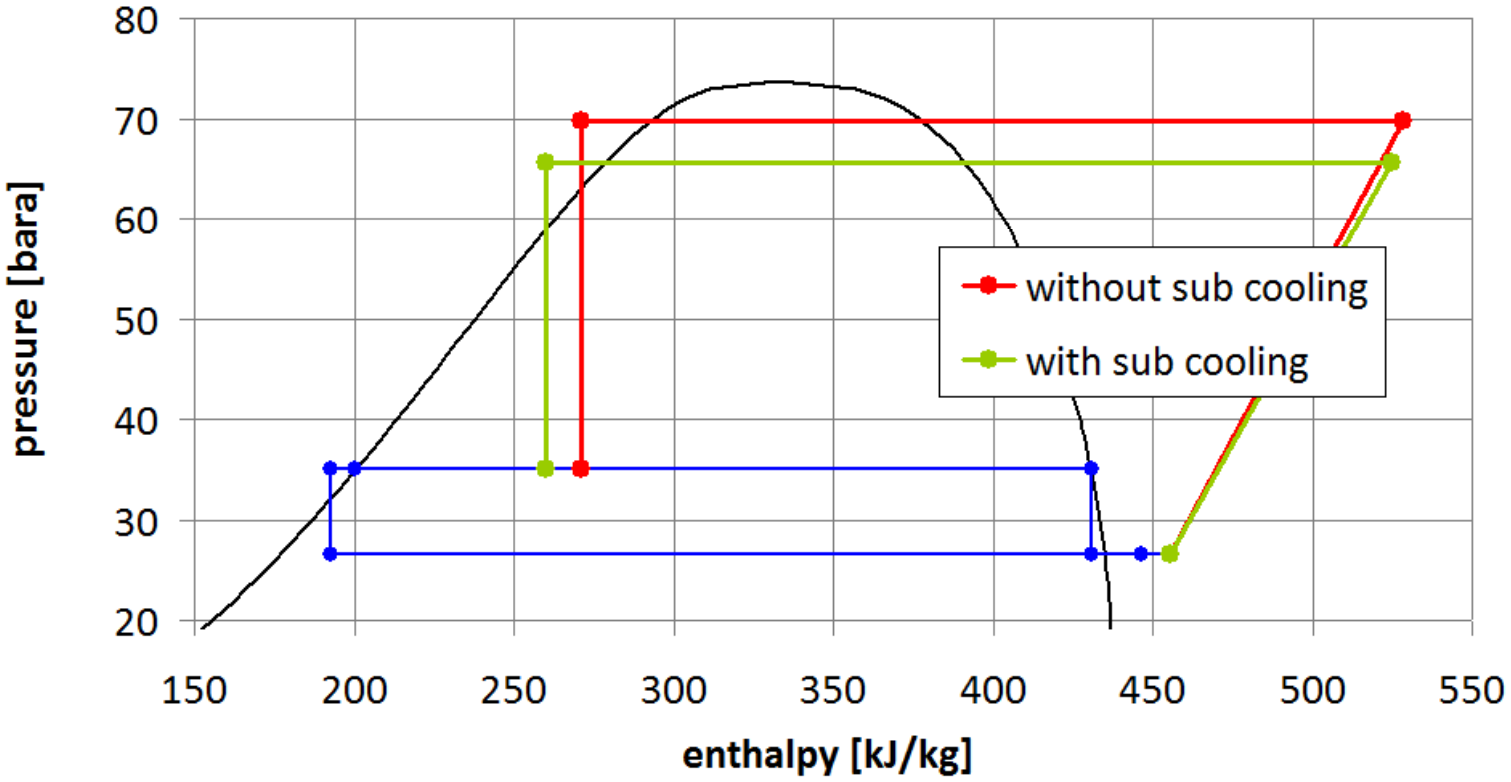
Efficiency analysis of refrigeration system



Efficiency analysis of refrigeration system

Prozess of transcritical CO2-pack plotted in p-h-diagramm

23. August 2011 (11:00 bis 13:00), average ambient temperature: +25°C



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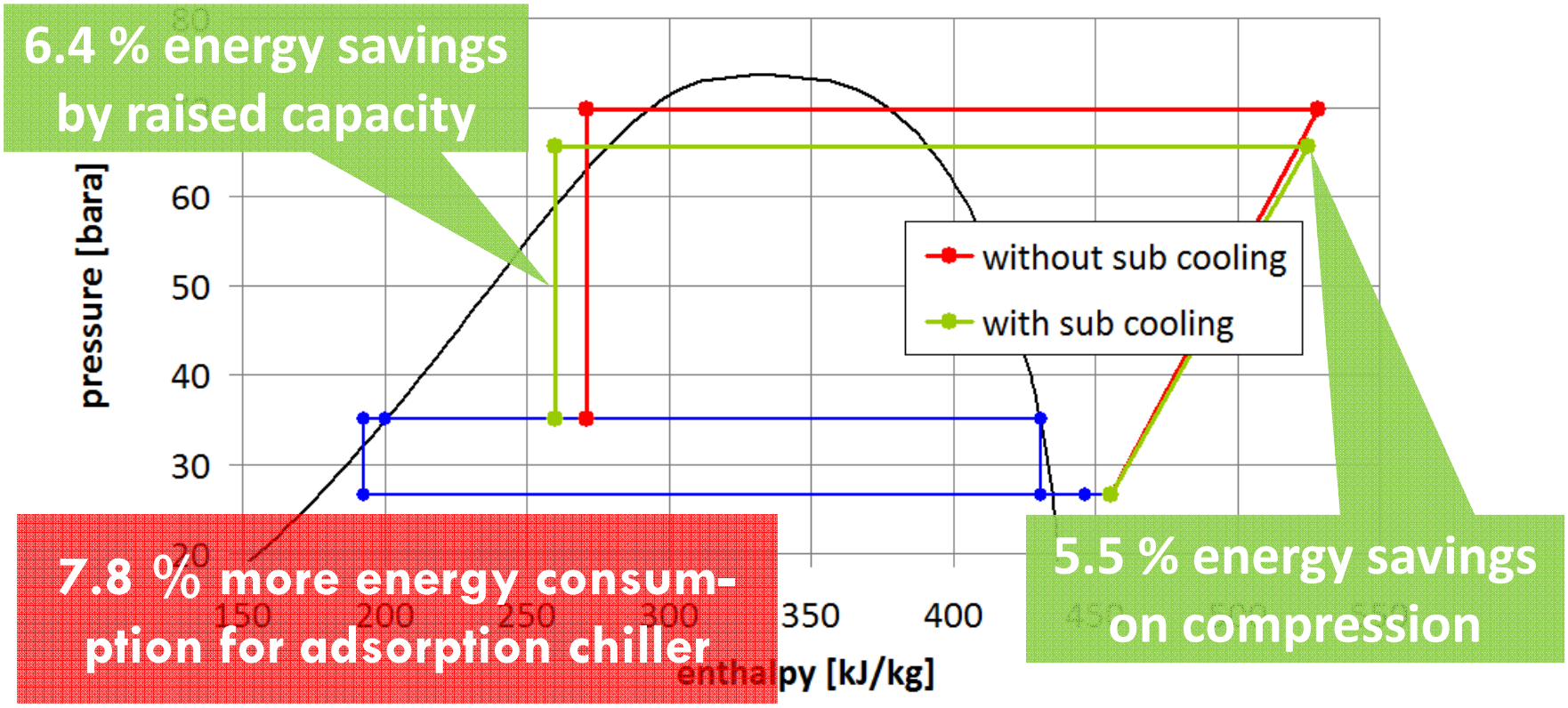

Barriers and solutions

- finding good parameters for varying operating conditions is crucial
- defective valve flap of adsorption chiller needed repair

Lessons learned

- The adsorption chiller is not used to capacity due to lower waste heat available
  - lower workloads of CO_2-pack than assumed
  - system can be further optimized by increasing available waste heat
- Special attention needs to be put on system dynamics
- Initial evaluations indicate that the cold storage is not absolutely necessary and thereby cost can be reduced

Further applications

- Support cold vapor process with:
  - high amounts of waste heat
  - on a high temperature level
  - especially in warm climates
- Particularly for systems with the refrigerants:
  - R744 (CO_2)
  - R717 (NH_3)
- Air conditioning by waste heat

Partners

engineering

FRIGO CONSULTING AG
Competence in CO_2
INGENIEURBÜRO FÜR KÄLTETECHNIK
WWW.FRIGOCONSULTING.CH

by order of

TRANSGOURMET

cash + carry prodega

implementation

SorTech AG

ALPIQ

Summary

- The adsorption technology is an option to optimize the overall efficiency of transcritical CO_2-systems bases on standard components.
- Further analysis and optimization will allow higher efficiencies of future systems.
- Only natural refrigerants are used: CO_2 and water.

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