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

FRIGO CONSULTING LTD.
REFRIGERATION CONSULTING & ENGINEERING
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Competence in CO_2

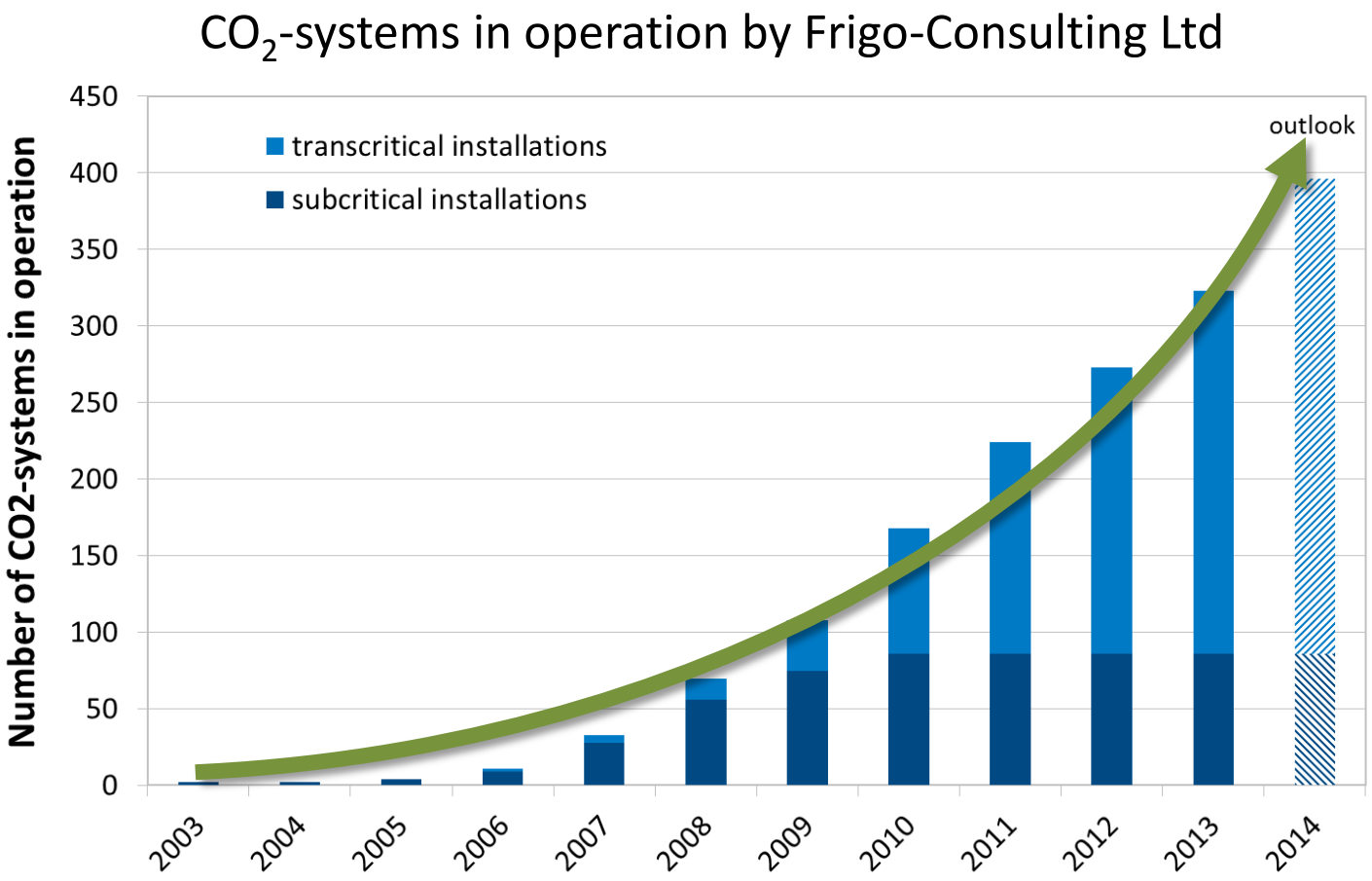
ATMOsphere Europe 2013

Advanced CO_2-booster system for warm climates

16.10.2013

Jonas Schönenberger

CO_2 commercial references



Partners

MIGROS
Neuchâtel Fribourg

enex
Leading in refrigeration

ALPIQ

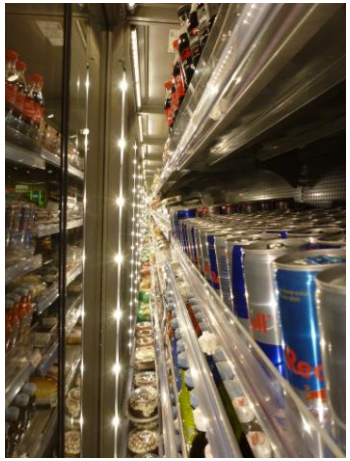
SINTEF

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

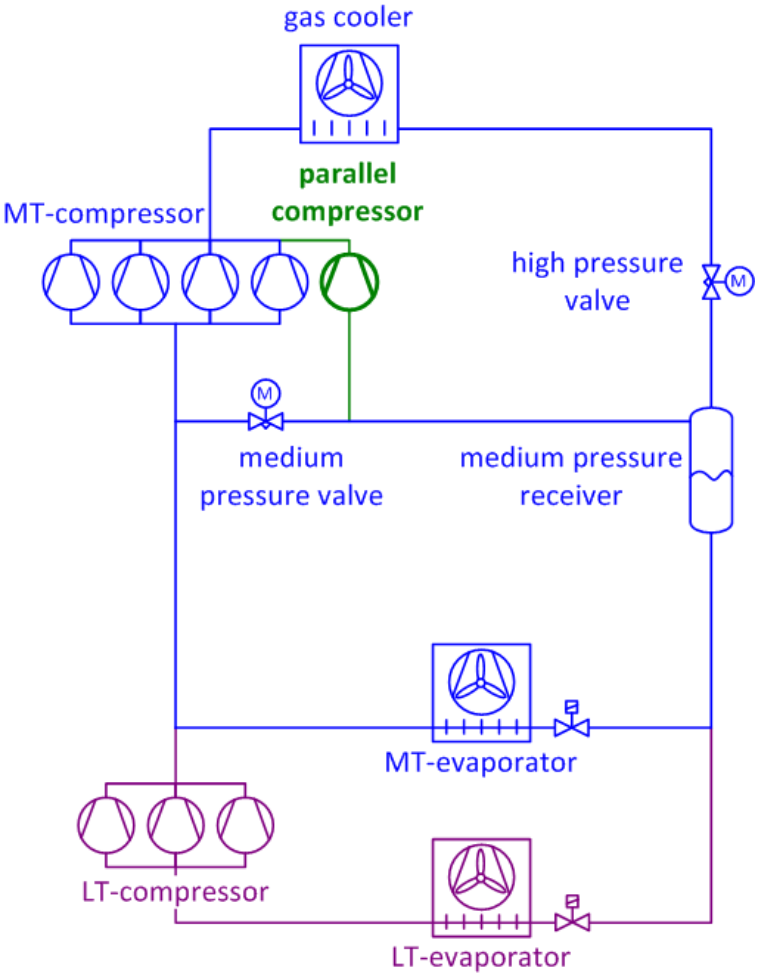
Bundesamt für Energie BFE
Office fédéral de l'énergie OFEN

Job site

- Supermarket: Migros Bulle, Switzerland
- Sales area: 5’000 m^2
- Total length of cabinets: 135 m
- All cabinets closed with glass doors
- Cabinets with LED-lighting
- Walk-in-cooler/freezer: 14 pcs
- Medium temperature capacity: 120 kW
- Low temperature capacity: 55 kW

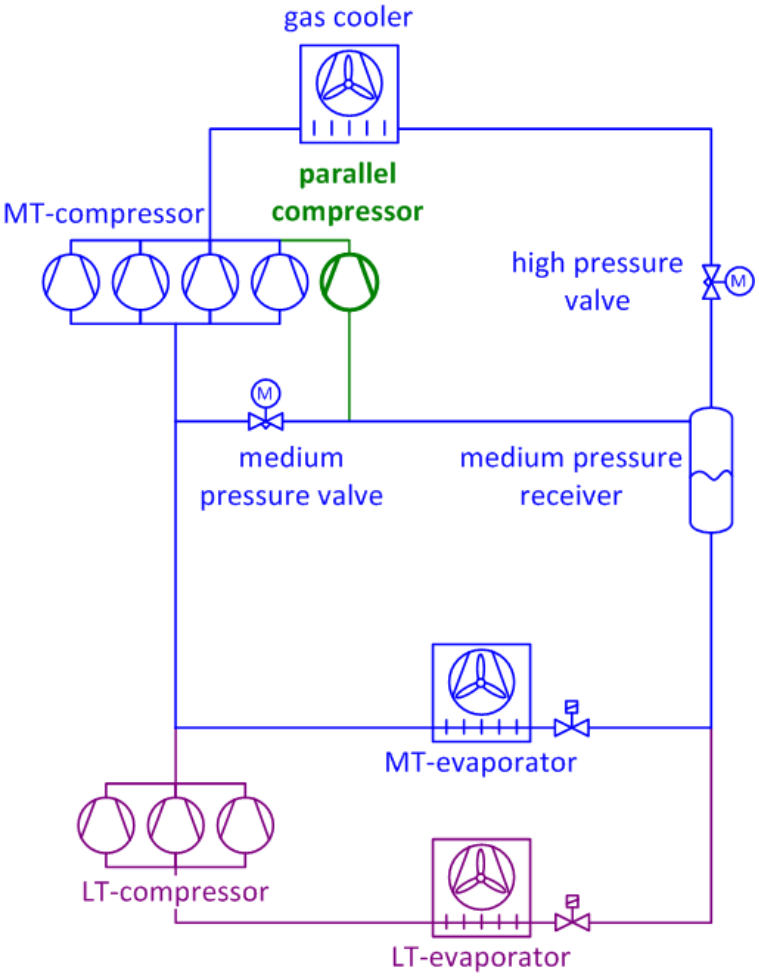


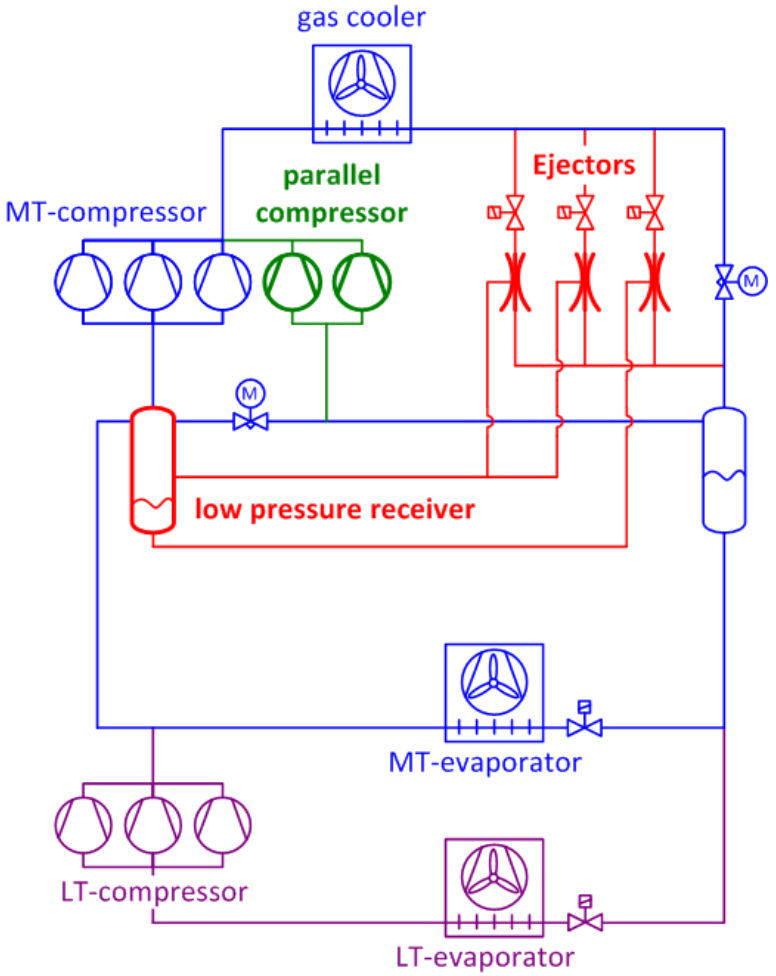
Transcritical CO_2-booster



- Superheat evaporator: 8 K
- Dry expansion
- No liquid in suction line
- Evaporation temperature: -8°C

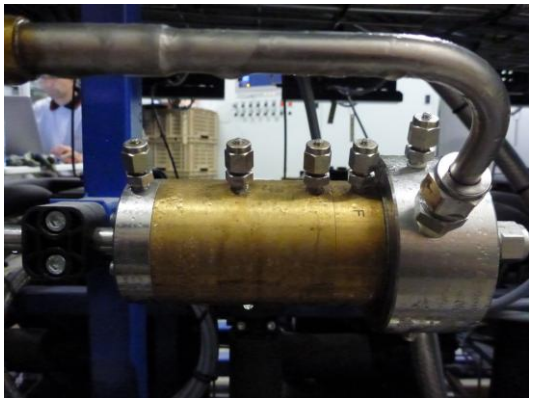
Transcritical CO_2-booster with EJECTOR

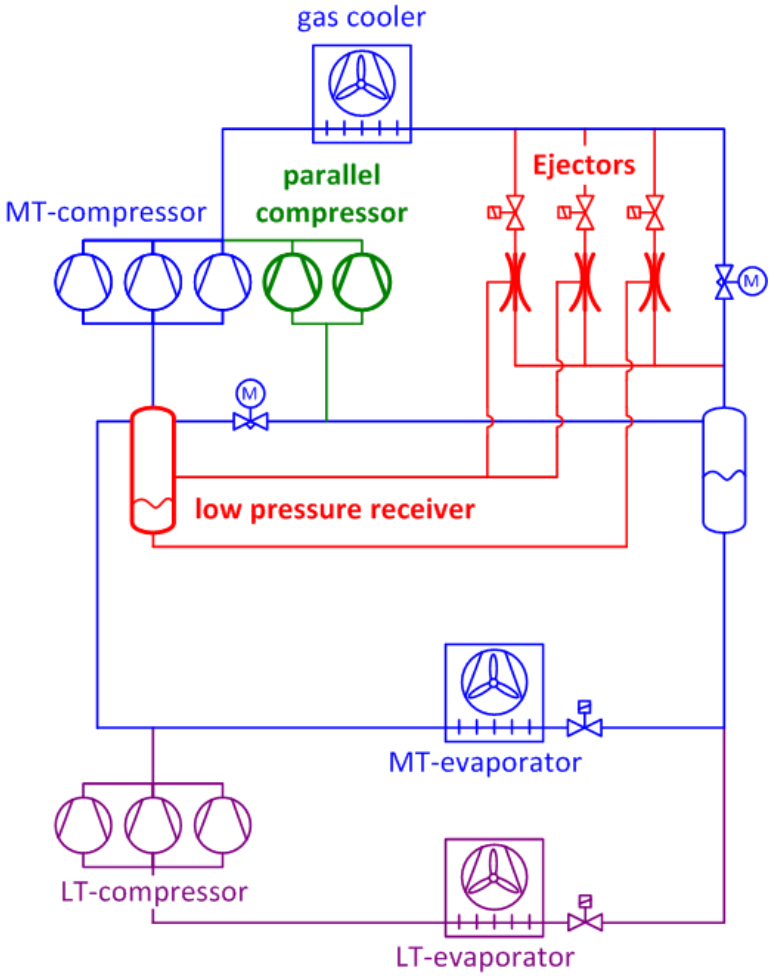




Transcritical CO_2-booster with EJECTOR

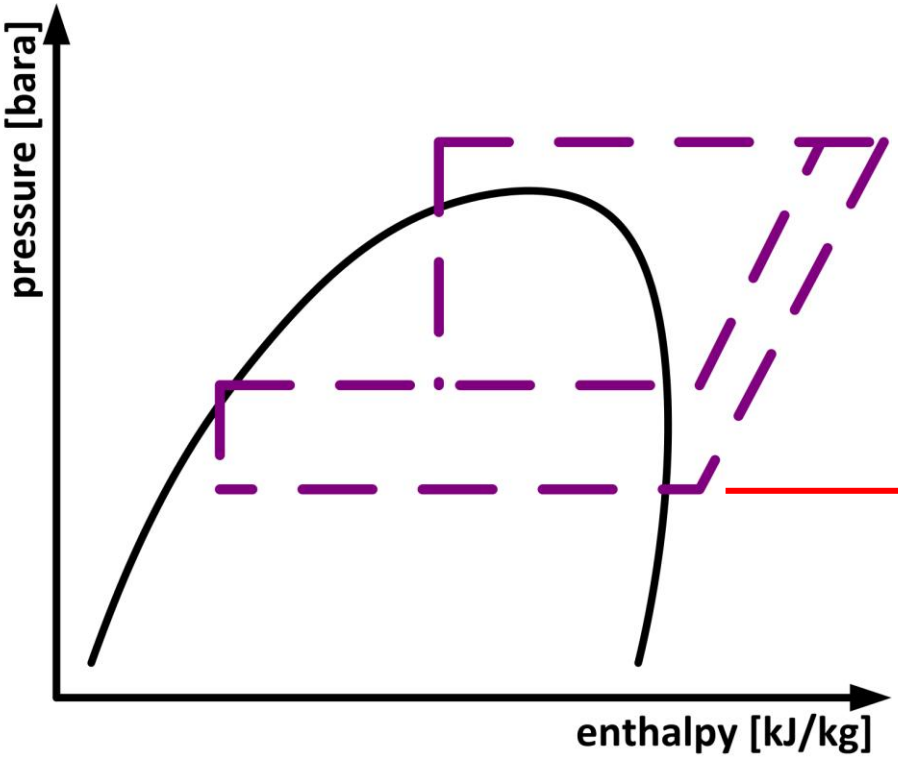
- Liquid in suction line acceptable
- Reduce superheat at cabinet: 0 K
- Flooded evaporators
- High heat exchange efficiency
- Increased evaporation temperature to -1.5°C



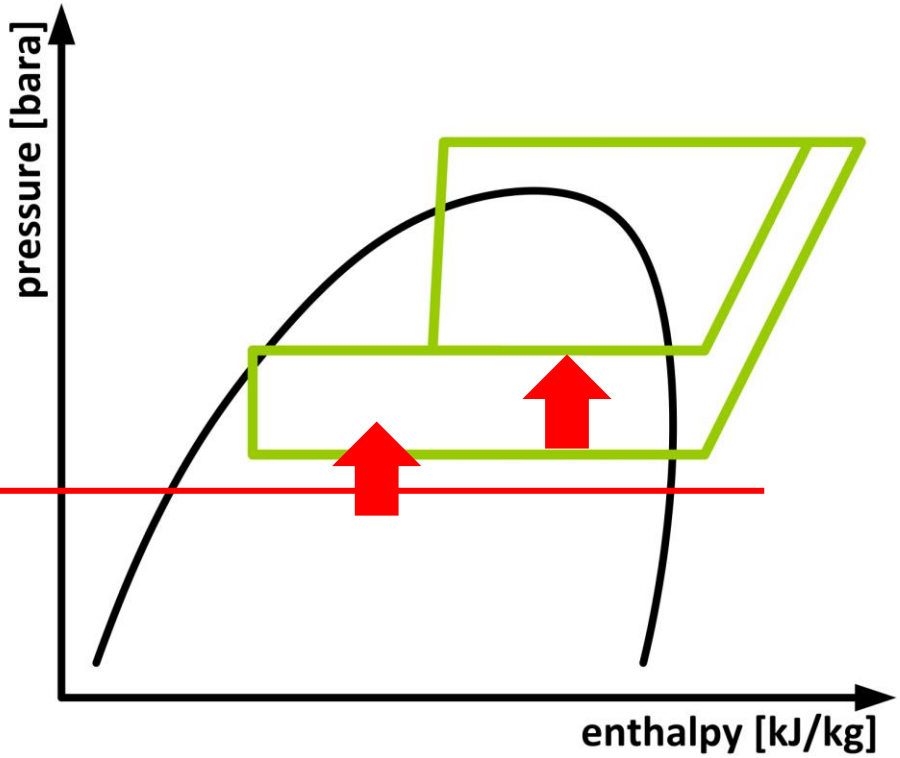


Process in pressure enthalpy diagram

CO_2-Booster System

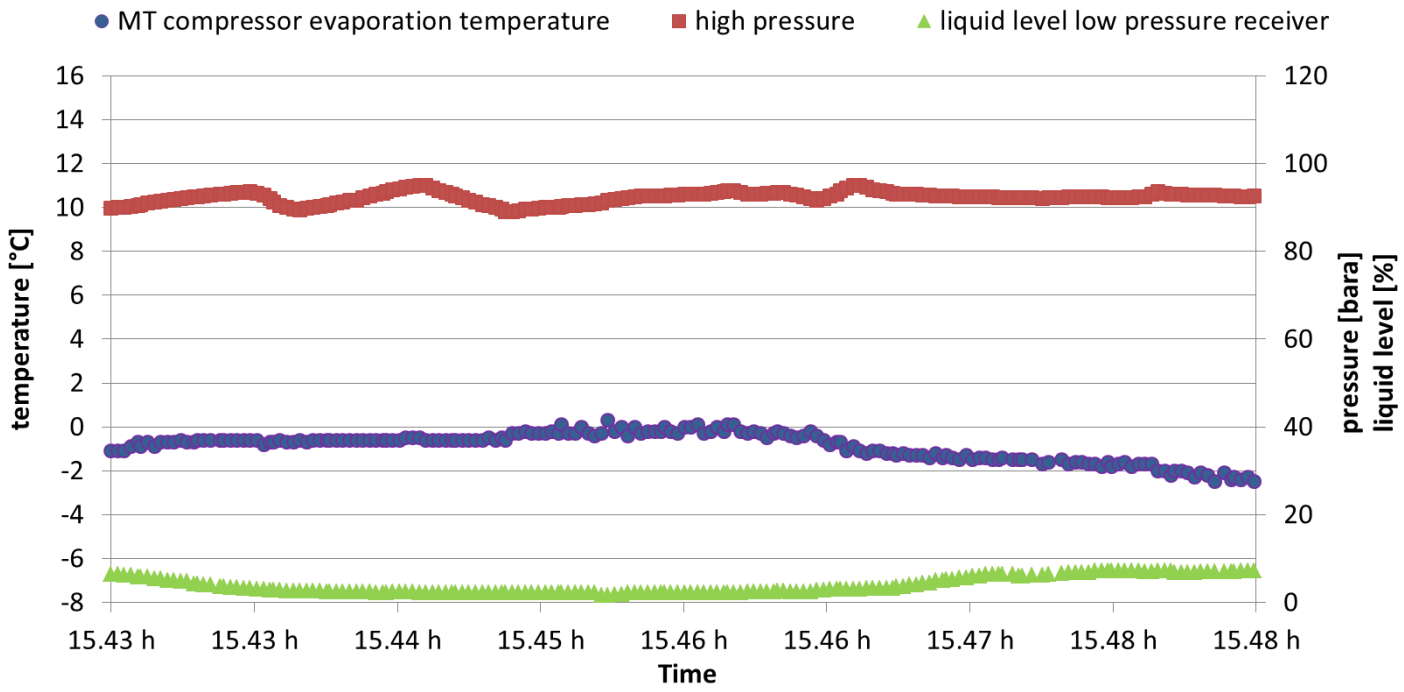


CO_2-Ejector System



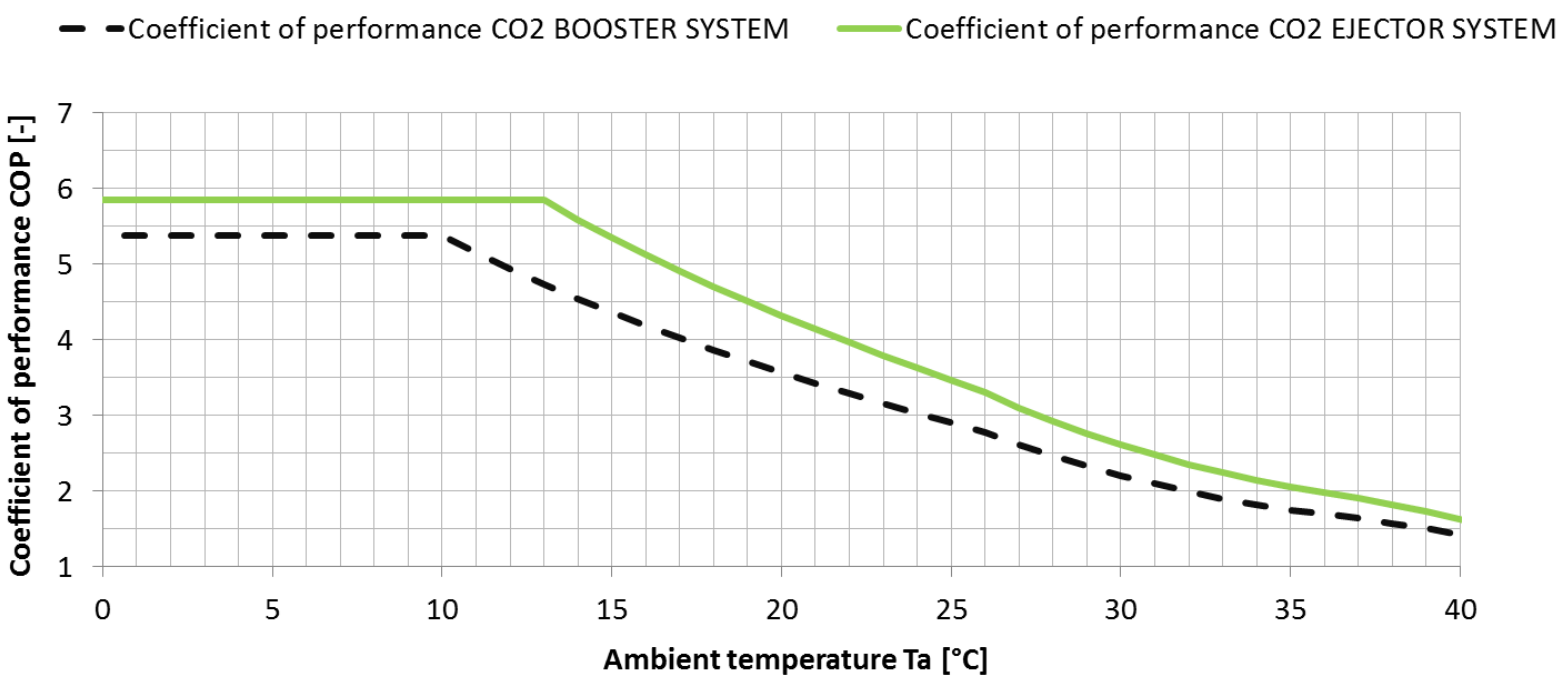
Transcritical CO_2-Booster with Ejector

- Date: 09.10.2013, transcritical operation
- Average evaporation temperature -1.5°C
- High pressure control by ejector



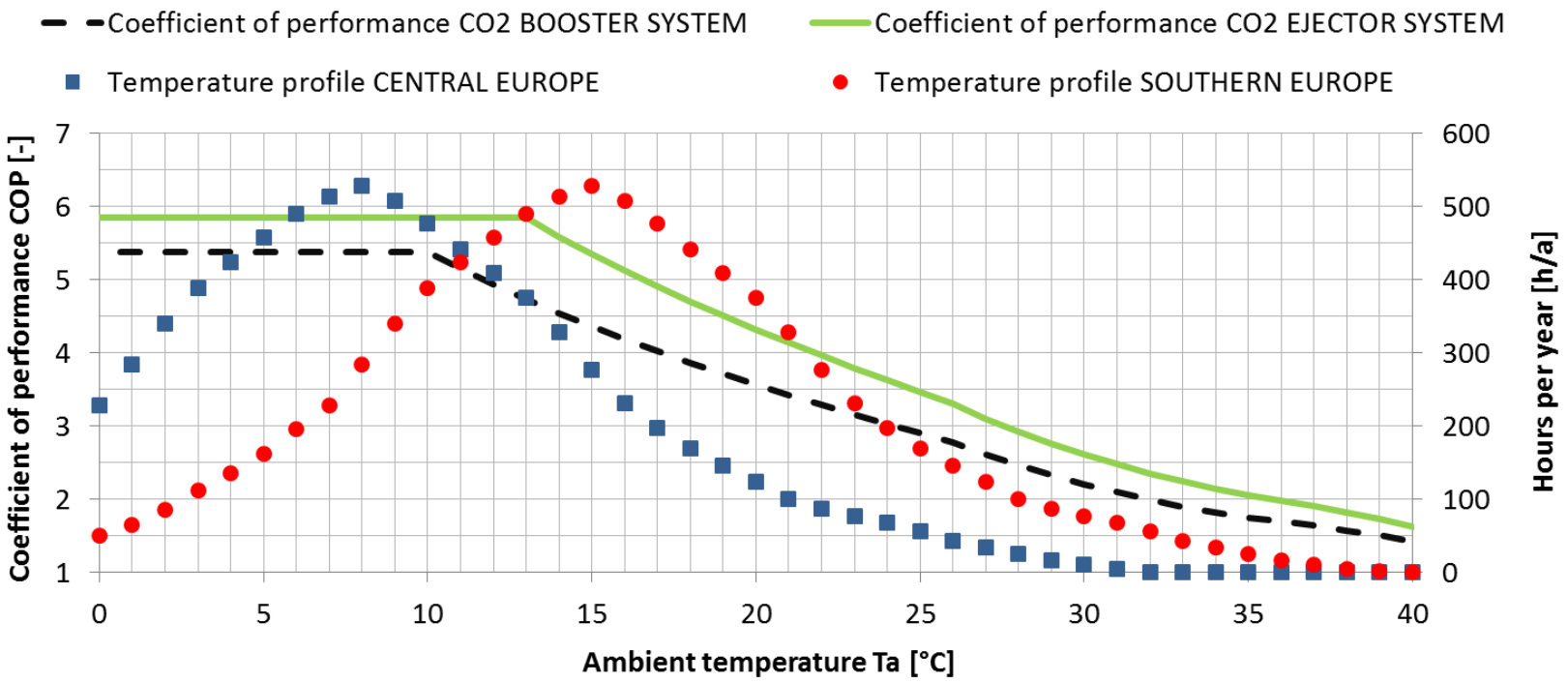
Efficiency increase

- Increased evaporation temperature
- Shift mass flow to parallel compressor



Energy consumption

- **12%** less energy consumption in **Central Europe**
- **16%** less energy consumption in **Southern Europe**



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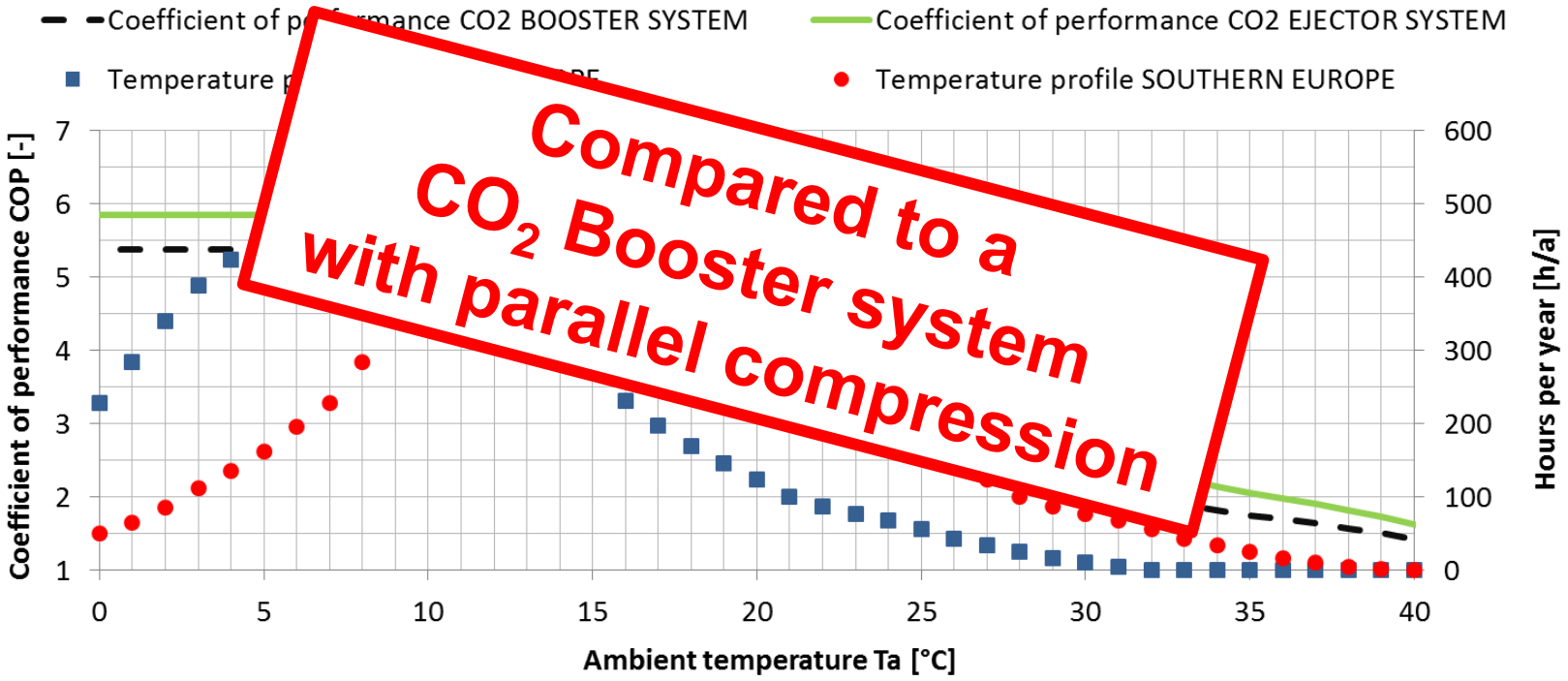

Summary

- Installation at Migros Bulle Switzerland, in operation since summer 2013
- CO_2-booster with ejector successful in operation
- Implementation based on standard components
- 6.5 K higher evaporation temperature
- Increase operation of parallel compressor
- Efficiency increase of 12% in Central Europe
- Efficiency increase of 16% in Southern Europe