ATMOsphere EU solutions for europe

natural refrigerants

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DANISH TECHNOLOGICAL INSTITUTE

Improving efficiency for small transcritical CO_2 supermarket installations

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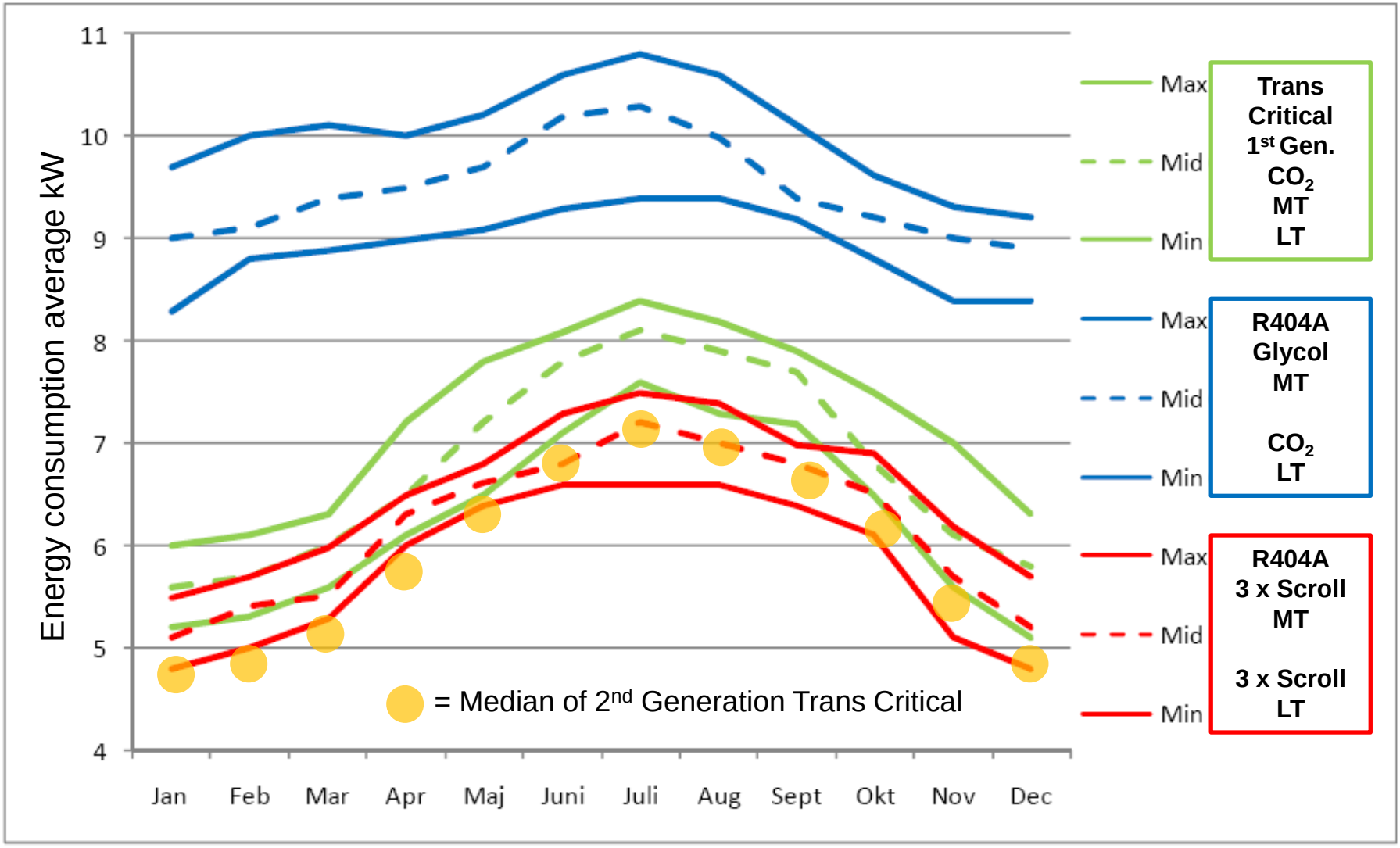
Project Partners ESO2

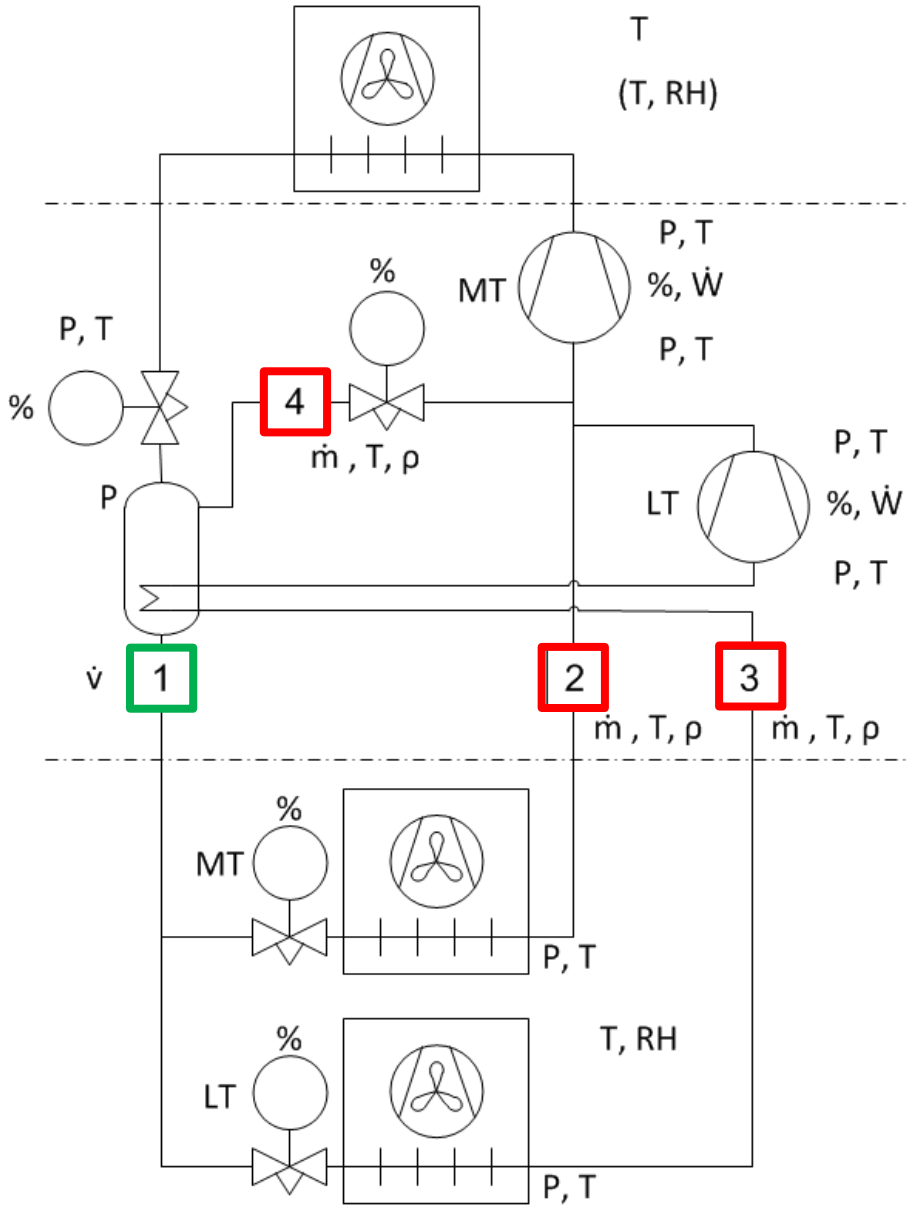
The Danish Energy Agency (funding via the EUDP program)
Advansor
COOP
Danfoss
DTI (project management)
DTU Informatics
DTU Mech. Eng.
IPU
SuperGros
Super Køl

ESO2 Optimization of super market refrigeration systems, main objectives:

- Measure actual refrigeration capacity needed on the cabinets and identify saving potential
- Software for diagnosing energy performance of plant
- Compare mass flow measuring methods direct/ indirect
- Software tool for sizing compressors and estimating load profile
- Optimized energy performance by coordinating/ overriding local controllers as an add on for the present control system

Fakta Reference Installations

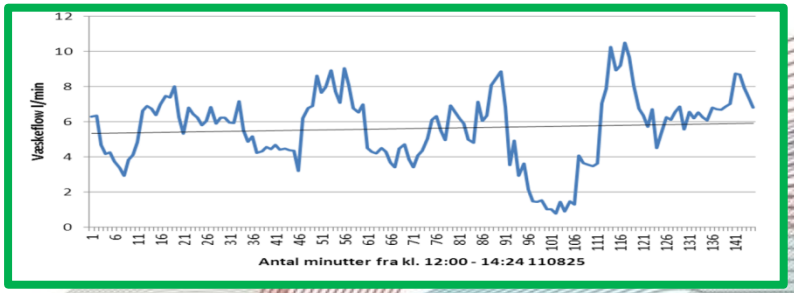




CO_2 Booster Pack

- MT 30 kW
  - 7 evaporators
  - 2 compressors (1 inverter)
- LT 8 kW
  - 4 evaporators
  - 2 compressors
- Danfoss AdapKool

+ Energy meters for compressors
+ Pos 1 vortex flow meter
+ Pos 2, 3 and 4 coriolis mass flow meters



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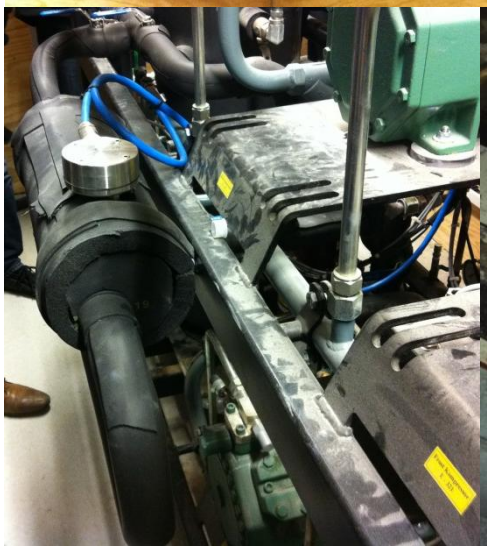
Flow meters

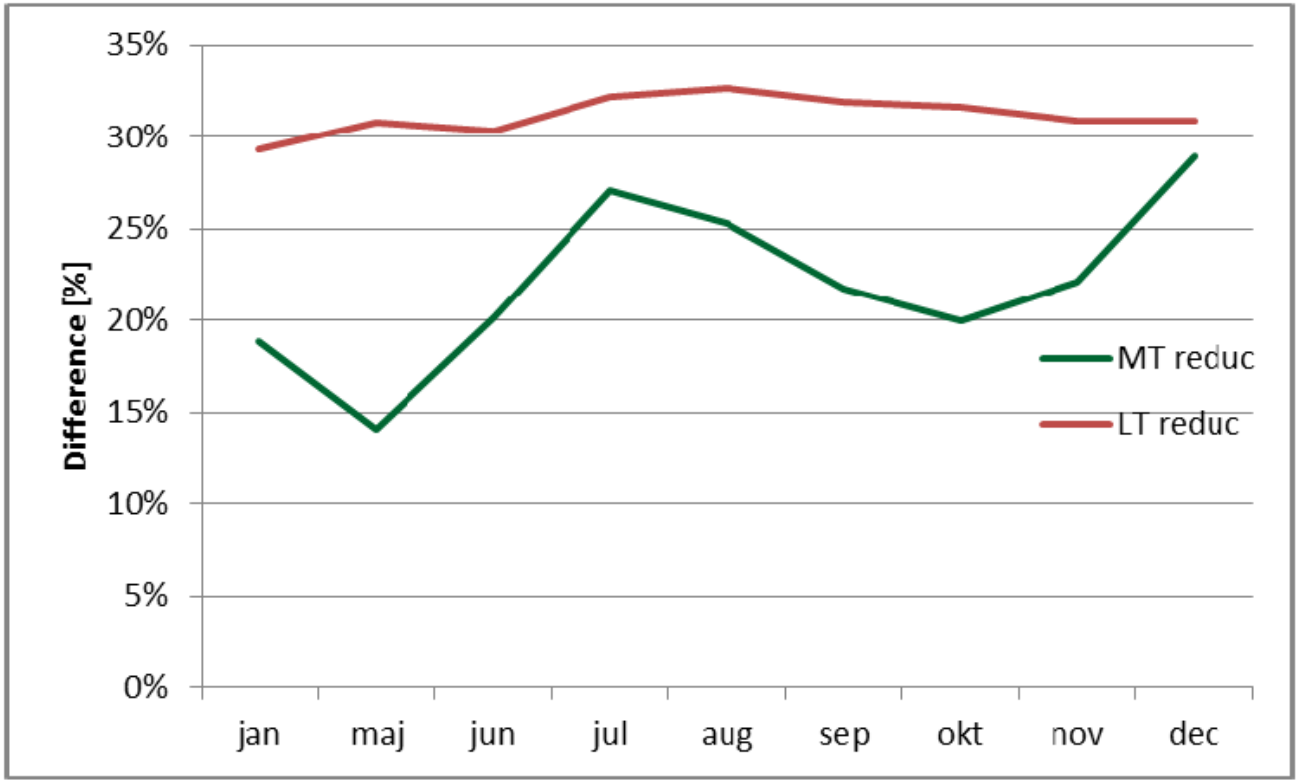
Top: LT and MT suction line
Bottom left: Gas bypass
Bottom middel: Vortex flow meter



Apparent energy saving potential

Suction and headpressure unchanged

Energy consumption measured/ calculated with PCII



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Overriding control algorithm
Preliminary test results

	Baseline	Test
Time period:	Wed 24-10-2012 23:00 to Thu 25-10-2012 06:00	Mon 22-10-2012 23:00 to Tue 23-10-2012 06:00
Switch frequency [Switches/hour]	0.0044	0.0013
Number of stops	9	3
Average power consumption	2.91 kW	2.65 kW
Energy consumption	20.4 kWh	18.5 kWh
Average outdoor temperature	10.14 °C	11.00 °C

ESO2 Optimization of super market refrigeration systems, main results:

- Measure actual refrigeration capacity needed on the cabinets and identify saving potential
- ✓ Done, apparent energy saving potential 20 to 30 %
- Software for diagnosing energy performance of plant
- ✓ Steady state model developed using exergy calculations for identifying mal-performance, not yet validated with data
- Compare mass flow measuring methods direct/ indirect
- ✓ Swept volume, AKV valves, coriolis, vortex
- Software tool for sizing compressors and estimating load profile
- ✓ Pack Calculation II load profile validated
- ✓ Display cabinet models finalized, but not yet implemented in PCII
- Optimized energy performance by coordinating/ overriding local controllers as an add on for the present control system
- ✓ Preliminary test results promising, energy saving 9 % (night)