



ATMO sphere





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sphere

Comparison between real plants using R744 with ejector and parallel compressor and a conventional R134a/R744 cascade in warm climates

**Enrico
Zambotto**



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Supermarket characteristics

- Largest hypermarket in Italy
- Hypermarket Brand: IPER
- 10,000 m² of covered area
- 147 MT cabinets, 29 LT cabinets
- 105 plug-in cabinets
- 26 MT-LT cold rooms (1700 m³ tot)

Cooling loads

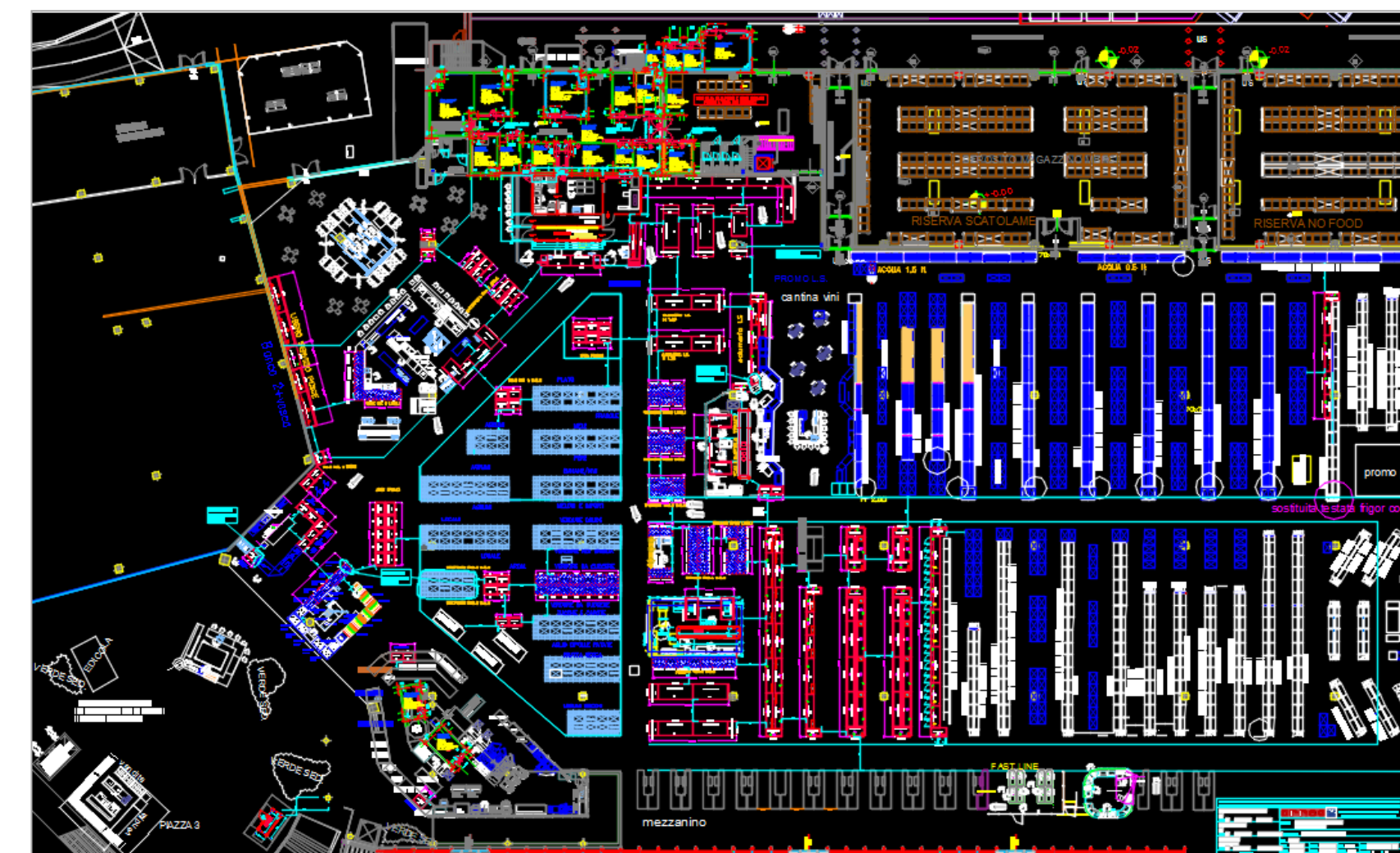
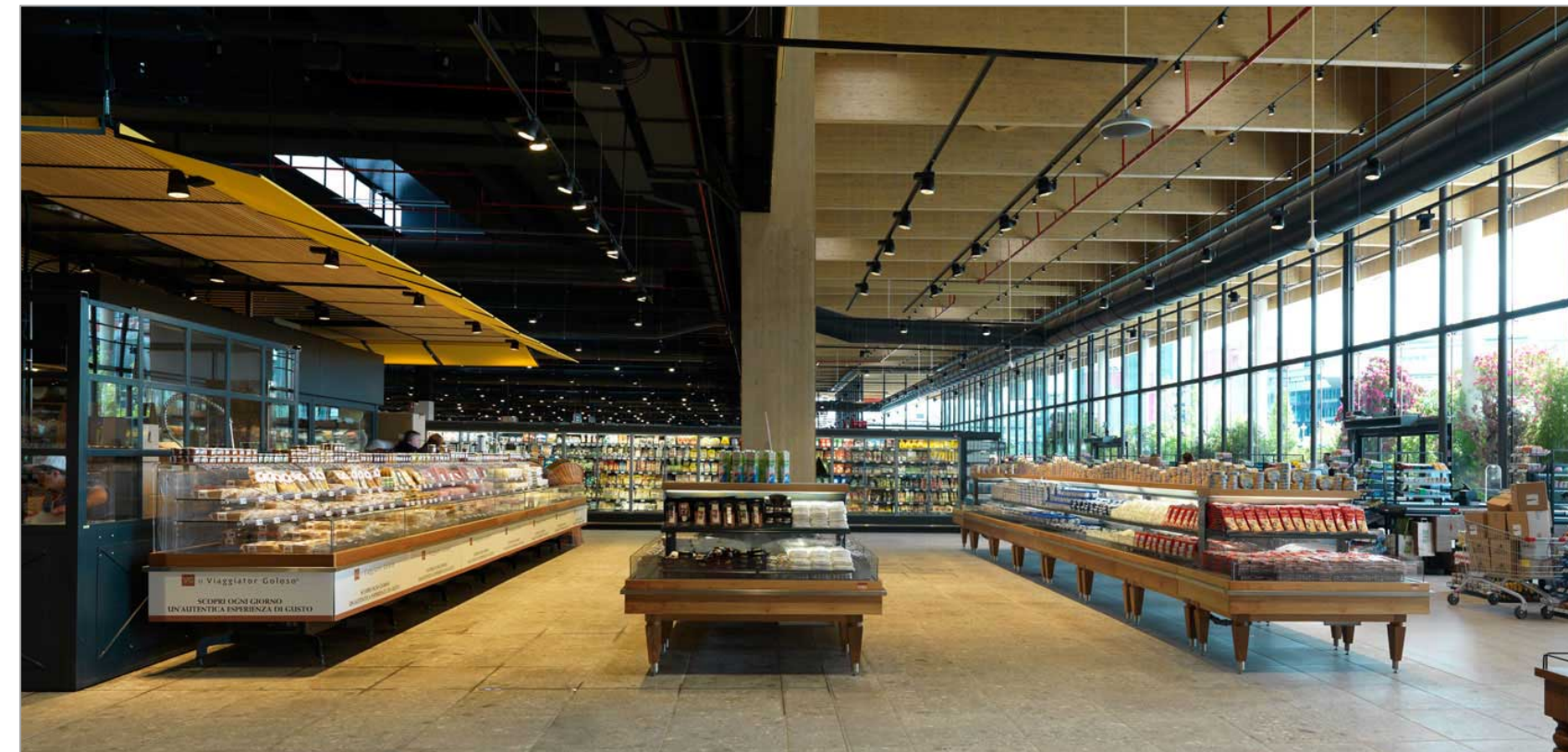
- 290 kW MT
- 40 kW LT

Geographic location

- Northern Italy- Arese (MI)
- Warm climate

Innovative technology

- International awards





Italy's largest hypermarket opts for CO₂ transcritical

31 May 2016

In April 2016, the largest hypermarket in Italy opened its doors in Milan. The hypermarket is pioneering a CO₂ transcritical refrigeration system using ejector technology to enhance efficiency in temperatures up to 38°C, further demonstrating that CO₂ refrigeration is advancing across Europe.

The Iper hypermarket is part of the new Arese shopping centre, which is the largest shopping centre in Italy and one of the largest in Europe. Sustainability is a key pillar of the building's design, which qualifies for U.S. Green Building Council (USGBC) LEED Gold certification, meaning that the hypermarket has been designed and constructed to use less water and energy and reduce greenhouse gas emissions.

"Using CO₂ to power the refrigeration system is a perfect match to the intentions of LEED. CO₂ is a low-GWP refrigerant and an excellent choice when it comes to reducing greenhouse gas emissions. At the same time, CO₂ provides excellent performance and exceptional properties for heat reclaim," says Gabriele Zambotto, a Key Account Manager at Danfoss Italy.

The Iper hypermarket is one of the first stores to implement new ejector refrigeration system. Convinced by the results of numerous tests in order to enhance the hypermarket's energy efficiency.

"Electricity for refrigeration makes up 50% of the total energy consumption. We will cut down this consumption year by year as part of their sustainability program. We will use natural refrigerants to cut the carbon footprint. In order to fulfill these goals, we installed several hundred cabinets and cold rooms operating under ambient temperatures up to 38°C. The installation with several hundred cabinets and cold rooms operating under ambient temperatures up to 38°C. Technical Support Manager from Arneg, a world leader in the production of complete refrigeration solutions for the retail industry.

REFRIGERANT RECOVERY UNIT



The use of CO₂ trans-critical refrigeration in warm climates has been a hot topic for many years. The tables are turning, however, and CO₂ refrigeration advances across Southern Europe as an efficient and viable solution. In April 2016, the largest hypermarket in Italy opened its doors in Milan. The 10,000 m² brand new Iper market is a pioneer in CO₂ trans-critical refrigeration system using Ejector technology to enhance efficiency in temperatures up to 38°C. The turnkey refrigeration system is supplied by Arneg.

The Iper hypermarket is part of the new Arese Shopping Center, erected on the old Alfa Romeo car production site that was formerly the cherished workplace of 40,000 workers. Building on this proud heritage, the Arese Shopping Center is the largest shopping centers in Italy and one of the largest in Europe, including 92,000 m² of Italian market style floor space with more than 200 shops, cafes and restaurants.

Sustainability is a key pillar of the building design that is LEED Gold certified, meaning that the center is designed and constructed to use less water and energy and reduce greenhouse gas emissions.

"Using CO₂ to power the refrigeration system is a perfect match to the intentions of LEED. CO₂ is a low-GWP refrigerant and an

excellent choice when it comes to reducing greenhouse gas emissions. At the same time, CO₂ provides excellent performance and exceptional properties for heat reclaim," says Gabriele Zambotto, a Key Account Manager, Danfoss Italy.

Why go for trans-critical refrigeration using Ejector technology?

The Iper hypermarket is one of the first stores to implement new ejector technology in the trans-critical refrigeration system. Convinced by the results of numerous tests in order to enhance the hypermarket's energy efficiency.

"Electricity for refrigeration makes up 50% of the total energy consumption of the hypermarket, and our ambition is to cut down this consumption as part of our sustainability program. Another key goal is to switch to natural refrigerants to cut the carbon footprint. In order to fulfill these goals, we proposed a trans-critical CO₂ solution. It is a large installation with several hundred cabinets and cold rooms operating under ambient temperatures up to 38°C," says Enrico Zambotto, Technical Support Manager from Arneg, a world leader in the production of complete refrigeration solutions for the retail industry.



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Il più grande ipermercato d'Italia sceglie la CO₂ per la refrigerazione

di redazione ZZ | 30 maggio 2016 in Impianti · 0 Commenti

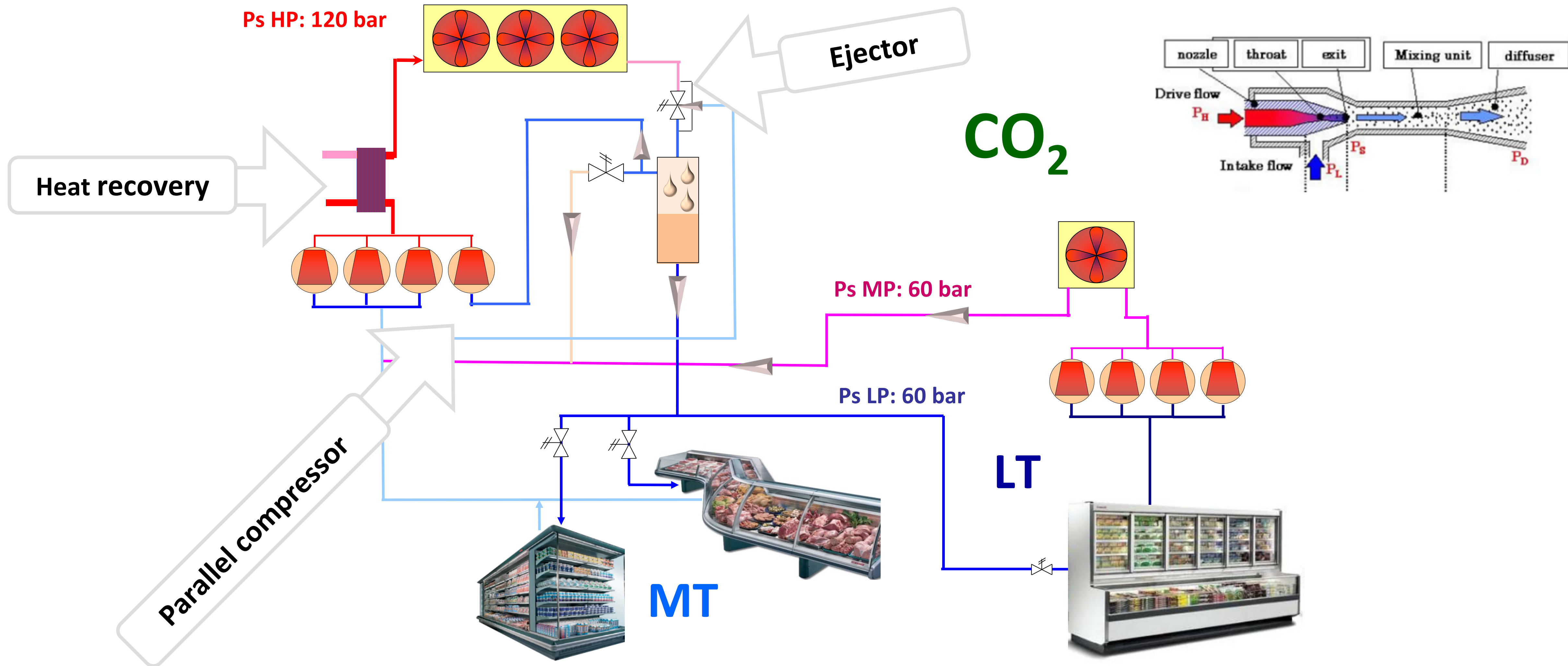
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L'uso della refrigerazione transcritical nei climi caldi è stato un tema trattato (e controverso) per molti anni. Il vento sta però cambiando e la refrigerazione a CO₂ avanza in tutta l'Europa del Sud come una soluzione efficiente e praticabile per la refrigerazione commerciale.

Nel mese di aprile 2016 il più grande ipermercato in Italia ha aperto le sue porte ad Arese, vicino a Milano. Il nuovo supermercato a marchio IPER con i suoi 10.000 m² di superficie è un pioniere nel sistema di refrigerazione a CO₂ transcritical e utilizza la tecnologia dell'eiettore per migliorare l'efficienza a temperature ambientali fino a 38°C. Il sistema chiavi in mano di refrigerazione è fornito dall'azienda italiana Arneg. L'Iper è parte del nuovo centro commerciale di Arese, costruito sullo storico sito produttivo dell'Alfa Romeo, ai tempi posto di lavoro di circa 40.000 lavoratori. Fiero di tanta

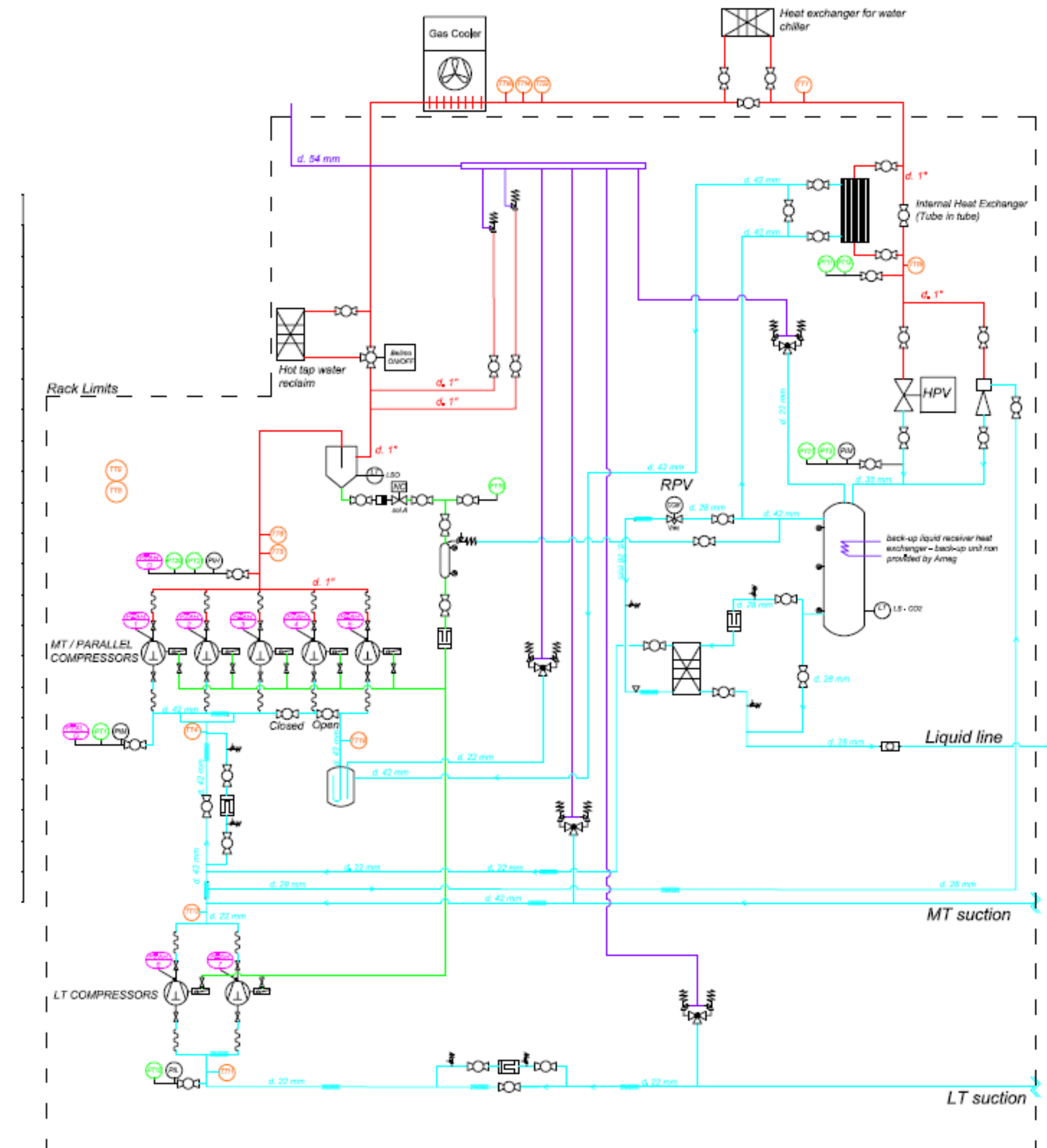


Two racks

- **Compressors: Dorin**
 - 3 x CD4000H
 - 2 x CD4000H
 - 2 x CD750M
- **Gas cooler: LU-VE EHVD 1 x 6226 4 fans EC**
- **Controller: Danfoss AKPC 781**

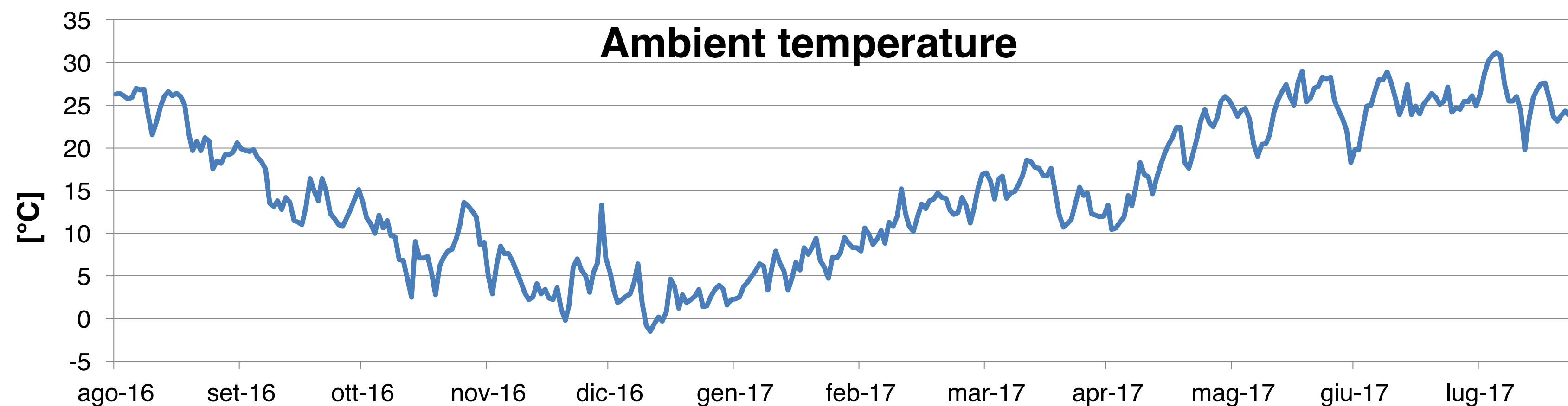
Energy saving devices

- **Parallel compressors**
- **Multistep vapour ejector**
- **Inverter on:**
 - 1° MT compressor
 - 1° LT compressor
 - 1° parallel compressor
- **Heat recovery (300 kW)**



Design conditions

- Evaporating temperature LT: -30 °C
- Evaporating temperature MT: -8°C
- Maximum ambient temperature: 40°C
- Maximum pressures:
 - HP 120 bar
 - MP 60 bar
 - LP 60 bar



Supermarket characteristics

- 9,500 m² of covered area
- 144 MT cabinets, 32 LT cabinets

Geographic location

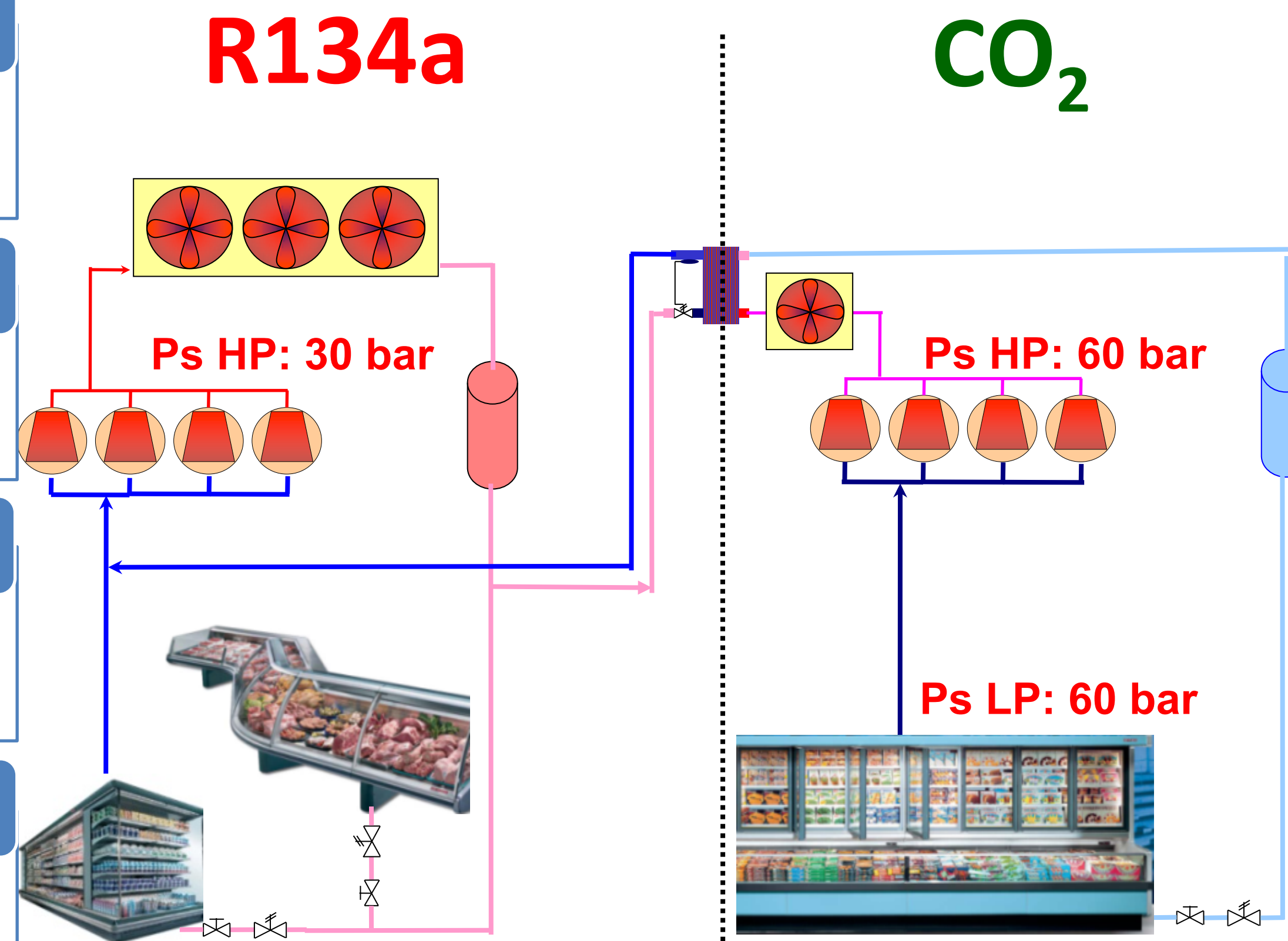
- Northern Italy – Padua
- Warm climate

Cooling loads

- 285 kW MT
- 41 kW LT

Design conditions

- Evaporating temperature:
 - -8 °C MT
 - -30 °C LT
- Maximum ambient temperature:
 - 37 °C

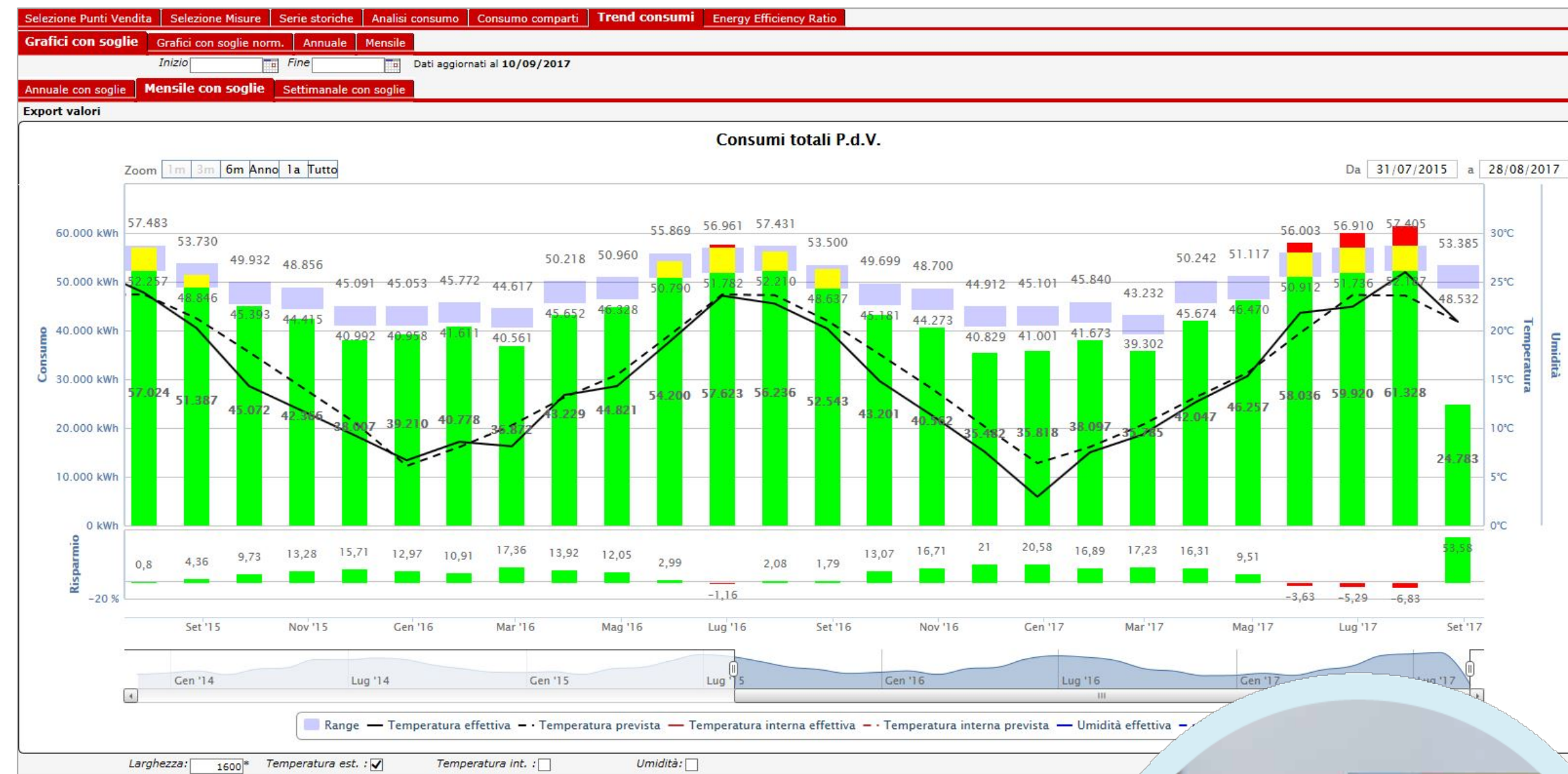


Supervision

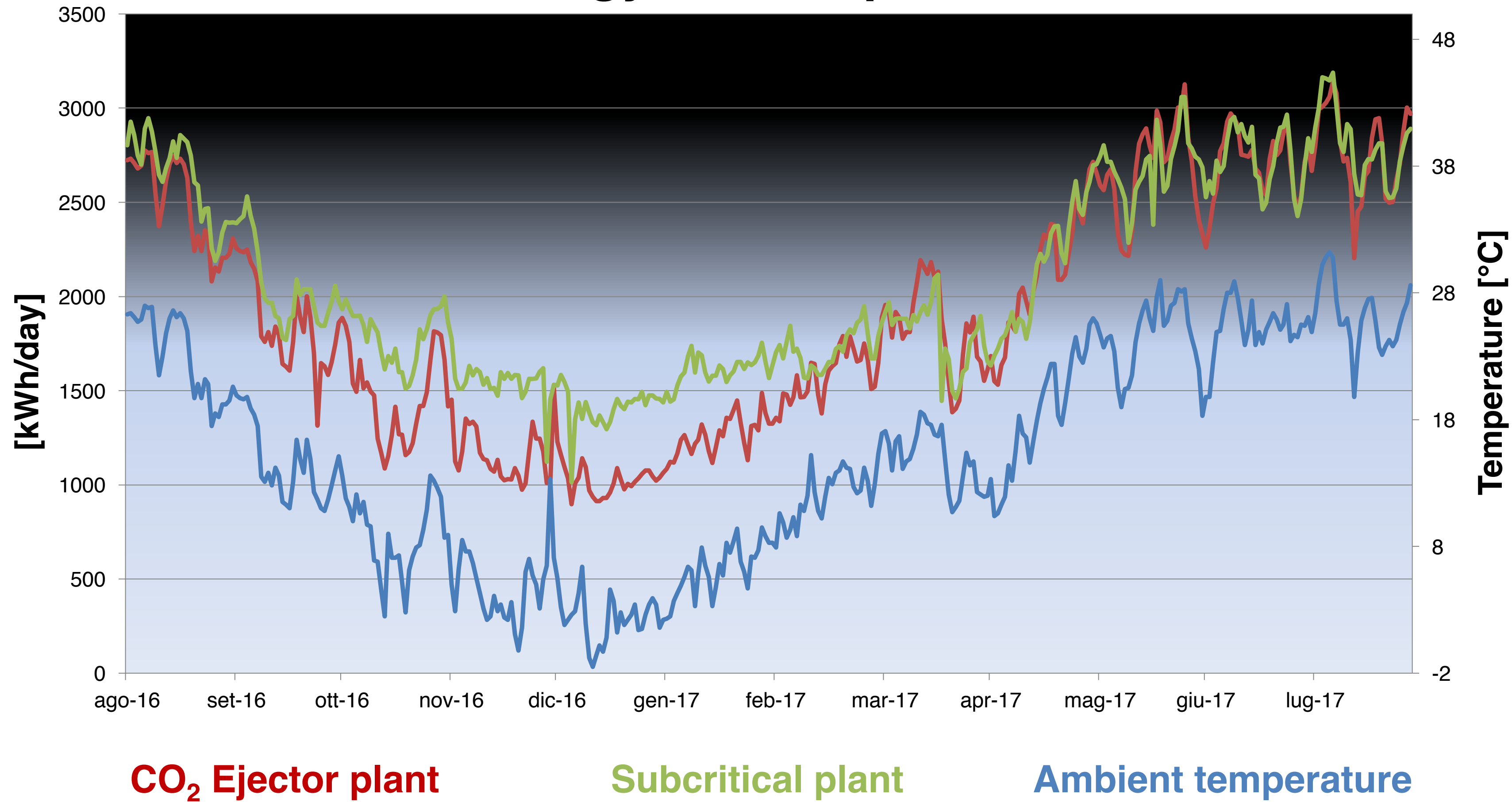
- Management of supermarket devices
- Maintenance planning and optimization
- Real-time display of data and alarms

Energy management

- Data analysis
- Prevision of energy consumption trends
- Optimization of plants in order to obtain maximum savings



Energy consumption



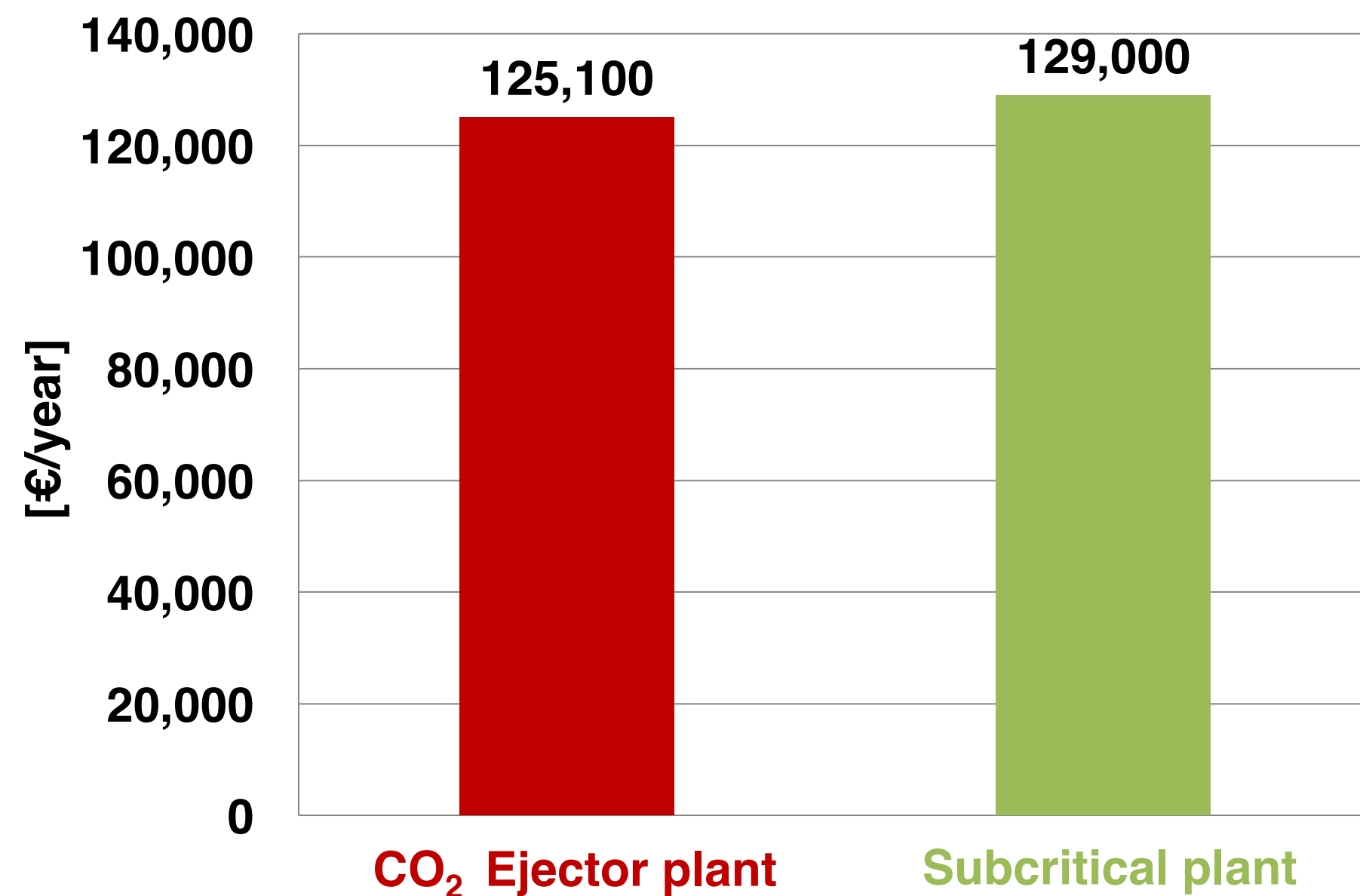
Summer

CO₂ ejector energy consumption similar to subcritical

Winter

Good performance of CO₂ ejector plant

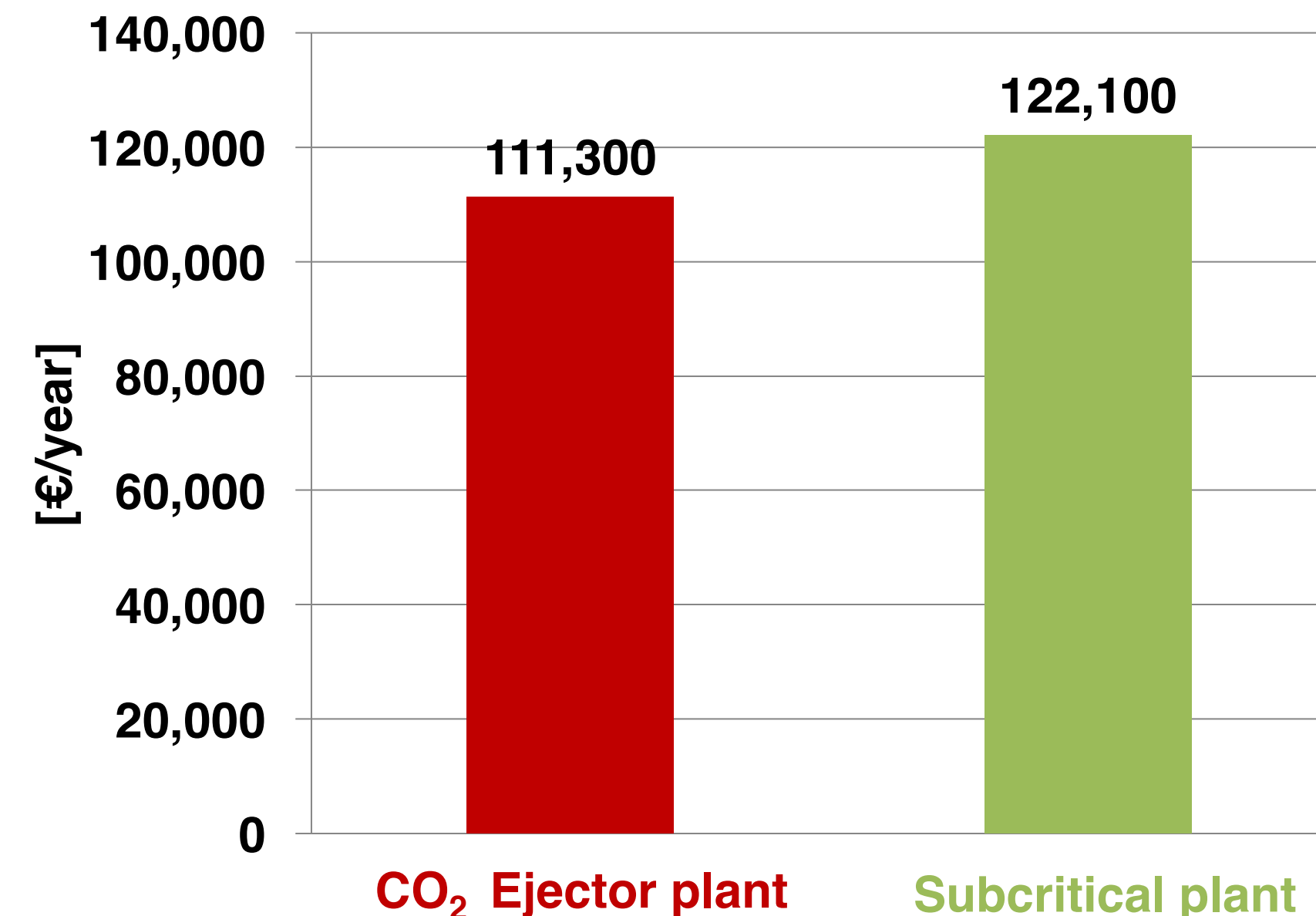
Energy consumption | THEORETICAL



Saving 3%

-21,700 kWh/year
-3,900 €/year

Energy consumption | MEASURED



Saving 9%

-60,300 kWh/year
-10,800 €/year

Plant	Direct emissions [ton CO ₂ eq]	Indirect emissions [ton CO ₂ eq]	Total emissions [ton CO ₂ eq]
CO₂ Ejector	2	2020	2022
Subcritical	1416	2217	3633

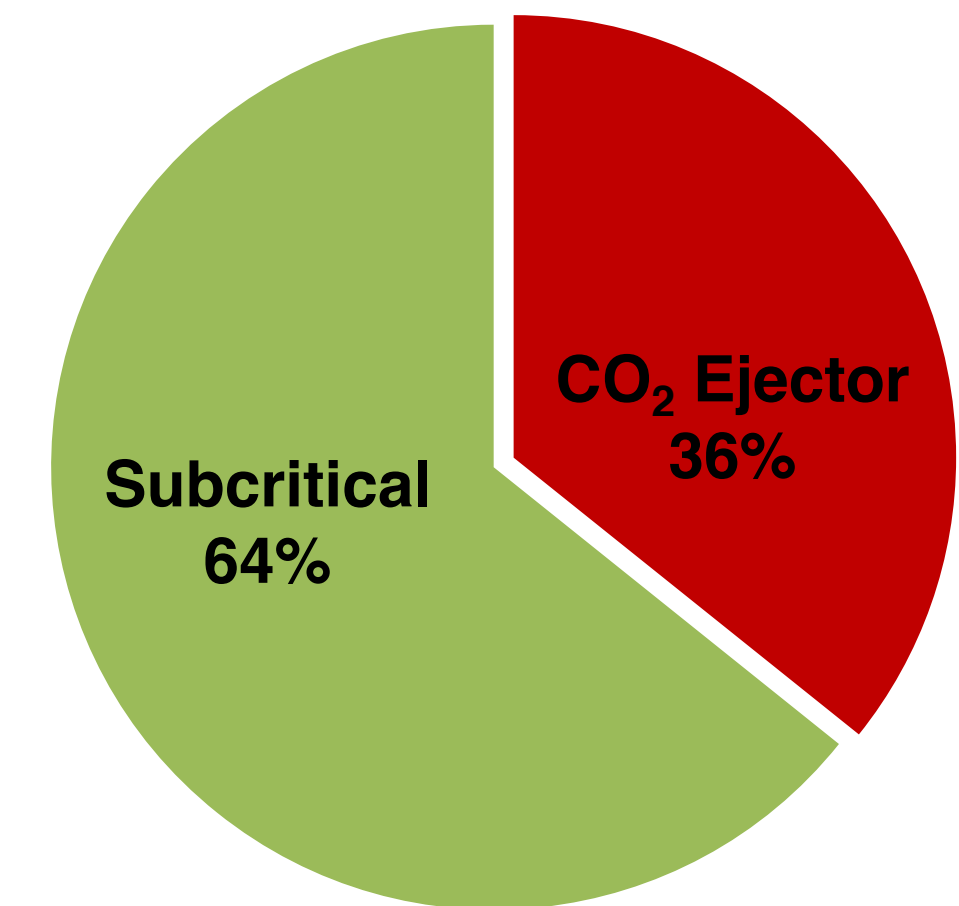
-44% of total emissions

Direct emissions

refrigerant losses
= 1 plant charge in 10 years

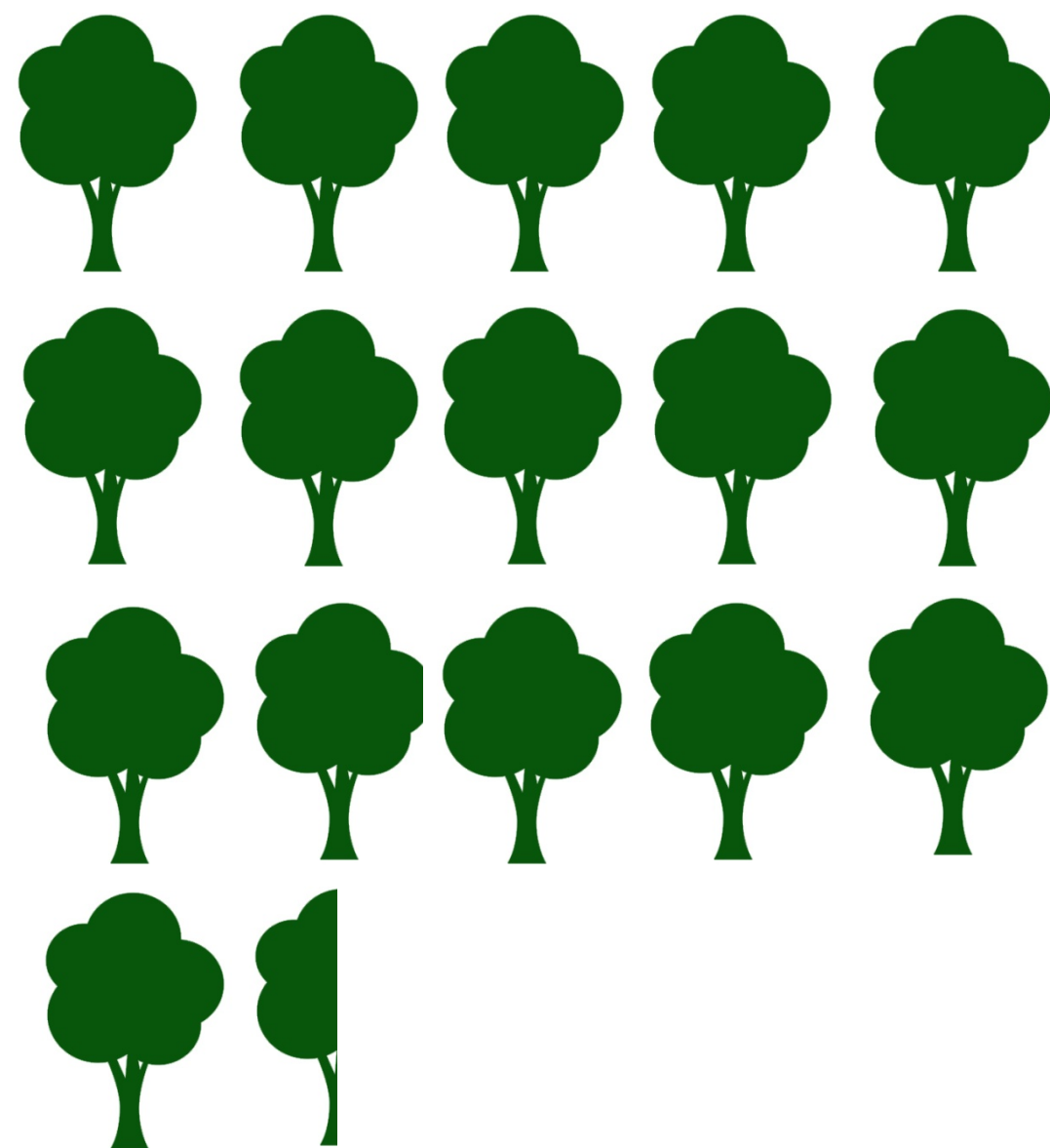
Indirect emissions

327 g CO₂/kWh for purchased electricity
(source: ISPRA)



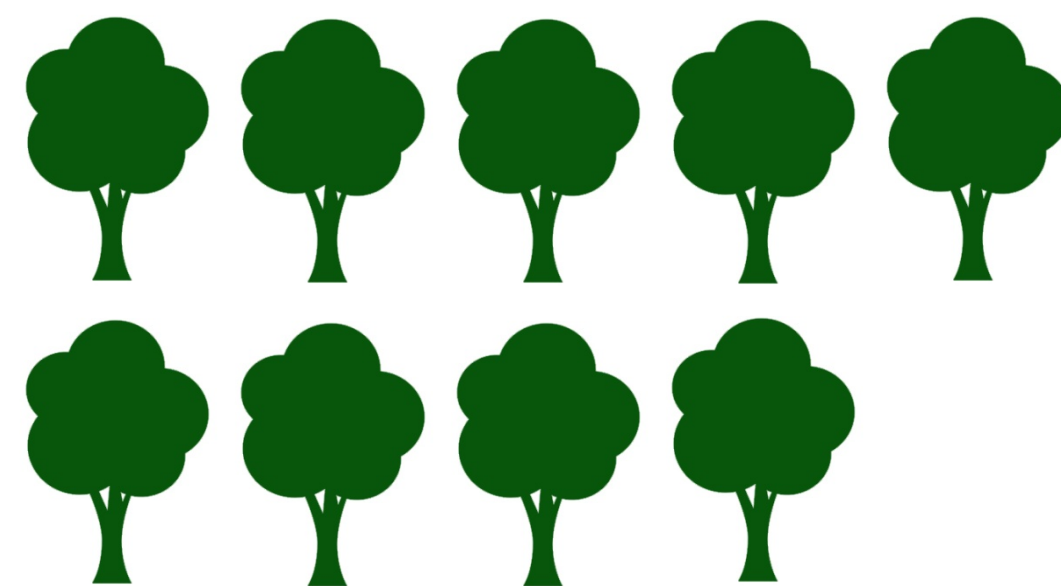
Total emissions of equivalent CO₂

Subcritical plant



16,100 trees

CO₂ ejector plant



9,000 trees

CO₂ total emission

**Reduction of 1,610 ton
CO₂ emission**

Equivalent trees

Saving of 7,100 trees

Conclusions

- Use of energy saving solutions makes CO₂ competitive compared to subcritical cycles also in warm climates.
- CO₂ ejector system performance is better than theoretical expected results.
- CO₂ technology helps to contain emissions in atmosphere with significant benefits for the environment.
- Thanks to its properties, CO₂ helps final customers to save energy and money.

Future developments

Arneg is following the way of innovation with natural gases.

Next step in energy saving with CO₂ are:

- Use of liquid ejector to flood evaporators in order to drop 10% energy consumption (new openings in 2017)
- Hot gas defrosting
- Heat reclaim and heat pumps (HVAC supermarket)

Work in progress...



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Thank you very much!

**Enrico
Zambotto**



**Chiara
Tognoli**

