Application note

Integrated design
the byword for efficiency and sustainability

The integrated design of refrigeration and air conditioning has paved the way for a synergy between the two systems that is allowing two sites – a service station in Copenhagen (DK) and a convenience store in Skutč (CZ) – to run with 100% natural refrigerants.
System integration means being able to ensure the optimum performance of the installation as a whole, rather than considering the needs of specific users (AC and REF) individually. This, together with CAREL's continuous modulation approach and the use of CO_2 as a refrigerant, is a further step towards energy saving and sustainability.

Where and when

- Service station in Copenhagen (Dk), 2022
- Convenience store in Skutč, Chrudim (CZ), 2022

What

The system integrates both air conditioning and refrigeration to supply:

- hot water for the heating system (AC);
- cold water for space cooling (AC);
- chilled water for the medium-temperature refrigerating users of the refrigeration system (REF).

Why

The integrated design between air conditioning and refrigeration systems means that exclusively natural refrigerants could be used, making the system:

- a sustainable solution that looks to the future;
- high-efficiency with next-generation modular components.

Two shops, one design

Integrated design means compliance with two different directives:

- **EPBD (Energy Performance of Buildings Directive):** maximising the energy savings of the building;
- **Eco design:** reducing consumption of refrigerating systems.

The use of natural refrigerants, compliant with F-gas guidelines, for abating the total CO_2 footprint.

A new store concept: the very best in plant integration

Integrated design principles were used to create a **synergy** between the air conditioning and refrigeration systems for a global approach to **energy saving**. The cold-water loop, powered by a heat pump/chiller combo, is the intersection between the two systems and used for the following functions:

- **direct cooling** of some of the circuits, typically the medium-temperature appliances, equipped with glycol evaporators (REF);
- **condensation** of the Heosbox CO2 units for the refrigeration of the remaining, typically low-temperature (REF) refrigeration circuits;
- **space cooling** using fan coils (AC).

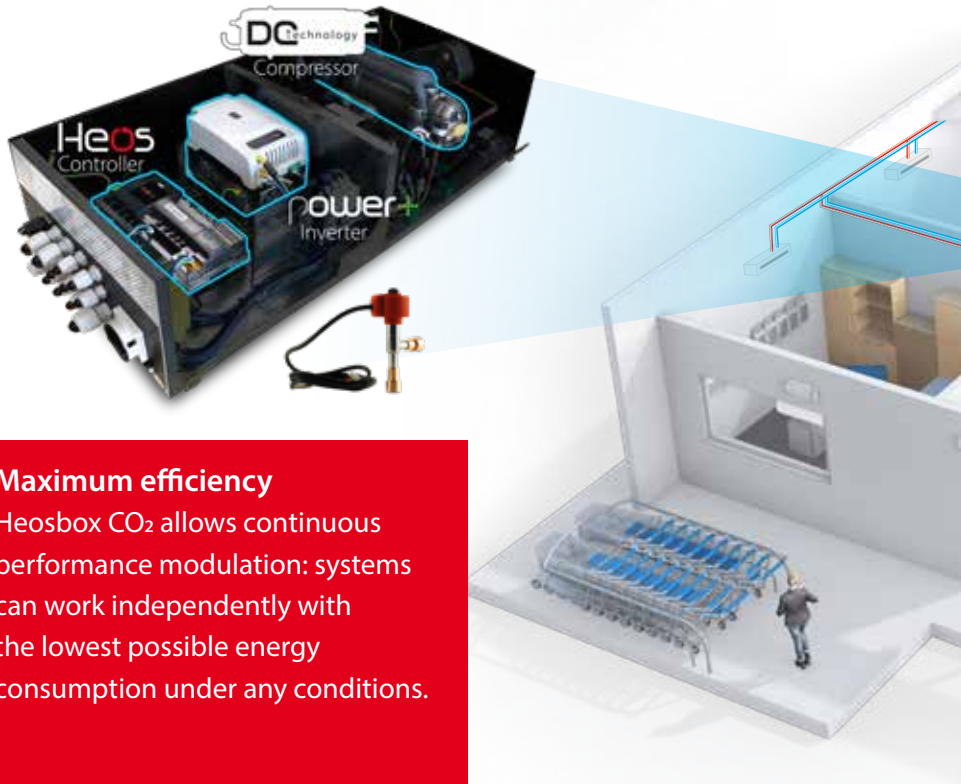
The availability of water to the various systems is managed through an automated system of regulating valves, which **controls the flow rate**.

CAREL Heosbox CO_2

Heosbox CO_2 exploits continuous modulation using:

- a **compressor** with a brushless permanent magnet motor offering the broadest possible modulation range (25%-100%) for optimum electrical efficiency and reliability;
- an **electronic expansion valve** for perfect superheat control that works with the compressor for maximum system output.

The **synchronised action** of the compressor and the valve is governed by the advanced Heos technology logic allowing the complete management of the condensing unit and functional control of the evaporator (lights, fans, defrost, etc.). The units can be installed in single or multi-evaporator configurations to serve up to three separate refrigerating circuits.



Maximum efficiency
Heosbox CO_2 allows continuous performance modulation: systems can work independently with the lowest possible energy consumption under any conditions.

System details

The integrated design allows the creation of a high-efficiency system that is a valid alternative to conventional technologies. The heart of the solution is a modular system of heat pumps/chillers, which use small amounts of refrigerant (typically propane) to produce hot and cold water.

The refrigerating applications, i.e. medium-temperature display counters and cold rooms, use glycol water. The glycol flow rate regulation ensures excellent temperature stability of the fluid and the products on display. The system features the use of CAREL Heosbox CO2 semi-plug-in units for managing low-temperature users. The heat extracted from the glycol units and the low-temperature evaporators are used for space heating, through fan coils with intelligent energy recovery.

Example of winter operation with heating using fan coils and counter cooling by glycol water and Heosbox units.

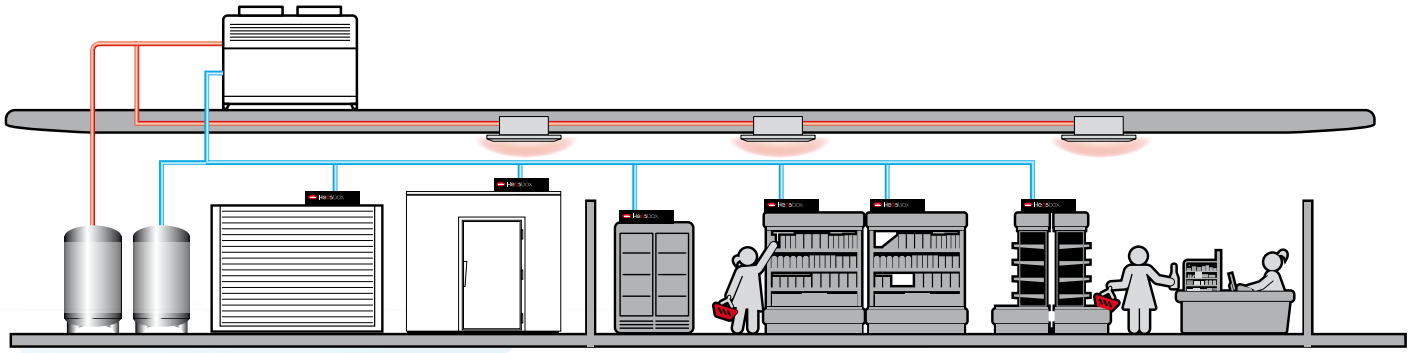


Fig. 1.a - Service station, Copenhagen (DK)

The store has a low-temperature unit and other medium-temperature units, with typical "convenience store" quantities and capacities, as shown in the table below:

	kW	Qty	User
MT	3	1	Closed cabinet
	8	1	Walk-in counter (12 doors)
	0.35	2	Small counters
LT	1.8	1	Freezer

Fig. 1.b - Convenience Store, Skutč, Chrudim (CZ)

The store area is 830 m² with 12 display counters, one MT cold room and two LT cold rooms, for a total of 22 kW, divided as shown in the table below:

	kW	Qty	User
MT	1.1	6	Meat and cheese
	0.73	2	Meat and cheese
	2.5	1	Cold room
LT	1.7	4	Upright freezer
	2.7	1	Cold room
	2	1	Cold room

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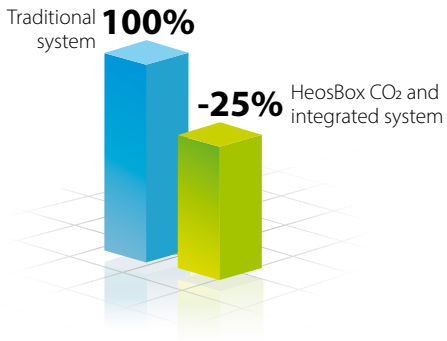
Conclusions

Easy integration, easy saving!



Integrated design in combination with Heosbox technology can provide important benefits to the end user:

- **maximum system efficiency** resulting from the seamless integration of air conditioning and refrigeration systems using the continuous modulation of Heosbox CO_2 in the low-temperature units;
- a **completely green system** using natural refrigerants;
- **lower installation costs** using semi-plug-in units with advanced connectivity and ease of use;
- **lower maintenance costs** using tested units pre-configured at the factory to minimise the possibility of start-up problems;
- **high flexibility** for changing the supermarket layout by adopting a decentralised approach;
- outstanding **temperature control** through continuous performance modulation.

The integrated design with Heosbox achieves energy consumption savings of up to 20% compared to systems without air conditioning system integration (according to system specifications and climate zone).

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