

Success Story



where

- Hypermarket situated in Guangzhou, Dongling Square, southern China

what

- Field testing of the solution and evaluation of benefits
- Comparative analysis between Heos sistema and a traditional ON-OFF system (TXV)

why

- Energy saving
- Analysis of Pay Back Period (PBP)
- Reduced refrigerant charge
- High quality food preservation
- Less space occupied by the refrigeration system
- Noise reduction

when

- November 2015

who

- Cabinet OEM: General Fushi

GENERALFUSHI
通用富士

Heos sistema

Real comparison against traditional technology

Partners Carel and General Fushi Refrigeration, a multinational dealing with the production, sale and installation of refrigeration units, have developed the first Heos system on the Chinese market.

Founded in 1997, General Fushi manufactures more than 12,000 units annually, including cabinets, compressor racks and heat exchangers, covering all applications from super/hypermarkets to convenience stores and cold rooms.

The store - belonging to one of China's leading retailers, with over 60 stores - has been designed to fully exploit the benefits offered by the Heos solution.

In particular, the Heos controller can manage all the functions of the standalone refrigeration units:

- cabinet temperature control;
- compressor management (envelope, COP calculation, oil recovery);
- superheat control with electronic expansion valve;
- condenser control;
- lights, defrosts, fans and alarms.

The information that is thus made available allows advanced system diagnostics: predictive leak analysis, compressor safety and smart defrost. By fitting the system with mains analysers - based on Carel's experience - and the PlantVisorPRO supervisor, hypermarket operation can be monitored in detail.

Below are the results of comparative analysis against traditional technology:

- 16% energy saving;
- 75% reduction in refrigerant charge;
- Higher quality food temperature control;
- 45% less space occupied by the refrigeration system;
- 30% noise reduction.

Based on the energy savings achieved and a cost estimate provided by the partner in the project, a Payback Period (PBP) of 18 months has been calculated.

Description of the store

The hypermarket is situated near Guangzhou, in southern China. The local climate profile sees average temperatures of around 23°C, with peaks that may exceed 40°C in summer. The store covers a total surface area of 4500 m² and comprises 58 cabinets and 14 cold rooms, divided between low and medium temperature applications. There are a total of 72 self-contained Heos units, with a total cooling capacity of 126 kW, divided as shown in the table below.



Map of the store on PlantVisor PRO

Application	Cooling capacity	Quantity	Type
MT	70.18 kW	8	Cold room
		25	Cabinet
LT	56.08 kW	6	Cold room
		33	Cabinet



Positioning of Heos single evaporator units



MT cabinets



LT cabinets

1 Units assembled in the factory

- High production quality
- Less leaks
- Fast and flexible installation

2

2 Heos controller

- Real-time COP calculation
- Real defrost on demand
- Optimum temperature control
- Refrigerant leak control

3 Power+ inverter

- High efficiency
- Compressor envelope control
- Increased reliability

4 Variable speed DC compressor

- Very high efficiency
- Wide control range
- Minimum ON/OFF cycles

5 Electronic expansion valve

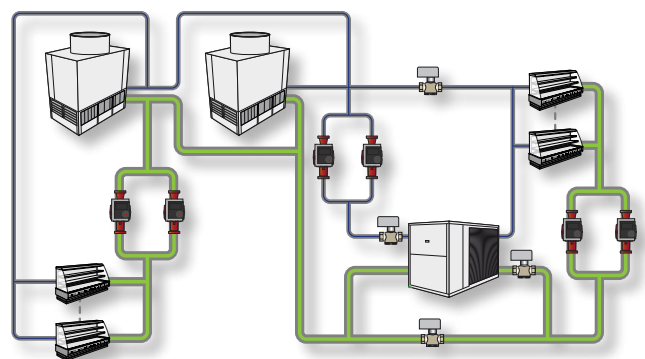
- Optimum superheat control
- Synergy with envelope control



3

Water loop

The circuit - the first designed using Heos technology for this manufacturer - was developed in collaboration with Carel. The water outlet temperature is kept between 20°C and 35°C, allowing the compressors on the units to operate with maximum efficiency.



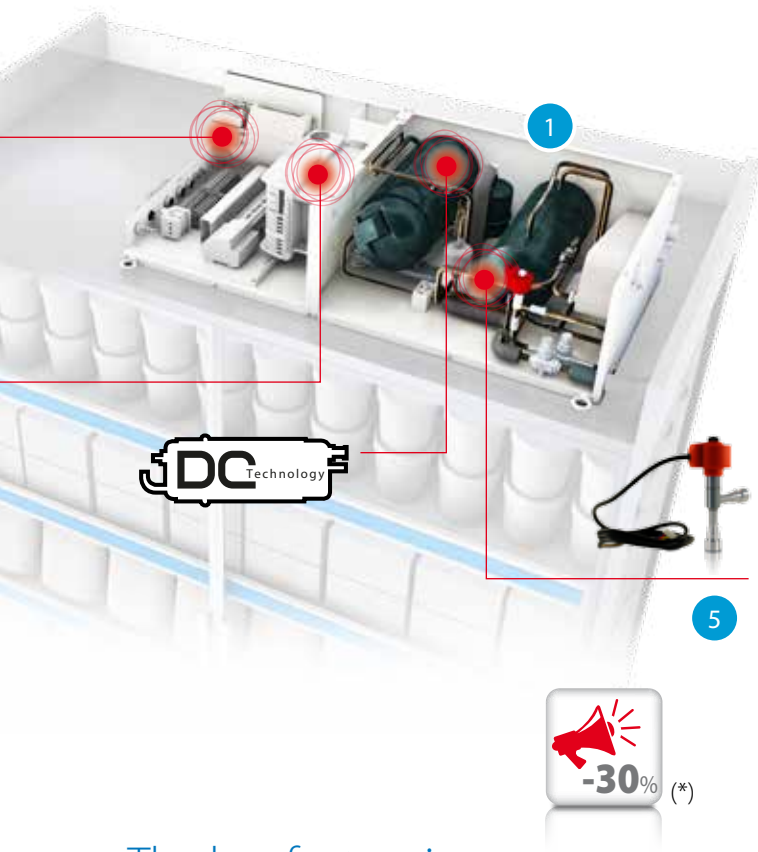
MT loop: free cooling

An evaporative tower takes away the heat generated by the MT units throughout the entire year.

LT loop: free cooling + chiller

An evaporative tower takes away the heat generated by the LT units. The chiller installed to handle summer conditions has proven redundant: it has been possible to operate in free cooling mode at all times.

Heos sistema



The key factors in Heos efficiency

Traditional system	Heos sistema
Low evaporation temperature, due to demand from the most critical cabinet	The evaporation temperature of each cabinet depends only on its own set point and load
Modulation only possible with ON-OFF duty cycles. When on, the compressor works at rated conditions	Speed modulation allows higher evaporation temperature, increasing efficiency at part loads
Pressure drop along the lines	Reduced pressure drop

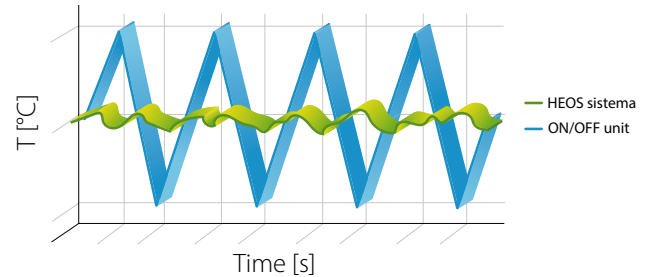
(*) -30% less noise than a plug-in cabinet with ON/OFF compressor.

Stable control

Temperature control on the refrigeration units is managed by an advanced algorithm that varies cooling capacity on a scale from 0-100%, based on the value and trend over time of the difference between control temperature and set point. Depending on the type of DC compressor installed, this value is then translated into a speed request, expressed in revs per second. An ON-OFF compressor on the other hand would only be able to modulate cooling capacity by varying the duty cycle, not being able to continuously adapt to variations in load. Synergy between DC compressor and electronic expansion valve allows stable temperature control, thus ensuring maximum quality of food preservation. An ON-OFF unit would not be able to keep a constant control temperature, rather this would fluctuate by several degrees.

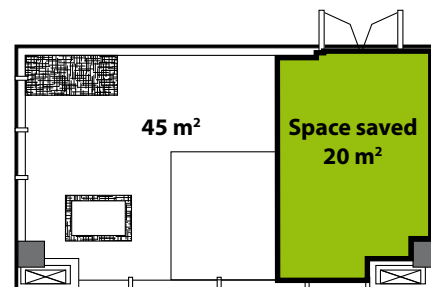


Fluctuation in food temperature around the average



Expansion of the selling area

The self-contained solution means no compressor racks are needed inside the store, thus freeing up the space occupied by these in a traditional system. Heos sistema therefore allowed the store's selling area to be increased by 45%.



Reduced refrigerant charge

The use of self-contained cabinets means no more long liquid pipelines, typical of centralised systems, thus drastically reducing refrigerant charge. In this store, the total quantity of refrigerant when commissioning the system was 75% lower. The use of cabinets that are fully assembled and tested in the factory significantly reduces leaks and related annual maintenance.

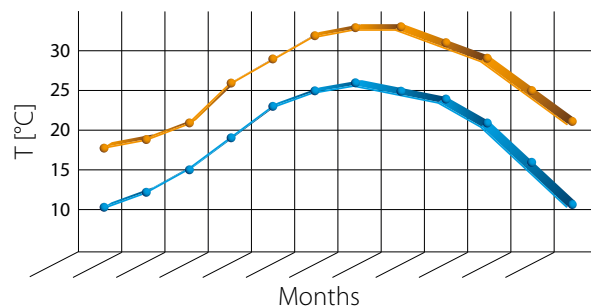
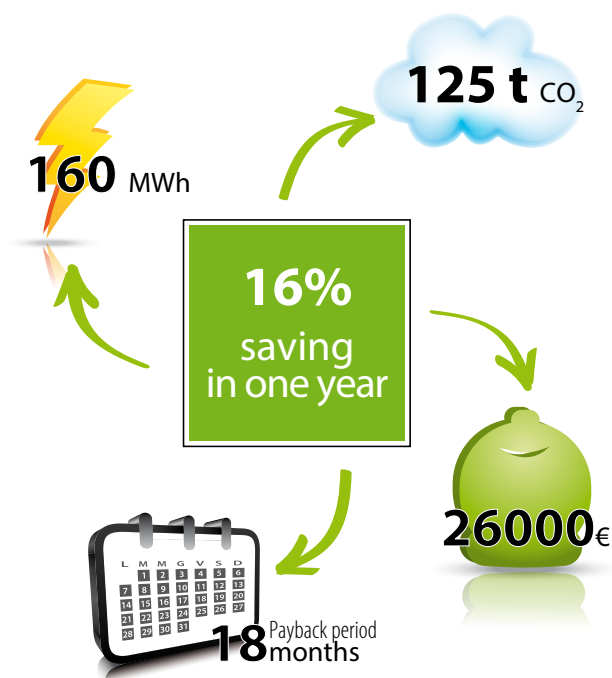
R410A charge reduction
-520 kg
-3.400€
recharge
-1.500€/year

Energy saving

The data acquisition process began in December 2015. The most significant temperatures on the refrigeration units and the water loop were measured.

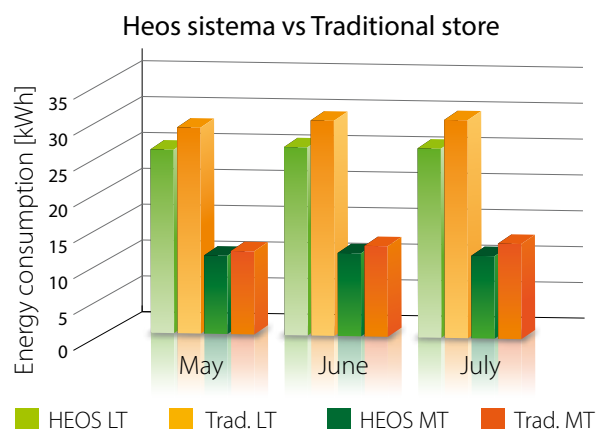
The mains analysers allowed power consumption to be divided between MT, LT and water loop. As less than a year has passed since the store opened, a mathematical model was created to estimate system power consumption as the outside temperature varies, then validating it using the nine months of data available.

As a result, annual supermarket energy consumption was extrapolated and compared against the data from a similar-sized traditional system supplied by the manufacturer. The energy savings were calculated to be 16%. It should be considered that the water loop design in the store – the first experience for this company – represented a compromise between maximum possible efficiency and conservative safety criteria. Further system optimisation will guarantee significant increases in energy savings.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
°C	18	19	21	26	29	32	33	33	31	29	25	21
	10	12	15	19	23	25	26	25	24	21	16	11

Guangzhou climate profile



The data measured over three months coincide with the estimated values for the entire year

Payback period - Guangzhou

	Heos vs Traditional
extra capital cost	+10%
energy saving	-16%
annual energy saving	160 MWh
Payback period	18 months

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