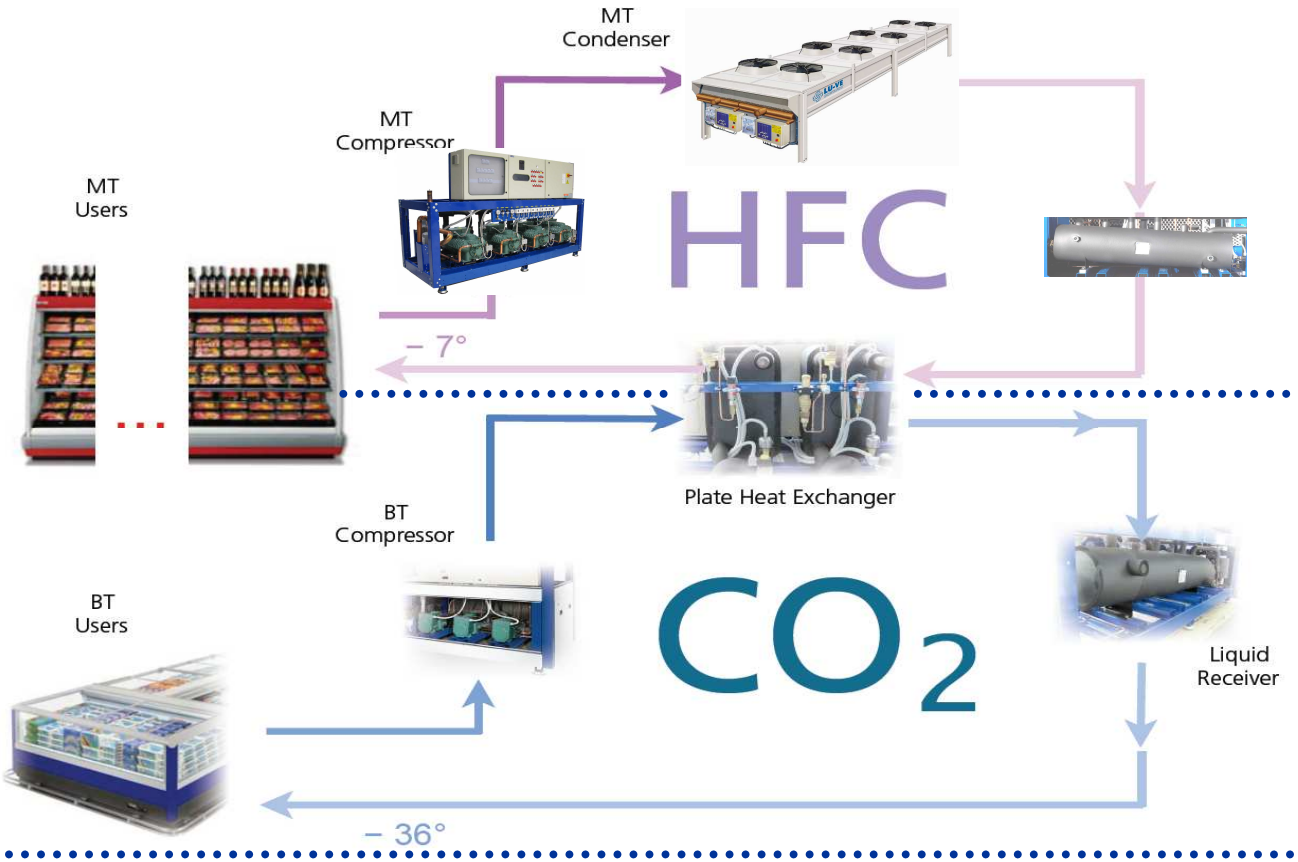
NATURAL REFRIGERANT cascade range

CO_2

EPTAGreen

LT: 8-84 kW

A Cascade System



The **primary circuit**

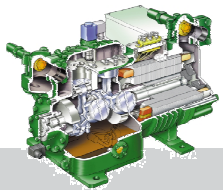
absorbs **all the** condensing heat of the LT pack and releases it in the atmosphere (bigger condenser)

The **secondary circuit**

operating with CO2, extract the heat from the LT cabinets and transfer it to the primary circuit

MT system can be **HFC** or **CO2** in **direct** or **pumped** system

PHE act as **condenser** for CO2 and as **evaporator** for the MT unit



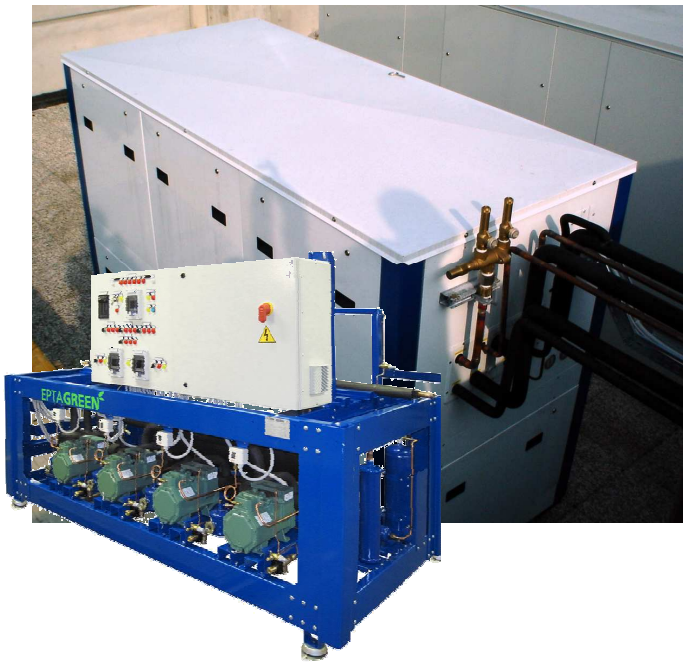
EptaGreen identity card

Store format:	supermarket – hypermarket
Cooling capacity:	**LT = 8 – 84 kW** (Te=-36°C ; Tc=-7°C)
Installation site:	technical room / outside
Frame L x W x H [mm] max:	riveted frame; 3.300 x 1.270 x 1.900
Soundproof housing:	optional for indoor or outdoor installation
Control panel:	optional / integrated top mounted
Controller Brand & type:	Danfoss
Liquid Receiver:	horizontal on board
Oil regulation system:	optional (3x) / complete AC&R (4x)
Compressor N°& Brand:	3-4, Bitzer
Refrigerant & Supply voltage:	R744; 400V/3ph/50Hz
Condenser:	on board, 2 or 4 plate heat exchangers
Evaporating fluid:	R404a, R407a, R407c, R134a

EPTAGreen /store format

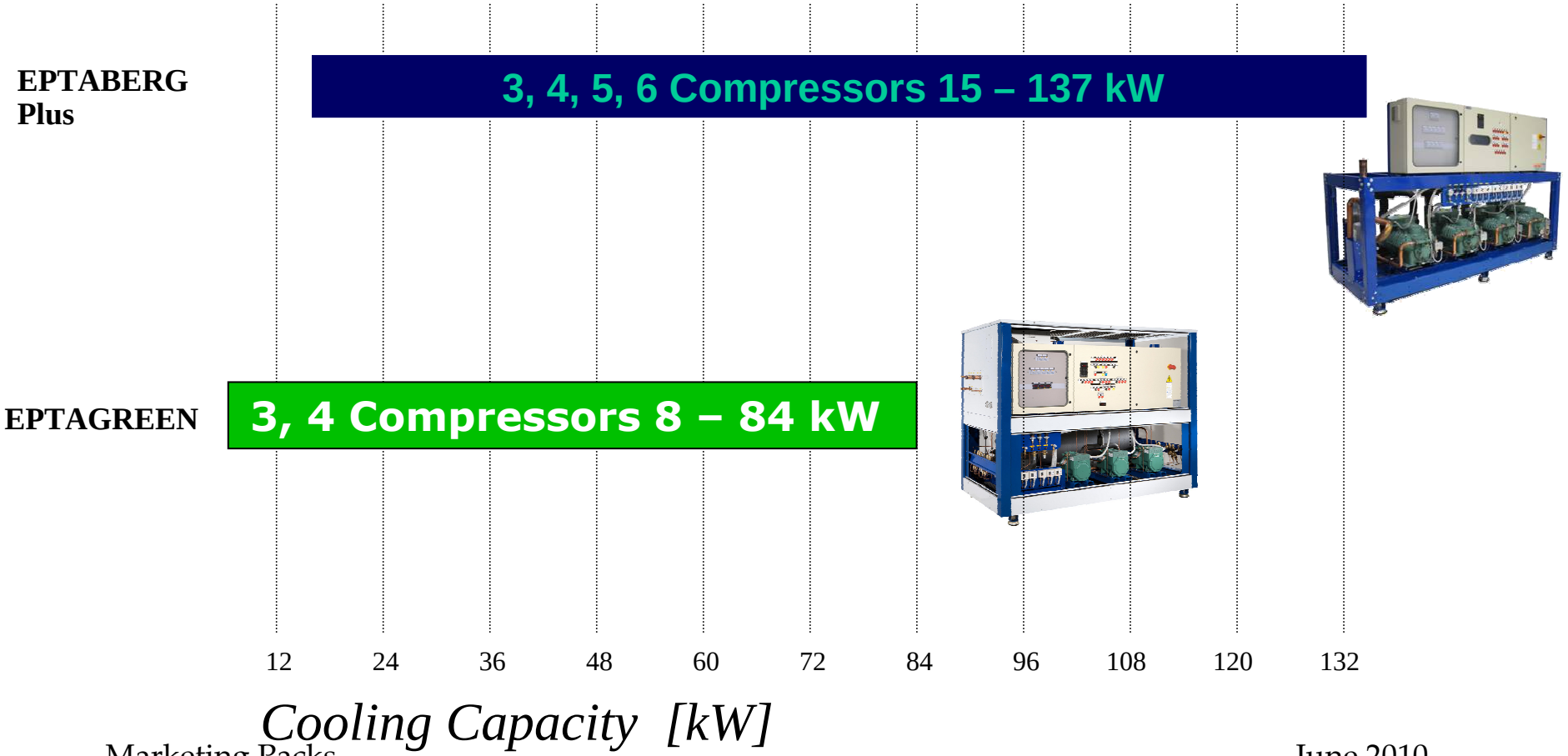
HIGH CAPACITY COMPRESSOR PACKS

- Designed to satisfy the **hypermarket** and **supermarket** needs



Comparison with EPTABERG

Cooling Capacity LT: Tev.=-35°C (EN 12.900)



EPTAGreen /main features

Compressor models & COOLING CAPACITY*

Low Temperature: **8 – 84** kW

BT -36°C/-7°C	Q [kW]	
Model/Comp.Number	3	4
2MHC-05K	8,04	
2KHC-05K	13,38	
2JHC-07K	17,22	
2HHC-2K	21,51	
2GHC-2K	25,05	
2FHC-3K	31,53	42,04
2EHC-3K	38,94	51,92
2DHC-3K		61,40
2CHC-4K		74,32
4FHC-5K		84,00

(*) According to EN12.900

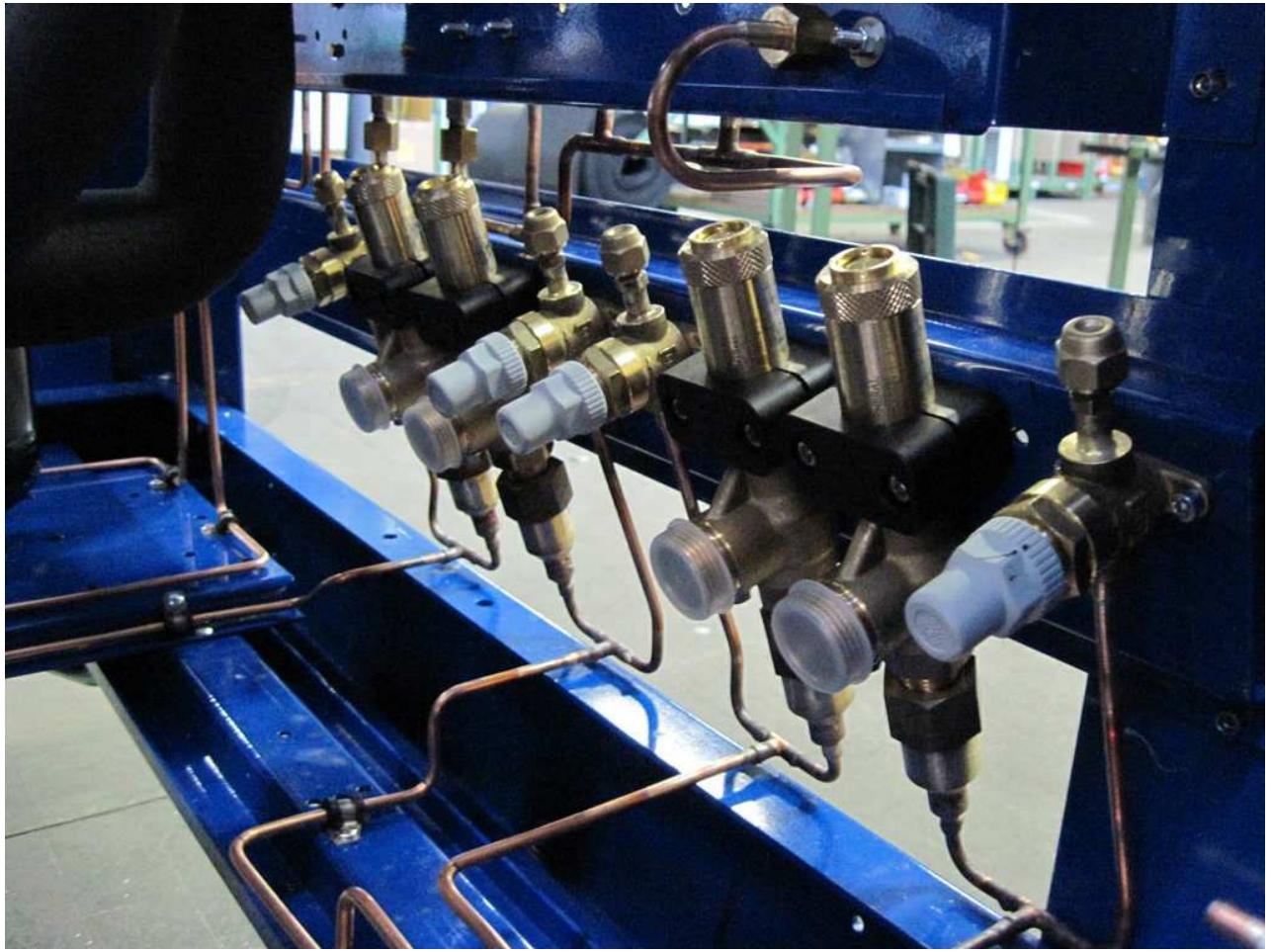
EPTAGreen /main features

19 mm thickness **complete insulation** of:

- Suction line: manifold, piping, filters and valves, vapour-liquid separator
- Liquid line: piping, filters, liquid receiver and valves

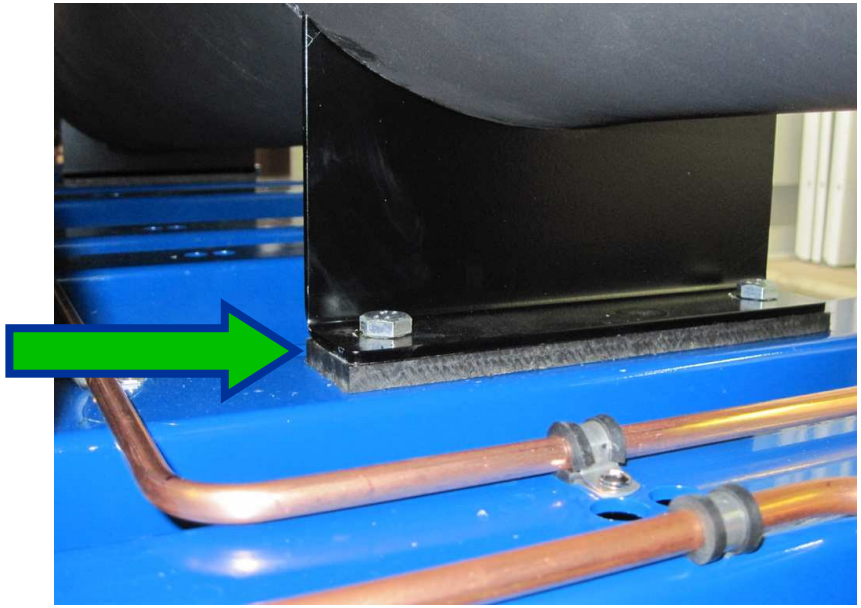
EPTAGreen /main features

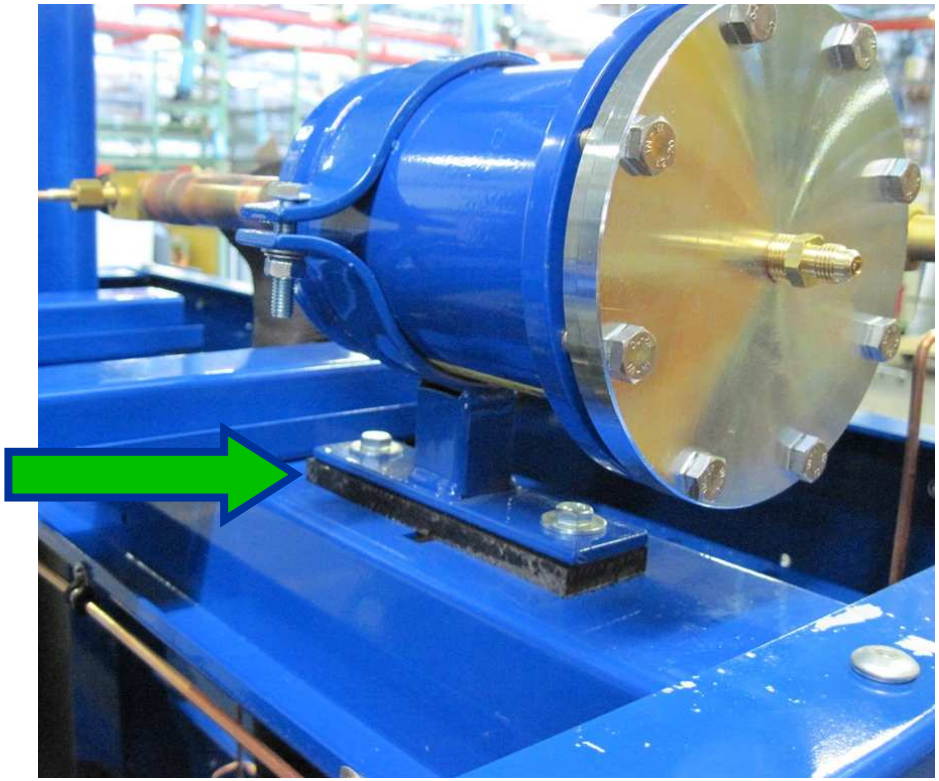
Safety valves



EPTAGreen /main features

Insulation of **cold parts** from the frame

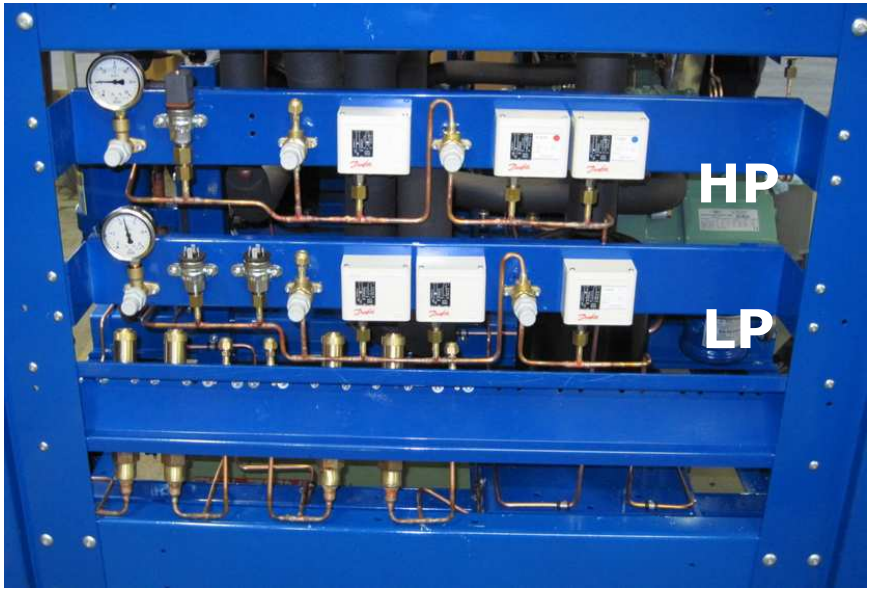




EPTAGreen /main features

Pressure switch panel

- HP and LP pressure gauges with 6 mm copper piping intake (no capillary-type)
- 1 HP and 1 LP switches for Back-up
- 1 HP switch for each compressor
- 2 common safety HP switches
- 1 LP safety pressure switch
- 1 HP ratiometric pressure probe
- 2 LP ratiometric pressure probes



▪ 1 Optional additional LP switch

For disconnecting all the loads

in case of system failure

EPTAGreen /main features

BACK-UP (controller failure)

- **Low pressure electronic back-up**: with EKC 331/T controller on all compressors.

The back-up LP switch, allow to by-pass the main controller AK-PC530 in case of failure

- **High pressure back-up**: HP safety pressure switch. When the intervention threshold is reached, all condensing valves are activated

EPTAGreen /main features

- On board **liquid-vapour** suction separator

EPTAGreen /main features

- horizontal **liquid receiver** on board with optoelectronic sensor for liquid level alarm
- 80 L (3 compr.) or 110 L (4 compr.)

MAIN ADVANTAGES

- **Environmental friendly** solution:
  1. Improved efficiency & carbon footprint reduction
  2. Vibration free thanks to the new frame technology
  3. Extremely low noise solution
- Maximum **flexibility & configurability**
  1. Mechanical and electrical configurability
  2. Installation inside or outside
  3. With or without electrical control panel
- Improved **maintenance and reliability**
  1. Easy access to all parts
  2. Design for reliability

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Environmental friendly

Greener image of the store thanks to:

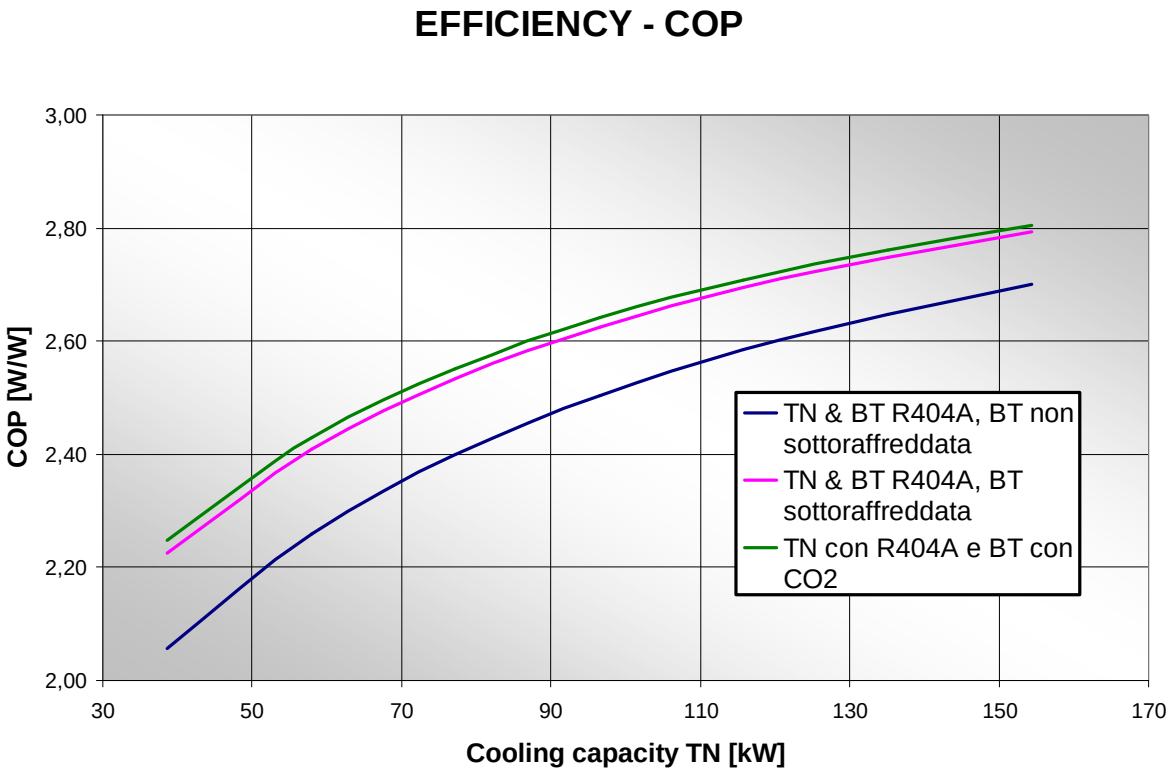
- **improved efficiency**, not influenced by the external temperature

-10%

The value of energy

Environmental friendly

- EXAMPLE OF REFRIGERATION SYSTEM LT 20KW
  - Results **indipendent from the external ambient temperature** and so from the area
  - CO2 LT system is **up to 10%** more efficient than standard solution R404A



Environmental friendly

and to an:

- **effective reduction** of the potential harmful emission of global warming gas

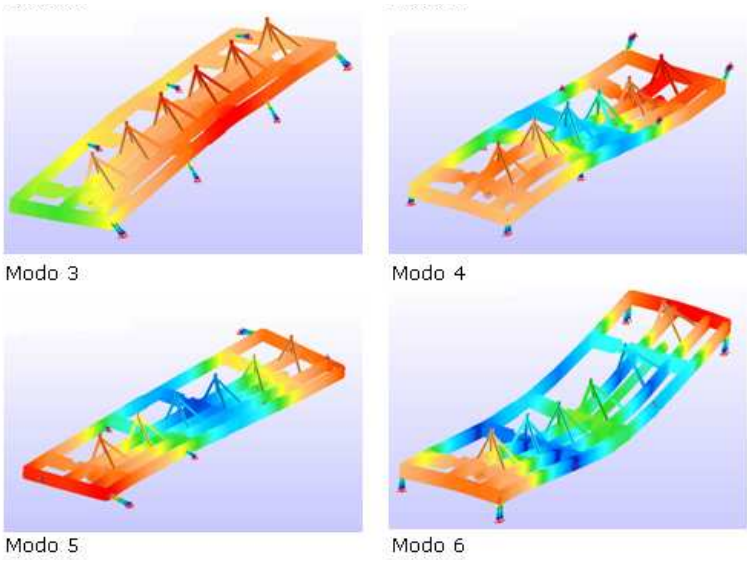
Carbon Footprint Reduction

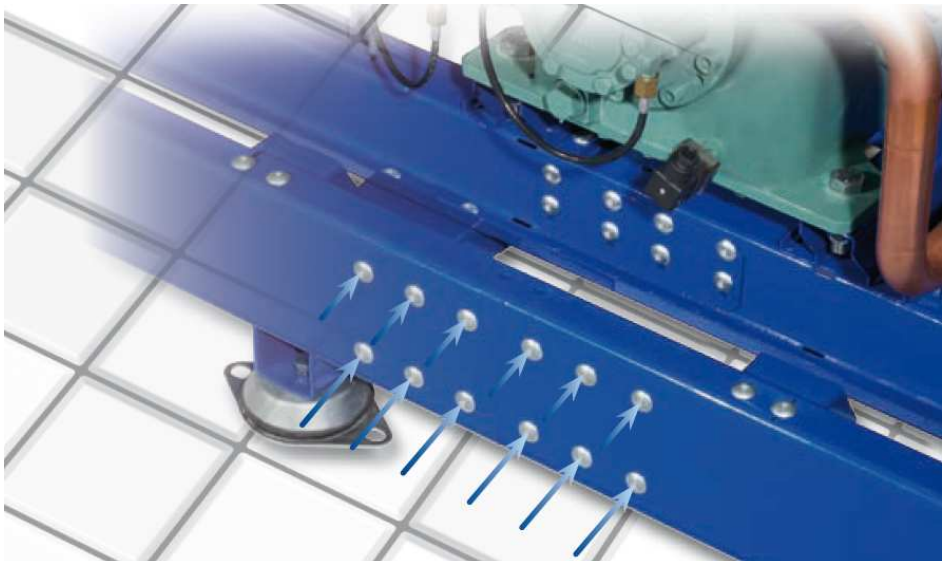
(*) against a conventional solution

Environmental friendly

Optimised frame

- Frame designed and minimize **the vibrations and eliminate the risk of leakages**

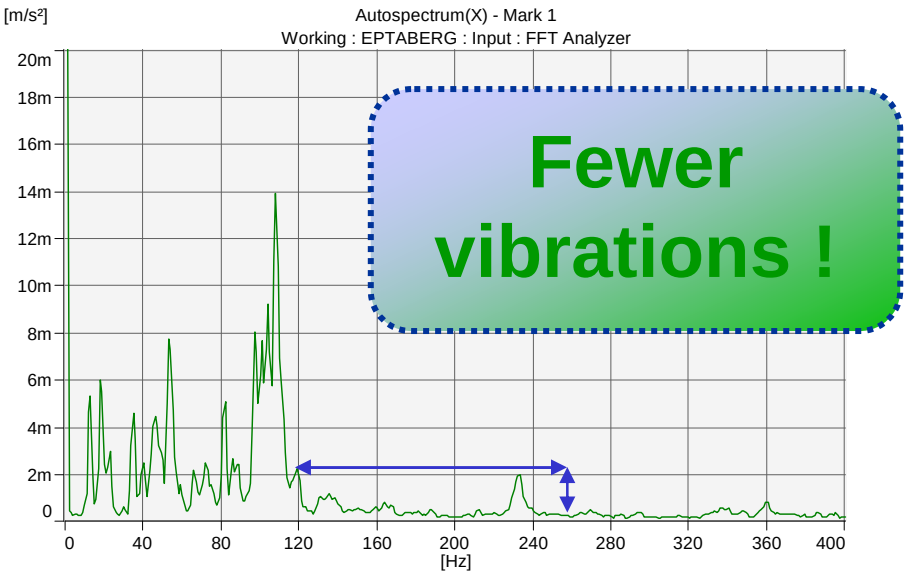




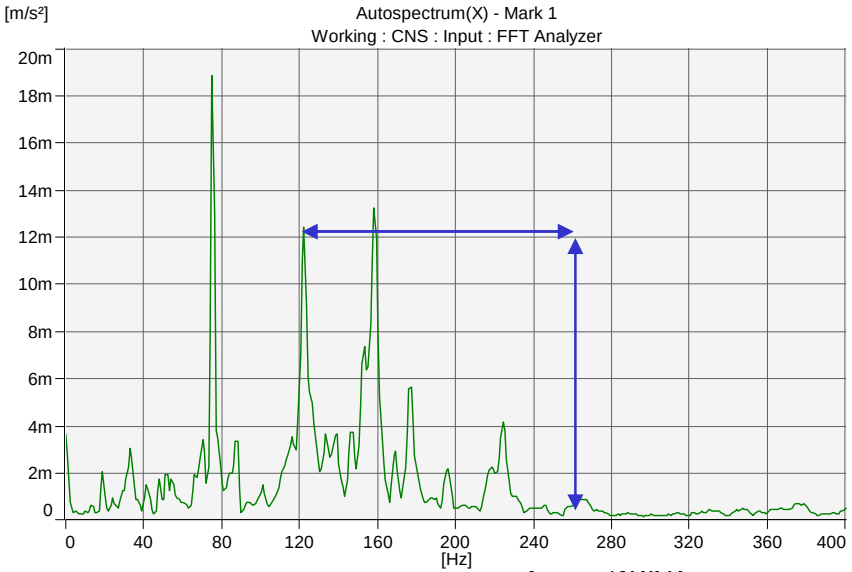
Environmental friendly

Optimised frame

- Analysis of a riveted frame compared to a welded frame in cooperation with 2 Italian Universities



WELDED FRAME



Environmental friendly

Low noise solution thanks to

- Soundproof housing for outdoor installation

Tev = -35 °C, Tcond = -10°C		w/o housing	with housing
N° Compr.	MODEL	Lp @ 10 m dB(A)	Lp @ 10 m dB(A)
3	3x 2MHC-05K	46	40
	3x 2KHC-07K	46	40
	3x 2JHC-07K	46	40
	3x 2HHC-2K	48	42
	3x 2GHC-2K	48	42
	3x 2FHC-3K	49	43
	3x 2EHC-3K	53	47
4	4x 2FHC-3K	50	44
	4x 2EHC-3K	54	48
	4x 2DHC-3K	56	50
	4x 2CHC-4K	57	51
	4x 4FHC-5K	58	52

MAIN ADVANTAGES

- **Environmental friendly** solution:
  1. Improved efficiency & carbon footprint reduction
  2. Vibration free thanks to the new frame technology
  3. Extremely low noise solution
- Maximum **flexibility & configurability**
  1. Mechanical and electrical configurability
  2. Installation inside or outside
  3. With or without electrical control panel
- Improved **maintenance and reliability**
  1. Easy access to all parts
  2. Design for reliability

Flexibility and configurability

Plate heat exchangers – primary fluid

- refrigerants that can be used on the primary circuit (MT pack):
  - **R134a**
  - **R404a**
  - **R407a**
  - **R407c**

Flexibility and configurability

Plate heat exchangers – control valves

- Valves to control the primary refrigerant flow:
  - **T**hermostatic **E**xpansion **V**alves
  - **E**lectronic **E**xpansion **V**alves [Independent step motor electronic expansion valve for each condenser]

Flexibility and configurability

- Installation **inside** a machinery room or **outside**

Flexibility and configurability

With or without electrical control panel

MAIN ADVANTAGES

- **Environmental friendly** solution:
  1. Improved efficiency & carbon footprint reduction
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- Improved **maintenance and reliability**
  1. Easy access to all parts
  2. Design for reliability

Improved maintenance and reliability

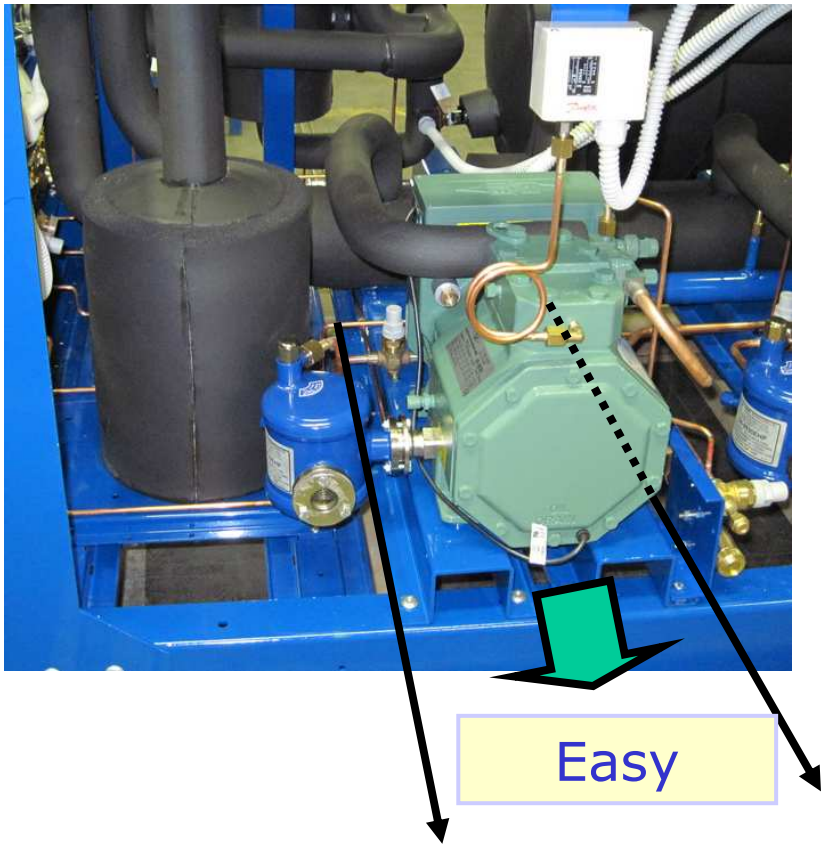
- All main components position assure an easy access

Improved maintenance and reliability

- At least two plate heat exchangers, sized to allow constant working even during repairs, maintenance or breakdown

Improved maintenance and reliability

- Suction and discharge headers and oil piping placed on the same side in order to facilitate the compressor maintenance operations

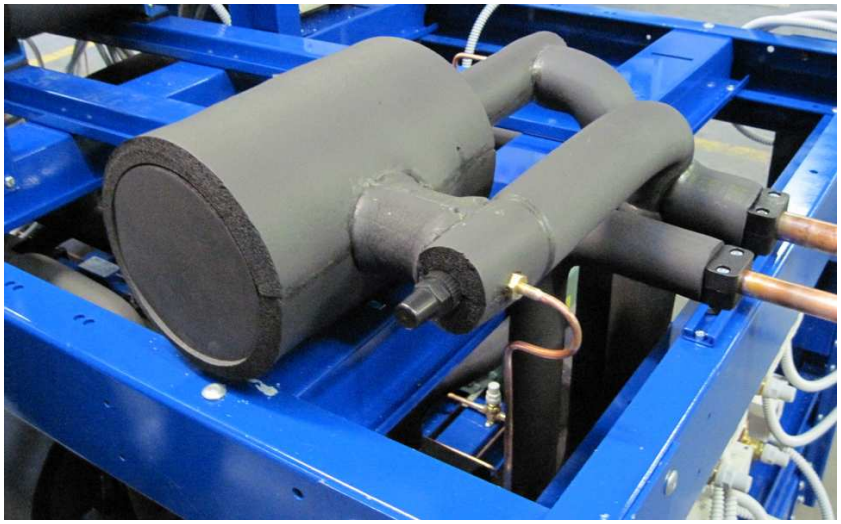


Improved maintenance and reliability

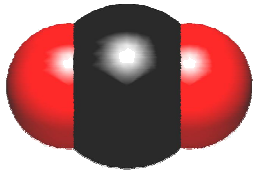
- **Angle valves** allow improved safety during maintenance operations

Improved maintenance and reliability

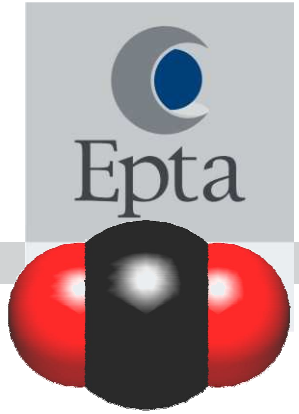
- Easy inspection of the suction and liquid line filters with a **by-pass for maintenance**



Why CO_2 ?

- CO_2 
- **OZONE DEPLETION POTENTIAL** ODP
- **GLOBAL WARMING POTENTIAL** GWP
- **TOTAL EQUIVALENT WARMING IMPACT** TEWI

Why CO_2 ?



Among the natural fluids **CO_2 (R744)** is,

- **not flammable**, **not toxic**, **chemically inactive** and **not explosive**
- has an **ODP = 0**
- has a **GWP*** = direct effect of global warming, **equal to 1**
- is not included in the fluids of the **European Directive for HFC** (EC 842/2006); no inspections every 3 months to verify there are no leakages in the pipings
- a better efficiency of the system reduce the CO2 emissions due to the **indirect effect**

* R404a GWP is equal to 3.260, which means that 1 kilogram leakage is equal to releasing 3.260 kilograms of CO_2

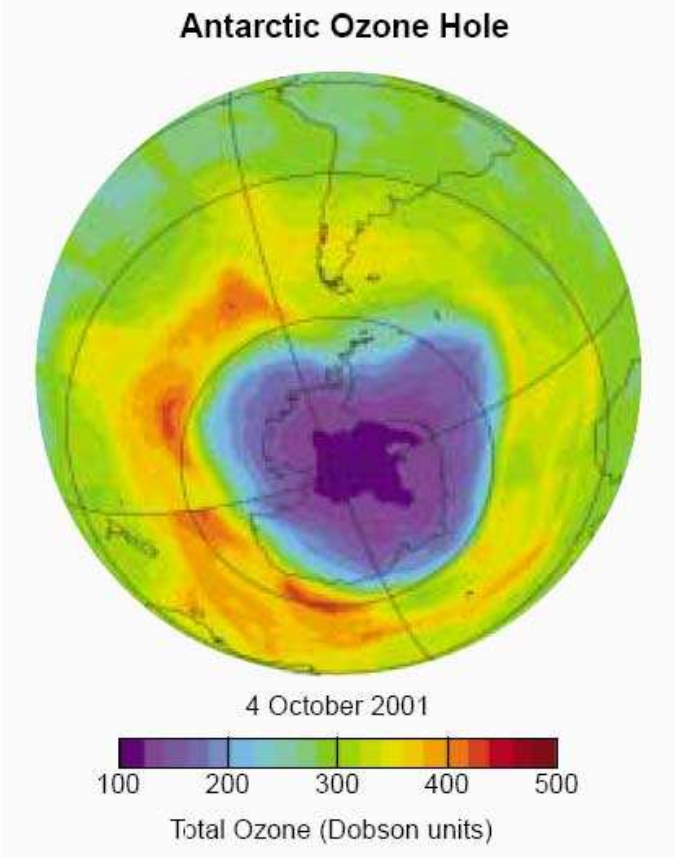
Refrigerant	GWP
R744 (CO_2)	1
R134a	1.300
R404A	3.260

What is **Ozone Depletion Potential**

ODP

ODP - **O**zone **D**epletion **P**otential

as means of quantifying the disruptive effects of a a chemical substance on the ozone barrier in the stratosphere



What is **Global Warming Potential**

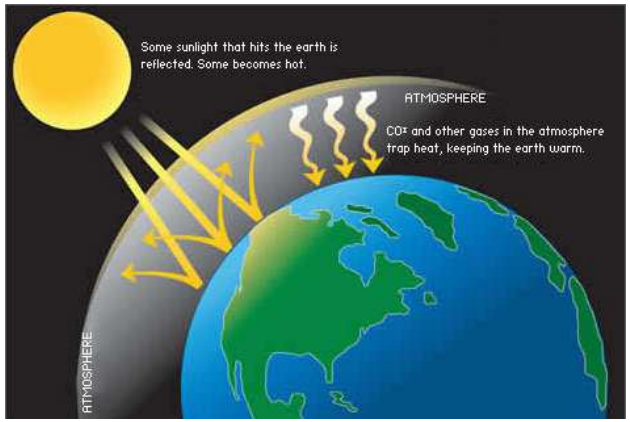
Epta

GWP

GWP - **G**lobal **W**arming **P**otential

measures **how DANGEROUS** is a a refrigerant for the environment

The GLOBAL WARMING effects is the earth temperature increase due to human activity.



By burning COAL, NATURAL GAS and OIL, using fuels in vehicles and factories, we produce **GREENHOUSE GASES** in excessive amounts. These emissions rise into the atmosphere and trap the sun's energy, keeping heat from escaping and causing **CLIMATE CHANGES**.

The **impact of HFCs** in the athmosphere

- 1 kg R404A in the athmosphere equals 3260 kg of CO_2
- In 2009, just for new installations by Costan in Italy, 60 tons of R404A were used
- With the best of our efforts to leakage reductions and controls requested by EU, the greenhouse effects is that of **1800 cars driving 20000 km/year each**
- R404A lays in the atmosphere 13 years because, unlike CO_2, it is not absorbed by plants, and every year we live with its venomous effects

For this reason **UE issued 842/2006** (**F-gas**) regulation that fixes the maximum yearly leakage potential for R404A for systems using more than 300kg of HFCs

The greenhouse effect

1. **CO_2 emissions of the plants for the production of electricity**
2. **Refrigerant lost in the atmosphere and rejected at the end of the installation life cicle**

The greenhouse effect from refrigerant leakages and losses is measured in CO2 equivalent kgs

- GWP CO_2 = 1
- GWP R134a = 1300 kg CO_2
- GWP R404A = 3260 kg CO_2

- The total overall effect is measured by the *Total Equivalent Warming Impact* (TEWI)

What is **Total Equivalent Warming Impact**

TEWI

TEWI - **T**otal **E**quivalent **W**arming **I**mpact

As a measure of the environmental impact of a refrigeration plant is given by the sum of:

- the ***direct contribution*** of greenhouse gases used to make or operate the systems (leakages), also assumed to be released at the end of the service life

- and the ***indirect contribution*** of the carbon dioxide emissions resulting from the energy required to run the systems over their normal live

The TEWI

$$TEWI = \underbrace{[GWP \times L \times n]}_{\text{Direct leakages}} + \underbrace{[GWP \times m(1 - \alpha_{recovery})]}_{\text{End of running life waste}} + \underbrace{[n \times E_{annual} \times \beta]}_{\text{Indirect effect}}$$

L: yearly leakage rate

n: number of years

m: refrigerant quantity in the system

$\alpha_{recovery}$: end-of-running life refrigerant recovery percent

E_{annual}: yearly energy consumption

B: CO_2 emission per kWh

- References:
  - EN 378-1:2006 (E), Appendice B
  - Guideline Methods of Calculating TEWI, Issue 2 (2006), British Refrigeration Association

The **TEWI for the LT part**

Refrigerante	404A	R
Carica d'impianto	110	kg
Consumo energetico annuale (compressori)	125236	kW.hr
Consumo energetico annuale (accessori)	11271	kW.hr
Ciclo di vita dell'impianto	10	anni
GWP del refrigerante	3260	kgs CO2
L1 = Perdite annuali	5	%
L2 = Scarichi automatici	0	%
S1 = Eventi occasionali	0	%
S2 = Interventi meccanici o eventi catastrofici	0	%
Effcienza di recupero a fine vita	95	%
Fattore di produzione di CO2 in generazione	0,47	kg CO2 per kW.hr
Perdite di refrigerante in condizioni operative	55	kg
Perdite di refrigerante a fine vita	5,5	kg
Perdite sull'intero ciclo di vita	60,5	kg
CO2 equivalente diretto	197230	kg CO2
Effetto indiretto	64158	kg CO2
TEWI	261388	kg CO2
TEWI	**261**	**t CO2**
Costo per kW.hr	0,12	
Costo nel ciclo di vita	**€ 163.808,11**	
Capacita' del sistema	19,3	kW
COP medio	1,35	W/W

Refrigerante	744	404A	R
Carica d'impianto	70	30	kg
Consumo energetico annuale (compressori)	44492	75080	kW.hr
Consumo energetico annuale (accessori)	890	6006	kW.hr
Ciclo di vita dell'impianto	10	10	anni
GWP del refrigerante	1	3260	kgs CO2
L1 = Perdite annuali	5	5	%
L2 = Scarichi automatici	0	0	%
S1 = Eventi occasionali	0	0	%
S2 = Interventi meccanici o eventi catastrofici	0	0	%
Effcienza di recupero a fine vita	95	95	%
Fattore di produzione di CO2 in generazione	0,47	0,47	kg CO2 per kW.hr
Perdite di refrigerante in condizioni operative	35	15	kg
Perdite di refrigerante a fine vita	3,5	1,5	kg
Perdite sull'intero ciclo di vita	38,5	16,5	kg
CO2 equivalente diretto	38,5	53790	kg CO2
Effetto indiretto	21329	38110	kg CO2
TEWI	21368	91900	kg CO2
TEWI	**21**	**92**	**t CO2**
Costo per kW.hr	0,12	0,12	
Costo nel ciclo di vita	**€ 54.458**	**€ 97.303**	
Capacita' del sistema	19,3	27,4	kW
COP medio	3,80	3,2	W/W

LT 19,3kW, CO2 cascade cooled by R404A MT unit

TEWI RESULTS

- +7% efficiency CO_2 in LT - energy saving 1200€/year
- –57% greenhouse effect of CO_2 in LT – equals to 5 less cars driving 20000 km/year
- - 400kg CO_2 released by the electricity power plants = 2 more ectars of forests

Installation cost comparison R404A Vs CO_2

	Remarks	CO_2
Power Pack	More expensive but it includes the condenser (plate heat exchangers) and the liquid receiver	
Condenser	An aluminium fins and copper tubes is not necessary, the MT condenser just needs to be a bit bigger	
Tubes and connections	Diameters are smaller (20-35 mm gas + 15-22 mm liquid) and no connection from LT to external condenser	
Refrigerated shelves/cases	Electronic expansion valve and special evaporators on cases are required	
Refrigerant	R744 is 3 times chaper than R404A	
Overall result	Cost is similar, except for electronic expansion valves	

EPTA **GREEN SOLUTION** TREND

- MT R134A
- LT R744 (CO_2) CASCADE

EPTA **GREEN SOLUTION** TREND

R134a

Output Evaporating SST: Condensing SDT:	Operating point A -11.0°C 45.0°C				Operating point B -11.0°C 30.0°C			
Compressor	Qo kW	Pe kW	COP	Ratio %	Qo kW	Pe kW	COP	Ratio %
Total	**86.4**	**39.2**	**2.20**	**57.6**	**108.2**	**35.9**	**3.01**	**72.1**
1 4G-30.2Y-40P	21.6	9.80	2.20	25.0	27.1	8.98	3.01	25.0
2 4G-30.2Y-40P	21.6	9.80	2.20	25.0	27.1	8.98	3.01	25.0
3 4G-30.2Y-40P	21.6	9.80	2.20	25.0	27.1	8.98	3.01	25.0
4 4G-30.2Y-40P	21.6	9.80	2.20	25.0	27.1	8.98	3.01	25.0

Eff.: +18%

R404A

Output Evaporating SST: Condensing SDT:	Operating point A -11.0°C 45.0°C				Operating point B -11.0°C 30.0°C			
Compressor	Qo kW	Pe kW	COP	Ratio %	Qo kW	Pe kW	COP	Ratio %
Total	**144.3**	**77.7**	**1.86**	**96.2**	**190.8**	**66.5**	**2.87**	**127.2**
1 4G-30.2Y-40P	36.1	19.41	1.86	25.0	47.7	16.63	2.87	25.0
2 4G-30.2Y-40P	36.1	19.41	1.86	25.0	47.7	16.63	2.87	25.0
3 4G-30.2Y-40P	36.1	19.41	1.86	25.0	47.7	16.63	2.87	25.0
4 4G-30.2Y-40P	36.1	19.41	1.86	25.0	47.7	16.63	2.87	25.0

Combined **R134a MT / R744 LT**

The winning experience with

Delhaize Greece

Edeka Germany

IGA Australia