



Commercial refrigeration revolution

Energy efficiency – Natural refrigerants – Safety and digitalization

HP_sim&app23 – Carnot User Meeting 2023

June 22 -23, 2023, Bologna, Italy



- **Introduction**
- **CO₂ solution**
- **R290 solution**
- **Digitalization**
- **Laboratory**

1.

Introduction

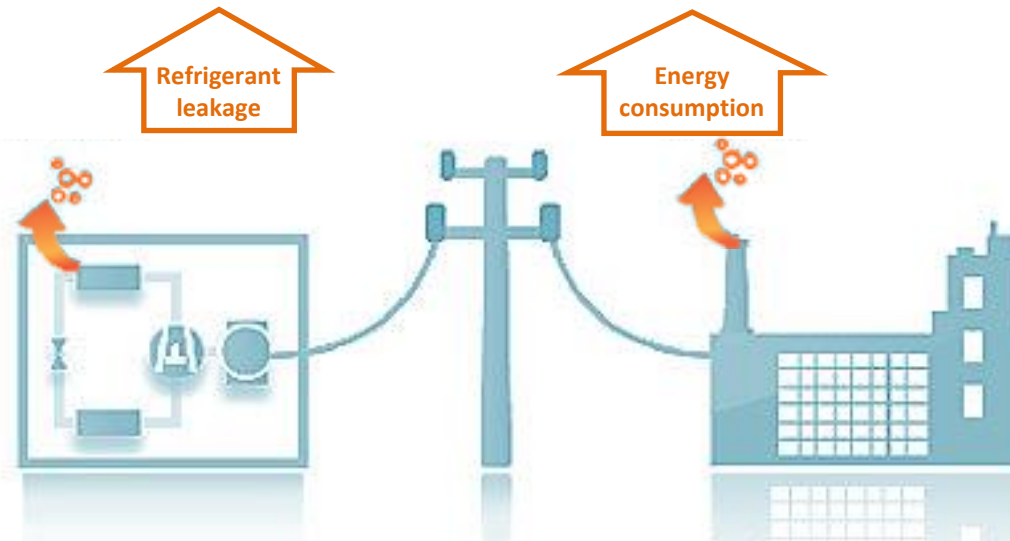
RESPECT OF THE ENVIRONMENT

TEWI = Total Equivalent Warming Impact

TEWI is the most important indicator to reduce emissions

It's expressed in CO₂ equivalent tons (ton_{CO₂eq})

TEWI = Direct Emissions + Indirect Emissions

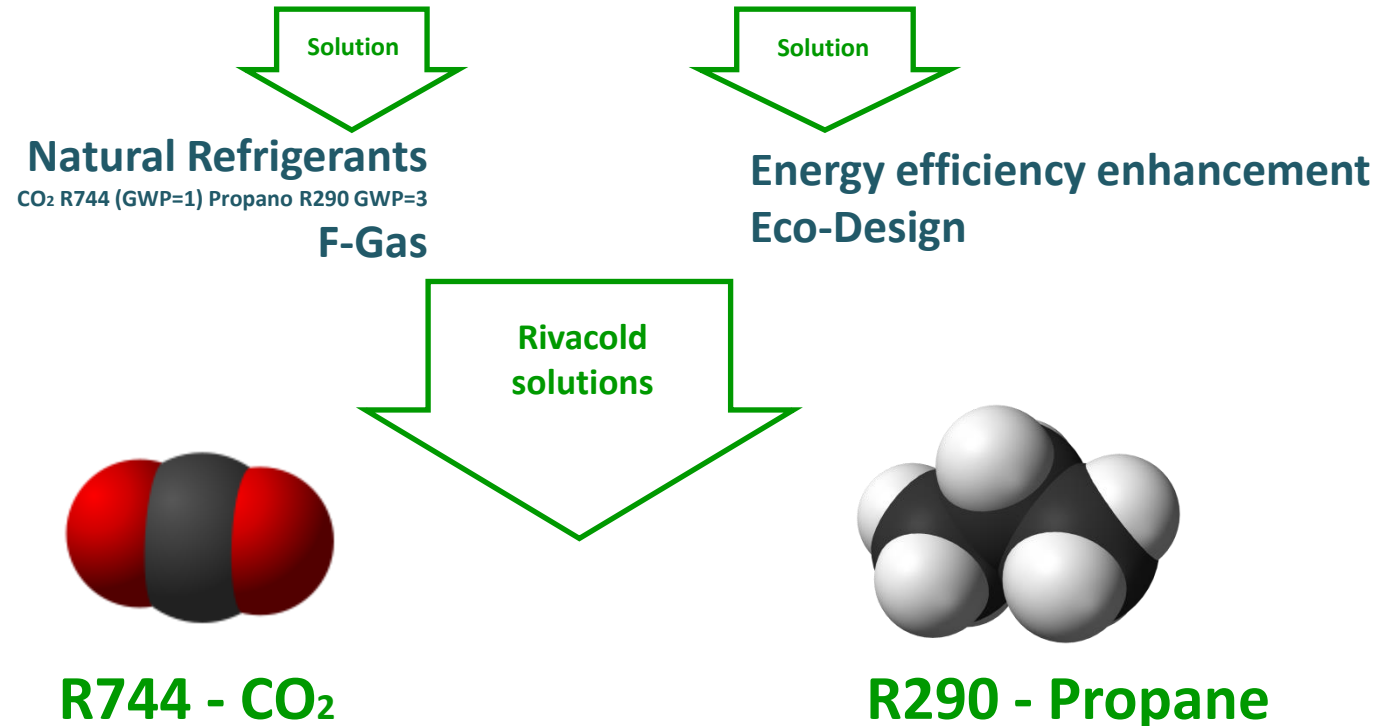




RESPECT OF THE ENVIRONMENT

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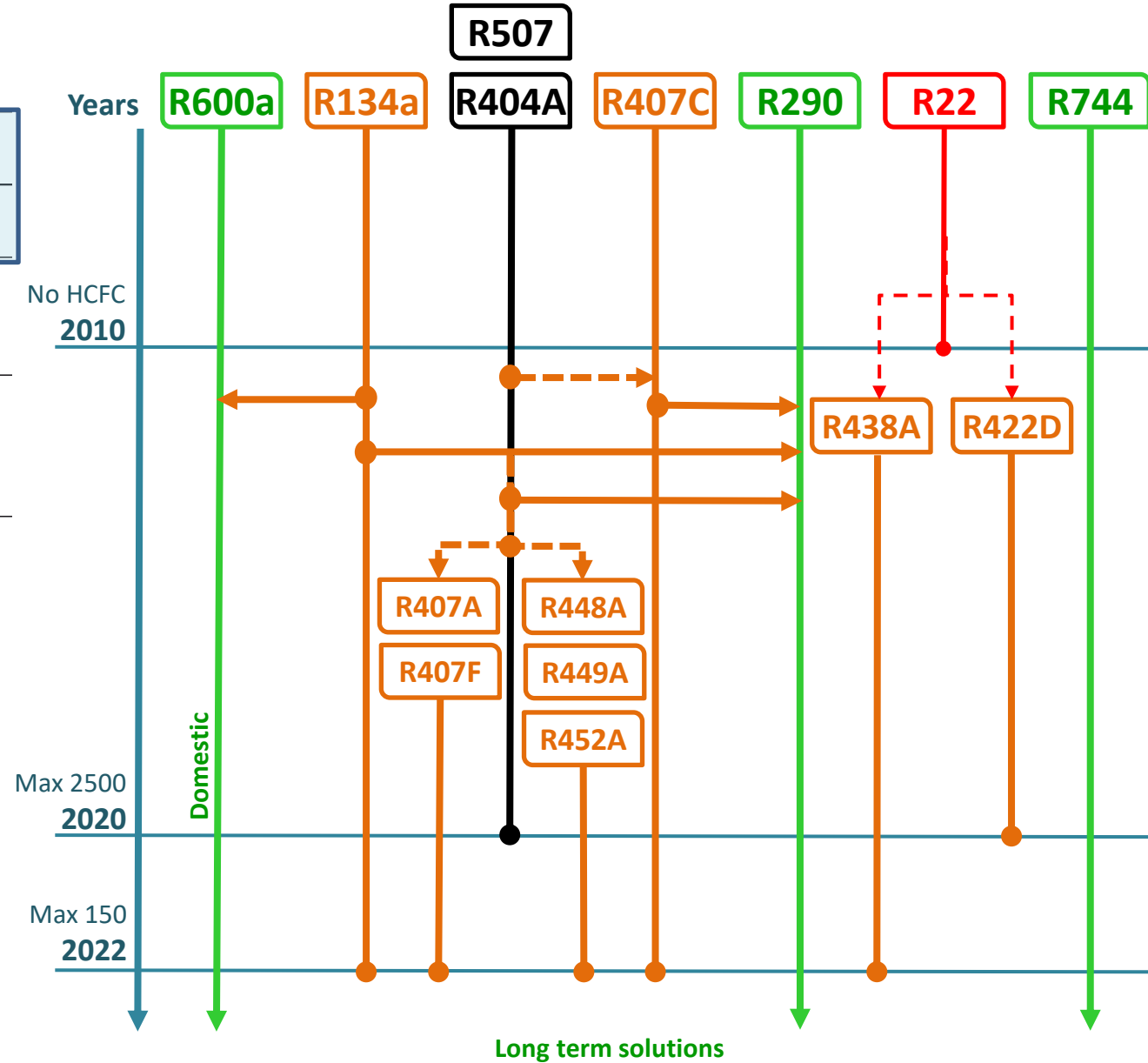
TEWI = Direct Emissions + Indirect Emissions



F-GAS REGULATION (EU) No 517/2014

ho.re.ca

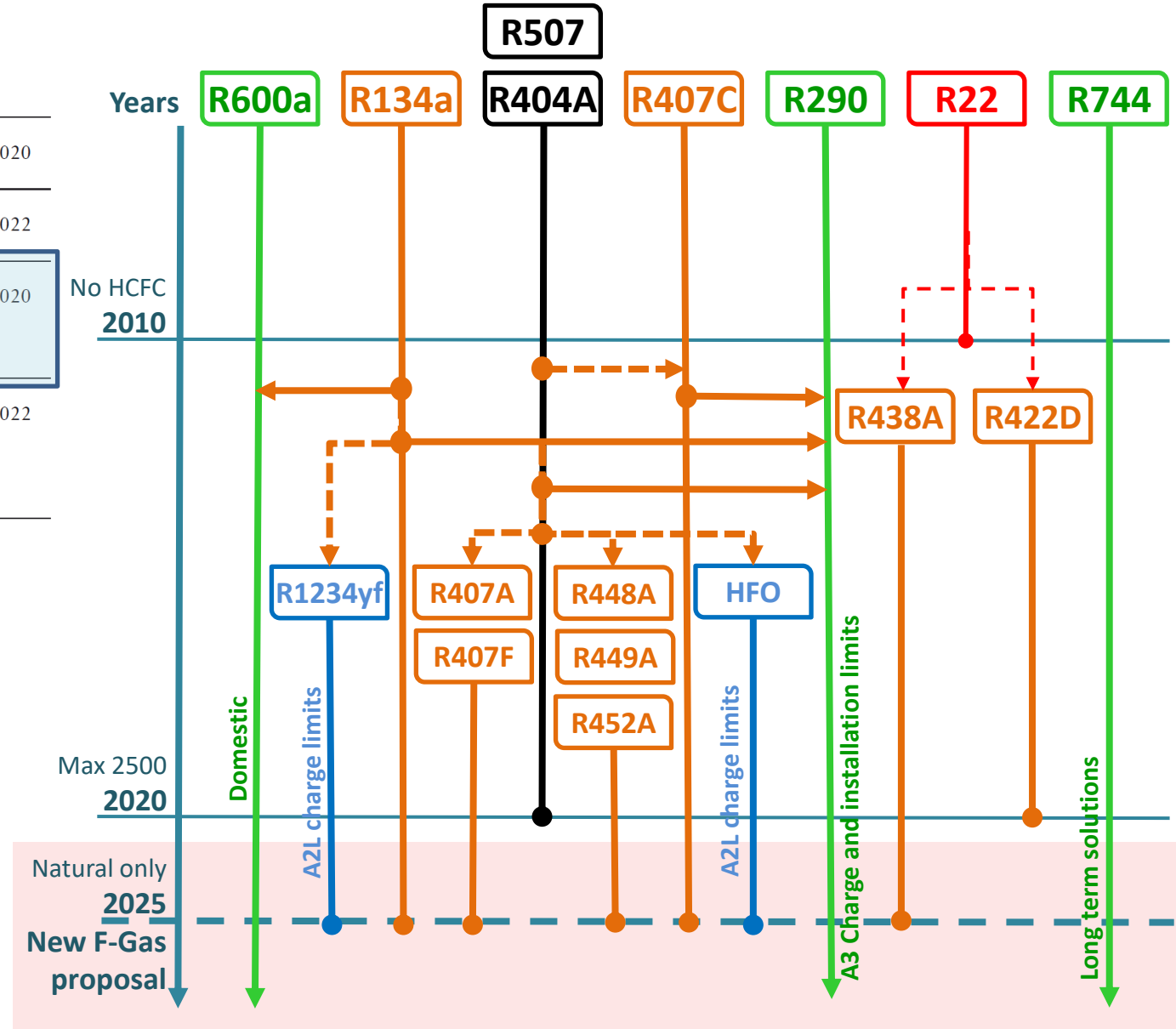
11. Refrigerators and freezers for commercial use (hermetically sealed equipment)	that contain HFCs with GWP of 2 500 or more	1 January 2020
	that contain HFCs with GWP of 150 or more	1 January 2022
12. Stationary refrigeration equipment, that contains, or whose functioning relies upon, HFCs with GWP of 2 500 or more except equipment intended for application designed to cool products to temperatures below - 50 °C		1 January 2020
13. Multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW or more that contain, or whose functioning relies upon, fluorinated greenhouse gases with GWP of 150 or more, except in the primary refrigerant circuit of cascade systems where fluorinated greenhouse gases with a GWP of less than 1 500 may be used		1 January 2022



F-GAS REGULATION (EU) No 517/2014

Stationary refrigeration

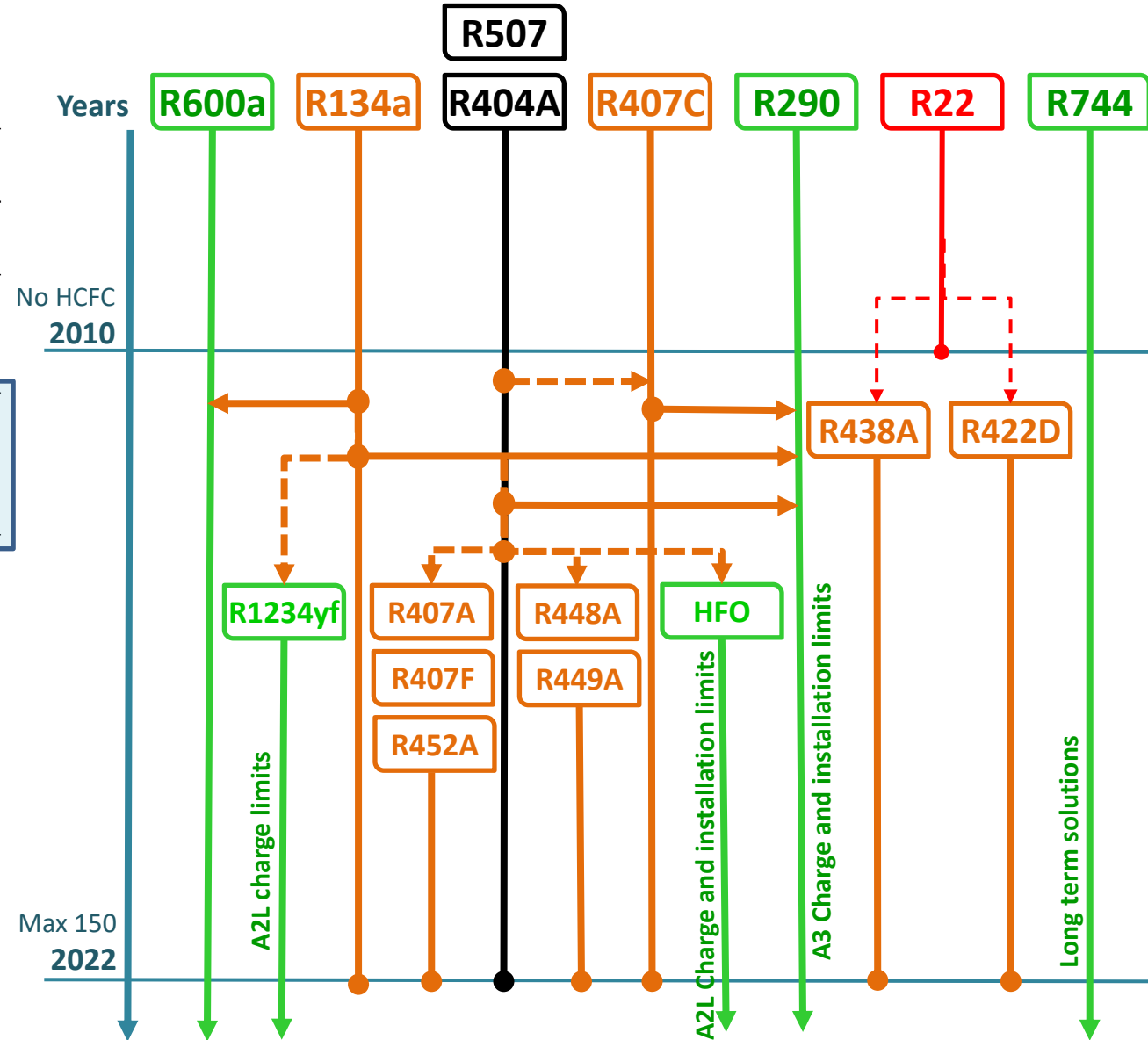
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F-GAS REGULATION (EU) No 517/2014

Multi-compressor packs

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Minimum energy efficiency requirements



(b) From 1 July 2018, the coefficient of performance (COP) and the seasonal energy performance ratio (SEPR) of condensing units shall not fall below the following values:

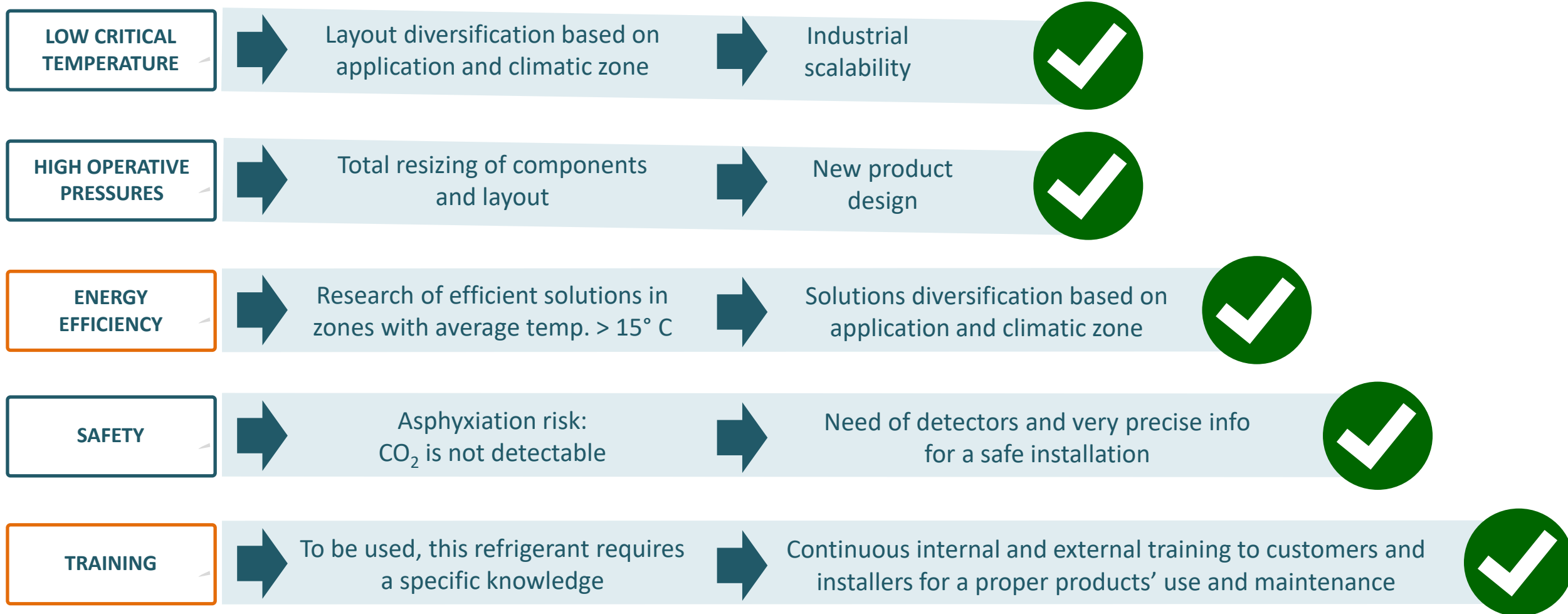
Operating temperature	Rated capacity P_A	Applicable ratio	Value
Medium	$0,2 \text{ kW} \leq P_A \leq 1 \text{ kW}$	COP	1,40
	$1 \text{ kW} < P_A \leq 5 \text{ kW}$	COP	1,60
	$5 \text{ kW} < P_A \leq 20 \text{ kW}$	SEPR	2,55
	$20 \text{ kW} < P_A \leq 50 \text{ kW}$	SEPR	2,65
Low	$0,1 \text{ kW} \leq P_A \leq 0,4 \text{ kW}$	COP	0,80
	$0,4 \text{ kW} < P_A \leq 2 \text{ kW}$	COP	0,95
	$2 \text{ kW} < P_A \leq 8 \text{ kW}$	SEPR	1,60
	$8 \text{ kW} < P_A \leq 20 \text{ kW}$	SEPR	1,70

Refrigerants with GWP <150 can have 10% lower limits

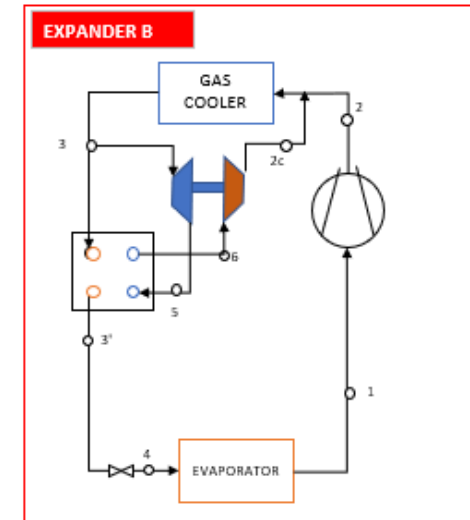
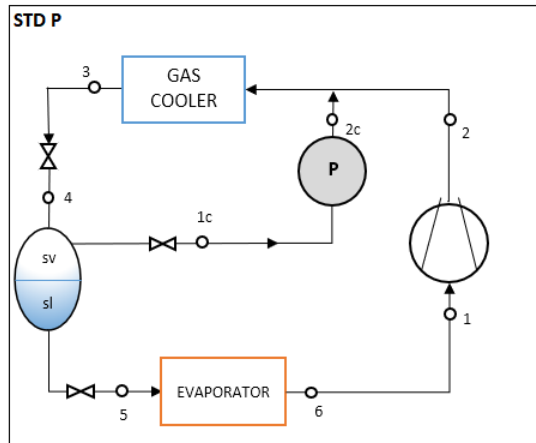
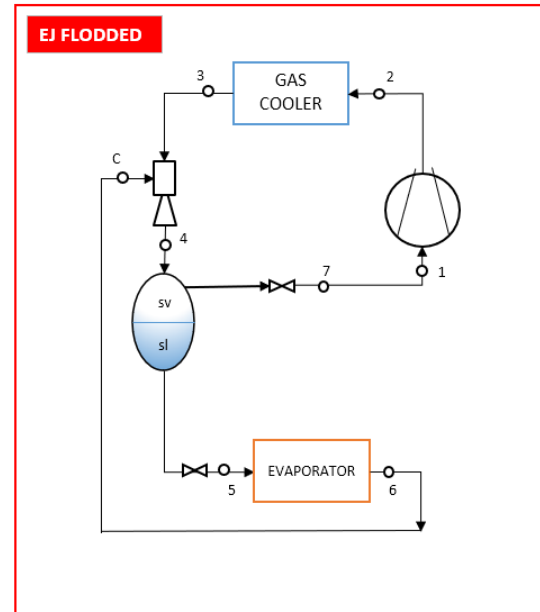
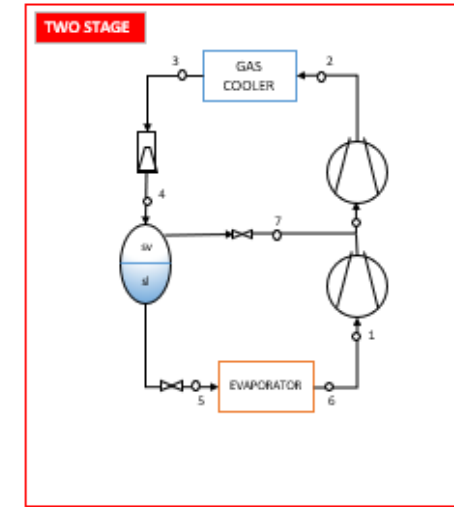
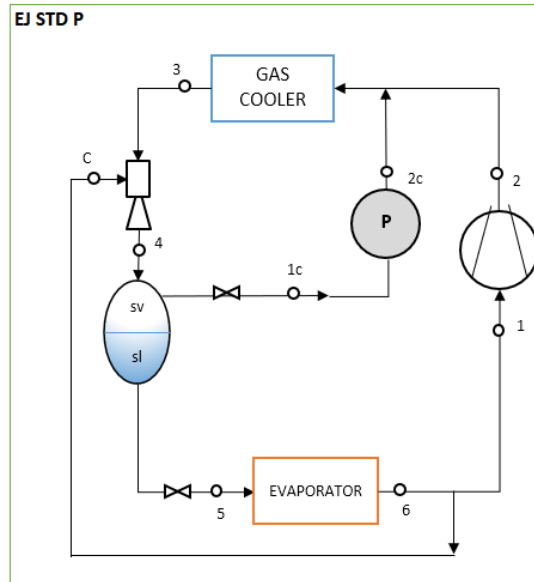
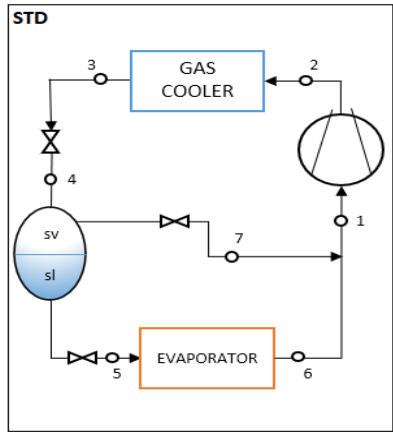
2.

CO₂ Solutions

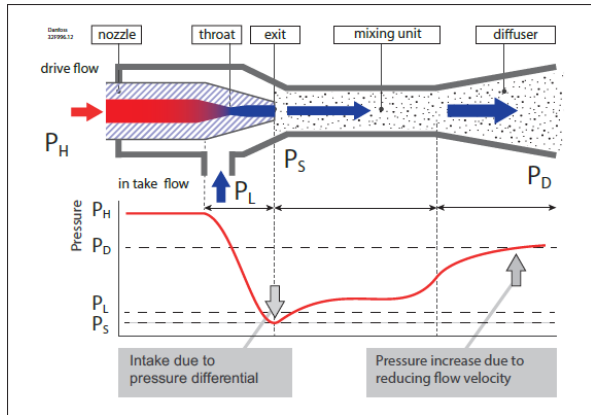
Introduction to CO₂ in commercial refrigeration



Comparison of CO₂ solutions



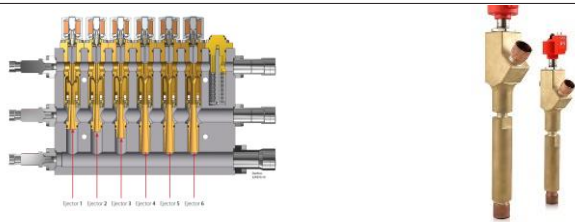
Efficiency of CO₂ ejector



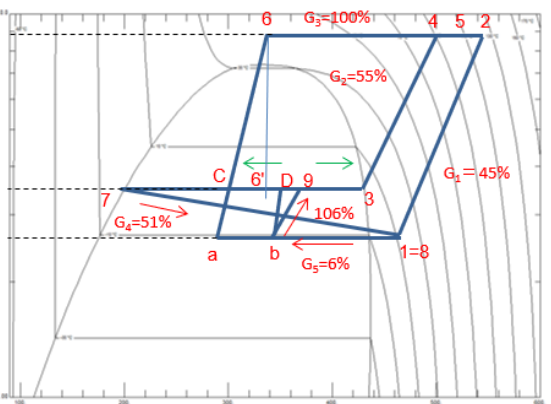
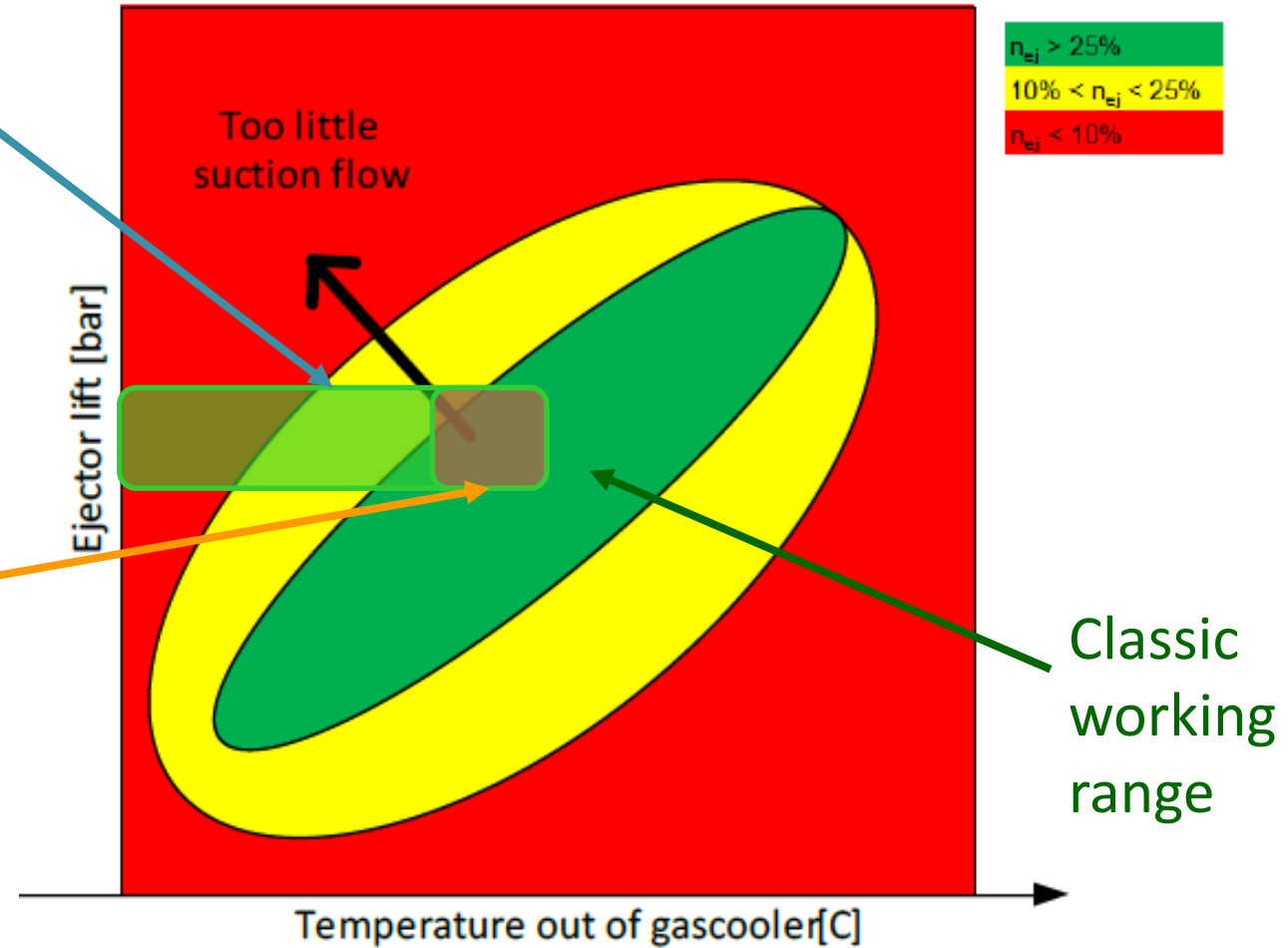
The ejector doesn't increase the efficiency for medium-low ambient temperatures

The ejector is efficient only for high ambient temperatures

By combining the advantages of the ejector with other configurations, it's possible to significantly boost the efficiency

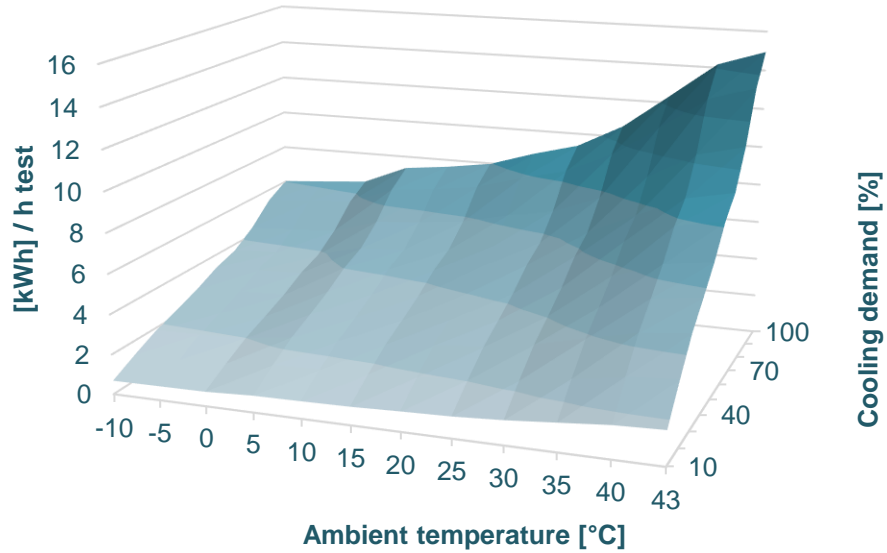


Ejector efficiency

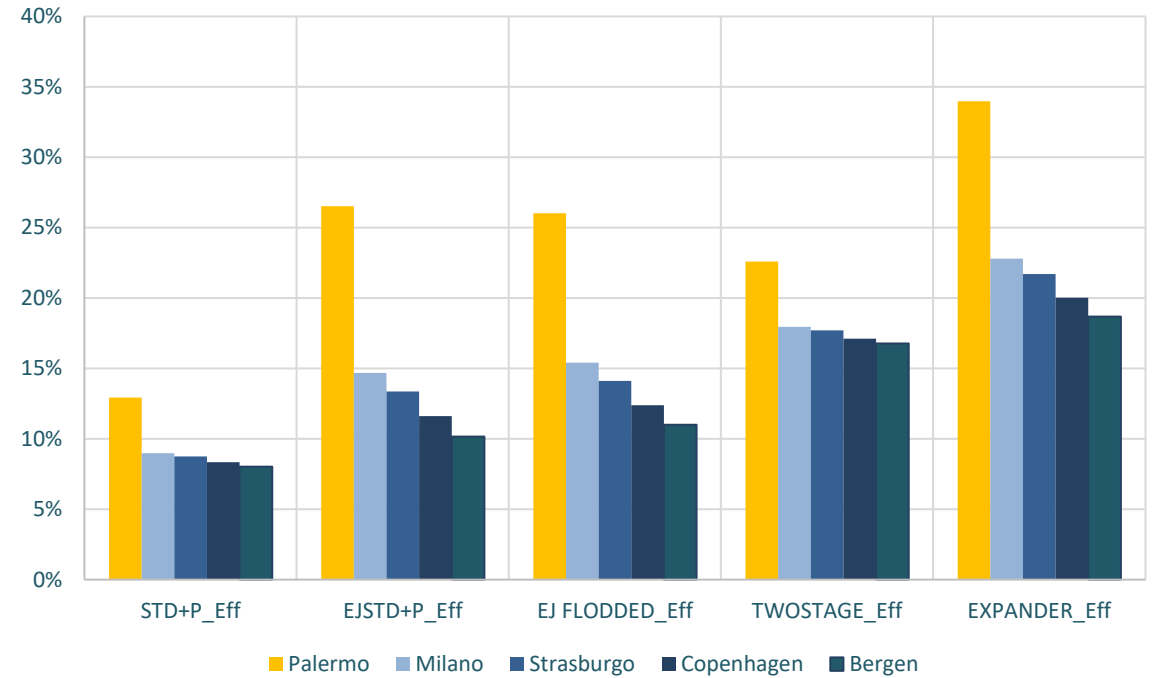


Comparison of CO₂ solutions

Energy consumption



Annual efficiency vs STD CO₂ system [reference]



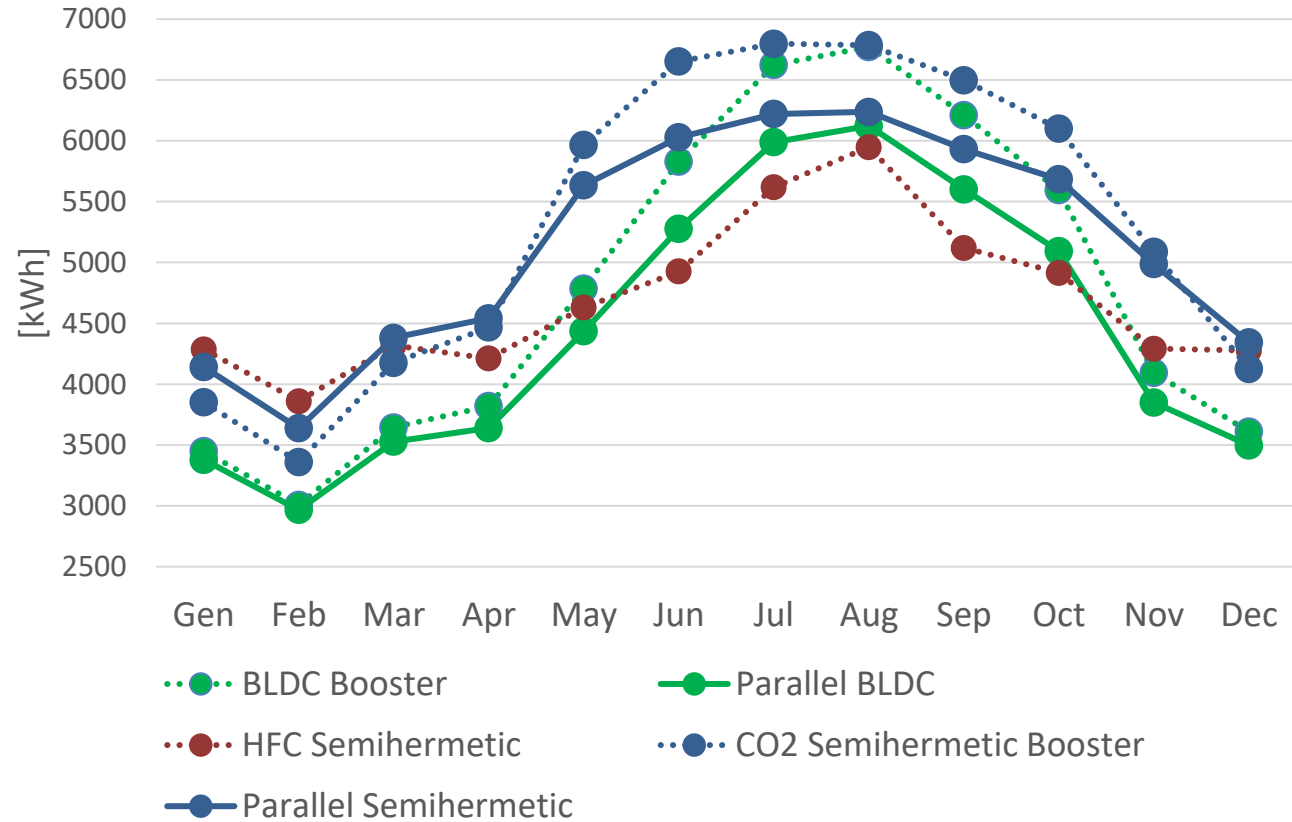
The rack with different technology has been tested in Rivacold LAB with different ambient temperature and different cooling demand observing the energy consumption

Comparison of technological solutions based on CO₂

Energy Consumption

Su base dati laboratorio, profilo temperature per climi caldi (Rif. Palermo) e profilo di richiesta freddo tipica dei market la nuova tecnologia permette di ottenere risparmi energetici

With data result from test lab with warm climate profile temperature (Ref. Palermo) and market typical cooling demand, the new technology provides energy saving



REFRIGERANTE NATURALE R744
NATURAL REFRIGERANT R744

TEWI -82%

RISPARMIO ENERGETICO
ENERGY SAVING

-14% SH Booster vs HFC

-2% BLDC Booster vs HFC

-2% SH Booster with PRL vs HFC

6% BLDC Booster with PRL vs HFC

7% SH Booster with PRL+EJ vs HFC



**Unità condensatrici
CO₂nnext e MHX**
Compressor BLDC/SHR
TN 2,5/11 kW
BT 3/28 kW
Multi set

**NEW
2023**



**Mini packs
Multi CO₂nnext**
2 to 4 compressors BLDC
TN 9/39kW
TN+BT 9/25kW (TN) 2/7,5kW
(BT)
BT 7,5/22kW
Multi set



**Packs
and integrated systems**
TN from 10 to 152 kW
BT from 3,5 to 25 kW
Summer and winter air
conditioning up to 130 kW
Also in compact version



Gascooler
From 1 to 8 fans
Up to 733 kW
Diameter up to 1000mm



Aero evaporators
From 1 to 5 fans
Up to 61 kW
Diameter up to 500mm

TX



TX COMPACT4
NEW 2023



MC



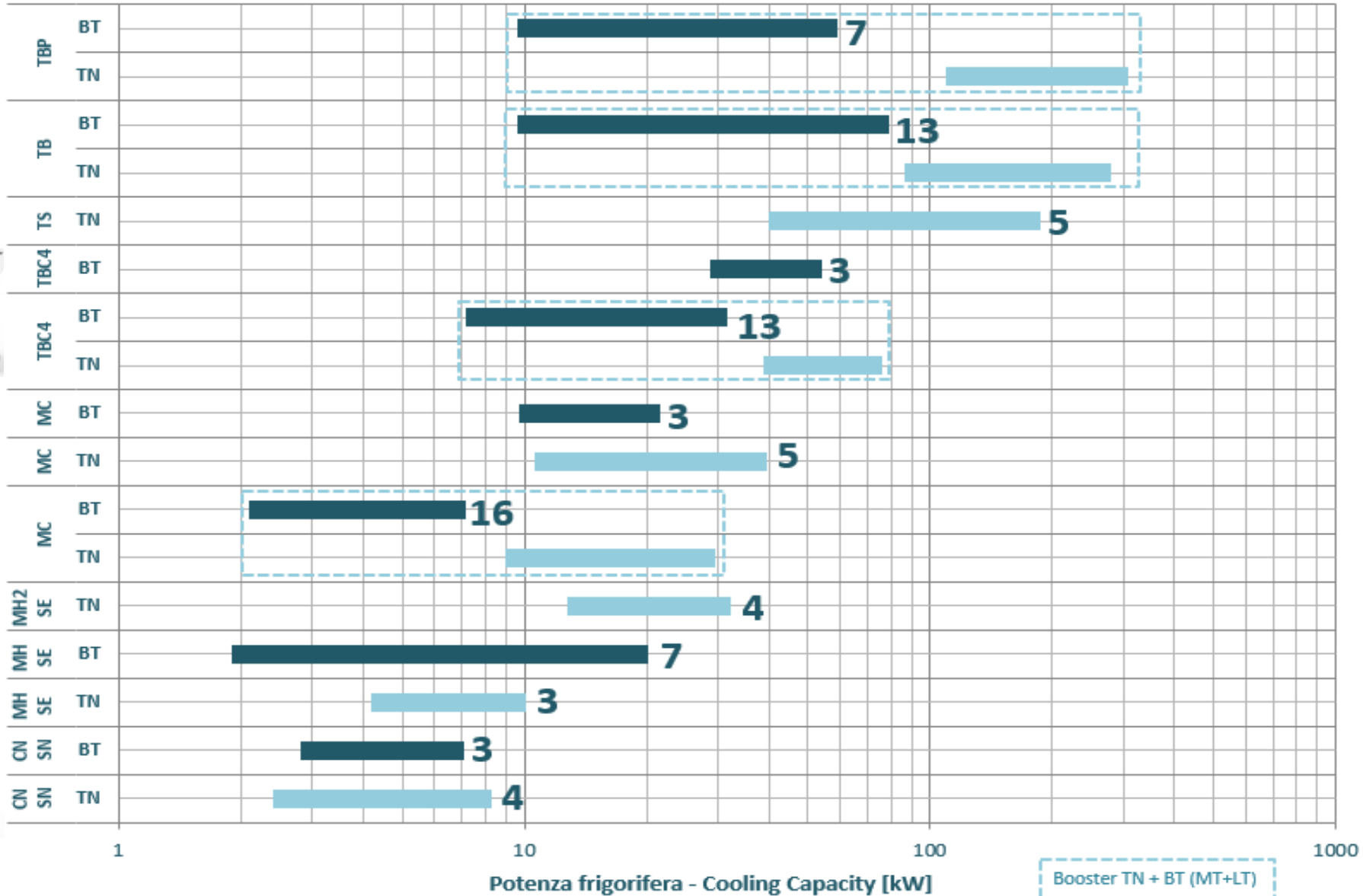
NEW 2023

MH X MH₂ X










CN

SN



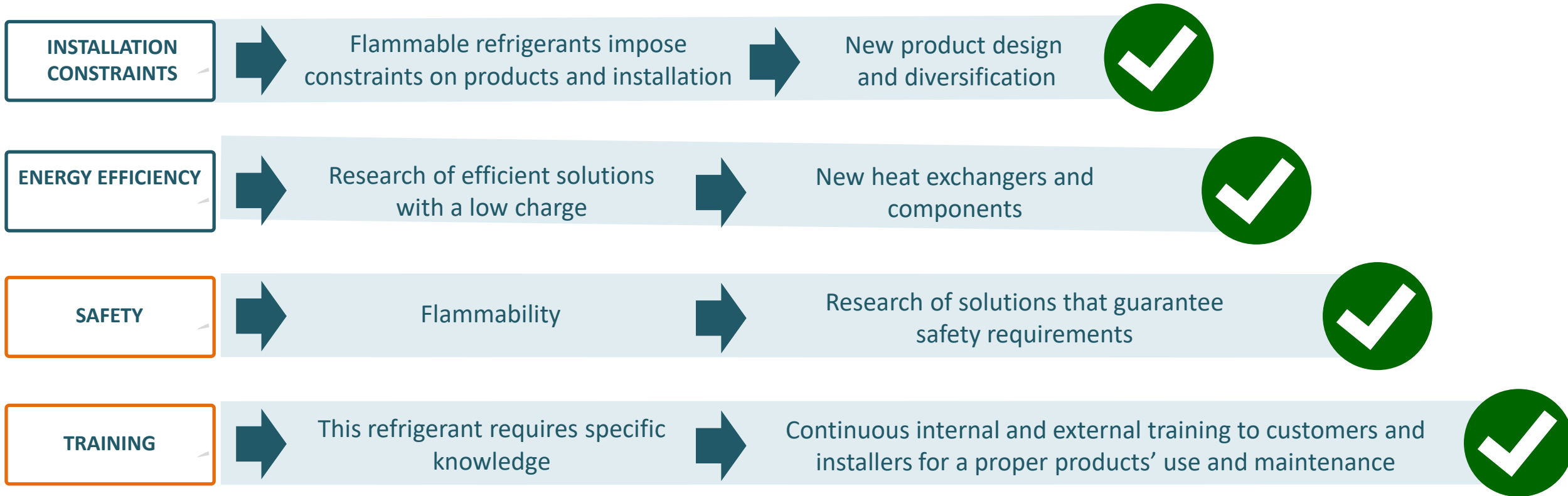
Booster TN + BT (MT+LT)
[n] numero modelli (model quantity)

		Product	HO.RE.CA.	Retail SHOP	Retail GDO	Food Industry	Logistic	Industrial	Medical
TX					●	●	●	●	●
TX COMPACT4					●	●	●		●
MC				●	●	●	●		●
MH X				●	●	●	●		●
MH₂ X				●	●	●	●		●
CN			●	●	●	●	●		●
SN			●	●	●	●	●		●

3.

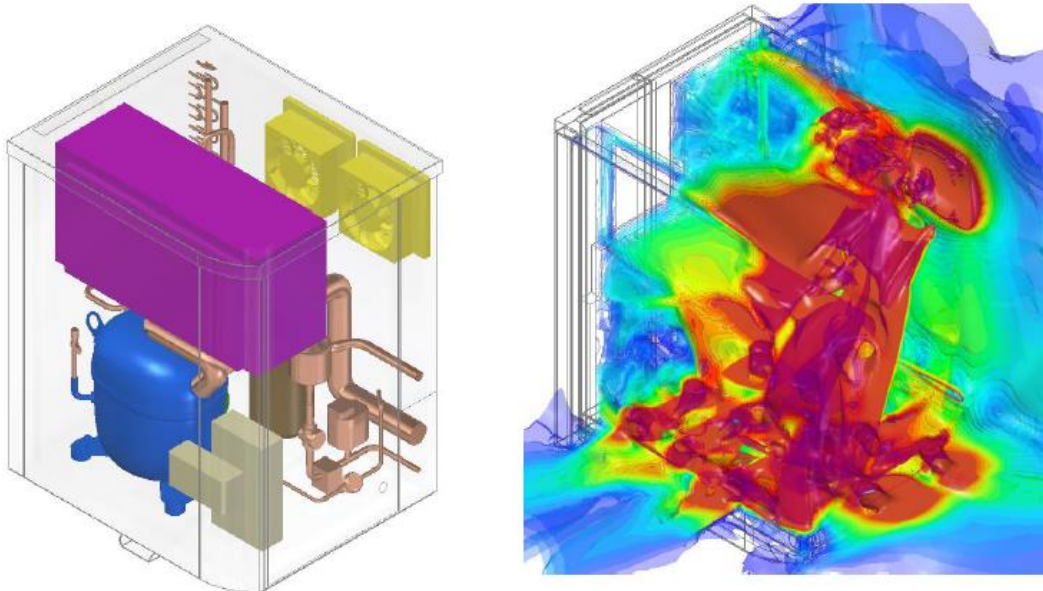
Propane solutions

Introduction to propane in commercial refrigeration



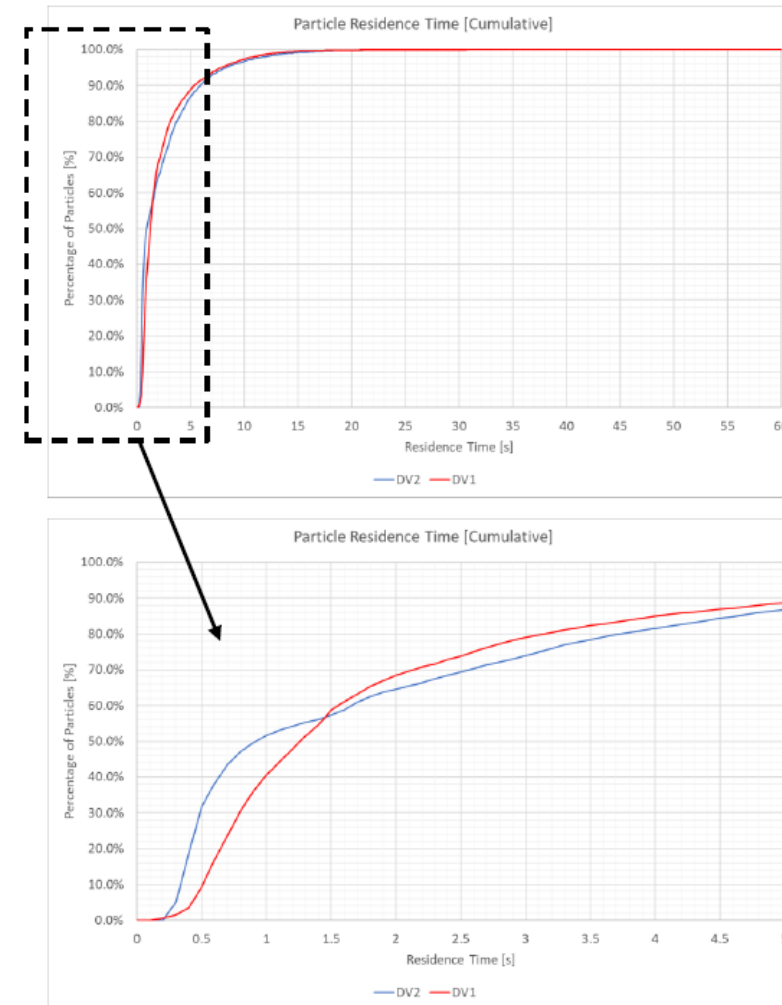
Inflammable refrigerant leakage in the environment

Study of the internal ventilation of compressor compartment with flammable fluid



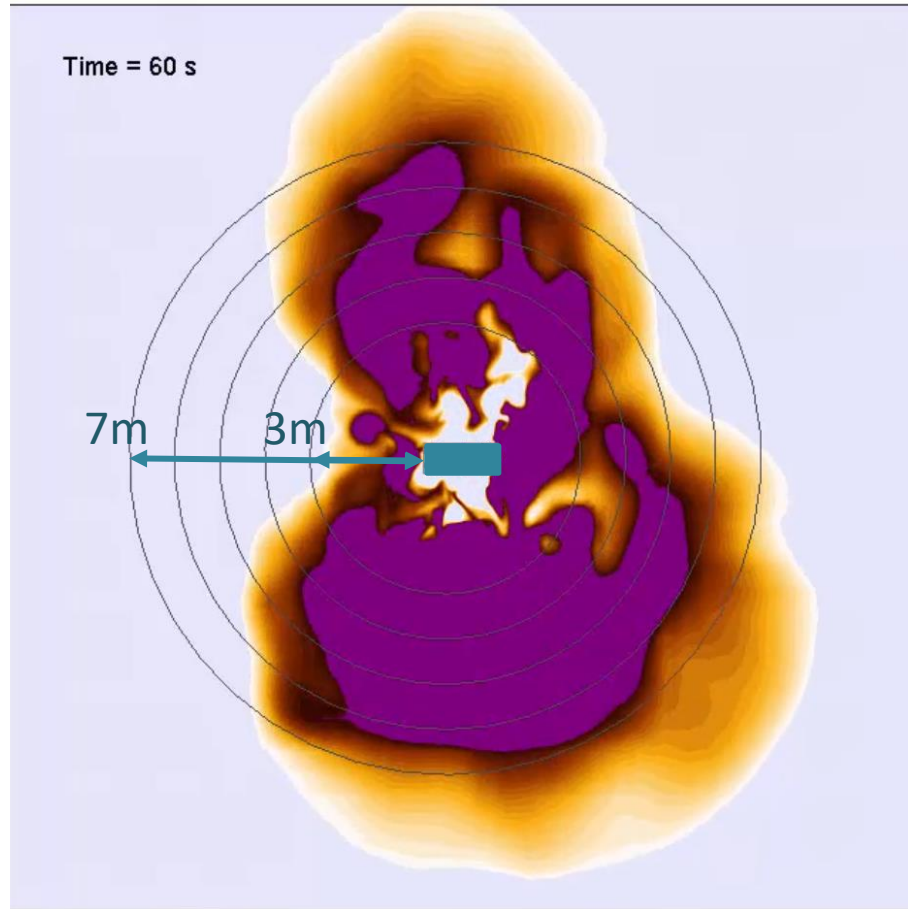
90% of particles pass through the compartment and exit within 5 seconds – based on this, we evaluated safety systems to treat leakages of flammable refrigerant

Evaluation of internal air circulation

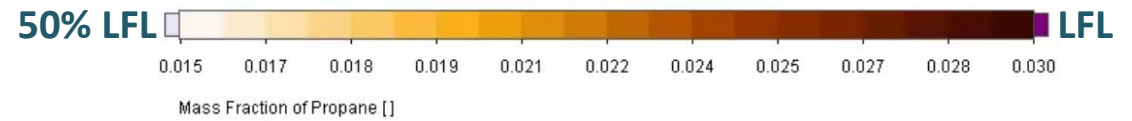
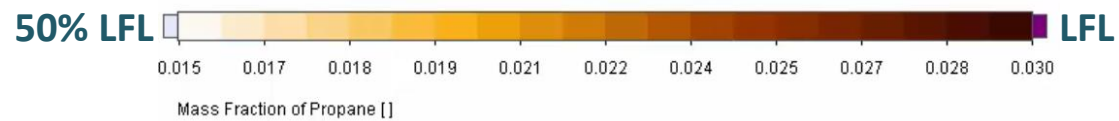
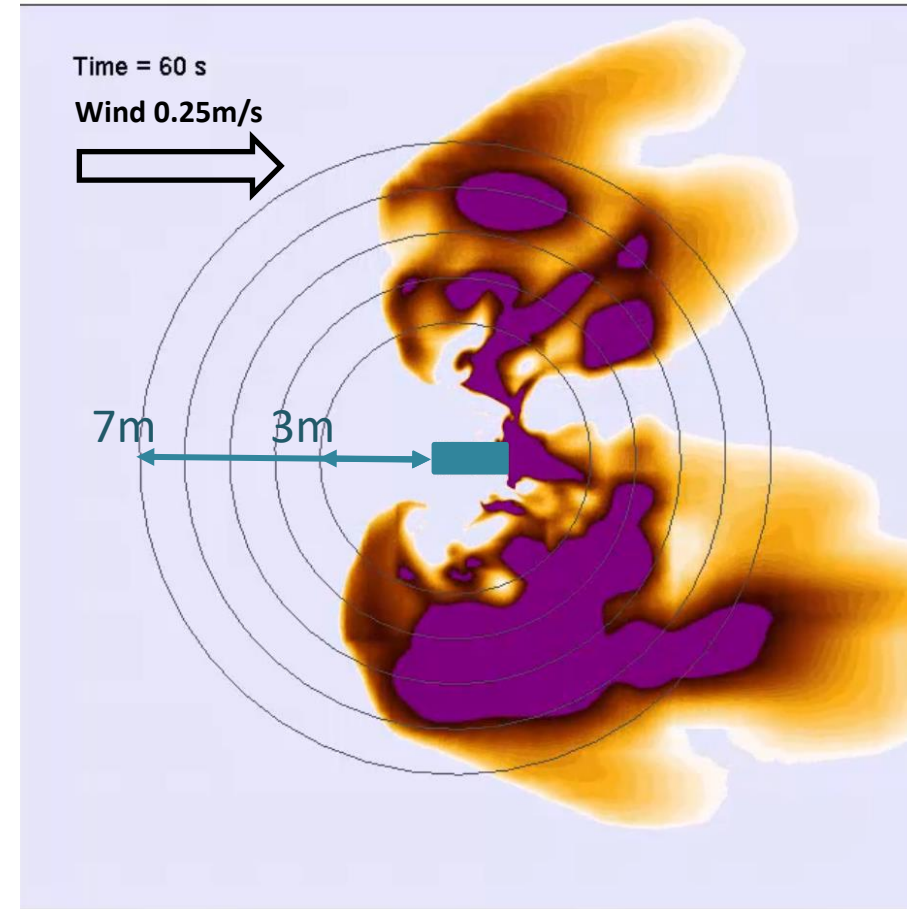


Diffusion of the flammable refrigerant into the environment

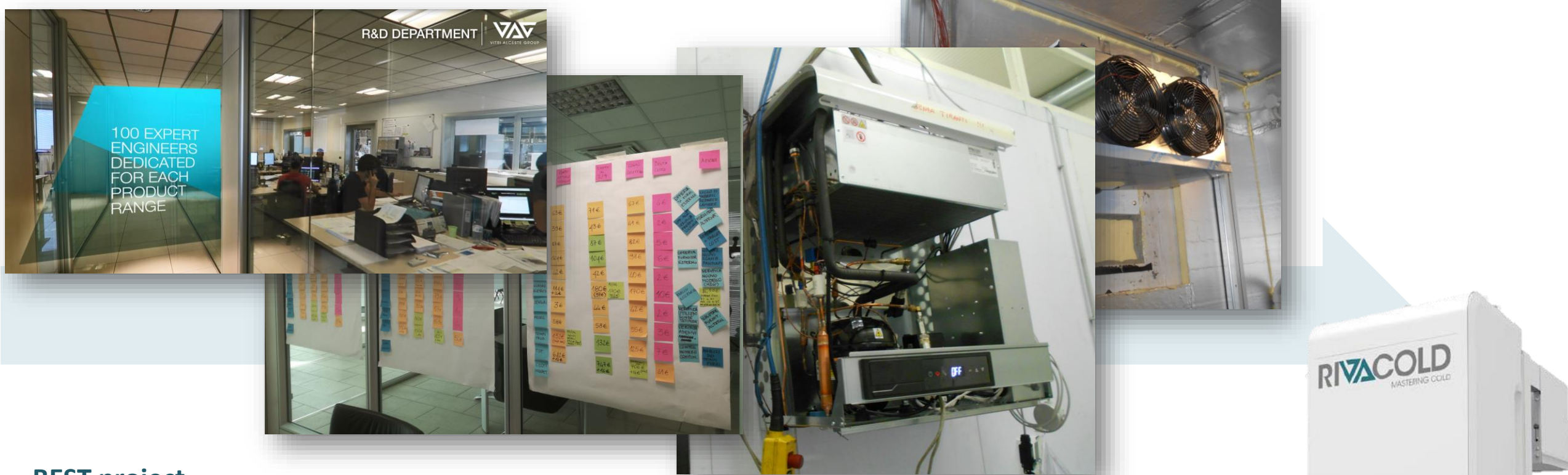
Propane diffusion after 60s without wind



Propane diffusion after 60s with a wind speed of 0.25m/s



Designing safe systems



BEST project

- 1.300 hours of laboratory tests
- 170 hours of meetings
- 450 hours of design
- 55 samples
- > 1.000 post-it for visual planning

GREEN SOLUTIONS



REFRIGERANTE
NATURALE
NATURAL
REFRIGERANT



RISPARMIO
ENERGETICO
ENERGY
SAVING

➤ CONDENSING UNITS AND COMPACT SYSTEMS: HIGH EFFICIENCY AND INTERNAL VOLUME REDUCTION

June 2023
Ok to order
water condensed
units



**ECO
DESIGN**



BANCHI
COUNTERS



ARMADI
CABINETS



MURALI E
VETRINE
WALL AND
DISPLAY CABINETS

GREEN SOLUTIONS



REFRIGERANTE
NATURALE
NATURAL
REFRIGERANT



RISPARMIO
ENERGETICO
ENERGY
EFFICIENCY



BASSA
RUMOROSITÀ
LOW
NOISE



MEDIA
TEMPERATURA
MEDIUM
TEMPERATURE

Reciprocating compressor

TN 343/1483 W

BT 200/836 W



Ready for
energy label

GREEN SOLUTIONS



GAS NATURALE
R290
NATURAL GAS
R290



RISPARMIO
ENERGETICO
ENERGY
SAVING



REFRIGERANTE
A BASSO GWP
LOW GWP
REFRIGERANT



BASSA
RUMOROSITÀ
LOW
NOISE



EASY
FIX
EASY
FIX

Reciprocating compressor

(refrigerated drawers)

AT 442/735 W

TN 386/551 W

BT 458/704 W



Ready for
energy label

GREEN SOLUTIONS



GAS NATURALE
R290
NATURAL GAS
R290



RISPARMIO
ENERGETICO
ENERGY
SAVING



REFRIGERANTE
A BASSO GWP
LOW GWP
REFRIGERANT



BASSA
RUMOROSITÀ
LOW
NOISE



EASY
FIX
EASY
FIX

Reciprocating compressor

(refrigerated tables)

AT 546/749 W

TN 386/551 W

BT 530/652 W



BE CM

- waterloop
- air condensation
- water condensation



GREEN SOLUTIONS



Hermetic Compressor
 TN 1069/3713 W (Tcella=0°C)
 BT 749/2733 W (Tcella=-20°C)

BE BEST



GREEN SOLUTIONS



Hermetic Compressor
 TN 938/3904 W (Tcella=0°C)
 BT 663/2580 W (Tcella=-20°C)

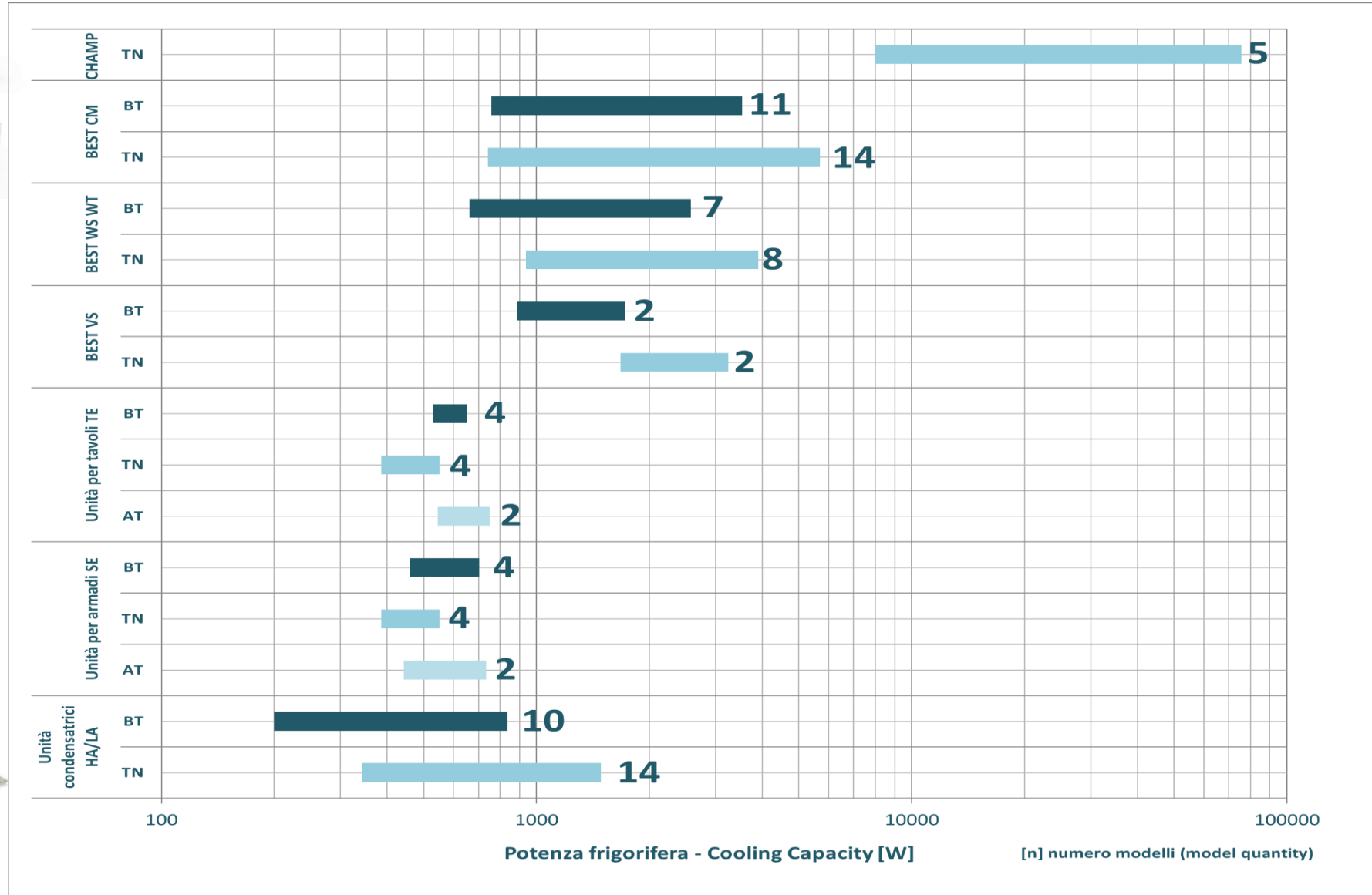
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GREEN SOLUTIONS



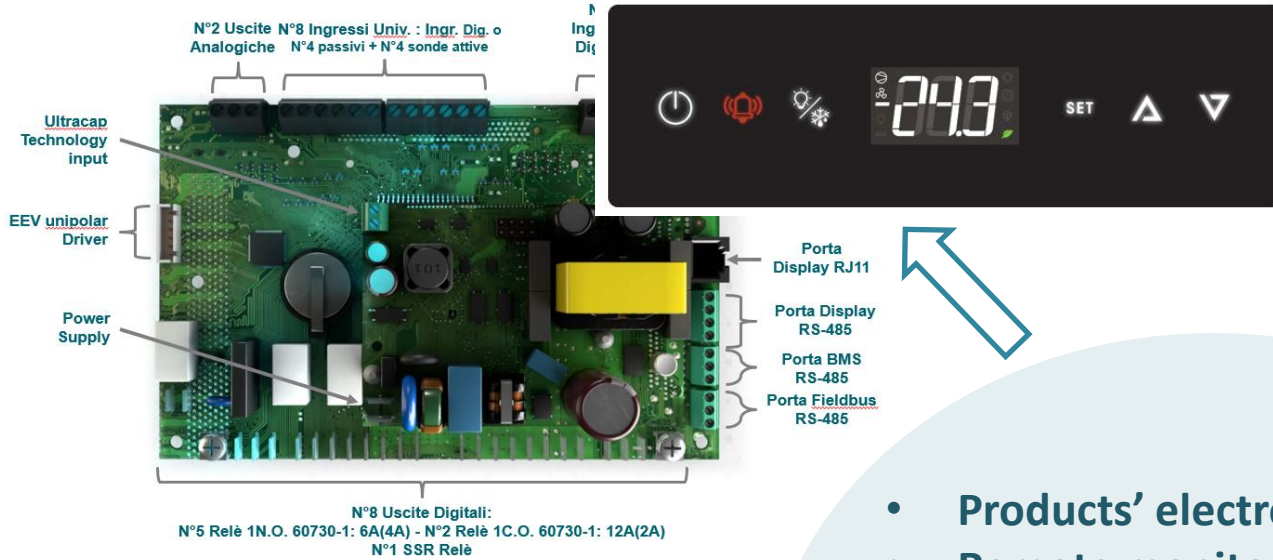
Scroll Compressor
 TN 8/19,3 kW



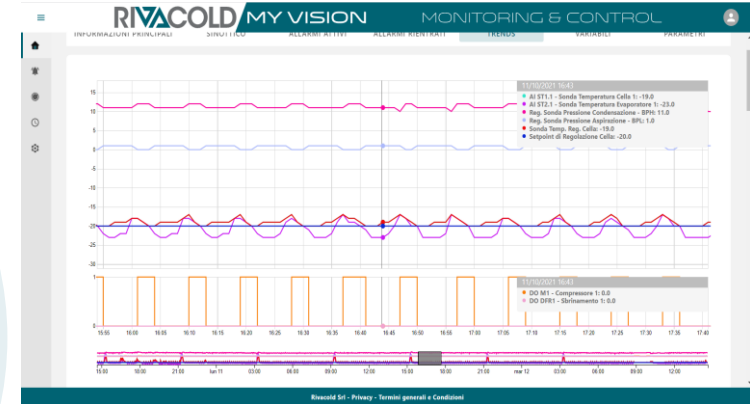
	Product	HO.RE.CA.	Retail SHOP	Retail GDO	Food Industry	Logistic	Industrial	Medical
CH		●	●	●	●	●		●
SF		●	●	●	●	●		●
BE		●	●	●	●	●		●
TE		●	●	●				●
SE		●	●	●				●
HA		●	●	●				●

4.

Digitalization



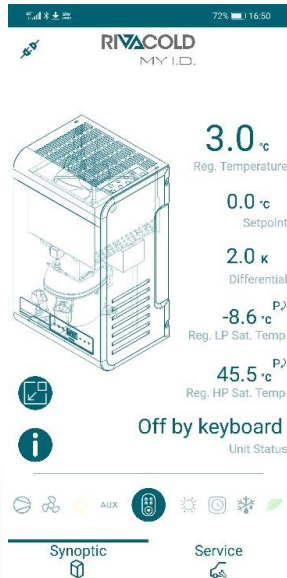
- Products' electronic controls
- Remote monitoring and management
- Connectivity
- Multi-device applications
- Services and digital documentation
- Environmental sustainability



RIVACOLD
 MASTERING COLD
Centro Supporto Digital Services
<https://appwebservice.rivacold.com/supportcenter>



- Knowledge center
- Ticket via e-mail
- Bot Telegram
- Chat Online



5.

Laboratory for tests and innovation

LABORATORI TEST
3.000 MQ



15 ENGINEERS AND TECHNICIANS

900 TEST FOR 20.000 TOTAL HOURS EVERY YEAR

**EVERY POSSIBLE ENVIRONMENTAL CONDITION SIMULATED:
TEMPERATURE FROM -45°C TO +55°C**

9 LABS TO COVER DIFFERENT TEST PURPOSES

LABORATORIES DEDICATED TO NATURAL REFRIGERANTS

ACCREDIA ACCREDITATION CONFIRMS THE COMPETENCE, INDEPENDENCE AND IMPARTIALITY OF THE TESTING LABORATORIES AND ENSURES COMPLIANCE WITH THE REQUIREMENTS OF THE STANDARDS AND THE ABILITY TO ASSESS THE CONFORMITY OF GOODS AND SERVICES

6.

Conclusions

- In the commercial refrigeration business, the solutions based on natural refrigerants are more and more used
- Energy efficiency is a fundamental characteristic of every new product designed
- A technology change requires new skills to be managed
- Flammable refrigerants can be used, but the safety must be considered from the beginning of product design
- Training is fundamental both for manufacturers, with universities support, both for customers that use the systems, to perform the regular servicing to keep high standards of safety and efficiency

THANKS FOR THE ATTENTION