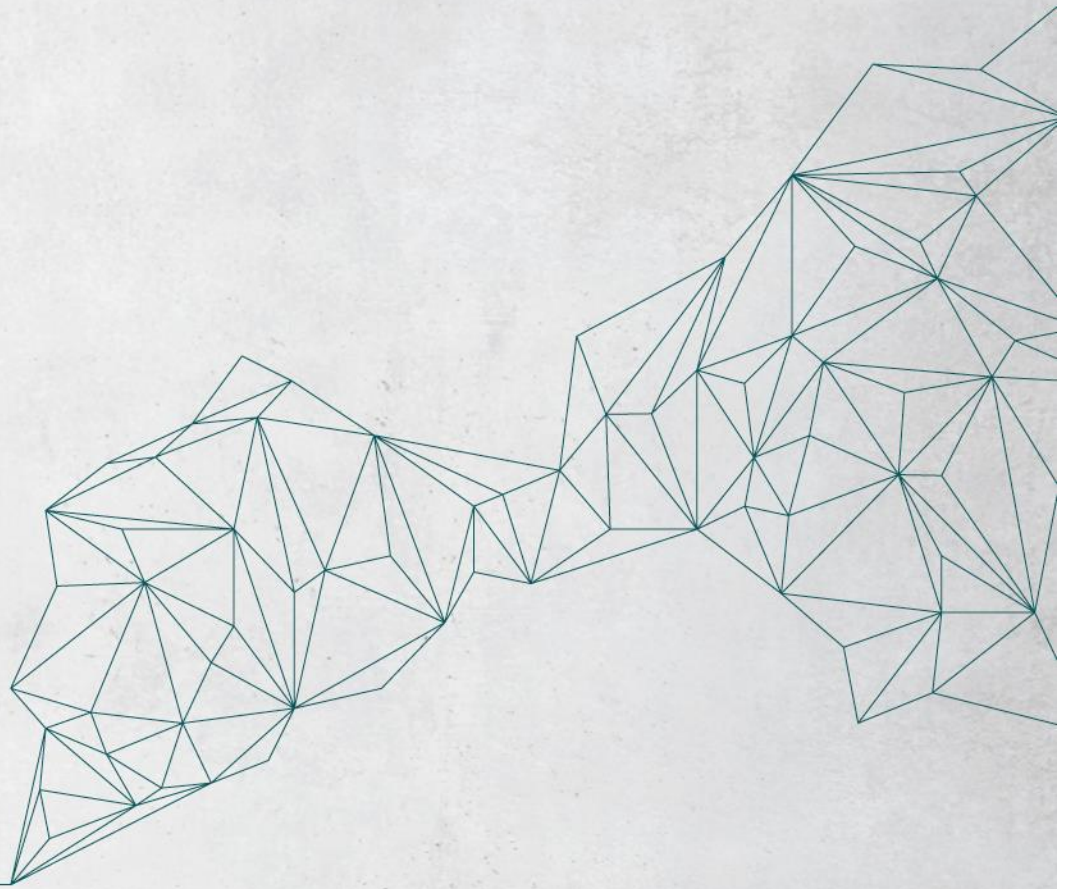
Hall 7A

CHILLVENTA

Chillventa Specialist Forums 2022
Chillventa Fachforen 2022

CONNECTING
EXPERTS.



ECO-EFFICIENT SOLUTIONS TO ENSURE THE SUSTAINABILITY OF YOUR INVESTMENTS

New HFO alternatives below 150 for commercial and industrial refrigeration

October 11th – Delphine Martin / Pierre-Emmanuel Danet

climalife®

climalife.com

THE CONCEPT OF A CIRCULAR ECONOMY, THE VERY ESSENCE OF OUR BRAND

- The environmental responsibility is at the heart of our technological innovations.
- Opening of an **excellence hub in Circular Economy** with state-of-the-art equipments
- For efficient resource management in technical processes

IN FIGURES

75% of fluorinated greenhouse gas waste i**s recovered.**

More than 30 millions t. Eq. CO_2 **avoided** by our action in Europe

R&D Investment **: + 10%** TO

Introduction of bio-sourced materials in the formulation of heat transfer fluids

climalife®

TICK THE MAXIMUM BOXES WITH SUSTAINABLE SOLUTIONS

How to choose a refrigerant?

- Reducing t. eq. CO2 of greenhouse gas emissions should strongly encourage the use of new ultra-low GWP refrigerants
- But GWP is not sufficient to select the right refrigerant

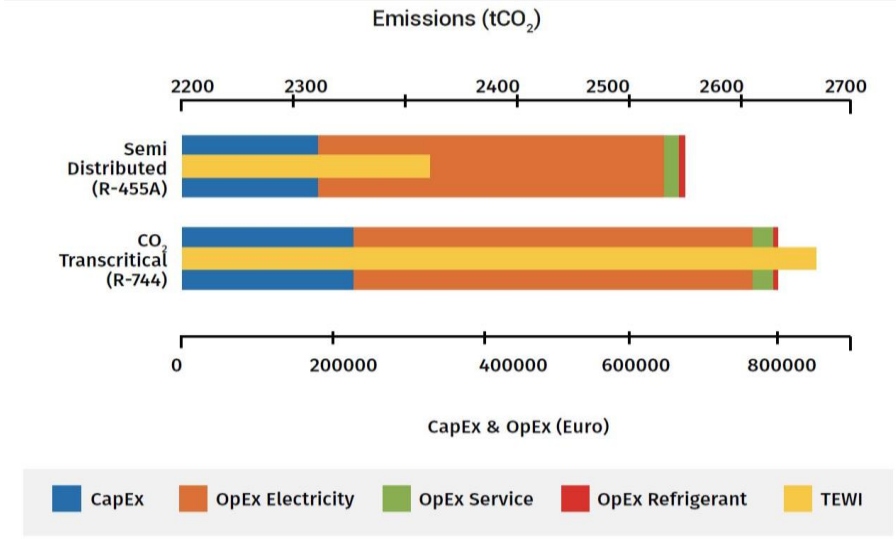
- Taking into account the eco-efficiency approach allows :
  - Total cost of ownership (TCO)
  - Environmental impact (TEWI)

climalife®

HOW TO DEFINE THE INVESTMENT VALUE IN RETAIL SECTOR?

The Eco-Efficiency Decision Support Model

- The concept of eco-efficiency allows refrigeration systems to be compared in terms of their environmental impact and total cost of ownership (TCO).
- Honeywell's Eco-Efficiency Model is a powerful decision support tool, which has been validated by the independent Cemafroid Institute.
- It allows the selection of the solution that offers the lowest environmental impact with the lowest possible TCO, and to check the sensitivity of the results to changes in specific parameters.



The eco-efficiency model takes into account:

- **System design** (direct expansion, transcritical, semi-distributed, etc.)
- **Choice of refrigerant** (HFO / HFO blend / HC / CO_2)
- Sales **area**
- **Climate**
- **Investment costs** and maintenance of system
- **Electricity consumption** (compressors, display cabinets, condensers, etc.)

A simulation of different parameters such as:

- Price fluctuations (electricity, refrigerant, etc.)
- Carbon tax (where applicable)
- Plant leakage rate

Climalife has a dedicated team that can carry out simulations on your future projects.
Contact us!

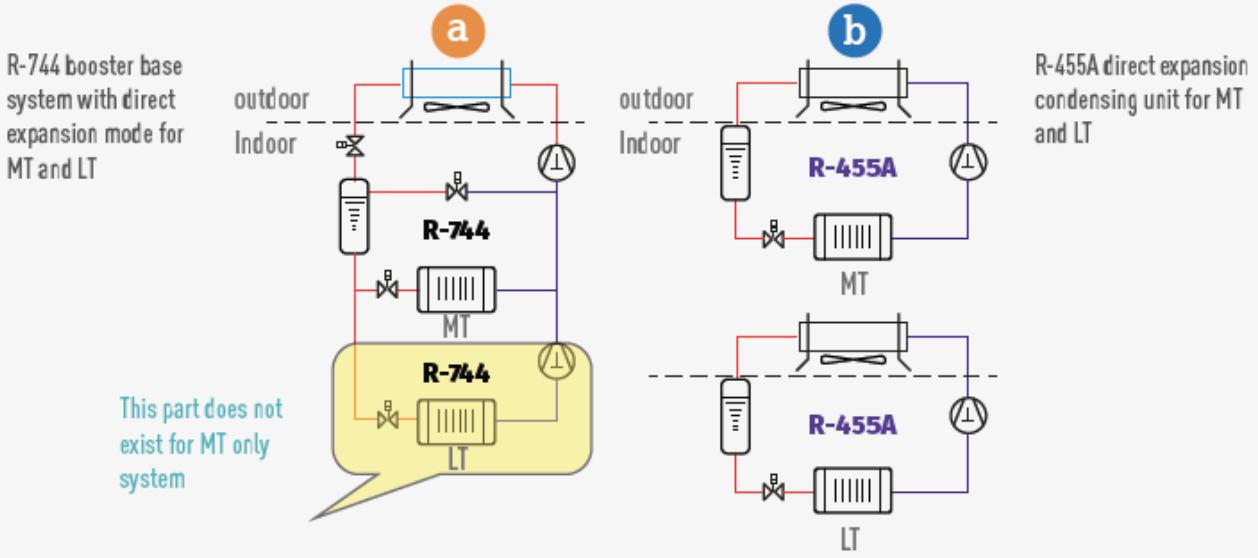
climalife®

ECO-EFFICIENCY SIMULATION FOR THE LECLERC EXPRESS (SUPERMARKET 800 SQM)

Description of the systems compared by the eco-efficiency model validated by Cemafroid

a CO_2 booster with direct expansion mode for the 3 chilled and frozen cold rooms.

b R-455A direct expansion condensing unit for the 3 chilled and frozen cold rooms.



Type of cold rooms	Internal temperature	Evaporation temperature	Cooling capacity
	(°C)	(°C)	(kW)
CR Chilled Fruit and Vegetables	+1	-4	3.88
CR n°2 Frozen (Bakery)	-28	-33	2.42
CR n°1 Frozen products	-28	-33	3.27

climalife

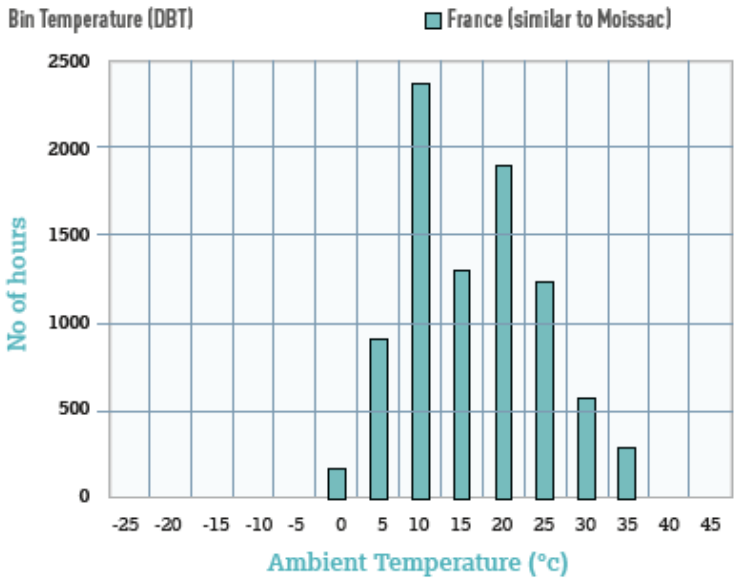
ECO-EFFICIENCY SIMULATION FOR THE LECLERC EXPRESS (SUPERMARKET 800 SQM)

Assumptions taken into account in the eco-efficiency tool:

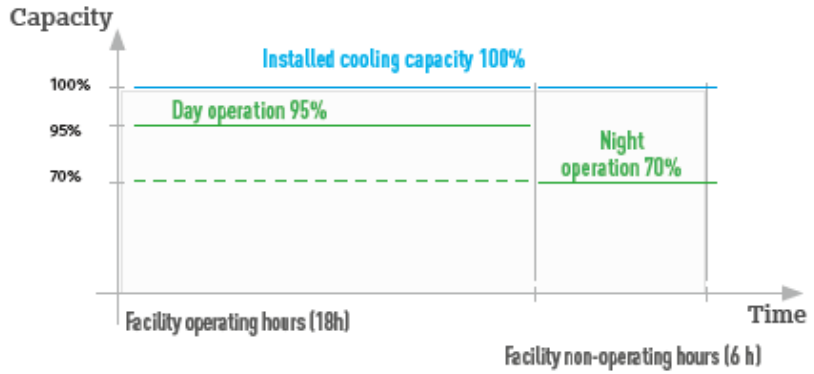
- **The leakage rate is fixed at 5% per year** for R-455A and 20% for R-744.
- **The cost of electricity is:**
  - 0.2 €/kWh for fixed electricity rate
  - 0.2 €/kWh for year 1 in a variable electricity rate scenario, the annual price increase is 8%, the electricity price in year 10 (end of system life) is 0.4 €/kWh.
- **CO_2 emissions per kWh = 58 grams CO_2 /kWh** (ref: coal ~ 1000gr. CO_2 /kWh, nuclear ~ 50gr. CO_2 /kWh).
- **The energy efficiency class** of the air-cooled condenser / gas cooler for $C0_2$ is 50 kW/kW, low level or class "C" (*).
- **The minimum condensation temperature** is 15°C for R-455A and 10°C for R-744.
- **Evaporating and condensing temperatures** for the R-455A are "mid" because of glide.
- **For the high side of the system**, following Temperature Difference in condensers have been assumed:

	Subcritical operation	Transcritical operation
R-744 system (condenser / gas cooler)	10 K	Gas cooler exit temp 3K above ambient
R-455A system (condenser)	10 K	N/A

- The temperature profile is the following:



- **The lifespan of the systems is 10 years**
- **Cooling load is distributed during 24 hours in the following way:**

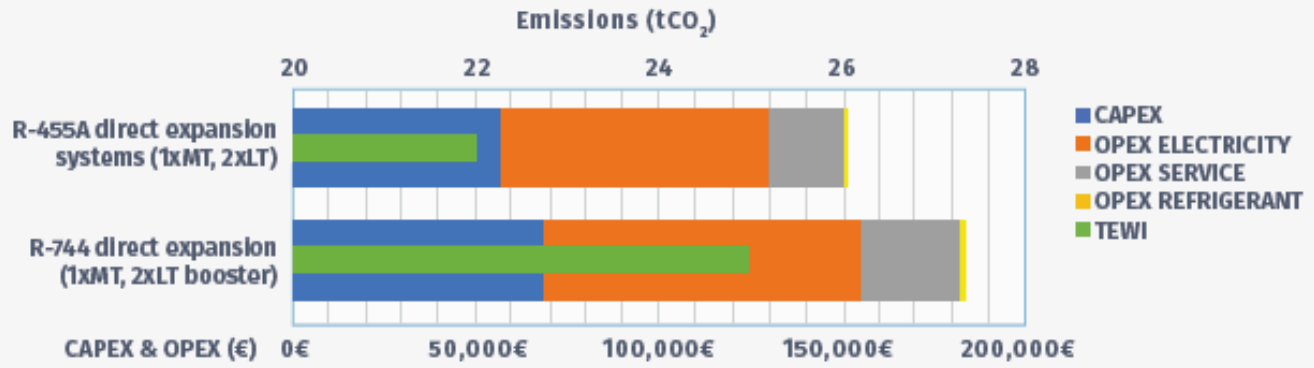


climalife®

ECO-EFFICIENCY SIMULATION FOR THE LECLERC EXPRESS (SUPERMARKET 800 SQM)

Results with a fixed electricity price

Architecture system	CAPEX	CAPEX compared to the CO_2 solution	OPEX ELEC. (electricity bill)	OPEX ELEC. compared to the CO_2 solution	OPEX maintenance	OPEX refrigerant refill	∑ OPEX	CAPEX + OPEX	CO_2 EMISSIONS from the power plant	CO_2 EMISSIONS emissions from refrigerant leaks	∑ EMISSIONS OF CO_2
[-]	[€]	[%]	[€]	[%]	[€]	[€]	[€]	[€]	[t.equ. CO_2]	[t CO_2]	[t CO_2]
1. R-744 direct expansion (1xMT, 2xLT booster)	67.834	100.00%	87.268	100.0%	27.751	900	115.919	183.752	25	N/A	25
2. R-455A direct expansion system (1xMT, 2xLT)	57.036	84.08%	73.300	84.0%	20.400	475	94.175	151.211	21	1.0	22



Over **€32k** savings on total cost of ownership over 10 years

NB: If we extend the lifespan of the system to 20 years, the gain would be €58k.

climalife®

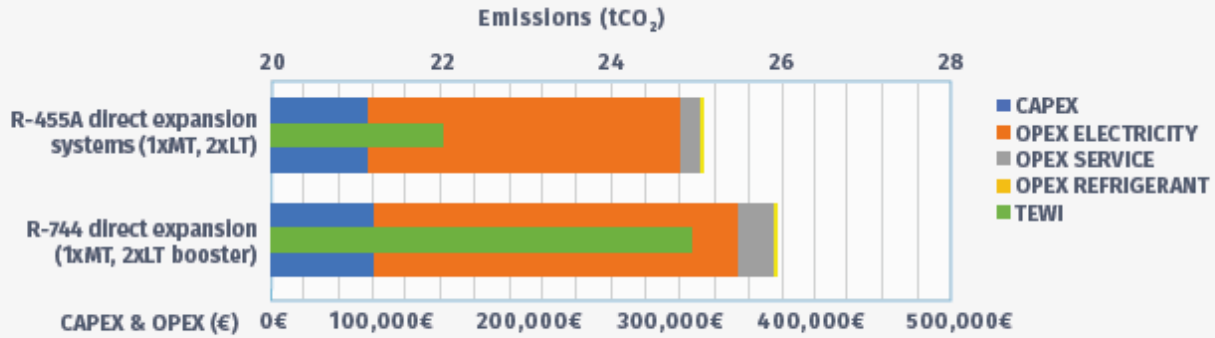
ECO-EFFICIENCY SIMULATION FOR THE LECLERC EXPRESS (SUPERMARKET 800 SQM)

Results with an 8% annual increase in electricity prices

Architecture installation	CAPEX	CAPEX compared to the CO_2 solution	OPEX ELEC. (electricity bill)	OPEX ELEC. compared to the CO_2 solution	OPEX maintenance	OPEX refrigerant refill	∑ OPEX	CAPEX + OPEX	CO_2 EMISSIONS from the power plant	CO_2 EMISSIONS emissions from refrigerant leaks	∑ EMISSIONS OF CO_2
[-]	[€]	[%]	[€]	[%]	[€]	[€]	[€]	[€]	[t CO_2]	[t CO_2]	[t. CO_2]
1. R-744 direct expansion (1xMT, 2xLT booster)	67.834	100.00%	297.963	100.0%	27.751	900	326.614	394.448	25	N/A	25
2. R-455A direct expansion system (1xMT, 2xLT)	57.036	84.08%	246.496	82.7%	20.400	475	267.371	324.407	21	1.0	22

Over **€70k savings** on total cost of ownership over 10 years

NB: If we extend the lifespan of the system to 20 years, the gain would be €82k.



(*) energy efficiency 50 kW/kW, means that in the condenser / gas cooler 50 kW of heat is rejected with consumption of 1 kW of electricity by the fan.

climalife®

ROADMAP FOR RETAIL SECTOR

			Medium temperature	Low temperature
Retrofit or "Interim Solution (GWP <2500)	R-404A		R-448A (Solstice® N40)	
		Transport	R-452A	
	R-134a		R-513A / R-450A	N.A.
New System / "Remodelling (GWP <150)	**Small Format (<2000 m²)**		R-455A (Solstice® L40X)	
	Large Format (>2000 m²)		R-471A (Solstice® N71)	R-455A (Solstice® L40X)

Eco-efficient solutions for new and existing systems

climalife®

SOLSTICE® N71 (R-471A)

Physical and chemical properties	
ASHRAE number	R-471A
Composition	R-1234ze(E) / R-227ea / R-1336mzz(E) 78.7 / 4.3 / 17 %
Molar mass (g/mol)	122.1
Boiling point at 1.013 bar (°C)	-16.87
Temperature glide at 1.013 bar (K)	3.3
Critical pressure (bar)	35.34
Critical temperature (°C)	112.36
Saturated liquid density at 25°C (Kg/m^3)	1195.5
Ozone Depletion Potential	0
GWP according to IPCC-AR4	148
ASHRAE safety classification	A1

climalife®

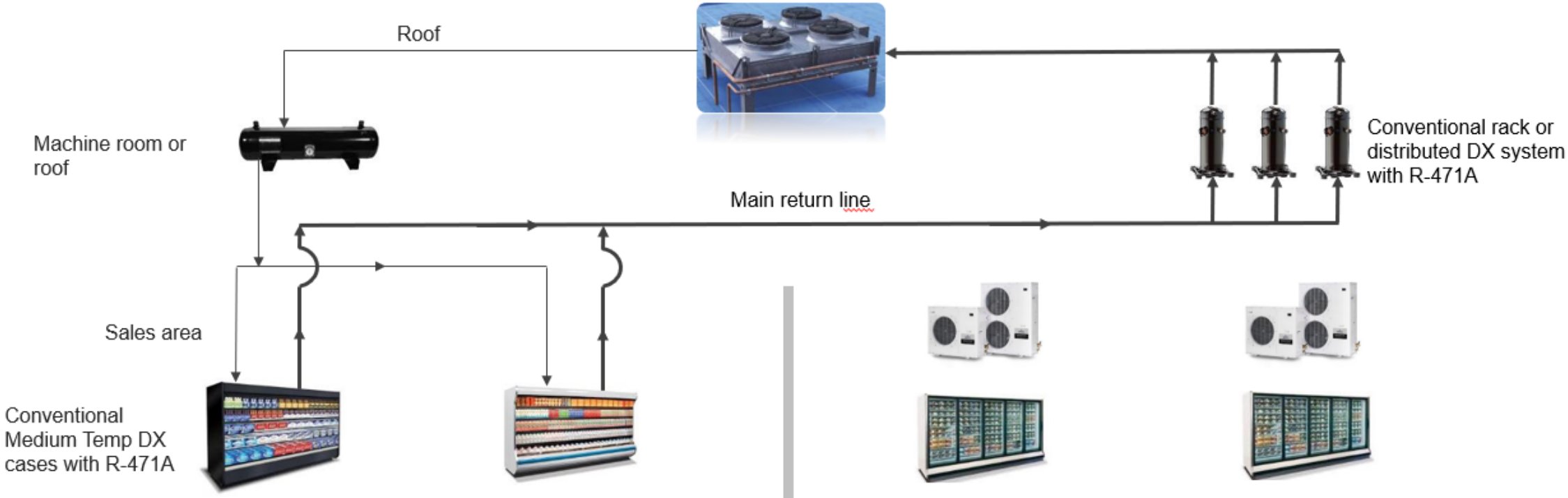
SOLSTICE® N71 CHANGES THE GAME IN MEDIUM TEMPERATURE REFRIGERATION

Features	Benefits
GWP<150	Long-term solution, compliant with regulatory requirements globally
Class A1 / Non-flammable	• Possibility to use in Direct Expansion systems w/o charge limitation • Possibility to re-use components in case of remodelling • Same handling, storage & transportation as well-known low pressure, A1 refrigerants
High efficiency: • Similar to R-134a • 13% higher than R-404A	Lower electricity consumption
Low pressure	Low leaks, minimal recharge volumes
Similar system technology to R-134a	Standard service practices and traditional contractor base

Commercialisation planned in 2023

climalife®

ARCHITECTURE FOR FOOD RETAIL STORE (A)



Medium Temperature Solstice® N71 (R-471A)

Centralized Rack System

- Traditional rack or distributed system (well-know technologies)
- Uses a non-flammable refrigerant of GWP<150 throughout the sales area
- Expect similar performance to typical R-134A Medium Temp systems

Low Temperature Solstice® L40X (R-455A)

Condensing Units

- Condensing units with Solstice® L40X (R-455A)
- Possible use of Solstice® N40 (R-448A) for systems < 40 kW

ECO-EFFICIENCY SIMULATION FOR A SUPERMARKET

Parameter	Assumption
Life Span	10 Years
Number of Trading & nontrading hours	14 Trading Hours 10 Nontrading Hours
Installed cooling capacities	Med Temp 162 kW Low Temp 34 kW
Supermarket Size	4000 m^2
R-744 System CO2 Booster Running conditions (Tevap, min. Tcond)	Tevap = -8^{0}C MT, Tevap = -32^{0}C LT min Tcond = 10^{0}C
R-471A / R-455A System Medium Temp Direct Expansion Low Temp Cascade Running conditions (Tevap, min. Tcond)	Tevap =-8^{0}C MT, Tevap =-32^{0}C LT min Tcond = 15^{0}C
Store Location	London
Cooling load distribution	90% of the total installed cooling capacity during the day 70% of the total installed cooling capacity during the night
Electricity Cost	0.097 € /kWh
Energy Efficiency Class for Condenser / Gas Cooler	45 kW/kW (low level or class "C" *) for all systems.

High Side TD Assumptions in Condensers / Gas Coolers		
	Sub-critical operation	Trans-critical operation
R-744 system	8 K	3°K above ambient
R-455A system	8 K	Not applicable
R-471A system	8 K	Not applicable

** Class "C" or energy efficiency 45kW/kW, means that in the condenser / gas cooler, 45 kW of heat is rejected with consumption of 1 kW of electricity by the fan.*

climalife®

ECO-EFFICIENCY SIMULATION FOR A SUPERMARKET* 4000 sqm

Solution	CAPEX (kEUR)	OPEX | Electricity + Service (kEUR)	TCO | CAPEX + OPEX (kEUR)	Energy Consumption (millions of kWh)	Total Carbon Footprint (t CO_2e)
R-471A (N71) Centralized Rack (Med Temp) + **R-455A (L40X)** Condensing Units (Low Temp)	561	444	1,005	4.29	1,871
R-744 (CO_2) Transcritical Booster System	648	529	1,177	5.01	2,191
Delta in favour of R-471A	**87 kEUR**	**85 kEUR**	**172 kEUR**	**0.72 million kWh**	**320 t CO_2e**

*Based on specific assumptions and 10-year system operating period. Honeywell can conduct a simulation reflecting accurately your own situation and investment options.

climalife®

ECO-EFFICIENCY SIMULATION FOR A SUPERMARKET* 4000 sqm

Electricity cost increase to 0.5 EUR/kWh

Solution	CAPEX (kEUR)	OPEX | Electricity + Service (kEUR)	TCO | CAPEX + OPEX (kEUR)	Energy Consumption (millions of kWh)	Total Carbon Footprint (t CO_2e)
R-471A (N71) Centralized Rack (Med Temp) + **R-455A (L40X)** Condensing Units (Low Temp)	561	2,161	2,732	4.29	1,871
R-744 (CO_2) Transcritical Booster System	648	2,572	3,230	5.01	2,191
Delta in favour of R-471A	87 kEUR	411 kEUR	498 kEUR	0.72 million kWh	320 t CO_2e

*Based on specific assumptions and 10-year system operating period. Honeywell can conduct a simulation reflecting accurately your own situation and investment options.

climalife®

SOLSTICE RANGE® : SUSTAINABLE SOLUTIONS FOR REFRIGERATION

1

COMPLIANCE WITH REGULATIONS

- **New systems:** with GWP <150, Solstice® solutions allow for **long-term regulatory compliance** in Europe and worldwide.
- **Existing systems:** retrofitting with R-448A / R-513A / R-450A allows the installations to be used until the end of their life, in compliance with the regulations.

2

LOW EMISSIONS

- Very low GWP values.
- R-455A / R-1234yf / R-1234ze, but also R-448A / R-513A / R-450A, contribute to the **reduction of energy consumption** in refrigeration systems.
- Lower pressures than CO_2 systems minimise the risk of leakage.

3

MINIMISED COSTS

- Low **CAPEX (capital costs)** due to simple technology.
- **Low energy costs** due to high efficiency and **low maintenance costs** (OPEX).
- Low risk of system failure due to maximum reliability.

4

MAXIMUM SAFETY

- **Components and systems** approved for "A2L" are **available**.
- The systems are **easy to** handle, install and maintain.
- **Minimal flammability risks** compared to hydrocarbons / **Low pressures** compared to CO_2 .

climalife®

THANKS FOR YOUR ATTENTION

climalife®

The expert in eco-efficient solutions to service the industry

www.climalife.com

Hall 7A

CHILLVENTA

Chillventa Specialist Forums 2022
Chillventa Fachforen 2022

CONNECTING
EXPERTS.