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TRANSPORTATION

APPLICATION : REFRIGERATED TRANSPORT

POSSIBLE SOLUTIONS

DESIGN OF THE SYSTEM

	R-454C / R-455A	R-290
Direct expansion design	No solution currently available, but can be considered	
Indirect expansion design or HP cascade	No solution currently available, but can be considered	Light commercial vehicle. Cascade system with R-744 on low-pressure side. Not a current solution by now.

	R-1270	R-744 (CO_2)
Direct expansion design		• Truck or trailer. Cascade system with R-1270 on high-pressure side. Not a current solution by now. • Light commercial vehicle. Cascade system with R-744 on low-pressure side. Not a current solution by now. • Seafreight container
Indirect expansion design or HP cascade	Truck or trailer. Cascade system with R-744 on low-pressure side. Not a current solution by now.	

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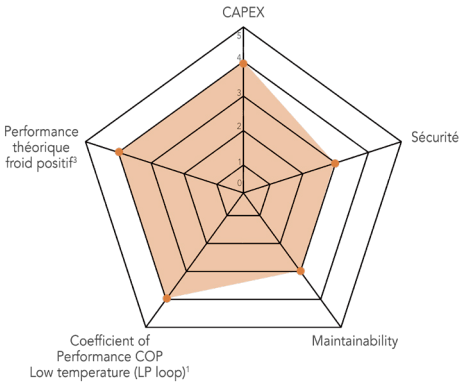
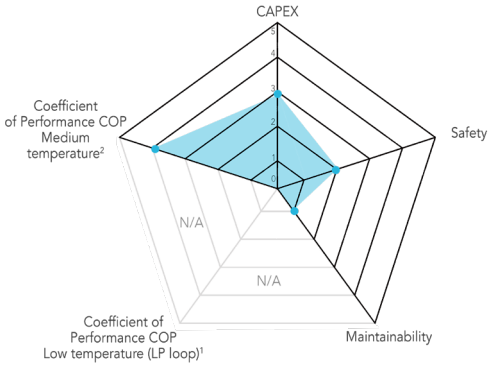
	R-454C / R-455A	R-290	R-1270	R-744 (CO_2)
Refrigerant type (HFC/HFO/HC/Inorganic)	HFC/HFO	HC	HC	Inorganic
GWP (according to F-Gas UE/2024/573)	146	0.02	0	1
Safety classification Lower Flammability Level LFL	R-454C: A2L - 0.293 kg/m³ R-455A: A2L - 0.431 kg/m³	A3 - 0.038 kg/m³	A3 - 0.046 kg/m³	A1
Classification (according to Pressure Equipment Directive PED)	1	1	1	2
F-gas quotas	Applicable	Non-applicable	Non-applicable	Non-applicable
Specific regulatory constraints	++	+++	+++	++
Maintenance complexity (training, safety, tooling, Personal Protection Equipment PPE ..)	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE
Coefficient of Performance COP (theoritical) - Medium temperature[1]	3.8	3.9	3.9	Non-applicable
Coefficient of Performance COP (theoritical) - Low temperature[2]	7.4	Non-applicable	Non-applicable	6.5
Technology readiness (prototyping, field test, availablity)	Not applicable	No specific certificate is required	No specific certificate is required	No specific certificate is required

[1] *Tk = 45°C - To = -10°C - SC = 5K - SR = 10K - Isentropic efficiency = 100%*
[2] *Theoritical estimation of of LP cascade performances : Tk = 0°C - To = -30°C - SC = 5K - SR = 5K - Isentropic efficiency = 100%*

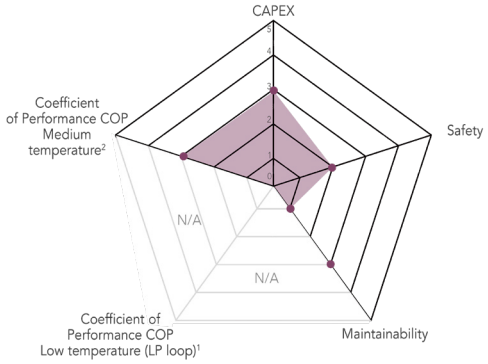
R-454C / R455A



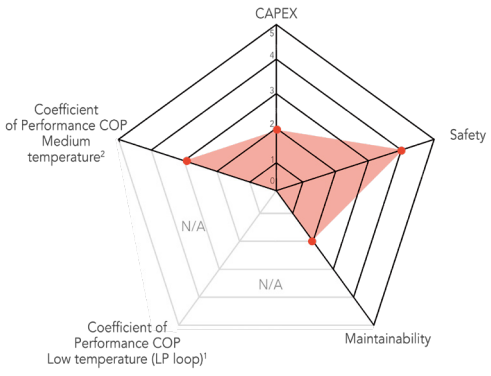
R-290



R-1270



R-744 (CO_2)



CONCLUSION

There are actually no widely-available GWP<150 solution that can address all the needs of the vehiculs. Manufacturers do currently tend to use R-454A, though with GWP = 237, but express concerns about the refrigerant strategy in regards of a lifespan of 12 years and potential regulatory changes, especially with the coming REACH legislation to PFAS. 2027 update of F-gas legislation is thought to bring clarity in refrigerant strategy. HFC/HFC blends are currently not used.
HC solutions are available in Germany and Austria, with direct expansion design or cascade system with R-744.
Some OEMs manufacture alternatives to vapor compression, like sorption sytems for light commercial vehicles (e.g. solid-gas sorption ones using R-717) or even liquid nitrogen cooling for refrigerated trucks and trailers.
These alternative solutions remain actually marginal, weighting for less than 2% of the market.

Data collection by
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POLE CRISTAL