COOLING CHOICES: BALANCING SAFETY, PERFORMANCE, AND COST – COMMERCIAL REFRIGERATION

COMMERCIAL REFRIGERATION (40 KW – 150 KW)

As the EU continues to prioritise industrial competitiveness within its policy agenda, the role of sustainable cooling solutions has never been more critical for businesses and consumers alike. Hydrofluoroolefins (HFOs), a widely adopted refrigerant technology, are now at the centre of a potential regulatory shift.

Moving away from HFOs would require availability of suitable alternatives. However, the current industrial alternatives in commercial refrigeration including Propane, CO2 and Ammonia could add cost increases to industry due to lower performance, increased maintenance, energy efficiency and retrofitting as drop in solutions are not viable. In addition unlike the alternatives, HFOs are non-toxic and have low flammability reassuring end users with safety concerns.

MAIN APPLICATIONS

Supermarkets and Grocery Stores: Used to keep produce, dairy, meat, and frozen foods fresh for consumers.

Cold Storage Warehouses: Designed for long-term storage of large quantities of perishable goods.

Healthcare Facilities: Used in hospitals and clinics to store medicines, blood, and laboratory samples safely.

Office Buildings: Helps maintain comfortable environments and precise climate control.

Industrial Processing: Critical in food and beverage industries for processing and preserving products.

Restaurants and Hotels: Vital for kitchen operations, storing ingredients, and serving guests.

HFOS VS ALTERNATIVES – COMMERCIAL REFRIGERATION (40 KW - 150 KW)

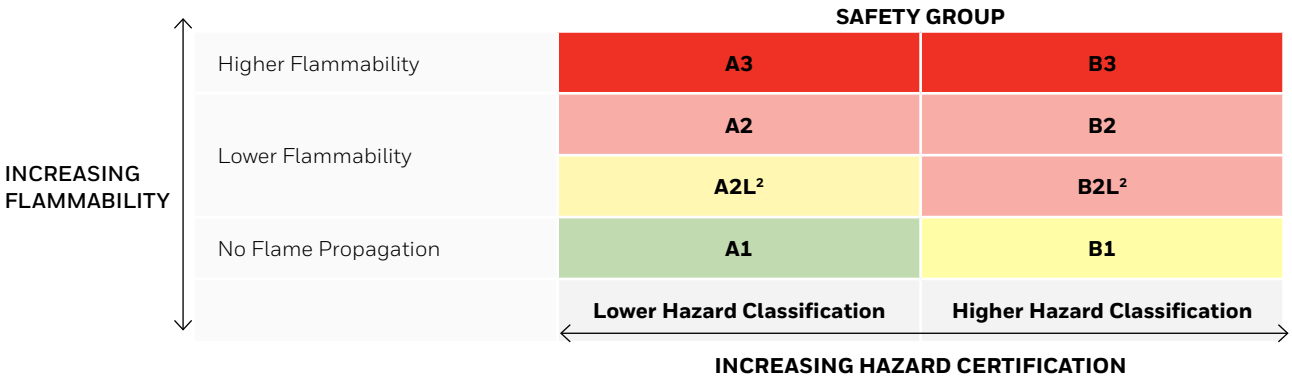
As you can see in the table below, across nearly all metrics; from Energy Efficiency to Hazard Classification and Managed End of Life - HFOs perform to or above expectations. This clearly demonstrates the unmatched utility of HFOs when compared with other industrial alternatives within Commercial Refrigeration.

	HFOs and HFO-blends (454C / 455A)	Propane	CO_2	Ammonia*
Energy Efficiency (device & system)	454C and 455A considered against 410-A[1]	Lower efficiency (5% to 21% more energy than HFO blends)[1]	Lower efficiency (8% to 50% more energy than HFO blends)[1]	N/A
Technical System Feasibility	Technically feasible with standard system cost[2]	Technically feasible, but higher system cost[3]	Technically feasible, but higher upfront system cost[4]	Technically feasible, but higher system cost[5]
ASHRAE Rating	A2L[7]	A3[7]	A1[7]	B2L[7]
Hazard Classification (CLP)	H280 – Gas under pressure [8] 	H280 – Gas under pressure [10] 	H280 – Gas under pressure [11] 	H280 – Gas under pressure [12] H331 – Toxic if inhaled [12] H314 – Severe skin burn / eye damage [12] H400 – Very toxic to aquatic life [12] H411 – Aquatic lasting effects [12*] 
Atmospheric Products	TFA, % varies with blends [13]	Contributes to ground-level ozone and aldehydes [14, 15]	Atmospheric accumulation [16]	Low air quality, fine particles, and nitrogen oxides (NOx) [17, 18]
Managed End of Life	Recovery or destruction as mandated by EU F-gas Regulation (Art. 8) [19]	Recovery and recycling for commercial systems [20]	Not mandated, usually released to atmosphere [21]	Mandated, however technically complex / costly, requires incineration or an aqueous treatment [20]
Current Availability of Refrigerant	Acceptable[8, 9]	Acceptable[10]	Acceptable[11]	Acceptable[12]
Equipment / System Adoption	Broad Range (Food Retail, Food Service, Chillers, Data Centres) [23]	Smaller Applications (Charge Limited, or Cascade) [23]	Hybrid Systems (Cold Storage, Supermarkets, Data Centers) [23]	Commercial (Cascade w/ CO_2 (warm climates >38 °C), Industrial [23, 24]
Payback Period / ROI	Assumed baseline [2, 22]	Increased (multiple compressors, extra leak detection / alarms) [3]	Increased (custom electronics, additional components / software) [4]	Increased (higher upfront costs, net cost increases over 20-years)
Future Development**	Enables next-gen high-efficiency turbo-compressor [25]	Enables next-gen high-efficiency turbo-compressors – with limited availability to date [25]	Incompatible with turbo-compressors, requires lubricants [25]	Incompatible with turbo-compressors, material limitations [25]

* Niche applications in commercial

** Turbo compressor refrigeration uses high-speed centrifugal compressors to compress and cool refrigerants, achieving efficient temperature control for large-scale industrial and commercial applications, such as air conditioning or process cooling

ASHRAE Designations and Safety Classifications of Refrigerants[1]



1 ASHRAE https://www.ashrae.org/file%20library/technical%20resources/refrigeration/unep---ashrae-factsheet--english----april2023.pdf

2 A2L and B2L are lower flammability refrigerants with a maximum burning velocity of < 3.9 in/s (10 cm/s)

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