

Low GWP refrigerant gases

For commercial and
industrial refrigeration



New F-gas regulation (UE) 2024/573 for refrigeration systems

European environmental regulations are creating new opportunities in the refrigeration market for operators who choose efficient technological solutions that comply with the new regulatory requirements.

The new F-gas Regulation (EU) 2024/573 requires that, in new commercial and industrial refrigeration systems, conventional high GWP HFC refrigerants be replaced with new low GWP HFO blends. Non-toxic and mildly flammable, these new refrigerants provide a solution that complies with the requirements of the new F-gas Regulation.

Pursuant to the new F-gas Regulation, HFO refrigerants will be in use for a long time, so the time is right for change.

A progressive reduction in the use of high GWP refrigerants by the refrigeration industry marks a shift towards the use of more environmentally friendly refrigerants. According to the Kigali Amendment to the Montreal Protocol, the goal of the new F-gas regulation is a net reduction in the consumption and production of HFCs by 2050.

While for refrigerated transport the GWP limit is set at 2,500, with the entry into force of the new F-gas rules, stationary refrigeration systems are subject to much stricter limits.

Unfortunately, no NON-flammable fluorinated refrigerants with low GWP are available, at least for low temperatures. This entails the need to use synthetic refrigerants in commercial and industrial refrigeration, such as HFO-based blends, which permit the use of standard equipment and simplified management of safety-related matters.



New F-gas Regulation (EU) 2024/573: bans for new installations

Stationary refrigeration		
Ban on placing on the European market		Effective
Household refrigerators and freezers that contain, or whose functioning depends on, fluorinated gases ⁽¹⁾		01/01/2026
Self-contained refrigerators and freezers for commercial use containing fluorinated gases with GWP ≥150		01/01/2025
Self-contained refrigeration equipment, other than chillers, containing fluorinated gases with GWP ≥150 ⁽¹⁾		01/01/2025
Refrigeration equipment, chillers, with the exception of chillers and appliances in the lines above and below, containing.	Fluorinated gases with GWP >2,500 with the exception of equipment intended for product cooling at temperatures below -50°C	01/01/2025
Fluorinated gases with GWP ≥1500 ⁽¹⁾		01/01/2030
Centralised multipack refrigeration systems for commercial use with nominal capacity ≥40 kW containing fluorinated gases with GWP ≥150 (Annex I to the Regulation), other than in the primary cooling circuit of cascade systems, where fluorinated gases with GWP <1,500 may be used.		01/01/2022
Chiller		
Ban on placing on the European market		Effective
Chillers with a rated capacity of up to 12kW that contain, or whose operation depends on,	Fluorinated gases with GWP ≥1500 ⁽¹⁾	01/01/2027
	Fluorinated gases ⁽¹⁾	01/01/2032
Chillers above 12kW that contain, or whose operation depends on, fluorinated gases with GWP =750 ⁽¹⁾		01/01/2025

(1) Except when necessary to meet safety requirements

Bans on the use of fluorinated gases for refrigeration equipment service and maintenance

Gas type	Quality	2024	2025	2026	2027	2028	2029	2030	2031	2032
Gas with GWP >2,500	Virgin	*	NO	NO	NO	NO	NO	NO	NO	NO
	Reclaimed	YES	YES	YES	YES	YES	YES	NO	NO	NO
Gas with 750< GWP <2,500	Virgin	YES	YES	YES	YES	YES	YES	YES	YES	NO
	Reclaimed	YES	YES	YES	YES	YES	YES	YES	YES	YES
Gas with GWP <750	Virgin	YES	YES	YES	YES	YES	YES	YES	YES	YES
	Reclaimed	YES	YES	YES	YES	YES	YES	YES	YES	YES

*Only in circuits with charge <40 ton CO₂ eq (e.g.,10 kg Virgin R404)

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What are A2L gases?
According to ISO 817:2014, refrigerant gases are divided into four categories based on their flammability level:

A1

Non-flammable

A2

Flammable

A2L

Mildly flammable

A3

Highly flammable

High flammability limit and extremely low flame propagation speed make ignition of A2L blends very difficult, which means they can be considered safe at ambient temperature and atmospheric pressure.

Classified according to ASHRAE safety standards, A2L refrigerants are characterized by mild flammability, low toxicity, and a low global warming potential (GWP). This category includes HydroFluoroOlefins (HFOs) and HFO blends. A2L refrigerants have operating characteristics similar to traditional refrigerants but offer a better safety profile compared to Ammonia and Hydrocarbons. From an energy perspective, they are more efficient than R-410A and transcritical CO₂ systems.

In the fight against climate change, A2L refrigerants have become replacements for HFCs and HCFCs in air conditioning and commercial refrigeration systems.

They are essential for helping companies meet global targets outlined in the Montreal Protocol and the Kigali Amendment of 2016, as well as the EU Green Deal objectives.

With increasingly stringent emission regulations, A2L and A3 gases are being used more in new HVAC/R systems.

Solutions based on HFO A2L are one of the options available in the transition away from traditional refrigerants. For example, the HFO refrigerant R-1234yf offers a 99% reduction in GWP compared to R-134a.

Their low GWP and mild flammability make HFO A2Ls a compatible solution in light of the restrictions imposed by the new F-gas Regulation 2024/573.

HFOs offer several advantages over natural gases such as ammonia, CO₂, and Propane, including lower total cost of ownership, greater product availability, and, in some cases, an improved safety profile.

Thanks to their physical properties being similar to HFC refrigerants, they are also relatively easy to use and do not complicate system design.

Comparison of Properties between Propane R-290 (Flammability Class A3) and R-454C (Flammability Class A2L)

	R-290 (Propane)	R-152a	R-717 (Ammonia)	R-454C Opteon™ XL20
Classification	A3	A2	B2L	A2L
Lower and Upper Flammability Limit LFL (vol. %) kg/m³	[0.038]	[0.130]	15.0 [0.130]	[0.293]
Minimum Ignition Energy MIE (mJ)	0.25	0.38	680	>300
Flame Front Propagation Speed BV (cm/s)	46	23	7,2	1.6
Heat of Combustion HOC (kJ/g)	43.3	16.5	18.6	10.5

Nippon Sanso' solutions

Refrigerants R-455A (Solstice® L40X) and R-454C (Opteon™ XL20 by Chemours) provide cutting-edge solutions to achieve energy efficiency, T.E.W.I. values compatible with the applications in question, and total costs (CapEx + OpEx) over the system's life cycle in medium and low temperature refrigeration.



R-455A - Solstice® L40X

Zeotropic mixture of HFO/HFC with the addition of a small percentage of mildly flammable R-744, designed to serve as an alternative in low, medium and high temperature applications in new systems. Its ultra-low GWP of only 146 (<150) makes it compatible with the new rules on F-gases. Designed to allow a rapid transition from R-448A and R-404A to very low GWP levels. As a class A2L gas it is subject to larger charge limits than highly flammable A3 gases.



R-454C - Opteon™ XL20

Mildly flammable refrigerant with a global warming potential (GWP) below 150 for replacing R-404A and R-22 in newly installed refrigeration systems. Based on low GWP hydrofluoro-olefins (HFOs), Opteon™ XL20 is an optimal refrigerant with the right properties to replace R-404A and R-22 in commercial and industrial low and medium temperature direct-expansion refrigeration systems. Opteon™ XL20 is subject to much larger charge limits than other more highly flammable refrigerants and, with a GWP of 148, falls under the threshold value of <150 provided for in F-gas Regulation 517/2014, which makes it eminently suitable for hermetically sealed systems.

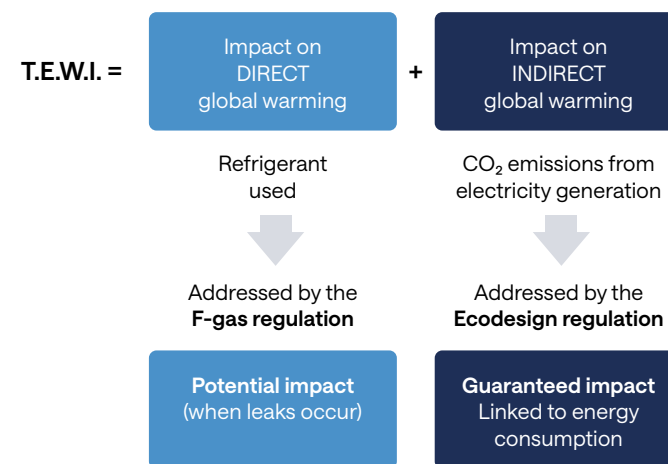
	R-455A Solstice® L40X	R-454C Opteon™ XL20
Type	Zeotropic Blend	Zeotropic Blend
Composition	R-32 21.5% R-1234yf 75.5% CO ₂ 3%	R-32 21.5% R-1234yf 78.5%
GWP	146	148
Critical temperature	85.6°C	82.4°C
Boiling point under 1 atm	-52°C	-46°C
ASHRAE class	A2L	A2L
Lower flammability limit	0.431 kg/m³	0.293 kg/m³
Temperature Glide	14k	6k

Both gases are suitable for use in commercial refrigeration, in both storage and freezing cold rooms, and can be used in many segments of the HVACR industry, including:

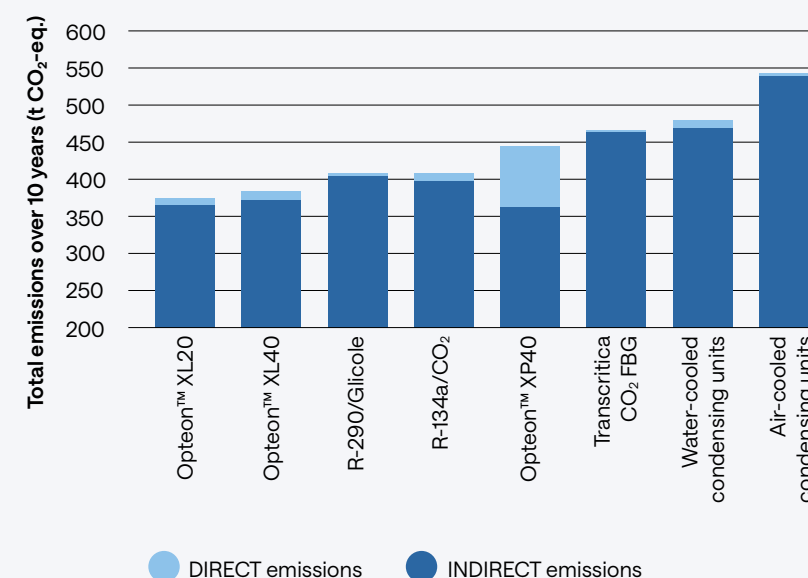
- small charge plug-in units
- moto-condensing units and monoblocks for cold rooms
- small-sized refrigerators, heat pumps and chillers
- compressor racks within the admissible charge limits

An aerial photograph showing a dark, winding road or path that curves through a dense forest. The trees are heavily covered in snow, appearing as a bright white and light blue texture. The road itself is a dark, continuous line that meanders from the top right towards the bottom right of the frame.

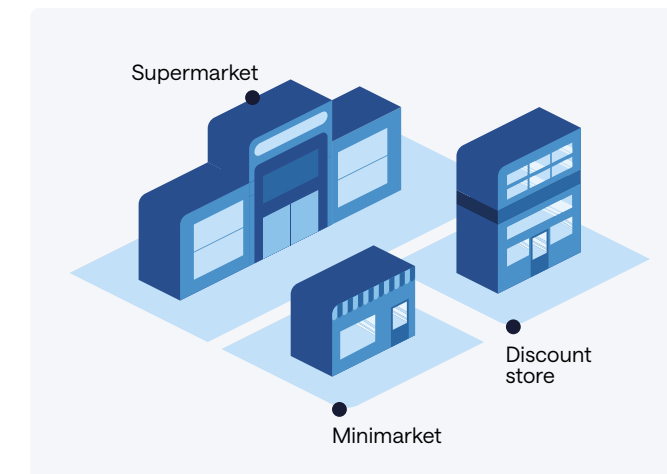
Such emissions account for the greatest share of the impact on the environment and reflect the operating costs due to electric energy consumption over the lifespan of refrigeration systems. The sum of the direct and indirect impact is the **Total Equivalent Warming Impact (TEWI)**.



With low GWP refrigerants the incidence of direct emissions is lower.



One of the aims of Nippon Sanso is to help large-scale retail operators choose the best system solution. The new low GWP HFO refrigerants enable the plant to operate effectively and reduce leakage rates, thanks in part to the availability of compatible components. In order to reduce indirect emissions and operating costs in commercial refrigeration and large-scale retailing, a parameter to be considered is the area of the store.



Refrigerants R-455A and R-454C are the right choice for retail premises measuring from 300 to 2,000 m². Unlike transcritical CO₂ systems, A2L refrigerants don't require high operating pressures or complex components, which helps reduce installation costs and simplifies system management. In commercial refrigeration, A2L gases may be likened to class A1 (non-flammable) gases in terms of safety at atmospheric pressure and ambient temperature and do not require ATEX certifications unless the system is installed in an explosion-hazardous location.



Low noise level

Making life better through gas technology



Nippon Sanso Industrial S.r.l.

Single Member Company subject to management
activity and coordination of Nippon Sanso Italia S.r.l.
Cap. Soc. € 46.326.216 i.v.
RE. of MI-MB-LO / C.F. / VAT number 08418350966
Rea of MI - 2024603

Headquarter

Via Benigno Crespi, 19 - 20159 Milan
Ph. +39 02771191 - Customer care 011 22 08 911

info.italy@eu.nipponsanso.com

eu.nipponsanso.com/it