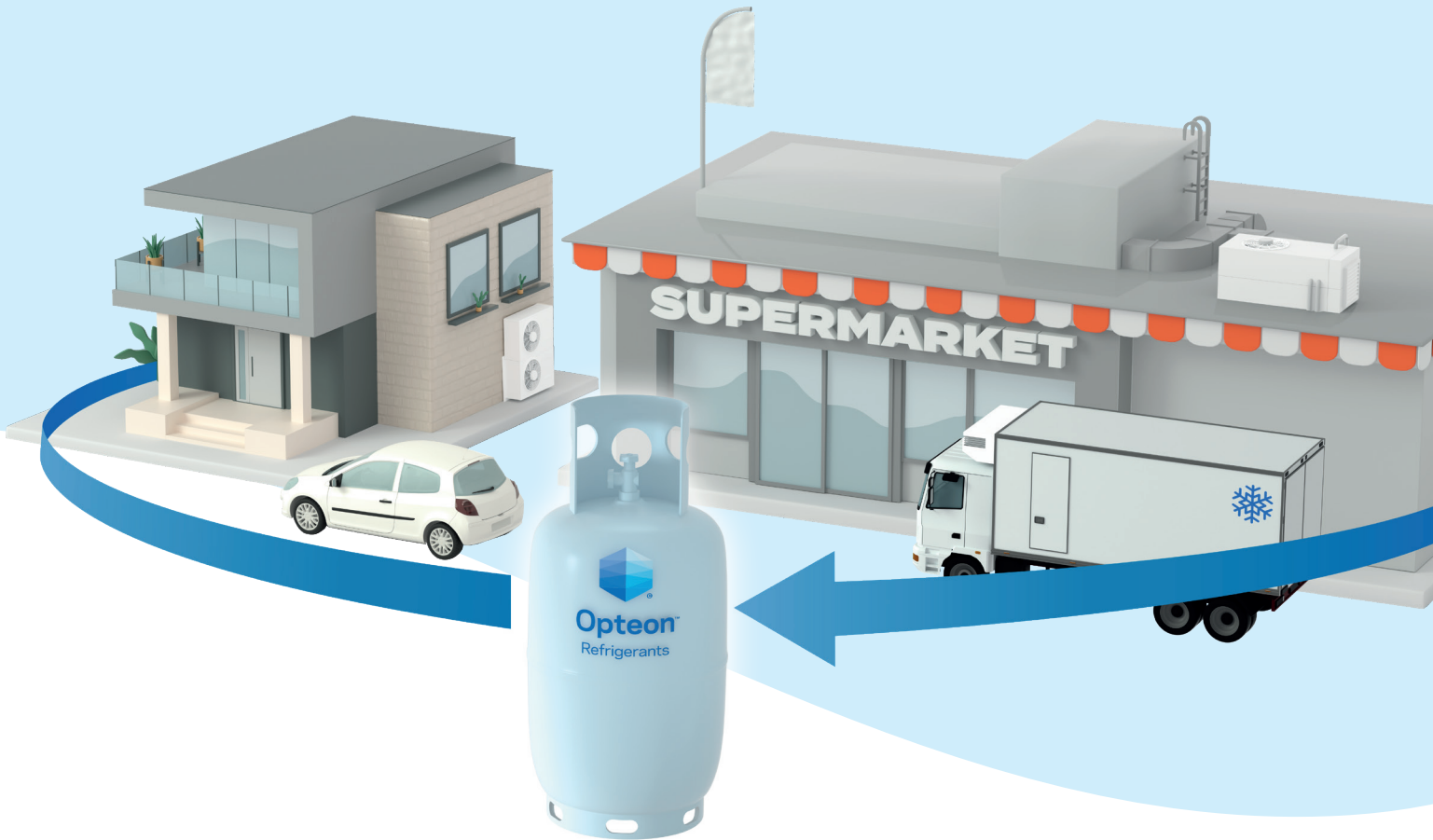




# Opteon™ XL Time for Energy Efficiency

What every business should  
know about refrigerants



## Introduction

No matter what type of business you run, or what type of heating, ventilation, air conditioning or refrigeration equipment you use, understanding energy-efficiency has become a crucial factor in day-to-day operations and controlling long-term costs.

This guide can help you understand the most important factors to consider when choosing a sustainable refrigerant solution. One that is not only cost-effective now and, in the future, but also contributes to reducing system emissions.

Opteon™ can enable every business that uses refrigerants to make energy-efficient and cost-effective choices that support the reduction of carbon emissions to meet European and global climate targets.



# The benefits of getting it right

Efficiently optimizing refrigerants in HVACR systems will yield the following benefits:



**Compliant** with international and regional regulations on ozone depletion and global warming potential. Leading international regulations enforce the phase-down of high Global Warming Potential refrigerants, in favor of lower GWP solutions. GWP values are defined by the United Nations Intergovernmental Panel on Climate Change (IPCC).



**Safe** to handle during installation, maintenance, and operation. Refrigerants with lower flammability and low toxicity contribute to overall safety protocols within your business.



**Cost-effective** design, installation, and maintenance of HVACR equipment.



**Versatile** — for a wide range of applications and system designs.



**Energy-efficient** — a reduction in the cost per kW of cooling or heating capacity and ultimately of energy bills.



**Sustainable** — enabling the decarbonization of heating through electrification and waste heat recovery, which in combination with the use of renewable energy helps driving down total system emissions and achieving carbon reduction targets.

## Understanding different types of refrigerants

This chart shows the properties of commonly found refrigerants, some of which are being phased-down or phased-out in favour of lower-GWP alternatives with suitable thermodynamic and safety properties for the applications they are designed for.

Group	R-Number	Known as	GWP (AR4)	Toxicity	Flammability	Supply status	Typical system application
Hydrocarbon (HC)	R-290	Propane	3	Lower (A)	Higher (3)	Good	Residential and commercial refrigeration and heating
Inorganic	R-744	CO <sub>2</sub>	1	Lower (A)	NFP (1)	Dependent on other industries	Commercial refrigeration & Industrial refrigeration
	R-717	Ammonia	0	Higher (B)	NFP (1)		
HydroFluoroCarbons (HFC)	R-404A	Freon™ 404A	3922	Lower (A)	NFP (1)	Low Low Low	Commercial refrigeration, Heat Pump & Mobile air conditioning
	R-410A	Freon™ 410A	2088	Lower (A)	NFP (1)		
	R-134a	Tetrafluoroethane	1430	Lower (A)	NFP (1)		
Hydrochlorofluorocarbon (HCFC)	R-22	Freon™ 22	1810	Lower (A)	NFP (1)	Very low	Air conditioning & commercial refrigeration (being phased-out)
Hydrofluoroolefins (HFO)	R-454C	Opteon™ XL 20	148	Lower (A)	Lower (2L)	Good	Commercial refrigeration, Heat Pump & Mobile air conditioning
	R-454B	Opteon™ XL41	466	Lower (A)	Lower (2L)		
	R-1234yf	Opteon™ YF	4	Lower (A)	Lower (2L)		
	R-513A	Opteon™ XP 10	631	Lower (A)	NFP (1)		

# Refrigerant glossary

The following terms are typically used when talking about refrigerants for HVACR systems:

## Global Warming Potential

The level of heat a gas traps in the atmosphere compared to Carbon Dioxide CO<sub>2</sub> which has a GWP of 1.

## Ozone depletion

The ozone layer is a naturally occurring gas found in the atmosphere that absorbs most of the sun's ultraviolet light. Substances that degrade this layer are known as ozone-depleting.

**F-gas** Fluorinated gases are commonly used in heating, ventilation, air-conditioning and refrigeration systems. They are a group of halogenated gases commonly referred to as F-gases.

**HydroFluoroOlefins (HFOs)** are non-ozone-depleting gases with low or ultra-low global warming potential.

**HydroFluoroCarbons (HFCs)** are non-ozone depleting gases which, alongside some hydrocarbons and CO<sub>2</sub>, have been identified in the early 80s to contribute to global warming by the Intergovernmental Panel on Climate Change (IPCC).

**HFO blends** are a mix of refrigerant fluid molecules composed to perform in HVACR systems.

**A2L** Refrigerant safety classification is divided into different groups according to toxicity and flammability. A2L is lower toxicity (A) and lower flammability (2L).

## HVACR

(H) heating, (V) ventilation, (AC) air conditioning and (R) refrigeration

## NFP

No Flame Propagation

# Energy-efficiency and refrigerant best practices

Energy-efficiency is an important factor when evaluating the operating energy costs of any HVACR system, and most businesses will focus on day-to-day energy consumption levels in order to keep costs under control. However, other operational factors which impact energy-efficiency longer-term, such as equipment performance and energy recovery systems, which optimize waste heat, should also be considered.

For example, a study<sup>1</sup> examining three different commercial refrigeration application scenarios:

- 1) back of store cold rooms;
- 2) retail area refrigeration; and
- 3) central distribution centre (CDC) cold rooms,

found variances in system emissions and life cycle costs when different types of refrigerants were used.

In another study<sup>2</sup> comparing six different refrigeration technologies, in different climates, using either an inorganic refrigerant (R-744 - CO<sub>2</sub>) or HFO (R-454C - Opteon™ XL20), the latter demonstrated lower emissions and energy expenditure while still being competitive on installation and maintenance costs.

Emissions were calculated in terms of mass of Carbon Dioxide per kilowatt-hour of electricity. Therefore, the greater the energy consumption, the greater the indirect carbon dioxide emissions.

System performance calculations were made using cycle calculation models using

compressor volumetric and isentropic efficiencies reported by the compressor manufacturers.

In domestic applications such as heat pumps, energy-efficiency is calculated using the equipment Seasonal Coefficient of Performance (SCOP). In our paper “Low-GWP Refrigerants: Setting the Benchmark in Heat Pump Efficiency (2021)” a specifically developed technical tool to compare refrigerants for heat pump applications, showed there are marked differences between HFCs and HFO blends in terms of efficiency.

In a wider range of domestic HVACR applications featuring heat exchangers, the glide of a refrigerant can have an impact on performance, as well as introducing servicing challenges. Glide describes the temperature difference at which the liquid refrigerant bubble becomes gaseous. Refrigerants with a limited glide can potentially allow efficiency gains and are a compatible low-GWP alternative to legacy refrigerants, in addition glide can have positive effects on efficiency when taken into account by the equipment design.

## Questions to ask regarding energy efficiency when evaluating a refrigerant for your HVACR system:

What levels of system energy consumption and expenditure can we expect?

What is the typical capital expenditure impact on installation and over a typical 10-year period?



# Locking in energy efficiency and operational effectiveness

With the drive towards the adoption of more sustainable lower GWP refrigerant solutions for HVACR systems, the practical side of implementing any new solution also needs to be carefully considered.

## Equipment

There are now lower GWP refrigerant solutions on the market that can be retrofitted into existing equipment to replace less sustainable refrigerants. Where equipment is still operationally viable and an investment in a new system is not economic, selecting replacements that match existing system performance and efficiency is key. Equally, when designing the next upgrade or innovation for HVACR systems and applications, sustainable, operationally safe solutions should be considered.

## Supply

It's important to note that the current regulatory landscape does not seek to prescribe solutions for HVACR. Instead, the objective is to establish a framework for reducing environmental impact and facilitating numerous technology options that best balance specific system requirements.

However, as the phase-down of higher GWP refrigerants accelerates, the supply of legacy solutions will come under greater pressure, impacting continuity of operation and also cost. Every business should therefore be cognizant of the potential exposure on supply and cost for their HVACR systems or designs.

## Safety

Flammability is a major safety issue when handling refrigerants during installation, maintenance and also during operation. The potential flammability risk should be assessed. For instance, in a leak scenario, it is critical to know whether a refrigerant can ignite or, when ignition happens, that propagation can often be difficult to avoid.

Product specification documentation indicates the correct classification for each refrigerant, as follows:

### Safety classification

↑ INCREASING FLAMMABILITY	Higher flammability	<b>A3</b>	<b>B3</b>
	Flammable	<b>A2</b>	<b>B2</b>
	Lower flammability	<b>A2L</b>	<b>B2L</b>
	No flame propagation	<b>A1</b>	<b>B1</b>
		Lower toxicity	Higher toxicity
		→ INCREASING TOXICITY	

## ASHRAE Refrigerant safety group classification

Interoperability cannot be assumed. Components and devices made for A1 or A2L refrigerants for instance, cannot be used with A3 refrigerants, as they are specifically designed for no flame propagation or lower flammability. Whereas the other way around might be possible depending on the conditions.

In today's market for HVACR systems, equipment designed for A2L refrigerants and in particular qualified with Opteon™ XL is now broadly available.

### Operational questions to ask when evaluating a refrigerant for your HVACR system:

What is the likelihood of my equipment or product requiring a more sustainable solution in the near future?

What is the anticipated supply and potential for fluctuating costs of my current refrigerant?

What is the flammability risk of the current or considered solutions?



# The Opteon™ XL range

**Opteon™ XL** refrigerants are a range of non-ozone-depleting, very low GWP solutions. They are designed for enabling modern equipment to work efficiently and to replace high environmental impact systems.

**Opteon™ XL** refrigerants offer multiple essential benefits for a wide variety of applications.



## Cost-effective

Opteon™ XL refrigerants offer lower installation, operation and maintenance costs.



## Energy-efficient

The Opteon™ XL range allows for the reduction of system emissions through increased efficiency.



## Reliable equipment

Opteon™ XL refrigerants are versatile and offer long-term operational benefits for system equipment.



## Sustainable

Opteon™ XL refrigerants enable lower carbon emissions for true long-term system sustainability.



## Compliant

The Opteon™ XL range facilitates compliance with new regulations driving higher global warming potential refrigerants phase-down.



## Safe

Opteon™ XL refrigerants are less likely to ignite as they are classified with lower flammability.





**Is the temperature glide of Opteon™ XL refrigerants (i.e., XL20 and XL40) much higher than the common Opteon™ XP40 (R-449A)?**

No it isn't. The real difference is of 0,5 to 1K at the evaporator and 0,5 to 1,5K at the condenser.

**Which temperatures and pressure do I have to deal with when using Opteon™ XL refrigerants?**

The same as the standard for direct expansion refrigerants (R-404A, R-449A).

**Is equipment released for Opteon™ XL refrigerants readily available on the market?**

Yes. All main equipment manufacturers have released product lines to be used with Opteon™ XL refrigerants. (Moreover, some are merging A1 and A2L ranges in one only line.)

**Is the maintenance of Opteon™ XL systems easy to perform?**

Yes, it is. The Opteon™ XL systems are as simple as the standard low pressure direct expansion loops, and do not require additional skills for proper maintenance.

**Can the best efficiency be guaranteed for the entire life of the Opteon™ XL system to ensure the lowest energy consumption and costs?**

Yes. The simplicity and low operating pressure of Opteon™ XL installations make it easy to obtain high efficiencies even at high ambient temperatures.



## Our Team

We believe in superior product solutions paired with a strong, knowledgeable team to support our customers. Rely on our experts to help you build a more sustainable solution for your business.



1. Low-GWP Refrigerants Good for the Planet, Good for your Bottom Line, Chemours
2. The Path to Reducing Climate Change Emissions from Commercial Refrigeration Applications, Chemours

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