

# Advisory Note

A Service to A.G. Coombs Group Clients.

## The Future of Refrigerants

As the world grapples with rising temperatures caused by the emission of greenhouse gases, refrigerants are under renewed scrutiny, as common refrigerants are classified as greenhouse gases which can be hundreds or even thousand times worse from a Global Warming Potential (GWP) versus the equivalent volume of natural refrigerants such as carbon dioxide (CO<sub>2</sub>).

This Advisory Note provides an update on refrigerants in the commercial HVAC industry.

### HFC Phase-down

Since the phase-out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) the most common type of refrigerant available in the market today are hydrofluorocarbons (HFCs).

HFCs are synthetic, manufactured refrigerants, that were widely implemented predominantly due to their inability to break down and deplete the ozone layer (also known as having Zero Ozone Depletion Potential - ODP). HFCs are beneficial due to their efficient heat transfer properties, whilst being both inert and non-toxic.

The major problem with HFCs arise from their global warming potential (GWP). GWP is a physical property of greenhouse gases which indicates the propensity of the gas to trap atmospheric heat. The Montreal Protocol on Substances that Deplete the Ozone Layer is an international agreement made in 1987. It was designed to stop the production and import of ozone depleting substances and reduce their concentration in the atmosphere to help protect the earth's ozone layer. The global HFC phase-down under the Montreal Protocol was agreed in 2016 in Kigali. This amendment will phase-down their product and imports of HFCs by 85% between 2019 and 2036.

In response to this, the Australian Government has initiated a "HFC Phase-down", in line with many developed nations in the world. The HFC Phase-down is a gradual reduction in the maximum amount of HFCs permitted to be imported into Australia.

### Current Refrigerant Market

The structure of the Australian Government HFC Phase-down is geared towards limiting the importation of HFC gases, with a view of encouraging market forces to determine the best solution. As such, it is useful to observe the market to see what changes, trends and innovations are taking place.

### HFC Alternatives

Awareness of the issues with HFCs preceded the implementation of the government phase-down in 2018. HVAC equipment manufacturers, especially those with a global presence, had been working on developing equipment that functions on alternative refrigerants for some time.

Currently, the alternatives can be split broadly into three separate chemical groups. They are:

- + Hydrofluoroolefins (HFOs) – These compounds are synthetic organic compounds composed of hydrogen, fluorine and carbon. These compounds generally have low GWPs, however they can be slightly flammable.
- + HFC-HFO Blends – A transitional family of refrigerants blends that leverage the respective benefits of both HFOs and HFCs. These blends are a short-term solution which have a GWP approximately half that of HFCs.
- + Natural Refrigerants – These are refrigerants with simple chemical composition, such as Ammonia (NH<sub>3</sub>) and carbon dioxide (CO<sub>2</sub>). These refrigerants are typically not as easy to use and require significantly more engineering in the machinery. Despite this, these compounds are generally very well understood due to their abundance in usage throughout history. Furthermore, both substances have 0 ODP, and a GWP of 0 and 1 respectively.

A broad comparison of the different families of refrigerants is displayed in the table below.

Refrigerant Family	Thermodynamic Properties	Current Efficiencies	Safety	ODP	GWP	Overall environmental Impact understanding
HFC	Excellent	Excellent	Excellent	Excellent	Very Poor	Understood
HFO	Very Good	Very Good	Requires Some Engineering	Very Good	Very Good	Somewhat Understood
HFC-HFO Blend	Very Good	Very Good	Very Good	Excellent	Poor	Somewhat Understood
Natural	Very Good	Good	Requires Significant Engineering	Excellent	Excellent	Very Well Understood

### Current Refrigerant Trends

When reviewing refrigerants, it is also important to understand their safety classification, and in particular, their flammability. ISO established a system for assigning safety classifications and is adopted in AS/NZS 5149.

Current refrigerant trends with regard to chillers available in the Australian market are outlined as follows:

- + R134a (HFC) is the current predominant refrigerant in the Australian market and has an A1 safety rating. R134a is included in the phase-down due to its high GWP of 1300.

A.G. Coombs Group Pty. Ltd.

Melbourne | Sydney | Brisbane | Canberra

P: +61 3 9248 2700 F: +61 3 9248 2751 W: www.agcoombs.com.au

Published February 2022. While every effort has been made to ensure the accuracy of information in this publication, the A.G. Coombs Group assumes no responsibility for errors or omissions for any consequence of reliance on this publication.



## Advisory Note: The Future of Refrigerants

- + R1234ze (HFO) is mostly used through Europe and Asia and is currently the most developed HFO refrigerant, with excellent full load and part load efficiencies. Its GWP is less than 1; however, it has an A2L safety classification (meaning a low flammability rating) which may require additional ventilation in plantrooms.
- + R1233ze (HFO) is the predominant HFO offered in North America, with its A1 safety rating and low GWP of 4.5. R1233ze Chillers are typically negative pressure machines which are generally heavier compared to positive pressure machines at the same capacity therefore are better suited to new builds compared to retrofitted due to their additional structural impacts.
- + R513a is a HFC/HFO blend and is used as a direct replacement (“drop-in”) for R134a. It provides a reduced GWP to 631 with only a slight reduction in capacity and efficiency. This is an interim option as it is not clear yet if this blend will be impacted by the HFC phase-down.

		Refrigerant Safety Groups	
		A3	B3
FLAMMABILITY	Higher	A3	B3
	Lower	A2	B2
	Difficult to Ignite and Sustain	A2L	B2L
	No Flame Propagation	A1	B1
		Lower	Higher
		TOXICITY	

Reference: AS/NZS ISO 817-2016

### What does this mean for commercial HVAC systems?

With the phase-down of HFC refrigerants, there will be reduced supply, and this is likely to result in increasing cost of the gas over time. This has been observed with an increasing cost of R134a over the past 5 years.

**In common with the previous refrigerant phase-outs, the following actions are recommended to pre-empt and prepare for this issue:**

1. Keep an accurate asset schedule of all equipment incorporating HFC refrigerants. This should list the plant age, refrigerant, refrigerant charge and chiller capacity.
2. Speak with your mechanical maintenance providers to identify any plant that is currently operating with HFC refrigerant and consistently requires additional gas replenishment or ‘gas topping’ over its life, as this will impact on energy consumption and operating costs due to the rising cost of the refrigerant.
3. Prepare a refrigerant management plan reviewing the existing plant design, condition, age and capacity of air-conditioning equipment and identify whether a retrofit or replacement strategy is proposed for the asset/s.
4. Review your chiller plant replacement strategies to assess the available HFO chiller refrigerant options, part load efficiencies, plant ventilation requirements, weight and impact on the building structure and overall impact on the total cost for replacement of the asset.

5. Review your need for reverse cycle chillers (or heat pumps) as we move away from gas-fired plant for space heating and adopt electric heat pumps for heating applications. Consideration of systems that can offer both cooling and heating at the same time to leverage cost efficiencies during capital upgrade works.

It should be noted that the Kigali agreement is a phase-down and not a phase-out, meaning there are no HFC production bans as there were with like there was with hydrochlorofluorocarbons (HCFCs) such as R22; however, it is still important to consider the selection of the refrigerants in any new and replacement plant.

It is also important to understand that as the demand for HFO refrigerants grow, the list of approved HFC substitutes will likewise expand and better alternatives will enter into the market, whilst at the same time the new HFO machines’ pricing will become more competitive.

**For more information about Refrigerant Management, contact:**

**Jamie Park** – A.G. Coombs Advisory  
**P:** +61 3 9248 2700 **E:** [jpark@agcoombs.com.au](mailto:jpark@agcoombs.com.au)