# The Big Short: Australia's Refrigerant Supply Challenge




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REFRIGERANTS AUSTRALIA

EXPERT GROUP

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# 1 Executive Summary

## Australia is entering the most challenging stage of the HFC phase-down

Australia's import quota on bulk hydrofluorocarbons (HFC) which is used for service and manufacturing will be reduced by 45% from 2025 to 2030. This reduction takes the quota from 5.25 million tonnes (Mt) of carbon dioxide equivalent ($CO_2$-e) in 2025 to 2.90 Mt in 2030. Over the same period, the market must continue to service a large installed-equipment bank that requires substantial quantities of HFC-404A, HFC-410A and HFC-134a. Phasing out this technology is slow and it will likely remain in operation for many years. Since the quota constrains imports on a $CO_2$-e basis, continuing demand for these higher global warming potential (GWP) refrigerants disproportionately consumes quota and reduces the physical tonnes of refrigerant that can be supplied in Australia.

**Refrigerant shortages are now inevitable. The key uncertainty is when and where they will emerge, which refrigerants will be affected, and which applications will be most exposed. Australia will not simply "run out" of refrigerant at a national level. Shortages will emerge progressively, first affecting individual refrigerants, suppliers and regions, well before the aggregate national inventories are exhausted.**

## Supply is tightening faster than demand can adjust

The underlying challenge is the mismatch between the rate at which HFC supply is being constrained and the rate at which refrigerant demand can decline. **Under the Baseline scenario, aggregate bulk import volumes of HFC refrigerant decline by approximately 34% between 2025 and 2030, while refrigerant usage declines by only around 21%.** A progressively lower-GWP import mix allows more physical tonnes to be supplied within the available quota, while reclamation, recycling and re-use provide additional supply. However, these adjustments are not sufficient to fully offset continuing servicing demand from the installed equipment bank.

Industry feedback indicates that aggregate refrigerant inventories at the beginning of 2026 were unlikely to have exceeded 1,500 tonnes, equivalent to around five months of supply based on 2025 usage. This relatively limited opening inventory provides the buffer between declining bulk imports and continuing servicing demand. **Under the Baseline scenario, aggregate stock will fall to 950 tonnes by December 2026, recover modestly during 2027, then decline sharply following the next quota reduction in 2028 (refer Figure 1). Inventories will fall to approximately 216 tonnes by December 2028 and be effectively exhausted during late 2029.** The scenario is not a certainty but illustrates how quickly the available inventory buffer could be eroded if demand adjusts at the rate assumed in the Baseline scenario.

Importantly, industry feedback indicates that stocks of **some individual legacy refrigerants could become critically low during late 2026 or over the 2026-27 summer period**, well before aggregate national inventories are exhausted.

The pressure was already visible in 2025. Estimated HFC usage was approximately 3,598 tonnes compared with 2,846 tonnes of bulk imports. The difference of 752 tonnes was supplied from

refrigerant that was already within the Australian market. Approximately 90% of this physical difference was attributable to HFC-410A and HFC-404A.

## The risk is concentrated in the legacy refrigerant bank

As summarised in Table 1, HFC-404A and HFC-410A represent the principal near-term supply risks. Commercial refrigeration remains heavily dependent on HFC-404A and has relatively high refrigerant leak rates, creating substantial recurring servicing demand. Supply constraints have the potential to affect supermarkets, food retail, hospitality, cold storage and other critical temperature-controlled applications.

Stationary air conditioning presents a different challenge. Australia had an estimated 22,000 tonnes of HFC-410A in installed equipment in 2022, representing approximately 40% of the regulated refrigerant bank by mass (DCCEEW 2024a). Although new equipment is transitioning rapidly towards HFC-32 and other lower-GWP technologies, the existing HFC-410A fleet will require servicing for many years and there is no practical retrofit pathway for much of this equipment.

HFC-134a is less exposed in the immediate term because recent bulk imports have been more closely aligned with usage. However, supply pressure will increase from 2028 onwards, particularly if demand does not decline in response to tightening supply and higher prices. Mobile air conditioning is the principal exposure, with the Australian vehicle fleet continuing to generate substantial HFC-134a servicing demand.

## National supply is not a national stockpile

The structure of Australia's refrigerant market increases the potential for shortages to emerge before aggregate national inventories are depleted. Importers operate independently, with different quota positions, refrigerant mixes, inventories and customer requirements. A supplier can therefore exhaust its stock of a particular refrigerant while another supplier continues to hold inventory. Commercial arrangements and established distribution channels can also limit the extent to which importers can redistribute refrigerant.

Australia's geographic scale adds another constraint. Refrigerant inventories are dispersed across more than 200 wholesale outlets and storage facilities and cannot be regarded as a single readily interchangeable pool. The availability of certain refrigerants may therefore vary between suppliers, regions and individual branches, resulting in localised and supplier-specific shortages well before aggregate national stock approaches zero.

Supply pressure is also highly seasonal. The greatest pressure occurs during Q4 and early Q1, when refrigerant demand rises leading into summer, inventories have been progressively drawn down, and late-year imports reduce. A new quota period provides renewed capacity to import from January, but quota availability does not necessarily translate into immediate physical supply. Manufacturing, shipping and domestic distribution lead times mean shortages emerging in late Q4 may continue into the following year before replacement stock becomes available. This can be compounded by the Chinese New Year period, when manufacturing and logistics activity in China slows or temporarily ceases, potentially delaying Q1 production and shipments to Australia.

## The speed of transition will determine the severity of the adjustment

Australia commenced its HFC phase-down in 2018 with time for equipment and refrigerant use to progressively transition towards lower-GWP alternatives. Almost a decade later, that transition remains incomplete in several major applications. Large installed banks of HFC-404A, HFC-410A and HFC-134a continue to generate servicing demand, while high-GWP refrigerants continue to enter the installed equipment bank in some applications even where lower-GWP technologies are available.

At the same time, parts of the market demonstrate that transition can occur with relatively limited disruption. Applications that have already moved to lower-GWP technologies, or where equipment can be readily replaced, have materially lower exposure. This includes domestic refrigeration, self-contained commercial refrigeration, small split-system air conditioning and several heat-pump applications.

The market is already responding to tightening supply and higher prices. HFC-404A usage began declining during the second half of 2025 as lower-GWP alternatives gained ground. This shift was aided by increasing refrigerant prices that strengthen the commercial incentive for substitution in addition to equipment replacement, improved containment and greater recovery and re-use of HFC-404A. This response will become increasingly important as the quota tightens, but the large installed bank means that market adjustment alone will take time to be effective.

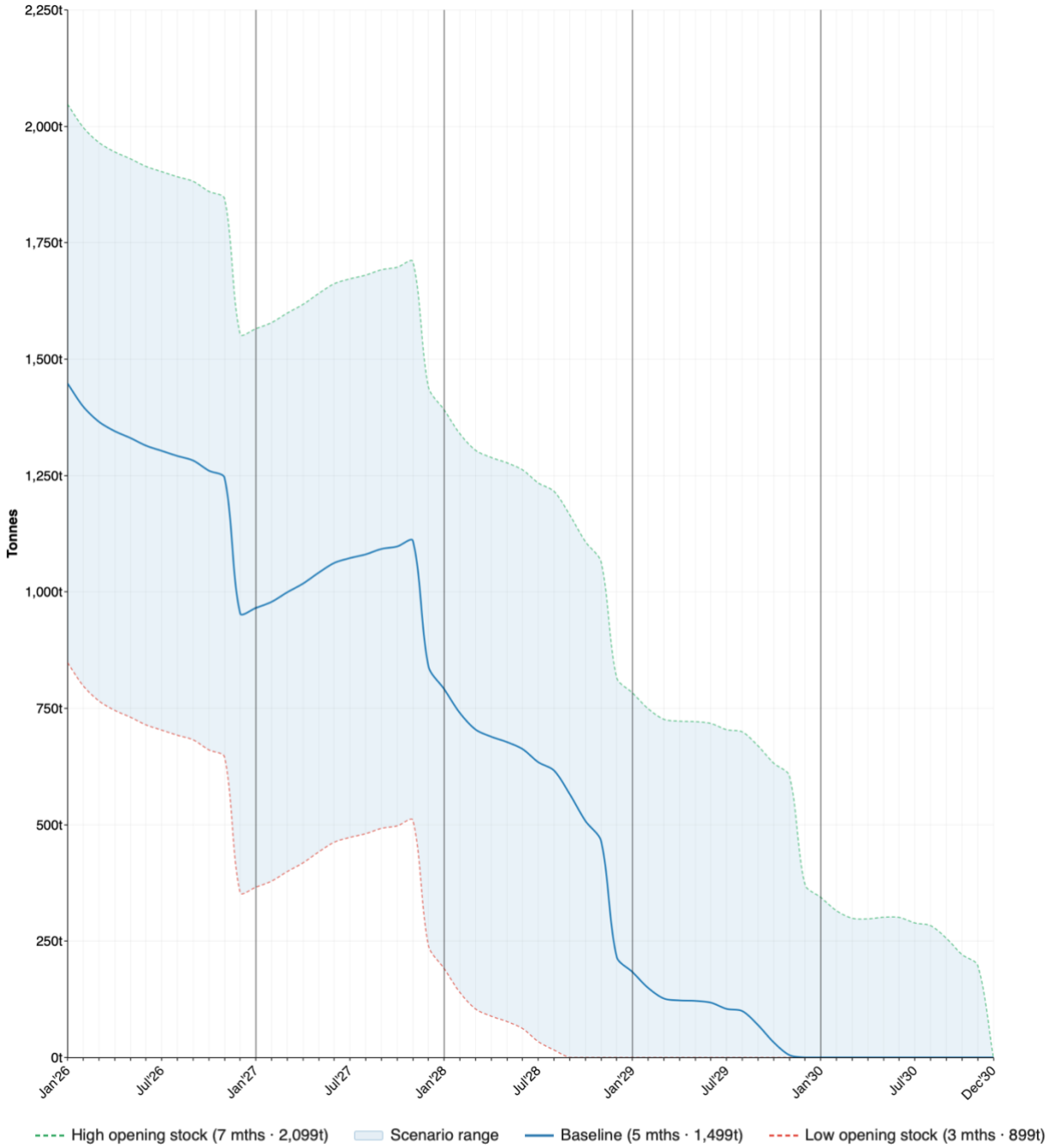
Reducing servicing demand from the existing equipment bank will take many years, making it increasingly important to avoid adding further high-GWP equipment to that bank. Government action is also critical to the transition. The HFC quota constrains bulk refrigerant imports but does not prevent high-GWP refrigerants from continuing to enter Australia in pre-charged equipment, which adds to the installed bank and increases future servicing demand. Accelerating equipment controls where proven lower-GWP technologies are available, particularly HFC-134a in mobile air conditioning, HFC-404A in commercial refrigeration and HFC-410A in larger stationary air conditioning, would reduce the growth of these legacy banks and relieve future pressure on the progressively tightening bulk HFC supply.

Refrigerant already within the Australian market will also become increasingly valuable. Under the Baseline scenario, reclamation will contribute 250 tonnes in 2026, increasing to 400 tonnes from 2029, while additional recycling and re-use increases refrigerant available from within the Australian market from 75 tonnes to 150 tonnes. The model assumes that recycling and re-use already occurs within the market; these quantities represent the additional, or incremental, volume expected to become available as supply tightens and the commercial incentive to recover and re-use refrigerant increases. Together, these sources provide an increasingly important buffer, although their contribution depends on recovery rates, commercial incentives, reclamation throughput and effective collection and return pathways.

The assessment therefore points to three factors that can materially influence the severity of the remaining transition: reducing future servicing demand through continued equipment transition; reducing refrigerant losses through improved containment; and making greater use of the refrigerant already within the Australian market through recovery, recycling, re-use and reclamation.

Supply pressure will intensify through the 2026-27 summer period, with shortages expected to become more evident across parts of the supply chain during 2027 and progressively more widespread through to 2030. The severity and duration of those constraints will depend increasingly on how quickly refrigerant demand adjusts to tightening supply.

**Figure 1: Projected National Refrigerant Stock, 2026 to 2030**




Source: (Expert Group 2026a)

**Note:** Dark vertical lines indicate the commencement of each annual HFC quota allocation period. Where modelled national inventory reaches zero, this represents a temporary supply constraint under the assumptions modelled, not permanent exhaustion of refrigerant supply. A new quota allocation becomes available to importers at the beginning of each calendar year, allowing imports and inventories to be replenished. Inventory associated with subsequent quota years is not shown on the chart once modelled inventory reaches zero.

> *The immediate concern is the limited inventory buffer entering the 2026-27 summer period. Beyond this period, the severity and duration of supply constraints will depend increasingly on how quickly refrigerant usage adjusts to tightening supply and higher prices.*

**Table 1: Indicative Refrigerant Supply Risk by Species**

| Refrigerant | 2026 | 2027 | 2028 | 2029 | Principal Exposure |
|---|---|---|---|---|---|
| **HFC-404A** | | | | | Large commercial refrigeration bank; high servicing demand and high GWP; approved retrofits exist. |
| **HFC-410A** | | | | | Large stationary AC bank; substantial servicing demand; no practical retrofit pathway. |
| **HFC-134a** | | | | | Large installed bank, but current bulk imports broadly balance usage; approved retrofits exist. |
| **Lower-GWP alternatives** | | | | | Increasing demand as transition accelerates. |
| **HFC-407C** | | | | × | Imports cease and remaining historical stocks are depleted; no practical retrofit pathway. |
| **HFC-452A** | | | | | Imports cease and remaining historical stocks are depleted. |

Low Moderate Critical × Unavailable

**Low:** Supply expected to meet demand. **Moderate:** Tightening supply with potential intermittent or localised shortages. **Critical:** Supply is insufficient to consistently meet demand, with shortages expected across parts of the supply chain during periods of peak demand. **Unavailable:** Bulk imports have been discontinued by suppliers and remaining historical stocks are projected to have been depleted.

**Note**: Supply risk reflects the availability of refrigerant to the Australian market, including bulk imports and reclaimed refrigerant.

# 2 Introduction

Australia commenced its HFC phase-down on 1 January 2018, one year ahead of the international schedule established under the Kigali Amendment to the Montreal Protocol. Australia adopted a starting point of approximately 8.1 Mt $CO_2$-e, 25% below its Kigali baseline of 10.814 Mt $CO_2$-e. The phase-down is implemented through progressively lower limits on the quantity of bulk HFCs that may be imported, measured in $CO_2$-e, and administered through a quota system for licensed importers under the Ozone Protection and Synthetic Greenhouse Gas Management Act 1989. Quota reductions occur in staged steps, providing industry with time to move towards lower-GWP equipment and refrigerants.

Australia's transition away from high-GWP HFC refrigerants is now entering a more constrained period. The national HFC import quota reduced to 4.25 Mt $CO_2$-e in 2026 and steps down further to 3.2 Mt $CO_2$-e in 2028, increasing the need for the refrigerant market to transition towards a lower average GWP while continuing to service a large installed base of refrigeration and air conditioning (RAC) equipment.

Refrigerants Australia commissioned Expert Group to independently assess the potential for an imbalance between refrigerant supply and demand as the HFC phase-down progresses, and the timing and implications of potential refrigerant shortages.

The assessment examines the Australian refrigerant market at an individual species level, drawing on historical usage, bulk import data and industry market intelligence. It considers projected demand, imports, existing inventories, reclamation and the changing refrigerant mix to identify where and when supply constraints may emerge. The detailed assessment focuses on the period from 2026 to 2030, by which time the modelling indicates that supply constraints would become increasingly severe if sufficient adjustment has not already occurred. The longer-term quota trajectory to 2036 is also considered to assess the scale and pace of the transition required in the refrigerant mix.

# 3 Australia's Refrigerant Supply Challenge

Australia's HFC phase-down progressively reduces the quantity of HFCs that can be imported, measured in carbon dioxide equivalent ($CO_2$-e). The phase-down does not prescribe which refrigerants can be imported within the quota. Instead, importers determine the mix of refrigerants they bring into Australia, with higher-GWP refrigerants consuming proportionately more quota of the $CO_2$-e than lower-GWP alternatives.

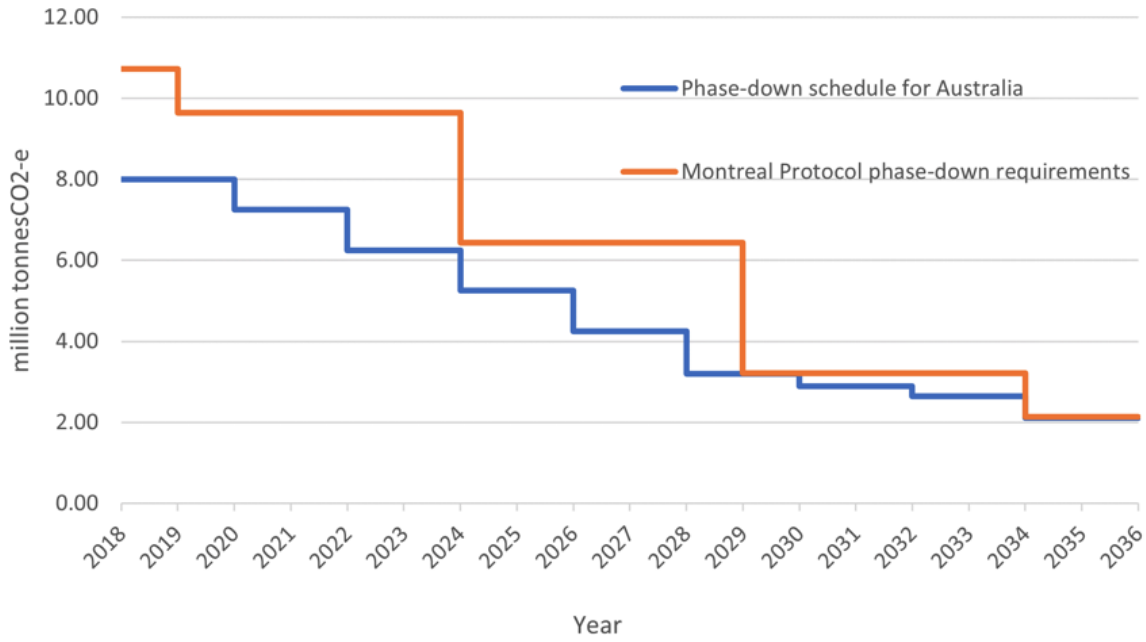
As illustrated in Figure 2, the national quota reduced from 5.25 Mt $CO_2$-e in 2025 to 4.25 Mt $CO_2$-e and from 2026, steps down further to 3.2 Mt $CO_2$-e from 2028 and reaches 2.9 Mt $CO_2$-e from 2030. This represents an approximately 45% reduction in the HFC quota over five years. These reductions represent a significant tightening in the quantity of HFCs available to the Australian market. Because the quota constrains the $CO_2$-e value of imports rather than the physical tonnes of refrigerant, maintaining sufficient supply requires the average GWP of the imported refrigerant mix to progressively decline. The greater the continuing demand for high-GWP refrigerants, the fewer physical tonnes of refrigerant are available within the quota.

Importantly, compliance with the national quota does not necessarily translate into an adequate supply of every individual refrigerant. Demand is determined by the existing equipment fleet and the refrigerants those systems require, while import decisions are made independently by individual market participants. Consequently, the market may operate within the national quota while experiencing shortages of particular refrigerant species.

This issue is particularly important for servicing the installed equipment base. Most of Australia's RAC equipment has operating lives measured in decades and will continue to require its original refrigerant for maintenance and repair. Transitioning new equipment to lower-GWP alternatives can reduce future demand but does not immediately eliminate the servicing requirements of equipment already in operation.

Refrigerant supply is therefore not simply an environmental policy issue. Refrigeration and air conditioning are embedded throughout the Australian economy, supporting the cold food chain, healthcare, commercial and residential buildings, transport, industrial processes and digital infrastructure. Significant or sustained shortages of individual refrigerants could result in higher servicing costs, equipment downtime, operational disruption and business closures.

**Figure 2: Australia's HFC phase-down**




(Source: DCCEEW 2026b)

> *The challenge is not simply meeting the quota. It is supplying sufficient physical tonnes of the right refrigerants to service Australia's installed equipment base.*

# 4 The Australian Refrigerant Market

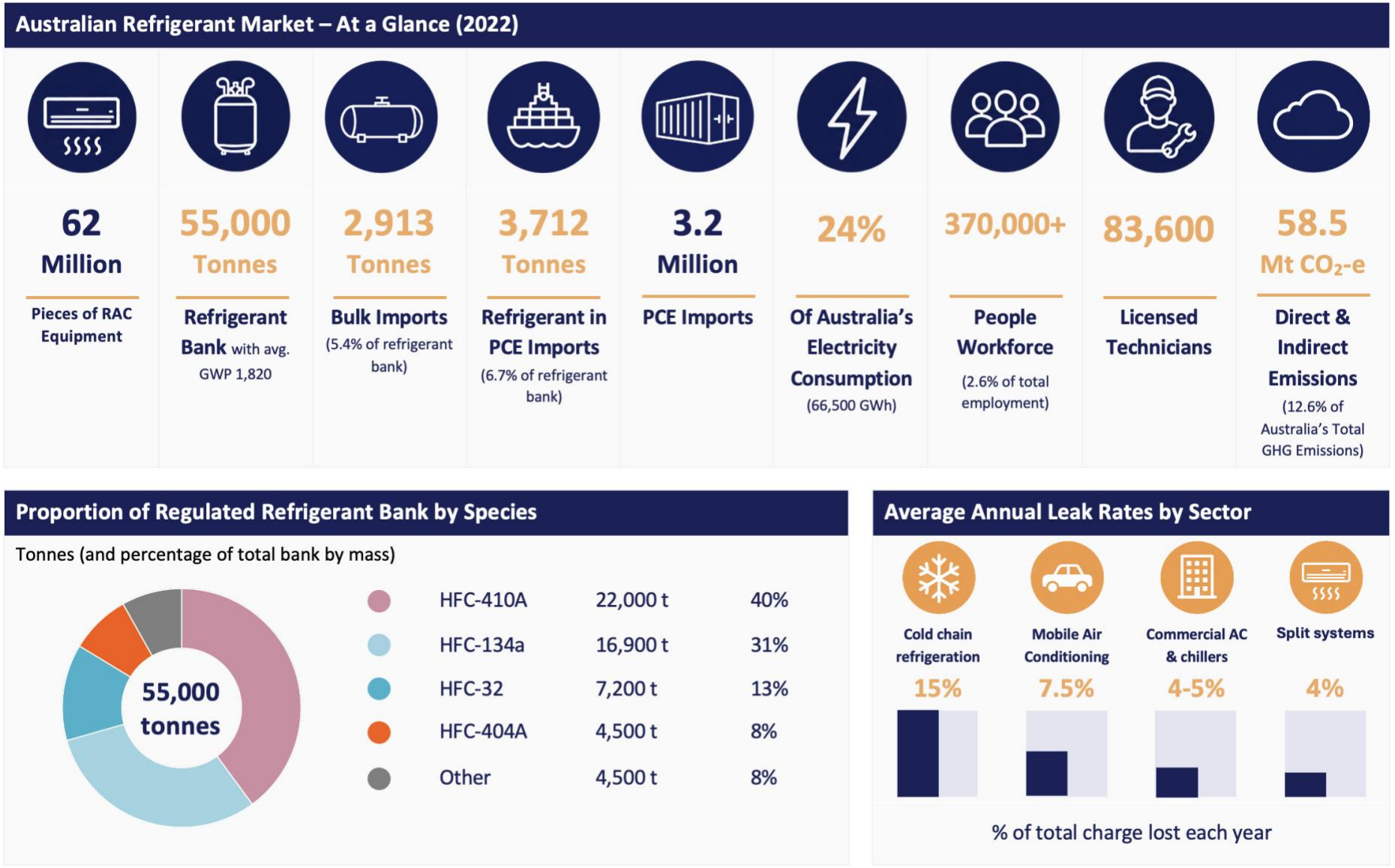
Refrigeration and air conditioning is a large, cross-cutting part of the Australian economy, providing cooling, heating and refrigeration services across residential buildings, commercial premises, healthcare, data centres, transport, food processing and the cold food chain. In 2022, Australia had an estimated 62 million pieces of RAC equipment, containing a refrigerant bank of approximately 55,000 tonnes.

The market can be broadly divided into three major classes: stationary air conditioning and heat pumps, mobile air conditioning, and the cold chain. Together, these classes encompass more than 60 product categories, ranging from domestic refrigerators and small split air conditioners through to supermarket refrigeration systems, commercial chillers, transport refrigeration and large industrial systems.

Although Australia's refrigerant mix is progressively transitioning towards lower-GWP alternatives, the installed equipment base changes only gradually. Many RAC systems remain in service for 15 to 25 years or longer, meaning servicing demand is driven largely by the existing refrigerant bank rather than annual equipment sales. While some sectors, including small split system air conditioners, heat pumps and chillers, have transitioned rapidly, others remain heavily dependent on legacy refrigerants such as HFC-134a, HFC-410A and HFC-404A. As a result, future refrigerant demand will continue to be shaped by equipment already in operation.

Refrigerant leakage remains a major driver of servicing demand. Average annual leak rates range from approximately 4% for split air conditioning systems and 5% for commercial air conditioning and chillers, to 7.5% for mobile air conditioning and 15% for cold chain refrigeration. Although the cold chain represents a relatively small proportion of installed equipment, its significantly higher leak rates result in disproportionately high refrigerant consumption. Consequently, improving refrigerant containment, recovery and leak reduction will be critical to managing future demand as the HFC phase-down progresses.

**Figure 3: Snapshot of Australia's Refrigerant Market**




(Source: DCCEEW 2024a)

**PCE** Pre charged equipment. **Split systems** include commercial and residential.

# 5 Assessment Methodology

## 5.1 Data Foundation

The assessment is founded on HFC bulk import data by refrigerant species obtained from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) through the Ozone Layer and Synthetic Greenhouse Gas (OLaRS) licensing system. This dataset provides an authoritative independent record of Australia's regulated HFC imports and establishes the historical supply baseline for the assessment.

This is complemented by Expert Group's quarterly market intelligence program, which collects monthly refrigerant sales data from Australia's major refrigerant wholesalers (Expert Group 2026b). The import and sales datasets allow historical supply to be reconciled against actual market consumption at species level and provide the basis for estimating inventories and projecting future demand.

Expert Group also undertook targeted data collection and industry consultation across the mobile air conditioning aftermarket, independent refrigerant wholesalers, local manufacturers, marine and shipping, and non-HVAC&R applications including foam blowing, fire protection, aerosols, medical and scientific uses. These datasets support the allocation of refrigerant demand across applications and inform key modelling assumptions, including future demand, reclamation and technology transition.

## 5.2 Supply-Demand Model

The assessment uses The Big Short Model, a purpose-built monthly supply–demand model that projects refrigerant availability from January 2026 to December 2030 for twelve refrigerant species. The model applies a mass-balance approach, tracking opening stock, monthly imports, reclaimed refrigerant, consumption and closing stock for each species. Species-level results are then aggregated to evaluate the overall adequacy of refrigerant supply within Australia's HFC quota while preserving the individual behaviour of each refrigerant. This approach enables the timing, magnitude and duration of potential shortages to be assessed rather than simply identifying annual supply deficits.

Model assumptions are held in a separate scenario module, isolated from the calculation logic, so that each input can be reviewed, challenged and updated independently without altering the model structure.




**Table 2: Variable Definitions**

| Variable | Definition |
|---|---|
| **Closing Stock** | Aggregate refrigerant on hand at end of month, by species (tonnes) |
| **Opening Stock** | Closing stock from prior month; scenario-set on 1 January 2026 |
| **Imports** | Licensed imports arriving in month; zero in December (all scenarios) |
| **Reclamation** | AHRI Standard 700 purity recovered refrigerant entering supply |
| **Incremental R&R** | Additional recycling and re-use above historical baseline usage, avoids double counting |
| **Usage** | Refrigerant consumed in month across all RAC end-uses |

## 5.3 Scenario Analysis

Future outcomes are evaluated using a structured scenario framework. Six independent scenario switches control the principal drivers of uncertainty:

- opening stock available at 1 January 2026;
- future refrigerant import mix;
- refrigerant usage response to tightening supply and increasing prices;
- refrigerant reclamation volumes and mix;
- additional recycling and re-use volumes and mix;
- refrigerant heel recovery (the additional usable volume recovered from cylinders beyond nominal net weight).

These switches may be varied independently or combined to produce Low, Baseline and High scenarios. The methodology allows the sensitivity of individual assumptions to be isolated while also examining the cumulative effect of multiple uncertainties. The scenarios are not forecasts; they represent a range of plausible outcomes designed to identify the conditions under which supply shortfalls may emerge.

## 5.4 Key Assumptions

The most influential assumptions relate to opening inventories, future refrigerant import mix, reclamation, additional recycling and re-use, and the extent to which demand responds to tightening supply and increasing prices. Opening stock estimates are informed by confidential consultation with industry participants and are incorporated only as aggregated values. Reclamation assumptions draw on Refrigerant Reclaim Australia data and stakeholder consultation. Recycling and re-use already embedded in historical consumption are not counted again, however, the scenario variable represents additional activity expected as supply tightens. Demand projections also recognise that a significant component of servicing demand from the existing equipment bank cannot readily be deferred or substituted.

## 5.5 Limitations

The assessment is intended as a decision-support tool rather than a precise prediction of future market behaviour. Actual outcomes will depend on future import patterns, market responses, stockholding behaviour, technology transition and reclamation performance. The model has been designed to support periodic recalibration as additional market information becomes available. The quarterly update program is designed to progressively narrow this uncertainty as actual import data, stockholding intelligence and market behaviour replace modelled assumptions.

The core supply–demand model assesses bulk HFC supply subject to Australia's HFC quota. Refrigerant entering Australia in pre-charged equipment is outside the scope of the model, although it is considered where relevant to the future servicing requirements of the installed equipment bank.

# 6 Projected Refrigerant Supply and Demand

The assessment examines how Australia's refrigerant supply and demand balance is expected to evolve as the HFC quota progressively tightens. It begins with the significant changes observed during 2025, when the first clear signs of transition away from high-GWP refrigerants emerged, before presenting the modelled outlook from January 2026 to December 2030.

The analysis considers the national stock position, the seasonal cycle of inventory depletion and replenishment, and the availability of individual refrigerant species. It also examines the contribution of reclamation, recycling and re-use in supplementing virgin refrigerant supply. Importantly, aggregate national supply does not necessarily indicate whether sufficient quantities of individual refrigerants will be available when and where they are required.

## 6.1 The Turning Point: 2025

The Australian refrigerant market began to show clear signs of transition during the second half of 2025. Refrigerant demand remained elevated during the first half of the year, broadly consistent with the high consumption levels experienced in 2023 and 2024. However, Q3 2025 marked a turning point, with the first significant decline in HFC-404A usage accompanied by increasing use of lower-GWP alternatives, particularly R448A/R449A and R452A. HFC-404A prices had also increased substantially, providing a growing commercial incentive to transition.

Despite these early signs of adjustment, the market entered the 2026 quota period with substantial continuing demand for high-GWP refrigerants. Total HFC usage in 2025 is estimated at 3,598 tonnes (7.438 Mt $CO_2$-e), compared with bulk imports of 2,846 tonnes (5.239 Mt $CO_2$-e), a difference of approximately 752 tonnes and 2.20 Mt $CO_2$-e. The difference was supplied from refrigerant already within the Australian market, including existing inventories, reclamation, recycling and re-use.

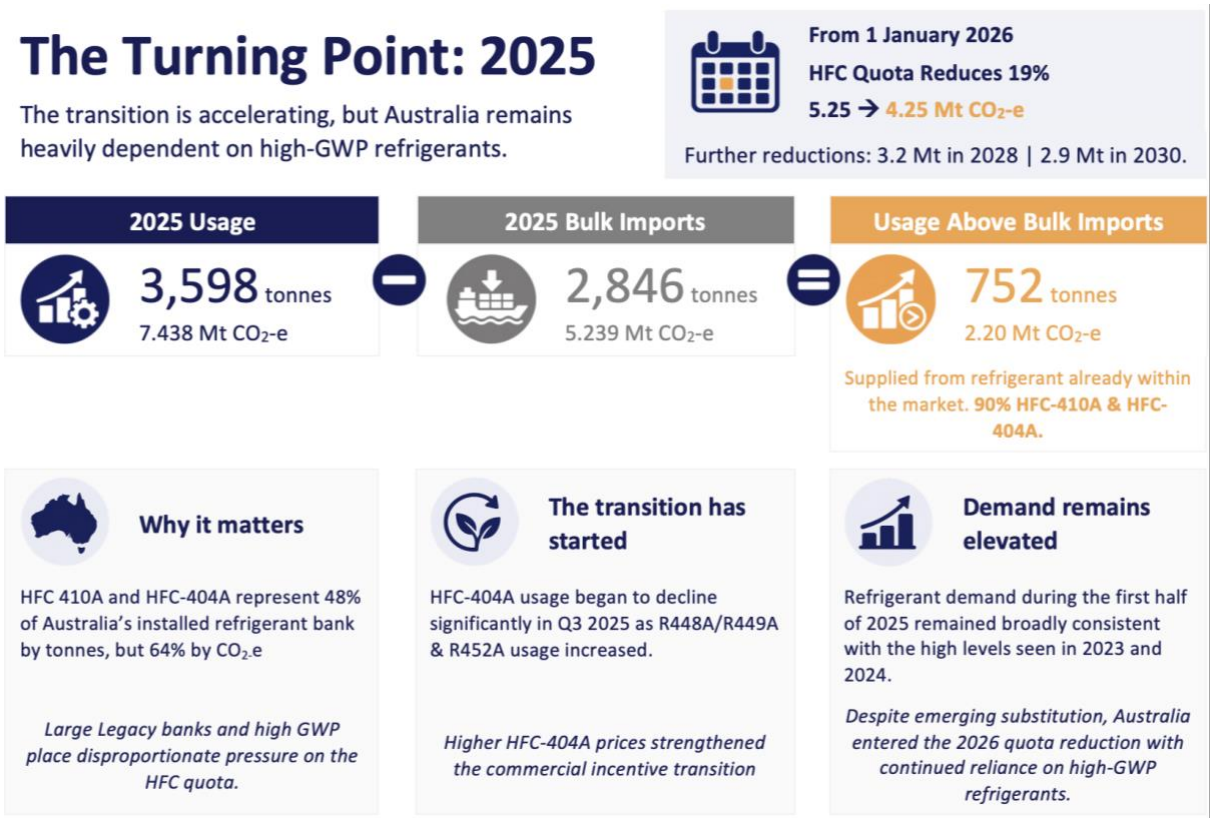
Importantly, the difference was heavily concentrated in HFC-410A and HFC-404A, which accounted for approximately 90% of the physical difference between 2025 usage and bulk imports. These refrigerants also represented approximately 48% of Australia's installed refrigerant bank by tonnes and 64% by $CO_2$-e in 2022 (DCCEEW 2024b). The combination of large servicing requirements and high GWP means these legacy banks place disproportionate pressure on the HFC quota.

HFC-134a presents a different picture. While it also represents a substantial proportion of Australia's installed refrigerant bank, 2025 bulk imports were broadly aligned with estimated usage. Consequently, HFC-134a accounted for only a relatively small proportion of the 2025 difference between bulk imports and usage. This demonstrates that the immediate supply pressure is not determined by bank size alone, but also by the relationship between ongoing servicing demand, available supply, and the GWP of each refrigerant.

The transition away from high-GWP HFCs had therefore begun by the end of 2025, despite the continuing dependence on these gases to service Australia's existing equipment bank. From 1

January 2026, the national HFC quota reduced by 19%, from 5.25 to 4.25 Mt $CO_2$-e, substantially tightening the supply available to meet this continuing demand. Figure 4 summarises the key changes observed during 2025 and the market position entering the 2026 quota period.

**Figure 4: The Turning Point: 2025**




Source: (DCCEEW 2026a, Expert Group 2026a)

> *The transition began in 2025, but from a position of continuing dependence on high-GWP refrigerants.*

## 6.2 National Supply Outlook

Opening inventory at 1 January 2026 remains one of the largest uncertainties in the assessment. Three opening stock scenarios are modelled, representing approximately three, five and seven months of national usage. All other assumptions are held constant, allowing the effect of the opening stock position to be isolated. The Baseline scenario assumes approximately 1,500 tonnes of opening stock, equivalent to five months of usage. Recent consultation with industry suggests that actual inventories are unlikely to exceed this level, with some suppliers indicating that stocks of individual legacy refrigerants could become critically low during late 2026 or over the 2026-27 summer period.

The underlying driver of the projected stock depletion is a mismatch between the rate at which HFC supply is being constrained and the rate at which refrigerant demand is reducing. Between 2025 and 2030, Australia's HFC quota falls by approximately 45%, from 5.25 to 2.90 Mt $CO_2$-e, in accordance with the legislated phase-down schedule. Over the same period, the Baseline scenario projects aggregate bulk import volumes will decline by approximately 34%, while

refrigerant usage will fall by only around 21%. The difference reflects the changing refrigerant mix, with increasing use of lower-GWP refrigerants allowing more physical tonnes to be imported for each unit of quota, together with additional supply from reclamation, recycling and re-use. However, these adjustments are not sufficient to fully offset the continuing servicing demand from the installed equipment bank.

As a result, the market progressively draws on existing inventories to balance supply and demand. Under the Baseline scenario, aggregate stock declines from approximately 1,500 tonnes at the beginning of 2026 to around 950 tonnes by December 2026. Inventories recover modestly during 2027 as imports replenish supply but remain below the opening 2026 position. By the end of the year, they will likely fall to approximately 840 tonnes. From 2028, when the HFC quota reduces further to 3.2 Mt $CO_2$-e, the position deteriorates more rapidly, with aggregate stock falling to approximately 216 tonnes by December 2028 and being effectively exhausted during late 2029.

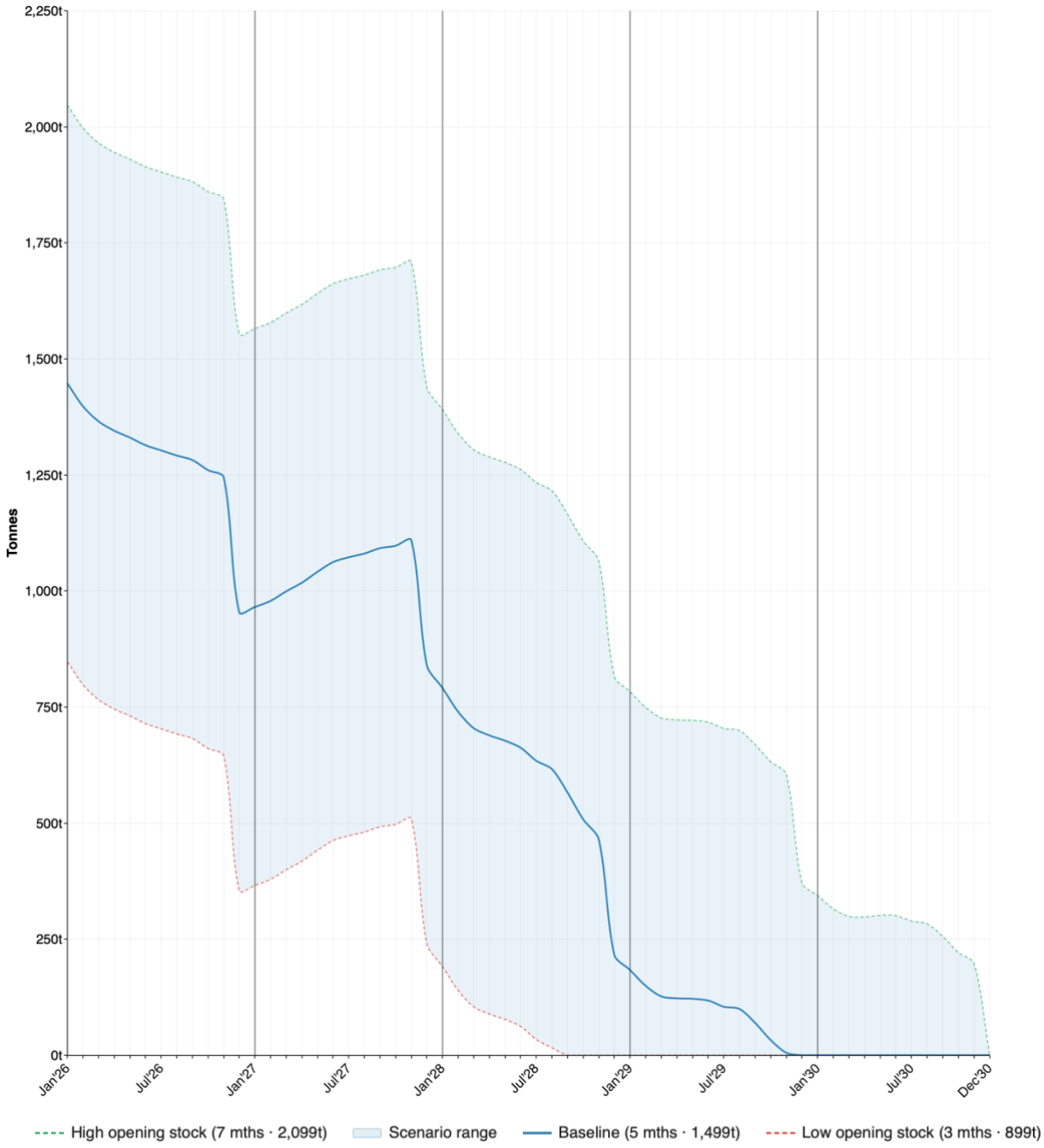
The opening stock position has a material effect on the timing of aggregate supply constraints. Under the Low Stock scenario, national inventories are depleted during 2028, while the additional inventory assumed under the High Stock scenario provides a substantially greater buffer. Importantly, these aggregate results should not be interpreted as the point at which shortages first occur. Individual refrigerants can become unavailable to particular suppliers, regions or parts of the distribution network well before aggregate national inventories approach zero.

The longer-term outlook is also highly dependent on how the market responds to tightening supply and increasing refrigerant prices. The Baseline scenario already assumes a material reduction in refrigerant usage over the assessment period as the market transitions. Higher prices and emerging supply constraints could accelerate substitution, equipment replacement, improved containment, recovery, recycling and re-use, resulting in a faster reduction in demand. Conversely, if usage responds more slowly than assumed, inventories would be depleted earlier and supply constraints would become more severe. Market response is therefore one of the most important uncertainties in the assessment, particularly from 2027 onwards. Consistent with the methodology, these scenarios should be regarded as plausible outcomes rather than forecasts.

Figure 5 illustrates the projected national refrigerant stock profile from 2026 to 2030 under the Low Stock, Baseline and High Stock scenarios.

> *The immediate concern is the limited inventory buffer entering the 2026-27 summer period. Beyond this period, the severity and duration of supply constraints will depend increasingly on how quickly refrigerant usage adjusts to tightening supply and higher prices.*

**Figure 5: Projected National Refrigerant Stock, 2026 to 2030**

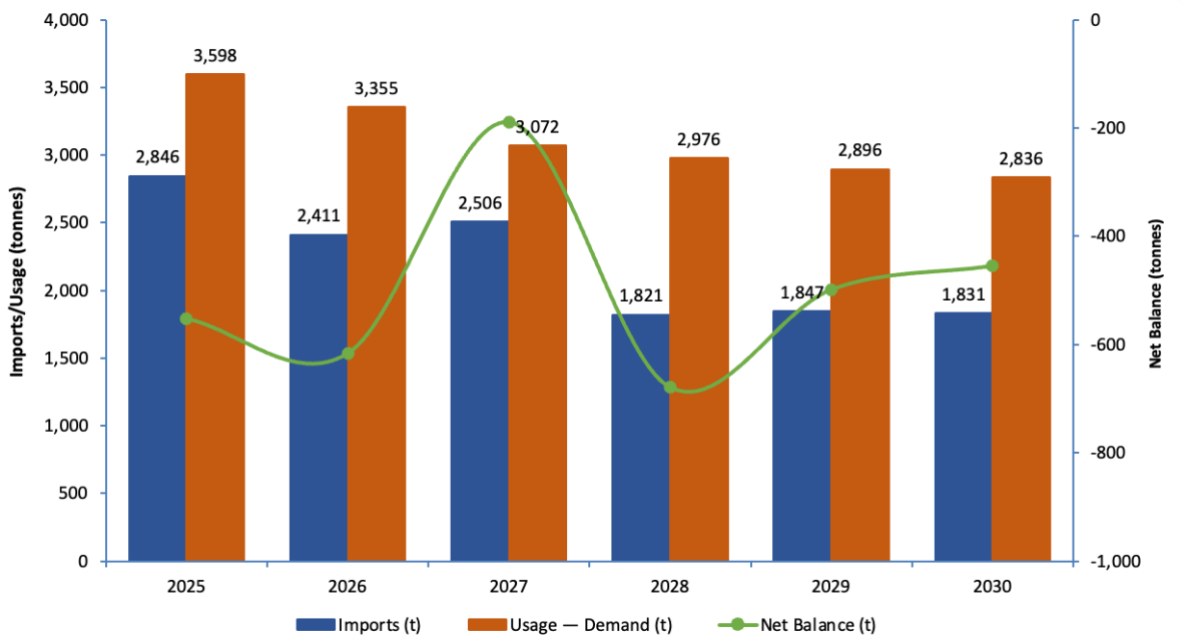



Source: (Expert Group 2026a)

**Note:** Dark vertical lines indicate the commencement of each annual HFC quota allocation period. Where modelled national inventory reaches zero, this represents a temporary supply constraint under the assumptions modelled, not permanent exhaustion of refrigerant supply. A new quota allocation becomes available to importers at the beginning of each calendar year, allowing imports and inventories to be replenished. Inventory associated with subsequent quota years is not shown on the chart once modelled inventory reaches zero.

Figure 6 provides a complementary view of the Baseline scenario, comparing projected annual bulk imports with refrigerant usage. Usage remains above bulk imports throughout the assessment period, with the difference partly offset by reclamation and additional recycling and re-use. The remaining imbalance is met through the progressive drawdown of existing inventories shown in Figure 5. The position becomes particularly constrained from 2028, when the next quota reduction substantially reduces the physical volume of HFCs that can be imported while servicing demand from the installed equipment bank remains comparatively high.

**Figure 6: Annual Supply versus Demand (Baseline Scenario)**




| Baseline Scenario | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|
| Reclamation (t) | 250 | 275 | 350 | 400 | 400 |
| Incremental R&R (t) | 75 | 100 | 125 | 150 | 150 |

Source: (DCCEEW 2024, DCCEEW 2026a, Expert Group 2026a)

**Reclamation:** Recovered refrigerant processed to AHRI Standard 700 purity and returned to market as available supply during the modelled period. These volumes do not represent the quantity of recovered refrigerant collected as feedstock, which may be higher. The model therefore reflects estimated reclamation throughput rather than total recovery activity.

## 6.3 The Shortage Cycle

A key finding of the assessment is that refrigerant supply pressure is highly seasonal, with the greatest pressure occurring during the fourth quarter of each calendar year. Refrigerant consumption is not uniform throughout the year, with demand typically increasing in Q4 as RAC service and installation activity rises leading into summer. At the same time, available inventories have been progressively drawn down through the year.

Import timing further accentuates this pattern. By late Q4, importers have generally utilised much of their available quota for the calendar year and typically avoid shipments arriving in December, as these imports would be counted against the current year rather than the following year. The

combination of high seasonal demand, declining inventories and limited late-year imports means that Q4 consistently produces the greatest supply pressure.

Figure 7 illustrates this cycle under the Baseline scenario. The quarterly supply-demand balance is negative throughout most of the assessment period, but the largest imbalance consistently occurs in Q4. The effect becomes particularly pronounced from 2028 as the HFC quota reduces to 3.2 Mt $CO_2$-e and the inventory buffer available to absorb these seasonal imbalances becomes progressively smaller.

The beginning of a new calendar year provides renewed capacity to import HFCs, but this does not necessarily translate into immediate physical replenishment of Australian inventories. Refrigerant must first be available from overseas manufacturers, shipped to Australia and distributed through the domestic supply chain. Industry consultation indicates that these lead times can extend replenishment well into Q1. Consequently, shortages emerging during late Q4 may continue into the following year before replacement stock becomes available.

This timing can be further complicated by Chinese manufacturing cycles, particularly around the Chinese New Year period, when refrigerant production and logistics can slow or temporarily cease for several weeks. As Australian inventories decline, particularly from 2028, these disruptions may become more significant and could be compounded where Chinese manufacturers have limited remaining annual HFC production quota, increasing the risk that shortages emerging in Q4 persist well into Q1.

Shortages are also unlikely to occur simultaneously across the Australian market. Major refrigerant importers operate independently, with different quota positions, refrigerant mixes, inventories and customer requirements. One supplier may therefore exhaust stocks of an individual refrigerant while another continues to hold inventory. Commercial arrangements and established distribution channels can further limit the extent to which available refrigerant can be redistributed across the market.

Australia's geographic scale adds another layer of complexity. Refrigerant is distributed across more than 200 wholesale outlets and storage facilities, meaning national inventory cannot be regarded as a single readily interchangeable pool. Availability can vary between suppliers, regions and individual branches, while the time and cost of relocating stock can further constrain supply. Localised and supplier-specific shortages can therefore emerge well before aggregate national inventories are depleted.

As the national inventory buffer declines, the consequences of this seasonal cycle become more significant. Shortages may initially be temporary and confined to individual refrigerants, suppliers or locations, but declining inventories increase the likelihood that they become more frequent, persist for longer and extend across a greater proportion of the supply chain. Higher prices and periods of restricted availability may, in turn, accelerate the transition towards lower-GWP alternatives and reduce future demand.

**Figure 7: Quarterly Refrigerant Supply-Demand Balance, Baseline Scenario, 2026 to 2030**




Source: (DCCEEW 2024, DCCEEW 2026a, Expert Group 2026a)

**Note:** The model assumes no refrigerant is landed in December.

## 6.4 Refrigerant Species at Risk

The national supply outlook does not provide a complete picture of refrigerant availability. Australia's HFC quota is expressed in $CO_2$-e and does not prescribe the quantity of individual refrigerants that can be imported. Availability at species level will therefore depend on opening inventories, servicing demand, GWP, importer decisions and the rate of transition to lower-GWP alternatives.

The modelling indicates that supply pressure will be concentrated in higher-GWP refrigerants servicing large installed equipment banks, particularly HFC-410A and HFC-404A. These refrigerants have substantial ongoing servicing requirements and consume comparatively large amounts of quota. HFC-134a presents a different profile: despite its large installed bank, current bulk imports are broadly aligned with usage, resulting in lower near-term exposure.

For some lower-volume legacy refrigerants, product rationalisation becomes an additional risk. As the quota tightens, importers are expected to increasingly concentrate available quota on refrigerants with greater ongoing demand. The modelling assumes that HFC-407A/F is rationalised first, followed progressively by HFC-407C and then HFC-452A. Once bulk imports are discontinued, remaining historical stocks are progressively depleted until these refrigerants become unavailable through conventional supply channels. Table 3 summarises the indicative species-level supply risk from 2026 to 2030.

**Table 3: Indicative Refrigerant Supply Risk by Species**

| Refrigerant | 2026 | 2027 | 2028 | 2029 | Principal Exposure |
|---|---|---|---|---|---|
| **HFC-404A** | | | | | Large commercial refrigeration bank; high servicing demand and high GWP; approved retrofits exist. |
| **HFC-410A** | | | | | Large stationary AC bank; substantial servicing demand; no practical retrofit pathway. |
| **HFC-134a** | | | | | Large installed bank, but current bulk imports broadly balance usage; approved retrofits exist. |
| **Lower-GWP alternatives** | | | | | Increasing demand as transition accelerates. |
| **HFC-407C** | | | | × | Imports cease and remaining historical stocks are depleted; no practical retrofit pathway. |
| **HFC-452A** | | | | | Imports cease and remaining historical stocks are depleted. |

● Low ● Moderate ● Critical × Unavailable

**Low:** Supply expected to meet demand. **Moderate:** Tightening supply with potential intermittent or localised shortages. **Critical:** Supply is insufficient to consistently meet demand, with shortages expected across parts of the supply chain during periods of peak demand. **Unavailable:** Bulk imports have been discontinued by suppliers and remaining historical stocks are projected to have been depleted.

**Note**: Supply risk reflects the availability of refrigerant to the Australian market, including bulk imports and reclaimed refrigerant.

## 6.5 Reclamation, Recycling and Re-use

As virgin HFC supply becomes increasingly constrained, refrigerant already within the Australian market will become an increasingly important source of supply. The model recognises two distinct contributions: formal reclamation to AHRI Standard 700 purity, and additional recycling and re-use above the level already embedded in historical usage.

Reclamation involves processing recovered refrigerant to restore it to the purity requirements of AHRI Standard 700, allowing it to be returned to the market as a recognised source of refrigerant supply. Under the Baseline scenario, reclamation throughput increases from 250 tonnes in 2026 to 275 tonnes in 2027, 350 tonnes in 2028 and 400 tonnes from 2029 onwards. These volumes represent refrigerant assumed to be processed and returned to market during each year, rather than the quantity of recovered refrigerant collected as feedstock. The 400 tonne assumption from 2029 onwards does not represent an estimate of the technical capacity of Australia's reclamation industry. Rather, it reflects the expectation that, as refrigerant becomes more valuable and supply tightens, an increasing proportion of recovered refrigerant will be retained and recycled or re-used directly by contractors and end users rather than returned through the supply chain for formal reclamation.

The extent to which formal reclamation can expand will therefore depend not only on available reclamation capacity, but also on the quantity of suitable recovered refrigerant returned for processing. Further investment in reclamation infrastructure could increase capacity and potentially redirect some refrigerant that would otherwise be recycled or re-used towards formal reclamation, particularly as increasing refrigerant prices improve the commercial case. However, expanding reclamation will also require more effective reverse supply chains and appropriate incentives for contractors and end users to recover and return refrigerant. This will require efficient collection, consolidation and transport of recovered refrigerant back to reclamation facilities.

> *Australia's installed refrigerant bank is a valuable domestic resource, but converting it into available supply will depend on effective recovery, collection and return pathways.*

Recycling and re-use are already established within the Australian industry and are therefore embedded in the historical usage data underpinning the model. Recycling generally involves more limited processing than reclamation, while re-use includes recovered refrigerant returned to service without formal reclamation. To avoid double counting, the model includes only the additional recycling and re-use assumed to occur as virgin refrigerant supply tightens. Under the Baseline scenario, this incremental contribution increases from 75 tonnes in 2026 to 100 tonnes in 2027, 125 tonnes in 2028 and 150 tonnes from 2029 onwards.

There is greater uncertainty around this additional recycling and re-use contribution. Unlike established activity already reflected in historical consumption, these incremental volumes represent an assumed future market response to increasing scarcity and prices. The scale of this response is uncertain and warrants further investigation and industry consultation.

The assumed refrigerant mix for both reclamation and additional recycling and re-use is concentrated in HFC-404A, HFC-410A and HFC-134a, reflecting their large installed banks and corresponding opportunities for recovery and continued use. Under the Baseline scenario, the combined contribution increases from approximately 325 tonnes in 2026 to 475 tonnes in 2028 and 550 tonnes from 2029 onwards. While potentially material, these quantities should be interpreted as scenario assumptions rather than firm projections of available supply. Their achievement will depend on recovery rates, commercial incentives, reclamation throughput and the effectiveness of Australia's reverse refrigerant supply chain.

# 7 Market Exposure and Risk

## 7.1 Commercial Refrigeration

### *7.1.1 Market Overview*

Commercial refrigeration represents one of the Australian market segments most exposed to tightening HFC supply. The sector supports supermarkets, food retail, hospitality, convenience stores, cold rooms and other applications essential to maintaining Australia's cold food chain as well as critical applications such as pharmaceutical storage and blood banks.

The principal exposure is the large installed refrigerant bank and its high ongoing servicing requirement. In 2022, commercial refrigeration contained an estimated 7,100 tonnes of refrigerant, including approximately 4,500 tonnes of HFC-404A. Commercial refrigeration systems have historically experienced relatively high refrigerant losses, with leak rates of approximately 15% per annum in many applications. The combination of a large HFC-404A bank and high leak rates creates substantial and recurring demand for replacement refrigerant.

This dependence remains evident in current consumption. In 2025, approximately 728 tonnes of HFC-404A were used, compared with 112 tonnes of R448A and 36 tonnes of R452A. Despite increasing use of lower-GWP alternatives, HFC-404A remains by far the dominant refrigerant used to service the existing commercial refrigeration bank.

### *7.1.2 Risk Profile: High to Extreme*

Commercial refrigeration has a high to extreme exposure to refrigerant supply constraints because of its continuing dependence on HFC-404A, relatively high leak rates and the essential nature of many refrigeration services. The consequences of a shortage vary considerably across the sector, depending on system size, refrigerant charge, equipment value and the availability of practical replacement or retrofit options.

Medium commercial refrigeration and independent supermarkets are among the most exposed applications. This includes remote condensing units serving cold rooms, refrigerated display cases and other food retail and hospitality applications. These systems have historically relied heavily on HFC-404A and are frequently owned by small and medium businesses that are sensitive to capital and servicing costs. The 2024 Refrigerant Leak Study estimates annual leak rates of approximately 15% for remote condensing units and independent supermarkets, compared with around 11% for major supermarket chains. Industrial refrigeration and cold storage applications using HFCs are also estimated at around 15% per annum (RA 2024). These relatively high leak rates create substantial recurring demand for replacement refrigerant and increase exposure as HFC-404A supply tightens.

Major supermarkets have substantial refrigerant requirements but are generally better positioned to manage the transition. The major chains have progressively adopted R744 ($CO_2$) trans-critical systems in new stores and when completing major refurbishments. They also have greater technical capability and capital resources to plan replacement and retrofit programs. Their exposure is therefore increasingly concentrated in the remaining legacy HFC systems rather than new installations.

The potential consequences extend beyond the direct cost of refrigerant. Commercial refrigeration supports the cold food chain, and prolonged loss of refrigeration can result in product losses, business interruption and, in more severe cases, temporary closure of affected facilities. The highest risk therefore occurs where high HFC-404A dependence, high leakage and limited transition capability coincide with refrigeration that cannot readily be taken out of service or economically replaced.

### *7.1.3 Transition Pathways*

Commercial refrigeration has several transition pathways, although the appropriate solution varies considerably by application and the age and configuration of existing equipment.

For the existing HFC-404A bank, retrofit provides an important near-term pathway. Some larger supermarkets and other system owners are recovering or "harvesting" HFC-404A and converting suitable systems to lower-GWP alternatives. R448A is increasingly being used in both retrofit and new applications, with R452A also used in some low-temperature applications. Recovery of HFC-404A during these conversions also provides a valuable source of refrigerant that can be re-used or reclaimed to support the remaining legacy bank.

For new equipment, there is an increasing transition towards refrigerants that substantially reduce or eliminate dependence on the HFC quota. Hydrocarbons, particularly R290, are well established in self-contained commercial refrigeration, while R744 ($CO_2$) systems and condensing units are increasingly favoured for larger applications because they provide a long-term, future-proof solution and can deliver energy-efficiency benefits. Their higher capital cost, however, remains a barrier in some applications.

A2L refrigerants provide another emerging pathway, including very low-GWP alternatives such as R455A (GWP 148). The adoption of these refrigerants in commercial refrigeration is currently limited, however, this is partly due to refrigerant charge restrictions and other requirements under ISO 5149. Changes to these requirements could broaden the range of applications in which A2Ls can be practically deployed.

### *7.1.4 Key Findings*

Commercial refrigeration is one of the market segments most exposed to tightening HFC supply, principally because of its large HFC-404A equipment bank, which represents approximately 18% of Australia's regulated refrigerant bank on a $CO_2$-e basis, combined with high servicing demand and relatively high leak rates. Despite the transition underway, HFC-404A usage remained at approximately 728 tonnes in 2025, demonstrating the continuing dependence of the installed equipment base on this high-GWP refrigerant.

The modelling indicates that shortages of HFC-404A are likely to emerge in parts of the supply chain during 2027, become more widespread from 2028, and progressively intensify through to 2030. These shortages are unlikely to affect all suppliers or regions simultaneously but could create periods where refrigerant is difficult to obtain, particularly during peak seasonal demand. Given the sector's role in the cold food chain and critical temperature-controlled applications, these shortages could have significant consequences on the cold food chain.

It is therefore imperative the transition away from HFC-404A systems accelerates before shortages become widespread. Retrofitting suitable HFC-404A systems, recovering and re-using

refrigerant, reducing leakage, and accelerating deployment of R448A, R744 ($CO_2$), emerging A2L technologies and hydrocarbons in self-contained equipment can all reduce pressure on virgin HFC-404A supply. Importantly, HFC-404A recovered from systems being transitioned can help maintain those parts of the installed bank where replacement or retrofit is more difficult.

> *HFC-404A shortages are expected to emerge across parts of the supply chain during 2027, become widespread from 2028 and intensify through to 2030.*

## 7.2 Stationary AC

### *7.2.1 Market Overview*

Stationary air conditioning is Australia's largest RAC equipment sector and a major source of refrigerant demand. The principal exposure is the very large installed HFC-410A fleet. By 2022, more than 10 million HFC-410A charged systems were operating in Australia, containing approximately 22,000 tonnes of HFC-410A, equivalent to around 40% of the regulated refrigerant bank by mass (DCCEEW 2024a).

This installed bank creates a substantial and long-lived servicing requirement. In 2022, stationary air conditioning and heat pumps represented approximately 18.2 million pieces of equipment and contained around 36,000 tonnes of refrigerant across all species (DCCEEW 2024a).

The new-equipment market is transitioning rapidly from HFC-410A to lower-GWP HFC-32, particularly in small split systems. HFC-410A contained in imported stationary AC equipment declined from approximately 1,379 tonnes in 2019 to 793 tonnes in 2022, while HFC-32 increased to more than 1,821 tonnes (DCCEEW 2024a). However, the installed equipment base transitions much more slowly than new equipment sales, meaning that substantial HFC-410A servicing demand will continue for many years.

HFC-410A usage was approximately 793 tonnes in 2025, including local manufacturing, compared with bulk imports of approximately 424 tonnes (DCCEEW 2026a). This underlying imbalance becomes increasingly important as HFC supply tightens.

### *7.2.2 Risk Profile: High to Extreme*

Exposure varies considerably by equipment type. Smaller systems can generally be replaced relatively readily with lower-GWP equipment, whereas larger commercial systems have greater refrigerant charges, higher replacement costs, longer operating lives and greater dependence on continued refrigerant availability.

**Small split systems** comprise a very large legacy HFC-410A fleet. As HFC-410A becomes more expensive and constrained, older systems experiencing major refrigerant loss are increasingly likely to be replaced with HFC-32 equipment rather than be repaired. This transition therefore primarily represents an economic risk, rather than a significant threat to the provision of cooling.

**Ducted and light commercial systems** and medium heat pumps have greater exposure due to larger charges, higher replacement costs, longer service lives and physical access constraints, particularly where concealed indoor units require removal of ceilings or other building fabric for

replacement. Continued access to HFC-410A and, for some older equipment, HFC-407C remains important, increasing the potential for higher servicing costs and difficult repair-versus-replacement decisions.

**Large chillers** have greater operational and financial exposure in the transition. They are high-value, long-life assets with large refrigerant charges and are often installed where continuity of cooling is critical. Although lower-GWP technologies are available for new equipment, premature replacement can involve substantial capital expenditure and long project lead times.

### *7.2.3 Australian AC Manufacturing: Extreme to Catastrophic Risk*

Australian manufacturers of ducted and packaged air conditioning systems and chillers are disproportionately exposed to the HFC phase-down. Refrigerant used to charge locally manufactured equipment is imported in bulk and consumes Australian HFC quota, while competing imported equipment arrives pre-charged with refrigerant that does not draw on the Australian bulk HFC quota. This creates a potential competitive disadvantage for Australian manufacturers that will become more significant as the quota tightens and domestic refrigerant prices increase.

Local manufacturing remains significant but is already reducing its reliance on controlled refrigerants. HFC consumption declined from 261 tonnes in 2020 to 248 tonnes in 2021, 243 tonnes in 2022, 224 tonnes in 2023, 167 tonnes in 2024 and approximately 118 tonnes in 2025. This includes HFC-410A, HFC-32, HFC-134a and R513A, with HFOs increasingly used in locally manufactured chillers. The HFCs consumed by local manufacturers in 2025 represented approximately 197 kt $CO_2$-e, equivalent to around 3.8% of Australia's 5.25 Mt $CO_2$-e HFC quota in that year.

The competitive impact can be illustrated by a locally manufactured 19 kW packaged ducted air conditioning system containing approximately 4.0 kg of HFC-32. At an Australian refrigerant price of around $90 per kg, the refrigerant charge represents a material cost of approximately $360 per unit. An equivalent pre-charged system manufactured in Asia may incur a refrigerant cost of around $20, based on industry consultation indicating an HFC-32 cost of approximately $5 per kg for Asian manufacturers. This cost differential between Australian and international manufacturers is already significant, even before other manufacturing costs are considered. As the HFC quota tightens, there is also a risk that Australian refrigerant prices will increase further, potentially widening this competitive disadvantage.

Industry has proposed that Australian manufacturers be given priority access to the non-grandfathered component of the HFC quota where requested, before the remaining balance is then allocated more broadly. This could reduce the unintended competitive impact of the quota system on domestic manufacturing without altering the overall HFC phase-down trajectory.

### *7.2.4 Transition Pathways*

The transition of new stationary AC equipment is already well advanced, particularly from HFC-410A to HFC-32 in smaller systems. Larger ducted, packaged and chiller applications are progressively adopting HFC-32, HFO/HFC blends, HFOs and natural refrigerants where technically suitable.

The greater challenge is the existing HFC-410A fleet, for which there is no widely accepted drop-in replacement. Rising prices and constrained supply are likely to accelerate replacement of older systems following major refrigerant loss, while larger and higher-value equipment will remain dependent on HFC-410A for longer. Recovery, recycling and reclamation will therefore become increasingly important in supporting the installed fleet through the transition.

### *7.2.5 Key Findings*

The principal exposure for stationary air conditioning is the large installed HFC-410A bank and its continuing servicing requirement. The rapid transition of new equipment to HFC-32 reduces future HFC-410A demand but does little to alleviate the near-term servicing requirements of equipment already installed.

At the same time, HFC-410A continues to enter the installed bank through imported pre-charged equipment. Although outside the scope of this assessment, it is estimated that as much as 500 tonnes of HFC-410A entered Australia in stationary AC equipment over the past 12 months, which will add to future servicing demand. This important information highlights the case for further equipment controls to accelerate the transition away from HFC-410A in new stationary AC equipment. This regulation is necessary to avoid adding to a legacy bank that will become increasingly difficult and costly to service as the HFC phase-down progresses.

## 7.3 Mobile Air Conditioning

### *7.3.1 Market Overview*

Australia's mobile air conditioning (MAC) sector remains heavily dependent on HFC-134a. Aftermarket demand reached a record 762 tonnes in 2025, while demand for HFO-1234yf is estimated to be less than 10 tonnes per annum. This highlights the slow transition of Australia's vehicle fleet and the continuing reliance on HFC-134a for servicing existing vehicles.

### *7.3.2 Risk Profile: Medium*

HFC-134a is projected to come under increasing supply pressure from 2028 onwards, particularly if usage does not decline in response to tightening supply and higher prices. These shortages are expected to disrupt the MAC aftermarket through reduced refrigerant availability and higher servicing costs, although the direct financial impact on most vehicle owners is unlikely to be severe. Even substantial increases in the price of HFC-134a would have a relatively limited impact on the total cost of vehicle ownership, as a typical passenger vehicle air conditioning system contains only around 0.6 kg of refrigerant. However, higher refrigerant and servicing costs may increasingly affect repair decisions, particularly for older or lower-value vehicles where the cost of restoring the air conditioning system becomes significant relative to the value of the vehicle.

### *7.3.3 Transition Pathways*

Several transition pathways are available to the aftermarket, although each has advantages and limitations. Hydrocarbon refrigerants are commercially attractive because refrigerant charges are typically around one-third of those required for equivalent HFC systems, substantially reducing refrigerant costs per vehicle. However, hydrocarbons are flammable and their use in

MAC systems requires appropriate consideration of safety and regulatory requirements, particularly when retrofitting systems originally designed for non-flammable refrigerants.

R513A is a non-flammable refrigerant originally designed to replace HFC-134a in various applications that may become an increasingly viable retrofit option should the price of HFC-134a continue to rise relative to R513A. HFO-1234yf is another potential pathway; however, as a mildly flammable (A2L) refrigerant, retrofit applications require careful consideration of safety, regulatory requirements and system compatibility. Additionally, HFO-1234yf remains the highest-cost alternative in Australia and is unlikely to become widely adopted for retrofit applications until the cost of HFC-134a increases substantially.

### *7.3.4 Key Findings*

Unlike the European Union, USA and Japan, Australia has not implemented equipment bans or other measures to drive the transition from HFC-134a to lower-GWP refrigerants in new mobile air conditioning systems. In 2022, 628 tonnes of HFC-134a entered Australia in pre-charged mobile air conditioning equipment (DCCEEW 2024a). While pre-charged equipment imports are outside the scope of this assessment, it is estimated that more than 400 tonnes of HFC-134a entered the Australian market in new vehicles over the past 12 months, with more than 5,000 tonnes added to the installed base over the past decade. The continued introduction of HFC-134a equipment has delayed the transition to lower-GWP alternatives and increased Australia's future servicing demand, further extending reliance on a refrigerant with an increasingly constrained supply.

## 7.4 Low Risk Applications

Not all RAC applications are expected to be materially affected by tightening HFC supply. Several market segments have been assessed as having Low or Nil to low risk, generally because equipment is self-contained, has relatively small refrigerant charges, is infrequently serviced, or has readily available lower-GWP replacement technologies.

- **Small self-contained air conditioning:** including window/wall units, portable air conditioners and other small self-contained systems. These are generally low-capital products that are infrequently repaired following major refrigerant loss and can increasingly be replaced with equipment using hydrocarbons such as R290.
- **Small domestic hot-water heat pumps:** including domestic hot-water heat pumps, heat-pump clothes dryers and other small heat-pump products. This market is transitioning rapidly towards hydrocarbons and other lower-GWP technologies.
- **Large commercial heat pumps:** including commercial heat pumps and multi-function chillers. New equipment is increasingly available using HFOs and natural refrigerants including $CO_2$ and R290, reducing dependence on constrained HFCs.
- **Domestic refrigeration:** including domestic refrigerators, freezers and portable refrigeration equipment. These products are predominantly self-contained, and the market has already transitioned extensively to hydrocarbon refrigerants, particularly R600a.
- **Small self-contained commercial refrigeration:** including integral refrigeration cabinets, beverage vending machines, beverage coolers, ice makers, water dispensers and other self-contained equipment. Hydrocarbon alternatives, particularly R290, are well established and

older equipment can generally be replaced rather than extensively repaired. Small slide-in/drop-in cool room systems are also assessed as low risk.

These segments demonstrate the importance of technology availability and equipment replacement economics in determining exposure to refrigerant shortages. Where proven low-GWP technologies are already commercially available and equipment can be readily replaced, tightening HFC supply is expected to accelerate an existing transition, rather than create significant operational disruption.

## 7.5 Overall Findings

The modelling and market analysis indicates a progressively tightening refrigerant supply position through to 2030, resulting in uneven impacts across refrigerant species, suppliers, regions and market sectors. The key findings are:

- Refrigerant shortages are now considered inevitable. The key uncertainty is no longer whether shortages will occur, but when and where they will emerge, which refrigerants will be affected, and which applications will be most exposed.
- Aggregate national supply masks the underlying risk, with shortages expected to emerge first at individual refrigerant, supplier and regional levels.
- 2026 is principally an adjustment year, with shortages emerging in parts of the supply chain during 2027 and becoming progressively more widespread and severe through to 2030.
- HFC-404A and HFC-410A represent the principal near-term exposures, while HFC-134a will become increasingly constrained later.
- Tightening quota will also drive product rationalisation as suppliers concentrate available quota on refrigerants with the greatest ongoing demand. Lower-volume legacy products, including HFC-407A/F and HCFC replacement blends, are expected to be withdrawn first, followed progressively by HFC-407C and HFC-452A, potentially making some refrigerants unavailable before the aggregate national supply is exhausted.
- Shortages are expected to be highly seasonal, with the greatest supply pressure occurring in Q4 and some shortages relieved as imports resume under the new annual quota in Q1.
- The consequences are highly uneven: commercial refrigeration, medium and large stationary AC and Australian AC manufacturing face materially greater risks than applications with readily available lower-GWP alternatives.
- The largest uncertainty is how quickly the market responds to tightening supply and higher prices. A stronger response through reduced consumption, improved containment, substitution, equipment replacement and greater recovery and re-use would reduce the severity and duration of shortages, while a slower response would result in more severe supply constraints.
- The servicing demand from the large legacy refrigerant bank of equipment cannot readily be deferred or substituted which limits how quickly demand can adjust.
- Accelerating the equipment transition is now urgent. Extending controls to new applications where proven lower-GWP technologies are available, particularly HFC-134a for mobile air conditioning, HFC-404A for commercial refrigeration and larger HFC-410A stationary air conditioning, would reduce the growth of the legacy bank and future servicing demand.

- Recovery, recycling, re-use and reclamation can provide an increasingly important supply buffer, but their contribution depends on recovery rates, commercial incentives, reclamation capacity and effective reverse supply chains.

# 8 Appendix A

## 8.1 Bulk Import Data

**Table 4: Bulk Import Data**

| | 2023 | 2024 | 2025 |
|---|---|---|---|
| HFC-134a | 1,094.3 | 1,247.8 | 1,353.9 |
| HFC-404A/507A | 700.5 | 423.1 | 421.4 |
| HFC-407C | 92.9 | 82.7 | 145.1 |
| HFC-407A/F | 4.8 | 2.6 | 4.8 |
| HFC-410A | 632.9 | 582.0 | 424.1 |
| HCFC/CFC Replacements | 32.7 | 57.0 | 0.1 |
| HFC-32 | 111.7 | 148.5 | 267.4 |
| R448A/R449A | 74.9 | 78.1 | 150.0 |
| R452A | 18.4 | 20.4 | 39.4 |
| R513A/R450A | 3.7 | 26.2 | 30.6 |
| Other HFO blends | 3.5 | 4.1 | 3.9 |
| HFC-Mix (foam/fire) | 31.8 | 8.4 | 5.0 |
| **Total** | **2,802.0** | **2,681.1** | **2,845.6** |

(Source: DCCEEW 2026a)

## 8.2 Global Warming Potential of Refrigerants

**Table 5: Global Warming Potential of Refrigerants**

| | GWP (AR4) | Notes |
|---|---|---|
| HFC-134a | 1,430 | — |
| HFC-404A/507A | 3,922 | HFC-404A used; HFC-507A = 3,985 |
| HFC-407C | 1,774 | — |
| HFC-407A/F | 1,825 | HFC-407F used; HFC-407A = 2,107 |
| HFC-410A | 2,088 | — |
| HCFC/CFC Replacements | 2,264 | HFC-438A used |
| HFC-32 | 675 | — |
| R448A/R449A | 1,387 | R448A used; R449A = 1,397 |
| R452A | 2,140 | — |
| R513A/R450A | 631 | R513A used; R450A = 605 |
| Other HFO blends | 466 | R454B used |
| HFC-227EA | 3,220 | — |
| HFC-245FA | 1,030 | — |
| HFC-365mfc | 794 | — |

**Note:** For grouped refrigerant categories, the GWP shown is based on the dominant refrigerant within the category, as identified in the notes column. **GWP (AR4):** Fourth Assessment Report of the Intergovernmental Panel on Climate Change for the United Nations Framework Convention on Climate Change, released in 2007. Australia's legally binding emission obligations under the second Kyoto Protocol commitment period are calculated based on AR4.

# 9 Glossary

| Term | Definition |
|---|---|
| AC | Air conditioning |
| ammonia refrigerant | Anhydrous ammonia (R717) has excellent thermodynamic properties and a GWP of zero, making it effective as a refrigerant, and is widely used in large cold storage facilities and process refrigeration applications because of its high energy efficiency and relatively low cost. Ammonia is used less frequently in commercial refrigeration applications, such as in supermarket and food retail, freezer cases and refrigerated displays due to its toxicity, and the proximity of the general public. |
| AR4 | Fourth Assessment Report of the IPCC |
| AR5 | Fifth Assessment Report of the IPCC |
| bulk importers | Companies with a licence to import bulk refrigerant. |
| chlorofluorocarbons (CFCs) | Molecules containing carbon, fluorine, and chlorine. CFCs are one of the major ozone depleting substances phased out by the Montreal Protocol on Substances that Deplete the Ozone Layer. CFCs are also potent greenhouse gases. CFCs and HCFCs are not counted as part of the greenhouse gases reported under the Kyoto Protocol of the United Nations Framework Convention on Climate Change, as they managed through the Montreal Protocol. |
| $CO_2$-e | Carbon dioxide equivalent is a measure that quantifies different greenhouse gases in terms of the amount of carbon dioxide that would deliver the same global warming. |
| $CO_2$ refrigerant | Carbon dioxide refrigerant (R744) is a natural refrigerant with a GWP of 1 and favourable thermodynamic properties. It is widely used in industrial and commercial refrigeration, including supermarkets, cold storage and food processing, and is increasingly used in heat pump applications, particularly for water heating. Advances in system design, compressors, controls and other components have enabled the widespread adoption of trans critical $CO_2$ systems and condensing units across a broad range of commercial refrigeration applications. |
| DCCEEW | Department of Climate Change, Energy, the Environment and Water |
| direct emissions | Emissions of refrigerant directly from equipment. Measured in $CO_2e$. |
| drop-in refrigerant | Drop-in (or near drop-in) refrigerant replacements are refrigerants that are intended to replace the original refrigerant with the same refrigerant classification (e.g. A1) and similar technical specification and keep the system running to the same or similar specification. Examples of HCFC-22/CFC replacements include HFC-422D, HFC-437A, HFC-417A, HFC-422A, HFC-438A, HFC-426A, HFC-424A, HFC-428A, HCFC-508A, HCFC-508B, HCFC-408A and HCFC-409A. Refer to refrigerant supplier instructions for further details. |
| EOL | End-of-life |
| end-of-life (EOL) equipment | Domestic, commercial or industrial device reaching the end of its useful lifespan. |
| end-of-life (EOL) emissions | End-of-life (EOL) emissions are direct emissions of ozone depleting substance (ODS) and synthetic greenhouse gases (SGG) not recovered for destruction or reclamation. |
| Fourth Assessment Report (AR4) | Fourth Assessment Report of the Intergovernmental Panel on Climate Change for the United Nations Framework Convention on Climate Change, released in 2007. Australia's legally binding emission obligations under the second Kyoto Protocol commitment period are calculated based on AR4. AR4 GWP values are used throughout this report, unless stated. Fifth Assessment Report of the IPCC (AR5) and Sixth Assessment Report of the IPCC (AR6) are later assessments that are not part of the legally binding emissions obligations. |

| Term | Definition |
|---|---|
| global warming potential (GWP) | Global warming potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere. A GWP is calculated over a specific time interval, commonly 20, 100, or 500 years and is expressed as a factor of carbon dioxide (whose GWP is standardised to 1). The Kyoto Protocol and Montreal Protocol are based on GWPs from pulse emissions over a 100-year time frame abbreviated as GWP-100. |
| GWh | Gigawatt hours is a unit of measurement for electricity use (1 watt hour x $10^9$). |
| high GWP substances or refrigerants | For the purposes of this report this term is used to refer to refrigerants commonly used today with GWPs greater than 1,400. This includes the widely employed HFC-404A (GWP of 3922), HFC-410A (GWP of 2088) and HFC-134a (GWP of 1430). Refer to definition of reduced GWP refrigerants and low GWP refrigerants. |
| hydrocarbons (HCs) | Hydrocarbon is a chemical that contains only carbon and hydrogen. The term hydrocarbon used in this report refers to the main types and blends of hydrocarbon refrigerant in use in Australia including HC-600a, HC-290 and HC-436 (a blend of HC-600a and HC-290). Users should refer to equipment manufacturer installation guidelines for further details. |
| hydrochlorofluorocarbons (HCFCs) | Chemicals that contain hydrogen, fluorine, chlorine, and carbon. They deplete the ozone layer, but have less potency compared to CFCs. Many HCFCs are potent greenhouse gases. HCFC-22 is the most common refrigerant in the Australian refrigerant bank. CFCs and HCFCs are not included in the GHGs reported under the Kyoto Protocol or United Nations Convention on Climate Change, as they are managed through the Montreal Protocol. |
| hydrofluorocarbons (HFCs) | Chemicals that contain hydrogen, fluorine, and carbon. They do not deplete the ozone layer and have been used as substitutes for CFCs and HCFCs. Many HFCs are potent greenhouse gases. |
| hydrofluoro-olefins (HFOs), and HFO blends | Chemicals known as hydrofluoro-olefins that contain hydrogen, fluorine, and carbon, and are described as unsaturated HFCs. They do not deplete the ozone layer and have very low GWP values. For example, HFO-1234yf and HFO-1234ze were originally cited by industry to have a GWP of 5, and a GWP-100 of 1 based on AR5. |
| HVAC&R | Heating, ventilation, air conditioning and refrigeration |
| indirect emissions | Emissions from the generation of the electrical energy required to operate electrical equipment, sometimes also referred to as 'energy related emissions.' Measured in $CO_2e$. |
| importer | Organisations and businesses that import bulk refrigerants and/or equipment containing refrigerant. |
| Kigali Amendment | The Kigali Amendment to the Montreal Protocol agrees a phase-down of HFC production and imports starting from 1 January 2019. It sets out a timetable for a phase-down of HFC production and imports that results in total HFC production and imports falling to 15% of the baseline levels from 2036 onwards. Australia started its phase down of HFCs one year earlier on 1 January 2018. |
| kt | Kilotonnes, or thousand tonnes |
| kW | Kilowatt (1 watt x $10^3$), unit of power. |
| kWh | Kilowatt hour (1 watt hour x $10^3$), unit of power consumption. |
| low GWP substances or refrigerants | For the purposes of this report this term is used to refer to refrigerants with a GWP of less than or equal to 10, including the 'natural' refrigerants ($CO_2$, ammonia, hydrocarbons), and the newly commercial HFOs sometimes referred to as low GWP HFCs. Refer to the definitions for High GWP Refrigerants and Reduced GWP Refrigerants. |
| MAC | Mobile air conditioning |
| Montreal Protocol | The Montreal Protocol on Substances that Deplete the Ozone Layer sets binding obligations for all countries to phase out import and production of ozone depleting substances and phase-down obligations for HFCs. |
| Mt | Megatonne, or million tonnes |

| Term | Definition |
|---|---|
| natural refrigerants | Hydrocarbons (R600a, R290 and R436), ammonia (R717) and carbon dioxide (R744) are commonly referred to as natural refrigerants. The term 'natural' implies the origin of the fluids as they occur in nature as a result of geological and/or biological processes, unlike fluorinated substances that are synthesised chemicals. However, it must be noted that all 'natural' refrigerants are refined and compressed by bulk gas manufacturers via some process and transported like other commercial gases so also have an 'energy investment' in their creation, storage and transport. |
| ODP | Ozone-Depleting Substances. |
| OPSGGM Act | *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989*, including amendments, and associated Regulations. |
| pre-charged equipment (PCE) | Pre-charged equipment is defined as any equipment, primarily air conditioning equipment or refrigeration equipment, (including equipment fitted to a motor vehicle) that is imported containing an SGG and any air conditioning or refrigeration equipment that is imported containing a HCFC. |
| RAC | Refrigeration and air conditioning |
| reclamation or reclaimed refrigerant | 'Reclamation' means the reprocessing of a recovered fluorinated greenhouse gas to the equivalent performance of a virgin substance, taking into account its intended use, in reclamation facilities that have the appropriate equipment and procedures in place to enable the reclamation of such gases and that can assess and attest to the level of the required quality (European Commission 2024, Regulation (EU) 2024/573). |
| recovery or recovered refrigerant | 'Recovery' means the collection and storage of fluorinated greenhouse gases from containers, products and equipment during maintenance or servicing or prior to the disposal of the containers, products or equipment (European Commission 2024, Regulation (EU) 2024/573). |
| recycling or recycled refrigerant | 'Recycling' means the reuse of a recovered fluorinated greenhouse gas following a basic cleaning process, including filtering and drying (European Commission 2024, Regulation (EU) 2024/573). |
| reuse | Charging equipment with used refrigerant without any cleaning or processing. This is often done by a contractor/technician rather than by a specialist or wholesaler. |
| refrigerant | Working fluid in the vapour compression refrigeration cycle. |
| refrigerant bank | The 'bank' of refrigerant gases is the aggregate of all compounds and substances employed as working fluids in the more than 60 million mechanical devices using the vapour compression cycle in Australia. Refrigerant in pre-charged imports is included in this value in the year of import. Refrigerant in equipment that is estimated to have retired from service in any year is not included. |
| refrigerant charge | The original refrigerant charge of refrigerant used as the working fluid for heat transfer inside a piece of equipment. |
| refrigerant classifications | AS/NZS ISO 817: 2016 Refrigerants - Designation and safety classification assigns safety classification to refrigerants based on toxicity and flammability data; and provides a means of determining the refrigerant concentration limit. |

| | Safety Group | |
|---|---|---|
| | Lower Toxicity | Higher Toxicity |
| Higher Flammability | A3 | B3 |
| Flammable | A2 | B2 |
| Lower Flammability | A2L | B2L |
| No Flame Propagation | A1 | B1 |
| A1 group refrigerants include the majority of HFCs and HCFCs.<br>A2L group refrigerants include HFO-1234yf and HFC-32.<br>B2L group refrigerants include R717 (Ammonia). | | |

| Term | Definition |
|---|---|
| | Refer to AS/NZS ISO 817, Supplier Material Data Sheets and equipment supplier Installation Guidelines for further details. |
| refrigerant consumption | The Montreal Protocol definition of consumption is bulk imports plus refrigerant manufacture minus bulk exports. Australia has not manufactured refrigerant since 1996. Bulk refrigerant is imported and used largely for servicing the existing refrigerant bank of equipment, as well as charging new equipment not imported as pre-charged equipment and in other applications including foams, fire protection, aerosols, export and other. Refer definition refrigerant usage. |
| refrigerant decanting into tradable quantities | There are three significant import/decanting facilities in Australia. Gas is decanted at these sites into thousands of cylinders ranging in size through 10 kg, 18 kg, 60 kg and larger transportable tanks. Transportable tanks with a volumetric capacity of approximately 900 litres are commonly referred to as 'one tonners', and 'half tonners' for tanks with a 450 litres capacity. These transportable tanks can contain between 400 kg and 700 kg of product depending on the gas involved. |
| refrigerant leak rate or effective leak rate | The leak rate referred to in this report is expressed as a percentage of the initial charge lost per annum and is calculated as the sum of gradual leaks during normal operation plus: catastrophic losses amortised over the life of the equipment; losses during service and maintenance; and gas lost along the supply chain. In the case of mobile air conditioning equipment, the annual leak rate takes into account losses from vehicle crashes, which are classed as catastrophic losses. |
| refrigerant species | A refrigerant species is defined as a refrigerant category based on its chemical family. For example, CFCs, HCFCs and HFCs are all synthetic gases and are defined as different gas species. Similarly, hydrocarbon refrigerant is another gas species, and HC-600a, HC-290 and HC-436 (a blend of HC-600a and HC-290) refrigerants are all part of this family. Other gas species include anhydrous ammonia and carbon dioxide. |
| refrigerant usage | Refrigerant usage is the refrigerant used in the economy installing and manufacturing new equipment and maintaining existing equipment. Refer definition refrigerant consumption. |
| refrigerated cold chain | The refrigerated cold chain is part of the value chain, which involves transport, storage, primary and secondary processors, and display of chilled and frozen products from farm gate to consumer. The products include foodstuffs, pharmaceutical, medical, and scientific applications. This report now includes domestic refrigeration and freezers as part of the cold chain. |
| RHL | Refrigerant handling licence |
| RRA | Refrigerant Reclaim Australia |
| RTA | Refrigerant trading authorisation |
| self-contained RC | Refrigerated cabinet with its refrigerating machinery sited inside the cabinet structure. |
| technician | Qualified individuals must hold the appropriate Refrigerant Handling Licences (RHL) for their skillset and application. |
| tonne (t) | Metric tonne |
| wholesaler | Provide equipment, tools, parts and refrigerant gas to the HVAC&R industry. |

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