



# AIR-CONDITIONING EXPERT SECRETS



# **EXECUTIVE SUMMARY**

**A structural change has occurred in the air conditioning industry. Many air conditioners sold in the market today have become outdated.**

**Government legislation is already phasing down the supply of environmentally harmful hydrofluorocarbon (HFC) chemical refrigerants in Australia and internationally.**

# AIRAH'S MESSAGE

AIRAH, Australia's peak Air Conditioning industry body has published strong directives such as...

*“The biggest threat is to do nothing. The phase-down is a reality, the transition to low Global Warming Potential (GWP) technology must happen, the industry must rise to the challenge... the first best thing anyone in the industry can do is to learn about the low GWP refrigerant-based solutions... Stop designing and installing with high GWP refrigerants, now! The worst thing anyone can do is to do nothing. Do something.”*



**THERE ARE A  
RANGE OF  
ADDITIONAL  
MARKET  
FACTORS  
MAGNIFYING  
THE CHANGE.**



# CLIMATE ISSUES



# MONEY ISSUES



# SAFETY ISSUES

# CLIMATE ISSUES

Local Governments, such as City of Sydney, are beginning to require that air conditioners in new developments have a GWP of 3 or less. Most chemical refrigerant air conditioners have a GWP of more than 200 times this.

The past year has seen an unprecedented focus on climate action and reducing greenhouse emissions. The youth of today are expecting responsible actions for their future world.

Consumers are more willing to pay extra for environmentally friendly products. Money talks... and it's going green.

Businesses with poor sustainability practices are under increased scrutiny.

Many financiers are backing off investments that have high sustainability related risk.

Climate has never been a more important factor in the marketplace.

# MONEY ISSUES



**At the same time, the 2020 virus pandemic and associated financial challenge is increasing consumer focus on costs at all levels.**

**Not only the initial cost of a purchase, but also the ongoing operating cost it involves. Consumers and businesses are needing to reduce overheads and operating costs to enable them to rebuild financially.**

**High electricity expenditure has been a pain point for many years and people and businesses do not want to continue to waste money on inefficient air conditioners.**



# **SAFETY ISSUES**

**The days of ignoring serious threats to human health and safety are over.**

**Any person who reads the manufacturer material safety data sheets of chemical refrigerant air conditioners will realise that the potential health risks are serious.**





**CLIMATE,  
SAVING MONEY  
AND SAFETY  
ARE NOW MORE  
RELEVANT TO  
THE WORLD  
THAN EVER  
BEFORE.**

Multinational chemical companies have controlled the market and resisted change.

An aerial photograph of a white SUV driving on a dirt road through a dry, scrubby landscape. The road is a single track with deep tire marks, winding through a field of sparse, dry vegetation and scattered trees. The background shows rolling hills under a clear sky. The overall tone is warm and earthy, with a mix of browns, tans, and greys.

# AN AUSTRALIAN INNOVATION PROVIDES THE SOLUTION

**Pioneer Air Conditioners with Engas hydrocarbon natural refrigerant are designed for environmental performance, safety and saving money. They are able to meet the changing market needs of the world.**

**It is the outcome of 10 years engineering and product development between these Australian companies.**

**The result is an internationally patented technology and the world's best air conditioner.**

**The environmental performance can help Local, State and Federal Government, and businesses and organisations of all sizes meet their greenhouse reduction targets.**

**The energy saving performance reduces electricity costs. This increases business profitability and competitiveness and can help grow the economy and generate jobs.**

**The safety performance is what HVAC technicians and building occupants deserve.**

**This document outlines in detail the shift in the air conditioning market, and how the Pioneer technology is able to fulfill the key requirements of air conditioners of the future.**

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Note: This document relies on third party information. We have used reasonable efforts to ensure the accuracy of data and information presented. Energy, financial and CO<sub>2</sub> savings presented are estimates only and may depend on a range of variables. No liability is accepted for reliance on this document. You should discuss your specific circumstances and requirements with us so we can recommend the appropriate solution.



**COMPLIANT  
WITH  
REGULATORY  
CHANGES AND  
NOT SUBJECT  
TO  
OBSOLESCENCE**

■ You wouldn't buy a black and white TV.

*“Around the world, the vision for a future without HFCs is becoming a reality as Governments and major corporations move ahead with plans to eliminate their use”*

*Full Steam Ahead: Charting the Path to a Future without HFCs, The Environmental Investigation Agency.*<sup>1</sup>

HCFC chemical refrigerants (i.e. R22) are ozone depleting. Their supply has already been phased down in accordance with the Montréal protocol global agreement. As a result of the phasing down of these chemicals, scientists expect the Antarctic ozone to recover back to the 1980 level around 2070.<sup>2</sup>

The majority of air conditioners now use HFC chemical refrigerants (i.e. R410a and R32). The release of these refrigerant gases into the atmosphere contributes to global warming.

Their supply is presently being phased down in accordance with the Montréal protocol Kigali amendment.<sup>3</sup>

Scientists estimate the Kigali accord will reduce global warming by nearly one degree Fahrenheit (0.55°C).<sup>4</sup>

**The Ozone Protection and Synthetic Greenhouse Management Legislation Amendment Bill 2017 enforces the HFC phase down within Australian law.<sup>5</sup>**

**A shift toward low Global Warming Potential (GWP) refrigerants is therefore mandated in Government policy.**

**Local Governments, such as City of Sydney, have introduced a requirement in development applications ensuring that the refrigerants used in air conditioning (AC) systems have a GWP of 3 or less.**

**As the supply of HFC chemical refrigerants is phased down by law, the cost of replacement gas is expected to increase. This trend has already occurred with R22.**

**You wouldn't buy a typewriter or a black and white TV.**

**Why buy an air conditioner that Government legislation has already deemed will be obsolete?**

# ALIGNED WITH AUSTRALIAN INDUSTRY DIRECTION

The following was published in 'Ecolibrium' (Aug 2018), the Official Journal of AIRAH (The Australian Institute of Refrigeration, Air Conditioning and Heating) which represents over 10,000 air conditioning, refrigeration, heating and ventilation professionals across Australia.



*“Due to this huge technology transition and renewal of existing RAC (room air conditioner) infrastructure over the next 15 years, the individual and commercial opportunities within the industry are almost unlimited. It will be a great time to be in the industry. It’s a great industry that is cleaning up its act, and it is a pivotal industry that will drive how far and how fast the global community can move towards net zero emissions.*

*The biggest threat is to do nothing. The phase-down is a reality, the transition to low-GWP technology must happen, the industry must rise to the challenge. Rise, humans of HVAC&R...*

*The first best thing anyone in the industry can do is to learn about the low-GWP refrigerant-based solutions and alternatives that are currently available in your sector and the new technologies and methodologies that are under development. Inform yourself of what you are using now and its potential replacement. Stop designing and installing with high GWP refrigerants, now!*

*The worst thing anyone can do is to do nothing. Do something”.*<sup>6</sup>

**With the phase down of HFCs, the air conditioning industry has reached a fork in the road. Change is guaranteed.**

**Grosvenor Engineering Group is the first major technical services company in Australia to introduce a dedicated natural refrigerant technology service for HVAC &R systems. Grosvenor currently employs over 800 staff, 400 of which are HVAC technicians, and will train all of them in natural refrigerant technology within the next 12 months.**

*“Grosvenor staff have been observing market trends overseas and the exponential growth in environmentally friendly HVAC &R solutions which deliver significant energy savings.*

*The technology that underpins the ability to achieve these outcomes is the use of natural refrigerants such as hydrocarbons.*

*Hydrocarbon technology offers significant benefits including reduced energy and maintenance costs; diminished carbon emissions and the solution can be delivered as a service, negating capital expenditure.*

*We will soon have a dedicated team of highly experienced and accredited staff equipped to implement natural refrigerant technology in commercial buildings.*

*The aim is to support the multi-billion-dollar Australian commercial office market in reducing its carbon footprint by providing a green alternative.*

*If customers use HVAC &R systems that utilise natural refrigerants they benefit from reduced energy costs, in some cases up to 60 per cent, lower maintenance costs and can sustain a reduced carbon footprint. The business and environmental cases continue to grow stronger.*

*Green assets are also more desirable investments for investors. NABERS and Green Star ratings improve property capital values.*

*It is part of Grosvenor's DNA to be at the forefront of cutting-edge technology used within the built environment.”<sup>7</sup>*

*- Nicholas Lianos, Managing Director  
Grosvenor Engineering Group*

*“Minimization of direct and indirect emissions from all refrigeration and air conditioning plant is becoming increasingly important”.*

*- Stefan Jensen*

*Member of the Board of Directors of the International Institute of Ammonia Refrigeration and Member of the Board of Directors of the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH).<sup>8</sup>*

# MEANINGFUL CLIMATE IMPACT

*“The number of room air conditioning units in service is estimated to increase from 1.2 billion units today to 4.5 billion units by 2050.... the world needs a radical change in comfort cooling technology, one that can effectively and assuredly offset the exponential increase in cooling energy demand and put us on a path to cooling with less warming.”*

*- Solving the Global Cooling Challenge,  
Rocky Mountain Institute.<sup>9</sup>*

*“We are in the critical decade. It is no exaggeration to say that what we do regarding emissions reductions between now and 2030 will determine the quality of human life on this planet for hundreds of years to come, if not more.”*

*- Christiana Figueres, former executive secretary of the United Nations Framework Convention on Climate Change. <sup>10</sup>*



*“If you want to keep warming well below 2°C then you really need to hit net-zero by 2040, but we're not even close to achieving that.*

*We're on target for 3°C or 4 °C.*

*There are some people who say at that Temperature the earth can't even handle human habitation.”*

*- Professor Steffen,  
Australian National University. <sup>11</sup>*

*“The world has only six months in which to change the course of the climate crisis and prevent a post-lockdown rebound in greenhouse gas emissions that would overwhelm efforts to stave off climate catastrophe”*

*- Executive Director, Environmental Energy Agency.<sup>12</sup>*

*“Let’s act with the fierce urgency of now. It’s our responsibility to ensure a liveable planet - for us and for all future generations.”*

*- World Bank President.<sup>13</sup>*

*“The most immediate, cost-effective, and tangible global measure to address climate change ever contemplated, the phasedown of HFCs.”*

*- Briefing for the 26th meeting of the Parties to the Montreal Protocol.<sup>14</sup>*



**155 companies with a combined market capitalisation of over US\$2.4 trillion and representing over 5,000,000 employees, have signed a statement urging governments around the world to align their COVID-19 economic aid and recovery efforts with the latest climate science.**<sup>15</sup>

**Whether you personally believe in manmade climate change or not - with the stakes being so high - why take the gamble...?**

**HFCs have become the fastest-growing source of greenhouse gas emissions worldwide.**<sup>16</sup>

**Adopting low GWP air conditioning can make a meaningful impact on the level of greenhouse gas emissions.**

**Environmentally harmful high GWP refrigerants must be properly disposed of to minimise leakage into the atmosphere.**

**There is no economic downside. Shifting to low GWP refrigerants can be achieved while supporting businesses, consumers, jobs and growing the economy.**



A misty forest of tall evergreen trees, likely a coniferous forest, with a soft, hazy atmosphere. The trees are dark green and stand against a light, greyish background. The overall mood is serene and natural.

# CO<sub>2</sub> EMISSIONS SAVINGS

Direct greenhouse emissions from AC refrigerant leakage are significant.

The table shows the kg of CO<sub>2</sub> equivalent for every 1 kg of refrigerant, and its atmospheric lifetime.<sup>17</sup>

REFRIGERANT	20-YEAR kg CO <sub>2</sub> e	100-YEAR kg CO <sub>2</sub> e	LIFE TIME (years)
R22	5,280	1,760	11.9
R410a	4,260	1,924	28.2
R32	2,430	677	5.2
Hydrocarbon	< 3	< 3	< 1

Refrigerant leakage from air conditioning is estimated at 9% of the refrigerant volume, each year, on average.<sup>18</sup>

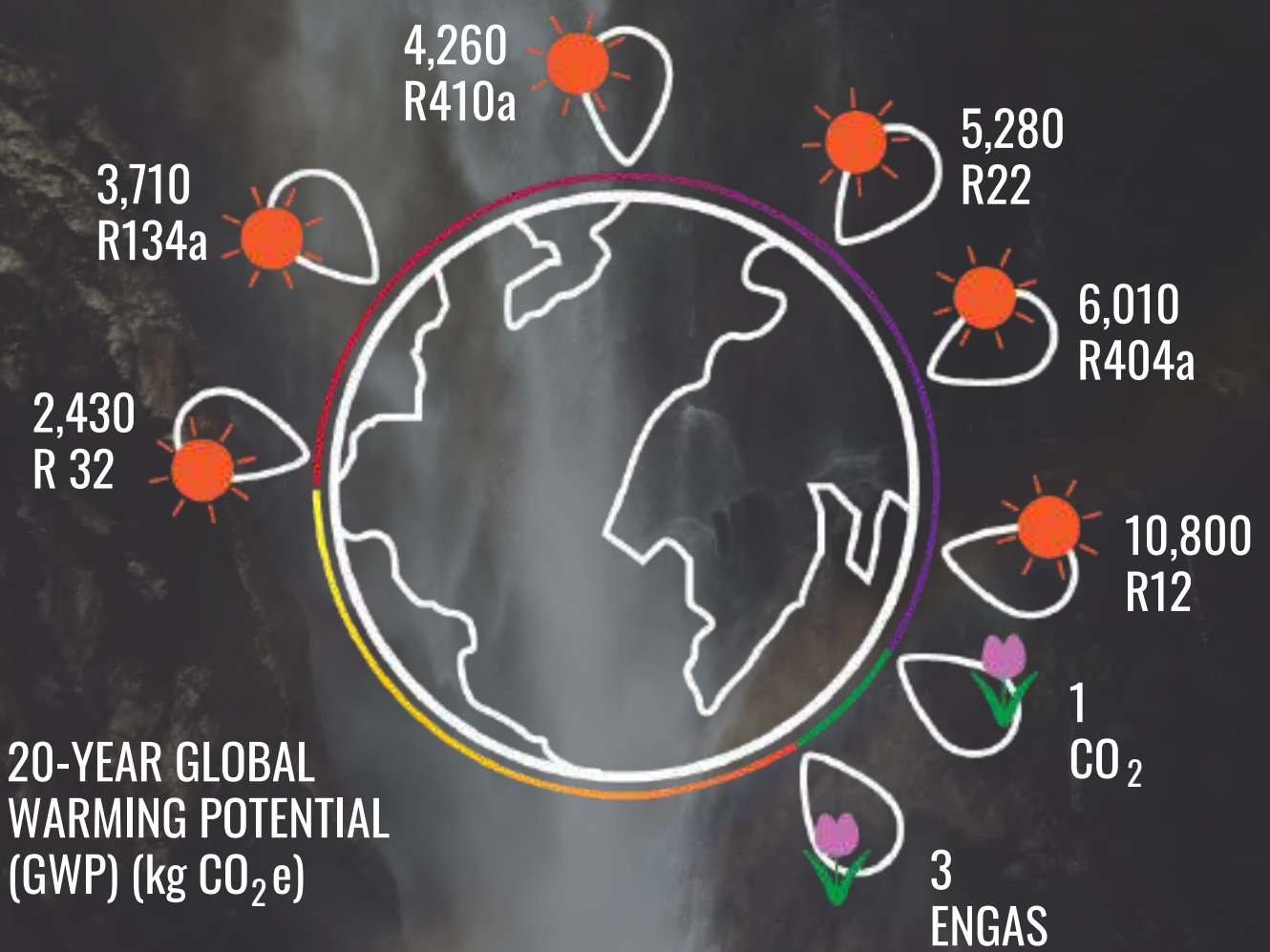
Many of the millions of AC units in Australia will end their life with equipment failure and leak HFC refrigerant into the atmosphere unless changed under planned obsolescence. Industry data shows that 80% of all HCFC 22 ever produced has already been released into the atmosphere, as at 2003.<sup>19</sup>

The direct greenhouse emissions for 1 x R410A 9kW split system AC is more than 1,100 kg CO<sub>2</sub> e each year, for the next 28 years (based on 9% leakage p.a., 2.9 kg of refrigerant and 20-yr kg CO<sub>2</sub> e).

For a Pioneer unit it is less than 4.5 kg CO<sub>2</sub> e p.a. for less than 1 year.

The improved energy efficiency also reduces the indirect greenhouse emissions from the electricity used.

For instance, 1 x 9kW Pioneer AC in an apartment can save 1,298 kg CO<sub>2</sub> p.a., compared to a new chemical refrigerant air conditioner of the same product class, from the reduced electricity consumption.





# NATURAL REFRIGERANTS ARE INTERNATIONALLY ENDORSED

There are five natural refrigerants;  
Air, Water, CO<sub>2</sub>, Ammonia, and Hydrocarbons

## Natural Refrigerants are Internationally Endorsed

For any concerns about introducing hydrocarbons into your building, an estimated 700 million refrigerators already operate with this natural refrigerant.

*“ASHRAE has recognized that the advancement of sustainable building design and operations is critical to the protection of our global environment and to society.*

*Expanding the safe and efficient application of natural refrigerants supports this move towards sustainability and continues ASHRAE’s legacy as an international leader in the field of refrigeration and air conditioning.”*

- ASHRAE Position Document on Natural Refrigerants  
(over 57,000 members in 132 countries).<sup>20</sup>

The international Consumer Goods Forum, comprising 400 of the world’s largest companies across 70 countries, has called for the use of natural refrigerants.

*“Natural refrigerants are the best available technology and offer the long-term solution”*

- Greenpeace Position Paper, October 2009,  
HFOs: the new generation of F-gases.<sup>21</sup>

## Natural Refrigerants are Internationally Endorsed

*“In short, no matter what industry you are in, the case for switching to natural refrigerants has never been stronger, and the time to move is now!”*

*- Understanding the Most Cost Effective Way to Fight Climate Change, The Consumer Goods Forum. <sup>22</sup>*

**Project Drawdown has identified refrigerant management as the most critical step towards reducing global CO<sub>2</sub> emissions. <sup>23</sup>**

*“In order to achieve a global phase-down of HFCs, replacement fluids must be identified, and a global refrigerant transition must be implemented. The theoretically ideal refrigerant is the one having zero ozone depletion potential, low GWP, nontoxic, non-flammable, has appropriate thermodynamic and heat transfer properties and is compatible with any type of lubricating oil. Hydrocarbons satisfy all the requirements except being highly flammable”*

*- El-Sayed, El Morsi, and Mahmoud 2018, Project Drawdown. <sup>24</sup>*

**Note: Refer ‘Flammability Safely Addressed’ on page 57 of this document**

# LOWER ELECTRICITY CONSUMPTION

Pioneer air conditioners using Engas hydrocarbon natural refrigerant use considerably less electricity than air conditioners operating on chemical refrigerant.



## Lower Electricity Consumption

This is due to the increased heat absorption ability of natural refrigerant molecules. To achieve the same heat transfer, up to 62% less refrigerant volume is required. This results in lower discharge operating pressures, reduced demand on the compressor and lower electricity usage.

# 30-50%

Electricity savings compared to other brands of new split system air conditioners in the same product class.

# UP TO 65%

Electricity savings compared to older fixed speed air conditioners.

Further, chemical refrigerants have a lower critical temperature (the temperature at which refrigerant gas will not turn to liquid in the vapour compression cycle).

For instance, the critical temperature of R410a is 71.3°C and R32 is 78.1°C.<sup>25</sup>

During hot weather the temperatures within an air conditioner may reach or exceed this. The result is decreased cooling performance and increased electricity consumption during times when cooling is most needed.

**The critical temperature of Engas M60 is 90°C. The performance does not reduce in hot weather.**

**Reducing wasted energy is a fundamental step in building sustainability and environmental performance.**

**Given that air conditioning is the highest user of electricity in most Australian buildings, this represents enormous electricity, CO<sub>2</sub> and financial savings for Australian businesses and households.**

**In NSW and Victoria these energy savings may generate financial rebates on large commercial projects, under the Government energy saving programs.**



# PEAK DEMAND REDUCTION

A fundamental challenge for most electricity grids is peak power demand.

**During extreme heat periods, air conditioning usage increases, pushing electricity grids to their capacity.**

*“Between a mild day and a hot day, demand across a city or suburb can literally double.”*

*- Glenn Platt, CSIRO's energy research director.*

*When the weather is hotter than 35 degrees, every rise of a degree results in extra electricity demand of about 100 megawatts in Victoria alone, the equivalent required to power 100,000 homes.<sup>26</sup>*

*“Growing demand for air conditioners is one of the most critical blind spots in today’s energy debate. Setting higher efficiency standards for cooling is one of the easiest steps governments can take to reduce the need for new power plants, cut emissions and reduce costs at the same time.”*

*- Fatih Birol, International Energy Agency Executive Director.<sup>27</sup>*

**Blackouts have occurred in recent years when electricity grids cannot meet demand.**

**More efficient air conditioners that use less electricity, particularly in high ambient temperature conditions, are fundamental to solving this problem.**

**Pioneer Air Conditioners meet this requirement. They draw less power demand than other reverse cycle air conditioners and reduce demand on electricity grids.**

**Reducing power demand helps increase grid reliability. It also reduces the need for continual investment in grid infrastructure, which has been a major factor in electricity price rises over the last decade.**

**It can provide financial benefits for businesses that are constrained in their electrical capacity. Demand reduction can free up capacity without needing expensive upgrades to infrastructure such as cabling, switchboards and transformers.**

**Demand reduction from efficient air conditioners may also generate additional financial rebates as energy saving programs move to incentivise power demand reductions as well as energy savings.**

**As an example of the demand savings from Pioneer air conditioners, the measurement and verification data displayed on the next page was recorded with a like-for-like comparison of 2 residential apartments, normalising the variables in electricity consumption as much as practical to reliably demonstrate savings.**

# Peak Demand Reduction



R22 inverter  
8kW Cooling  
Capacity  
Running Amps  
= 9.87 A



Pioneer inverter  
10.6kW  
Cooling Capacity  
Running Amps  
= 5.43 A

= 45% reduction

On a kW for kW basis,  
the actual demand reduction  
demonstrated is 59%.

# **LOWEST LIFECYCLE COST**

**THE LIFECYCLE COST OF AN  
AIR CONDITIONER INCLUDES:**

- up-front equipment**
- installation**
- service and maintenance**
- replacement components from  
out of warranty failure / wear**
- electricity running costs**
- replacement refrigerant**

**over the useable life of the  
equipment.**

**Pioneer Air Conditioners have substantially  
lower electricity costs than reverse-cycle  
chemical refrigerant air conditioners in the  
same product class.**

**Due to the lower operating pressure within the system and the absence of acid producing chemicals, wear and tear on the compressor and other components is reduced.**

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**This extends equipment lifespan and reduces maintenance and component replacement costs.**

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**Pioneer Air Conditioners have a market leading warranty duration, therefore out of warranty costs are typically less than other brands.**

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**As households and businesses become increasingly discerning and cost-conscious in their purchase choices, this matters.**

**HFC chemical refrigerants are being phased down. As this happens the cost of replacement refrigerant is expected to increase significantly, as has already occurred with R22. Natural refrigerants are not being phased down and their cost will not rise in the same way.**

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**These financial benefits make Pioneer the lowest lifecycle cost reverse cycle air conditioners in the world.**

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**Over the lifetime of equipment it would cost less to invest in a Pioneer air conditioner than to install a comparable air conditioner using chemical refrigerant - even if the other unit was given to you for free.**



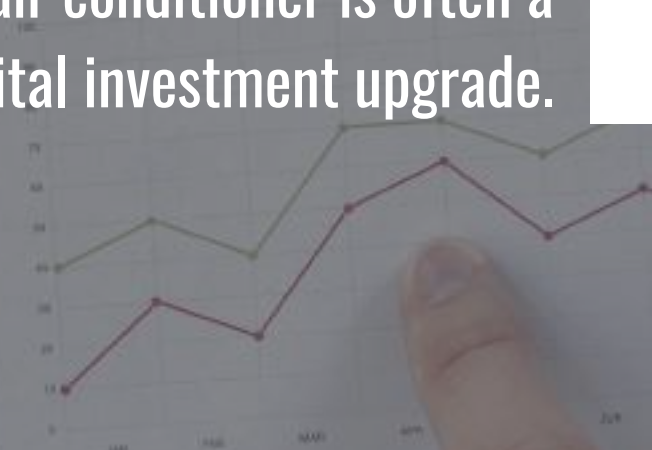
# HIGH RETURN ON INVESTMENT

Our company



Replacing an old air conditioner is often a significant capital investment upgrade.

Business items



**Air conditioning is fundamental to maintain comfort in most buildings. Until now, air conditioning upgrades have typically been performed to maintain equipment reliability for ongoing building comfort, with energy savings secondary.**

**The old financial model is to use capital funds or finance an infrastructure upgrade, with the energy savings taking many years to recoup the investment.**

**Pioneer air conditioning changes the financial model.**

**The high level of electricity cost savings from Pioneer can provide a financially attractive return on investment.**

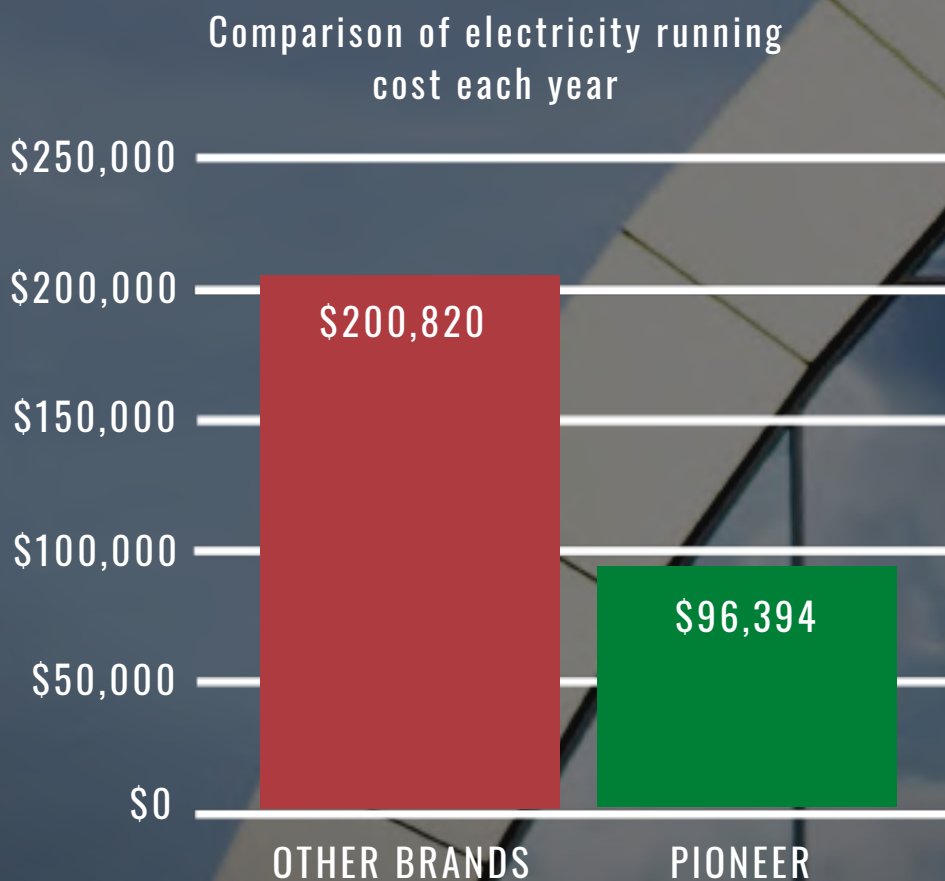
**Typically, if the equipment is financed via a lease (on balance sheet) or service agreement (off balance sheet) the electricity cost savings from changing an old air conditioner to a Pioneer air conditioner can exceed the repayments.**

**The new financial model is no-upfront cost and then positive cash-flows each month (depending on site specific cost and usage variables). At the end of the finance term all of the savings are retained by the business.**

In this scenario, the business is receiving the equipment for no net financial cost.

Reducing energy usage can often result in a smaller solar system being required, providing further investment savings.

As an example of the financial benefits enabling a high return on investment from projects using Pioneer, this chart displays the electricity cost savings replacing 157 x R22 air conditioners with Pioneer, in a Meriton serviced apartment building in Parramatta, NSW.





# BETTER FOR BUSINESSES

Installing the most energy efficient air conditioners with low GWP enhances environmental performance.

**Businesses can promote their environmental performance to clients, stakeholders and investors. It can often be monetised.**

*"Money talks...  
and it's going green"*

*- Professor Karen Hussey,  
University of Queensland Centre  
for Policy Futures. <sup>28</sup>*

*"The shift in consumer buying, with more consumers willing to pay extra for environmentally friendly products reinforces the need for companies to increase their commitments to responsible business practice"*

*- Managing Director,  
Accenture Strategy. <sup>29</sup>*

**Increase Green Star and NABERS ratings & BASIX Compliance. This can generate real financial benefits, with the Green Building Council of Australia stating that Green Star rated offices in CBD's have a 4.3% higher capital value per square metre than non-rated buildings. <sup>30</sup>**

**Improving environmental performance can help meet supply chain / Corporate Social Responsibility requirements.**

**Many financiers are moving away from high greenhouse polluters. For instance, the world's largest asset management company, BlackRock (~ AUD \$10 trillion in investments) announced in Jan 2020 it will “place sustainability at the centre of our investment approach” and begin to back off from investments that “present a high sustainability-related risk.”<sup>31</sup>**

**The world's largest sovereign wealth fund, owned by the Government of Norway, in May 2020 for the first time, used carbon emissions as a criterion to blacklist firms and exclude them from its fund.<sup>32</sup>**

**Reduced electricity and maintenance costs.**

**Lower operating costs increases the net operating income and capitalisation value of commercial buildings.**

**Landlords can pass on lower outgoing costs to attract and retain tenants.**

**Frees up money otherwise wasted on electricity bills, to be put to better use.**

**Reducing operating costs increases business profitability, resilience, competitiveness and value.**



# **COST-EFFECTIVE SOLUTION FOR REPLACING R22 AIR CONDITIONERS**

R22 air conditioners use relatively thin walled copper pipework.



## Cost-Effective Solution for Replacing R22 Air Conditioners

**The shift to R410a and R32 requires higher operating pressures and therefore thicker gauge copper pipework is needed.**

**Therefore, when replacing an R22 air conditioner with an R410a or R32 air conditioner, it is likely that the copper pipework needs to be replaced.**

**This can add substantial cost, particularly if the pipework is in walls, floors or ceilings, or the building has asbestos or heritage listing. Construction works and remediation often costs more than the actual equipment changeover.**

**Interruption to business can add further cost in lost revenue.**

**Due to the performance and low operating pressure of the refrigerant in Pioneer units, the same pipework as that used by R22 units can be reused with Pioneer.**

**Simply replacing the outdoor and indoor units and re-using this existing infrastructure can save significant time and money.**

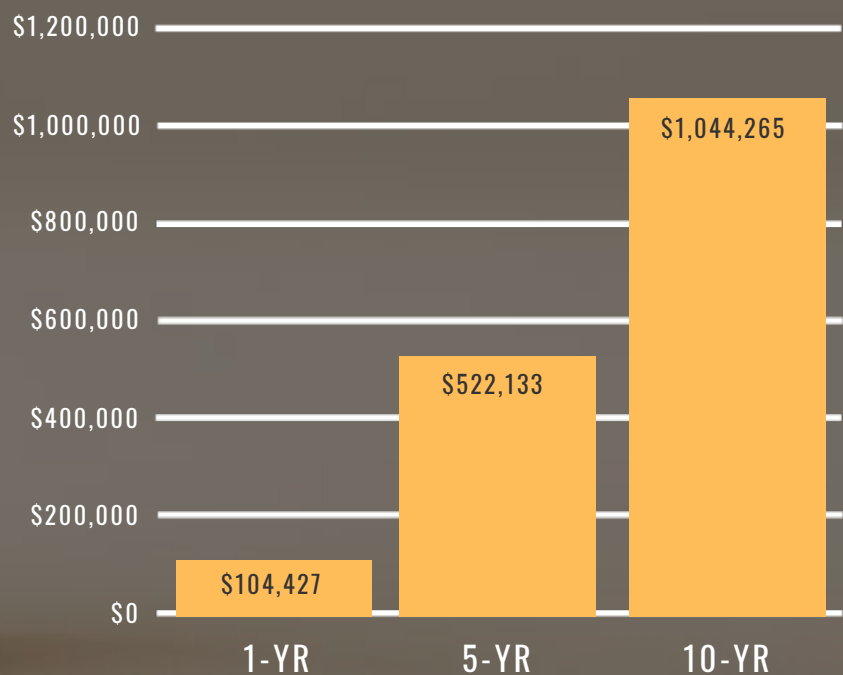
# Cost-Effective Solution for Replacing R22 Air Conditioners

Meriton is Australia's largest and most successful residential developer, having built, sold and leased more than 75,000 residential apartments.

Meriton saved nearly \$1,000,000 in construction costs retrofitting 157 old R22 air conditioners to Pioneer at their Riva Parramatta boutique apartment complex.

Further, based on recorded measurements, electricity cost savings of \$104,427 p.a. and CO<sub>2</sub> reductions of 393,973 kg p.a. are expected.

## ELECTRICITY COST SAVINGS INVESTING IN PIONEER



# Cost-Effective Solution for Replacing R22 Air Conditioners

*“Using a low GWP refrigerant demonstrates Meriton's commitment to improving its environmental performance in the residential apartment community.*

*“We want to adopt the best for our clients and the community.”*

*- David Cremona, Meriton  
Construction Director. <sup>33</sup>*



# ‘RENEW’ EXISTING AIR CONDITIONERS

Old HVAC units waste energy and money.

Many operate with fixed speed compressors and use chemical refrigerant. Electricity costs are high and maintenance increases with age.



**The average lifespan of a HVAC scroll compressor using chemical refrigerant in commercial buildings is around 11 years.**

**With the high capital cost to replace HVAC equipment, businesses often push their equipment to failure and risk the impact this will have on their business, as well as waste maintenance and electricity costs.**

**Pioneer 'Renew' is a more reliable and cost-effective alternative to waiting until failure or replacing HVAC equipment with a chemical refrigerant unit.**

**A new Pioneer condenser unit is installed and new wall controls added.**

**This approach saves money in capital upgrades and reduces electricity consumption by 40 - 65%.**

**Existing components subject to less wear and tear, such as ductwork, wiring, copper piping and the evaporator fan and coil, if in suitable condition, continue to be used. You have already paid for them. Why waste money and throw them out?**

**For larger HVAC equipment, a rebuild can occur with a hydrocarbon designed compressor, natural refrigerant, controls and other components as necessary.**

**A NSW pub invested \$41,000 in this approach. A new HVAC unit was \$115,000. In addition to saving \$74,000 in capital cost, the new system has higher quality compressors and uses 35% less electricity than the new HVAC replacement option.**

**A shopping centre in Sydney, NSW, experienced similar benefits. Rebuilding the chiller with hydrocarbon compressors and refrigerant delivered capital cost savings in excess of \$1 million and a 50% energy reduction.<sup>34</sup>**

A grayscale background image of HVAC equipment, showing various pipes, valves, and a circular component with text. The text on the circular component includes "HAMILTON" and "THE M...".

# **SAFER FOR TECHNICIANS AND BUILDING OCCUPANTS**

The following potential risks are what HVAC technicians and building occupants may be exposed to in their use of refrigerants:

# Safer for Technicians and Building occupants

Chemical refrigerants such as R32 may cause a detonation under pressure (known as the diesel effect).

The combustion by-products of chemical refrigerants include hydrogen fluoride (which becomes hydrofluoric acid upon contact with moisture or human skin) which is toxic.

It can be fatal if inhaled, if swallowed or in contact with skin. <sup>35</sup>

Refrigerant poisoning can cause a range of potential health issues.

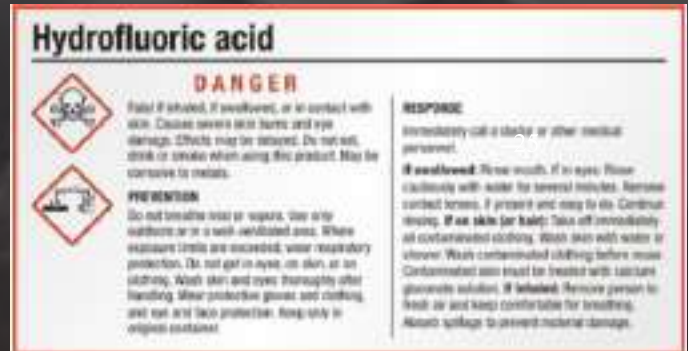
Manufacturer material safety data sheets include such warnings as: <sup>36</sup>

*“Causes asphyxiation in high concentrations. The victim will not realise that he/she is suffocating.”*

*“May cause cardiac arrhythmia.”*

*“Causes serious eye irritation.”*

*“WARNING! This product contains a chemical known in the State of California to cause cancer, birth defects or other reproductive harm.”*





*“From asbestos to tobacco to oil spills, history shows that those who mislead the public, the market or the government about the risks of their products, or the availability of safer alternatives, can face substantial legal liability, both as companies and as individuals. As the impacts of climate denialism and regulatory obstruction become clear, we want to understand how corporations, insurers, and officers and directors are allocating those risks among themselves. Just as importantly, we ask what steps they're taking to prevent the misconduct that creates those risks in the first place.”*

*- Carroll Muffett,  
President of the Centre for International Environmental Law <sup>37</sup>*

**Time will tell how much damage to humans chemical refrigerants may have already caused, and may continue to cause, and whether this leads to culpable liability upon chemical refrigerant manufacturers.**

**In the meantime each person and organisation can do their own due diligence about the potential risks and take their own duty of care.**

# Safer for Technicians and Building occupants

**Hydrocarbon natural refrigerants are the safer alternative for technicians and building occupants:**

**Hydrocarbon natural refrigerants if ignited in a confined space will cause overpressure, they will not detonate.**

**The combustion by-products of hydrocarbon natural refrigerants are harmless, being carbon and steam.**

**Hydrocarbon natural refrigerants are not known to cause poisoning to humans.**

**Hydrocarbon natural refrigerants are non toxic and are not known to cause cancer, birth defects or other reproductive harm.**

**Hydrocarbon refrigerants are stench so they can be identified. The pungent smell will alert occupants in any confined space to open a door or window or leave the area.**

**In response to recent virus and bacteria threats, Pioneer Health Air system is available in ducted systems and includes germicidal UVC light to kill 98% of bacteria.**



# FLAMMABILITY SAFELY ADDRESSED

Historically, the main objection from competing chemical refrigerant interests was that hydrocarbon refrigerants are flammable.

**All refrigerants can burn and hydrocarbon refrigerants have a lower auto-ignition temperature than high GWP refrigerants.**

**Additional facts provide a more accurate understanding and demonstrate why the difference in auto-ignition temperature has little relevance in real-life application.**

**Hydrocarbon refrigerants have a dangerous goods safety classification 2.1 - highly flammable.**

**R32 chemical refrigerant has the same dangerous goods safety classification 2.1 - highly flammable. They are treated the same as hydrocarbon refrigerants. Both should only be handled by properly trained and accredited professionals.**

**Many chemical refrigerant air conditioners are shifting to R32, which has a lower GWP relative to R410a and R22 refrigerants.**

**The fact that R32 has the same dangerous goods classification as hydrocarbon refrigerant has effectively nullified the competing focus on hydrocarbons being flammable.**

Further, it is necessary to evaluate the application of refrigerants in practice:

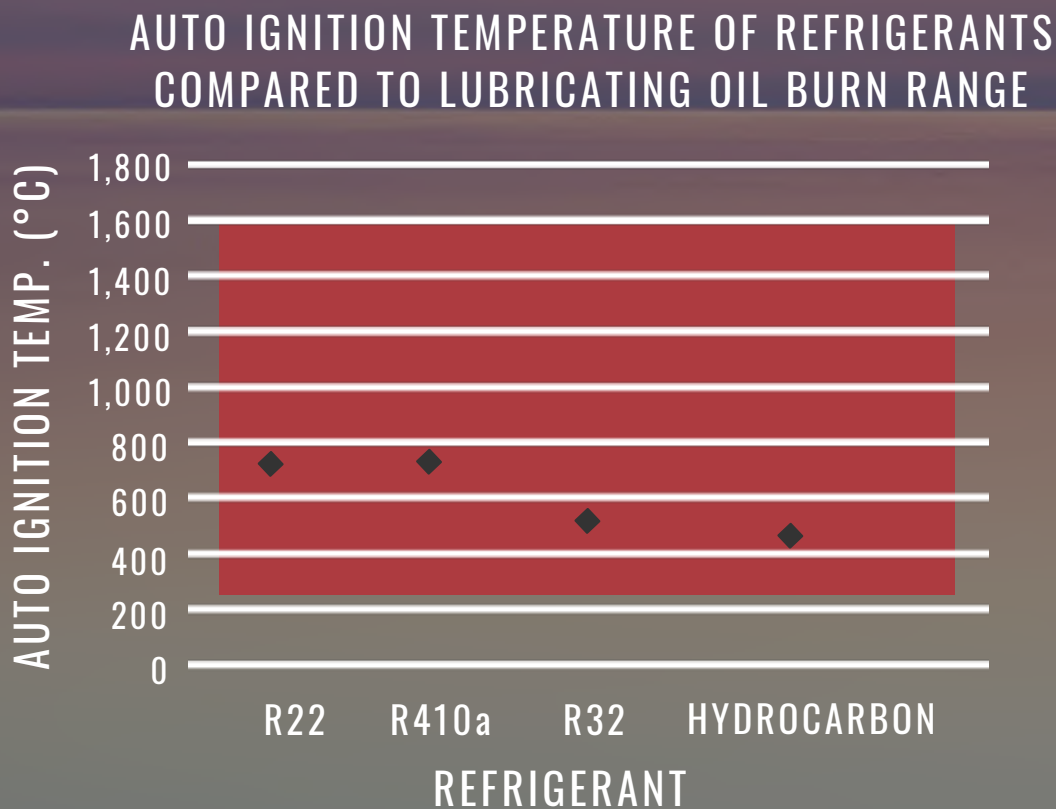
AUTO IGNITION TEMPERATURE	°C
R22	740
R410a	755
R32 <sup>38</sup>	530
HYDROCARBON ENGAS M60 <sup>39</sup>	480
LUBRICATING OIL	262

The auto ignition temperature of most lubricating oils under high pressure, being atomised as through a leak, is 262 °C.

Lubricating oil burns to 1600°C, igniting all refrigerants in the process.

Therefore, the actual auto-ignition temperature of all refrigerants mixed with lubricating oil is 262°C.

This chart displays the auto ignition temperature of refrigerants. The red is the temperature range at which lubricating oil burns.



Hydrocarbon refrigerants are only flammable when the ratio of refrigerant to air is in the range of 2-10% refrigerant to 90-98% air. Outside of this narrow range they are non-flammable.

*“Subject to compliance with certain safety principles, the application of flammable hydrocarbon refrigerants can be done as safely as with any other type of refrigerant.”*

*Bernhard Schrempf,  
Head of Centre of Competence for Refrigeration and Air Conditioning, TUV  
SUD (one of the world’s leading technical service organization with 22,000  
employees across 800 locations).<sup>40</sup>*

There are more than 700 million domestic refrigerators using hydrocarbon natural refrigerant, with few flammability incidents recorded.

A study comparing the risk of hydrocarbon domestic refrigerators (DR) with hydrocarbon split system air conditioners (SAC) concluded the following:

- *The overall ignition frequency of split system air conditioners (SAC) is about one-hundredth of the domestic refrigerator (DR)*
- *The overall risk of overpressure and the risk of thermal intensity for the SAC was around 100 times lower than the DR*
- *The calculated ignition frequency of both appliances is extremely low, being less than one ignition event per 100 million SACs in 10 years, with the frequency of secondary fire is about 10 times lower than the ignition frequency*
- *The risk for enclosures should be very low, but it is notably higher for the DR cabinet because of the inability of the refrigerant to drain from it*
- *The reasons for lower ignition frequency risk of SACs are because of the use of a fan that helps to disperse the leaked refrigerant, and due to the fact that a high level release can easily disperse to below the flammable limits through the adoption of certain measures.*

*‘Comparative Risk Assessment of Hydrocarbon Refrigerant in Refrigerators and Split Air-Conditioners’, Dr Daniel Colbourne, the leading member of the UK based Refrigerants Technical Options Committee. Dr Colbourne is one of the world’s foremost experts on refrigeration and consults regularly for GIZ (German Agency for International Cooperation) and the United Nations Environmental Programme.* <sup>41</sup>

**Pioneer air conditioners comply with the requirements of AS/NZS 5149 for the use of hydrocarbon refrigerants.**

**Additionally, Pioneer air conditioners with more than 500g of refrigerant (equating to units of 10 kW cooling capacity and above) have a built-in gas sensor. The sensor isolates power to the air conditioner when a prescribed level of gas is detected, to remove the potential ignition source.**

**All Pioneer units have additional patented safety systems.**

**This raises the standard of safety in the air conditioning industry.**

**If an ignition does occur, hydrocarbon natural refrigerants will combust with a 'flash' creating by-products of carbon and steam.**

**This compares to chemical refrigerants detonating and creating toxic hydrogen fluoride as a by-product.**



# WHAT ABOUT HFOs



Due to increasing concerns about the high GWP of chemical refrigerants currently on the market, the chemical industry has introduced low GWP fluorocarbon products, or unsaturated HFC's, branded as HFO's (hydrofluoro-olefins).

*Chemically, HFOs are HFCs, but due to the negative connotations that HFCs have acquired, this new class of chemicals has been marketed under a different name. This is part of a marketing strategy to portray these new HFCs as having a low impact on the climate while glossing over their negative environmental effects.*

*These new HFCs have real and dangerous environmental and health impacts.*

*HFOs: The New Generation of F-gases, Greenpeace Position paper, 2009. <sup>42</sup>*



The 2012 Greenpeace publication, 'Cool Technologies: Working Without HFCs' includes the following statements about HFO-1234yf:<sup>43</sup>

- *The embedded GWP of any given substance also needs to be considered. The embedded GWP of HFO-1234yf is not yet reported.*
- *A key production ingredient of HFOs is HCFCs (i.e. R22, the supply of which has already been phased down in accordance with the Montréal protocol global agreement). This means that the production of HCFCs will need to be maintained in perpetuity to produce HFOs.*
- *Industry is in the process of creating HFO/ HFCs blends, where the bulk of the blended component (at least 60%) will be HFC 32. These blended components will be marketed as HFOs with their implied low GWP rating. However, upon their atmospheric dissolution, these blends will revert to their basic components and will make the global warming contributions accordingly.*
- *TFA (Trifluoroacetic acid) is a byproduct when most HFCs break down. HFO-1234yf produces 4-5 times more TFA than the same amount of HFC 134a. The concentration of TFA in freshwater bodies around the world could have dramatic effects on plants and animals and human health.*
- *When it burns, it releases hazardous substances such as hydrogen fluoride (HF). HF is very toxic and potentially lethal to humans in unventilated spaces. While the flammability of a substance is not an impediment for its use as a refrigerant, the toxic byproduct of a substance when it burns is of great concern to human safety.*
- *Reduced efficiency. HFO-1234yf has been tested to be at least 10% less efficient than HFC-134a, the substance it is meant to replace.*
- *Higher costs. HFO-1234yf is expected to be more than 10-20 times more expensive than HFC-134a.*

**Germany's Federal Environment Agency warned that TFAs could contaminate the water supply and cannot be removed after contamination has taken place.<sup>44</sup>**

**In 2012, Mercedes-Benz/Daimler announced that the company will not be using HFO-1234yf in its products due to flammability, toxicity and environmental concerns.**

*The substance caught fire as soon as it hit the hot surface, releasing a toxic, corrosive gas as it burned. The car's windshield turned milky white as lethal hydrogen fluoride began eating its way into the glass.*

*"We were frozen in shock, I am not going to deny it. We needed a day to comprehend what we had just seen."*

*- Stefan Geyer,  
Senior Daimler engineer who ran the tests.<sup>45</sup>*

Dr Joachim Lemberg, Head of Safety, Security, Health and the Environment, Roche (the world's largest biotech company, with over 90,000 employees in more than 100 countries), on whether Roche considered going down the HFO route:

*“No way! We ban them. This is part of our precautionary principle.”*<sup>46</sup>

*“The chemical companies have had some 30 years to develop a new business model. But every new generation of refrigerants they have come up with has harmed the environment”*

*- Juerg Walder,  
Global Lead Sustainability, Roche*

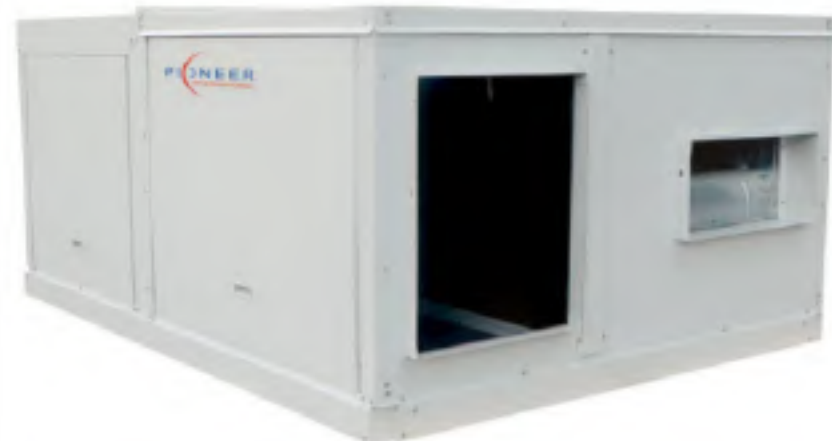
*“The vigorous promotion of this new generation of F-gases is delaying the large-scale uptake of natural refrigerants, even though they are environmentally safe, technologically proven, and relatively inexpensive and provide the long-term solution to meeting our cooling needs.*

*From a precautionary perspective, given the sordid track record of fluorocarbon refrigerants, the manufacturers of HFOs should accept legal responsibility today for any and all future environmental and human safety impacts the products may cause.”*

*- Greenpeace, ‘Cool Technologies: Working Without HFCs’*

Each person and organisation can do their own due diligence and decide for themselves whether HFOs are an appropriate refrigerant for the future.

# PIONEER PRODUCTS



# INTERNATIONAL PATENTS

Enabling the safe and efficient use and application of natural refrigerants in new air conditioners.

**WORLD WIDE  
PATENTED  
TECHNOLOGY**

# BEST WARRANTY

The lower operating pressure and reduced wear and tear enables Pioneer air conditioners to have a market leading warranty.

## 5-YEAR

COMMERCIAL PARTS & LABOUR

*Warranty for all models.*

## 5-YEAR

RESIDENTIAL PARTS & LABOUR

*Warranty for Hi Wall split system units.*

## 7-YEAR

RESIDENTIAL PARTS & LABOUR

*Warranty for Ducted / Ceiling Cassette units.*





# LONGER EQUIPMENT LIFESPAN

Lower operating pressure within the air conditioner reduces wear and tear.

**Higher refrigerant critical temperature results in less wear and tear in hot temperatures.**

**HFC chemical refrigerant such as R410a contains fluorine. Fluorine reacts with any traces of moisture inside the system, producing an acid that can break down the insulation on the windings of the compressor and contribute to motor burn out.**

**Natural refrigerants do not contain fluorine and do not produce acid.**

# CATERING FOR BROAD INDUSTRY APPLICATION

PIONEER AIR CONDITIONERS  
ARE SUITABLE FOR:

# Catering for Broad Industry Application

**Developers & Builders**

**Residential homes and apartments**

**Commercial office buildings**

**Pubs and Clubs**

**Hotels, motels and resorts**

**Caravan Parks**

**Local Government**

**State Government**

**Federal Government**

**Hospitals and healthcare**

**Schools and Universities**

**Shopping Centres**

**Retail**

**Banks & Service Centers**

**Manufacturing & Warehousing offices**

**Fast food restaurants**

**Outlet / big box stores**

**Supermarkets**

# COMMERCIAL AND RESIDENTIAL RANGE

MODELS PRESENTLY AVAILABLE OR  
IN PRODUCTION INCLUDE:

- Hi-wall split systems
- Ducted units
- Ceiling Cassette split units
- Outdoor condenser unit upgrades
- Multi-head Variable Refrigerant Flow (VRF)
- Mini VRF
- Rooftop Package Units
- Water Cooled Package Units

# SUITABLE FOR OFF-GRID BUILDINGS

**Air conditioning presents the biggest challenge to powering an off-grid home.**

**KDV Homes in Sydney had constructed a 262 square metre home powered by a solar system and battery, not connected to the electricity grid.**

**They had been trying for 5 years to install air conditioning without success.**

**The power demand of the chemical refrigerant air conditioners exceeded the electrical capacity of the solar system.**

In 2018, they successfully installed a 16kW Pioneer ducted air conditioner. Not only did the air conditioner fully operate, there was sufficient spare power left over to meet all other normal household power usage requirements.

*“I am still trying to get my head around the fact that the unit's power source is completely solar, and the results are amazing. We switched on heating for the first time recently and the entire house was warm in 30 minutes”*

*- Abdul Khan,  
Diversified Property Group*

This is a fundamental shift in being able to heat and cool homes that are not connected to the electricity grid.

This will support the growing trend of people seeking self-sufficiency in their lives and homes.

# EDUCATION AND TRAINING

TAFE's around Australia provide natural refrigerant training courses.

*“TAFE SA is matching training with the technologies of the future.”*

*- Lecturer Steve Excell:  
on the natural refrigerant training  
course. <sup>47</sup>*

**Superior Training Centre is a Registered Training Organisation providing training and accreditation for chemical and hydrocarbon natural refrigerants. <sup>48</sup>**



# EMPLOYMENT & APPRENTICES

**Modernising Australia's air conditioning equipment is a substantial employment driver**

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**Thousands of new apprentices are needed to support the industry change to low GWP air conditioners.**

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**Australia's workforce needs to be upskilled to meet market demand and enable this transition.**

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**Retrofitting buildings to improve energy efficiency is a key employment driver**

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**This is an opportunity to create new jobs and help stimulate the Australian economy.**

# **NATURAL REFRIGERATION RETROFIT**

**Many air conditioners have years of useable life remaining and include modern features such as DC inverter compressors and variable refrigerant volume.**

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**It is often not yet practical or viable to replace this existing equipment.**

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**A financially attractive option to get the best value out of this existing HVAC equipment is to replace the chemical refrigerant with natural refrigerant.**

**AS/NZS 5149.2. provides for the use of hydrocarbon refrigerants subject to certain conditions, building requirements and plant locations being satisfied.**

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**It is a safe and easy retrofit solution for properly trained professionals.**

---

**A frequently asked question is whether changing the refrigerant will damage the existing HVAC equipment. Provided the refrigerant is changed properly by a competent, trained person, natural refrigerant will not cause damage to existing HVAC equipment.**

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**Rather, it will reduce the operating pressures and improve the efficiency.**

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**This results in environmental, financial and safety benefits.**

Engas manufacture a range of refrigerant blends to replace specific chemical refrigerants.

Engas natural refrigerants are higher performing than chemical refrigerants. The table shows the amount of work that each refrigerant is capable of.

REFRIGERANT	REFRIGERANT EFFECT kJ/kg
R22	199
R32 <sup>49</sup>	190
R410a <sup>49</sup>	115
Engas M60	435

Therefore less refrigerant mass flow is required.

REFRIGERANT CHANGE	TYPICAL REDUCTION IN REFRIGERANT INVENTORY
R22 to Engas M50	62%
R410a to Engas M60	52%
R32 to Engas M20	50%

**Which results in lower operating pressures.**

REFRIGERANT CHANGE	TYPICAL REDUCTION IN DISCHARGE INVENTORY
R22 to Engas M50	25%
R410a to Engas M60	35%
R32 to Engas M20	45%

**The lower operating discharge pressure reduces the work that the compressor has to do, reducing wear and tear and extending the life of the compressor, pipe work, joints, hoses, fittings and other components.**

**This reduces the likelihood of leaks, minimising replacement refrigerant costs, equipment downtime and direct greenhouse emissions.**

# Natural Refrigerant Retrofit

The retrofit from chemical to natural refrigerant increases the energy efficiency of the existing air conditioning equipment and reduces electricity usage and costs.

REFRIGERANT UPGRADE	TYPICAL ELECTRICITY SAVINGS
R22 to Engas M50	25%
R410a to Engas M60	35%
R32 to Engas M20	45%

*“A contract winery in WA has realised electrical energy savings of 32% through a hydrocarbon refrigerant conversion of its liquid chiller”*

*- HVAC&R Nation (Aug 17), an AIRAH publication.<sup>50</sup>*

A photograph of a brick building facade with several windows and numerous air conditioning units mounted on the wall. The text is overlaid on the left side of the image.

# THE HISTORY OF AIR CONDITIONING

## 1758

Benjamin Franklin and John Hadley, a professor at Cambridge University, experimented with the cooling effect of certain rapidly evaporating liquids.

## 1834

Jacob Perkins built the first practical refrigeration machine using ether in vapor compression cycle.

## 1859

Ferdinand Carr demonstrated an ammonia / water refrigeration machine.

## 1873

Ammonia first used in vapor compression systems.

## 1824

Michael Faraday discovered that heat would be absorbed by pressurising gas, like ammonia, into a liquid.

## 1850

Edmond Carr developed the first absorption machine, which used water and sulfuric acid.

## 1866

Chemogene, a mixture of petrol ether and naphtha, was patented as a refrigerant for vapor compression systems.

## 1875

Sulfur dioxide and methyl ether first used in vapor compression systems.



## 1876

German engineer Carl von Linden patented the process of liquefying gas, setting the stage for the modern air-conditioner.

## 1878

Methylchloride first used in vapor compression systems.

## 1926

Dichloroethene (dilene) was used in Willis Carrier's first centrifugal compressors, and then replaced with methylene chloride.

## 1928

HVAC and refrigeration equipment of this era used basic seals and open shaft compressors. This led to high refrigerant leakage, posing challenges for flammable refrigerants. This led to the search for less flammable refrigerants and the creation of synthetic refrigerants.

## 1930

Fluorocarbon refrigerants were developed.

## 1931

Commercial CFC production began with R-12 in early 1931.

Thomas Midgley, Albert Henne, and Robert McNary created chlorofluorocarbon (CFC) refrigerants. The compounds produced were the world's first lower flammable refrigerating fluids.

## 1936

The first hydrochlorofluorocarbon (HCFC) refrigerant, R-22, was produced.

## 1985

Scientists with the British Antarctic Survey shocked the world when they announced the discovery of a huge hole in the ozone layer over Antarctica. Their data, collected at the Halley Research Station in Antarctica, suggested that CFCs were to blame.

## 1989

Australia ratified the Montreal Protocol.

## 1996

Australia started its phase-out of hydrochlorofluorocarbons (HCFCs).

## 1987

The Montreal Protocol, an international treaty aimed to regulate the production and use of chemicals that contribute to the depletion of Earth's ozone layer was signed.

## 1991

The new Hydrofluorocarbon (HFC) refrigerant R-410a was invented by the Honeywell Corporation.

## 1997

The Kyoto Protocol, an international agreement that called for industrialised nations to reduce their greenhouse gas emissions significantly was signed.

## 2011

The European Commission has effectively banned the use of R-134a refrigerant in air conditioning in new car platforms in EU countries.

## 2020

In response to rising consumer interest in the climate, saving money and safety, the industry is moving back to natural refrigerants. Since the shift away from natural refrigerants to synthetic refrigerants from 1928, significant improvements in HVAC and Refrigeration equipment quality and safety over the last 90 years mean natural refrigerants are best able to meet the needs of the future.

## 2018

Hydrofluorocarbons (HFCs) such as R-134a and R-410a, making up 81% of refrigerant in use in Australia are being phased down.

# SUMMARY



It's time for change.  
What got us to where we are today will  
not get us to where we want to go.

**The facts are stark and undeniable.**

**Our planet is showing its fragility. Ecosystems are breaking down. The impact of a changing climate is increasingly affecting life for humans and all creatures.**

**Many economies, businesses and people across the globe are facing financial hardship.**

**Society is showing its vulnerability to threats to human health and safety.**

**Across many areas of life and business, new solutions must be found and embraced to solve these challenges.**

**Much depends upon it.**

**This document outlines one such solution.**

# **PIONEER AIR CONDITIONING**

**Commenced operation in 1990.**

**During the 1990's Pioneer was one of the largest Australian manufacturers of air conditioners.**

**International patented technology relating to air conditioning.**

**10 years designing and engineering a range of air conditioners for energy efficiency and optimal use of natural refrigerant.**

**Export globally.**

**> 5,000 Pioneer air conditioners with natural refrigerant have been installed in Australia.**

# ENGAS

**Natural refrigerant manufacturer for Pioneer Air Conditioners.**

**Established in 2010.**

**Export natural refrigerant globally.**

**Provide technical and application engineering support for projects.**

**Proprietary blends to replace common chemical refrigerants.**

**Technical Director, Dr Ladas Taylor, is a world-renowned expert on hydrocarbon refrigerant with 30 years experience. Dr Taylor has also been engaged by the United Nations Environmental Program (UNEP) to lecture and train globally on the safe use and application of hydrocarbons.**

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