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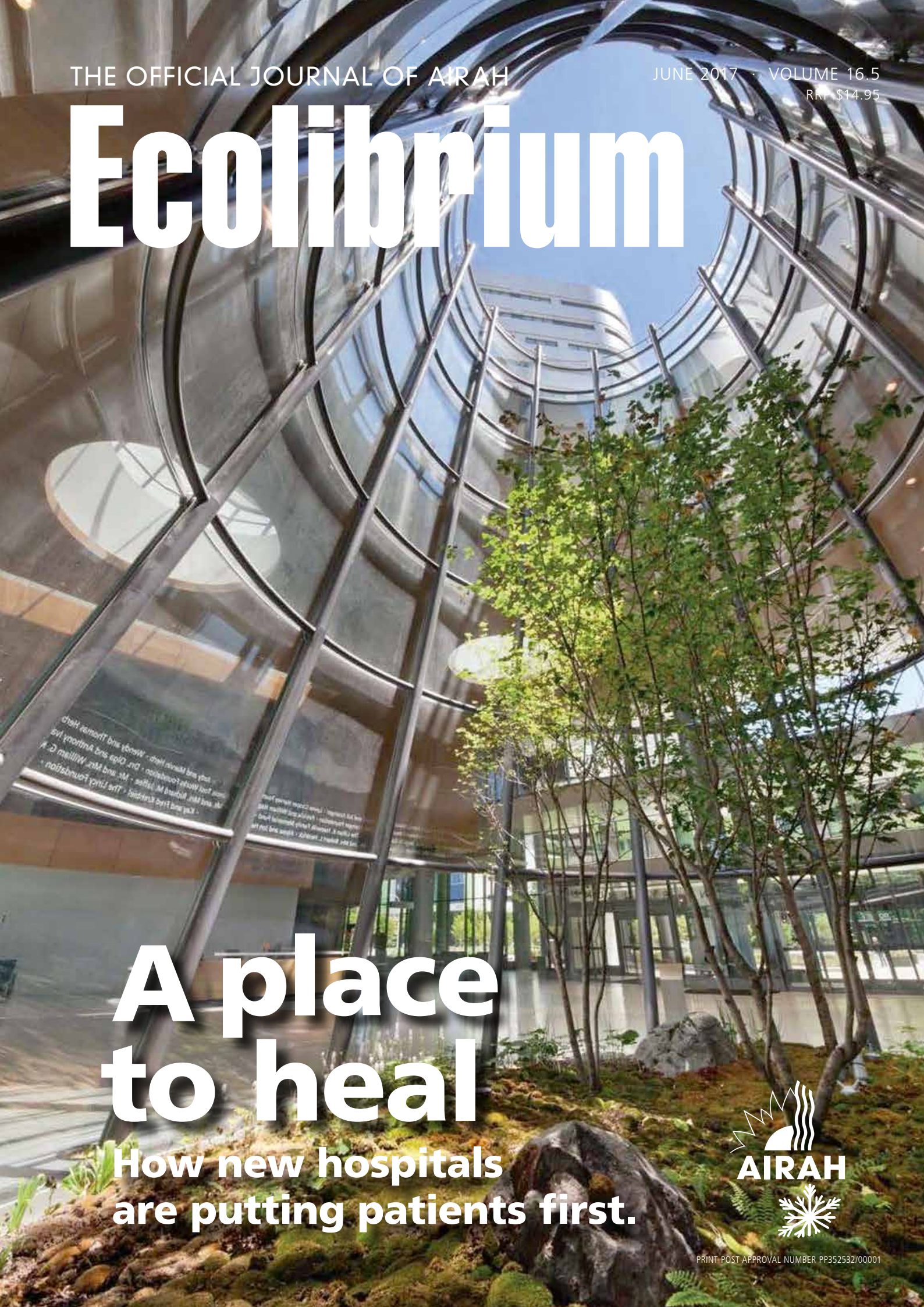

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The HFC phase-down – What are the solutions and how should the industry plan ahead?

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ABSTRACT

The introduction of an HFC import quota as the mechanism for the HFC phase-down will impact the availability of high-GWP refrigerants over time. Solutions such as HFOs and natural refrigerants are readily available to support the market in its transition to low-GWP. Now is the time for the industry to prepare, familiarise and invest in staff training to lead the necessary change in our industry. The environment will be the biggest winner of change, but companies and employees in the industry will also benefit from increased business opportunity and development of enhanced skills.

INTRODUCTION

Since the repeal of the Carbon Equivalent Levy in July 2014 the Australian HVAC&R market has enjoyed a period of HFC use without legislative restriction. This is due to change at the end of 2017 with the introduction of HFC import quotas, which are the Australian government's chosen mechanism for meeting its international obligation to phase down the use of HFC gases under the amended Montreal Protocol.

The exact detail of the phase-down is yet to be ratified by parliment but current information suggests that quota will be set at an initial level of 8 million tonnes of Carbon dioxide equivalent (CO_2E) which will be introduced from January 1, 2018. From that date, the quota will decrease every two years until 2036, with each drop being of the same amount, creating a smooth and predictable phase-down, allowing businesses to react accordingly. The final quota level will be just under 2 million tonnes of CO_2E, making this a "phase- down" rather than a "phase-out".

It is the opinion of the author based on market intelligence that the 8 million tonnes CO_2E start level for the quota is very close to current market usage. This will mean that the impact of the quota on industry refrigerant supply will be quicker than previous phase-out regimes. The market will need to react to ensure that it is not impacted by potential product shortages and the possibility that this may lead to higher pricing for the products with the greatest GWP.

AVAILABLE OPTIONS

1. New equipment

The specification of new equipment will be key and critical in the near future to ensure that the refrigerant used is "future-proof" and will not end up becoming a liability requiring an expensive retrofit to a lower GWP refrigerant.

Current market decision making is often commercially driven; with the quota on the horizon it may be worth spending a little extra at the installation phase to save money during the lifetime of the equipment. When specifying new equipmnent, all options are available for your choice of fluid, including low-GWP HFCs, HFOs and natural refrigerants, depending on what best suits the application.

With the trend towards lower-GWP solutions, refrigerants are becoming more challenging from a safety perspective – flammability, high pressures and toxicity are all hurdles that the industry will need to negotiatite. This will include ensuring systems are designed to the necessary safety standards, as well as ensuring that technicians in the field are properly trained to service and maintain systems using best- practice techniques to ensure their own safety.

Options currently avilable include:

1.1 Low-GWP HFCs

Low-GWP HFCs are readily available and a good way to reduce carbon footprint. For instance, the use of R407F (GWP = 1824) rather than R404A (GWP = 3922) in new equipment is an easy way to reduce future liability.

The growth of R32 (GWP = 675) in air conditioning equipment at the expense of R410A (GWP = 2088) is an excellent example of the insustry following this trend. R32 has higher pressures than many mainstream refrigerants, and also has mild flammability associated with it, so this is also an example of the industry overcoming the challenges of the refrigerant to release safe equipment with far less environmental impact that the mainstream alternative.

1.2 HFOs

HFO refrigerants such are R1234yf (GWP = <1) are now available in the Australian market. The global refrigerant manufacturers are also creating blends of HFO and HFC components to create low-GWP blends that are designed to match the characteristics and performance of mainstream HFCs.

New blends are designed to fit two distinct applications: new equipment and retrofit replacements.

Blends with the lowest possible GWP are being designed for new equipment. These blends exhibit slight flammability, and equipment needs to be designed accordingly.

Blends are also being designed as retrofit replacements for existing estate on high-GWP products. These gases are designed to be non-flammable, which comes with higher GWP, but they offer a safe retofit option with significant reduction on the HFC they are designed to replace.

Equipment manufacturers are being innovative in their approach while evaluating the best solution for their business in the long term. For instance, in transport refrigeration the two biggest global suppliers are now offering equipment on R404A (GWP = 3922) or alternatively R452A (GWP = 2140). R452A is a non-flammable HFO blend with a significant GWP saving compared to R404A. It offers a useful interim product with minimal engineering work on their systems until a long-term solution is selected.

1.3 Natural refrigerants

Natural refrigerants are well established in the Australian market and technology around their safe use is mature. R717 (GWP = 0) dominates the industrial and process cooling sector due to its superior energy efficiency and low fluid price. R717 systems tend to require a high capital expenditure on installation due to toxicity and lack of compatibility with copper and brass, but this is recouped with lower operating costs.

R744 (GWP = 1) has become the refrigerant of choice in the supermarket sector for new installations with both sub-critical and transcritical systems in operation. The market began with sub-critical systems but major supermarkets have recently installed transcritical systems, more are likely to be rolled out if the current trial sites are sucessful. Sub-critical cascade systems with an R134a (GWP = 1430) primary and R744 secondary can easily have the R134a upgraded to a non-flammable HFO blend such as R513A (GWP = 631) to further reduce carbon footprint.

Hydrocarbons such as R600a, R290 and R1270 have been slower to penetrate the Australian market than in Europe. This has been predominantly due to missuse of these products in retrofit and automotive application causing highly publicised incidents in which people have been injured. The introduction of the AS/NZS 5149:2016 standard will ensure safe use of hydrocarbons and it is expected that they will become more widespread in smaller charge application such as supermarket integral cases.

2. Existing equipment

With existing equipment, there are three main options available to system owners. The best option is often dependant on the age and condition of the system in question, but factors such as availability of capital expenditure funding will also play their part. As the phase-down progresses the most immediate priority will be systems utilising the highest GWP refrigerants such as R404A and R507. However all mainstream HFCs will be affected, and planning should not just be restricted to R404A.

2.1 Decomission the system and replace with new

Installation of a new system on a low-GWP product is an expensive option to reduce carbon footprint, and is only likely to be utilised by equipment owners if a sytem is very old and nearing the end of its service life. Although high cost is involved, it is the most effective way to reduce carbon footprint, and is likely to result in improved energy efficiency due to newer technology and controls available in modern system.

2.2 Remain on HFC refrigerants but develop a plan around supply

Remaining on higher-GWP refrigerants will be the most common approach in the market as system owners decide on their course of action as quota restricts supply. The speed at which system owners elect to act will be proportional to the effect of supply restriction on price.

Planning around remaining on higher-GWP refrigerants should include an enhanced maintenance regime, thorough system leak checking and also reviewing industry recycling schemes.

2.3 Retrofit

Retrofit options are already available to replace higher-GWP HFCs, and will become a regular strategy as companies look to reduce their liability. It is important that retrofit options match the properties of the original HFC they are replacing, especially with regards flammability; a non-flammable refrigerant should never be replaced with something flammable.

Retrofit options currently stocked in the Australian market include products such as R449A (GWP = 1397), R452A (GWP = 2140) and R513A (GWP = 631), all are non-flammable HFO-based blends that offer a substantial GWP saving compared to the product they replace.

R449A and R452A are designed to replace R404A (GWP = 3922), and based on case study evidence will offer energy-efficiency benefits along with a direct GWP reduction.

R513A is an azeotropic R134a replacement that closely mirrors the performance of R134a and has a GWP less than half that of R134a (GWP = 1430).

INDUSTRY PREPARATION

As the industry approachs the start of the HFC phase-down, preparation and planning is vital. With any kind of market change, companies that are able to adapt tend to gain a competitive advantage over companies that don't, and are better able to make the most of the opportunites change provides. The following steps are advised in the lead-up to and at the start of the phase down:

1. Contracting organisations should evaluate exposure to high-GWP refrigerants at customer sites and catalogue system charges, equipment age and condition to facilitate easier decision making on low- GWP transition.
2. Future-proofing should become a major consideration in new equipment supply with end users provided a full picture of legislation and the effect it will have on supply of high-GWP refrigerants. Look to source equipment on lower-GWP HFCs, HFO blends or natural refrigerants.
3. Becoming familiar with new refrigerants, especially the new HFO retofit gases, can provide a significant advantage in the market. Doing a trial retrofit to understand the requirements, knowing how to optimise the system for optimum performance and understanding energy-efficiency benefits is a must.

REFRIGERANTS, THEIR COMMON NAMES AND USES

	Description	Predominant application	Chemical Components	% Composition	GWP (AR4)	Safety classification	Toxic	Flammability
R134a	HFC	"Automotive Airconditioning, Chillers"	"R134a (1,1,1,2-tetrafluoroethane)"	100%	1430	A1	Non-toxic	Non-flammable
R32	HFC	Airconditioning	R32 (difluoromethane)	100%	675	A2L	Non-toxic	Mildly flammable
R404A	HFC blend	Medium temperature refrigeration	R125 (pentafluoroethane)	44%	3922	A1	Non-toxic	Non-flammable
		Low temperature refrigeration	"R143a (1,1,1-trifluoroethane)"	52%				
			"R134a (1,1,1,2-tetrafluoroethane)"	4%				
R410A	HFC blend	Airconditioning	R32 (difluoromethane)	50%	2088	A1	Non-toxic	Non-flammable
			R125 (pentafluoroethane)	50%				
R507	HFC blend	Medium temperature refrigeration	R125 (pentafluoroethane)	50%	3985	A1	Non-toxic	Non-flammable
		Low temperature refrigeration	"R143a (1,1,1-trifluoroethane)"	50%				
R407F	HFC blend	Medium temperature refrigeration	R32 (difluoromethane)	30%	1825	A1	Non-toxic	Non-flammable
		Low temperature refrigeration	R125 (pentafluoroethane)	30%				
			"R134a (1,1,1,2-tetrafluoroethane)"	40%				
R1234yf	HFO	Automotive Airconditioning	"R1234yf (2,3,3,3-tetrafluoro-1-propene)"	100%	<1	A2L	Non-toxic	Mildly flammable
R513A	HFO Blend	R134a retrofit	"R1234yf (2,3,3,3-tetrafluoro-1-propene)"	56%	631	A1	Non-toxic	Non-flammable
		Chillers and Sub-critical R744 cascade	"R134a (1,1,1,2-tetrafluoroethane)"	44%				
R449A	HFO Blend	R404A retrofit	R32 (difluoromethane)	24.30%	1397	A1	Non-toxic	Non-flammable
		Stationary application	R125 (pentafluoroethane)	24.70%				
			"R1234yf (2,3,3,3-tetrafluoro-1-propene)"	25.30%				
			"R134a (1,1,1,2-tetrafluoroethane)"	25.70%				
R452A	HFO Blend	R404A retrofit	R32 (difluoromethane)	11%	2140	A1	Non-toxic	Non-flammable
		Transport Refrigeration application	R125 (pentafluoroethane)	59%				
			"R1234yf (2,3,3,3-tetrafluoro-1-propene)"	30%				
R717	Natural Refrigerant	Industrial Refrigeration	R717 (Ammonia)	100%	0	B2L	Toxic	Mildly flammable
R744	Natural Refrigerant	Medium and Low temp commercial Refrigeration	R744 (Carbon Dioxide)	100%	1	A1	Non-toxic	Non-flammable
R600a	Natural Refrigerant	Domestic refrigerators	R600a (methylpropane)	100%	~4	A3	Non-toxic	Highly flammable
R290	Natural Refrigerant	Medium and Low temp integral cabinets	R290 (propane)	100%	~4	A3	Non-toxic	Highly flammable

4. Employee training is going to be crucial as the market progresses towards refrigerants that are flammable, toxic or high-pressure. The safety of engineers in our industry is paramount, so as an industry we must ensure they are equipped to work on more complex systems without undue risk of injury.
5. Maintainance and leak prevention has to be a higher priority as the industry moves into the phase- down. Keeping refrigerant in systems and preventing leakage is good for both the environment and equipment owners budgets. The use of higher technology leak-detection gases based on hydrogen and helium provide far better accuracy than traditional surfactant spray techniques. Fixed-leak detection systems in plant rooms are also a valuable tool to prevent leaks.
6. There are a number of recycling schemes on offer around the industry. These will provide end users with extra supply (outside of quota) and more time for key decision making. It is recommended that this option is considered, especially for high-GWP gases such as R404A.
7. Keep abreast of changes to industry standards to ensure that equipment and practices remain compliant. The recent introduction of AS/NZS 5149:2016 and AS/NZS 817:2016 replacing the outdated AS 1677:1998 is the start of change to both generic and specific standards affecting our industry.

CONCLUSION

The HFC phase-down is imminent, and the industry does not have much time to prepare before import quotas are introduced. The effect of quota introduction is likely to be felt immediately in the market but is not likely to be as pronounced as the start of the Carbon Equivalent Levy. A big plus point this time around is that a greater number of low-GWP solutions are available, and the technology around their use has evolved and improved since then (i.e. HFO solutions and R744).

The overwhelming winner from the new legislation will rightly be the environment, but there will also be a benefit to the industry because it will create business opportunities and upskilling across all parts of the supply chain. Organisations with an entreprenurial and proactive attitude to change are likely to find opportunity to differentiate themselves in the market. To be among those organisations it is recommended that action is taken now to trial and familiarise with new products to assist customers in their transition to low-GWP refrigerants.

The industry will need to invest in its people to facilitate change, with training being a key requirement to ensure that the knowledge and skill base is sufficient to service and maintain more complex systems in a safe manner. ▮

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ABOUT THE AUTHOR

Graeme Dewerson, BSC, Affil.AIRAH, is commercial manager for A-Gas Australia, based in Melbourne.

Qualified in environmental science, Dewerson, a passionate AIRAH member, has been a regular speaker at the Institute's conferences over a number of years on matters related to refrigeration and refrigerants.