

AUTUMN 2017

ACCELERATE

ADVANCING HVAC&R NATURALLY

A U S T R A L I A & N Z

HFC phase-down in
spotlight at
Refrigeration 2017

p. 14

The world's first
water-refrigerant turbo
chiller

p. 66

p. 18

***Australia joins
natural refrigerant race***
EuroShop special from Düsseldorf

AN INDUSTRY LEADER IN THE DESIGN AND DELIVERY OF ENERGY EFFICIENT REFRIGERATION SYSTEMS



HIGH DEGREE OF MOBILITY – LOW AMMONIA CHARGE WHEN YOU WANT TO TAKE YOUR PLANT WITH YOU

Plug and Play Low Charge NH_3 Plants adaptable to a large range of applications and site layouts, with high degree of mobility, annual energy consumption up to 67% lower than industry standard HFC based systems and totally future proof. This is an answer to the global HFC phase-down agreed in Kigali and Australia's ratification of COP 21 in October, 2016.

Aside from reducing your environmental impact, a low charge NH_3 system – whether new plant or retrofitted – will pay for itself in 3 to 6 years based on energy savings alone.

Other significant advantages of a low charge NH_3 system are:

- Documented annual energy performance improvements of up to 67% compared with single stage, multiplexed, air cooled Freon systems with electric defrost.
- Overall NH_3 inventory typically 0.6-0.7 kg NH_3 /kW or 3-5 times lower than equivalent conventional NH_3 plants with liquid overfeed.
- Automatic ambient air defrost.
- The use of 304SS interconnection NH_3 pipe lines means no rust – no painting – ever!

Contact us for more information on how we can help you increase your mobility and achieve total immunity against future environmental legislation.



Save on your Electricity Bills

Electricity cost savings by switching from old fashioned Freon to low charge NH_3 refrigeration systems will, in most cases, return the investment in 5 to 6 years.



scantec refrigeration technologies

www.scantec.com.au

Ph: +61 7 3890 9400

Email: sales@scantec.com.au

Refrigerant Authorization Number AU 00063

QBCC Licence No: 77103

ABN 73 073 109 065



Australia goes shopping at EuroShop

— Editor's note by Andrew Williams

With the Kigali Amendment to the Montreal Protocol giving leading retailers in Australia and New Zealand an extra incentive to forge ahead with their HFC phase-down pathways, the autumn edition of *Accelerate Australia & NZ* looks at how natural refrigerant-based HVAC&R solutions are already helping their European counterparts to reduce the environmental footprint of their stores.

Many of the technology solutions that will deliver the transition to natural refrigerants in Australia and New Zealand are already up and running in Europe – with new ones on display at EuroShop, the world's biggest retail tradeshow. Coles was among the homegrown retailers making the long trip to the German city of Düsseldorf to learn how some of this can be applied back home (p. 18).

HVAC&R industry leaders across the region see opportunities for natural refrigerants, particularly as the government in Australia moves ahead with its response to Kigali. AIRAH's Refrigeration 2017 conference served as a platform for discussion on how the sector will manage the Australian HFC phase-down beginning in January 2018 (p. 14).

Beyond these shores, Dutch retailer Albert Heijn has put natural refrigerants CO₂ and propane at the heart of 'Europe's most sustainable supermarket' in Purmerend, just north of Amsterdam (p. 36). And Wholesome Harvest Baking has become the first industrial operator in Canada – and only the second in North America – to install Mayekawa's NewTon low-charge NH₃/CO₂ packaged refrigeration system (p. 40).

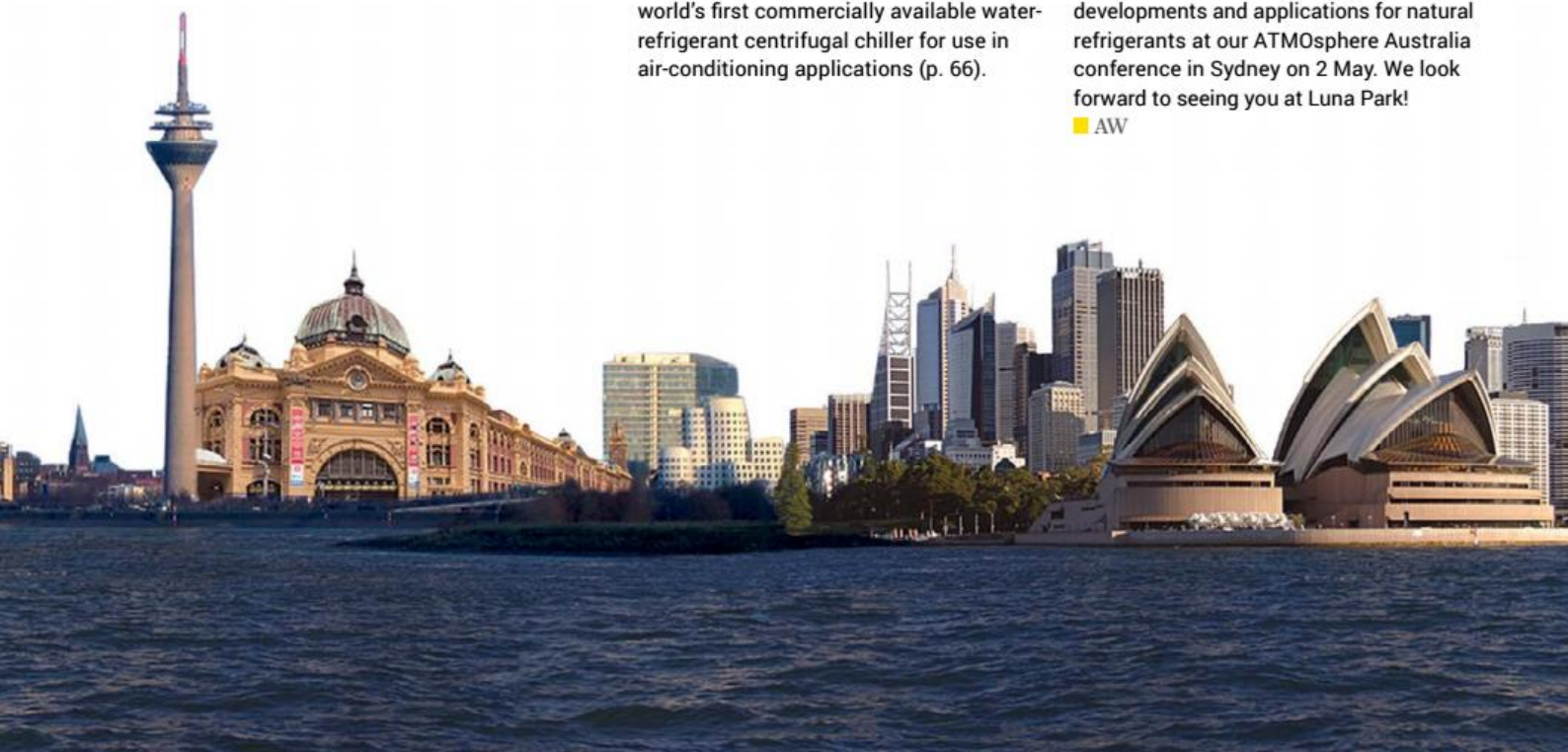
In Japan, meanwhile, Kawasaki Heavy Industries (KHI) is ready to market the world's first commercially available water-refrigerant centrifugal chiller for use in air-conditioning applications (p. 66).

Progress on standards is essential if hydrocarbon-based cooling solutions are to fulfill their true potential worldwide. It's good to hear, then, that the International Electrotechnical Commission is considering raising the 150g charge limit governing flammable A3 refrigerants to 500g (p. 44).

Thanks to the condensing unit, CO₂ refrigeration is reaching areas of application that some did not believe possible. Japanese and European manufacturers are already harnessing them to overcome the challenges of bringing CO₂ to convenience stores and other compact locations (p. 52). Features on AJ Baker & Sons (p. 60) and GEA (p. 64) add to this autumn edition of *Accelerate Australia & NZ*.

As you prepare to translate the innovations on display at EuroShop into deliverable HVAC&R solutions back home, come and hear about other exciting new developments and applications for natural refrigerants at our ATMOsphere Australia conference in Sydney on 2 May. We look forward to seeing you at Luna Park!

■ AW



VOLUME 2, ISSUE #5, AUTUMN 2017

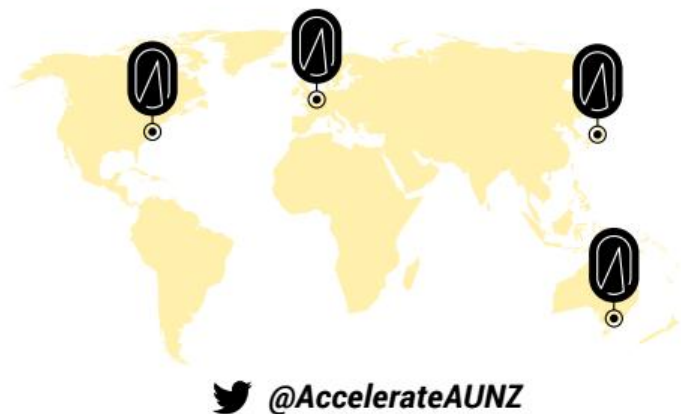
ACCELERATE

ADVANCING HVAC&R NATURALLY AUSTRALIA & NZ

ABOUT ACCELERATE AUSTRALIA & NZ

Brought to you by shecco, the worldwide experts in natural refrigerant news, *Accelerate Australia & NZ* is the first quarterly news magazine written for and about the most progressive business leaders working with natural refrigerant solutions in all HVAC&R sectors.

<http://accelerateaunz.com/>



03 EDITOR'S NOTE by Andrew Williams

OPINION

06 OPINION By Ian Tuena

08 EVENTS GUIDE

10 AUSTRALIA & NZ IN BRIEF

AUSTRALIAN RETAIL RACES AHEAD AT EUROSHOP

18
EVENTS

14
EVENTS

INFOGRAPHIC

12 NATURAL REFRIGERANTS TRAINING IN EUROPE IN 2017

32
EVENTS
ATMO
AUSTRALIA
PREVIEW



MARKET

46 DANFOSS PARTNERING
WITH TAFE ON CO₂
TRAINING INITIATIVE

48 OEMs FLOCK TO
HYDROCARBONS



EVENTS

14 HFC PHASE-DOWN IN
SPOTLIGHT
AT REFRIGERATION 2017

28 IIR'S NATURAL
REFRIGERANT SHOW

END USER

36 ALBERT HEIJN'S
CARBON-NEUTRAL STORE

40 A CANADIAN FIRST

POLICY

44 IS THE A3 CHARGE
LIMIT GOING UP?

66
TECHNOLOGY



TECHNOLOGY

52 CO₂ CONDENSING UNITS
BLENDING JAPANESE,
EUROPEAN KNOW-HOW

60 AJ BAKER, EPTA
DRIVING WORLD-CLASS
INNOVATION

64 GEA BRINGS NATURAL
REFRIGERANT
SOLUTIONS TO
AUSTRALIA

66 THE WORLD'S FIRST
WATER-REFRIGERANT
TURBO CHILLER

Are we upside down because we're Down Under or is the rest of the world the same?

Sitting on the train contemplating a meeting I had just left, that was the thought running through my head. I am now beginning to understand how big the retraining job for the industry is and how hard it is to implement. Since taking on what I now realise is an enormous task as president of the Australian Refrigeration Association, full credit to my predecessor Tim Edwards for the fantastic job he did during his presidency and full credit to those who head all of the various industry organisations. There is an amazing amount of work being done. So let me start...

At the recent AIRAH Refrigeration 2017, I stood up and asked the question of the presenter: "Where were you 10 years ago?" I received a few glares and during the break was immediately approached by a couple, obviously questioning my question as well as quickly claiming how much the industry has already done. To a degree, there was truth in their statement, but my question is this:

Why have we allowed ourselves, in this country, to be in a position where the freight train has arrived at the station, whilst the industry is standing on the tracks just milliseconds from disaster?

To evaluate what makes me say that, we need to look at where we currently are. The federal government signed both the Paris COP21 Agreement and the Kigali Agreement. Because of this, we are about to enter the next refrigerant change. To HFOs, and hopefully to a significant increase in the use of natural refrigerants, because this is our only choice. All of the suite of refrigerants now available have engineering issues that we, as manufacturers, consultants, design engineers and refrigeration mechanics, will have to deal with. The refrigerants we now have as a choice, except for air or water, will all be flammable, toxic or high pressure.



Ian Tuena is president of the Australian Refrigeration Association. He is also managing director of The Natural Refrigerants Company Pty Ltd., which provides a range of cooling solutions using CO₂, ammonia and hydrocarbons. It counts supermarkets, the food processing industry, the chemical industry and the cold storage sector among its customers.

There is broad industry agreement that we are poorly trained and ill prepared for this transition. This is exactly what a small group were forewarning the industry about over 10 years ago. Yet here we are, in what was an avoidable situation if we had listened and prepared the industry for the inevitable. We are now rolling out R32 and a range of HFOs as the industry alternative, with little or no knowledge of what we are really dealing with and how they should be treated.

R32 and the bulk of HFOs are class A2L and are therefore flammable. Their material safety data sheets reveal that the products of combustion are highly toxic (as was the case for all CFCs and HFCs). R32 is listed on the Kigali list of refrigerants to be phased out, so it is only another interim measure. But it is needed to support existing equipment as we progress through the transition.

There is little data available on the long-term exposure effects of HFOs, and their effect on the environment as they break down. Environmental groups are concerned about the effect such chemicals may have on waterways in the future. There are, at best, some doubts as to whether this group of chemicals is the right solution. At worst, will they go the same way of their predecessors due to their environmental impact?

That being said, there is – for the first time in a long time – a lot of industry consensus on some major issues facing the industry.

The industry is united on the issue of a skills-based national licence. We need the federal government to support this issue and not abdicate its responsibility in this area. They were, after all, the ones who committed the industry to this path.

The industry is united in the view that we need to re-educate the existing pool currently operating in the industry. This is right through apprentices, tradesmen, engineers, consultants, and manufacturers. Again, we need support from the government through legislation. The industry could self-fund via 'educational levies' on ALL refrigerants.

The industry on the whole is united in the view we ALL have to work together and be united in one voice if we are to gain recognition as an industry in our own right by government and by the public as a vital service in today's society.

The industry is united in the fact that our skillsets have been eroded and declined significantly. We need to regain those skills urgently.

This consensus gives me hope that we can, even at this late hour, turn around from where we are and get off the track before the train hits us. We have, however, a lot of heavy lifting to do and very little time in which to do it.

We can no longer look for the reasons why we cannot do this. Rather, we have to look for solutions as to how we can and we must do it united, for the benefit of the entire industry – not the commercial interests of a few.

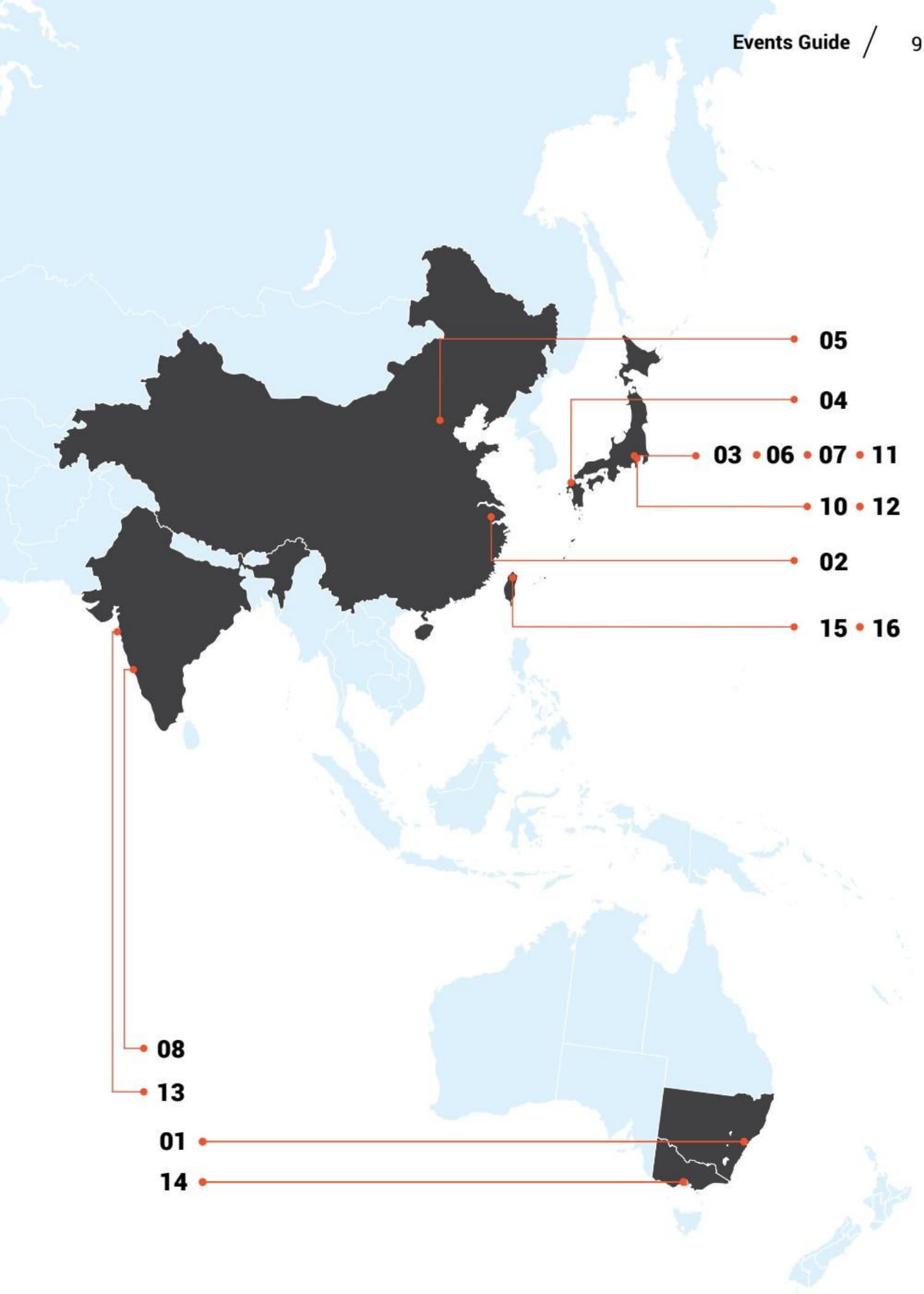
This is the challenge to the industry: to get the important things in the right order, act on them, and be active instead of reactive.

So my question is this. Is it just the Australian industry that has failed to plan until this late stage, or is the rest of the world in the same boat? ■ IT

EVENTS GUIDE

May 2017 / June 2017

- **01** 2 May, Sydney, Australia
ATMOsphere Australia 2017
www: <http://www.atmo.org/australia2017>
twitter: @ATMOEvents
#ATMOAustralia
- **02** 10-13 May, Shanghai, China
Bakery China-International Trade Fair
www: <http://www.bakerychina.com/en/index.jhtml>
twitter: @Bakery_China
- **03** 10-12 May, Tokyo, Japan
Data Center Expo
www: http://www.japan-it.jp/en/Concurrent-Shows_Spring/DC/About/
twitter: @ReedExhibitions
- **04** 17-19 May, Fukuoka, Japan
27th West Japan Food Industry Exhibition '17
www: <http://www.nikkanseibu-eve.com/food/>
- **05** 18-20 May, Beijing, China
ISH & CIHE - China Int'l Heating, Ventilating and Air-Conditioning Expo
www: <http://ishc-cihe.hk.messefrankfurt.com/beijing/en/visitors/welcome.html>
twitter: @ishchina
- **06** 23-26 May, Tokyo, Japan
26th New Environmental Exposition 2017
www: https://www.nippo.co.jp/eng/n-expo017/ne17_a.html
- **07** 23-26 May, Tokyo, Japan
9th Global Warming Prevention Exhibition 2017
www: <https://www.nippo.co.jp/stop-ondanka17/>
- **09** 5-7 June, San Diego, CA
ATMOsphere America 2017
www: <http://www.atmo.org/america2017>
twitter: @ATMOEvents
#ATMOAmerica
- **10** 6-8 June, Tokyo, Japan
Tokyo Café Show & Conference
www: <http://cafeshow.jp/en/>
- **11** 6-8 June, Tokyo, Japan
WtFood Expo
www: <http://www.wtfoodexpo.com/>
- **12** 13-16 June, Tokyo, Japan
Fooma Japan
www: <http://www.foomajapan.jp/english/>
twitter: @foomajapan
- **13** 15-17 June, Mumbai, India
The Bakery World Expo
www: <http://thebakeryworldexpo.com/>
twitter: @ReedManch
- **14** 20-23 June, Melbourne, Australia
Australian Energy Week
www: <http://www.energyweek.com.au/>
twitter: @questevents_aus
- **15** 21-24 June, Taipei, Taiwan
Foodtech & Pharmatech Taipei
www: <http://www.foodtech.com.tw/>
- **16** 21-24 June, Taipei, Taiwan
Taiwan HORECA
www: <http://www.taiwanhoreca.com.tw/>



AUSTRALIA & NZ IN BRIEF

MARKET

ADVANSOR OPEN FOR BUSINESS IN AUSTRALIA

Advansor is spreading its wings to Australia. Lucas Refrigeration will install the Danish company's first CO₂ transcritical rack in the country, in a United Food Express warehouse.

"Advansor, the world leaders in CO₂ transcritical technology, have arrived in Australia," says Ian Tuena, managing director of the Natural Refrigerants Company Pty Ltd – which represents Advansor in Australia.

United Food Express is a Victoria-based seafood importer and wholesaler that distributes to the Australian food service industry. The CO₂ transcritical system will provide the chilling and freezing for the complex, located in the Melbourne suburb of Keysborough.

The Natural Refrigerants Company is coordinating and providing back-up services for the Lucas Refrigeration installation.

"With the recent signing of the Kigali Agreement, synthetic refrigerants were no longer an option. This led to the decision for a cost-effective and future-proof solution – a transcritical CO₂ system," Tuena says.

"We're fortunate that we were one of the first ones involved in CO₂ transcritical in this country," he adds.

■ Andrew Williams

MARKET

DÜRR THERMEA PREDICTS ASIAN INDUSTRIAL CO₂ MARKET GROWTH

Dürr thermea manufactures high-temperature heat pumps, refrigeration units and compressed air dryers. It sees growing opportunities for industrial CO₂ heat pumps in Asia.

Sales and Project Manager Frank Glaser anticipates strong growth in CO₂ use in Korea as well as the Asia-Pacific region at large. "Last year we sold our first heat pump in the Korean market. We're confident that this market will grow due to the good ratio between electricity and gas for heat pumps overall," he says.

Glaser draws attention to two recently completed projects in China. The first was for a Volkswagen production factory in Qingdao and the second was for a mobile sludge dryer.

Although the majority of its business is in Europe, the company is now focused on growing in Korea and is optimistic about the growing CO₂ market in the wider region.

"In Europe, there is certainly an awareness of the use of CO₂ in the market overall from people who are interested in buying large-scale heat pumps. But in Korea, it is only the beginning."

■ Devin Yoshimoto

TECHNOLOGY

REPORT: NATREFS 'PREFERRED CHOICE' FOR MANUFACTURERS

Natural refrigerants will take centre stage in the greener refrigeration of the future, according to a new Danfoss report.

The global move towards climate-friendly technology to deliver the objectives of the Kigali and Paris Agreements will lead many manufacturers to see natural refrigerants as "the preferred choice whenever possible, though safety will still be an important factor in regulating the usage of certain refrigerants," the report predicts.

Danfoss see the obstacles to full market penetration of natural refrigerant falling away over the coming decades.

The report cites two important initiatives launched by the United Nations – the Global Refrigerant Management Initiative (GRMI) and the Refrigerants Driving License (RDL) – as playing crucial roles in providing the training and safety that the industry needs.

"Both initiatives aim at developing the service sector to encourage competent and safe servicing and installations," the report says.

■ Charlotte McLaughlin

UPCOMING EVENTS

Interactive conferences bringing together decision-makers from industry and government to change the future of heating and cooling technologies, naturally

ATMO America

**5-7 June 2017
San Diego**

ATMO Europe

**25-27 September 2017
Berlin**

ATMO Japan

February 2018

ATMO China

April 2018

ATMO Asia

**6 September 2017
Bangkok**

ATMO Australia

May 2018

VISIT ATMO.ORG
FOR MORE INFORMATION



ATMOsphere - NATURAL REFRIGERANTS FASTER TO MARKET



@atmoevents

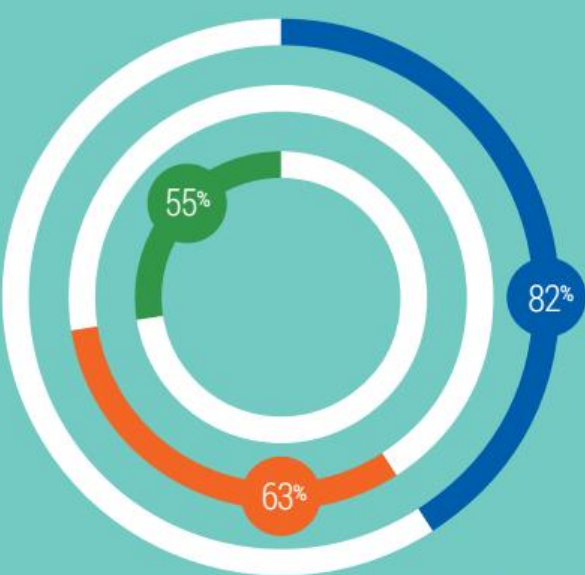
NATURAL REFRIGERANTS TRAINING IN EUROPE IN 2016

Organisations in Europe that provide training by country

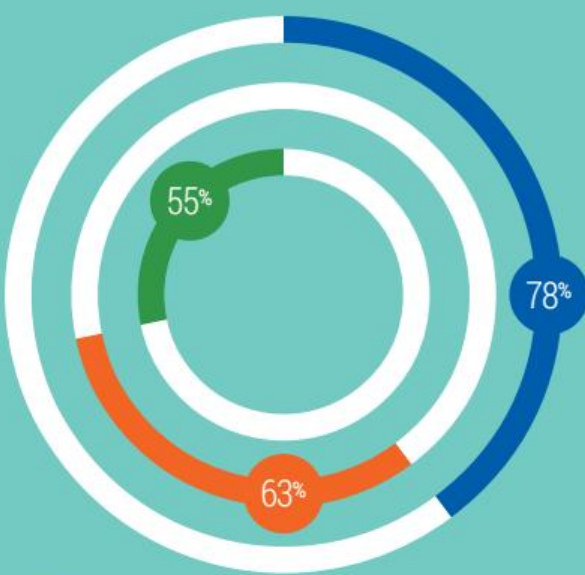


Organisations and technicians receiving and providing training in Europe by natural refrigerant - CO₂ is a clear leader

Natural refrigerant training providers:



Natural refrigerant training receivers:



Source: Guide Training Europe 2017.



ACCELERATE

VOLUME 3
ADVANCING HVAC&R NATURALLY
A M E R I C A

Brought to you by shecco, the worldwide experts in natural refrigerant news, **Accelerate America** is the first **monthly news magazine** written for and about the most progressive business leaders working with **natural refrigerant solutions** in all HVAC&R sectors.

Read **Accelerate America** online
<http://acceleratenam.com>

ACCELERATE

ADVANCING HVAC&R NATURALLY
J A P A N

Brought to you by shecco, the worldwide experts in natural refrigerant news, **Accelerate Japan** is the first **bi-monthly news magazine** in Japanese written for and about the most progressive business leaders working with **natural refrigerant solutions** in all HVAC&R sectors.

Read **Accelerate Japan** online
<http://acceleratejapan.com>





HFC phase-down in spotlight **at Refrigeration 2017**

HVAC&R industry leaders from all over Australia and New Zealand see opportunities for natural refrigerants in the upcoming HFC phase-down. *Accelerate Australia & NZ* reports from the Australian Institute of Refrigeration, Air Conditioning and Heating's (AIRAH) Refrigeration 2017 conference.

– By Devin Yoshimoto & Andrew Williams

Following the formal introduction in parliament of a bill to amend the existing Ozone Protection and Synthetic Greenhouse Gas Management (OPSGM) Act by adding an HFC phase-down plan, the gears of Australia's response to the Kigali Agreement are now beginning to turn.

AIRAH's Refrigeration 2017 conference – held on 27-28 March in Melbourne, Australia – served as a platform for more than 140 of the country's leading HVAC&R professionals to discuss how the sector will manage Australia's HFC phase-down beginning in January 2018.

With the Australian government only just beginning to provide industry with direction, some individuals have been taking the initiative by pushing ahead with natural refrigerant-based technologies regardless.

"In a way, the business case for natural refrigerants is much stronger because of the absence of strong policy and subsidies," argues Stuart Saville, national refrigeration engineering manager at Australian retail giant Coles.

Many of these industry pioneers were at Refrigeration 2017 to talk about recent exciting natural-refrigerant technology developments and their implementation in the Australian market.

Bringing efficient transcritical CO₂ to warm climates

Mike Baker, managing director of Perth-based supplier AJ Baker & Sons Pty Ltd, is excited about the company's growing number of CO₂ installations and sees natural refrigerants as an ideal solution for supermarkets in Australia.

"We have around 300 cascade CO₂ installations so far and are now on our 10th transcritical CO₂ installation," Baker says.

Innovations such as ejectors and parallel compression can help to accelerate the rollout of CO₂ systems in Australia and allow them to compete with traditional HFC systems in warm ambient temperatures.



Mike Baker of AJ Baker & Sons addresses Refrigeration 2017

Baker identifies controlling gas cooler outlet temperature as one of the main challenges facing transcritical CO₂ in the Australian climate.

"One of the big things in high ambient temperatures is to try and control gas cooler outlet temperature," says Baker, citing "direct exchange plate heat exchangers for de-superheating, adiabatic water sprays, and evaporative pre-cooling" among the ways of overcoming this issue.

AJ Baker & Sons' European partner, Italy's Epta Group, is confident it can overcome performance challenges in warm climates with its new 'Full Transcritical Efficiency' concept. The patented solution, launched at EuroShop 2017, harnesses a liquid receiver to improve the efficiency of standard CO₂ booster systems.

Operating all the positive cabinets with flooded evaporation technology, the patented FTE solution – based on adding the intelligent liquid receiver – allows the operating temperature of the cabinets to be increased.

"Transcritical CO₂ is increasingly being designed to operate efficiently in higher ambient temperatures. System complexity is also being minimised in order to make the technology understood by mechanics," Baker explains.

With AJ Baker and Sons' large cascade CO₂ installation base and their fast-growing number of transcritical installations, Baker makes a strong case that the technology is now proven and viable in the Australian market.

"Now, we are able to show retailers that we can maintain efficiency even in high ambient temperatures. So that's why we see transcritical CO₂ as the future," he says.

Woolworths investing in CO₂ to deliver sustainability targets

Demonstrating how natural refrigerants can play a key role in delivering on business goals as well as HFC phase-down requirements, Dario Ferlin, sustainability engineer for Woolworths Ltd, talked about the company's newly released 2020 Corporate Responsibility Strategy.

The report included Woolworths' intention to accelerate investment in natural refrigerant technology.

"By 2020, [Woolworths] will install ten natural [refrigerant-based] systems employing technologies such as transcritical CO₂ or water loop," it stated.

The report, released just a few weeks prior to the conference, signalled the company's intention to move forward with two key CO₂ applications.

The report continued, "in our New Zealand Countdown business, we have already installed one transcritical CO₂ system and plan to introduce another four".



Dario Ferlin of Woolworths at Refrigeration 2017

“The most exciting part is that the scale of these ammonia plants is now able to compete head-to-head with smaller 100 kW HFC-based systems.”

– Bruce Nelson, Colmac Coil



Bruce Nelson, Colmac Coil at Refrigeration 2017

“In Australia, we will further develop our organisational capacity and plan to pilot two transcritical CO₂ HFC-free natural refrigerant systems in greenfield supermarkets in 2017,” it said.

Ferlin is confident that Woolworths’ leadership stance will have a positive effect on Australia’s refrigeration industry as a whole.

“The onus is on the larger retailers to demonstrate leadership. It is also important for us to invest in the Australian commercial refrigeration industry in order to generate momentum, spark imaginations, and sustain the innovation,” he says.

Pioneering low-charge ammonia in Australia

Colmac Coil Manufacturing Inc., which specialises in manufacturing low-charge ammonia heat exchangers, sees big opportunities for growth in Australia due to the increased use of low-charge ammonia in industrial refrigeration systems.

“The most exciting part to me is that the scale of these ammonia plants is now able to compete head-to-head with smaller 100 kW HFC-based systems,” enthuses Colmac Coil’s Bruce Nelson, who is vice-chair of the International Institute of Ammonia Refrigeration.

Nelson points out that some of the regulations and safety standards in place today governing the use of ammonia as a refrigerant – particularly in the United States – can restrict its use significantly, particularly at high charges.

He is nonetheless encouraged by the fact that low-charge ammonia systems are rapidly developing in Australia.

“This is something that has been a really exciting development for our company,” says Nelson, who is president of Colmac Coil Manufacturing.

“We’ve done a lot of work and had a lot of patents issued specifically on low-charge ammonia evaporators and low-charge ammonia refrigeration systems,” he adds.

Stefan Jensen, managing director at Scantec Refrigeration Technologies, is excited about the emergence of low-charge ammonia options as serious rivals of equivalent HFC-based systems.

“I believe that in ten years’ time, low-charge ammonia systems will be mainstream,” Jensen says.

Commenting on ammonia’s energy efficiency performance, Jensen says, “the figures speak for themselves – the energy performance of low-charge ammonia systems is up to two to three times better than the equivalent industry-standard HFC-based systems”.

Looking ahead to the forthcoming HFC phase-down, Jensen poses the question, “why bother with synthetic refrigerants?”

“[Low-charge ammonia systems] are completely future-proof. There’s very little likelihood of any government, anywhere, even thinking about outlawing the use of natural refrigerants because that’s the way we’re going,” he argues.

California leading the way in United States

shecco Japan Managing Director Jan Dusek shed light on the latest market and technology trends around the world – including from China, the United States and Europe.

“In the United States, despite the uncertain political climate, California continues to lead,” Dusek says.

“On 23 March, the California Air Resources Board approved the Short Lived Climate Pollutants reduction plan, which aims to reduce HFCs used in HVAC&R, insulation and propellants by 25% (below business-as-usual emissions) by 2020, and by 40% (below 2013 levels) by 2030,” he explains.



Scantec's Stefan Jensen holds court at Refrigeration 2017

“I believe that in ten years' time, low-charge ammonia systems will be mainstream.”

– Stefan Jensen, Scantec

“Additionally, today is 27 March. Today the U.S. Department of Energy's new energy efficiency requirements will become active and we will see a further increase in the number of companies switching from HFCs to hydrocarbons,” he predicts.

“Why? Because hydrocarbons are the only solution that makes it possible to achieve the new efficiency targets. This is happening today,” he says.

Outlining policy developments in China, Dusek points to the Chinese Ministry of Environmental Protection's list of recommended substitutes for HCFCs. “This list shows that natural refrigerants are an overwhelming majority of the recommended alternatives to replace R22 in several sectors, including split unit air conditioning and mobile air conditioning,” he says.

Dusek believes China's role in shaping global HVAC&R policy is undeniable and will continue to accelerate. “During the Kigali negotiations last year, China was proactively pushing for international standards for natural refrigerants,” he points out.

“The direction China wants to go is clear and there is no doubt it will have a significant impact on the global HVAC&R industry,” he argues.

Commenting on the commercial refrigeration trends apparent at EuroShop 2017, Dusek says, “this was the biggest year ever for natural refrigerants at EuroShop”.

“Equipment manufacturers we spoke to said there was a 20% increase in natural refrigerant equipment production just in the last year,” he adds.

Of particular relevance to an Australian audience is Dusek's observation that CO₂ is continuing to show impressive efficiency results in warm ambient climates in Europe.

“Though northern Europe has traditionally been very strong in adopting CO₂, we are starting to see countries like Italy, Spain, Romania and Bulgaria growing in the number of CO₂ store installations,” Dusek says.

“Italy has gone from 15 to 91 transcritical CO₂ stores over the past few years, proving that CO₂ can be efficient in high ambient temperatures,” he argues.

As for hydrocarbons, the number of hydrocarbon-based light commercial units being sold and put into use around the world continues to impress.

Austrian company AHT Cooling Systems told *Accelerate Australia & NZ* at EuroShop that it now has over one million propane-based food and beverage retail cabinets in operation worldwide.

One factor holding back wider adoption of hydrocarbon-based HVAC&R solutions is international standards – particularly restrictions on charge limits. “There is currently an ongoing discussion about increasing the charge limit for hydrocarbons,” Dusek says.

“What's on the table right now is an increase to a 500g limit. It's very likely that this will conclude by the end of 2017 or early 2018,” he predicts.

Throughout the discussion at Refrigeration 2017, one thing seemed clear – Australia is uniquely positioned to tackle the HFC phase-down head on.

Its remote location and a long-standing lack of regulatory direction on reducing greenhouse gas emissions have encouraged these pioneering industry leaders to become some of the most proactive in the world on natural refrigerant technology – applying it in a challenging natural as well as political environment.

Overcoming these perceived disadvantages has actually positioned Australia to play a globally significant role in bringing natural refrigerants to new heights. ■ DY & AW



Australian retail races ahead at EuroShop

European retailers are showing how natural refrigerants can help them to adapt to changing consumer habits and reduce the environmental footprint of their stores. Progressive HVAC&R leaders from Australia and New Zealand were at EuroShop 2017 to find out more. *Accelerate Australia & NZ* reports from Düsseldorf, Germany.

— By Andrew Williams, Charlotte McLaughlin, Devin Yoshimoto & Eda Isaksson

Technological innovation, regulatory change and the drive to reduce energy consumption are prompting leading European retailers to adopt CO₂, ammonia and hydrocarbon solutions for HVAC&R applications – trends which their counterparts in Australia and New Zealand are keen to tap into as they seek a competitive edge.

As the world's second-largest food retail market, Europe boasts between 110,000 and 115,000 supermarkets and hypermarkets. This figure even excludes convenience stores, a format that is expected to grow rapidly in the next few years.

In Europe, hypermarkets and large supermarkets still represent 60% of the food retail landscape. Yet urbanisation means space is at a premium in European cities. Other trends, such as smaller households and the growing popularity of convenience food for busy lifestyles, will also favour smaller, more flexible store formats.

The challenges facing Europe's food retail sector are echoed in Australia and New Zealand. From Sydney and Melbourne to Auckland and Wellington, consumers are changing their shopping habits to suit busy lifestyles. The growing popularity of convenience stores is leading HVAC&R manufacturers to develop innovative new cooling solutions for the modern urban environment too.

Emulating European solutions back home

113,000 visitors and 2,368 exhibitors flocked to the German city of Düsseldorf for EuroShop – the world's biggest retail trade fair – on 5-9 March. As the sun sets on the show for another three years, participants from Australia and New Zealand were in reflective mood ahead of the long flight home.

"We wanted to be able to leave with a clear understanding of how natural refrigerants were being implemented in similar retail environments," Stuart Saville, national refrigeration engineering manager at Australian retail giant Coles, told *Accelerate Australia & NZ*.

He is confident that EuroShop delivered in this regard. "The opportunity to get some time with industry leaders was the highlight. We will be able to apply what we're learning from these new relationships in new projects, enabling us to leap ahead with our designs," Saville says.

What challenges lie ahead in emulating similar natural refrigerant solutions back home? "Our challenge will be to implement these lessons in our environment – a challenge we are today knee-deep in and relishing," he enthuses.

Saville was not the only one inspired by all the innovation on show at EuroShop. Jonathan Fryer, director of IESCO Engineering Services – a Hawthorn, Victoria-based refrigeration consultancy – was impressed with how energy efficient HVAC&R technologies have become.

"I always get a real boost in terms of thinking about energy efficiency, as soon as you see what people in Europe are doing. They seem to be a lot more focused on energy efficiency," Fryer enthuses.

"By the time this stuff trickles down to Australia, we kind of lose some of the message. That's why it's important for us to travel to EuroShop and get that stuff straight from the horse's mouth," he says.

Today the most commonly used natural refrigerants in the commercial sector are ammonia, CO₂, and hydrocarbons such as propane, isobutane and propylene (also known as propene). Natural refrigerants do not deplete the ozone layer and make a negligible contribution to global warming – zero in the case of ammonia, water and air.

Some of Europe's biggest retailers – including the Schwarz Group (which operates the Lidl and Kaufland brands), Sainsbury's, Carrefour S.A., METRO AG and Ahold Delhaize – are turning to natural refrigerants to comply with the HFC phase-down taking place under the EU's F-Gas Regulation and to benefit from the efficiency savings on offer.



The EU F-Gas Regulation aims to reduce the bloc's HFC use by 79% by 2030, compared to the baseline of average levels in 2009-2012. To help deliver this target, it is progressively banning the use of certain HFCs in different types of new equipment.

Likewise, Australia and New Zealand have both made commitments under the Kigali Agreement to slash HFC emissions by 85% by 2036.

To deliver on this ambitious timetable, the Australian government must amend existing legislation by the end of 2017. This would allow for licences and quotas to be applied for and granted before the January 2018 start date.

In New Zealand, meanwhile, the government has increased the Synthetic Greenhouse Gas (SGG) Levy. Wellington has raised tax rates on SGGs by 295.5% compared to last year. Raising the price from \$0.30 per unit (as applied in 2016) to \$9.85 from 1 January 2017 has increased the tax burden on importing HFCs into New Zealand.

In view of the worldwide phase-down, there was a sense among stakeholders attending EuroShop that the HVAC&R industry in Australia and New Zealand must begin adopting long-term alternatives to HFCs – and quickly.

"In a way, the business case for natural refrigerants in Australia is much stronger because of the absence of strong policy and subsidies," argues Coles' Saville.

CO₂ and hydrocarbons take over EuroShop

Many exhibitors and visitors to EuroShop commented on the widespread use of CO₂ and propane for food retail, with many believing these natural refrigerants will become the global 'standard' for commercial refrigeration.

"There is only really CO₂ and propane here [at EuroShop] – not much else," Michael Nagler, business development manager for CO₂ applications at Germany-based compressor manufacturer GEA, told *Accelerate Australia & NZ*.



“Our challenge will be to implement these lessons in our environment – a challenge we are today knee-deep in and relishing.”

– Stuart Saville, Coles

Ümit Radanli of Turkish cabinet and systems manufacturer Kaplanlar Cooling – a 30-year-old company based in Turkey – agrees. “Both our company philosophy and market trends are leading us to work with natural refrigerants. With each oncoming year, we will be producing more and more products with CO₂ and other natural refrigerants,” Radanli says.

In a further indication of the trend towards natural refrigerants, a recent report on global trends in refrigeration and air conditioning by Danish giant Danfoss predicts that by 2025, CO₂ and propane will have become the only real options for light commercial and commercial applications worldwide.

Closer to home, New Zealand-based manufacturer EcoChill is convinced that natural refrigerants are the way to go too. It has already installed over 20 transcritical CO₂ systems in New Zealand at 14 different sites. “For us, the opportunities with naturals are huge,” says Managing Director Matthew Darby.

Upon arriving at EuroShop, “the first thing that struck me was just how commonplace it is now to see natural refrigerant solutions being offered by large manufacturers,” Darby says.

“If I think back to the last EuroShop three years ago, there were only a very small handful of manufacturers making high-pressure CO₂ or transcritical-capable CO₂ equipment. Even fewer were active in the hydrocarbons space. This time around, just about everyone is making either or both,” he says.

“We’re certainly very excited by the development of new technologies in the natural refrigerant space, because it reinforces everything that EcoChill is about,” Auckland-based Darby observes.

He believes EcoChill’s decade of experience of working with natural refrigerants puts it at a competitive advantage vis-à-vis its rivals in New Zealand and elsewhere. “Business-as-usual for us may not be business-as-usual for other commercial refrigeration businesses,” he points out.

Retailers in Australia and New Zealand stand to benefit from all the efficiency improvements for natural refrigerant-based HVAC&R systems and components.

“We’re really looking forward to working with these companies and seeing what they bring. We’ll never stop looking for new solutions that are cost-competitive and perhaps simpler,” says Coles’ Saville.

More options for small store formats

In Europe, the market for smaller applications has been slower to take off than in places like Japan where the trend towards small stores has been particularly strong. But this is changing fast, as European shoppers flock to smaller stores in urban centres.

European companies are keen to tap into the demand for smaller-scale natural refrigerant-based solutions. Advansor, SCM Frigo, Green & Cool (part of Carrier UTC), SANDEN Environmental Solutions and Arneg have all pursued their own CO₂ units for convenience stores.

“The packaged units would be very interesting to see. We’ve already asked the question of Hussmann, to get visibility on what they are doing in that space and to see if it is a suitable solution for our smaller format stores. We’re keen to see the offer,” says Coles’ Saville.

In Düsseldorf, Green & Cool was exhibiting its larger CO₂Y MC unit. Green & Cool describes the CO₂Y MC – a new CO₂ condensing unit ideal for larger convenience stores – as the multi-compressor sibling of its smaller CO₂Y unit. The latter was formally launched at the biannual Chillventa tradeshow in Nuremberg, Germany in October 2016.

The CO₂Y MC comes in various sizes, using from two to five rotary hermetic compressors. The multi-temperature solution can also cover applications from 10 to 40 kW.



Green & Cool's CO₂Y unit at EuroShop



SCM Frigo's Alessandro Franchin and the CUBO₂ Smart

▶ The European trend towards providing natural refrigerant-based cooling solutions for convenience store formats is not going unnoticed by observers from afar. "We're seeing development of small packaged units that can do anywhere from three to 50 kW. They are mainstream now, and readily accessible. That's very pleasing to see," says EcoChill's Darby.

"We're working very hard to make connections between us in New Zealand and our key partners based in Europe, so that we can bring this technology to New Zealand as quickly as possible," he says.

SCM Frigo, meanwhile, also showed an updated version of its transcritical CO₂ condensing unit – the CUBO₂ Smart. "We are using the DC brushless Toshiba compressor," explains Alessandro Franchin, area export manager at SCM Frigo for Central Europe, Spain, Portugal and Ireland.

With the help of global distributor Beijer Ref's export network, SCM Frigo is confident of selling 1,000 units in the first year and 3,000 by the end of the second. "It is a simple plug 'n' play unit. All the customer has to do is fit the pipe and they are ready to work," Franchin says.

Advansor has launched a very different CO₂ refrigeration system for convenience store formats – the compSUPER XXS mini-booster. "This is a new development for us. It's at a very early stage. We only shipped the first units out

of our factory this week," Advansor Managing Director Kim G. Christensen told *Accelerate Australia & NZ* in Düsseldorf.

Advansor began as a supplier of transcritical CO₂ racks for supermarkets. It subsequently launched the ValuePack line for smaller store formats.

The new compSUPER XXS transcritical CO₂ unit has a cooling capacity of 30 kW at -10°C and a freezing capacity of 4-5 kW at -30°C.

The system sees Advansor use rotary compressors for the first time. The company normally uses reciprocating compressors. "The intention is to use smaller compressors. It's a multiple compressor system using a brushless DC compressor from Toshiba, allowing us to deliver the capacity that stores need," Christensen says.

Kaplanlar launched a similar system at the show. The 'CORE' system consists of a standard CO₂ booster pack, a gas cooler with an integrated ambient scavenge evaporator, plate heat exchanger, water pump, valve sets, and a controller.

Ümit Radanlı, refrigeration engineering coordinator at Kaplanlar, told *Accelerate Australia & NZ* that despite its compactness, the system is easy to maintain and user-friendly.

'Natural refrigerants at high efficiencies in all latitudes'

Italian multinational CAREL is confident that natural refrigerant-based systems can now operate efficiently in all climates.

Until now, users of natural refrigerant-based technologies in food retail have sometimes been forced to "compromise" or accept "trade-offs" on issues such as efficiency or range of applications, admits CAREL Group Managing Director Francesco Nalini.

"We believe that these trade-offs are very quickly being overcome. I see a very bright future for natural refrigerants in Europe, because it's now possible to have natural refrigerants at high efficiencies in all latitudes," Nalini says.

In this spirit, CAREL – together with Carrier – has extended its range of EmJ modulating ejectors, helping to bring CO₂ transcritical systems to all store formats in all climates.

From small convenience stores to large supermarkets, transcritical CO₂ systems can now be optimised to operate in warmer climates. "The EmJ modulating ejector has been designed in six different sizes, so as to offer an effective response for all store formats," says Nicola Pieretti, application manager at CAREL.

It is precisely this type of innovation that attracts the likes of IESCO's Fryer to EuroShop in the first place. "I suspect that many Australian end users are a bit like us, in that we kind of wait for other people to test the technology [and] iron out all the [...] issues with it. We're a fast follower, I suppose, rather than early adopters, given that we're on the other side of the world," Fryer says.

"You don't want to be putting in a piece of technology, having major issues with it, and having to fly someone out from the factory in Europe to diagnose it," he points out.

Stuart Saville of Coles is also keeping his finger on the pulse. "For some years now, we've been watching the global trends with CO₂ transcritical refrigeration – with an understanding that once the technology evolves to suit our climatic conditions, we'll be in a great position," he told *Accelerate Australia & NZ*.

Indeed, as technological improvements continue to bring CO₂ transcritical technology to warmer climates than previously considered viable, SCM Frigo's Franchin reports impressive growth in the Spanish and Portuguese markets.

"There has been a lot of movement and more requests in Spain than a year ago," Franchin told *Accelerate Australia & NZ* at EuroShop.



Nicola Pieretti (l) and Alessandro Greggio (r), CAREL

SCM Frigo also sees ejectors as a vital means of adapting CO₂ systems to warmer climates. "We are testing a liquid-vapour ejector at the moment in a Luxembourg supermarket," says Franchin.

Once it has received results in April, SCM Frigo plans to use the ejector in more installations.

Another system manufacturer, Arneg – whose huge booth at EuroShop dominated Hall 16 – presented its new CO₂ rack using a Danfoss ejector at the show.

"We have the two technologies that make CO₂ possible in warm climates – the ejector and parallel compression," says Arneg's Chiara Tognoli.

Other companies showcased different solutions for overcoming the so-called CO₂ equator: the previously accepted geographical limit for cost-effective and efficient performance of CO₂ systems in all food retail store formats.

The new 'Evalift' solution, from TEK0, is an example of such technology. It is a control component for increasing the evaporating temperature in CO₂ cooling systems.

Alexander Wirsching, the German company's technical manager, argues that Evalift can be more effective than using liquid ejectors. "It can be used not just in medium-temperature but also in low-temperature applications, delivering very high efficiency improvements," Wirsching says.

"It's a good alternative to ejector technology, because it's easier for installers and maintenance personnel to understand and to handle," he argues.

Improving CO₂ transcritical efficiency

Italy's Epta Group has come up with its own response to the high ambient temperature challenges facing retailers in southern Europe and Australia alike – the Full Transcritical Efficiency (FTE) solution. "Eliminating superheat by flooding the evaporators is the key to increasing efficiency in warm climates," Francesco Mastrapasqua, the group's sales and marketing manager for refrigeration systems, told *Accelerate Australia & NZ*.

The evaporators of MT (positive) cabinets are overfired. "We operate positive cabinets without any superheat," Mastrapasqua explains.

"By the time this stuff trickles down to Australia, we kind of lose some of the message. That's why it's important for us to travel to EuroShop and get that stuff straight from the horse's mouth."

— Jonathan Fryer,
IESCO Engineering Services



AHT's new VentoGreen display case at EuroShop

By operating all the positive cabinets with flooded evaporation technology, the patented FTE solution – based on adding an intelligent liquid receiver – allows the operating temperature of the cabinets to be increased.

The liquid is delivered from the main liquid receiver to the positive and negative cabinets. "We introduce an additional low-pressure receiver to collect the liquid that's coming out of the empty cabinets. Flooding the evaporators means having a mix of liquid and vapour," Mastrapasqua explains.

The solution works all year round, in all climate types. Testing carried out over a two-year period in Italy demonstrated that is capable of delivering a stable efficiency gain of around 10%, he argues.

Perth-based AJ Baker & Sons Pty Ltd has joined forces with Epta to market the FTE concept in Australia.

"This is a new design that allows us to increase the efficiency of CO₂ transcritical systems. It's something that we've partnered with Epta, both here in Australia and in Europe, to test," says Mike Baker, the company's general manager.

"This is going to be one of the methods of making transcritical CO₂ work that we feel is going to take it to high ambient temperature areas like Australia. We're looking forward to implementing this into all our transcritical systems in future," Baker enthuses.



Liebherr cabinets at EuroShop

Seeing for himself the innovation on show at EuroShop helps Fryer, director of IESCO Engineering Services, to pitch his case to potential clients for natural refrigerant-based systems in Australia.

"We're certainly getting to the point now" where CO₂ transcritical systems, with innovations such as parallel compression and adiabatic pre-cooling, "are fairly mature technology," Fryer argues.

"I don't think there are any technical barriers in terms of taking that equipment up," he insists. As for the Australian market, "it's now just a matter of justifying the cost and getting clients to show the passion to perhaps spend a little bit extra to safeguard their future options," he argues.

Cabinets – another natural refrigerant success story

In a sign of the growing global popularity of hydrocarbons, many manufacturers have also seen demand for propane-based cabinets rise.

Austrian company AHT already has over one million propane-based food and beverage retail cabinets in operation worldwide.

"We think propane is the best solution on the market for supermarket units," says Reinhold Resch, AHT's vice-president (research and development).

Resch is convinced that independent plug-in cabinets are the way to go. AHT's plug-ins boast leakage rates of less than 0.1%. Opting for a plug-in solution dispenses with the need for both external production of the cold and the secondary circuit to transport it.

Turkish manufacturer Ugür, meanwhile, produces around 6,000 propane fridges per day; largely thanks to demand from "big suppliers like Pepsi, Unilever and Coca-Cola," Özgür Erkek, the company's export director, told *Accelerate Australia & NZ*.

This success with global beverage companies – who often provide distributors such as supermarkets and convenience stores with the fridges that display their wares – has allowed Ugür, established in 1954, to become operational in 142 countries.

"Most of Europe and the US has gone down the hydrocarbons route but in some parts of South America and Asia, this is taking a while," Erkek says.

In a bid to enter the lucrative supermarket sector, Liebherr showcased its new line of energy-efficient chest freezers using R290 for larger sizes and R600a for smaller offerings.

The firm is confident its new products will prove popular. "We are 20% better than the competition in terms of energy savings," insists Heiko Schulz, international sales manager for food retail at Liebherr.

Schulz cites the company's investment in research and development at its energy department as a key driver of cost savings for customers.

When Liebherr began to target the supermarket sector, it knew there would be a trade-off between energy efficiency of the product on the one hand and visual appeal on the other.

"I think we have really found the maximum possibility between the display [through the glass freezer door] and energy efficiency," Schulz says.

He cited the positioning of the block condenser and the fan key as playing central roles in optimising the thermodynamics.

Schulz believes hydrocarbons are the clear answer for plug-ins. "There is some activity with CO₂ [as a refrigerant for plug-in units] but I think the technology is not really ready for the market yet," he argues.

"Hydrocarbon refrigeration will be the leading technology," he confidently declares. The firm is currently growing in Southeast Asia and plans to increase sales there.

True Manufacturing, an American firm with a strong presence worldwide, would appear to agree. It will move its entire production portfolio to 100% hydrocarbons by 2019.

"At the moment we are two-thirds through the transition from R134a and R404A to R290," says Kurt Bahnmaier, True's marketing coordinator for Europe.

The transition to R290 has seen True invest heavily in R&D over the last five years.

Competition between natural refrigerants increasing

Competition between different natural refrigerants is also increasing. Some European manufacturers are opting for CO₂ in their cabinets, with the help of SANDEN Environmental Solutions.

Tapping into the trend towards flexibility in European food retail, the Japanese company is pursuing a 'Sanden inside' strategy of fitting CO₂ refrigeration units into cabinets built by Hauser, Arneg and TEKO.

"The strategy is to deploy our CO₂ solutions as widely as possible – in commercial refrigeration and also for heating," Olivier Campy, chief operating officer (EMEA) at SANDEN Environmental Solutions, told *Accelerate Australia & NZ*.

The 'Sanden inside' strategy sees Sanden install its equipment in different types of cabinet. "What we're showing at our partners' booths is that we're deploying this strategy with different condensing units, whether it's remote units or plug-in units, or air-cooled or water-cooled – basically, any solution for small or medium-sized stores," Campy says.

By combining Sanden's CO₂ technology expertise with the knowhow of the cabinetmakers, Campy hopes to speed up the rollout of smaller CO₂-based cooling systems in Europe.





New propane heat pumps

Many customers are opting for natural refrigerants in the heat pump market too – where they have been slower to take off than in refrigeration.

In cooperation with discount supermarket chain ALDI Nord, German manufacturer Viessmann has produced a propane-based energy system – the 'ESyCool green' – to heat and cool 10 of the discount retailer's stores.

"We are delighted that the ALDI Nord Group is using our holistic ESyCool concept to achieve more climate and environmental protection," says Dr. Frank Schmidt, head of the Refrigeration Systems Division at Viessmann.

'ESyCool green' operates based on heat pumps in combination with optimised refrigerated cabinets and cold rooms, as well as an integrated ice energy storage unit and photovoltaic system.

Christian Fleck, managing director of the ALDI regional subsidiary in Scharbeutz, Germany, says: "Part of our modernisation process is making our stores more energy-efficient and sustainable. To do this, we are making greater use of environmentally friendly and natural refrigerants."

"We want to significantly increase our in-store usage of energy generated through our photovoltaic panels and cold/warm power packs and ensure the panels are in tune with our needs," Fleck says.

Based on the promising results seen so far, 10 ALDI Nord stores will be fitted with the innovative cold-warm air system.

Along with new regulation, this is expected to trigger further investment in Germany in natural refrigerant-based heat pumps. "Heat pumps will become standard" domestic HVAC&R solutions due to new German regulations governing the use of fossil fuels in boilers, according to Michael Nagler, business development manager for CO₂ applications at Germany's GEA.

On 1 January 2016, new rules on constructing new buildings entered into force. New buildings in Germany must now meet a maximum primary energy requirement that is 25% lower than the previous threshold.

It does not explicitly ban fossil fuel heating systems, but in practice it would be nearly impossible to meet the new requirements with an oil or gas boiler. This means that people will have to find alternative ways of heating their homes. Heat pumps are one way of achieving this.

Nagler believes this will create opportunities for CO₂ heat pumps. He cited the example of Switzerland, where "CO₂ heat pumps have been used a lot".

With solutions for all store formats on display in Düsseldorf, natural refrigerants are poised to play an even greater role in the food retail landscape.

As the sun set on EuroShop for another three years, one thing seemed certain – the natural refrigerant revolution in Australia and New Zealand is only just beginning.

■ AW, CM, DY, EI

IIAR's natural refrigerant show

The industrial trade group, traditionally focused on ammonia, is increasingly addressing CO₂ applications, which were featured in its renamed conference and exhibition.

– By Michael Garry

This year, the International Institute of Industrial Refrigeration (IIAR) renamed its annual conference from the Industrial Refrigeration Conference & Exhibition to the Natural Refrigeration Conference & Heavy Equipment Expo, reflecting a new emphasis on, not just ammonia, but another natural refrigerant, CO₂.

The 2017 event, which took place February 26-March 1 in San Antonio, Texas, did indeed feature many exhibits and sessions that addressed systems using ammonia, ammonia/CO₂, or CO₂ by itself.

The following overview highlights some of the major announcements at the show.

Evapco's packaged chiller

Evapco displayed its new Evapcold low-charge packaged ammonia chiller at its IIAR show booth. The chillers are designed to produce temperatures ranging from 10°F to 60°F (-12° to 18°C), with a "sweet spot" between 10°F and 35°F (-12° to 1°C), says Kurt Liebendorfer, vice-president, Evapco.

Dairy operator Prairie Farms has purchased two of the chillers to process milk at one of its dairies, becoming the first end user to employ the new system. Prairie Farms chose the chillers "because they are expanding an existing facility and getting rid of a very old ammonia system," says Liebendorfer. Each chiller uses a small ammonia charge (less than 1 lb./ TR - 0.5 kg) to cool glycol at 22°F (-5.5°C), which is pumped into the milk processing area to generate a 35°F (1°C) temperature.

Prairie Farms also purchased two of Evapco's low-charge packaged penthouse refrigeration units, which are rooftop-mounted, Liebendorfer says. These produce a 35°F (1°C) temperature for a cooler area that stores processed milk. The penthouse unit and the chiller "complement one another," he adds.

Evapco offers more than 50 models of the chiller with capacities ranging from 20 TR to 150 TR (70 kW to 527 kW). The units include variable-speed screw compressors and water-cooled condensing.

The chiller also includes a heat reclaim loop that recovers heat from the compressor and warms glycol, which can be used for defrosting, humidity control and under-floor warming.

Other applications of the chiller include docks, produce rooms and HVAC.

Liebendorfer sees more adoption of low-charge ammonia units. "What I'm sensing at the [IIAR] show is that change is happening. There's less skepticism of low-charge and packaged configurations."

MRBRAZ's AC chiller

MRBRAZ & ASSOCIATES, an engineering design firm based in Azle, Texas, has designed and installed low-charge DX ammonia chillers that provide air conditioning in office space at about 10 warehouse locations run by a major U.S. retailer, including four in the past year.

"We have installed critically charged chillers for [the retailer] for six years," says Claude Wilkinson, director of engineering for MRBRAZ. He says the retailer – which he declined to name for publication without its approval – was one of the first in the U.S. to install a low-charge ammonia chiller.

The rooftop chiller is designed with only 1 lb. / TR (0.5 kg) of ammonia, which is confined to the unit; chilled water is pumped to an air handling unit, which delivers cool air to office space. The typical chiller contains about 100 lbs. (45 kg) of ammonia and employs a VFD screw compressor and ECM motors.

"The chiller is not only more energy efficient than an R404A unit but more maintenance-friendly," says Wilkinson.



Hillphoenix to distribute NXTCOLD

OEM Hillphoenix has announced that it will be the sole distributor of NXTCOLD's ultra low-charge packaged ammonia units for industrial applications in Canada, Mexico and Latin America, handling manufacturing, marketing and installation.

"The NXTCOLD product is a good fit for us because it taps into our core competency as a manufacturer," says David Neu, vice-president, industrial refrigeration for Hillphoenix. "With the innovation of the ultra low-charge system and our manufacturing and marketing capability, we believe there will be a rapid growth curve for the product in Mexico, Latin America and Canada. There's a tremendous amount of untapped opportunity."

In the industrial arena, Hillphoenix has installed transcritical CO₂ systems in ice rinks, including three in Anchorage, Alaska, with a fourth starting up in September. The NXTCOLD agreement "gives us an immediate entry into the ammonia side of the market," says Tim Henderson, industrial program manager for Conyers, Ga.-based Hillphoenix.

NXTCOLD, based in Los Angeles, designed the system to be capable of ammonia charges that are less than 1lb. / TR (0.5 kg). Over the past few years the company has installed units in cold-storage facilities in California, including a Lineage Logistics plant in Oxnard, Calif., a Baker Cold Storage Facility in Long Beach, Calif. (managed by Lineage Logistics), a Los Angeles Cold Storage facility, and a Neptune Foods seafood storage warehouse in San Pedro, Calif. Hillphoenix has also manufactured NXTCOLD units for the U.S. market.

Frick's low-charge central system

Frick Industrial Refrigeration, a division of Johnson Controls, introduced a low-charge ammonia central system that uses 'remote distributed condensing' (RDC) units to substantially reduce the amount of ammonia required in industrial applications.

The RDC units, which include a condenser (such as plate-and-frame or adiabatic) and a small liquid supply vessel, are placed near two to three DX evaporators – "the point of liquid use," says Joseph Pillis, director, global industrial refrigeration technology, Johnson Controls, Waynesboro, Pa., adding, "The concept of distributed condensing is really what makes this different".

Apart from the liquid ammonia transfer between the RDC and the evaporators, "only [ammonia] vapor is distributed through the plant," he adds. This eliminates long liquid lines and reduces the amount of liquid ammonia that needs to be stored. The use of DX evaporators also cuts down on the charge.

Frick's low-charge central system is capable of limiting the ammonia charge "in the range of 1.5 to 3 lbs. (0.6 to 1.3 kg) per ton [of refrigeration]," says Pillis.

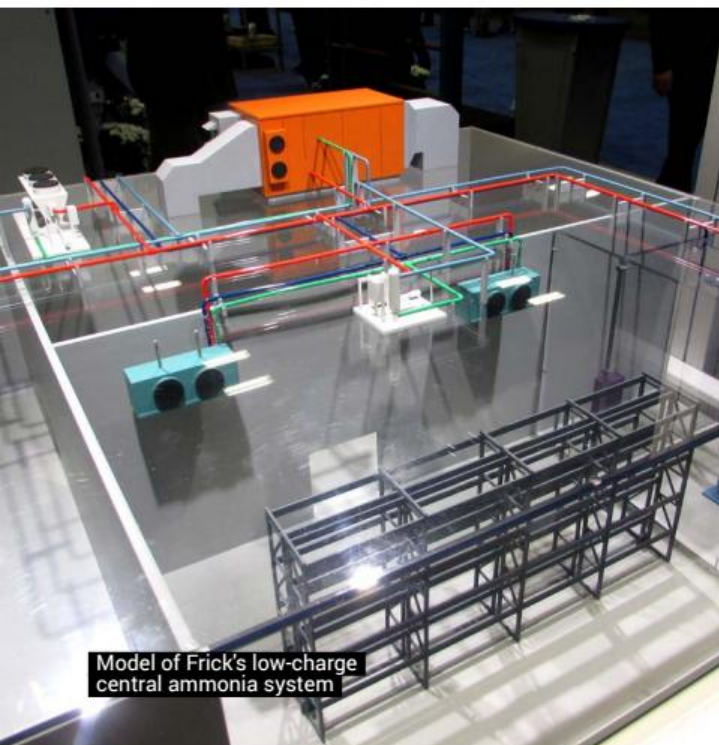


Unlike rooftop-based low-charge ammonia packaged systems, Frick's design maintains use of a traditional engine room, though it only contains compressors and a control panel. As a result, "compressors can be much larger machines [than in packaged systems], running at much higher efficiency than little machines – on the order of 5% to 25%," Pillis says. "We can run two-stage compressors and do economizers off both stages. It's a very flexible design."

Controls are key to managing the ammonia charge in the liquid supply vessels. "They monitor the liquid levels to make sure we don't run out of liquid in places where we need it," says Pillis.

The low-charge central system is installed at a food processing facility, providing 660 TR (0.6 to 1.3 kg) of capacity with only 2 lbs./TR (0.9 kg) of ammonia charge. The range of capacities for which the system is typically designed range from 250-1,000 TR (879 to 3,500 kW), says Michael Colley, Eastern regional sales manager for Frick.

“If you’ve got one CO₂ compressor that can do almost 200 tons for medium temperature, that changes the face of industrial refrigeration.”



Model of Frick's low-charge central ammonia system



From left: David Neu and Tim Henderson, Hillphoenix

Emerson's new CO₂ industrial compressors

At the IIAR show, Emerson, through its Vilter company, promoted transcritical and subcritical CO₂ compressors for industrial end users. Its new 550 series of open-drive reciprocating compressors, to be released in the next two months, will accommodate capacities ranging 50 TR to 223 TR (175 to 748 kW) for low-temperature applications (-20°F evaporating and 23°F condensing, equivalent to -28°C and -5°C respectively). The compressors will come in two, four- and eight-cylinder models. The eight-cylinder model was on display at Vilter's IIAR show booth.

The 550 series compressors have been running for the past year at Emerson's Helix Innovation Center in Dayton, Ohio. "It's pretty exciting stuff," says André Patenaude, director – CO₂ business development, Emerson Commercial and Residential Solutions.

Emerson is also developing single-screw compressors for medium- or low-temperature transcritical CO₂ applications, ranging from 188 TR to 357 TR (661 to 1255 kW) of capacity at 23°F evaporating and 95°F gas cooler out, equivalent to -5°C and 35°C respectively. The compressors will be offered in several displacements ranging from 128 CFM to 243 CFM. At the IIAR show, the 160 CFM model was on display. The compressors can also be used in low-charge ammonia applications.

The smallest, 188-TR screw compressor provides almost eight times as much capacity as Emerson's 25 TR unit, previously its largest offering. "If you've got one CO₂ compressor that can do almost 200 tons (700 kW) for medium temperature, that changes the face of industrial refrigeration," he says. Emerson will be seeking a field test site for the industrial screw compressor this year.

■ MG

Part of our Natural Refrigerant Range of Products.

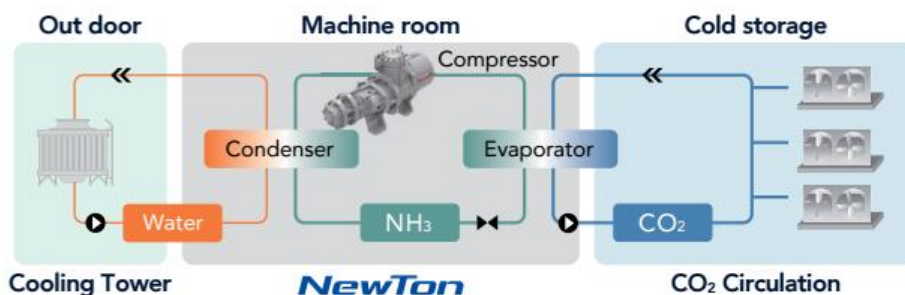
NewTon

NH₃/CO₂ Cooling Systems



Innovative Cold Storage Solution

- Only 75kg NH₃ charge for 300kW of cooling capacity
- High efficiency
- Standardized and simplified package
- Lower site work and running costs
- Stable temperature by CO₂ circulation
- No ammonia damage on the products
- Easy maintenance and remote monitoring
- Quiet operation



Model	R-3000	R-6000	R-8000
Cooling Capacity	94.7kW	189.4kW	270.0kW
NH ₃ Charge	25kg	50kg	75kg

* -32°C CO₂ Temp. -32°C Cooling Tower Water Temp.

For more details
www.mayekawa.com/lp/newton/

Mayekawa Australia PTY. LTD.

Unit 2, 44 McCauley Street Matraville NSW 2036, Australia
Tel : +61 2 9695 7000 E-mail : info@mayekawa.com.au
www.mayekawa.com.au

New Zealand

Unit 2, 30 Tui Street, Otahuhu, Auckland 2024, New Zealand
Tel : +64 9 276 2305 E-mail : info@mayekawa.co.nz

MAYEKAWA
MYCOM



ATMO sphere

Business Case for
Natural Refrigerants

02/05/17 - Sydney

THANK YOU TO OUR PROUD SPONSORS:

PLATINUM



GOLD



SILVER



BRONZE



PROGRAMME

MONDAY 1 MAY

19:00 **WELCOME RECEPTION**

Casual pre-event welcome drinks reception with appetizers sponsored by Dorin & Mayekawa

TUESDAY 2 MAY

07:30 **BREAKFAST**

Welcome breakfast will be served as participants arrive on site and register for the conference, sponsored by The Natural Refrigerants Company & CAREL & SCM Frigo

08:30 **WELCOME & INTRODUCTION**

Marc Chasserot, shecco

08:40 **POLICY SESSION**

Presentations by government and industry experts on the latest regulatory issues and standards for natural refrigerants in Australia and New Zealand and the international dimension.

Patrick McInerney, Int. Ozone Protection & Synthetic Greenhouse Gas Section, Department of the Environment and Energy, Australia
Marc Chasserot, shecco

09:30 **TRAINING ON NATURAL REFRIGERANTS**

Presentations by leading associations in Australia and New Zealand about their experiences, new opportunities, policy and technical barriers and the latest developments from each industry body to accelerate the adoption of natural refrigerant technologies.

Chair: Marc Chasserot, shecco
Matt Allfree, Climate Control Companies Association of New Zealand
Kim Limburg, Australian Refrigeration Mechanics Association
Glenn Evans, ARC
Steve Smith, TAFE NSW
Inderpal (Indy) Saund, Danfoss

10:50 NETWORKING BREAK

Networking coffee break, sponsored by BAC & Advansor & McAlpine Hussmann

11:20 MARKET TRENDS SESSION

Strategic and visionary presentations by leading industry representatives on their latest success stories, lessons learned, challenges and next steps.

Chair: [Jan Dusek](#), shecco
[Ian Suffield](#), Bitzer
[Trent Miller](#), Mitsubishi Heavy Industries
[Stefan Jensen](#), Scantec
[Peter O'Neill](#) Mayekawa
[William Pagani](#) and [Steve Laing](#), EPTA
[Massimo Casini](#), Dorin
Speaker tbc., Danfoss
[Brian Rees](#), McAlpine Hussmann

13:10 NETWORKING LUNCH

Networking lunch served in the sponsors exhibition area, sponsored by Epta & Danfoss

14:30 CEO INTERVIEW

In this brand new panel, [Marc Chasserot](#) of shecco will interview one of the most successful CEOs in the industry, [Robbie Mayer](#) of F. Mayer Imports

14:45 END USER PANEL

Key end users will share their experiences including benefits, challenges and future plans

Chair: [Stuart Saville](#), Coles and [Jan Dusek](#), shecco
[Paul Brandt](#), Nestle Australia
[Tim Hill](#), Costco
[Michael Englebright](#), Woolworths
[Steven Mitchell](#) and [Lindsay Rowels](#), Foodstuffs North Island

16:00 NETWORKING BREAK

Networking coffee break, sponsored by Arneg, Emerson, Heatcraft & GEA

16:30 **TECHNOLOGY CASE STUDIES IN HVAC&R**

Participants can choose to attend Commercial Refrigeration or Industrial Refrigeration, Air Conditioning and Heat Pump case study sessions:

Commercial Refrigeration case studies:

Dario Ferlin, Woolworths Engineering Services, Woolworths' investment in the Australian industry to deliver sustainable HFC-free refrigeration innovation
Ian Suffield, Bitzer, Efficiency gains of a booster system with parallel compression
Mirko Bernabei, SCM Frigo, Improving the energy efficiency of CO₂ refrigeration systems
Abel Gnanakumar, Emerson, The Helix Innovation Center, Providing infrastructure to enable natural refrigerant adoption
Kristian Sørensen, Advansor, Status on the newest implemented CO₂ transcritical technology as well as upcoming technology
Michael Baker, AJ Baker & Sons, Transcritical CO₂ and Australian supermarkets – a reality
Ian Wilson, Strathbrook Industrial Services, Transcritical CO₂ system performance in warm climates

Industrial Refrigeration, Air Conditioning and Heat Pump case studies:

Trent Miller, MHI Australia, Introduction of commercial CO₂ heat pump in Australia – case study from North Queensland
Martin Millow, Mayekawa Australia, Natural refrigerant NH₃/CO₂ cascade freeze dry application in New Zealand
Stefan Jensen, Scantec Refrigeration Technologies, The rise of low-charge NH₃ refrigeration systems
Wynand Groenewald, CRS (South Africa), Blast freezing of avocados with CO₂
Klaas Visser, KAV Consulting, Two CO₂ projects with evaporative condensers
Hayato Sakamoto, Kawasaki Heavy Industries, Kawasaki turbo chiller using R718 (water) as refrigerant
Matthew Darby, EcoChill, Perfecting Produce – The success of hydrocarbon systems in the produce distribution industry in New Zealand

18:30 **PRE-DINNER DRINKS RECEPTION**

Pre-dinner drinks reception, sponsored by Scantec & Mitsubishi Heavy Industries Air-conditioners Australia

19:30 **NETWORKING DINNER**

Networking dinner, sponsored by Bitzer

Albert Heijn's carbon-neutral store

The Dutch retailer's new hypermarket employs solar energy and a CHP plant, as well as a transcritical CO₂ refrigeration system – one of 110 in the chain – to achieve a net-zero carbon footprint.

— By Andrew Williams



Bicycle pump station, Albert Heijn XL store, Purmerend, the Netherlands

In the small town of Purmerend, the Netherlands, north of Amsterdam, a new Albert Heijn XL hypermarket has achieved the rare distinction of carbon neutrality.

And so, Albert Heijn, a chain of 950 supermarkets across the Netherlands and Belgium, has dubbed it "Europe's most sustainable supermarket".

"It's our own assessment based on the technology we've put inside the store," says Vincent van Dijk, a store-engineering consultant for Albert Heijn. "We've looked around Europe to see if there are comparable supermarkets – we don't think there are any."

The Purmerend store, which opened last November, is the first but certainly not the last Albert Heijn store to reach this goal. The retailer – a division of Ahold Delhaize, based near Purmerend in Zaandam – wants all of its stores to be carbon neutral by 2025. "That's a big aim for the future," says Alfard Clerc, the senior manager, store engineering in Albert Heijn's real estate & construction department.

At the Purmerend store, 50% of the energy used on site is provided by a combination of 700 solar panels (on the roof and sides of the building) and a combined-heat-and-power (CHP) plant in the parking lot. The CHP is fired by biogas and provides in-store heating and electricity.

Part of the motivation for placing solar panels on the side of the building was to make sure that customers see them. "We've done a lot of things, from small to large," van Dijk says.

The store's transcritical CO₂ booster refrigeration rack – Purmerend is one of 110 Albert Heijn stores with a transcritical CO₂ system – handles not only cooling but air conditioning in concert with absorption machines (Albert Heijn is now remodelling its stores to include transcritical CO₂ refrigeration at the remarkable rate of 60-80 per year).



From left: Vincent van Dijk and Alfard Clerc, Albert Heijn

The Purmerend store is also fitted with phase-change equipment for heat storage. "When we have too much heat, we store it," says van Dijk. "When we need heat, we take it out and put it back into the CO₂ transcritical system. Underground, we store the cold. This is all managed remotely from the centre of the Netherlands."

Albert Heijn's use of fully closable refrigerator doors cuts electricity use by 25%. Display cases use '6K' evaporators that deliver energy savings of 10% compared to the previous cabinets.

The new Albert Heijn XL is 30% more energy efficient than the previous store on the Purmerend site, and 10% more efficient than the company's previous standard-bearer. "If we improve like that every year, that'll be very nice," van Dijk says.

Customers cannot miss the row of charging stations for electric vehicles in front of the store. "Of course, we're in the Netherlands – so you can [also] pump up your bicycle tyres!" Clerc says.

In sum, the carbon neutrality comes from "a combination of producing energy, buffering the storage, and the energy savings that we're making with the refrigeration installation," says van Dijk. "Nobody else in Europe is making installations in this combination."

Excitedly hopping from one feature to another at the Purmerend store, Clerc stressed that this hypermarket is very much a pilot for new ideas. "This is really a playground. It's the best spot to do it, because we can try everything here. It's about learning what's happening with our innovations."

GOING HFC-FREE

At the heart of Albert Heijn's strategy to go carbon-neutral are plans to become HFC-free. "We're looking at an HFC phase-down," says van Dijk. "That's the main route we're following – and making our installations a little bit better every day."

Since 2015, Albert Heijn's policy has been to fit all new and remodelled stores with CO₂ transcritical installations. As an intermediate step, the company installed 350 hybrid CO₂-HFC systems between 2010 and 2015.

Fast forward to 2017, and Albert Heijn's 110 transcritical CO₂ stores (including franchises) represent about 10% of its total store portfolio. "We have the ambition to work faster, but it's also about cost," van Dijk says. "The remodelling sequence is about 10 years, so that's a very important consideration in speeding up towards going completely [carbon] neutral."



CHP plant supplying
Albert Heijn XL store,
Purmerend,
the Netherlands

For flexibility, Albert Heijn also uses stand-alone plug-in propane units to display certain products. Its distribution centres are cooled by a combination of ammonia and brine. "Always natural refrigerants," notes van Dijk.

REGULATORY IMPACT

In Europe, regulation plays a critical part in driving natural refrigerant adoption. In particular, the European Union's F-Gas Regulation, which entered into force in 2015, aims to reduce HFCs by 79% by 2030, as compared to average levels in 2011-2013.

To help deliver this target, the EU is progressively banning the use of certain HFCs in different types of new equipment. In 2022, for example, bans on using certain HFCs with GWPs above 150 in new centralised and plug-in commercial refrigeration equipment will come into effect.

"The HFC phase-down was an alarm bell that we have to start innovating," says Clerc. Yet switching to natural refrigerants is a no-brainer for him regardless of the evolving policy landscape. "It's about doing the right thing. It's also about saving energy, and saving money."

The global adoption last October in Kigali, Rwanda, of a Montreal Protocol amendment limiting the production and use of HFCs has only strengthened Albert Heijn's resolve in this regard.

"Kigali confirmed that we're going in the right direction," Clerc says. "It's also helping us to raise awareness that we need to remodel our stores." What challenges has the company encountered in remodelling stores with CO₂? Availability of components and training have proved to be crucially important, Clerc says. "Educating people plays an important role in determining how fast you can go."

The biggest lesson Clerc has learned is the importance of forward planning, gathering data and getting calculations right. "All this is really important to finally going for that shift [to natural refrigerants]."

In Purmerend, owning the real estate made it easier to make the business case for investing in environmentally friendly innovations. "We had a unique opportunity [in Purmerend] to do this," Clerc says.

"Now we're learning, and looking at which of the technologies at Purmerend we can develop and put into the normal remodelling of our other stores."

■ AW

Albert Heijn's standard stores are fitted with the same CO₂ system regardless of location, keeping investment costs down. The capacity can differ but "we try to put the same installation and the same components in every store," says van Dijk.

At the Purmerend store, though, the transcritical CO₂ booster system features parallel compression and is one of only a handful in Europe to use ejectors. An adiabatic gas cooler and a dry-cooler on the roof complement the rack.

Albert Heijn builds its refrigeration racks itself, in close cooperation with a team of advisors and the installers. "That's a different way of doing it than most other companies, because we want to know all about it ourselves," Clerc says.

"We make a document listing all the components," explains van Dijk.

"We make the calculation up front and know exactly what has to go in. Then the installers know exactly what to build." This is important for future maintenance of the systems. "Sometimes the maintenance people are maintaining stores they didn't build. So you have to have the same type of installation."

Albert Heijn has contracted four companies – Retail Technics, Frimex, Carrier and Veld – to install and maintain the transcritical CO₂ systems in its stores. The firms monitor and adjust the systems remotely. "These companies are very much part of our innovation and the improvements that we're making to our installations," van Dijk says.

Transcritical CO₂

McAlpine Hussmann are continuing their proud history of providing **proven energy efficient and environmentally friendly solutions** to a wide range of customers.

In partnership with Green & Cool, McAlpine Hussmann have supplied and installed more than 20 Transcritical CO₂ systems to customers in Oceania to date.

With an extensive current and future product range, we have a variety of solutions that we can provide to a broad range of customers:

- Transcritical CO₂ DX Rack Systems
- Transcritical CO₂ Condensing Units
- Transcritical CO₂ systems for high standstill pressure
- Subcritical CO₂ DX Rack Systems
- Walk-in outdoor machine rooms
- Reach-in outdoor machine rooms
- A full range of low GWP solutions
- A full/extensive range of compliant display cases
- Design and engineering advice
- Installation services
- Ongoing service and maintenance



**CALL
NOW!**

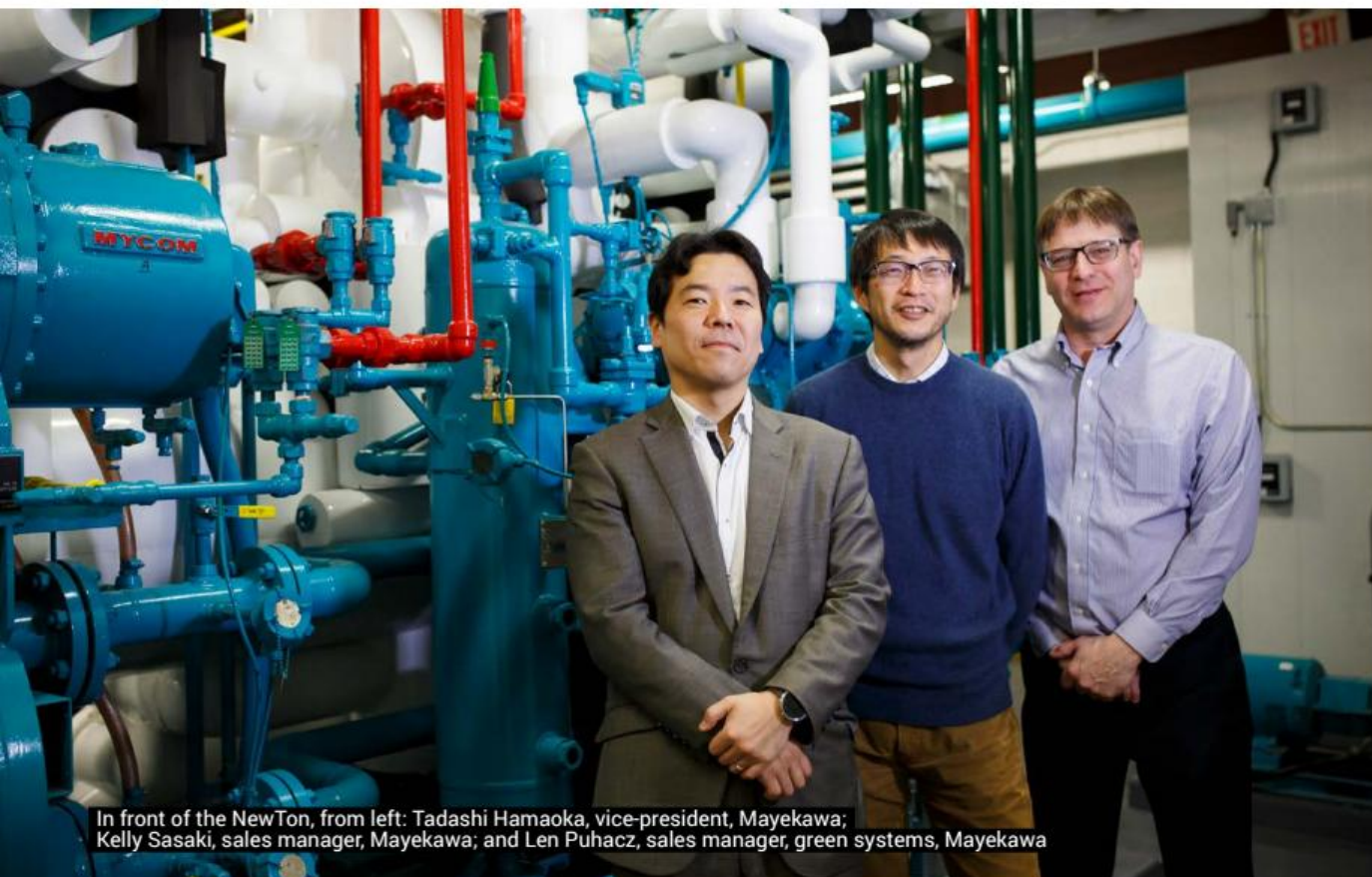
REFRIGERATION & HVAC
Design - Manufacturing - Installation - Service

New Zealand: 0800 473 374

Australia: 02 8805 0400

Email: refrig@hussmann.com

Website: www.mcalpinehussmann.com



In front of the NewTon, from left: Tadashi Hamaoka, vice-president, Mayekawa; Kelly Sasaki, sales manager, Mayekawa; and Len Puhacz, sales manager, green systems, Mayekawa

A Canadian First

Impressed by its safety, environmental friendliness and energy efficiency, Wholesome Harvest Baking is the first industrial operator in Canada – and only the second in North America – to install Mayekawa's NewTon low-charge NH_3/CO_2 packaged refrigeration system.

– By Michael Garry

What makes a company decide to invest in a refrigeration system never before tried in its chosen country?

Last September, Wholesome Harvest Baking, a division of Mexican baking giant Grupo Bimbo, became the first company in Canada to operate the NewTon, Mayekawa's ammonia/ CO_2 packaged refrigeration system, in an expansion of a bread-making plant in the Etobicoke section of Toronto. The project included the refrigeration system, a spiral freezer, their installation, and building modifications.

The NewTon is one of a growing breed of low-charge ammonia packaged refrigeration systems that keep the ammonia charge well below the 4,500kg threshold that triggers greater regulatory scrutiny. The factory-made system uses the ammonia to condense gaseous CO_2 , which is the only refrigerant providing cooling in operating areas.

Mayekawa is installing the NewTon at the rate of about 300 per year, mostly in cold storage and food processing facilities, says Len Puhacz, sales manager, green systems, at Mayekawa's Toronto office.

In the North American continent, Mayekawa has partnered with Toronto-based CIMCO Refrigeration to market the NewTon (see 'Coming to America', *Accelerate America*, February 2016). So far the companies have deployed one other NewTon at an operating facility – an Imuraya confectionery plant in Irvine, California. The Garden City Ammonia Program (GCAP), a training facility in Garden City, Kansas, has also installed the NewTon, but only for training purposes.

The Etobicoke facility runs two 158 kW NewTon F-600 packaged NH_3/CO_2 units, each with two ammonia compressors, 54kg of ammonia and about 520kg of CO_2 ; the units serve as the freezing agent for a spiral freezer added to the existing facility. CIMCO handled the installation of the refrigeration system.

The Etobicoke plant is the kind of mid-sized food processing facility suitable for the NewTon, says David Fauser, Ontario sales manager for CIMCO, who worked with Wholesome Harvest on the NewTon project. Mayekawa sees a great opportunity for the NewTon in North America as a replacement for R22 systems in those facilities as R22 enters the final chapter of its phase-out, says Puhacz. The same opportunity would apply to HFC systems once the phase-out of HFCs accelerates. Large plants that would normally employ direct ammonia systems represent another target; in Japan, such plants have installed up to 12 NewTons.

Walking the talk

Part of the appeal of the NewTon to Grupo Bimbo (which acquired Wholesome Harvest Baking in 2014) resides in its environmental friendliness. In contrast to HFC condensing units, the NewTon's working fluids, ammonia and CO₂, are natural refrigerants; if they escape they "return to nature; there's zero impact to the environment," says Frank Barrese, engineering and maintenance manager for Wholesome Harvest's Etobicoke plant, who was recognised for his work on the NewTon installation with a President's Award from Wholesome Harvest. Moreover, the NewTon's energy efficiency is far greater than that of an HFC system, further reducing greenhouse gas emissions.

Grupo Bimbo also emphasises sustainability in its corporate policies. "Companies may state they have strong environmental and safety policies," says Barrese. "Grupo Bimbo is committed to these policies, as it is demonstrating through this investment."

"Grupo Bimbo seems focused on environmental sustainability as part of their business case," says Fauser, adding: "I feel really lucky that I was involved with this."

Wholesome Harvest opted not to install a conventional direct-ammonia overfeed system – which would have been slightly less expensive than the NewTon with about the same efficiency – for safety reasons. Unlike a conventional system, the two NewTon units use a small amount of ammonia and confine it to the mechanical room, preventing any potential exposure of the gas to employees. "The [conventional] ammonia systems we purchase are safe, but the NewTon gives an added measure of safety," says Barrese.

Safety has been a major driver of the NewTon's adoption overseas, Puhacz notes. "The attraction is that it's green without using ammonia in the storage space," he says.

Enclosed in the NewTon units, liquid ammonia goes into a plate-and-shell heat exchanger where it condenses CO₂ gas returning from the spiral freezer evaporators. The liquid CO₂ is then pumped to, and across, the roof, and down into the freezing room, about 14 metres from the mechanical room. The now gaseous ammonia is liquefied by glycol in another plate-and-shell heat exchanger inside the NewTon units (the glycol regains its low temperature from a water tower on the roof). "The ammonia never leaves the mechanical room," emphasises Barrese.

Ease of use is a key aspect of the NewTon. In adding spiral freezing to the Etobicoke plant, Wholesome Harvest wanted to employ a refrigeration system that would be comfortable for longtime employees to run. The NewTon – with its "one-button-type" operation and intuitive controls – matched that description, running continuously even under different loads, says Barrese. "We were very careful to make the equipment a good fit to the people and the culture. It's peace of mind for me, our managers. and Grupo Bimbo."

"It runs itself," Fauser adds.

"We were very careful to make the equipment a good fit to the people and the culture."

– Frank Barrese, Wholesome Harvest Baking





Frank Barrese, in the freezer room at Wholesome Harvest Baking's Etobicoke plant in Toronto

Efficiency winner

The NewTon has a reputation for energy efficiency; this was borne out at the Etobicoke plant in a study conducted by I.B. Storey, a third-party energy consultant, to qualify Wholesome Harvest for an energy incentive. The study compared the NewTon to an HFC system.

"As an indirect ammonia system, the NewTon is close to the same energy efficiency as a direct ammonia system, without any of the hazards of direct ammonia," says Barrese. "And it's heads and tails more efficient than Freon." Fauser points out that the NewTon minimises the energy penalty normally associated with an indirect system that uses two refrigerants. "That's what makes it so unique."

As its baseline, I.B. Storey estimated the annual energy performance of a standard HFC refrigeration system by using energy metering of its compressors during a 28-day period. A similar estimate was done for the NewTon.

The conclusion: the NewTon generated 588,063 kWh annually, compared to 1,200,931 kWh for the conventional HFC system, a saving of 612,268 kWh. In addition, the annual savings in peak energy consumption achieved with the NewTon was 122 kW. Based upon these savings, I.B. Storey recommended an energy incentive from the SaveONenergy Retrofit Program run by Toronto Hydro-Electric System, which conditionally approved the application in late January.

The NewTon is monitored remotely from Mayekawa's Japanese headquarters, which does predictive maintenance. "If they see something and we choose to ignore it, they'll still be knocking on your door," says Barrese. Fauser notes that the NewTon is very low-maintenance and leak-tight, while Puhacz points out that the NewTon's compressors have no shaft seals, making them less likely to leak.

In North America, the NewTon follows in the footsteps of other low-charge packaged ammonia systems offered by NXCOLD, Evapco, Azane, Stellar and CIMCO. Some operators are reducing the ammonia charge in conventional industrial systems using DX coils or other methods. In addition, M&M Refrigeration has installed large-scale ammonia/CO₂ systems for cold storage operators like U.S. Cold Storage (see 'Shaking Up Industrial Refrigeration', *Accelerate America*, April 2015).

But for a spiral freezer application, "there's not a better solution [than the NewTon] if you don't want ammonia in the plant," says Fauser. ■ MG

SYSTEM SPECS

The Wholesome Harvest Baking facility in the Etobicoke section of Toronto employs two NewTon F-600 NH₃/CO₂ units, made in Lebanon, Tennessee. Here are specifications for each unit:

No. of compressors: two

Compressor type: semi-hermetic compound screw

Compressor drive method: VFD

Compressor motor type: IPM motor

Ammonia charge: 54kg

CO₂ charge: about 520kg

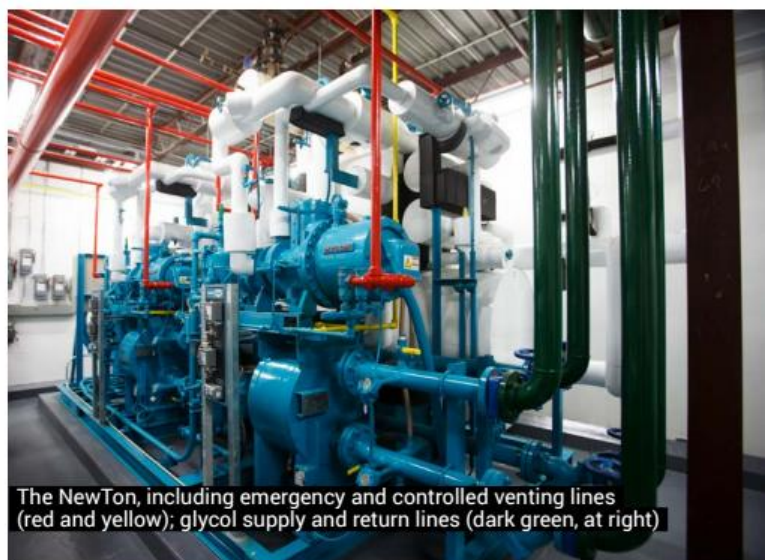
Cooling capacity: 158 kW

Typical operational temperature: -26°C

CO₂ supply temperature: -42°C

Heat exchangers: shell-and-plate

Net weight: 7,700kg



The NewTon, including emergency and controlled venting lines (red and yellow); glycol supply and return lines (dark green, at right)

Oil Separators •

Reservoirs •

Liquid Receivers •

Oil Management Products



Natural Refrigerants Compatible

Ammonia • CO₂ • Hydrocarbons

*Use Temprite's Product Selector to choose the best model(s)
for your system: www.temprite.com*

www.temprite.com

email: fgervele@temprite.com

1.800.552.9300

1.630.293.5910

FAX: 1.630.293.9594



Is the A3 charge limit going up?

The IEC is considering raising the 150g limit for flammable A3 refrigerants to 500g, as research projects on hydrocarbons and A2Ls move forward

– By Michael Garry

One of the often-cited limitations of hydrocarbons as refrigerants in the U.S. is the small charge that is allowed – 150g for commercial applications (60g for water coolers) and 57g for domestic uses – by the Environmental Protection Agency (EPA).

While this small quantity works effectively in fractional horsepower refrigeration systems, it is insufficient for larger systems; this means that multiple units must be employed to accommodate larger loads, driving up costs considerably.

In February of 2016, UK-based OEM Carter Retail Equipment submitted an application to the EPA's SNAP (Significant New Alternatives Policy) programme to increase to 1kg from 150g the maximum charge of propane permitted in stand-alone commercial refrigeration equipment. That application is still pending.

On a global level, the International Electrotechnical Commission (IEC), through its SC61C subcommittee Working Group 4 (WG4), is working on raising the charge limit for flammable (A3) refrigerants. The new maximum charge under consideration for propane is 500g, says Marek Zgliczynski, chairman of the SC61C subcommittee, and manager of commercial refrigeration product engineering for Brazilian compressor manufacturer Embraco.

Standards from the IEC, a body that proposes rules governing how to use electrical, electronic and related technologies, influence the development of the market by providing manufacturers and customers with guidelines as to what is safe to use and buy. This month, Working Group 4 is holding a meeting in

Turin, Italy, to review the latest comments made about the charge-standard proposal and “will come out with the next draft proposal,” Zgliczynski says. Subsequent meetings will be held this year; during a plenary meeting in Vladivostok, Russia, in October, the SC61C subcommittee will decide whether a final draft is ready to be submitted for a yes-or-no vote. “The chances are we’ll finalise this by the end of 2017 and publish the standard in 2018,” he says.

A new IEC standard for the maximum allowable flammable refrigerant charge would influence the adoption of the same standard in the U.S. by the EPA and Underwriters Laboratories (UL), notes Zgliczynski. “This would be a reference, the global standard.”



From left: John Prall and Marek Zgliczynski, Embraco

Zgliczynski would like to see the U.S. “adopt exactly the same standard so that it is a universal standard”. The majority of the 26 experts in Working Group 4 represent U.S. manufacturers like True Manufacturing, Emerson, Hussmann and United Technologies. Working Group 4 also comprises representatives of 12 other countries, including Germany, New Zealand, and Japan.

Zgliczynski noted that most plug-in cases don’t require a propane charge as high as 500g. “For our products and main customers in America, 250 to 350 grams is enough to cover most of the applications,” he says. “Five hundred grams would be necessary just for some specific applications.”

Flammable refrigerant research projects

Meanwhile, major research efforts addressing flammable refrigerants – which would potentially support an update in safety standards and an increase in charge limits – are underway.

The largest is a \$5.8 million programme started last year that is focused on the risks associated with flammable refrigerants, both A3 and A2L (slightly flammable). It has support from the U.S. Department of Energy (DOE), the Air Conditioning, Heating and Refrigeration Institute (AHRI), the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), the state of California and Johnson Controls. The research initially considered A2L refrigerants, and was expanded to include A3 refrigerants.

In late January, Omar Abdelaziz, group leader, building equipment research, energy & transportation science division for the DOE’s Oak Ridge National Laboratory, said that the research on A3 refrigerants would start “in the next couple of months,” with a final report issued by September 30 of this year. He said this in answer to a question at the Sustainable Technologies for Stationary Air Conditioning Workshop, held at the AHR Expo in Las Vegas.

Ultimately, the research will be used to update ASHRAE standards 15-2013 (Safety Standard for Refrigeration Systems) and 34-2013 (Designation and Safety Classification of Refrigerants). In addition, by the end of 2017, findings will be provided to safety code committees in North America and globally, said Stephen Yurek, president and CEO of AHRI, at the workshop.

That will, in turn, lead 2018 to changes in building and fire codes used by municipalities, which would take effect in 2021 and ultimately be adopted by state and local model codes.

“There are a lot of efforts going on to incorporate flammable refrigerants,” said Xudong Wang, director of research for AHRI, at the workshop. “The question is how to safely use them.”

AHRI’s efforts, through its Air-Conditioning, Heating and Refrigeration Technology Institute (AHRTI) research arm and UL, are focused on “identifying the main knowledge gaps in the safe use of flammable refrigerants,” including leak and ignition testing, Wang added. “We want to understand the relative risks compared to A1 refrigerants with oil currently in the field.”

In another research project, launched this year, the U.S. Fire Protection Research Foundation is evaluating the fire hazard posed by flammable refrigerants to lay the groundwork for raising the 150g charge limit

“This would be a reference, the global standard.”

– Marek Zgliczynski, Embraco

on hydrocarbons. Co-leaders of the \$170,000 project include Target, a user of self-contained propane display cases, and the North American Sustainable Refrigeration Council.

“There is a need to assess the fire hazard of class A3 refrigerants, and specifically propane,” says Amanda Kimball, project manager for the Fire Protection Research Foundation, an affiliate of the National Fire Protection Association, based in Quincy, Mass.

The overall goal of the project, says Kimball, is to evaluate the fire hazard of up to 1,000g of propane in refrigeration appliances used in a commercial retail setting.

The project is expected to be completed this June. ■ MG



Danfoss partnering with TAFE on CO₂ training initiative

The Danish giant has begun offering a two-day CO₂ training programme in collaboration with TAFE NSW.

– By Devin Yoshimoto

At recent industry events like AIRAH's Refrigeration 2017, much of the discussion centered on the need to improve training in the use of natural refrigerant-based HVAC&R systems among installers and technicians in Australia. Danfoss is partnering with TAFE NSW to help close this gap.

Given the growing popularity of more complex CO₂ transcritical systems for supermarkets, for example, programmes like this are needed more than ever. The course, which has been promoted since February 2017, covers the following topics:

- ▶ How to safely handle and work with refrigerant-grade carbon dioxide (R744).
- ▶ Training on the various system types currently being installed by the supermarket sector. This includes both sub-critical (cascade) systems and transcritical systems.
- ▶ How to charge a system and make basic repairs: the college possesses a fully functional supermarket setup that can be operated in either sub-critical or transcritical mode.

Accelerate Australia & NZ caught up with Inderpaul (Indy) Saund, food retail business development manager at Danfoss (APAC), to learn more about Danfoss' activities in Australia as well as about the programme itself.

Accelerate Australia & NZ: Can you provide a little background on Danfoss' transcritical CO₂ projects in Australia to date?

Indy: Danfoss first engaged in transcritical CO₂ projects back in 2006, with Bitzer at their R&D centre. Back in those days, we helped Bitzer come up with a demo system. From there we then worked with Ian Wilson from Strathbrook to create what we have today at the TAFE. We have since then worked with Strathbrook, Coles and Countdown in New Zealand on transcritical CO₂ plants.

Accelerate Australia & NZ: How did the collaboration with TAFE originate?

Indy: We were first asked by Strathbrook to help engineer a CO₂ system for TAFE back in 2007-2008. Once the system was installed, we then worked on supporting TAFE with all information regarding the system and its setup.

Accelerate Australia & NZ: Why did you see a need to offer this two-day training programme?

Indy: TAFE has had this course running for some time now, but interest in the market has dropped due to a change in direction with the industry. So we thought, as CO₂ is again gaining momentum, how about we further our partnership with TAFE and help them with getting the latest trends and information on new technologies.

We see a need for more training, if we are to see a greater acceptance of CO₂ technologies. Without the knowledge in the marketplace, then people will always naturally shy away from CO₂ or other natural refrigerants.

Accelerate Australia & NZ: How does this programme fit in with your overall global training initiatives?

Indy: Danfoss is big on training and the programme at TAFE fits hand in hand with our online e-learning platform, where we have a number of CO₂ modules.

The TAFE two-day training programme allows the students to put the theory they have learnt into practice with hands-on experience.

Accelerate Australia & NZ: Going forward, do you envision Danfoss' relationship with TAFE growing?

Indy: Yes, I do see the relationship with TAFE growing and I believe as natural refrigerants gain more momentum in the marketplace, together we will be able to offer valuable and essential training for the industry.

At this stage we have started with CO₂, but long term we will help on other natural refrigerants, such as ammonia, due to the vast experience that Danfoss has.

Accelerate Australia & NZ: Do you see this type of programme being offered in other parts of Australia? How about internationally like China?

Indy: Early days yet, but the idea is Danfoss will help promote the programme with our APAC customers. We have a few customers requesting classroom and hands-on training so this is the perfect platform for them to gain the experience.

The programme will be mainly focused in Australia at this stage but we are exploring extending it into other regions. ■ DY



Course information

Location:

TAFE NSW (90000) – Nirimba

Refrigeration and Air Conditioning Trades

Building T11, Colebee St, Schofields, Nirimba College

www.wsi.tafensw.edu.au

Target audience:

Contractors, installers, consultants, and wholesalers

Practicalities:

Maximum number of participants: 12

Training date can be tailored to your needs

Course will be conducted in English

Pre-requisites:

To ensure a high level of subject knowledge, all participants will be required to complete e-lessons prior to face-to-face training. These are available online 24/7.

For more information contact:

Steve Smith, Head Teacher

Refrigeration and Air Conditioning Trades

Tel. 02 9208 7585

stephen.smith@tafensw.edu.au



OEMs flock to hydrocarbons

Myriad manufacturers of commercial refrigeration have made the move to propane and isobutane in order to meet the U.S. Department of Energy's new efficiency standards – and prepare for the Environmental Protection Agency's refrigerant changes. Many are embracing the move, though others have lingering concerns about flammability and training.

– By Michael Garry

On February 28, 2014, the U.S. Department of Energy (DOE) announced new efficiency standards for commercial refrigeration equipment – an update to the last round of standards implemented in 2012.

After a period of extensive review incorporating industry feedback – and despite some legal challenges by industry groups – the new standards went into effect on March 27, 2017. They cover a wide array of equipment, including vertical, semi-vertical and horizontal cases, with and without doors, at medium and low temperatures, and using remote and self-contained condensing units. And they make the average commercial refrigeration unit about 30% more efficient compared to the previous standards.

Also on March 27, the Environmental Protection Agency announced the ENERGY STAR 4.0 efficiency standard, which applies to a range of commercial and home appliances. This optional standard is typically at least 15% more stringent than federal requirements.

For OEMs, the challenge imposed by new energy efficiency standards is how to go about meeting them. What combination of components will do the trick cost effectively? This is where natural refrigerants, specifically hydrocarbons like propane (R290) and isobutane (R600a), come in.

The DOE lists numerous technologies that can increase the efficiency of equipment, such as variable-speed compressors, fan motors and LED lighting. A more fundamental decision, though, is what type of refrigerant to use. And what many OEMs interviewed in February at the NAFEM show in Orlando, Florida, said is that switching to from HFCs to hydrocarbons – and using the compressors and other equipment that support hydrocarbons – can provide a critical boost to the efficiency

of a commercial refrigeration system; this is particularly true of equipment that uses solid or glass doors, for which the mandated jump in efficiency is greatest.

"Major light commercial equipment suppliers, if not all, have developed or are developing hydrocarbon solutions for the majority of their models," says Antoine Azar, former global programme director for Coca-Cola and head of his own sustainability consulting practice, Sustainable Solutions.

Outside the U.S., OEMs have long taken advantage of the efficiency of hydrocarbons in refrigeration. For example, on the domestic side, there are more than two billion hydrocarbon refrigerators and freezers in homes worldwide, according to True Manufacturing. Commercial refrigerators using hydrocarbons have been used for more than 20 years, with more than four million units installed today.

But in the U.S., concerns about hydrocarbons' flammability – despite the small charge (150g) allowed in refrigeration equipment – have slowed adoption. Still, many major end users are embracing hydrocarbon equipment. And some OEMs would like to raise the charge limit to at least 500g in order to more economically support larger applications.

The DOE's efficiency rules represent the most immediate regulatory pressure on commercial refrigeration. But another regulatory action is on the horizon; the Environmental Protection Agency's (EPA) SNAP (Significant New Alternatives Policy) programme plans to delist HFCs like R404A, R507A and R134a in stand-alone commercial equipment in 2019 and 2020, forcing manufacturers to switch to lower-GWP refrigerants. Hydrocarbons, with their near-zero GWPs, fit that need as well, and many OEMs are using them with an eye to prepare for the delisting of HFCs.

An early start

One of the leaders in the development of propane-based commercial refrigeration, True Manufacturing, had been prepared for March 27, 2017, for some time.

The O'Fallon, Missouri-based OEM has, over the past two years, converted about 80% of its foodservice and food retail coolers and freezers from HFCs to propane refrigerant, says Todd Washburn, director of sales & marketing, retail division for True. "The fact that we started with hydrocarbons much earlier than others puts us in a good position to meet the 2017 requirements."

According to Charles Hon, True's engineering manager, the company offers 327 hydrocarbon base models that meet the DOE's 2017 standards. 35% to 45% of True's hydrocarbon equipment meets the ENERGY STAR 4.0 standard, adds Washburn.

Thanks to the propane equipment alone, True's units are on average 15% to 25% more efficient than their HFC predecessors, says Washburn. Other enhancements, like LED lighting and high-efficiency motors, boost the average efficiency advantage to between 25% and 30%.

"End users need to be aware of the new energy standards and ask their suppliers whether their equipment is compliant," advises Washburn. New equipment that does not meet the efficiency standards cannot be legally sold in the U.S. as of March 27. "If suppliers don't meet the standard, and you need [new equipment], you could have a supply issue. Customers don't want to be in that position."

“Major light commercial equipment suppliers, if not all, have developed or are developing hydrocarbon solutions for the majority of their models.”

— Antoine Azar, Sustainable Solutions

For True, propane also satisfies the EPA's upcoming regulations delisting high-GWP HFCs. Moreover, the company does not plan to use HFO blends as a lower-GWP alternative to HFCs in its equipment. "We can do our product line with propane so there's no need to use a refrigerant with a higher GWP than propane," says Washburn. And, he notes, if California adopts plans to ban refrigerants with a GWP over 150 from commercial refrigeration, then many HFO blends would not be a viable alternative – while propane would.

Large chain rollout

Another major OEM, Welbilt (formerly Manitowoc Foodservice) has completed conversion of its reach-in and under-counter refrigerator and freezer units for chain restaurants to propane refrigerant from R404A.

The full conversion of those units to propane, completed late last year, followed a rollout of R290 units by a large chain customer, says Sara Sunderman-Kirby, product manager for Welbilt's Delfield brand, who declines to name the retailer without its permission.

Welbilt's propane units are 15% to 17% more efficient than their HFC predecessors and meet the new DOE efficiency requirements, she says, adding that the cost of both equipment types is comparable.

Minus Forty Technologies Corp., a Georgetown, Ontario-based manufacturer of freezer and refrigerated cabinets, has converted all but one of the 36 products in its portfolio to propane.

"We've been working towards converting our entire product line to R290 for two years now," says Chris Strong, the company's vice-president of sales and marketing. "What we discovered in our research and speaking to our component suppliers is that we had a better chance of achieving the DOE initiatives by converting to R290, because it operates as a more efficient refrigerant."

"We have a small quantity of R404A systems remaining. In the interest of not scrapping parts, basically we're just getting through our remaining inventory. Pretty much everything else is R290 now."

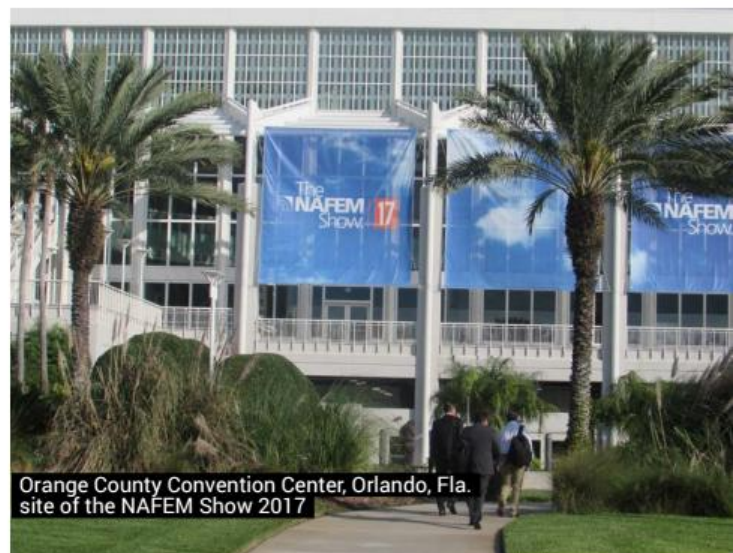
In addition to regulatory pressures, the company's decision to opt for propane was partly driven by its corporate social responsibility policy. "That's our mandate for environmental sustainability," Strong says.

Strong reported growing demand for its propane equipment in the United States, partly driven by strong sales in the pet food industry, which needs freezers to store frozen raw pet food.

Flammability and training

To address concerns about flammability, Welbilt "trained the public and our customers on the safety and good benefits of R290, because instantly when people think of R290 there's a lot of hesitation because it's flammable," says Sunderman-Kirby. With the charge limit of 150g for hydrocarbons in commercial refrigeration, Welbilt's smallest unit "only has as much charge as a Bic lighter," Sunderman-Kirby says. "When we let them know that they feel a lot better."

True's Washburn does not see propane's flammability – especially at the 150g charge limit in refrigeration cases and freezers – as a roadblock in the marketplace. "Once customers understand the charge size, [flammability] becomes a non-issue."



Orange County Convention Center, Orlando, Fla.
site of the NAFEM Show 2017



Warning sign from True Manufacturing at its NAFEM Show booth

“It appears the R290 market may be gaining momentum.”

– Harrison Horning, Hannaford Supermarkets

▶ True has also met another concern about hydrocarbon equipment – the availability of trained service technicians – head on. “We train third-party service technicians all the time,” Washburn says. “We go to them, and sometimes they come to [our headquarters in O’Fallon, Missouri], and we do online training.” With the growing number of hydrocarbon units in the marketplace, technicians are more apt to seek out training, he notes.

But the changeover to hydrocarbon equipment in food service and retail in the U.S. is still in its early stages, notes Washburn, adding that Canada, Mexico, Latin America and South America are also just getting started. “When you look at the total amount of cabinets in the marketplace, it’s going to take years for all of the HFC units to flush through.” ■ MG

HYDROCARBONS IN THE FIELD

The following end-user companies have installed hydrocarbon cases:

- ▶ U.S. discounter Target, which has made a commitment to installing self-contained cases using propane as the refrigerant, as of January had them in 580 of its more than 1,800 stores throughout the United States, according to Paul Anderson, Target’s director of engineering. In 2017, Target plans to operate some stores that use nothing but propane cases for refrigeration, Anderson says.
- ▶ Whole Foods Market, which is testing a propane/CO₂ cascade system in a store in Santa Clara, California, has installed self-contained propane display cases – mostly horizontal bunker units – from AHT Cooling Systems in more than 100 stores (including Whole Foods, more than 1,000 U.S. stores have AHT’s propane cases – mostly modular islands but also spot merchandisers).
- ▶ Last year, Red Bull reported deploying more than 200,000 isobutane ECO-Coolers in the U.S., with expectations that this number would double within two years.
- ▶ Dr Pepper Snapple Group’s acquisition of propane coolers “is getting underway,” says spokesperson Chris Barnes. “We’re working with several different suppliers for this equipment, and they’re at different stages of deployment with their systems, so implementation of new R290 cooling equipment in our system will begin soon.”
- ▶ In the U.S., PepsiCo is phasing out HFCs from new vending machines in 2019 and new coolers in 2020, using propane instead “where regulations allow,” says Emad Jafa, director, R&D equipment development, PepsiCo. Currently Pepsi is halfway through its conversion plans.
- ▶ Hannaford Supermarkets has installed AHT’s dual-temp spot propane cooler in the seafood department at 30 stores, says Harrison Horning, director of equipment purchasing, maintenance and energy. The chain is also running about 120 of True Manufacturing’s propane beverage coolers in about 15 stores, with plans to install about 100 more coolers per quarter “until we have them in all Hannaford stores,” he says.
- ▶ In addition, Hannaford has two stores using eight to 10 low-temperature, self-contained propane island cases from Novum Refrigeration Technology. “We are considering Novum dual-temperature coffin cases for another store, and may continue to install them in more stores in the future where it makes sense to replace old coffins with new coffins,” says Horning.
- ▶ Hannaford is also developing plans to install water-cooled, self-contained R290 display cases in a proposed new store. This would include all low-temperature cases, about 16 in all. Horning is considering using either an air-cooled chiller or a fluid cooler to cool the water. It appears the R290 market may be gaining momentum, he says.

ARNEG GROUP GREEN BEATING HEART



- > CO₂ and R290
natural refrigerants
- > CO₂ transcritical systems
- > Water Loop Systems



ATMO sphere Business Case for Natural Refrigerants
AUSTRALIA 02/05/17 - Sydney

arneg OCEANIA **SILVER SPONSOR**

YOUR NATURALLY INNOVATIVE PARTNER FOR RETAIL SOLUTIONS

arneg
OCEANIA

www.arneg.com.au



CO₂ condensing units blending Japanese, European know-how

CO₂ refrigeration is reaching areas of application that some did not believe possible – thanks to the condensing unit. *Accelerate Europe* looks at how Japanese and European manufacturers are overcoming the challenge of bringing CO₂ to smaller stores.

– By Charlotte McLaughlin, Jan Dusek & Andrew Williams

The market for CO₂ transcritical refrigeration has taken off in a big way in Japan – largely thanks to the growing popularity of condensing units for convenience stores. With over 2,200 installations in place as of the end of 2016, impressive innovation from manufacturers and the popularity of small convenience stores (CVS) look set to ensure that the condensing unit market will continue to grow.

Japan's three largest CVS chains – Lawson, 7-Eleven and Family Mart – all have stores that use CO₂ technology. Currently, around 5% of the three retailers' 44,000+ stores in Japan use CO₂ as the refrigerant.

Given the startling pace at which end users are going CO₂ in Japan, this proportion is expected to increase dramatically in the future.

A Japanese Ministry of Environment (MOE) scheme to combat rising HFC emissions in the commercial refrigeration sector has played a major role in increasing natural refrigerant uptake by providing subsidies for food retail refrigeration systems and showcases. For the 2016 Japanese fiscal year, the MOE allocated JPY 7.3 billion (€57.3 million) to subsidise costs in the commercial and industrial refrigeration sectors in Japan.

In 2015, the subsidy supported 557 individual new commercial refrigeration installations in Japan, up from 409 in 2014 – primarily in CVS. The number of companies aided was 23 and 24 in 2014 and 2015 respectively.

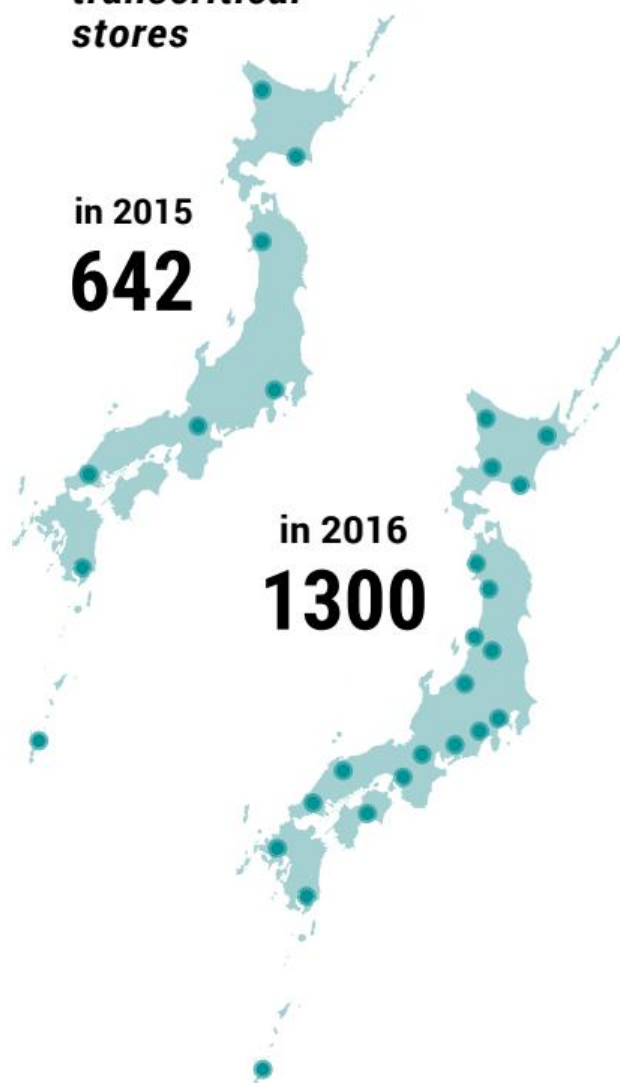
"Panasonic has installed CO₂ refrigeration systems in more than 1,800 stores in Japan as of September 2016 and is aiming for 2,000 stores by the end of March 2017," says Hidekazu Tachibana, Group Manager in the Refrigeration System Department, part of the Refrigeration and Air-conditioning Devices Business Division, at Panasonic Corporation.

Tachibana adds: "Our next target market is Europe." He believes the Japanese giant's two-stage compression CO₂ outdoor condensing unit for small CVS will prove popular in small retail stores in Europe.

Lawson's transcritical stores

in 2015
642

in 2016
1300



However, most of the 9,000+ CO₂ transcritical installations believed to be in place in Europe today are big racks that cool large supermarkets in Europe (8,700+). Yet there are signs that this is changing.

A 2016 report into the retail sector by management company Nielsen revealed strong growth globally, as well as in the European Union, for small format stores in particular. "Perhaps the new retail mantra should be 'go small or go home,' as the 'bigger is better' paradigm has been challenged virtually everywhere," says Steve Matthesen, global president of retail at Nielsen.

Drawing inspiration from their Japanese rivals, European companies are beginning to launch their own units.

Advansor, a leading manufacturer of sustainable thermal systems for heating and cooling utilising CO₂ as the only refrigerant, launched its first series of CO₂ condensing units back in 2013. Ever since then, demand has been "big and growing," Jens Kallesøe, director of internal sales and projects at the Danish firm, told *Accelerate Europe*.

Other European companies are following suit. SCM Frigo, Carrier Transicold UTC (under the banner of Green & Cool) and SANDEN Europe are all pursuing their own CO₂ condensing unit models. Japanese firms like Panasonic and Mitsubishi Heavy Industries Thermal Systems (MHI) are also seeking new markets.

CO₂ vs. HFCs: Challenges and benefits

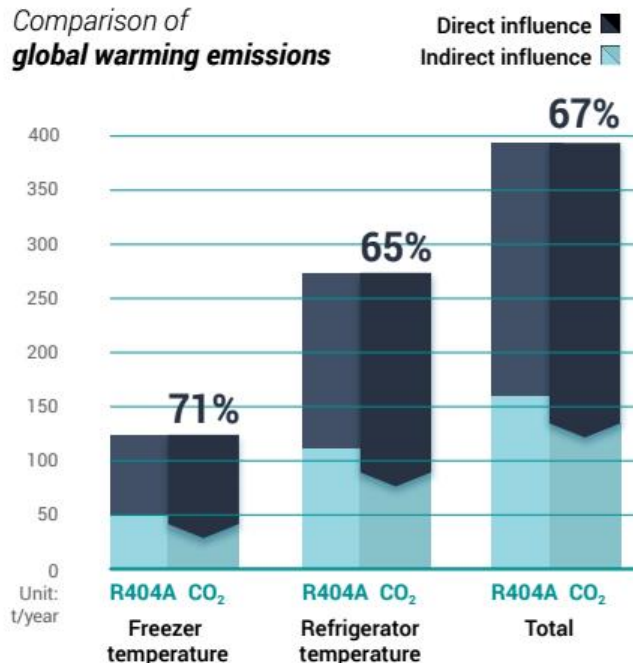
Many manufacturers and end users alike have decided to invest in CO₂ due to the environmental benefits it can yield. CO₂, the benchmark against which all global warming potential (GWP) is calculated, has a GWP of one. HFCs have GWPs in the thousands. R410A – the HFC commonly used in condensing units – has a GWP of 1,725.

Research by Panasonic reveals that the emission savings from using CO₂ over HFCs are dramatic. The decision to adopt CO₂ refrigeration has already reduced Japanese retailer Lawson's annual greenhouse gas emissions by 40,000 tonnes of CO₂e.

Others cite the efficiency gains to be won from switching to CO₂. Panasonic's condensing units produce average energy savings of approximately 20% compared with their HFC systems (R404A), the firm's own research reveals.

Technological breakthroughs have played a key role in achieving savings at Advansor too. "The trend in the market plus new compressor technology makes [the company's condensing units] a great investment in the long term. The compressor has an inverter, which means lower energy consumption," says Mads Holst Nielsen, Advansor's R&D manager.

Comparison of global warming emissions



Source: Panasonic presentation at ATMosphere Europe 2016, Barcelona

This could make condensing units a lot easier to install for end users. Sylvain Gillaux, European sales and marketing manager at SANDEN Environmental Solutions, explains: "The most important thing is the ease of installation of our CO₂ condensing units compared to HFC ones."

Of course, CO₂ presents its own challenges. "CO₂ is used in higher working pressures, so different materials and components need to be used," explains Mirko Bernabei, technical director at SCM Frigo. CO₂ transcritical systems often require high pressure piping, usually up to 120 bars (of pressure), an area in which companies such as SANHA, IBP and Mueller Industries are continuing to innovate.

These and other manufacturers of tubes, fittings and valves for HVAC&R applications such as Wieland and Carly already provide equipment for pressures of up to 120 bars. Panasonic, however, is taking a different approach by reducing the pressure of the CO₂ itself.

It has introduced a new adjustable pressure control model in its CO₂ condensing unit which reduces the maximum pressure of the CO₂ transferred to the display cases by one-third – from 9MPa to 6MPa.

“In addition, our store controller optimises the refrigerant flow” to maintain the correct pressure, says Panasonic’s Tachibana.

Many of the CO₂ units on the market boast smaller designs than comparable HFC products. Panasonic estimates that it has reduced their size by 34% and their weight by 20% compared to their HFC counterparts.

Condensing units vs. racks

Condensing units are familiar technology for anyone already comfortable with CO₂ systems and even offer benefits lacking in large racks.

“Condensing unit technology is not rocket science. They are basically [like the] bigger CO₂ booster systems, but with smaller pipes. So if they’ve already installed a bigger CO₂ system, a condensing unit will be like a walk in the park,” Advansor R&D Manager Nielsen told *Accelerate Europe*.

SANDEN Europe’s Gillaux believes condensing units could actually be more beneficial for stores than alternative CO₂ solutions. “Easy and versatile installation, limited footprint and weight, excellent sound pressure level, and unmatched flexibility are the main advantages quoted by clients,” he says.

One reason for this is the fact that customers can stack several CO₂ condensing units beside each other to provide more cooling capacity for bigger operations, without the need for the large machine room required by racks.

The units are often placed outside, meaning that they can be mounted on the wall at the back of the shop. The cooling is transferred through pipes to showcases on the shop floor. SCM Frigo’s technical director Bernabei explains, “yes, the units have also been developed in order to allow stacking; this will also help the distributors with stock and logistics and will optimise the installation’s footprint”.

Making inroads into warm ambient climates

Japanese manufacturers SANDEN and Panasonic have already been selling condensing units in warm ambient climates for a while now.

“Traditionally, warm ambient climates have not been particularly friendly towards CO₂ applications,” says SANDEN Europe’s Gillaux. “We’ve had good experience of three years in Japan where temperatures reach up to 45°C during summer [and] good operations in France last summer where temperatures were over 38°C in several installations.”

SANDEN manufactures outdoor solutions as well as plug-ins based on a water-loop or a single air source, which offers customers who want solutions for different stores and applications several alternatives.

Panasonic’s Tachibana agrees: “In Japan, [...] we experienced several summers with high ambient temperatures. Such an experience taught us how to cope with these problems.” He puts this down to their complete system of using the showcase, controller and condensing unit for efficient operation in a warmer environment.

Market on the up...and up!

Advansor’s first installations were for the pharmaceutical industry and small business. “Now gas stations and publicly administrated institutions such as kitchens” are also seeking this equipment, Kallesøe says.

He estimates, “300 units are currently running in the EU at this moment but we have many orders [and] for the US, we [currently] have around 15-20 units running”.

SCM Frigo Managing Director Nicola Pignatelli believes that the market has developed significantly in recent years. “We have noticed an increasing demand for low-capacity units, so we are very near to reach cost parity and to have almost a full switch to CO₂ products on these products,” he says.

SCM Frigo thinks the technology is commercially viable now and believes increased supply will surely translate into lower prices for consumers.

The company has already sold 100 units of its new CuBO₂ series, with capacities of up to 30 kW. In the next two years, Pignatelli is aiming to “reach production of 3,000 pieces per year”. He hopes to roll out the line to new markets.

“We are already largely expanding sales [for other CO₂ applications] in the Pacific region (Australia, New Zealand) and also in South America (especially in Chile). We are also looking at the US market, hoping that new political trends will keep on supporting the use of natural refrigerants,” Pignatelli says.

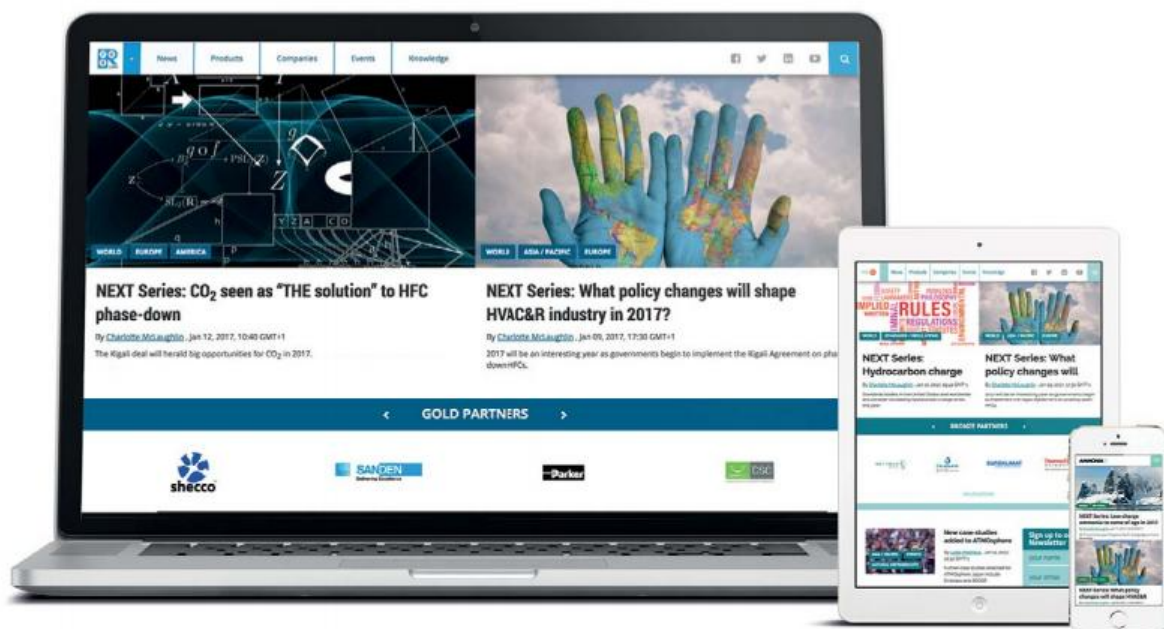
Advansor compSUPER XXS CDU



BOOST YOUR ONLINE VISIBILITY

NEWLY REVAMPED INDUSTRY PLATFORMS FOR NATURAL REFRIGERANTS

LAUNCHED OCTOBER 2016



HYDRO
CARBONS 21



AMMONIA 21

NEW FEATURES

- Improved functionality and design
- Full social media integration
- Smartphone and tablet friendly
- Interactive multimedia content

Join as a partner today to showcase your
natural refrigerant products and services

For benefits and pricing, contact us at:

sales@shecco.com



Sanden condensing unit at Biocoop store in Pontivy, Brittany, France



Sanden condensing units at Auchan store in Vaux-le-Pénil, Melun, France



SCM Frigo units

SANDEN Europe is also confident. "In 2017, several thousand SANDEN CO₂ condensing units will be installed, being remote units or plug-in solutions," Gillaux says.

Training and sales: two sides of same coin

Many of these innovators see investing in training customers and installers as an important way to expand the market.

Training has proven very helpful in boosting SANDEN's sales. Many CVS customers "consider themselves as 'ambassadors' of CO₂ applications and CO₂'s key advantages as a non-toxic and non-flammable refrigeration technology," Gillaux says. "Installers and contractors [believe they are] key partners who hold training sessions and education on our units and promote them to end-clients," he adds.

The correlation between sales and training is often so intertwined in the industry that many invest in it to a great extent.

SCM Frigo is working on a mobile training unit to make training easier and more accessible to customers all over the world.

Currently, the firm provides training "directly on site during start-up [of more complex units] or in our training room at SCM Frigo [...]. Anyhow, the market for CO₂ condensing units is quite big and it would be impossible to offer proper training to all. That's why, together with each unit, we provide a detailed installation and maintenance manual, complete with pictures, schemes and checklists," Bernabei says.

Advansor also currently runs training courses for its customers and for technicians. Similarly, holding training workshops in Europe is a central part of Panasonic's strategy for approaching the market there.

"We are going to sell our condensing units through Panasonic Home Appliance Air-conditioning Europe ('PAPAEU'). We hope to utilise some of the product training centres of PAPAEU that are currently in 11 countries in Europe to launch the product," Panasonic's Tachibana told *Accelerate Europe*. "We have already been approaching installers and will hold installation training this March before launching the product this spring in Europe," Tachibana concludes.

THE FUTURE IS OUR HISTORY

CO₂ technology is DORIN



Dorin CD Range results from almost two decades of experience and more than 20.000+ running **transcritical compressors** on the field. **Reliability** and **Efficiency** make these compressors the Natural Solution for Sustainable Global Market.

Dorin naturally goes on broadening the **CD Range** with following compressors **Newest** on the global market:

CD500, the **largest 6 piston**, **39.85- 98.58 m³/h**

CD4, the **newest 4 piston**, **4.67 to 9.21 m³ /h**

CD2, the **smallest 2 piston**, **1.60 to 4.60 m³ /h**

DORIN DYNAMIC INNOVATION

goes on meeting customers' requirements globally!

COME AND MEET US IN

China Refrigeration (Shangai, CN) 12-14/04/2017

ATMOsphere Australia 02/05/207 | ATMOsphere America 05-07/06/2017



OFFICINE MARIO DORIN SINCE 1918

DORIN
INNOVATION

www.dorin.com | dorin@dorin.com



Green & Cool's Johan Hellman

▶ CO₂ race heating up

Last October, Green & Cool formally launched its CO₂Y condensing unit aimed at the European market, and in December Mitsubishi Heavy Industries Thermal Systems, Ltd. also announced its entry into the CO₂ race in Japan.

Green & Cool's CO₂Y, first unveiled at the ATMOsphere Europe conference in Barcelona last April, is a small stand-alone condensing unit suited to less demanding refrigeration applications such as small cold rooms, display cases, or petrol stations.

The unit is "basic and cheap, but still bears state-of-the-art eco-performance," Johan Hellman, sales engineer at Green & Cool, told *Accelerate Europe* at Chillventa 2016.

The condensing unit complies with EU Eco-design regulations. Prior to the launch, it underwent field tests in Sweden, Finland and the UK. With a maximum capacity of 5.5 kW at ambient temperatures of up to 30°C, it features a DC rotary compressor that can be regulated at various speeds of up to 100 rotations per minute.

The control system incorporates a small microprocessor linking the unit to the cloud. This allows users to monitor the unit's operation remotely from a mobile phone.

"The 2-9 kW segment, which CO₂Y falls into, has enormous future potential since there has not been an economical environmentally friendly alternative until now," says Joakim Westerberg, responsible for refrigeration appliances at Kylkvalitet, a Swedish supplier of Green & Cool systems. With other companies already getting a foothold in Europe, is Green & Cool ready to rise up to the challenge?

"We're not the only ones, but we think that we're the first ones who are ready to sell the product [...]. It is ready for the market," says Westerberg's colleague Hellman.

Green & Cool is launching a stand-alone CO₂ freezing unit in 2017. Other CO₂Y models will follow too. "[In 2017] we will have five units in a size of up to 10 kW," Hellman says.

Mitsubishi Heavy Industries Thermal Systems, Ltd. will not make its 10 horsepower (HP) system available to the Japanese commercial refrigeration sector until April.

The new unit is equipped with MHI's patented two-stage scroll-rotary compressor technology. As reported by *Nikkei Sangyo Shimbun* – a Japanese industry magazine – MHI plans to sell 100 units in the first year. The unit will first be made available in Japan but the company is interested in introducing the technology in other fast-growing markets too.

The two-stage compressor uses scroll on the high side and rotary on the low side of compression. The two-stage scroll rotary compressor with mid-pressure gas injection is the world's first such type.

The unit can operate in ambient temperatures of -15°C to +43°C and can cover cooling needs ranging from -45°C to -5°C.

MHI introduced its new CO₂ condensing unit at the ATMOsphere Japan 2017 conference, held in Tokyo on 20 February.

■ CM, JD & AW

Baker Refrigeration, *Naturally.*

10 Transcritical systems
installed in Australia so far



EPTAGREEN

Preserve naturally

State of the art CO₂ cascade and transcritical compressor packs, the natural choice for the supermarket industry.

RTA: AU10320

For more info call

1800 423 626

email@ajbaker.com.au





AJ Baker, Epta *driving world-class innovation*

Collaboration goes both ways. Australian manufacturers regularly travel to Europe to tap into the latest technology trends. Now European firms are likewise looking to Australia's unique environment as an ideal testing ground for new ideas. *Accelerate Australia & NZ* spoke to AJ Baker & Sons and the Epta Group to find out more.

– By Devin Yoshimoto

The relationship between AJ Baker & Sons and Italy's Epta Group is proving fruitful for rolling out natural refrigerant-based systems in Australia. Their work currently accounts for over 300 cascade CO₂ installations, six CO₂ liquid recirculation plants, and most recently, 10 transcritical CO₂ installations.

Steve Laing, national commercial manager at Epta Australia, and Mike Baker, managing director of Australia-based AJ Baker & Sons, told *Accelerate Australia & NZ* how their history of close collaboration has led to world-class innovation and how their results are having an effect on the entire natural refrigerant industry.

None of this was built overnight. The foundations of their success, says Laing, are a combination of time and communications. "The relationship between Epta and AJ Baker has evolved over the course of 20+ years of close collaboration," he says.

"The success is built around transparency, with a strong communication channel – particularly with CO₂ technology, which is constantly evolving. We have to rapidly leverage from one another's experience," Laing explains.

Baker says that AJ Baker & Sons – which is based in Perth and has branches in Brisbane, Sydney, Melbourne, Adelaide and Bunbury – is able to leverage the know-how Epta brings



from Europe to provide their customers with the best possible solutions and to give their business a competitive advantage.

“For a long time, AJ Baker has had a focus on providing customers with solutions. Having an alignment with a case supplier that was independent allowed the company to provide a point of difference with respect to case design,” Baker says.

“Again, this point of difference allowed AJ Baker to offer technology and designs that were different and (in our eyes) superior to locally available equipment. Our ability to offer a full solution (for plant and display cases) allows us to be a one-stop shop and remove any interface issues during design, construction, and importantly the warranty period,” he explains.

Epta’s Laing adds: “With the release of CO₂ technology, the extensive design and operational experience Epta that has in Europe allowed AJ Baker to implement fully integrated and proven solutions.”

Leveraging each other’s experience was crucial in developing their fruitful relationship, and eventually led to the development and testing of key CO₂ innovations with global applications.

Testing, iterating and evolving

The Australian climate presents many challenges, but also many opportunities. Baker reveals how AJ Baker addressed these obstacles via several different methods.

“Our ten transcritical CO₂ installations, which we’ve been able to in most of the [main] cities in Australia, have allowed us to look at different climatic conditions, different store sizes and different measures of gas cooler outlet temperature control,

which is one of the most important things with transcritical CO₂ in high ambient temperatures,” Baker says.

Laing reveals that the varied climate in Australia has proved to be a great test basin for adapting CO₂ technology to different conditions.

“System designs across the country have varying configurations to adapt to local conditions. We have sites with high-pressure sub-coolers, adiabatic assistance, and pre-coolers,” he says.

Baker adds: “We are also installing parallel compression systems with 60 bar liquid as part of our ongoing system engineering.”

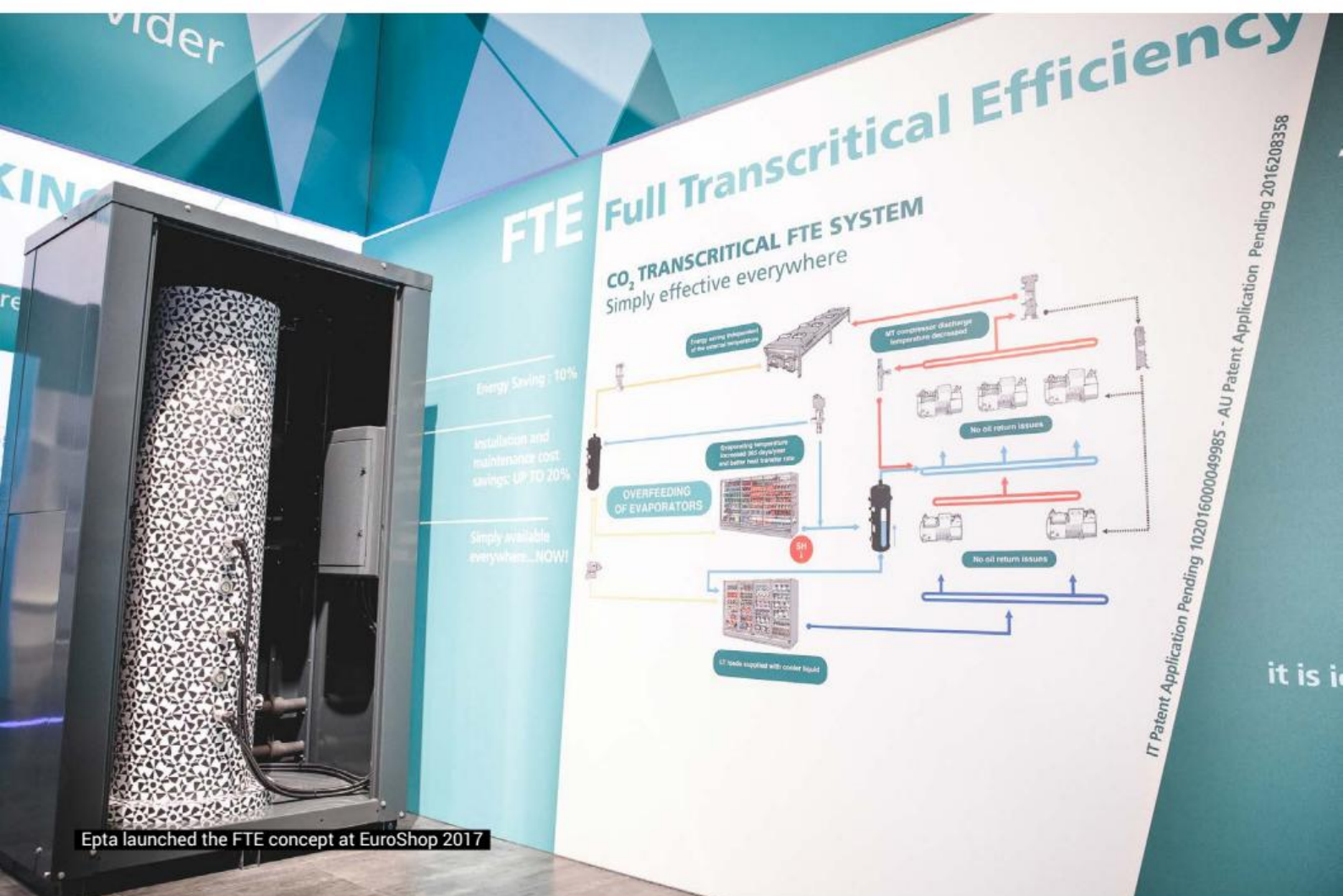
“We need to cater for ambient conditions from 0°C to 47°C air on to gas coolers so we are always testing new technologies that have the potential to add to the overall system performance,” he says.

This culture of constant testing and innovation led to one of Epta’s most recent innovations, which debuted at EuroShop 2017.

Full Transcritical Efficiency – from EuroShop to Australia

Epta’s Full Transcritical Efficiency concept debuted at EuroShop 2017. The company currently has 13 systems operating to this blueprint in Europe and Australia, yet much of the testing was done in Australia.

“With Australia having the higher ambient conditions, this created an opportunity to conduct a field trial with AJ Baker to test Epta’s new FTE (Full Transcritical Efficiency) –



commissioned north of Perth in October 2016 – which was released at EuroShop,” says Laing.

“We’re lucky enough to be one of the pioneers in Australia with the guys in Europe. We had one on trial since September last year,” adds Baker.

Results and installations to date

This long history of close collaboration, transparent communication and exchange of ideas demonstrates the power of working together across different markets and environments.

As a result, end users enjoy more options that are tailored to their specific needs.

“AJ Baker has always wanted to offer the most up-to-date proven technology available on the market. Our technical people have spent a long time, with the help of the Epta technical teams, to develop and refine CO₂ technology in Australia. Our efforts are to align with what the best Europe can offer. This has been the uptake of CO₂ cascade initially, and now moreover the expanding natural refrigerant sector,” says Baker.

“With Australia having higher ambient [temperature] conditions, this created an opportunity to conduct a field trial with AJ Baker to test Epta’s new FTE (Full Transcritical Efficiency).”

– Steve Laing, Epta Australia

“With the newly launched FTE system and the trials conducted over the previous 18 months, we are now able to prove to retailers that we can maintain efficiency in high ambients with transcritical CO₂ in a simplified format,” adds Laing.

“Epta & AJ Baker will continue to drive the technology in collaboration, further strengthening their partnership and ultimately supporting the retailer’s investments,” he says. ■ DY



#GoNatRefs





GEA brings natural refrigerant solutions to Australia

German process technology manufacturer GEA is playing a key role in bringing natural refrigerant-based HVAC&R solutions to the Australian market. *Accelerate Australia & NZ* spoke to GEA Refrigeration Australia's Greg Clements to find out more.

— By Devin Yoshimoto

Germany-based GEA has long supplied compressors to contractors in Australia. The firm's compressors are at the heart of industrial ammonia plants, as well as commercial cascade and transcritical CO₂ systems. GEA is now targeting the convenience store sector with its new propane chiller.

Accelerate Australia & NZ spoke to GEA Refrigeration Australia's Sales Manager Greg Clements to learn more about GEA's work in Australia and its most recent developments.

Accelerate Australia & NZ: How long has GEA been operating in Australia? What were some of the difficulties you faced?

Clements: GEA entered Australia in 1995 via Grasso Australia Pty Ltd. Our natural refrigerant solutions have been available here since 1995.

In the early days the biggest challenge was twofold. First was overcoming the financial challenge due to the wide availability of Freon. Second was then educating the population on the environmental benefits of natural refrigerants.

Accelerate Australia & NZ: What types of industrial ammonia projects have you supplied recently?

Clements: In 2016, GEA supplied a number of Blu series (Blu Genium/Blu Air) critically charged ammonia chillers for food and beverage processing projects (hydrocooler for carrot processing/orange juice/soft drinks). This also included Blu Air chillers for outdoor installations complete with weatherproof covers, which require no plant room infrastructure.

We also have V reciprocating compressor technology, which has enjoyed enormous success in Australia with critically charged ammonia systems.

Accelerate Australia & NZ: You recently presented to the Dairy Manufacturers Sustainability Council (DMSC), whose members comprise sustainability/environmental managers from nine of the largest dairy processors in Australia.

What was their reaction towards natural refrigerant solutions?

Clements: The feedback was very positive. They were particularly interested in compression capital equipment that delivers value via high co-efficient of performance results, minimal energy consumption, predictive maintenance ability, and reduced ongoing maintenance costs, and is ideally suited for load turn-down applications.

It appears that large industry bodies, such as the DMSC, understand the environmental benefits of natural refrigerants and are now strongly considering their commercial benefits as well.

Accelerate Australia & NZ: What type of commercial projects does GEA supply in Australia?

Clements: GEA is the manufacturer of Bock compressors, which have a strong presence in the Australian commercial refrigeration market. GEA has supplied CO₂ sub-critical compressor racks predominantly for supermarket applications. The compression offer available from GEA for commercial refrigeration includes semi-hermetic & open drive compressors for mobile & stationary applications including value added products such as Plusboxes, indoor condensing units, basic condensing units, and compressor racks for air cooled & water cooled condensing applications.

We've recently released, here in Australia, our air-cooled hydrocarbon water chiller for small heat load applications like convenience stores and small supermarkets.

In October of last year, we took our first order for the hydrocarbon water chiller and we've seen positive results even on extremely high ambient temperature days.

Accelerate Australia & NZ: Why did you decide to pursue R290 as the refrigerant for the water chiller?

Clements: GEA currently manufactures chillers designed for natural refrigerant applications operating on ammonia. In manufacturing the R290 chiller, the challenge presented to GEA was to manufacture a "small heatload water chiller operating on a natural refrigerant"; R290 was deemed as the solution.

Accelerate Australia & NZ: How much have you seen market awareness increase, especially after the Kigali amendment last year? What challenges remain?

Clements: Market awareness of natural refrigerants has definitely expanded. There has been an embracing of natural refrigerant education by key stakeholders such as technicians and plant operators.

There is increased awareness of environmental impact, energy efficiency gains, the need to budget for long-term investment, and also an acknowledgment of the fact that smaller commercial refrigeration should be included under the banner of natural refrigerants.

However, ongoing acceptance and education of natural refrigerants into the larger commercial refrigeration sector is still needed. ■ DY



(L) Hayato Sakamoto, Assistant Manager, Aero-Dynamic Machinery Department, Machinery Division and (R) Takahiro Hirao, Senior Manager, Aero-Dynamic Machinery Department, Machinery Division

The world's first water-refrigerant turbo chiller

Kawasaki Heavy Industries (KHI) is ready to launch the world's first commercially available water-refrigerant centrifugal chiller for use in air-conditioning applications. *Accelerate Japan* reports.

— By Devin Yoshimoto & Jan Dusek

Sometimes complex solutions come from simple questions. As global momentum continues to snowball towards finding alternative refrigerants to HFCs, some companies are rethinking their entire approach by asking very basic questions.

Hayato Sakamoto is assistant manager in the Machinery Division of Kawasaki Heavy Industries (KHI). When he and his team saw the global market start to shift towards using more environmentally friendly refrigerants, they asked themselves the question:

"Is there an ultimate refrigerant that does not heat the planet, deplete the ozone layer, or present the risk of combustion or toxicity?"

"The answer is yes – water."

After several years of development and testing, KHI is now ready to market the world's first commercially available water-refrigerant



Kawasaki water-refrigerant turbo chiller

centrifugal chiller for use in air-conditioning applications. "For the air-conditioning industry, systems using water as a refrigerant have been an eternal theme. Although there were other manufacturers who worked on development, no-one could invent a feasible product, because their solutions were several times larger than existing systems with the same refrigeration capacity," says Takahiro Hirao, senior manager in the Aerodynamic Machinery Department, Machinery Division.

KHI, however, has never been the type of company to shy away from engineering challenges – especially if the work leads to breakthroughs that have the potential to change the world.

Development of the water-refrigerant turbo chiller

Kawasaki Heavy Industries has had a long history of solving technical challenges by leveraging knowledge across different technical fields.

KHI does this through what it calls matrix management – a corporate manufacturing philosophy which encourages researchers to internally share issues with experts in other fields to look for the best technical solutions, rather than having departments working independently from one another.

One of the most recent examples of this is the release of Kawasaki's new Ninja H2R/H2 motorcycle. The motorcycle has been able to achieve the company's highest performance

benchmarks to date. This was achieved by incorporating industrial technology – from KHI's work with gas turbines – in the motorcycle's research and development process.

Why is this so important? Because this gas turbine knowledge was the same source of inspiration that led to overcoming the challenges of working with water as a refrigerant. Hayato Sakamoto told *Accelerate Japan* how KHI overcame those challenges.

Two-stage compression, high speed motor

Using water as a refrigerant presents two main challenges. First, the use of water requires the achievement of a significantly higher-pressure ratio between the condenser and the evaporator, compared with standard HFC chillers.

"Unlike HFCs, which exist in the form of gas under normal atmospheric conditions, water is a liquid, and its pressure needs to be reduced in order to change phases from liquid to gas," Sakamoto explains.

Second, because water exists as a liquid in normal atmospheric conditions, it has a much larger volume than HFC gases. This means that, in addition to increasing the performance of the compressor, the size would also have to increase.

"Using water as a refrigerant," Sakamoto says, "multiplies the volumetric flow rate 100-fold, necessitating the use of a large

compressor, which inevitably makes the chiller larger”.

To improve the compressor performance while minimising its size, KHI developed a high-speed motor and a two-stage compressor, leveraging knowledge gained from fluid analysis technology in the development of KHI's gas turbines and steam compressors.

The proprietary high-speed motor achieves a high rotation speed by using fine control of magnetic force.

“The motor is integrated with the compressor and is placed in the refrigerant atmosphere. Therefore, the motor's coil is coated with resin for insulation and to make it waterproof. Because the motor is connected directly with the compressor, there is no need for a speed-increasing gear or oil,” Sakamoto explains.

In addition to the high-speed motor, KHI adjusted the number and shape of the impeller blades. They developed a two-stage compressor by placing an intermediate cooler in between the two-stage compression process to keep the temperature low inside the compressor.

These compressor enhancements allowed the system to achieve a seven-fold pressure ratio between the evaporator and the condenser. In addition, it allowed the compressor to remain small yet perform well enough to overcome water's large volumetric flow rate when used as a refrigerant.

Optimal component arrangement

The final touch came from arranging all the components inside a single enclosure before vacuum sealing it, which further enhanced the system's performance and efficiency.

This, however, was no easy task.

“At the beginning of the development process, we made a prototype with just a quarter of the current capacity to examine if water refrigerant is even viable for turbo chillers. Back then we had difficulties just making the inside of the system a vacuum, causing us to fail to achieve expected results,” Sakamoto recalls.

“To make it smaller, we needed to lay out the components in a very complicated manner, just like putting together the pieces of a jigsaw puzzle. And the complex structure caused another challenge: internal energy loss,” he reveals.

In order to increase the efficiency of the system, Kawasaki had to minimise the air leaking from the motor. This was done by “enclosing the motor inside the entire system and connecting it directly with the compressor”.

This means that the evaporator, compressor, motor, and other primary components are all packaged within the vacuum container.

Once the optimal arrangement of the components had been found, KHI was finally ready to put the system into action and measure its operating performance.

Water-refrigerant turbo chiller in operation in Kobe, Japan

In 2013, KHI installed the chiller at its Kobe Works in Kobe, Japan. The chiller powers the six-story office building's centralised air-conditioning system – providing cooling for a total of 5,000m².

The water-refrigerant chiller, along with secondary absorption chillers, supplies air-conditioning for a canteen on the first floor and offices from the second to the fifth floors. The sixth floor has meeting rooms, which are air-conditioned by packaged systems.

Sakamoto details the water-refrigerant chiller's typical operational day.

“Before 6am, the chilled water and the cooling water are saturated at the ambient temperature. At 6am, the system controller starts the chilled water pump, the cooling water pump, the cooling tower fan, and finally, the turbo chiller.”

“The compressor gradually increases rotational speed to the set value to avoid surge phenomena in the compressor. After the compressor reaches the set value, the chiller starts to control the chilled water temperature.”

“During stable load conditions, the chiller controls the chilled water temperature at $7 \pm 0.3^\circ\text{C}$.”

“The system then supplies chilled water at 7°C to air handling units on each floor.”

The entire system is operated on a daily start-and-stop basis, with chilled water stored every morning automatically before the load starts to increase.

The load then begins to increase around 8am and peaks in the mid-afternoon, when the first floor canteen opens from 11:30am to 2pm.

“If the load exceeds 352 kW, one of the absorption chillers starts to run. In this case, the number of system units changes from one to two and the required load for the water-refrigerant chiller itself drops sharply from 352 kW to 176 kW.”



Cooling water inlet and outlet piping

Before testing the system, one of the major operational concerns of Sakamoto and his team was how the chiller would handle sudden load changes.

"We were concerned about whether or not the chiller would be able to keep up and maintain the chilled water's required temperature," says Sakamoto – the reason being that "the inertia of the compressor rotor is much larger than HFC chillers due to the compressor's large size".

However, the team observed that the chiller was able to maintain the chilled water temperature at $7 \pm 0.5^\circ\text{C}$ even if the load required for the chiller changes sharply.

"Finally, the chiller stops operating at 9pm and the cycle starts again the next morning."

Results

As of June last year, the chiller had operated for a total of 4,260 hours and the team had confirmed the chiller's ability to handle temperature and load fluctuations as well as the compressor's ability to avoid surge phenomena.

The water-refrigerant turbo chiller is "performing well, just like our initial estimation, delivering COP 5.1, which is comparable to existing HFC systems, throughout three years of operation," says Sakamoto.

"Assuming a service life of 15 years, the amount of HFC reduction would be 575 CO₂-tons."

Why water?

Looking to the future, there is no doubt that the speed of technological development with respect to natural refrigerants will only accelerate. But the question is, do we want to use this opportunity to come up with mere stop-gap solutions, or seize the chance to find a long-term solution?

"We regard water as the ultimate refrigerant, because it has no ozone depletion potential nor greenhouse gas effect. Also, it is neither combustible nor poisonous. So, we hope to promote it globally in the future," says Takahiro Hirao.

Market awareness and adoption of natural refrigerant technology is a must for the water-refrigerant turbo chiller to succeed. Kawasaki has a long-term vision, but at the end of the day, there needs to be an overall awareness and willingness to choose natural refrigerant technology.

Asked what must still be done to create these conditions, Sakamoto replies: "Improving efficiency and reducing product costs by manufacturers is important."

"In addition, since GWP regulation is less strict in the air-conditioning market, I believe a favourable environment for natural refrigerants will be formed if more strict regulations are imposed on HFCs in that sector."



Pioneer's pride

Challenges undoubtedly remain for the introduction of the water chiller.

Nevertheless, as one of a few pioneers who work on natural refrigerant technology in the air-conditioning market, Sakamoto and his team show strong conviction for their product.

"Our system is as small as existing systems while delivering a comparable performance. This is a breakthrough. We hope our customers recognise this and consider using our product," he says.

"Don't be afraid. Let us make it prevail together."

If innovative companies like Kawasaki are able to overcome the challenges of using water as a refrigerant through technology and innovative engineering, it only serves to show that the possibilities of natural refrigerants are limitless.

As global competition continues to increase, and innovative companies continue to push for this technology, it remains to be seen what can be achieved when we take the time to step back and ask ourselves simple questions. ■ DY, JD

SYSTEM SPECS

The turbo chiller has been used for air-conditioning in Kawasaki's Kobe Works office since 2013. Here are the specifications of the system currently in use:

Turbo chiller capacity: 352 kW
High-speed motor rating: 110 kW
Secondary absorption chiller capacity: 422 kW
Stand-by absorption chiller capacity: 422 kW
Chilled water inlet temperature: 12°C
Chilled water outlet temperature: 7°C
Cooling water inlet temperature: 30°C
Cooling water outlet temperature: 35°C
Size: 2.5m x 2.5m x 2.6m
Net weight: 8.0t
Coefficient of Performance: 5.1
No. of cooling towers: 3
No. of buffer tanks: 1

ACCELERATE

ADVANCING HVAC&R NATURALLY AUSTRALIA & NZ

Be the first to get it & never miss an issue



Brought to you by shecco, the worldwide experts in natural refrigerant news, *Accelerate Australia & NZ* is the first quarterly news magazine written for and about the most progressive business leaders working with natural refrigerant solutions in all HVAC&R sectors.

Subscribe to the newsletter

accelerateAUNZ.com

VOLUME 2, ISSUE #5, AUTUMN 2017

ACCELERATE

ADVANCING HVAC&R NATURALLY

A U S T R A L I A & N Z

Accelerate Australia & NZ is published quarterly by shecco sprl, whose network of offices stretches from Brussels and Tokyo to New York. Every issue is available in digital format on www.accelerateaunz.com. Printed copies are available to pick up at Australia and New Zealand's leading HVAC&R tradeshow and are posted to key end users and industry professionals.

Issue #6

Winter 2017

Focus: Woolworths

Ad submission deadline: Early July

Publication date: Mid-July

Issue #7

Spring 2017

Focus: Policy special on Australia's HFC phase-down

Ad submission deadline: Mid-October

Publication date: End October



ISSUE# 5
VOLUME 2

Publisher	Marc Chasserot marc.chasserot@shecco.com @marcchasserot
Editor	Andrew Williams andrew.williams@shecco.com @a_williams1982
International Editors	Michael Garry michael.garry@shecco.com @mgarrywriter
Contributing Writers	Charlotte McLaughlin Eda Isaksson Devin Yoshimoto
Advertising Manager	Jan Dusek
Events Coordinator	Silvia Scaldaferri
Art Director	Anna Salhofer
Graphic Designers	Juliana Gómez Karolina Klat
Photographer	Ben Beech



Follow us on twitter
[@AccelerateAUNZ](https://twitter.com/AccelerateAUNZ)



Subscribe to our newsletter
on accelerateAUNZ.com

Accelerate Australia & NZ is published every quarter. The views expressed by the contributors are not necessarily those of the Publisher. Every care is taken to ensure the content of the magazine is accurate but we assume no responsibility for any effect from errors or omissions.

Published by shecco sprl. All rights reserved. Reproduction in whole or in part is prohibited without prior written permission of the copyright owner.



Cooling with natural refrigerants GEA piston and screw compressors

As a technology partner for refrigeration, air-conditioning and heating applications GEA offers comprehensive knowledge and equipment for the natural refrigerants ammonia (NH_3), carbon dioxide (CO_2 subcritical and transcritical), and hydrocarbons (HC/R290). For commercial requirements our CO_2 and HC compressors provide economically efficient solutions. For industrial applications our successful range of compressors includes long-proven ammonia systems.

Whether GEA Bock HG CO_2 , GEA Bock HG $\text{CO}_2(\text{T})$, GEA Bock HG HC, GEA Grasso M, GEA Grasso LT, GEA Grasso V, or GEA Grasso 5HP – our extensive portfolio of commercial and industrial compressors is available for any task.

phone: 03 8877 9966 | email: sales.au@gea.com

