

SUMMER 2019

ACCELERATE

ADVANCING HVAC&R NATURALLY

AUSTRALIA & NZ

Woolworths
pushes ahead
with CO₂ training

p. 14

ALDI turns to water-loop
CO₂ in Melbourne

p. 32

Racing ahead

The Bend Motorsport Park:
A sustainability leader

p. 18



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A year of opportunity

— Editor's Note by Andrew Williams

Happy New Year to all our readers! As we look ahead to new opportunities for natural refrigerants in the year to come, you'll find plenty to pique your interest in this first edition of 2019.

The Bend Motorsport Park, which opened last April, is already putting South Australia on the motorsport map. By choosing natural refrigerants, the new facility is also racing ahead of the HFC phase-down curve.

For this edition's cover story, we sat down with John Domino from the Peregrine Corporation, which owns The Bend, to hear how an innovative CO₂ system for the race track's commercial kitchen and cold store is delivering energy savings in Tailem Bend's hot climate ([p. 18](#)).

Speaking of hot climates, the first CO₂ transcritical supermarket in the Middle East, in Jordan, has been delivering energy savings since opening in February 2018 ([p. 26](#)).

Closer to home, Heatcraft and SCM Frigo are teaming up to train Woolworths technicians, which in turn should help pave the way for wider use of natural refrigerants in Australia ([p. 14](#)).

ALDI Australia has installed the world's first 'EptaBlue Natural' CO₂ water-loop refrigeration system, fitted in a Melbourne supermarket last September ([p. 32](#)). Meanwhile Link

Logistics, a freight company, has chosen CO₂ for its new cold storage facility at Hobart Airport in Tasmania ([p. 36](#)).

Beyond these shores, we report from the ChinaShop tradeshow, where several Chinese manufacturers presented their own natural refrigerant-based systems for their home market ([p. 46](#)).

In Europe, five visionary movers and shakers were recognised at our ATMOsphere Europe conference with *Accelerate Europe* awards for their unique contributions to advancing natural refrigerants in 2018 ([p. 50](#)). At the event, leading thinkers saw a bright future for CO₂ in industrial as well as commercial applications ([p. 42](#)).

Austrian snowboard maker CAPiTA, meanwhile, is using an ammonia heat pump at its new factory in Feistritz ([p. 30](#)).

Sergio Giroto, president of Italian firm enEX, richly deserves his *Accelerate Europe* Person of the Year crown. He has worked tirelessly over his long career to bring CO₂ to new areas of application. Of all his achievements, he is perhaps best known for installing the first-ever CO₂ transcritical system in a large supermarket, in 2001 ([p. 38](#)).

Policy should also help to improve the market prospects for natural refrigerants this year. Parties to the Montreal Protocol are discussing support for energy-efficient technologies to complement the HFC phasedown ([p. 54](#)).

We sat down with Scantec's Stefan Jensen to hear how low-charge ammonia is changing the global cold storage and logistics industries ([p. 58](#)).

This issue concludes with a Technology Focus looking at a whole host of technologies that are now available to help widen the use of CO₂ transcritical systems in warm climates like Australia's ([p. 60](#)).

On behalf of the *Accelerate Australia & NZ* team, let me take the opportunity to wish you and your loved ones a healthy and prosperous 2019.



Andrew Williams
Editor

In this issue

03

Editor's Note

A year of opportunity.

06

About Us

About the *Accelerate* family.

08

Events Guide

Important industry events in February, March, April and May.

10

Australia & NZ in Brief

Japan confirms \$95.65m NatRef subsidy; Tumble dryer harnesses R290 heat pump; Coles goes CO₂ transcritical in small Melbourne store.

12

Infographic

Worldwide impact of the Kigali Amendment.

14

Woolworths pushes ahead with CO₂ training

Heatcraft and SCM Frigo team up to target technicians.

18

Racing ahead

The Bend Motorsport Park puts itself among sustainability race leaders...with CO₂.

26

Sun shines on CO₂ in Jordan

Middle East's first CO₂ transcritical supermarket hailed as success.

30

'World's biggest snowboard factory' puts faith in ammonia

Austria's CAPiTA opts for NH₃.

32

ALDI turns to water-loop CO₂ in Melbourne

ALDI Australia installs world's first 'EptaBlue Natural' CO₂ water-loop system.

36

Flying high with CO₂ transcritical

Link Logistics chooses CO₂ for Hobart Airport cold storage facility.

38

The CO₂ magician

Sergio Girotto has worked tirelessly to bring CO₂ to new areas of application.

42

A bright future

Leaders mull growth prospects for CO₂, hydrocarbons and ammonia at ATMOSphere Europe.

// End User

// Market





// Events

46 NatRefs blooming in Chinese retail

Chinese firms debut natural refrigerant tech at ChinaShop 2018.

50 Hail to the innovators

Europe's natural refrigerant movers and shakers win *Accelerate Europe* awards.

// Policy

54 Implementing the Kigali Amendment

Reporting from the 30th Meeting of the Parties to the Montreal Protocol in Quito, Ecuador.



// Technology

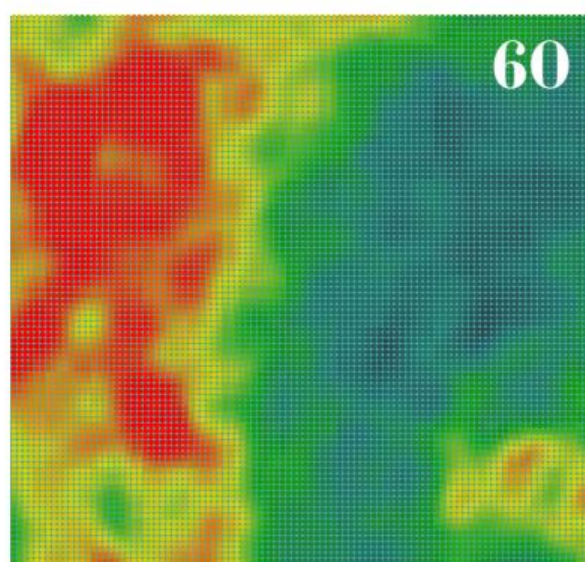
58 Low-charge NH₃ changing the game

Scantec's Stefan Jensen speaks of improved system design and efficiency.

60 CO₂: No longer sun-baked!

Various technologies are helping to bring CO₂ to warm ambient climates.

66 Editorial Corner



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About *Accelerate Australia & New Zealand*

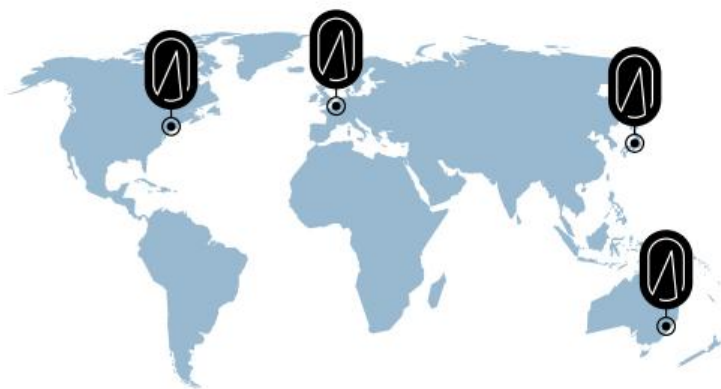
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The *Accelerate* family of magazines includes editions in Europe, America, Japan, China, Asia, and Australia & New Zealand.

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#GoNatRefs



FEB -



12.02

**ATMOsphere Japan 2019
Tokyo, Japan**

This natural refrigerants conference returns to Tokyo the day before the Supermarket Tradeshow, Japan's largest retail exhibition.



www.atmo.org/Japan2019



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13-15.02

**SMTS 2019: Supermarket
Tradeshow
Makuhari Messe, Japan**

Annual leading international tradeshow for supermarkets in Japan.



www.smts.jp/en/index

28.02-02.03

**ACREX India 2019
Mumbai, India**

ACREX India returns to Mumbai to celebrate its 20th edition. Participants will attend from over 25 countries worldwide.



www.acrex.in

25-27.03

**HVACR Vietnam
Ho Chi Minh City, Vietnam**

International exhibition on HVAC&R, air-filtration and purification systems.



www.hvacrseries.com/vietnam/en/home.html

25-26.03

**AIRAH Refrigeration 2019
Melbourne, Australia**

The HVAC&R conference will review the latest developments in legislation and technology, as well as a multitude of industry-specific case studies.



www.airah.org.au



MAY



14-15.03

**Sydney Build 2019
Sydney, Australia**

Sydney Build ranks among Australia's leading construction shows.



www.sydneybuildexpo.com

08-09.05

**ATMOsphere Australia 2019
Melbourne, Australia**

This year, Australia's leading natural refrigerants conference heads to Melbourne.



www.atmo.org/Australia2019



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09-11.04

**China Refrigeration
Shanghai, China**

Shanghai hosts the 30th edition of this international exhibition for refrigeration, air conditioning, heating, ventilation, frozen food processing, packaging and storage.



www.cr-expo.com

11-12.04

**ATMOsphere China 2019
Shanghai, China**

The second ATMOsphere China conference will correspond with China Refrigeration.



www.atmo.org/China2019

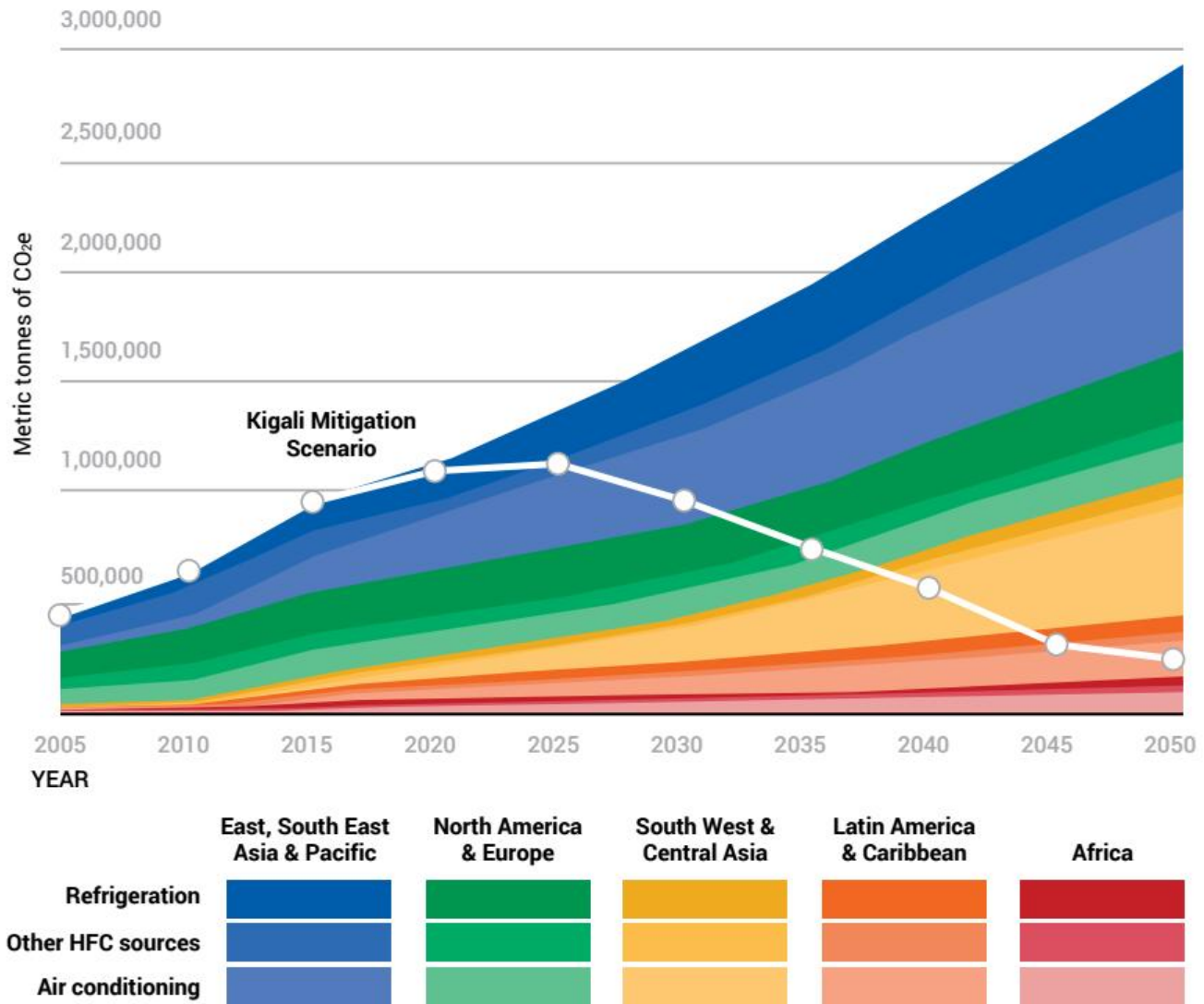


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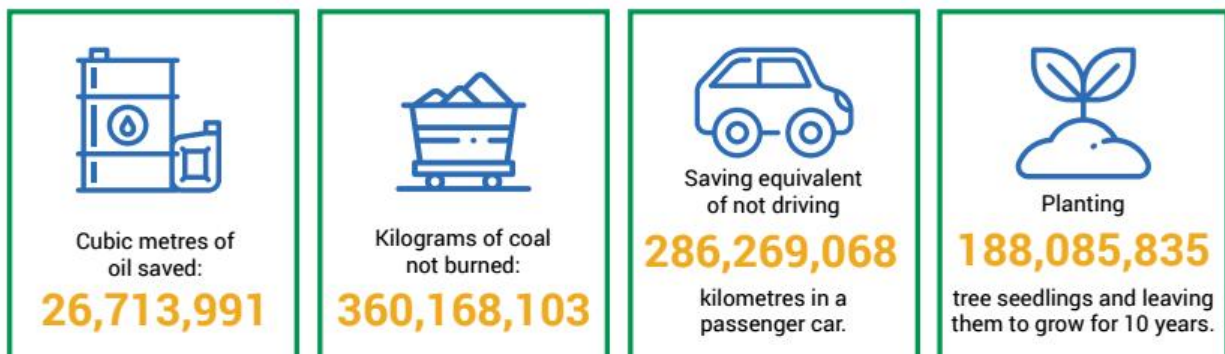


Worldwide impact of the Kigali Amendment

Evolution of HFC emissions from main sources and Kigali Amendment mitigation scenario*



Greenhouse gas mitigation impact**



*International Institute for Applied Systems Analysis (IIASA) / Climate and Clean Air Coalition (2016-2017 Annual Report)

**According to the European Commission, 80 billion metric tonnes of direct GHG and CO₂e emissions will be saved from Kigali between 2020 and 2050, which translates (using the U.S. Environmental Protection Agency's greenhouse gas equivalencies calculator) to the above.



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AUSTRALIA & NZ IN BRIEF

Rise in chloroform emissions threatens ozone layer

A Massachusetts Institute of Technology (MIT) study, published in the journal *Nature Geoscience* in December, identifies chloroform – used in the manufacture of R22 – as a threat to the recovery of the ozone layer, according to the MIT News Office.

The researchers found that between 2010 and 2015, emissions and concentrations of chloroform in the global atmosphere increased significantly. They traced the source of these emissions to East Asia.

They predict that if chloroform emissions continue to increase, then the recovery of the ozone layer – made possible by phasing out CFC and HCFC gases via the Montreal Protocol – could be delayed by four to eight years.

Chloroform is among a class of compounds called “very short-lived substances” (VSLs), for their relatively brief stay in the atmosphere (about five months for chloroform). Because it is generally assumed that chloroform and other VSLs are unlikely to do any real damage to ozone, the Montreal Protocol does not stipulate regulating the compounds.

Using an atmospheric model, the researchers estimated that between 2000 and 2010, global chloroform emissions remained at about 270 kilotons per year. However, this number began climbing after 2010, reaching a high of 324 kilotons per year in 2015. They observed that two stations in East Asia – one in Hateruma, Japan, and the other in Gosan, South Korea – showed dramatic increases in the frequency and magnitude of spikes in the ozone-depleting gas. ■ MG

Japan confirms \$95.65m NatRef subsidy for FY2019

On 21 December, the Japanese Ministry of the Environment confirmed it had set the budget for natural refrigerant subsidies in Japan at ¥7.4 billion (AU\$95.65 million) for the 2019 Financial Year (FY2019).

It exceeds the ¥6.4 billion (AU\$82.7 million) budgeted last year for FY2018.

The natural refrigerant subsidy scheme is a five-year project, beginning in 2018 and ending in 2022. The sectors targeted remain the same as last year: food retail, food manufacturing, and cold stores.

The goal of the subsidy is to encourage the “shift to natural refrigerants [...] and to widely promote the use of energy-efficient equipment,” Japan’s Ministry of the Environment states. ■ DY

Chinese manufacturer unveils new CO₂ heat pump

DunAn, a large Chinese precision-equipment manufacturer, in December unveiled a new CO₂-based hot water heat pump.

The air-source CO₂ heat pump water heater is “mainly designed for domestic high-temperature hot water production up to 90°C,” the company said.

With an inlet temperature of 15°C and an outlet temperature of 55°C, test results from DunAn demonstrated a heating capacity of 78.6 kW with a power consumption of 15.5 kW – translating to a coefficient of performance (COP) of 5.07.

“We see CO₂ as the only alternative refrigerant for commercial heat pump water heaters in the future,” DunAn said.

■ CM

France adopts HFC tax, NatRef incentives

France’s 2019 Finance Bill, officially adopted on 30 December 2018, confirmed the entry into force of a tax on HFCs as of 2021.

The new French scheme will also support the adoption of HFC alternatives from 1 January 2019 until 31 December 2022.

To help companies to transition to HFC-free alternatives, an income tax discount is applicable until 31 December 2022 for companies subject to French tax.

Companies can deduct from their taxable profit an amount equal to 40% of the original value of all HFC-free refrigeration and air-conditioning equipment – including that based on natural refrigerants.

The tax discount of 40% for HFC alternatives is applicable for the next four years, for new refrigeration and air-conditioning installations.

The progressive tax is set at 15 euros per ton of CO₂ equivalent (€/tCO₂e) in 2021, €18/tCO₂e in 2022, €22/tCO₂e in 2023, €26/tCO₂e in 2024 and €30/tCO₂e as of 2025. (These sums roughly correspond to AU\$24, AU\$29, AU\$35, AU\$42 and AU\$48 respectively).

The tax applies to the entity that makes the first delivery of HFCs in France (producers and importers).

■ MB

Tumble dryer harnesses R290 heat pump

The Siemens IQ700 tumble dryer, with a European Union Energy Label rating of A++, uses an R290 (propane) heat pump, according to Siemens.

Using a heat pump system allows the tumble dryer to achieve considerably shorter drying times than before, according to the German white goods manufacturer.

It also uses a self-cleaning system, which makes the condenser obsolete and keeps energy consumption consistently low, Siemens says.

The tumble dryer is currently on sale throughout Europe.

South Korea's LG Electronics has developed propane heat pump compressors specifically for use with tumble dryers, which it launched last October at Chillventa 2018 in Nuremberg, Germany. ■ CM

Coles goes CO₂ transcritical in small Melbourne store

Last December, City Holdings commissioned its fourth CO₂ transcritical project, at a small-format Coles Local convenience store in Melbourne, Victoria.

SCM Frigo, an Italian multinational that is part of the Beijer Ref Group, provided the system. "It's another great project using natural refrigerants, and our fourth transcritical project for the year," said Brian Toulson, senior project engineer, City Holdings (Aus).

Coles' first 'local neighbourhood supermarket', which features an in-store chef and a barista, is the retailer's answer to competitor Woolworths' small-format Metro shops.

The 1,280 m² Melbourne store sells local gourmet produce and speciality ranges, with exclusive Coles Local-branded products including ready meals, the 'Beyond Meat' vegetarian and vegan range, and gourmet bakery and pastry ranges. ■ AW

Global HFC phasedown comes into effect

The Kigali Amendment to the Montreal Protocol on phasing down the production and use of HFCs entered into force on 1 January 2019. But two thirds of the Parties to the Montreal Protocol are yet to ratify the text – including the USA and China, two of the world's largest producers and consumers of HFCs.

Kigali sees developed countries take the lead on phasing down these potent greenhouse gases, starting with a 10% reduction this year and delivering an 85% cut in 2036 (compared to the 2011-2013 baseline).

"Cutting the use of these gases could avoid up to 0.4°C of global warming by the end of the century," said Joyce Msuya, acting executive director of UN Environment.

The entry into force of the Kigali deal establishes a clear HFC phase-down schedule, giving a strong message to the HVAC&R sector to provide the technology solutions – including natural refrigerant-based equipment – that will deliver the Kigali targets.

Dubbing the amendment "the New Year's Resolution that we must not break," Tina Birmipili, executive secretary, Ozone Secretariat, UN Environment, drew attention to the practical steps that some Montreal Protocol parties had already taken to implement it.

"With funding from the Multilateral Fund for the Implementation of the Montreal Protocol, parties are building their capacity, strengthening institutions and developing national strategies to ensure we tackle HFCs quickly and decisively," Birmipili said.

"This preparatory activity gives us hope that we can succeed, as does the Montreal Protocol's record at keeping its resolutions," she added. ■ AW

HC charge limit vote pushed to mid-March

The International Electrotechnical Commission (IEC) will cast its final vote on whether to increase the charge limit for A3 (flammable) refrigerants in mid-March.

The charge-limit increase to 500g from 150g will apply to hydrocarbons like propane and isobutane in commercial refrigeration equipment under the IEC global standard 60335-2-89. The higher charge would likely widen the use of hydrocarbons as natural refrigerants worldwide.

The final vote, known as the Final Draft International Standard (FDIS) phase, represents the last step in a lengthy standards process.

The FDIS vote had been expected by the end of 2018 but "is not ready yet," said Marek Zgliczynski, Embraco's manager of commercial refrigeration

product engineering, who chairs the IEC SC61C subcommittee. "So the vote will happen probably in mid-March, not earlier than this."

In the FDIS phase, the charge-limit document is circulated to national committees for a two-month voting period. An FDIS is approved if a two-thirds majority of P (Participating)-members vote in favour and if less than 25% of the votes submitted are negative.

If the document is approved, it progresses to the final publication stage and could be published in the first half of 2019. If it is not approved, it is referred back to a technical committee or subcommittee to be reconsidered.

■ MG

Woolworths pushes ahead with CO₂ training



“Plant room working groups have no parallel when it comes to up-skilling and knowledge sharing.”

– Dario Ferlin, Woolworths

Amid growing deployment of advanced CO₂ systems in Australia, Heatcraft and SCM Frigo are teaming up to train technicians and help lay the groundwork for more uptake of natural refrigerants in Australia.

— By Devin Yoshimoto & Caroline Rham

In July 2018, Australian retailer Woolworths commissioned its second transcritical CO₂ system at a supermarket in Wadalba, NSW.

Heatcraft supplied the system, a Kirby eCOBoost transcritical CO₂ rack.

Feedback from Woolworths' technicians has been very positive so far, according to Dalveer Sangha, a strategic account manager at Heatcraft Australia, a wholly owned subsidiary of Beijer Ref.

"The technicians were quite encouraged to see a whole day of in-depth training provided by a supplier that could relate not only to everyday CO₂ systems but also to evolving technologies," says Sangha.

"They also had the opportunity to apply recent learnings in practice by looking at and touching the system during full operation," he adds.

Plant room working groups

Woolworths, in particular, has found that training conducted with live operational systems provides the most value in terms of knowledge and up-skilling.

The Wadalba installation has been useful in this regard, as it has been running very well even during the summer months.

"The CO₂ system's operation has been good," says Douglas Herkess, segment engineer at Heatcraft Australia, commenting on its performance since July 2018.

"The racks are operating across a range of ambient temperatures, up to 38°C so far this summer, with no issues," Herkess says. "The high ambient solutions (adiabatic cooling and parallel compression) are working to maximise efficiency due these warmer periods," he adds.

Woolworths is impressed. "The low, medium, and high-temperature suction groups are running like clockwork," says Dario Ferlin, the retailer's sustainable innovations engineer.

"The showcase/cool room temperature performance aren't at all on the store manager's radar," he says.

The Woolworths team has nonetheless faced some challenges with the system's operation, such as "getting the oil system working right and finding the sweet spot between the operation of the flash gas bypass valve and parallel compressors," according to Ferlin.

It is here where Woolworths has identified the most valuable training opportunities.

"With these challenges," Ferlin says, "comes the opportunity to work with our technology partners and field teams to optimise the installed system and improve subsequent iterations of system designs".

"Such plant room working groups have no parallel when it comes to up-skilling and knowledge sharing," he argues.

Heatcraft Australia's Sangha agrees. "Feedback was very encouraging from other senior figures within Woolworths too. This is the foundation for future training opportunities," he says.

Despite the need to fill the skills gap, Ferlin remains hopeful that such "deliberate measures that we're taking with each installation" will help to overcome these challenges.

Industry collaborates to provide training

Responding to the urgent need for more skilled HVAC&R technicians, Heatcraft Australia, in conjunction with SCM Frigo – another Beijer Ref company – has recently been training refrigeration contractors on CO₂ systems across Australia.

The need for technicians capable of installing, servicing and maintaining the mounting number of advanced CO₂ systems deployed in Australia has frequently been cited as the biggest barrier to further natural refrigerant uptake in the country.

In particular, Heatcraft has been targeting training sessions specifically at Woolworths service technicians who either have a transcritical system within their region or will have one in the near future.

Woolworths installed and commissioned its third transcritical CO₂ system in December.

"By 2020 we will install ten natural systems employing technologies such as transcritical CO₂ or water loop," states the retailer in its 'Corporate Responsibility Strategy 2020' report.



Woolworths and Heatcraft team in front of the Kirby eCOBoost transcritical CO₂ rack system in Wadalba, NSW.

“Uptake of natural refrigerants with new customers and segments is a priority in 2019.”

— Brett Hedge, Heatcraft Australia

Hands-on training

Heatcraft's Herkess has been leading the training sessions. He says that the combination of both theory and practical hands-on training has been valuable for the technicians who attended.

“The training consisted of a theory session involving the introduction of CO₂, safety, design theory, installation, service theory and controls,” says Herkess.

“This session was then followed up with a practical session on the recently installed Heatcraft transcritical equipment at Woolworths Wadalba, where the technicians had the opportunity to apply the theory learnt and to ask any questions they may have in relation to operation, controls, etc.”

Natural refrigerants a priority in 2019

Heatcraft says that it will continue to focus on pushing its natural refrigerant solutions in 2019, along with its CO₂ training sessions, which are open to the public.

“Our task now is to take the good work from the training that we have conducted with over 100 customers and convert applications from HFC systems to hybrid CO₂ or completely natural systems,” says Heatcraft Marketing Manager Brett Hedge.

“Uptake of natural refrigerants with new customers and segments is a priority in 2019.”

Anyone interested in attending a future course should email training@heatcraft.com.au.

Natural refrigerants will be discussed at the ATMOsphere Australia 2019 conference organised by *Accelerate Australia & NZ* publisher shecco, which will be held in Melbourne on 8-9 May 2019.

For more information go to www.atmo.org/Australia2019. ■ DY & CR

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Racing ahead

The Bend Motorsport Park, opened in April 2018, is already putting South Australia on the motorsport map. By choosing natural refrigerants, the facility is also racing ahead of the HFC phase-down curve.

— By Devin Yoshimoto & Caroline Rham

“Lifecycle costs are critical to our business, hence the choice of refrigerants was key to future-proofing this building.”

– John Domino, Peregrine Corporation Infrastructure (PCI)

In August 2018, over 40,000 motorsport fans made their way to Tailem Bend, South Australia to watch three days of touring car racing.

The '2018 The Bend SuperSprint' event, part of Australia's annual Supercars Championship racing series, was held on 24-26 August.

It was one of the first major events to be held at The Bend Motorsport Park, South Australia's brand-new \$160 million motor racing circuit near Adelaide, which opened for business in April 2018.

The local motorsport community is justifiably proud that this world-class facility has put South Australia on the racing map – with much positivity on show among drivers, fans and the driving force behind the track's development, John Domino, who proudly tells *Accelerate Australia & NZ* of his conviction that The Bend is "the world's best motor sport park".

Domino is chief operating officer of Peregrine Corporation Infrastructure (PCI), whose parent company the Peregrine Corporation operates service stations and convenience stores across South Australia and also financed, developed and owns The Bend.

The new race track is putting South Australia on the map beyond the world of motor sport – thanks to its use of sustainable HVAC&R technology.

The facility's commercial kitchens and cold storage rooms employ a new and innovative refrigeration system based on natural refrigerant CO₂. The system was funded, designed and developed locally in South Australia.

With Australia's HFC phasedown already underway since January 2018, by choosing natural refrigerants The Bend is making a splash in the world of sustainability as well as in motorsport.

ENERGY EFFICIENCY TOP OF THE AGENDA

In March 2018, energy prices once again made local headlines in South Australia when Steven Marshall, leader of the Liberal Party and current premier of South Australia, declared that South Australians have "the highest energy prices in Australia – some say in the world – and the least reliable grid".

These high energy prices, according to independent, not-for-profit media outlet The Conversation, are influenced by a variety of factors (including network and retailing costs, as well as levies related to 'green schemes'). This vulnerability is at the forefront of many people's minds throughout the state, affecting local households and businesses alike.

Indeed, high energy prices were the key motivation for the decision by independent retailer Drakes to begin installing energy-efficient CO₂-based refrigeration systems in its supermarkets, located in South Australia and Queensland (see *'The Big Comeback'*, *Accelerate Australia & NZ*, summer 2018).

The Peregrine Corporation is South Australia's largest privately-owned company. It is little wonder that the company is putting energy efficiency at the top of its agenda, like other local businesses.

"The Peregrine Corporation owns and operates hundreds of sites across the country," Domino told *Accelerate Australia & NZ*.

"With the ever-increasing cost of energy, we have substantial commercial motivation to maximise the energy efficiency of our sites, both large and small, as well as to ensure that the plant and equipment we install has an appropriate lifespan to deliver a return on our investments," Domino says.

The Bend Motorsport Park measures 2,000 acres and is located about 100 km south of Adelaide.



The Bend Motorsport Park, Tailem Bend, South Australia.

Photography: Glenn Power

The largest building on the property is the Primary Pit Building, a 300m-long, four-storey building. It was built to house a motor museum, corporate suites, 34 fully fitted pit boxes and a 100-room hotel.

The Primary Pit Building also houses the CO₂ refrigeration system, which serves the cooling needs of The Bend's commercial kitchens, cold rooms and freezers.

Domino estimates that around half of the 40,000+ people who attended *The Bend SuperSprint* used the Pit Building facilities.

For PCI, "overall lifecycle cost and environmental risk mitigation were key factors" in deciding what type of refrigeration equipment to install, according to Domino.

"We know that mechanical services systems contribute around half of the energy use and resultant greenhouse gas production associated with a building," Domino says.

Opting for a natural refrigerant, Domino says, avoids the potential need to replace the system in future, thus lowering costs over the installation's lifespan.

"We're aware that many existing commercial refrigerants are being phased out or have already been phased out of use," Domino explains.

"As ongoing owners and operators of numerous buildings and facilities, lifespan and lifecycle costs are critical to our business, hence the choice of refrigerants was key to future-proofing this building," he says.

Domino reveals that reliability of equipment and access to ongoing support were also very important in deciding who to work with.

"Being located more than 100 km from key suppliers in Adelaide, the functionality and reliability of the refrigeration system serving the commercial kitchens and cool rooms is critical," he says. "As such, we needed to work with partners who could deliver and support high-quality, reliable installations."

OVERCOMING THE CO₂ EQUATOR

PCI did not have to look far beyond South Australia to find a reliable technology supplier capable of supplying an energy-efficient refrigeration system based on natural refrigerants.



Julian Hudson, managing director, Glaciem Cooling (left) and John Domino, chief operating officer, Peregrine Corporation Infrastructure (right).

South Australian system manufacturer Glaciem Cooling Technologies (Glaciem) – with the support of the South Australian government and the University of South Australia – developed an innovative CO₂-based refrigeration system designed specifically for Australia's notoriously extreme climate.

The system, called the Dew Point-CO₂ system (DP-CO₂), uses 'indirect evaporative cooling' or what Glaciem calls 'Dew Point cooling' to enable the CO₂-only system to operate efficiently in hot climates without the use of HFC gases, while also reducing overall system complexity.

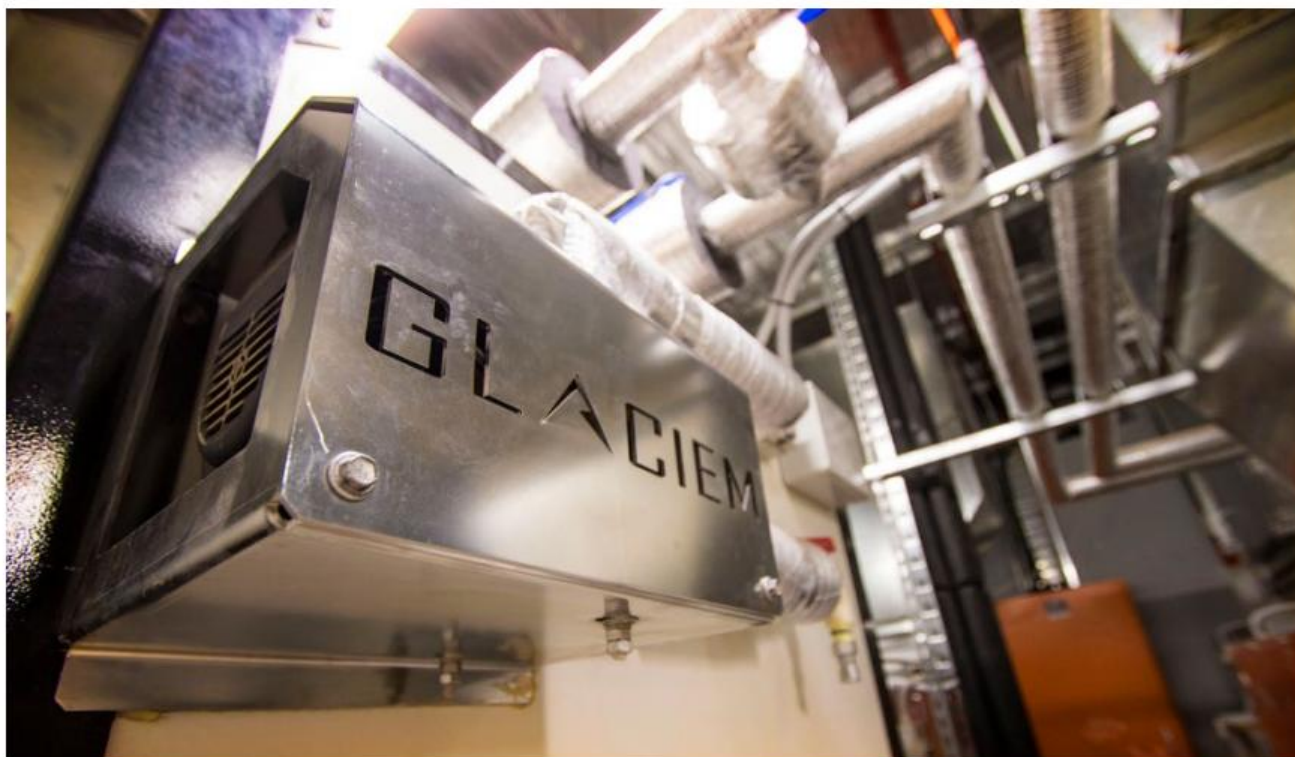
The 'Dew Point cooling' technology originated from a product that had already been under development for more than a decade by a company called Seeley International, based in Adelaide, explains Glaciem Managing Director Julian Hudson.

Seeley's research culminated in what the company dubbed the "climate wizard product".

"Upon reading the technical report on the climate wizard product," says Hudson, "it became clear to me that if this technology could be integrated with a CO₂-only system, then you would potentially have a system that remained subcritical even in 45°C ambient".

“ The need to reduce operating costs will drive the uptake of natural refrigerants. ”

– John Domino, PCI



Glaciem Cooling Technologies (whose ThermCOLD Thermal Energy Storage system is pictured above) provided the CO₂ system (pictured left), which features indirect evaporative (or 'Dew Point') cooling.

“The goal has always been to have a CO₂-only system that can operate in high ambient climates with greater efficiency than a CO₂/R134a hybrid cascade.”

– Julian Hudson, Glaciem Cooling Technologies

From there, Glaciem in conjunction with the University of South Australia carried out 18 months of R&D on the integration of Dew Point cooling with a CO₂-only system – ultimately resulting obtaining a worldwide patent on this technology.

Outlining his motivation for undertaking R&D into a CO₂-only refrigeration system, Hudson says, “for me personally, the goal has always been to have a CO₂-only system that can operate in high ambient climates with greater efficiency than a CO₂/R134a hybrid cascade [system]”.

A refrigeration system for the future

While the innovative DP-CO₂ system can be implemented on its own, Hudson explains that the opportunity at The Bend to implement an even more comprehensive sustainable refrigeration system – designed with the future in mind – became obvious.

In addition to the DP-CO₂ system, Glaciem incorporated 100 kW of thermal energy storage (TES) and advanced control and forecasting algorithms to help optimise the total energy use of the system even further.

Dubbed ‘ThermCOLD’, TES is based on the use of proprietary phase-change material developed by the Barbara Hardy Institute at the University of South Australia.

Combined with the advanced control and forecasting algorithms, the entire setup results in a future-proof refrigeration system ideal for the prevailing conditions in South Australia, according to Hudson.

“For HVAC&R end users to fully benefit from decentralised renewable energy grids, energy storage and smart software able to dynamically interact with these grids is required,” Hudson explains. “This is essentially what The Bend installation aims to demonstrate,” he says.

His larger view is of a global energy landscape that is changing quickly. He sees a larger proportion of energy being provided by renewables, and that the way in which energy is distributed is changing too.

“The HVAC&R sector as a whole is very short-sighted and for 28 years or so has jumped from one crisis to another i.e. CFC phaseout – HCFC phaseout – HFC phaseout – energy efficiency and indirect emissions, without stopping and taking a long-term view of things,” Hudson argues.

“Worldwide and particularly in Western economies, we’re moving away from burning fossil fuels towards renewable energy sources,” he says. “This transition will mean more decentralised grids.”

“In a carbon-neutral future where >80% of power generation is from renewable energy sources, electricity is essentially free once the capital investment has been paid for,” Hudson says. “So energy efficiency really doesn’t matter.”

At The Bend, a solar PV system was also installed to supply renewable energy to the entire system – with surplus energy stored by the TES system.

It is the surplus energy that is then stored by the TES, making the fully integrated system as energy and cost-efficient as possible.

“In a world with localised micro-grids, it is the ability of HVAC&R systems to dynamically interact with those grids that becomes the overriding factor in maximising the economic benefits of the installed renewable energy assets,” says Hudson.



CO₂ condenser/gas cooler integrated with a Dew Point cooler.

Indeed, the idea was to design a system with the future in mind.

"The performance of the DP-CO₂ (Dew Point-CO₂) system and the control algorithms has lived up to expectations so far," Hudson says. "We still require data from the summer months before we have a full year of operating data, as the system was commissioned in March/April 2017. We did have a couple of 39-40°C days during commissioning, and the system was still operating in subcritical mode".

Feedback from Peregrine has so far been positive. Domino is happy with how the installation and commissioning process has gone and is looking forward to seeing this new technology benefit his business.

"Commissioning went exceptionally well," he says. "The project was very well briefed to begin with. Project personnel were involved from the start until the end. Glaciem was proactive and worked very closely with PCI and its installers," he adds.

The system's operation to date, Domino says, "matches our expectations 100%".

THE BIG PICTURE

The success of the DP-CO₂ refrigeration system at The Bend represents a major step forward for CO₂ systems in warm climates.

It demonstrates that businesses can harness natural refrigerants to reduce their energy costs while future-proofing their operations.

Following further testing, Domino hopes to expand the use and application of the system blueprint to other businesses in the Peregrine Corporation portfolio.

"We have the ability to trial and develop sustainable technologies on sample sites and then roll out successful trials across the business for significant energy savings," Domino says.

Hudson argues that natural refrigerants are particularly suited to South Australia right now.

"With the steep rise in electricity prices, end users are actively looking for more efficient alternative options as a way of reducing operating costs," he says. "This need to reduce operating costs will drive the uptake of natural refrigerants."

Domino's knowledge of what is happening in the HVAC&R industry pays off when he makes investment decisions regarding equipment for PCI's businesses.

"We know that industry is moving away from many existing refrigerants and towards more sustainable refrigerants," says Domino.

Asked what advice he would give to similar businesses, Domino says, "we encourage building owners to look at the big picture and not just upfront cost when it comes to making key decisions in the design and selection of major plants and equipment". ■ DY



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SUN SHINES ON CO₂ IN JORDAN



The first transcritical CO₂ supermarket in the Middle East, in Jordan, has been hailed as a success – delivering energy savings of 30% since opening a year ago.

— By Charlotte McLaughlin



Amman, home to the first CO₂ transcritical supermarket in the Middle East.

The Hashemite Kingdom of Jordan is known for its high temperatures, as holidaymakers and anyone working on the Montreal Protocol know all too well.

The Montreal Protocol on phasing out substances that deplete the ozone layer (CFCs and HCFCs) and its subsequent Kigali Amendment, which phases down HFCs, lists Jordan as a so-called 'high ambient temperature' (HAT) country. The global agreements aim to get rid of high global-warming potential (GWP) and high ozone-depleting potential (ODP) substances.

Natural refrigerant CO₂ has not traditionally been noted for coping with sustained hot ambient temperatures. The so-called 'CO₂ equator' refers to the accepted geographical limit for cost-effective and efficient performance of transcritical CO₂ systems in all food retail store formats.

CO₂ has been able to overcome these issues with the use of innovative technologies like ejectors and parallel compression, which were used in this first installation in Jordan.

The CO₂ system at the Al-Salam military supermarket in Amman, Jordan in February 2018 was the first time the installer, Abdin Industrial, had worked with CO₂. Abdin is also responsible for future maintenance of the system.

The CO₂ transcritical system coped well with temperatures of up to 35-36°C between June and September, thanks to the use of the advanced technology.

Initially enEX S.r.l., the Italian manufacturer of the CO₂ system, doubted that an HVAC&R company with limited knowledge of this natural refrigerant would succeed – and was pleasantly surprised when it did.

"In the beginning we were sceptical about the feasibility with a company that had never done CO₂, nothing, not even cascade, but then we had to rethink our ideas," says Sergio Girotto, president of enEX and *Accelerate Europe* 'Person of the Year' (see '*The CO₂ magician*', page 38). "They learned very quickly [about] CO₂ systems."

"The fruitful cooperation of Abdin and enEX shows that local manufacturers and suppliers of commercial refrigeration equipment are able to leapfrog towards the latest CO₂ refrigeration technology," says Dr. Armin Hafner of SINTEF (Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology in Trondheim, Norway).

Hafner served as technical adviser on the Amman project.

The system also features non-superheated evaporator technology, for both chilled and frozen food cabinets and storage rooms. The waste heat from the system is recovered for hot sanitary water supply, which increases the energy efficiency of this system still further.

"The refrigeration system in the supermarket in Amman, Jordan, is able to maintain chilled food at the set-point temperatures with an evaporation temperature of -2°C, while the frozen foodstuff is cooled by evaporating carbon dioxide at -25°C," Hafner says.

The deployment of Dorin parallel compressors and Danfoss multi-ejector technology in the Middle East's first CO₂ supermarket helped the system to function efficiently in hot climates and to realise energy savings. Alfa Laval, LU-VE and Tempriate also supplied components.

After measuring the CO₂ system's performance against an HFC system in a similar supermarket in the same area, Abdin found that the CO₂ system performed more efficiently than the HFC one throughout the year.

Nasser Abdin of Abdin Industrial told *Accelerate*, "we installed energy meters in both projects [and] we found that the CO₂ system had saved more energy than the other [HFC supermarket] by 20-30%".

With a total surface area of 2,000 m², this supermarket represents a test for CO₂ in challenging weather conditions and could open the door to the expansion of CO₂ across the region.

"Recently I heard about the result – it seems [the military] is extremely satisfied [with] the energy saving," says enEX's Girotto.

Feedback from the military has been good, according to Abdin. The customer has not experienced any maintenance or food wastage issues. The military is also exploring the potential to install CO₂ systems in other locations in Jordan in the future.

"After installing the first CO₂ project in Jordan, we as Abdin feel that we now have the responsibility and duty to inform [others in the industry] about the benefits of CO₂ systems," Abdin explains. "I also think our government can do something to help [...], for example by [awarding] projects [to installers] that manage to reduce their energy bills."

HOW IT ALL BEGAN

The Al-Salam supermarket previously used a chemical refrigerant that depletes the ozone layer and has a high GWP (HCFC-22), before the new system based on CO₂ (with a GWP of just one) was put in with support from Jordan's Ministry of Environment. The demonstration project was funded by the Climate and Clean Air Coalition (CCAC) and implemented by the United Nations Industrial Development Organization (UNIDO).

There are currently around 20,000 CO₂ transcritical supermarkets in the world, according to October 2018 estimates from sheccoBase (the market development arm of *Accelerate* publisher shecco).

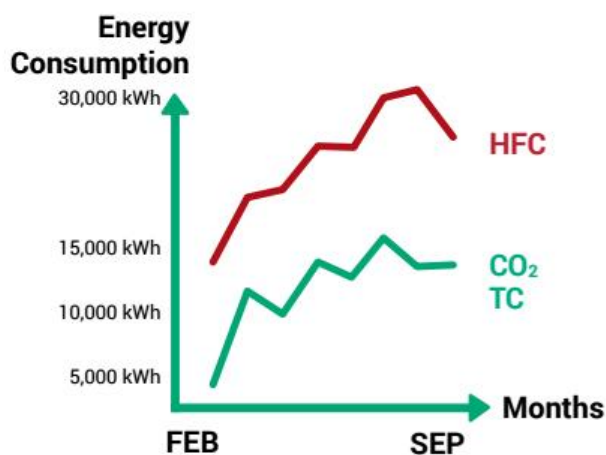
CO₂ has been successfully used in supermarkets in diverse and far-flung locations including Brazil, China, Russia, Indonesia, Peru and Australia, thanks to the commitment of local and multinational retailers, as well as with similar international funding on occasion.

Sulafa Mdanat, UNIDO's country representative in Jordan, said: "CO₂ technology is spreading very fast in the world, as it is considered one of the most energy-efficient and climate-friendly refrigeration technologies for the retail sector." ■ CM

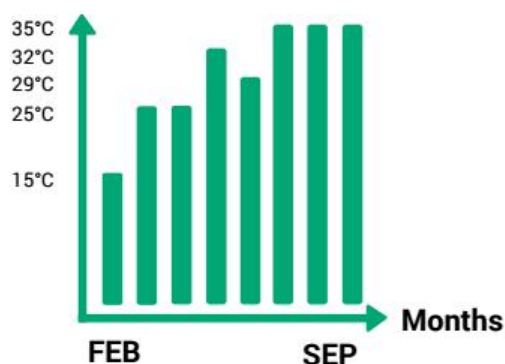
RIGHT

CO₂ transcritical system, Al-Salam military supermarket, Amman.

COMPARISON BETWEEN AN HFC AND CO₂ TRANSCRITICAL SUPERMARKET IN JORDAN:



Average Ambient Temperature in Jordan in 2018



Source: Abdin Industrial



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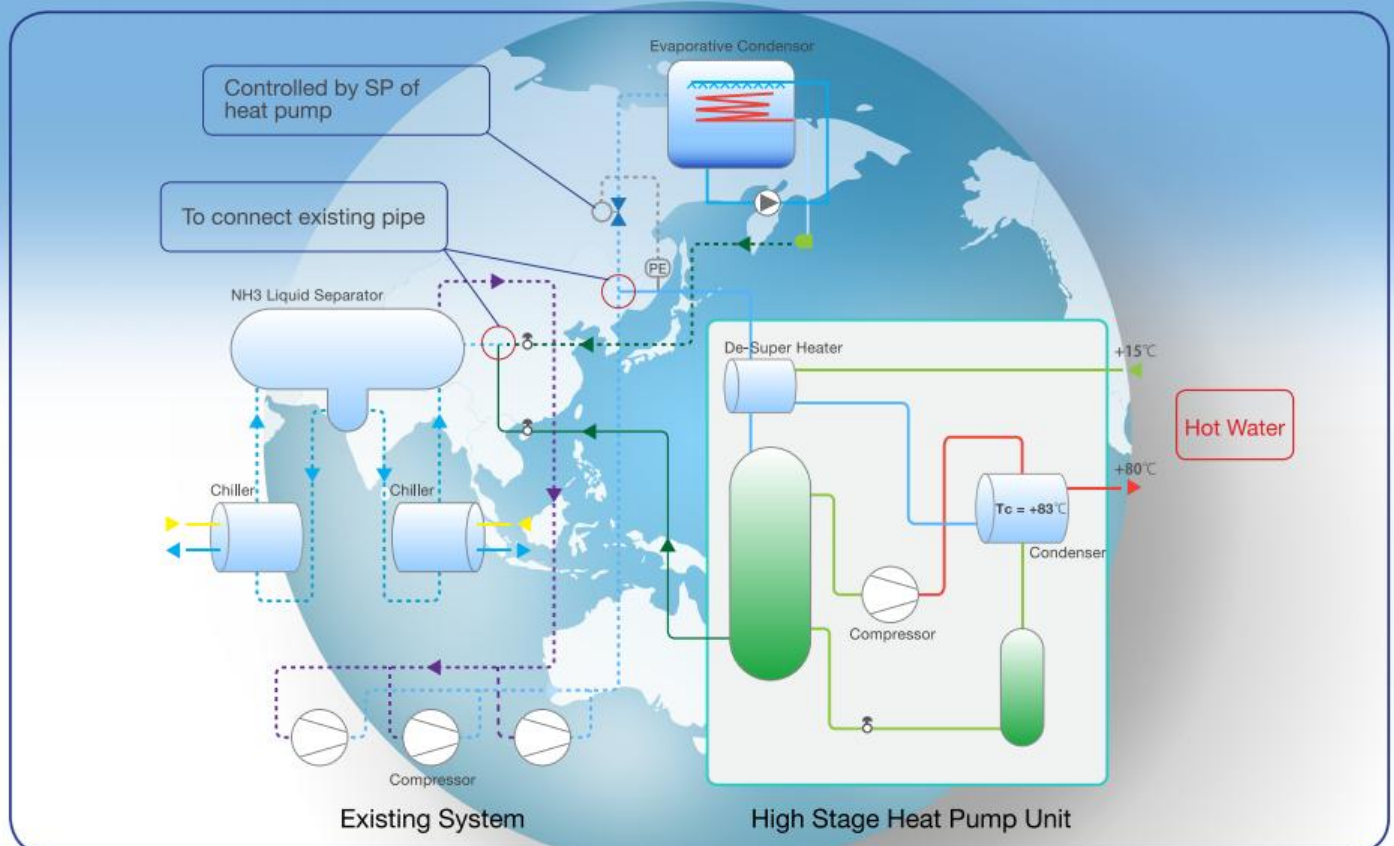
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How to Install on Existing Refrigeration System



'WORLD'S BIGGEST SNOWBOARD FACTORY' PUTS FAITH IN AMMONIA

In Feistritz, Austria, snowboard maker CAPiTA is using a high-temperature ammonia heat pump at its new snowboard factory.

— By Charlotte McLaughlin

Austrian firm CAPiTA ranks among the biggest snowboard makers in the world – and is committed to energy efficiency.

Reducing energy costs was of paramount importance at its new factory, the Mothership, in Feistritz, Austria, which was built in 2016. “When planning the factory, we focused on energy efficiency right from the start,” says Michael Kollmann, CEO of CAPiTA MFG GmbH.

To achieve this, CAPiTA opted for an ammonia-based high temperature heat pump at the Mothership, which the snowboard maker believes is one of the largest snowboard production sites in the world.

The heat pump, manufactured by Austrian company FrigoTherm Ferrari, is used for heating and cooling during the snowboard production process and for HVAC in the factory itself.

“[CAPiTA uses a] double-stage heat pump for the snowboard production plant,” Peter Rindler, owner, FrigoTherm Ferrari, told the ATMOsphere Europe 2018 conference (organised by *Accelerate* publisher shecco) in Riva del Garda, Italy. “It has been running for two-and-a-half years.”

A double-stage heat pump is used to lift the temperature up to the requirements needed in two bursts, Rindler explains. The factory needs

medium-temperature heat (74-75°C) and low-temperature cooling (3°C).

The ammonia heat pump, which uses river water to heat the presses and print the boards, as well as to cool the presses and snowboard grinding machines, has helped CAPiTA to meet its energy reduction targets.

“Generating heating and cooling with a single system is the easiest and best way to achieve high efficiency goals,” says Franz Josef Schögl from Sattler Energie Consulting, the consultancy firm involved in the project.

Compared to its previous factory, with no heat pump, the company has saved 84% of its energy costs, which works out as €294,000 (AU\$469,000), every year since installing the system. “Our new factory is, without doubt, the most energy efficient in the whole sector,” says CAPiTA’s Kollmann.

The German Energy Agency (dena) even awarded the snowboard manufacturer an Energy Efficiency Award in 2017 for its factory. “CAPiTA is a trailblazer for real-world innovation in the energy transition,” dena Managing Director Kristina Haverkamp said in November 2017.

Most of the materials used to produce the boards at the Mothership come from the surrounding Austrian forests. The Mothership also manufactures boards for Bataleon and Lobster Snowboards. ■ CM

**“ GENERATING
HEATING AND
COOLING WITH A
SINGLE SYSTEM
IS THE EASIEST
AND BEST WAY
TO ACHIEVE HIGH
EFFICIENCY GOALS. ”**

— Franz Josef Schögl, Sattler Energie Consulting



A world first

ALDI turns to water-loop CO₂ in Melbourne

ALDI Australia has installed the world's first 'EptaBlue Natural' CO₂ water-loop refrigeration system. The system, in a central Melbourne supermarket, was commissioned last September.

— By Andrew Williams & Caroline Rham

ABOVE RIGHT

New ALDI supermarket, central business district, Melbourne.

BELOW RIGHT

EptaBlue Natural units above Strateo cabinets, ALDI store, Melbourne.

Since ALDI opened its first store in Australia in 2001, the company has been growing steadily, claiming an increasing share of Australia's supermarket sector.

By spring 2018, ALDI Australia had opened over 500 stores, along with eight distribution centres, spanning every state (see '[ALDI banking on natural refrigerants in Australia](#),' *Accelerate Australia & NZ*, autumn 2018).

And on 12 September 2018, it reached another milestone in this journey with the commissioning of a CO₂-based water-loop system in a Melbourne CBD location.

Originally opened 12 years ago, the refurbished store – located in a multi-storey high-rise building in Melbourne's central business district – puts the natural refrigerant-based system at its heart.

AJ Baker & Sons Pty Ltd. installed and commissioned the 'EptaBlue Natural' refrigeration system from Italian multinational manufacturer Epta.

"This is the world's first installation of the EptaBlue CO₂ units," Claus Mecklinger, director, AJ Baker & Sons, told *Accelerate Australia & NZ*.

"The challenge for a full refrigeration refurbishment was to find a system able to respond to ALDI's need for a

self-contained solution, equipped with a small machine room, without having to compromise in terms of performance, efficiency or sustainability," Mecklinger said.

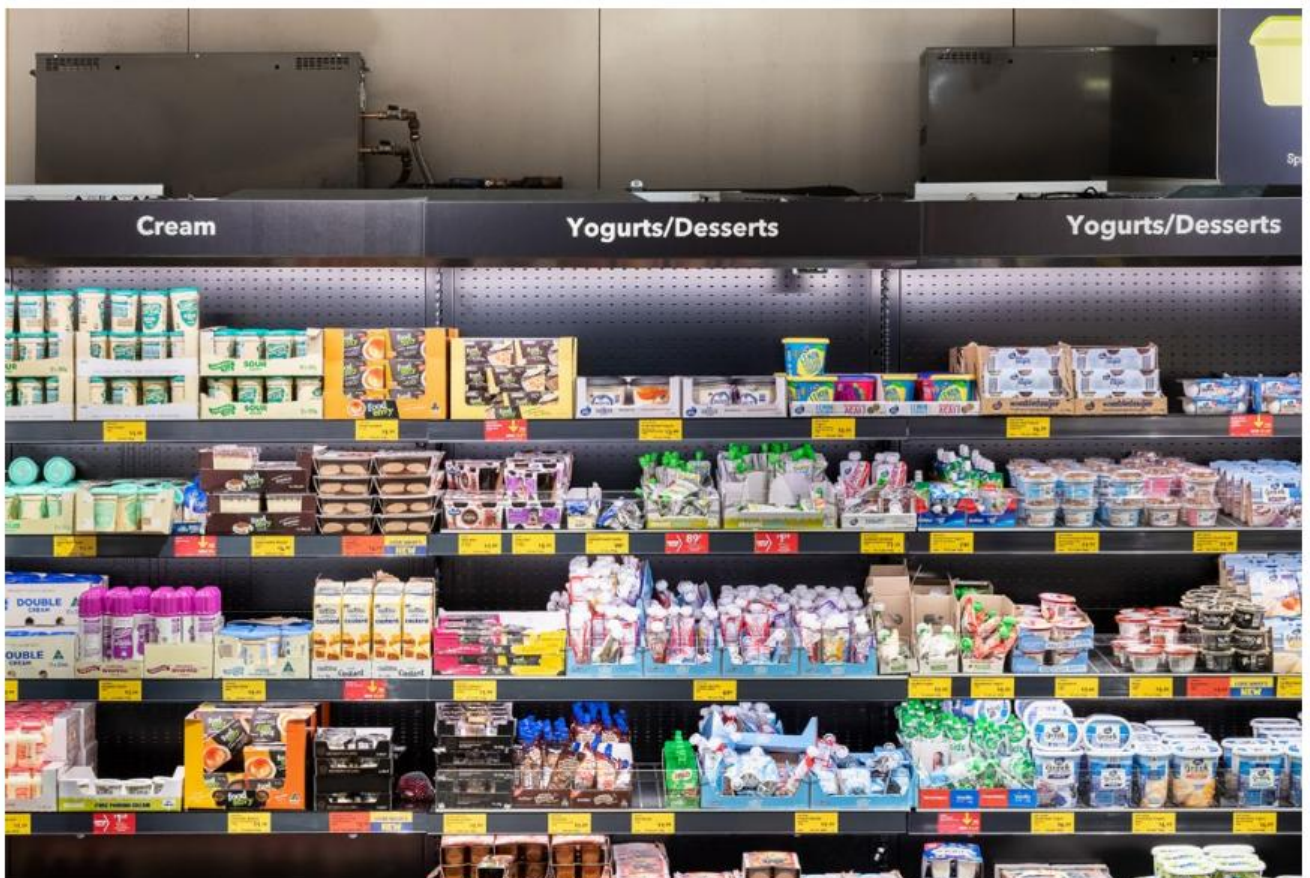
Variable-speed CO₂ compressors modify the refrigerating capacity distributed to the load of the refrigerated unit according to external conditions, such as the number of customers in the store, the season, and whether it is day or night.

Asserting that the 'EptaBlue Natural' is, "the ideal water-loop system to meet these needs," Epta reports that it "reduces the complexity of installing the refrigeration system while limiting energy consumption and noise level".

"With EptaBlue Natural, the 40m run of Epta brand Bonnet Névé's Strateo chilled open vertical cabinets are equipped with their own on-board refrigeration unit that transforms them from remote cabinets to integral cabinets, thanks to a water loop," said Epta.

The system allows the store to accommodate up to 60 metres of vertical cabinets, granting ALDI the flexibility to expand the refrigerated area in future if necessary. "This could not have been done using a traditional system due to lack of space in the machine room," Epta said.

"The cabinets used are the standard ALDI specification Strateo model with



a CO₂ evaporator,” says Mecklinger. “Each cabinet has an EptaBlue water-loop unit installed on top of the cabinet.”

ALDI Australia is part of Germany-headquartered ALDI Süd (South), which is a leading adopter of natural refrigerant technology in Europe and the United States.

In addition to Australia and the U.S., ALDI South operates in China, and eight countries in Europe (Germany, Austria, the United Kingdom, Ireland, Hungary, Switzerland, Italy and Slovenia).

The use of natural refrigerants plays a key role in delivering ALDI Süd’s worldwide target of reducing greenhouse gas emissions by 30% by 2020 (compared to a 2012 baseline).

In Germany, the company is now installing CO₂ transcritical refrigeration systems in all its new stores. It is currently the number one

user of CO₂ transcritical systems in the U.S. supermarket industry – counting over 130 stores, with more on the way.

Marcus Meier, who is responsible for ALDI Australia’s refrigeration development activities, explains that investing in new technologies – including CO₂-based refrigeration systems to phase out the use of R404A from stores – is central to achieving the firm’s sustainability goals. ALDI Australia made its first CO₂ transcritical installation in Victoria in 2015.

“We’ve already achieved a 10-15% energy reduction and are expecting more,” says Meier.

The firm’s target is to achieve the highest possible energy efficiency and reliability for transcritical refrigeration systems, and to minimise the use of water – a particularly important issue in Australia, a drought-prone country.

In its 2017 sustainability report published in July 2018, ALDI Süd said it had installed transcritical CO₂ systems in 1,496 stores worldwide, 1,324 of which were in Germany, by the end of 2017.

2018 was marked by another first for ALDI Australia, which also installed its first Advansor CO₂ rack – in Melbourne suburb Gladstone Park.

Meier cites cost as an ongoing barrier for CO₂ transcritical in Australia, bearing in mind the extra capital costs of adding the parallel compression and adiabatic pads required to perform efficiently in the country’s warm climate.

“We’re currently working on a concept which might be able to avoid adiabatic pads altogether,” he says, adding: “We’re hopeful with these changes to reduce the cost for transcritical systems for Australia, which would mean we might be able to go 100% transcritical for all future stores.”

■ AW & CR



LEFT

Machine room,
Melbourne store.

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Hobart Airport, Tasmania.

Flying high with CO₂ transcritical

Keen to capitalise on the green credentials of natural refrigerants, freight company Link Logistics chose CO₂ for its new cold storage facility at Hobart Airport in Tasmania.

— By Andrew Williams

Sustainability is part of the business model at Link Logistics, an Australian owned and operated freight specialist that moves perishable and other goods by air, ocean, road and rail.

Based in Tasmania, the company also has facilities on the mainland in Melbourne and Sydney, as well as in Shanghai, China.

Link Logistics manages every aspect of door-to-door distribution, helping to protect the quality and shelf life of perishable products. That's where natural refrigerants come into the picture – the company operates its own cold stores.

In October 2018, Link Logistics signed on as the first tenant of a new freight handling facility and commercial precinct at Hobart Airport. The new facilities allow local producers to transport their fresh produce – such as seafood, meat and fruit – by airfreight directly to their export destinations.

Previously, Tasmanian producers of goods for export had to transport their freight to the northwest coast by truck, where it was loaded onto ships bound for Melbourne or Sydney.

"Link Logistics invested more than AU\$3 million in the new freight forwarding and cold store facility," says Chris Fox, the firm's Tasmania director.

Degree C, the contractor on the project, works in the industrial, commercial and residential sectors. With operations across Tasmania, the firm delivers and maintains air conditioning, heating, refrigeration, electrical, metal fabrication and processing technologies.

"Although Tasmania is small, it is big in renewable energy. This clean, green image was one of the key drivers to install a refrigeration system with a clean, green, future-proof refrigerant," says Pieter Boon, project manager (refrigeration) at Degree C.

"The cool Tasmanian climate also makes transcritical CO₂ particularly suitable for this state," Boon adds.

The natural refrigerants journey began when Fox approached Chris Fontana, Hobart divisional manager at Degree C, about providing the cooling system for Link Logistics' new cold storage facility at Hobart Airport.



Jonathan Hare (second from right) with his team in front of the Advansor rack, Hobart Airport.

“ Although Tasmania is small, it is big in renewable energy. This clean, green image was one of the key drivers to install a refrigeration system with a clean, green, future-proof refrigerant. ”

— Pieter Boon, Degree C

“Degree C did all the groundwork to promote CO₂ as the appropriate solution for the project,” says Jonathan Hare, refrigeration engineer at the Natural Refrigerants Company, which represents Danish multinational CO₂ system manufacturer Advansor in Australia.

The CO₂ transcritical system was commissioned on 19 November. “It is the only one in Tasmania with 1,000 m² of freezer and 735 m² of chiller space,” said Link Logistics’ Fox.

The system has 78 kW on the medium-temperature side and 120 kW on the low-temperature side. It has an air-cooled gas cooler and desuperheater. Advansor provided the CO₂ transcritical rack, while Güntner provided the gas cooler, desuperheater and evaporators.

“Pieter and I worked through several iterations of the overall layout, design and capacity requirements,” Hare explains. “All options were costed to find the best solution for the end user.”

Hare is convinced that the business case for adopting CO₂ for this particular installation is compelling. “The environmental benefits in terms of direct emissions are clear,” he says.

Given that the system was only commissioned on 19 November, it is early days to draw conclusions about energy performance. But Hare is confident that the CO₂ system will deliver.

“Once the system has been running for a while, I believe it will speak for itself in terms of energy efficiency,” Hare says. ■ AW



THE CO₂ MAGICIAN

Sergio Girotto has worked tirelessly to bring CO₂ to new areas of application. *Accelerate Europe* sits down with the 2018 Person of the Year to find out what's next for the enEX president – and the HVAC&R industry.

– By Andrew Williams

Of all his achievements, Sergio Girotto is perhaps best known for installing the first-ever CO₂ transcritical system in a large supermarket, in 2001 – an adventure with natural refrigerants that began in 1996, when he asked Italian manufacturer Dorin to produce a CO₂ compressor.

In February 2018, Girotto added another string to his bow. His company, enEX, provided the system for the first CO₂ transcritical supermarket in the Middle East (see *'Sun shines on CO₂ in Jordan'*, page 26).

And on 20 November, this quiet and unassuming giant of the HVAC&R sector reached a new landmark when he was crowned *Accelerate Europe* Person of the Year 2018.

Girotto is characteristically modest in discussing his newfound status. "It's an honour to be Person of the Year," he says. "What I appreciate most is that I've been approached by several of my competitors who said, 'I'd choose you too'. I think this is the best recognition a professional can have."

A mechanical engineer by training, Girotto has enjoyed over two decades working for companies in the refrigeration sector, in roles including R&D, design, production and after-sales service.

In his long HVAC&R career, what's he most proud of? "Being a protagonist in the development of CO₂," replies Girotto with no hesitation.

Between 1988 and 1991, Norwegian researcher Gustav Lorentzen showed how the long-dormant refrigerant CO₂ could be used again as an active working fluid.

Girotto is quick to recognise Lorentzen's brilliance. "Professor Lorentzen had the intuition that CO₂ could become a major part of the answer to environmental issues in our sector," he says.

The crucial next step was to bring CO₂-based HVAC&R solutions to market, or as Girotto puts it, "moving from scientific papers into real systems". "I'm grateful for all the companies that have participated in the reinvention of this technology," he says.

Girotto himself has patented a number of refrigeration products and system designs. Among his personal favourites is a liquid ejector for overfeeding evaporators (see *'The restless innovator'*, *Accelerate Italy*, February 2018).

He founded his own company, enEX, in 2004. Ever since, the firm has focused solely on CO₂. Asked what he has enjoyed most about his time there, Girotto replies: "To have contributed to developing or bringing into practical use some of the main innovations in CO₂ technology."

At the forefront of an industry

At enEX, Girotto has been the driving force behind a host of innovations including the use of ejectors to recover energy in warm climates, auxiliary compressors for flash gas recompression, overfed evaporators, and water chillers – including an ejector version.

“

What I appreciate most about becoming Person of the Year is that I've been approached by several of my competitors who said, 'I'd choose you too'. I think this is the best recognition a professional can have.

– Sergio Girotto, enEX

”

His company has built over 1,000 CO₂ transcritical systems, the first of which came off the production line in 2006.

Asked why enEX chose to focus solely on CO₂, Girotto argues, “CO₂ is good for so many different applications and capacities that it doesn't make sense for us to expend our resources and energies in other directions”.

He is optimistic that his Person of the Year status will help to raise awareness of what his company, enEX, has to offer. “I hope and would like this visibility to help bring the name of the company and its products to a larger audience,” he says.

Targeting HVAC

Girotto is convinced that the future of the HVAC&R industry is natural. “10 years from now, natural refrigerants will be used in every HVAC&R application,” he says – with the exception of a few ultra-low temperature niche areas.

Air conditioning has proven a tough nut to crack. Girotto believes the most challenging area for natural refrigerants is domestic air conditioning, “where it is unrealistic to believe that flammable hydrocarbons will be the solution”.

Is it possible to use CO₂ in the HVAC sector? “Yes, absolutely!” Girotto says.

He points to his own company's achievements with CO₂ as examples. “enEX has already developed a product for direct heating and cooling – a kind of large VRF system,” he says. “And water and brine chillers are already available today.”

Girotto is convinced that the market share of CO₂-based products can increase at the same rate in HVAC as it has in commercial and industrial refrigeration. “There is no reason why not,” he says.

Asked why this is yet to happen, Girotto cites the “conservative approach” and “inertia” of many companies active in the HVAC sector who fear that change would make it harder to maintain their profitable status quo. “But they have no chance,” he says. “Solutions with natural refrigerants will take over the market.”

As Person of the Year, what advice would Girotto offer new engineers at the beginning of their HVAC&R journeys? “Keep an open mind, and be willing to work hard to be successful.”

How might their careers differ from his? The enEX president turns to the past to look to the future.

“Technology has evolved impressively since the 1980s. Not just the move from synthetic to natural refrigerants – but also the arrival of information technology into our sector,” Girotto says.

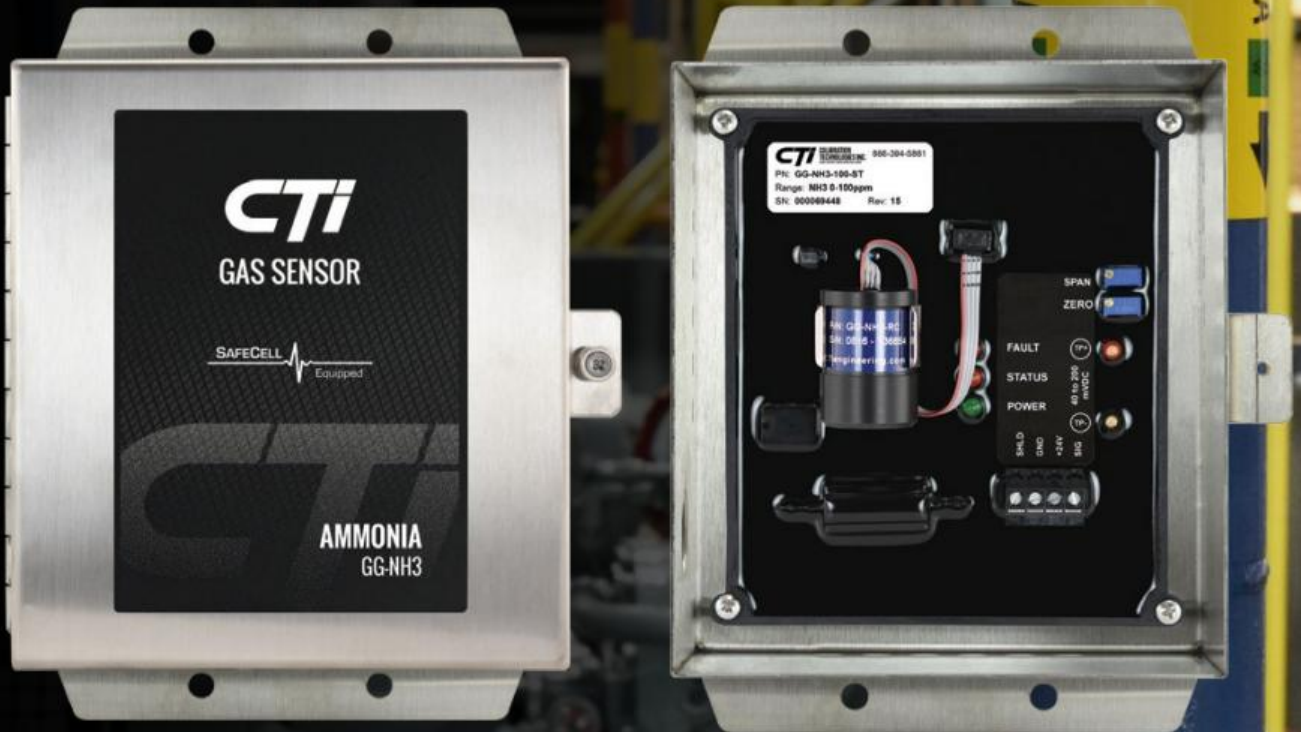
“Artificial intelligence is in its early stages. My guess is that AI will be the next revolution in the refrigeration and air-conditioning sector – the new engineers will have a completely new business area to develop,” he predicts.

Given his track record, only a fool would bet against him. ■ AW

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ATMOsphere Europe 2018 took place in Riva del Garda, Italy.

A bright future

CO₂ has a bright future in both commercial and industrial applications, while hydrocarbons stand to benefit from a charge limit increase in 2019. *Accelerate Europe* reports from ATMOsphere Europe.

— By Andrew Williams

Natural refrigerant CO₂ will continue to grow in Europe's refrigeration market as new technology developments pave the way for it to make greater inroads into industrial as well as commercial applications, heard participants in ATMOsphere Europe 2018.

Victor Calvo, president, Carrier Commercial Refrigeration, told the conference – hosted by shecco, publisher of *Accelerate*, at Lago di Garda, Italy from 19-21 November 2018 – that he sees both the commercial and industrial refrigeration sectors as promising growth areas for CO₂.

"We see more and more opportunities for CO₂ in the commercial segment," said Calvo. "Cold storage warehouses are also a significant growth area for CO₂, as well as industrial refrigeration more generally," he said.



Calvo said Carrier had made some 10,000 CO₂ rack installations in Europe so far, most of which are in large supermarkets. "Around three quarters of that number are CO₂ transcritical, and around a quarter are subcritical," he said.

Expanding production capacity

Andreas Meier, managing director of German system manufacturer TEKO, stressed the need to be ready to meet greater market demand. "For us, the need to add production capacity for natural refrigerant technologies is clear," he said.

To date, Meier said TEKO had installed some 2,900 CO₂ transcritical, 74 propane and 54 ammonia systems in Europe, mainly in Germany.

Meier stressed the importance of training HVAC&R technicians and installers in using natural refrigerants to ensure that they fulfil their potential in all world markets. "Practical training remains crucially important to growing the natural refrigerant sector," he said.

Kenneth Madsen from Advansor also expressed confidence in the growth prospects of CO₂. "Most of our sales are in Europe," said Madsen, estimating that Advansor had installed some 4,500 racks in Europe so far. "18 of Europe's top 20 retailers install CO₂ transcritical units from Advansor," he said.

Madsen argued that this growth was all the more impressive, given that it was organic. "We don't have the luxury of our competitors in that we can't convert our existing HFC systems to CO₂."

Madsen identified Spain and Eastern Europe as promising regions for growth, but stressed the need to ensure that CO₂ transcritical technology is simple enough to be accessible to all.

"We need to turn the space shuttles that we have at the moment into Volkswagens that everyone can drive," he said. "Simplification is the key."

Larger capacity compressors

Giacomo Pisano from Italian multinational compressor manufacturer Dorin stressed the importance of offering CO₂ compressors for large capacities, "because otherwise you would need to install several racks" for big industrial applications.

Pisano sees little future in HFCs or HFOs. "We see many drawbacks of HFOs. New blends pop up every six months," he said.

Fabio Fogliani from Beijer Ref, meanwhile, expressed confidence that natural refrigerants would become ever more important to the HVAC&R giant's business. "We're confident that natural refrigerant technologies will continue to add to our turnover," he said.

"Asia is a growing market for us, following our acquisition of Heatcraft Australia," Fogliani said. "Africa is another important growth region."

"We think that we have a duty to develop natural refrigerant technologies and that they are the best solutions to apply," Fogliani said. "Every day, we're trying to convince our customers that natural refrigerants are the best solutions," he said.

Tackling industry 'inertia'

Out-of-the-box thinking is needed in order to deliver the HFC phasedown enshrined in the EU F-Gas Regulation and in the Kigali Amendment to the Montreal Protocol.

"Too much activity has focused on dropping in similar refrigerants – for example, replacing HCFCs with CFCs," said Clare Perry, senior campaigner at the Environmental Investigation Agency, an NGO.

Perry said the legacy of synthetic refrigerants "continues to haunt us" and described it as "too big to be ignored".

"We need to go to natural refrigerants as quickly as possible. But there is mass inertia among industry," Perry said.

Accelerating the transition towards natural refrigerants "ultimately comes down to political will among governments," and in the case of the developing world, "on the amount of funding made available to developing countries by donor countries," she said.

Engage in the standards process

The maximum permitted charge of flammable refrigerants used in hermetically sealed commercial refrigeration units is poised for an increase in spring 2019.

An International Electrotechnical Commission (IEC) standard currently limits the use of flammable refrigerants in hermetically sealed commercial refrigeration equipment with an incorporated or remote refrigerant unit or compressor to 150g.

The 150g limit enshrined in IEC standard 60335-2-89 prevents refrigeration equipment manufacturers and users from fully exploiting the safe and efficient application of hydrocarbon refrigerants in the commercial refrigeration sector. But it is set to increase to 500g in 2019 following a lengthy standards revision process (see *'The home straight'*, *Accelerate Europe*, winter 2018).

The twists and turns of this process, which largely took place behind closed doors, serve as an example of why it is so important to get involved. "It's so important for companies to engage in the standards process," Perry said, urging companies to demand transparency from their industry associations.

"It's extremely hard to find out what's going on in those standards committees," Perry said. "The process is rather murky."

Boost certification

Marco Buoni from *Centro Studi Galileo*, an Italian HVAC&R training institute, stressed the importance of ensuring that people around the world are not just trained but also certified in using natural refrigerants.

"We want the end users to be safe, and therefore to certify as many people as possible in using natural refrigerants," Buoni said.

Indeed, participants in a sli.do poll during the conference identified lack of training alongside high initial costs as the two biggest obstacles to wider uptake of natural refrigerants in Europe.

Andreas Meier from TEKO argued that improving the training offer could ultimately reduce the cost of natural refrigerant technologies, as more people develop the expertise to work with them.

With efforts underway to develop new technologies, revise standards and improve training, the future certainly looks bright for natural refrigerants. ■ AW



“We think that we have a duty to develop natural refrigerant technologies and that they are the best solutions to apply.”

— Fabio Fogliani, Beijer Ref



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It's so important for companies to engage in the standards process.

— Clare Perry, Environmental Investigation Agency

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Cold storage warehouses are a significant growth area for CO₂, as well as industrial refrigeration more generally.

— Victor Calvo, president, Carrier Commercial Refrigeration

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NATREFS BLOOMING IN CHINESE RETAIL

After years of preparation, research and development, several firms chose ChinaShop 2018 to debut brand-new, locally developed natural refrigerant technology designed for the Chinese market. *Accelerate Australia & NZ* reports from Kunming, China.

— By Devin Yoshimoto

As China's retail industry continues to experience rapid growth and change, manufacturers are seeing opportunities to promote the energy efficiency and environmental benefits of natural refrigerants to end users – and are now making natural refrigerant-based HVAC&R systems themselves.

CO₂ transcritical...with a local twist

Chinese OEM Zhejiang XingXing Refrigeration Co., Ltd. (XingXing) is a case in point. The firm debuted a new transcritical CO₂ rack system at last year's ChinaShop, the largest trade exhibition for China's retail industry.

ChinaShop is organised by the China Chain Store & Franchise Association (CCFA), China's leading retail trade association. The 2018 edition was held on 1-3 November in Kunming, China.

XingXing's rack incorporates both parallel compression and ejector technology to maximise energy efficiency in China's warm summer ambient temperatures.

Italian multinational CAREL provides the system's ejector, high-pressure valves and control system, while Dorin – another Italian firm – provides the compressors.

Tingxun Zhang, director of XingXing's cold chain research and development department, stresses the importance of incorporating the latest advances in CO₂ technology into the system's design in order to improve energy efficiency in China.

"In China, from south to north, most regions belong to the medium ambient temperature range and even to the high ambient temperature range," Zhang told *Accelerate Australia & NZ* at ChinaShop. "Perhaps transcritical booster systems, including parallel compression, plus gas ejectors will be the best solution for Chinese applications," he argued.

XingXing is currently seeking customers for its transcritical CO₂ system, which attracted a lot of interest at ChinaShop.

"During the past two days, a lot of component suppliers, end users and even some local Chinese manufacturers came



1 / Kunming Dongqi Technology's transcritical CO₂ booster rack system.

2 / AHT's Milano R290 island cabinet.

1 /

to our booth," said Zhang. "We talked about the new CO₂ design and the different running models," he said.

While in China, *Accelerate Australia & NZ* toured the testing facility of another Chinese company – Kunming Dongqi Technology Co., Ltd. (Dongqi) – which was displaying its own recently developed transcritical CO₂ booster rack system.

The transcritical CO₂ booster system took two years to develop, in cooperation with the Chinese Ministry of Ecology and Environment's Foreign Economic Cooperation Office (MEP-FECO) and Xi'an Jiaotong University.

Dongqi said the system had been thoroughly tested over the past few months and the results had been positive.

"The technology has passed our acceptance test, the equipment is stable, performance is high, and commercial application conditions have been met," said Dongqi. "It can now be put on the market for practical application."

Xiaochuan Yang, Dongqi's chief engineer, told *Accelerate Australia & NZ* that the system's medium temperature range is from -2°C to +10°C, and its low temperature range is from -30°C to -20°C.

Yang admits that the company will need to bring down the cost of the system to make it more competitive on the Chinese market. Yet he already sees huge potential for CO₂ systems in China – and explains that Dongqi is currently in the process of marketing the system to end users.

Dongqi has a long history of working with CO₂ technology in China. Since it began to develop its own CO₂ heat pumps in 2009, the firm has grown to



2 /

become one of the leading manufacturers and suppliers of CO₂ heat pumps in China, boasting more than 700 units installed in the market at the end of 2017.

XingXing and Dongqi join other OEMs offering transcritical CO₂ rack systems in China, including China-based Panasonic Appliances Refrigeration System (Dalian) Co., Ltd., which exhibited its own transcritical CO₂ rack system at China Refrigeration in April 2018 (Panasonic did not exhibit the system at ChinaShop last year). Likewise Haier Carrier, which offers the CO₂OLtech EVO transcritical CO₂ system on the Chinese market, opted not to exhibit the system at ChinaShop 2018.



XingXing's transcritical CO₂ rack.

Hydrocarbon uptake increasing in China

Austria-headquartered OEM AHT Cooling Systems reported growing interest among Chinese customers attending ChinaShop in the energy efficiency benefits of propane (R290) systems. The company was exhibiting its propane cabinets at its own ChinaShop booth for the first time.

According to Jonas Chen, general manager, AHT Cooling Systems (Changshu), interest in and sales of AHT's propane solutions are growing in China due to the refrigerant's energy efficiency and an increased focus on environmental sustainability among market leaders.

Chen said AHT was in discussion with some of the "top ten big players" in China's food retail business to purchase R290 cabinets, though he did not reveal names.

Asked why these customers were interested in propane, Chen replied, "they want to take the lead and set a good example for others by saying, 'as a retailer we care about reducing energy consumption and [improving] environmental sustainability'".

All of the AHT cabinets on display at the exhibition boasted a rating of 'Level 1' on the China Energy Label (CEL) – an energy consumption label for products in China similar to that used in the European Union.

Chen said it was very rare for a product to achieve the highest energy-efficiency rating under the CEL, attributing AHT's score to a combination of using propane alongside variable speed drives.

"We are very happy," Chen said, "because not many equipment providers can provide 'Level 1' plug-in units. But we already have a whole series of these models here".

AHT was also at ChinaShop to exhibit its propane-based water-loop system. The firm is striving to educate its customers on the system's benefits – including simplified and shortened installation processes and increased flexibility for store owners compared to centralised or remote refrigeration systems.

XingXing is also a major manufacturer of R290 cabinets in China, and exhibited them at its booth. Both AHT and XingXing drew attention to the standards revision process under the auspices of the International Electrotechnical Commission (IEC), which could increase the charge limit on flammable refrigerants like hydrocarbons in commercial refrigeration equipment from 150g to 500g under IEC standard 60335-2-89 (see *'The home straight'*, *Accelerate Europe*, December 2018).

"With the new regulation for an R290 charging volume limit increase from 150 to 500 grams, more and more of XingXing's plug-in cabinets will start to use R290, replacing R404A," said Zhang. Chinese regulation currently limits the charge to 250g.

A charge limit increase would have a positive effect on the uptake of AHT's larger R290 cabinets in China, said AHT's Chen.

"For our bigger [R290] systems, normally we need a charge of around 400g," he explained. "To comply with current regulations, we therefore have to have three independent [refrigerant] circuits. This means we have three compressors and three systems running, which increases the cost of the whole unit. It also increases the complexity of the system."

"If the limit is increased to 500 grams, we can use just one system to cover one unit. That will make everything simpler and easier to use. It will bring us a lot of advantages, so we're eager to see what happens," Chen said.

Other significant barriers to wider uptake of natural refrigerants in China include high initial costs and a lack of trained technicians. But suppliers of CO₂ and hydrocarbon-based technology remain confident.

At ChinaShop, the companies cited above spoke of a continued push for education and awareness building, especially among the Chinese government and end users, helping to overcome these barriers.

The ATMosphere China conference on natural refrigerant technology, organised by *Accelerate* publisher shecco, serves as a key platform to continue this discussion. The next event will take place in Shanghai on 11-12 April 2019.

For more information, visit www.atmo.org/china2019.

■ DY



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HAIL TO THE INNOVATORS

METRO AG, Unilever, E.ON Sweden, GEA and Sergio Girotto received *Accelerate Europe* awards for advancing natural refrigerant adoption at an ATMOSphere Europe ceremony.

— By Andrew Williams

In an evening ceremony on 20 November at the ATMOSphere Europe 2018 conference – organised by shecco, publisher of the *Accelerate* magazine series – at Lago di Garda, Italy, representatives of four companies and one individual were recognised with *Accelerate Europe* awards for their unique contributions to advancing natural refrigerants in Europe.

As with the first edition of the awards in 2017, the assessment criteria for the Best-in-Sector Awards included metrics such as the number of installations of natural refrigerant systems, reductions in energy consumption and greenhouse gas emissions, commitment to future installations, and industry leadership.

The Innovation of the Year award looked at companies that had recently developed a particular natural refrigerant-based product with a significant impact on the market, with multiple installations in the field already.

For the second year running, the Innovation of the Year was chosen by the public. Conference participants could vote for it via the ATMOSphere Europe app, while this year people were also able to vote online in the week prior to the conference.

The Person of the Year award sought to recognise someone who has demonstrated clear leadership in forging new pathways for natural refrigerants in Europe – an individual who has changed the game.

Accelerate Europe profiles the winners on the following pages, while Person of the Year Sergio Giroto is profiled on [page 38](#).

All our winners reflect the mission of *Accelerate Europe*, which is to cover people, companies, technologies and ideas that disrupt the HVAC&R industry and advance the business case for natural refrigerants in Europe.

INNOVATION OF THE YEAR

BLUQ, GEA AIR CONDITIONING WITH AMMONIA

This year's winner of the Innovation of the Year award is German multinational GEA for the BluQ, a low-charge ammonia chiller for air conditioning large buildings.

Manuel Fröschle, GEA's application engineering manager responsible for natural refrigerants, said, "I collect this award on behalf of my colleagues in Berlin who were involved in the long process of developing this innovative product that can push the use of ammonia into air conditioning".

"Thank you very much to the voters who saw this innovation worthy of the award. We're very proud of it," Fröschle said.

The BluQ was launched at Mostra Convegno Expocomfort in Milan, Italy in March 2018.

BEST-IN-SECTOR: FOOD RETAIL

METRO AG BRINGING CO₂ TO NEW MARKETS

Germany-based METRO AG, the winner of the Best-in-Sector: Food Retail award, is a world-leading international wholesale and food retail company.

METRO has built a global reputation for environmental protection by committing to reducing CO₂ emissions across the group by 50% by 2030 (vs. 2011 levels).

The METRO Group's F-Gas Exit Program helps to deliver this target. In place since 2013, it aims to phase out f-gases in all METRO stores worldwide by 2030, replacing them with natural refrigerant systems where it is technically and economically feasible to do so.



The 2018 award recognises METRO's commitment to natural refrigerants in challenging new markets such as Russia and China in particular.

The installation of China's first transcritical CO₂ system in the retail sector, in a METRO wholesale store in the Lishuiqiao area of Beijing (which opened in January 2018), was the first step in a journey that will see the German multinational fit transcritical systems in all its new Chinese stores by 2025 (see '[Chinese retail's first transcritical CO₂ system](#)', *Accelerate China*, April 2018).

Olaf Schulze, METRO AG's director of facility, energy and resource management, collected the award on the group's behalf.



"I'm very proud to receive this award. I take it on behalf of my colleagues, who are working with me in the 25-35 countries around the world in which we operate – in Germany, France, Bulgaria, Italy, Portugal, Russia, China and many more," Schulze said.

"We're all on the same team – fighting for natural refrigerants in METRO," he said.

BEST-IN-SECTOR: LIGHT COMMERCIAL

UNILEVER HYDROCARBON-COOLED ICE CREAM

Dutch-British transnational consumer goods giant Unilever picked up the Best-in-Sector – Light Commercial award in recognition of its commitment to hydrocarbons, which it decided to adopt in 1999.

Unilever currently has some 2.6 million hydrocarbon-based ice-cream cabinets out in the field. It prefers to use propane (R290) and isobutane (R600a) for low-temperature applications.

Fabio Roberti, who is responsible for cabinets in Unilever's Italy office, collected the award at Lago di Garda.

"It's an honour for me to receive this award on behalf of Unilever," Roberti said. "I'm happy that the hard work of the past few years has been recognised."

"I'm proud that Unilever has purchased over 2.6 million ice-cream cabinets running on natural refrigerants," Roberti said. "And that reducing the environmental impact of our cabinets is embedded in the Unilever Sustainable Living Plan."

Roberti explained that Unilever focuses on two areas. "The first is to cut greenhouse gases by switching to natural refrigerants, and the second is to dramatically reduce energy consumption, thereby decreasing indirect CO₂ emissions," he said.

"Our journey hasn't ended. Unilever will continue to work with and innovate alongside the key freezer manufacturers to further reduce energy consumption, and also to explore using renewable energies to run our cabinets," Roberti said.

BEST-IN-SECTOR: INDUSTRIAL

E.ON SWEDEN AMMONIA HEAT PUMPS IN MALMÖ HARBOUR

E.ON, one of the world's largest investor-owned electric utility service providers, won the Best-in-Sector: Industrial award for a 40 MW ammonia heat pump project for district heating in the harbour area of the city of Malmö, Sweden.

Four GEA ammonia heat pumps, each with a heating capacity of 10 MW, use the heat from Malmö's sewage treatment and waste incineration plants to deliver heating to approximately 100,000 homes in the Swedish city.

Mats Egard, E.ON Sweden's heating segment project manager, was responsible for delivering the Malmö installation, while Kenneth Hoffmann, GEA's product manager for heat pumps, was also involved in the Malmö project.

Picking up the award on E.ON Sweden's behalf, Hoffmann said, "Mats is sorry he couldn't make it here today, and he's very happy that E.ON Sweden has won this award".

"Personally, I'm very pleased that this very big ammonia heat pump installation has won, because this is a territory into which natural refrigerants can still make a lot of progress," said Hoffmann, lamenting that the household heat pump market continued to be dominated by HFCs.

"This is an area where we must all work hard to grow natural refrigerants," Hoffmann said. "Hopefully this award is the first step in recognising that natural refrigerants are the way forward. I hope we'll see a lot more natural refrigerants in large heat pumps in the future," he said.

■ AW

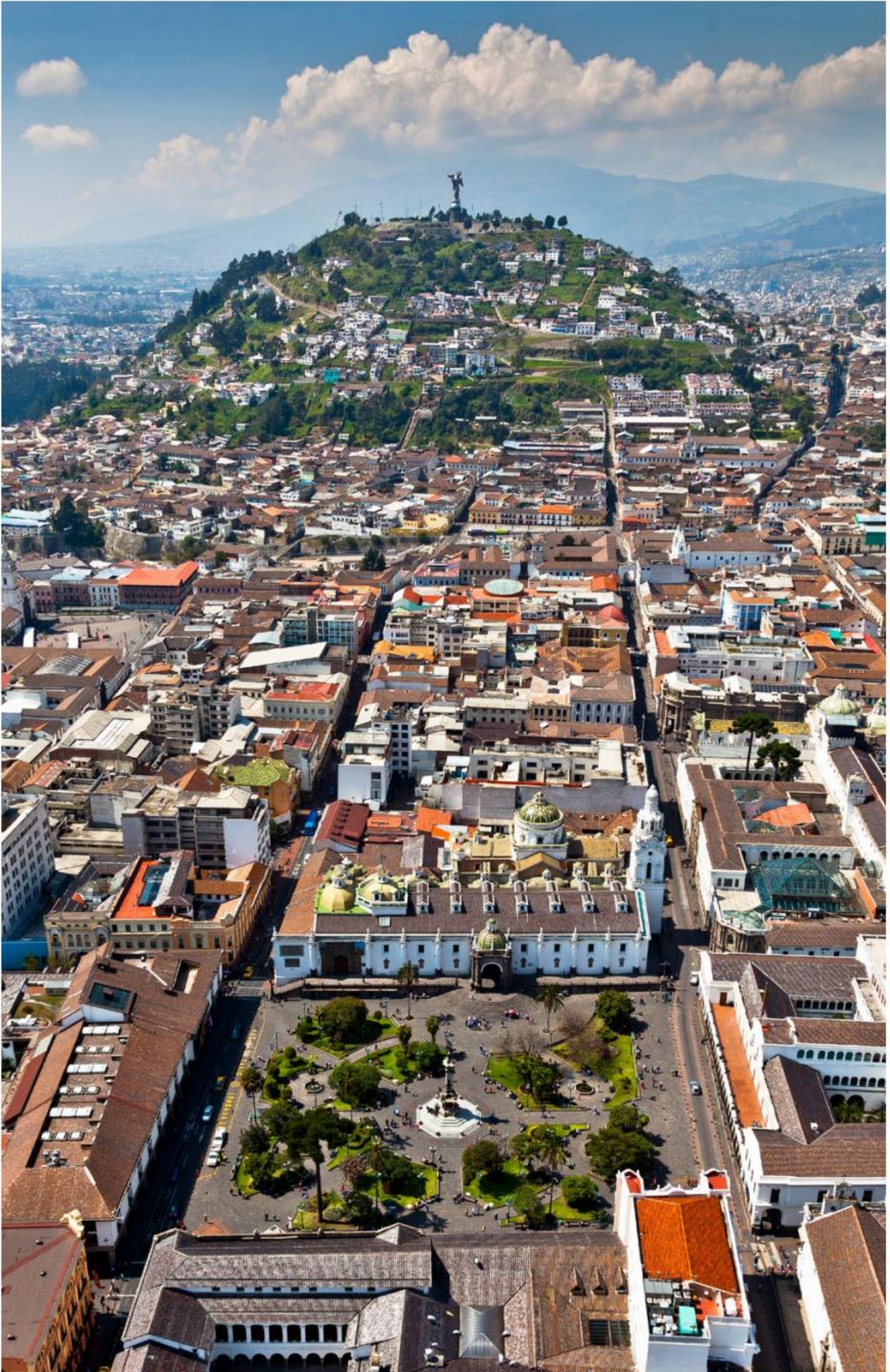
1 / Fabio Roberti, Unilever (l)
& Marc Chasserot, shecco (r)

2 / Olaf Schulze, METRO AG

3 / Kenneth Hoffmann, GEA

4 / Manuel Fröschle, GEA

Photography by:
Ben Beech



IMPLEMENTING THE KIGALI AMENDMENT

Parties to the Montreal Protocol are beginning to discuss supporting energy-efficient technologies while phasing down hydrofluorocarbons, improving compliance mechanisms, leapfrogging to natural refrigerants in emerging economies, and revising safety standards. *Accelerate Australia & NZ* reports from the 30th Meeting of the Parties to the Montreal Protocol in Quito, Ecuador.

— By Marie Battesti

With the Kigali Amendment to the Montreal Protocol on phasing down hydrofluorocarbons (HFCs) entering into force on 1 January 2019 after surpassing the required ratification threshold, the Parties met last November in Quito, Ecuador to negotiate practical arrangements for its swift implementation.

Although official decisions taken at the 30th Meeting of the Parties to the Montreal Protocol on 5-9 November 2018 focused on technical provisions such as approved technologies for the destruction of HFCs and new data-reporting requirements, it was the strength of political will to support the development of alternative technologies that took centre stage.

UNEXPECTED RISE OF CFC-11 EMISSIONS IN CHINA

The Environmental Investigation Agency (EIA) – an NGO active in the Montreal Protocol arena – last July revealed that several Chinese companies were still using refrigerant CFC-11 long after it had been phased out in rigid polyurethane foam (used predominantly as insulation by the construction industry).

The Parties to the Montreal Protocol found themselves oscillating between old and new challenges: the old being having to address the unexpected rise in emissions in China of CFC-11, a substance that has been banned since 1996; and the new being the potential need to reassess the Protocol's institutions to address compliance and enforcement. The CFC-11 emissions problem, "is a

threat to the Protocol, as much as it is a threat to ozone-hole recovery," said the United States in plenary, urging Parties to "take a pause and reassess how we got here", reported [IISD Reporting Services](#).

"It is critical to invest in systemic changes to aid continued compliance and also address the related issue of refrigerant banks, which could avoid up to 97 billion tonnes of carbon emissions equivalent globally between 2020 and 2050," said Avipsa Mahapatra, climate campaign lead in the EIA's US office.

In Quito, the Parties committed to providing all available data on the illegal use and production of ozone-depleting CFC-11, to enable the relevant Montreal Protocol bodies to act to ensure compliance with the United Nations environmental treaty.

Each Party will need to take measures to ensure that the phaseout of CFC-11 is sustained, and to share information on any illegal use or production of CFC-11 to the relevant Montreal Protocol bodies.

CALL FOR TECH NEUTRALITY ON SAFETY STANDARDS

European Commission representative Philip Owen stressed the need for the Montreal Protocol to be technologically neutral in analysing and identifying the relevant safety standards to achieve the HFC phasedown.

Owen highlighted the role of the Ozone Secretariat – part of UN Environment, and which organises the Montreal Protocol meetings – in providing the Parties with the relevant existing safety standards to help ensure that they fulfil their obligations under the Kigali Amendment.



ENERGY EFFICIENCY UNDER KIGALI TAKING SHAPE

Parties discussed the need to explore opportunities to create a financial architecture under the Montreal Protocol to support the development of energy-efficient refrigeration, air-conditioning and heat pump technologies while phasing down HFCs.

The Technical Economic Assessment Panel (TEAP) – a Montreal Protocol body – recommended that Parties update the Multilateral Fund, which finances projects in emerging economies and streamlines processes to enable timely access to funding through external financial institutions.

The Parties warned against making access to funding unnecessarily complex for fear that this could jeopardise the Montreal Protocol's objectives. They stressed the need to keep the interests of consumers at the centre of the new funding architecture, by prioritising a mechanism that would mitigate the price of energy-efficient technology at the consumer stage.

DEVELOPING COUNTRIES VOICE SUPPORT FOR NATREFS

Emerging economies are showing interest in leapfrogging HFCs by adopting natural refrigerants to replace the hydrochlorofluorocarbons (HCFCs) being phased out under the Montreal Protocol.

Chile and Cameroon told *Accelerate Australia & NZ* that they were interested in natural refrigerants as a means of leapfrogging from HCFCs to very low global warming potential (GWP) refrigerants. Most developing countries will freeze consumption of HFCs by 2024, with their first reduction steps starting in 2029.

"There is definitely very high interest in natural refrigerants in Africa," a delegate from Cameroon told *Accelerate Australia & NZ*. "I believe there is great potential for hydrocarbons," the delegate said.

Chile and Cameroon are eligible for financial assistance under the Multilateral Fund for the Implementation of the Montreal Protocol.

Claudia Paratori Cortés, from Chile's Office of Climate Change in the Ministry of Environment, highlighted progress made by South America in adopting CO₂ transcritical technology.

"Chile prioritises the adoption of natural refrigerants. We are trying to leapfrog from HCFCs to natural refrigerants, and we are trying to avoid HFOs as much as possible," Paratori Cortés explained.

"I see great potential to develop natural refrigerants in Chile. Many supermarkets are moving to CO₂ transcritical technology. Other industries, such as cold storage rooms, are also examining opportunities to adopt this technology," she said.

Growing awareness that the Parties will not be able to fulfill their objectives under the Kigali Amendment without natural refrigerants should help supporters of these environmentally friendly alternatives to HFCs to lift barriers to their uptake and allow them to fulfil their potential, according to Marie Battesti, a policy analyst for sheccoBase (the market development arm of shecco, publisher of this magazine).

Supporters of natural refrigerants must continue to monitor the negotiations and feed the debates with relevant market data and information regarding their potential to achieve the global HFC phasedown while saving energy compared to traditional equipment, urged Battesti in Quito.

■ MB

ABOVE

L-R: Gilbert Bankobeza, Ozone Secretariat; Tina Birmpilli, executive secretary, Ozone Secretariat; MOP 30 President Liana Ghahramanyan, Armenia; Megumi Seki, deputy executive secretary, Ozone Secretariat; Martha Leyva, Jacqueline Nyanjui, and Martha Mulumba, Ozone Secretariat.

Photo by IISD/ENB | Angeles Estrada.

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LOW-CHARGE NH₃ CHANGING THE GAME

Accelerate Australia & NZ sits down with Scantec's Stefan Jensen to hear how low-charge ammonia systems continue to change the game in the global cold storage and logistics industries through superior design and energy efficiency.

— By Devin Yoshimoto

Since first developing the modern version of its central-style low-charge ammonia systems in 2013, Australia-based Scantec Refrigeration Technologies (Scantec) has consistently led development and discussion of the technology worldwide.

The company currently boasts 17 installations in operation (with three more under construction). Most of these are located in Australia, with a few in China.

Having returned from speaking about low-charge ammonia systems in Germany, Scantec Managing Director Stefan Jensen spoke to *Accelerate Australia & NZ* about the potential for a huge global ammonia retrofit market, a recently completed installation in Brisbane, upcoming projects, and more.

// Accelerate Australia & NZ: What can you tell us about your most recent low-charge ammonia system installation in Brisbane?

Jensen: We've recently installed a low-charge, two-stage, central-style ammonia plant for a transport depot in Brisbane. The refrigerated volume is around 45,000 m³ and the system is in commissioning right now.

That one is quite good because it is DX (direct expansion), both on the low-temperature side and on the

medium-temperature side. It's DX all the way through, and there are no ammonia pumps. The low and medium-temperature capacities are 194/192 kW respectively with future expansion to 284/241 kW.

// Accelerate Australia & NZ: You have just returned from a refrigeration and air-conditioning technology conference in Germany, where you shared your knowledge about low-charge ammonia systems and energy performance. What kind of response did you receive?

Jensen: Yes, on the suggestion of one of our suppliers based in Germany, I attended the German Refrigeration and Climate 2018 conference in Aachen last November.

The event was organised by the German Society of Refrigeration and Air Conditioning (*Deutscher Kälte- und Klimatechnischer Verein* or DKV), which is a technical research organisation for refrigeration, air conditioning, and heat pump technology.

I received two major responses.

The first was that several companies showed interest in our low-charge ammonia installations.

One was from a German company, Kreuzträger, which has done 10 so-called low-charge ammonia systems. However they are not real central-style, low-charge ammonia systems. Because on the low side, they still use ammonia circulation

pumps and conventional distributors. They are still developing, but the interest was clearly there.

The other response was that I was being challenged on data I was showing about the poor energy performance of transcritical CO₂ systems in Melbourne.

Now, we have been given energy performance records for a transcritical CO₂ system for a small warehouse that has already been operating in Australia for over a year.

If you work out the specific energy consumption in kilowatt hours per cubic metre per year, it uses twice as much as an equivalent low-charge ammonia system located in the same neighbourhood.

I had to explain that refrigerant choice only has a minor impact on annualised system energy efficiency and that superior energy performance is all about system design. Everybody in the room liked that a lot, because there was a lot of applause.

I believe the refrigerated warehouse industry is ill-advised investing in something that has no chance of ever being as good as ammonia can be when it is done well.

I also believe that a huge ammonia retrofit market is emerging globally. Millions of existing ammonia plants are currently likely to be a long way away from the best energy performance they could deliver if modified appropriately.

// Accelerate Australia & NZ: We have also heard that you implemented a number of firsts at a recent installation in Australia. Could you tell us a bit about that?

Jensen: That's right. It's not a low-charge system. However, it is the first system in Australia with insulated coolers. It is also the first plant in Australia, to my knowledge, that uses cold lake air distribution.

The system was installed at a cold storage facility and has been in operation since August last year.

// Accelerate Australia & NZ: What is cold lake air distribution?

Jensen: What happens is that, inside the cold store, instead of blowing the cold air horizontally out from the evaporator and then expecting it to come back at low level, we do the opposite here.

We blow the air vertically down towards the floor. The cold air then crawls along the floor. As it heats up in the warehouse, it becomes lighter than the surrounding air. Then the warmer air in the cold store rises to the ceiling and then returns to the evaporator at high level without the use of ducts.

// Accelerate Australia & NZ: Why was cold lake air distribution implemented here?

Jensen: The builder didn't want any ducting inside the room. Normally when you use insulated coolers, you have long ducts inside the refrigerated warehouses.

We proposed cold lake air distribution, which avoids having air supply ducts inside the refrigerated warehouse.

// Accelerate Australia & NZ: What are you looking forward to in 2019?

Jensen: We may be getting close to being awarded a central, low-charge NH_3 refrigeration plant for a high-rise cold store in Asia.

The existing central liquid overfeed plant with screw compressors in two-stage configuration has an energy consumption of 59 kWh/m³ per year to service 37,000 m³ of refrigerated volume.

The predicted energy consumption of the new low-charge NH_3 system servicing the additional 110,000 m³ is 11 kWh/m³ per year.

This has the capacity to be a game-changer.

■ DY

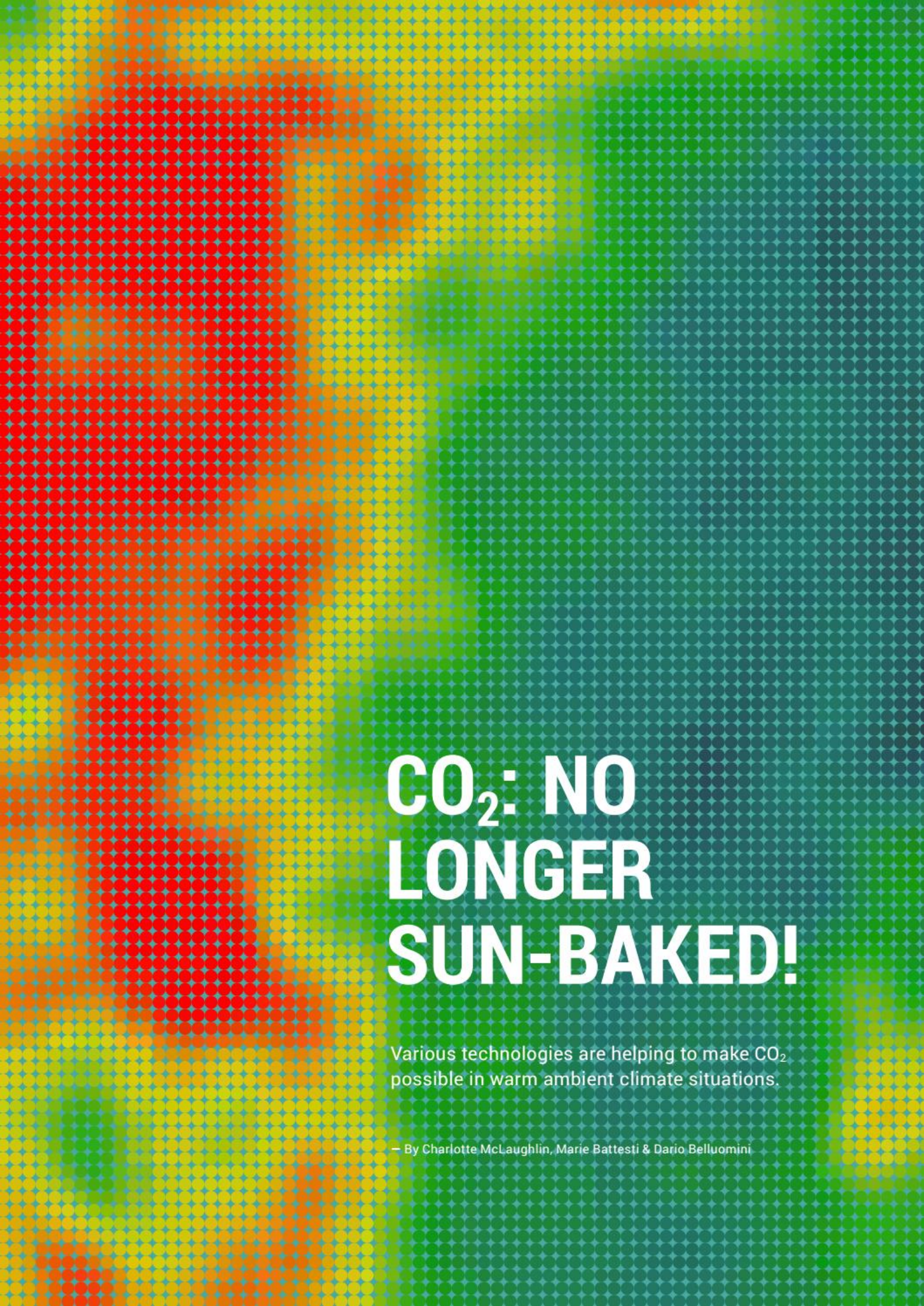


Scantec's central low-charge NH_3 (300 kg) plant room, in Brisbane.



The cold lake air distribution system installed at a cold storage facility last August.

Photography: Marty Pouwelse Photography



CO₂: NO LONGER SUN-BAKED!

Various technologies are helping to make CO₂ possible in warm ambient climate situations.

— By Charlotte McLaughlin, Marie Battesti & Dario Belluomini

Upon its rediscovery as a refrigerant during the 1990s, CO₂ was not considered suited to warm climates – and this idea that it is a refrigerant only for cold countries has never really left the minds of many in the HVAC&R industry.

“For a long time, the greatest challenge for CO₂ [transcritical] refrigeration systems has been efficiency in warmer climates,” according to the *‘Technical report on energy efficiency in HFC-free supermarket refrigeration’*, published by the Environmental Investigation Agency (EIA) and shecco, publisher of this magazine, and funded by the Kigali Cooling Efficiency Program (KCEP).

This warm ambient climate issue is commonly defined as the ‘CO₂ equator’ – the previously accepted geographical limit for cost-effective and efficient performance of CO₂ systems in all food retail store formats.

Compared to other refrigerants, the thermodynamic properties of CO₂ are quite different, as acknowledged in a 2004 paper by Professor Petter Neskå of the Norwegian University of Science and Technology (NTNU), Trondheim.

“Experience from testing and modelling of CO₂ refrigeration and air-conditioning systems shows that cooling COP [coefficient of performance] is more sensitive to ambient temperature variation than with conventional refrigerants,” Neskå explains.

“This typically leads to the situation [...] where the CO₂ system is superior at moderate and low ambient temperature, and slightly inferior at very high temperature.”

This critical point of CO₂ – 31.10°C – means that at high ambient temperatures, it exists as a supercritical fluid (without distinct liquid and gas phases), and more energy is required in the vapour compression cycle.

Yet despite this efficiency challenge, CO₂ has been moving increasingly south to warm ambient temperature countries where it was not thought possible a few years ago, like Australia (see *‘One Man’s Vision’*, *Accelerate Australia & NZ*, winter 2018), China (see *‘Chinese retail’s first transcritical CO₂ system’*, *Accelerate China*, April 2018), Indonesia, India (see *‘Innovators take to Gustav Lorentzen stage’*, *Accelerate Europe*, autumn 2018), Jordan (see *‘Sun shines on CO₂ in Jordan’*, page 26) and Mexico (see *‘Casa Ley takes a swing at transcritical’*, *Accelerate America*, September 2018).

“To overcome such challenges, experts in the field developed and introduced certain types of processes and components, which managed to overcome the so-called CO₂ equator,” the EIA/shecco report says.

These technologies, familiar to CO₂ enthusiasts, include parallel compressors, liquid ejectors, adiabatic cooling and mechanical sub-cooling.

Saving with parallel compression

Parallel compressors enhance the performance of conventional CO₂ transcritical refrigeration systems by recovering the energy loss.

In simple terms, parallel compression recovers the flash gas (the refrigerant in gas form produced spontaneously when the condensed liquid is subjected to boiling) lost in a CO₂ transcritical cycle by using the compressors to compress some or all of the vapour generated by the liquid receiver from an intermediate pressure to a higher one, according to Gullo et al. in a 2016 paper: *‘Energy and environmental performance assessment of R744 booster supermarket refrigeration systems operating in warm climates.’*

They recover the flash gas by re-directing it through an internal heat exchanger and then to the separate parallel compressor or compressors. “Adding parallel compression delivers 6-8% savings for the operation of the transcritical system,” notes the *‘Technical report on energy efficiency in HFC-free supermarket refrigeration’*.

Since the development of this parallel compression technology, many end users, such as Jordan’s Al-Salam military supermarket, Makro in South Africa, Selgros Cash and Carry in Romania (see *‘Scaling new heights in Romania’*, *Accelerate Europe*, autumn 2016), Migros in Switzerland (see *‘In Migros’s DNA’*, *Accelerate Europe*, summer 2018), Iper in Italy, and Carrefour in Spain (see *‘Crossing the CO₂ equator: Carrefour leads the march south’*, *Accelerate Europe*, summer 2016) have used it in warm ambient climates to achieve energy efficiency with CO₂, according to the report.

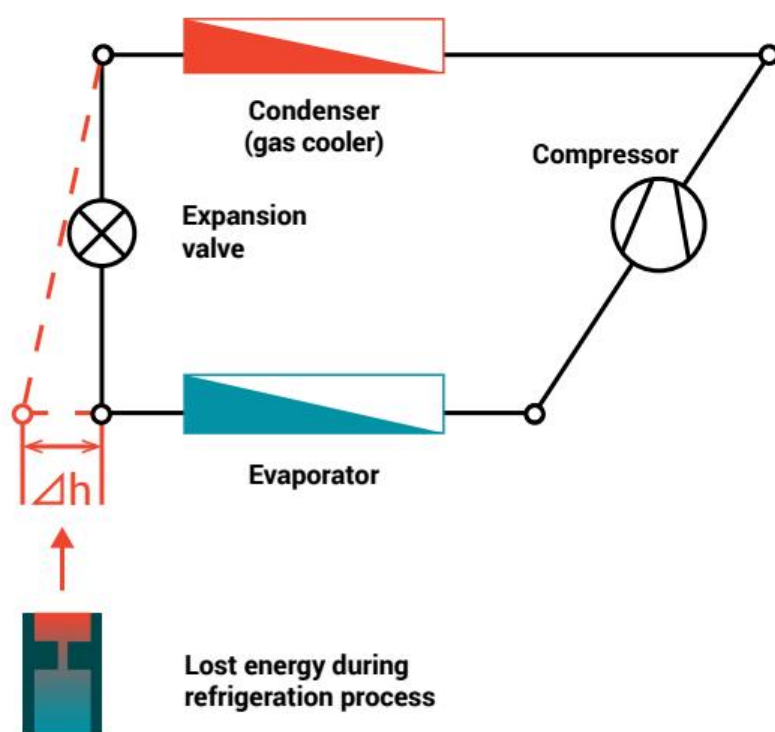
Geeking out on ejectors

Added to this, the development of the ejector has been hailed as a key achievement that is bringing CO₂ to warm ambient climates.

The devices can improve the efficiency of refrigeration systems by up to 20, 30 or in some cases 40% (see *‘Ejectors: To efficiency, and beyond’*, *Accelerate Europe*, winter 2016).

How do they work? The diagram overleaf depicts the energy lost during the refrigeration cycle as heat is transferred between the condenser, expansion valve and evaporator. Introducing an ejector into this space can improve compressor efficiency by recovering energy that is normally lost during the vapour compression cycle.

Figure 1:
Energy lost during refrigeration cycle



Source: Presentation by
Masahiro Takatsu, DENSO,
ATMOsphere Asia 2016

in another shecco report entitled '*F-Gas Regulation: Shaking up the HVAC&R industry*' from 2016 (see page 28 of the report) argued that the cost of ejectors is a non-issue – insisting that adding ejectors and parallel compression increases the price of a system by 10% at most.

Data from Danish CO₂ rack manufacturer Advansor reveals the strong relationship between increased efficiency of CO₂ systems and falling component prices (see table, page 75, *Accelerate Europe*, winter 2016).

Ejectors are proving popular despite price challenges. A study, supported by the Swiss Federal Office of Energy (SFOE) and published in December 2017 by the German magazine *Kälte Klima Aktuell*, reports that, "according to estimates, several hundred [CO₂] ejector systems are currently in use, the majority of which are in Europe".

Migros, the largest retailer in Switzerland, in December 2017 counted 60 stores fitted with CO₂ refrigeration technology using ejectors and said it planned to add 30 more every year.

"Today, ejectors are integrated into the planning of cooling technology as standard for the renovation and new construction of Migros stores whenever they are economical," said Daniel Duss, head of construction and technology at Migros Cooperative in Lucerne.

Coop, Switzerland's second-largest retail chain, also has opted to use ejectors, according to the study. "Refrigeration needs in food markets account for about half of the electricity consumption, which is why the ejector makes a significant contribution to the reduction of energy consumption," said Thomas Häring, head of energy and technology at Coop.

The ejector achieves this by increasing the compressor's intake pressure. Sounds complicated, right? The essential point is that ejectors yield significant long-term cost benefits to end users.

Many leading OEMs have had success with ejectors in the field – including enEX, Carrier/CAREL, Danfoss, Compact Kältetechnik and Würm – in a variety of different climates.

"We started trialling ejectors in 2014/2015 and released our first ejectors to the general market earlier this year, but we already have over 300 ejectors in the market," Danfoss' Hans Ole Matthiesen told *Accelerate Europe* at Chillventa 2018 in Nuremberg, Germany.

Danfoss primarily sells vapour multi-ejectors (which are made of blocs of around six ejectors stacked in rows), but they have also now launched a liquid ejector. "We were taking our time to bring the liquid ejector to market. I think it's very important to make sure the systems are simple [...]. We've been testing liquid ejectors for two years," Matthiesen adds.

Liquid ejectors, comprising an expansion valve system, use the energy of the high-pressure gas to lift liquid from the suction accumulator.

Carrier/CAREL's electronic modulating ejector (EmJ), launched in a joint venture in 2016, has also been a success. "This is not [...] a novelty in the refrigeration industry," Diego Malimpensa, CAREL's business unit manager – retail solutions, argued at Chillventa. But he did point out that more work needs to be done to make it a "standard" technology.

The EmJ's fundamental feature is the continuous modulation ensured by the ejector, which via dedicated control algorithms allows the system to continuously adapt to a refrigeration system's typical variations in operating conditions. The EmJ now comes in various sizes suitable for small stores and large stores, as well as industrial refrigeration systems with CO₂.

Ejectors and parallel compression also can mean the systems end up paying for themselves, as demonstrated by the efficiency of the Jordan CO₂ supermarket. Industry experts quoted



CAREL/Carrier's EmJ modulating ejector. Ejectors help to improve efficiency in warm climates.

Opening up the bag of tricks

Apart from ejectors and parallel compression, there are other tools in the HVAC&R technician's box to increase the efficiency of CO₂ in warm climates.

At ATMOsphere Europe 2018, organised by shecco – publisher of this magazine – at Lago di Garda, Italy on 19-21 November, there was a session dedicated to precisely this question.

Epta's Refrigeration Systems Sales & Marketing Manager Francesco Mastrapasqua presented the Italian firm's FTE (full transcritical efficiency) concept, which works by flooding the evaporators to eliminate superheat. "The FTE system is leading to annual energy savings of around 10% in warm countries like Malta, Italy, and Portugal," said Mastrapasqua.

"FTE could use parallel compression, but we want to promote it as a simple system," he said, explaining that it was developed to take account of, "the situation in developing countries where the knowledge about CO₂ is not that advanced".

Mastrapasqua said that in one case study in Malta, the ROI on the system was just 1.5 years.

The FTE was also the subject of a site visit to the Italmark supermarket in Brescia. Alvise Case, energy manager

at Epta, said that the system had been running for two years. "It is leading to significant energy savings when compared with conventional installations in the same area," Case said.

LU-VE is also developing technologies that help to improve efficiency in warm climates. "We have been pioneers of CO₂ transcritical installations in Europe since the early 2000s, and in 2018 we were proud to install the first CO₂ transcritical systems in India and Jordan," said LU-VE Marketing Manager Livio Perrotta at ATMO Europe 2018.

The Emeritus, a solution developed with the Polytechnic University of Milan, involves adiabatic precooling with a spray function. In this way, the system exploits the synergy between two effects: adiabatic humidification and the evaporation of water on the coil. Thanks to a sophisticated control system, the Emeritus boasts efficient performance in different climatic conditions.

The group is now "pushing to install it in southern Italy," said Perrotta. "The results of a simulation for a store in Trapani (Sicily) show that the Emeritus would lead to 9% energy savings in a year, thanks to the increased efficiency of the system and the reduction in outlet temperature," he said.

Perrotta stressed the importance of training. "Not all installers are familiar with CO₂," he said.

Other manufacturers of heat exchangers such as Modine, Güntner, Evapco, Alfa Laval, and Baltimore Aircoil Company (BAC) also offer CO₂ adiabatic systems in Europe.

Giovanni Gonzato, sales and applications engineer at Frascold, showed the results of simulations done for a CO₂ transcritical system using the firm's CapaFlex capacity control system. "It was developed in a partnership with the University of Padua," said Gonzato.

"Thanks to the innovative stepless capacity control – without the use of a variable frequency driver – the CapaFlex configuration is more efficient than conventional systems in high ambient temperatures," Gonzato said.

"Sometimes we do not need to look at the needs in terms of energy efficiency only, but also in economic terms," he said, showing how CapaFlex would lead to lower installation and maintenance costs. "We are running more simulations to support and validate this application to understand how to better use it," he said.

Other technology ideas were also being explored to increase the efficiency of CO₂ refrigeration systems, like

controls such as Eliwell's DOMINO solution, which has been used across Europe including in Italy, Belgium, Switzerland and Spain as well as in China. Bitzer, meanwhile, recently launched a sub-cooling unit during Chillventa 2018 (see '[Natural refrigerants aim high at Chillventa](#)', *Accelerate Europe*, winter 2018).

The DOMINO was used in China's second transcritical CO₂-based refrigeration system, at a CSF Market opened in Beijing in July 2018.

The control system from Eliwell and Dorin compressors in a Panasonic CO₂ transcritical rack help the system to cope with the high temperatures experienced in the Chinese city (July 2018 temperatures in Beijing hovered at 39°C).

Adiós to 'CO₂ equator'

CO₂ has seen impressive market success in warm ambient temperatures in Europe. 16,000+ CO₂ transcritical systems have been installed in supermarkets in Europe with the help of the various technologies cited above, according to data from sheccoBase, the market development arm of *Accelerate* publisher shecco.

"CO₂ has demonstrated efficiency and security: Goodbye to the psychological barrier of the 'CO₂ equator'!" said Julio Minguillón of Carrier during ATMOSphere Ibérica, organised by shecco in Madrid on 18 September (see '[NatRefs advancing in Spain and Portugal](#)', *Accelerate Europe*, winter 2018).

"Carrier has installed more than 7,500 transcritical CO₂ systems in Europe, and 94 systems in the Iberian Peninsula, for 16 different clients," Minguillón said.

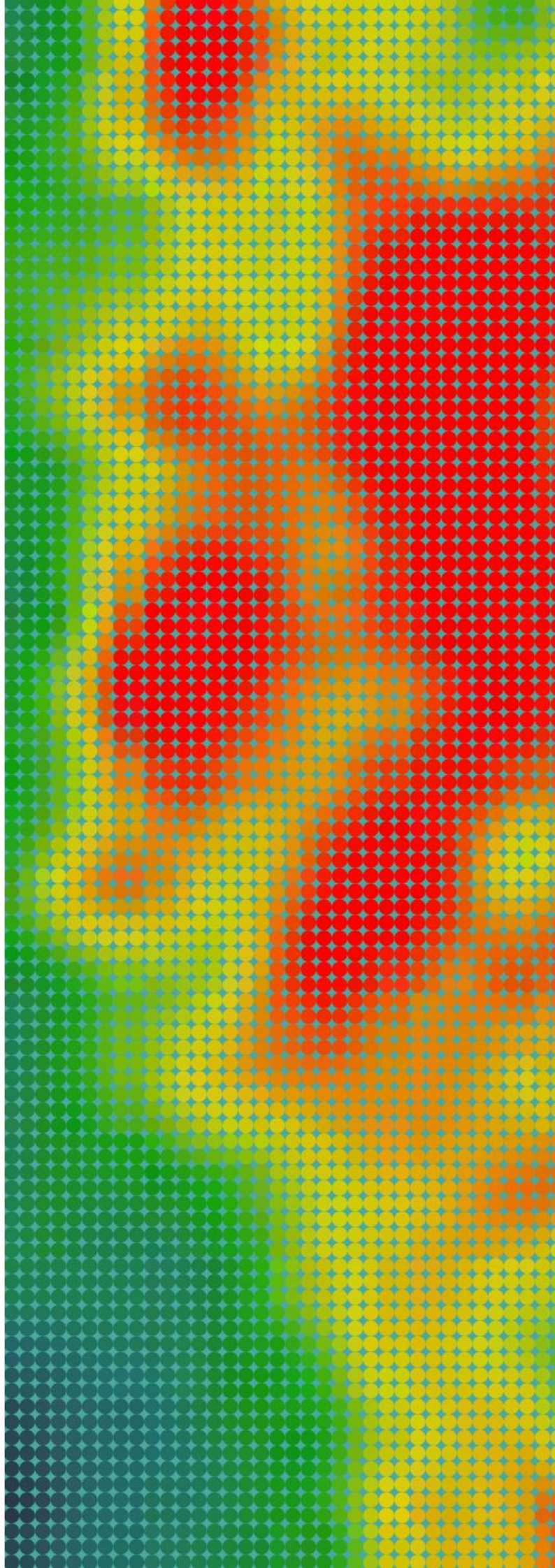
Boundary conditions like the warm climate of southern Europe had long been seen as a barrier to wider adoption of CO₂, limiting the efficiency of these systems.

Diego Ortega from Epta showed during his presentation the field results of the Full Transcritical Efficiency solution to boost the efficiency of CO₂ transcritical systems. Ortega presented the results obtained in a CO₂-based commercial refrigeration installation of 139.5 kW (-10°C) on the medium-temperature side and 34 kW (-35°C) on the low-temperature side in Bologna, Italy.

"The FTE solution has proven higher efficiency compared to a traditional system, even in warm ambient climates," said Ortega.

With all these technologies being employed in different configurations, it's 'adiós' to the CO₂ equator!

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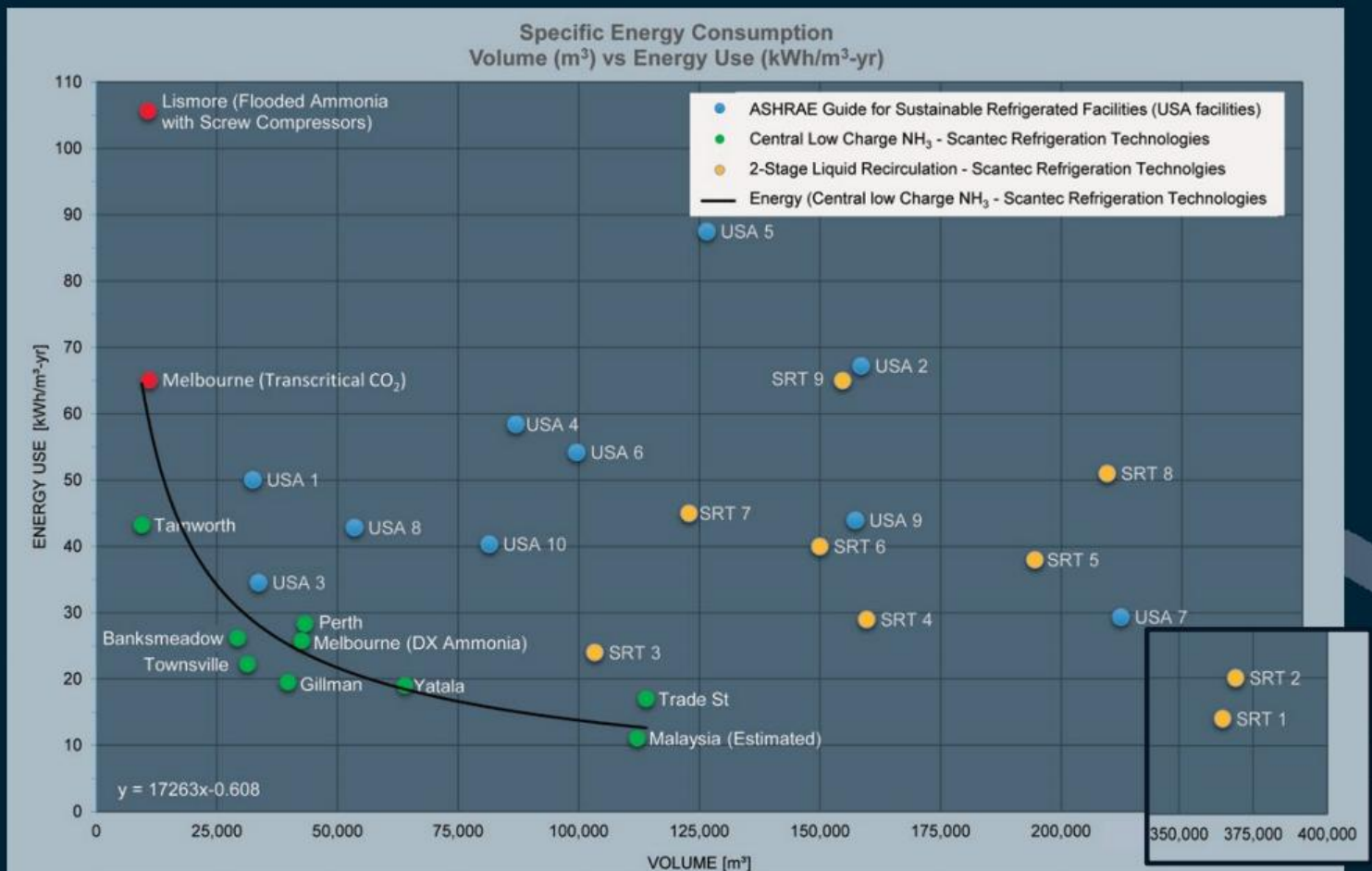
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