

SPRING 2017

ACCELERATE

ADVANCING HVAC&R NATURALLY

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

Nestlé's
pioneering vision

p. 14

Report:
ATMOsphere Asia

p. 32

CO₂ heat pump
for Alpine ski lodge

p. 62

The **CLOUD**
CATCHER — p. 18

Stone & Wood's Nick Cornish

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Sound business sense



— Editor's note by Andrew Williams

In this part of the world just like elsewhere, the first movers towards natural refrigerants were attracted by the environmental benefits. It was about companies reducing the climate footprint of their HVAC&R needs. Now we're seeing a new wave of adoption. As the technologies are scaled up and take on a bigger market share, it's about harnessing natural refrigerants to become more competitive.

With natural refrigerants we can typically see at least 10% energy efficiency gains compared to standard HFC-based equipment. The gains vary depending on the sector, climate and other criteria, with natural refrigerants capable of performing up to 20-30% better than HFC technology

in certain applications. For this new wave of end users, adopting these systems is about their bottom line.

This was the main message of Marc Chasserot – CEO of shecco, the publisher of *Accelerate Australia & NZ* – in his recent appearance on Jon Dee's Smart Money show, which aired on Sky News Australia's Business Channel on 4 October.

The Stone & Wood Brewing Company understands the business case for natural refrigerants. Nick Cornish, engineering manager at the award-winning independent craft brewer, teamed up with industrial refrigeration contractor Gordon Brothers Industries to fit a brand new ammonia plant at its brewery in Murwillumbah, New South Wales (p. 18).

Down in the Snowy Mountains, Mitsubishi Heavy Industries Air-Conditioners Australia has installed the Q-ton CO₂ air-to-water heat pump at the Matterhorn Lodge, Perisher Valley (p. 62).

Also in New South Wales, the state's Office of Environment and Heritage has released a new industrial refrigeration guide outlining 15 technologies that help save on

energy costs, including natural refrigerant solutions (p. 58).

Beyond these shores, this issue's industrial refrigeration theme continues. Swiss multinational Nestlé (p. 14), Mexican cold storage operator Frialsa (p. 50) and Belgian retailer Colruyt (p. 66) are all harnessing ammonia to satisfy some of their cooling needs.

Coverage of recent ATMosphere conferences in Asia (p. 32 and p. 54) and Europe (p. 40 and p. 44) also sheds light on the progress being made in bringing natural refrigerant-based technologies to market elsewhere in the world.

Features on the FMI Energy & Store Development Conference in Orlando, Florida (p. 46) and New Zealand-based company Photonic Innovations' new Australian partnerships (p. 60) complete this spring edition of *Accelerate Australia & NZ*.

Enjoy the issue!

■ AW



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ACCELERATE

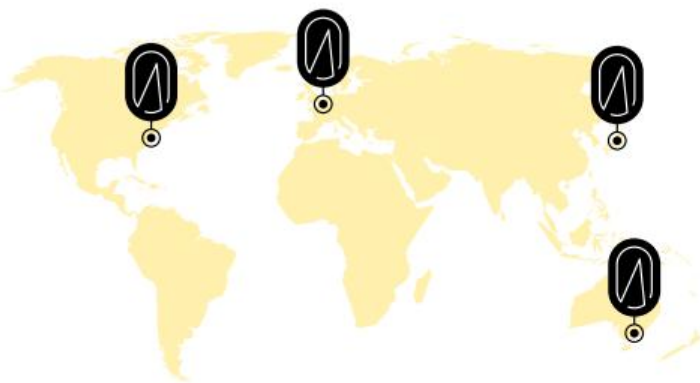
ADVANCING HVAC&R NATURALLY

AUSTRALIA & NZ

About Accelerate Australia & NZ

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

<http://accelerateaunz.com>



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03 EDITOR'S NOTE

by Andrew Williams

OPINION

06 OPINION

By Avipsa Mahapatra

08 EVENTS GUIDE

10 AUSTRALIA & NZ IN BRIEF

12 INFOGRAPHIC

Hydrocarbon standards revision

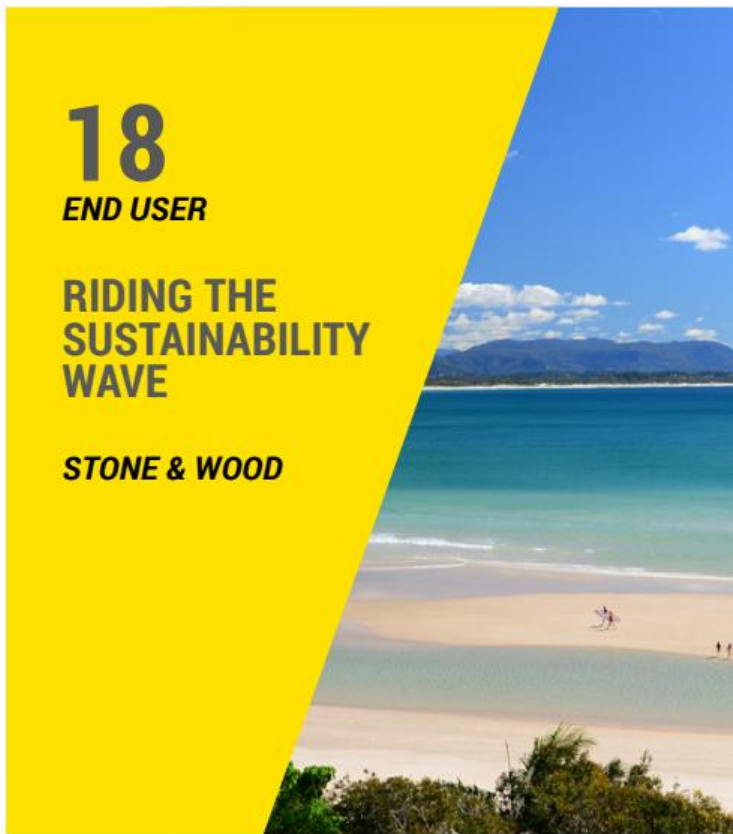


18

END USER

RIDING THE SUSTAINABILITY WAVE

STONE & WOOD



END USER

28 Coop Group flying high with ammonia

50 Ammonia-CO₂: A bold leap forward

**14****END USER****NESTLÉ'S
PIONEERING
VISION****EVENTS****32** Southeast Asia's industrial leaders eye NatRefs**40** Europe turning to future-proof natural refrigerants**44** *Accelerate Europe* awards recognise NatRef leadership**46** Retailers take lead at FMI Energy**32****POLICY****54** Kigali implementation underway in Southeast Asia**58** New guide to improving industrial plant efficiency**54****MARKET****60** Photonic Innovations foresees ammonia demand growth**TECHNOLOGY****62** Lofty potential for CO₂ heat pumps in Australia**66** Colruyt puts ammonia at heart of new factory**62**

The Kigali Amendment: Next Steps

A Montreal Protocol meeting in July in Bangkok focused on safety standards, energy efficiency and financial support for developing countries.

— By Avipsa Mahapatra

In October 2016, in Kigali, Rwanda, 197 countries agreed to extend the scope of the Montreal Protocol treaty from the original phase-out of ozone-depleting gases to a new phase-down of HFC super-greenhouse gases in what has become known as the Kigali Amendment.

Seven years in the making, this was a signature moment in the global struggle to reduce global warming. If successfully implemented, the Kigali Amendment could avoid emissions of over 70 billion metric tons of carbon dioxide equivalent (CO₂e) by 2050. Also, the amendment represents a major boost to the prospects for climate-friendly natural refrigerants.

But the work has just begun. On 11-14 July, in the first follow-up meeting to the Rwanda gathering, the Parties (countries) to the Montreal Protocol met in Bangkok, Thailand, to start addressing the critical elements needed to implement the Amendment. Officially, this was the 39th Session of the Open-Ended Working Group (OEWG) of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer.

Three key issues stood out among the topics under discussion.

Updating safety standards

Obsolete safety standards have been a barrier to market uptake of climate-friendly alternatives to HFCs in the cooling sector. To address this issue, a full-day workshop on 'Safety Standards Relevant to the Safe Use of Low-GWP Alternatives to Hydrofluorocarbons' was convened the day before the OEWG meeting.

The workshop was divided into four sessions: an overview of the international safety standards of greatest importance to the Montreal Protocol and its Kigali Amendment, and the process for developing and revising the standards; identifying limitations to the uptake of lower-GWP alternatives that could be addressed with changes to existing international safety standards; the relationship between international and national safety standards, and; how stakeholders can work together to maximise the opportunities for the safe use of lower-GWP alternatives.

Discussions revolved around unpacking the challenges associated with modernising and harmonising the standards that apply to this sector across geographies, while getting broader stakeholder participation and ensuring human safety is not compromised.

Broader participation by experts in developing (A5) countries could lead to more timely progress on key technical issues affecting refrigerant choices in priority sectors, and on increased focus on the most

Avipsa Mahapatra is the climate campaign lead at the Environmental Investigation Agency (EIA), based in Washington, D.C.



cost-effective and efficient technologies. For instance, A2L (so-called mildly flammable) refrigerants have received increased attention and focus in recent years as it is in the interest of multiple U.S., European and Japanese companies to open up the market to R32, HFOs and a number of new HFC blends that are A2Ls. But greater participation, including from developing countries, may help address the full range of alternatives, including A3 refrigerants.

Expanded participation in working groups focused on standards will also contribute to greater regional knowledge of the technical aspects of proposed changes, allowing for more rapid adoption of changes to international standards at the national level. Continued political attention is thus critical for progress in this arena.

Integrating energy efficiency

Energy efficiency was a key discussion point in the week's meeting. Two separate Conference Room Papers (CRPs) were presented – one from India and other Group 2 (high-ambient developing) countries, as well as one from the African Group – asking for additional work on how the refrigerant transition would be accompanied by concurrent energy-efficiency gains. These proposals received near-universal support from all developing countries.

Donor countries showed openness to discussing the scope of energy efficiency, and there was consensus around having a focused workshop to further flesh out an appropriate strategy. However, the challenge of incorporating energy efficiency compounds the complexities around how to best direct finite funds. There is a concern that transitional alternatives like HFC-32 or HFC/HFO blends, which are yet to be used in a widespread manner, are being pitched as “energy-efficient alternatives” but there seems no reason to spend public money toward such chemicals that will necessitate another transition in the near future anyway.

Replenishment

Another key negotiating issue was how much money will be available for the Multilateral Fund and what exactly it will be used for in helping developing countries to carry out an HCFC phase-out (the precursor to the HFC phase-down).

The Technology and Economic Assessment Panel (TEAP) estimated that for the years 2018-2020 around USD 600 million (AUD 767 million) to USD \$750 million (AUD 958 million) will be required, most of it going to phasing down HCFCs, and about 5%-10% going towards “enabling activities” for developing countries to start the HFC phase-down.

After protracted discussions in a contact group formed for this specific issue, Parties agreed on a list of items to be covered by TEAP in its supplementary report on funding needs for the 2018-2020 replenishment of the Multilateral Fund at the next Meeting of the Parties (MOP) to the Montreal Protocol.

A robust replenishment will be critical to assuring developing countries that they'll have adequate resources to plan for and implement the Kigali Amendment. This is particularly significant as Parties endeavour to ratify the amendment back home. Additionally, strong replenishment now will enable countries to look for greater opportunities to take the right preparatory steps for the HFC phase-down, or leapfrog HFCs altogether, thus being more cost-effective in the long run.

Other conversations, which included reporting data and HFC destruction, will be continued at the next meeting in November in Montreal, Canada.

In addition, the OEWG meeting was preceded by the meeting of the Executive Committee of the Multilateral Fund, where important guidance work was completed regarding cost guidelines, enabling activities, and a study on the most cost-effective ways to destroy R23, a super-potent by-product of R22 production, with a very high GWP (14,800).

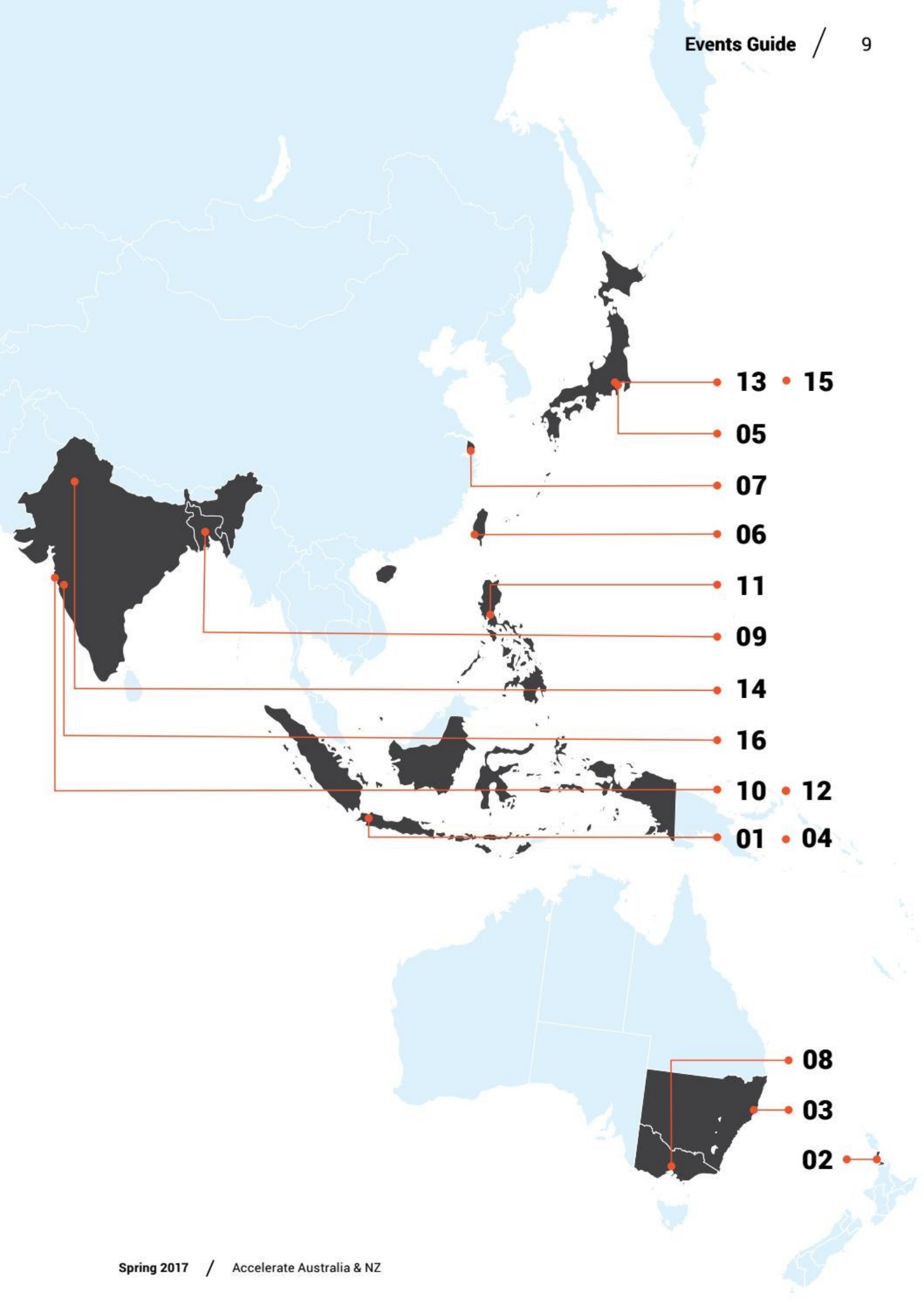
With the adoption of the Kigali Amendment, the Parties to the Montreal Protocol joined the urgent global effort to prevent dangerous anthropogenic climate change. It is now time for them to translate intent to actions in order to swiftly implement the Kigali Amendment and fulfil its potential.

When Parties to the Protocol meet again in November, the Protocol will be celebrating its 30th Anniversary. If we have learned anything in the last 30 years from the success of the Montreal Protocol, it is that a global agreement, regardless of how well intended, cannot meet its full potential unless it is accompanied by robust implementation. Well begun is half done!

EVENTS GUIDE

Nov / Dec 2017 — Jan / Feb 2018

- **01** 1-4 November, Jakarta, Indonesia
AllPack Indonesia
www: <http://allpack-indonesia.com/>
- **02** 2-3 November, Auckland, New Zealand
Auckland Build
www: <http://aucklandbuildexpo.com/>
twitter: @AucklandBuild #AucklandBuild
- **03** 2 November, Sydney, Australia
AIRAH Annual Awards
www: <http://bit.ly/2z3lkcA>
twitter: @AIRAHnews #AirahAwards
- **04** 28-10 November, Jakarta, Indonesia
The BIG 5 Construct Indonesia
www: <https://www.konstruksiindonesiabig5.com/>
twitter: @Konstruksi_INA #KIBIG5
- **05** 8-10 November, Chiba, Japan
Data Center Expo
www: <http://bit.ly/2gB3Qi3>
- **06** 9-11 November, Kaohsiung, Taiwan
Taiwan Fishery and Seafood Show
www: http://www.taiwanfishery.com/en_US/index.html
- **07** 14-16 November, Shanghai, China
FHC Retail & Hospitality Equipment
www: <http://www.fhcchina.com/en/index.asp>
- **08** 15-16 November, Melbourne, Australia
Australasian Building Simulation Conference 2017
www: <http://bit.ly/2wwHBDx>
twitter: @AIRAHnews #buildingsims17
- **09** 23-25 November, Dhaka, Bangladesh
5th BAPA Foodpro
www: <http://www.foodpro.com.bd/>
- **10** 12-14 December, Mumbai, India
ICCS India Cold Chain Show
www: <http://indiacoldchainshow.com/>
twitter: @ColdChainShow #coldchain
- **11** 6-9 January, Manila, Philippines
HVACR Philippines
www: <http://gesi.com.ph/hvacr/>
- **12** 18-20 January, Mumbai, India
Food Hospitality World
www: <http://www.fhwexpo.com/>
twitter: @FHWExpoIndia #FHWExpo2017
- **13** 14-16 February, Tokyo, Japan
SMTS - Supermarket Trade Show
www: <http://www.smts.jp/en/>
- **14** 15-17 February, New Delhi, India
World Sustainable Development Summit
www: <http://wsds.teriin.org/>
twitter: @teriin #Act4Earth
- **15** 20-23 February, Tokyo, Japan
Japan Food Service Equipment Show
www: <http://www.jma.or.jp/hcj/en/>
- **16** 23-25 February, Pune, India
FoodTech Pune
www: <http://foodtechpune.com/>
twitter: @FoodTech_pune



AUSTRALIA & NZ IN BRIEF

TECHNOLOGY

New mobile application to upskill Australia in NatRefs

A newly launched app provides natural refrigerant training and upskilling resources for RAC technicians in Australia under the Australian Refrigeration Council's Green Scheme Accreditation programme.

The app, which requires technicians to hold ARC Green Scheme Accreditation as a prerequisite, will provide "free access to an online 'tool box' full of features to help them maintain and promote their accreditation".

The tools include quick access to a supplier directory, technical resources and information on safety and standards, and proof of Green Scheme Accreditation credentials.

■ Devin Yoshimoto

TECHNOLOGY

Japan manufacturer debuts new CO₂ condensing units

The 29 September announcement by Japan-based Nihon Netsugen Systems (NNS) of its brand new 2018 lineup of transcritical CO₂ condensing units signals the entrance of another significant player in the rapidly growing CO₂ transcritical market in Japan.

The manufacturer is one of the first Japanese companies to seriously push for CO₂ transcritical use in industrial applications.

The new line-up of CO₂ transcritical condensing units, dubbed CO₂ Booster Super Green, consists of three main types.

■ Devin Yoshimoto

MARKET

Hillphoenix adds NXCOLD to portfolio

Conyers, Georgia-based OEM Hillphoenix has announced the addition of NXCOLD ultra low-charge ammonia systems to its industrial refrigeration portfolio, making the patented technology available to customers in North America and Latin America for cooler, freezer and blast freezer applications.

Hillphoenix also offers transcritical CO₂ to industrial and commercial operators.

"With our manufacturing capabilities and our core competencies focused in the arena of natural refrigerants, [NXCOLD] gives us the ability to add ammonia to our portfolio," said David Neu, vice-president, industrial refrigeration for Hillphoenix.

■ Michael Garry

MARKET

Aldi to roll out CO₂ tech in all UK stores

On 15 August, German retail giant Aldi announced plans to convert all its UK stores to natural refrigerant CO₂. By the end of 2018, up to 100 outlets will be equipped with natural refrigerant-based systems at an investment of some AU\$37m (£20m).

Thanks to this strategy, Aldi will see a reduction in its potential refrigerant gas carbon emissions by 99%.

Up to 100 of Aldi's circa-700 UK stores are set to incorporate CO₂ refrigerants by the end of next year. All its existing UK stores will eventually be converted to CO₂.

■ Pilar Aleu

END USER

METRO AG announces first CO₂ TC installation in China

Italy-based system supplier SCM Frigo has announced it will install a CO₂ transcritical system in a METRO Wholesale store in Beijing, China, by the end of this year. The system will be the first in China for both METRO AG and SCM Frigo.

Coming at a crucial time during Stage II of China's rapidly accelerating HCFC phase-down, the installation will be for two indoor racks, both with parallel compression. Refrigerating capacities will be approximately 275 kW medium temperature and 93 kW low temperature, including two remote air gas coolers.

"If the installation is successful, the perspective in the market will expand very fast," said Anna Stella, key account manager for SCM Frigo.

■ Andrew Williams

MARKET

SandenVendo America debuts HC vending machine line

SandenVendo America has introduced a line of vending machines with hydrocarbon refrigeration systems, its first for the North American market. The company's other units use CO₂.

The hydrocarbon refrigeration systems serve two types of SandenVendo America products: glass-front vending machines and stack-style vending machines.

The new R290 vending machines – a demonstration of SandenVendo's corporate climate commitment – are all cUL listed (meaning they meet Canadian and U.S. UL standards) and all meet or exceed U.S. Department of Energy and Environmental Protection Agency ENERGY STAR requirements.

■ Elise Herron



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*"What are the returns on investment in [natural refrigerant] – based solutions? It's **energy cost reduction and future proofing**" - Stefan Jensen, Scantec*



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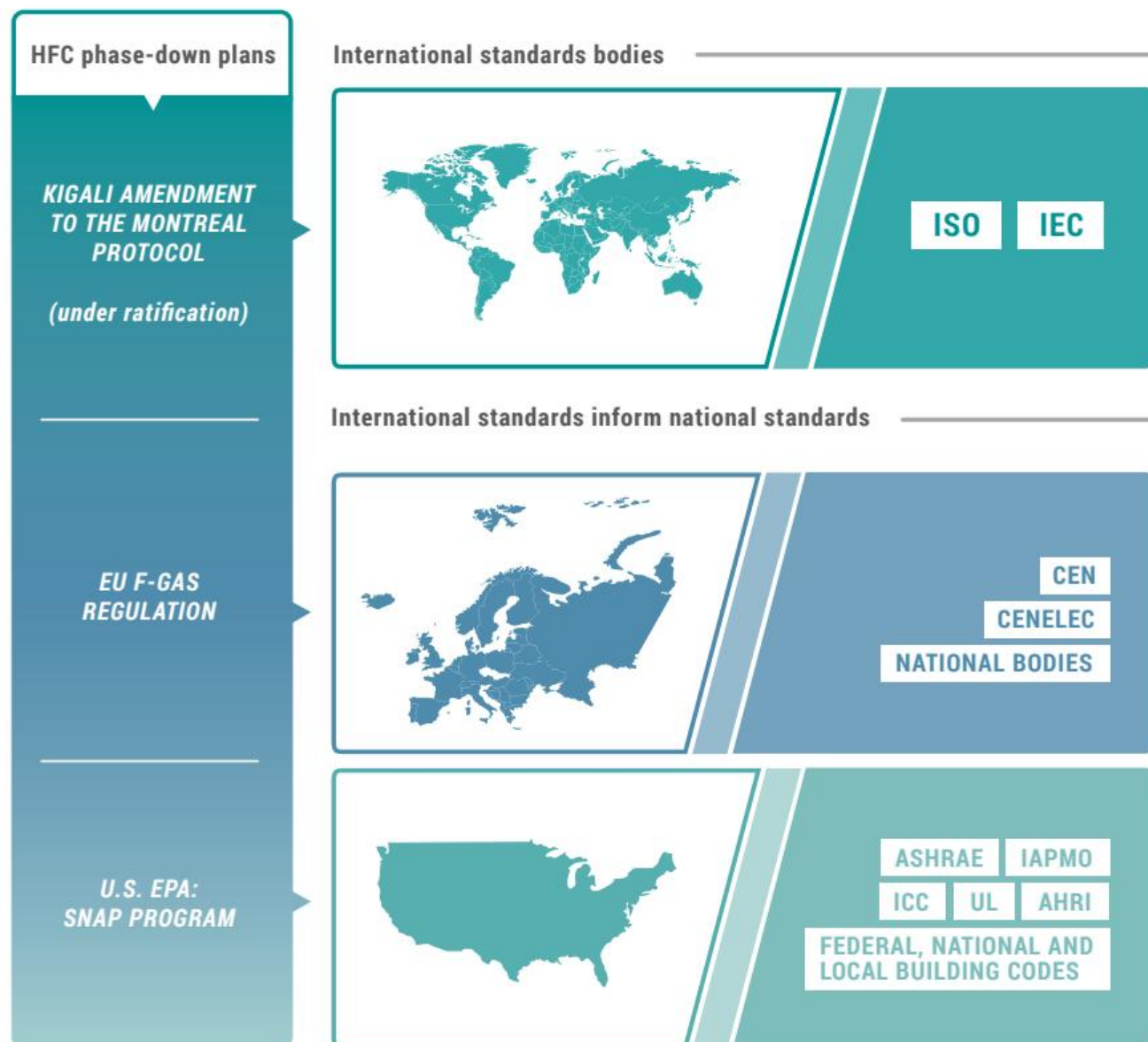
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- No refrigerant management problems following start after power failure
- Glycol/ammonia plate heat exchangers with dry expansion refrigerant feed
- Minimization of liquid hammer
- Office air conditioning with ammonia
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Driven by the HFC phase-down: Hydrocarbon standards revision



Hydrocarbon standards are being revised at the global level by the International Electrotechnical Commission (IEC) in two working groups



COMMERCIAL REFRIGERATION

IEC 60335-2-89

May decide to move A3 (hydrocarbon) charge limit from 150g to 500g in 2018



AIR CONDITIONING

IEC 60335-2-40

Possible increase of charge limits for A3s (hydrocarbons) and A2Ls (HFOs)

Alongside the IEC, many national and local standards bodies are also looking at revising their own standards.



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Nestlé's pioneering vision

Swiss multinational Nestlé began replacing its CFC and HCFC systems with natural refrigerants in 1986. Today, its commitment to adopting natural refrigerants for HVAC&R applications wherever possible is helping to bring the technology to new parts of the world. *Accelerate Europe* reports from Nestlé's hometown of Vevey.

— By Andrew Williams



From industrial refrigeration systems with NH_3/CO_2 at key production sites in Switzerland to ammonia-cooled data centres and the worldwide deployment of hydrocarbon-based display cabinets, the commitment of Nestlé to natural refrigerants is consistent and firm.

With snow-capped mountains casting their reflections in the water, visitors to Nestlé's lakeside headquarters in the Swiss town of Vevey cannot fail to be inspired by the magnificent surroundings.

Vincent Grass is a man with a vision as far-reaching as the lofty Alpine summits that tower above him on his daily commute to Vevey alongside Lake Geneva from his home in Evian, in nearby France. As refrigeration team leader in the 'corporate operations – engineering services' department at Nestlé, the Frenchman is responsible for turning the Swiss multinational's ambition to expand its use of natural refrigerants into a reality.

"We are expanding the use of natural refrigerants across the company," Grass says.

By 2020, Nestlé is aiming to reduce greenhouse gas (GHG) emissions per tonne of product in every product category to achieve an overall reduction of 35% in its manufacturing operations (versus 2010). Also by 2020, the company is aiming to reduce GHG emissions in its distribution operations by 10% (versus 2014).

Natural refrigerants have long played a central role in delivering this. Since 1992, Nestlé has invested CHF 299 million (AUD 450 million) in replacing HFC systems with natural refrigerant-based alternatives for industrial refrigeration. It installed 47 new industrial refrigeration systems based on natural refrigerants in 2016 alone.

Reducing industrial refrigeration footprint

The majority of Nestlé's refrigerant consumption by charge is attributable to industrial applications.

About 90% of Nestlé's refrigerant charge – and potential risk in terms of direct refrigerant emissions – is in manufacturing. Commercial applications account for the remaining 10%.

"We're focusing on industrial because that's where we can make the biggest impact. It's where we have the biggest risk of leakage and the highest electricity consumption," says Grass.

"For most big plants, ammonia is the most efficient option. In combination with CO_2 , you can address safety issues and still deliver low temperatures. By adding CO_2 , you need more components but the compressors are smaller, so you're reducing your footprint too," he argues.

Nestlé is already using natural refrigerants for over 90% of its industrial refrigeration needs worldwide. In the Europe, Middle East and North Africa (EMENA)



Vincent Grass, Nestlé

Photography by Anna Salhofer

region, 91% of its industrial refrigeration is provided by natural refrigerants. In the Americas – Nestlé's biggest market is the USA – the figure is 95%. "In Asia, Oceania and the rest of Africa, we're at 84%," Grass says.

He says it is hard to predict when the firm will achieve 100% natural refrigerants for industrial use. The official target is simply to expand their use in industrial refrigeration by 2020.

"The thing is, we have many different applications in our factories, on different scales and at different temperatures. We also have different geographies, with different climates. The cooling demand is different," Grass explains.

"We strive to hit 100%, but we can't say when we'll be there. Achieving the last 10% is very difficult," he admits.

Factors slowing down progress include lack of available technology in some countries, restrictive charge limits in some jurisdictions, and transitioning away from existing HFC systems on recently acquired sites.

"We need to look at it product-by-product and application-by-application. You have the environment, the climate, the surroundings to consider," Grass explains.

Peter Jaggy is head of engineering at Nestlé. He stresses the need to ensure that staff in headquarters and throughout the 119 countries in which Nestlé operates are on the same

page. "On the fringes, there is a lot of activity which we don't necessarily see from here in headquarters. This is why it's not so easy to get from 90% to 100%," he says.

The renaissance of CO₂

Nestlé's natural refrigerants journey begins in 1986 – three years ahead of the entry into force of the Montreal Protocol on Substances that Deplete the Ozone Layer in 1989 – when the company began to replace CFCs and HCFCs with ammonia. "At that time, we focused our efforts on our biggest plants, deciding to move from CFCs directly to ammonia. Later, we extended our use of natural refrigerants to the replacement of HFCs in smaller systems," Grass says.

In 2000, Nestlé turned to natural refrigerant CO₂ for the first time. At a factory in Beauvais, France, it replaced 15 tons of CFC R13 installed in the 1970s with an ammonia-CO₂ cascade system in which the CO₂ circulates without compression. "This was a renaissance of CO₂. It had been used at the turn of the century, but for over 50 years it had not been used at all," Grass says.

In 2001, Nestlé opened the world's first large NH₃-CO₂ cascade system to use compressed CO₂, built in cooperation with Star Refrigeration. It replaced an R22 system at Nestlé's coffee factory in Hayes, UK.

“The valves for CO₂ did not exist at that time. HERL was a valve manufacturer in Germany back then, and they developed the valves for us,” says Grass.

What is driving Nestlé’s phase-out of HFCs? “In many of the countries in which we operate, there is no regulatory deadline to change. But the day the units don’t match capacity any more, we need to switch to another refrigeration solution,” Grass says.

Nestlé’s long experience with natural refrigerants makes them the obvious choice. “My predecessor’s predecessor, Holm Gebhardt, was Nestlé’s chief refrigeration engineer and did a lot of work on natural refrigerants,” he says.

Gebhardt helped to convince not just Nestlé but the wider world that natural refrigerants are viable alternatives to f-gases. He was one of the founders of natural refrigerants advocacy group Eurammon in 1996.

In 2000, Gebhardt co-founded the now-defunct Carbon Dioxide Interest Group – bringing together manufacturers and end users – which blazed a trail by raising awareness of CO₂ technology’s potential.

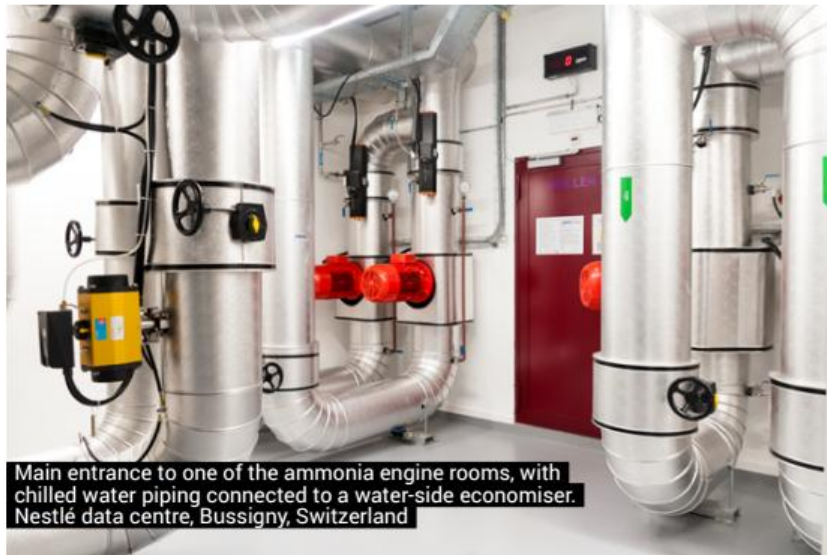
“This is why Nestlé is already above 90% natural refrigerants in industrial. We started this journey a long time ago. We’ve always been convinced that natural refrigerants are the right way to go,” Grass says.

Brewing up a Nescafé

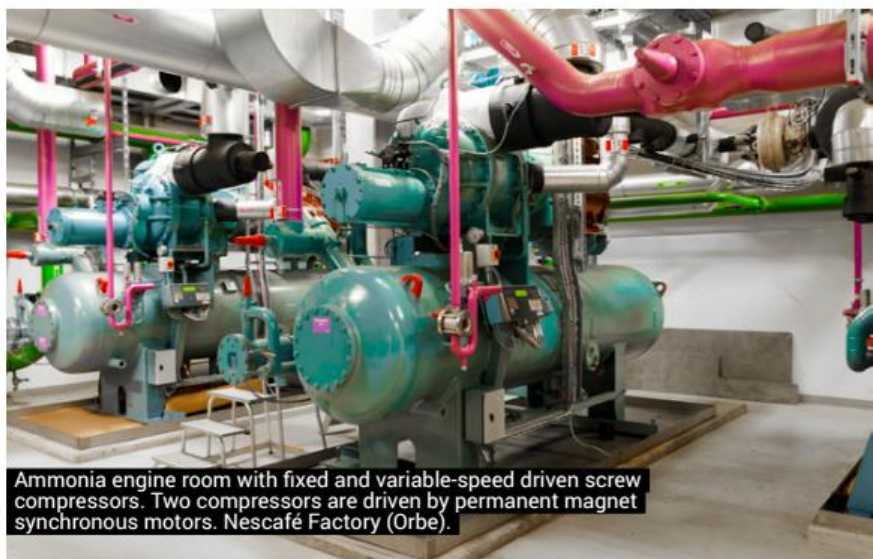
Nestlé’s industrial processes require negative temperatures, sometimes as low as -50°C, for certain applications. Nescafé coffee, for example, is freeze-dried, with the water removed by sublimation. The company also requires freezers for its ice cream and frozen food brands.

Grass is proud to show refrigeration technology at work on the occasion of *Accelerate Europe’s* visit. Upon arriving at a production site in Orbe municipality in the Swiss canton of Vaud, a 40-minute drive from Nestlé’s headquarters, the coffee that will become Nescafé – arguably the world’s most recognisable coffee brand – is cleaned of stones. It is roasted and then ground. “Once ground, it goes into a big coffee machine to capture the aroma. We evaporate some of the water, concentrate all the solids, and then we start to cool it. Then it becomes more viscous, and goes into a continuous air blast freezer where the product is frozen,” Grass says.

“Once it has been frozen, we grind it again. Then it goes into a vacuum chamber in which the ice turns directly to vapour without first passing



Main entrance to one of the ammonia engine rooms, with chilled water piping connected to a water-side economiser. Nestlé data centre, Bussigny, Switzerland



Ammonia engine room with fixed and variable-speed driven screw compressors. Two compressors are driven by permanent magnet synchronous motors. Nescafé Factory (Orbe).



CO₂ engine room with HPC 108S reciprocating compressors from Sabroe (JCI) operating at -54°C. Nescafé Factory (Orbe).

through the water stage – thanks to the process of sublimation. You need a cooling system to capture the moisture and remove it from the coffee. It is then filled in and packed into jars. This is the Nescafé freeze-dried soluble coffee production process,” he explains.

Competing with HFCs

Asked whether Nestlé has the internal expertise to make the switch to natural refrigerants, Grass says: “We have to use suppliers. We work with the key industry players around the world”. Jaggy goes further: “We depend 100% on them for the execution.”

Assessing the performance of Nestlé’s enormous asset base helps the company’s suppliers improve their systems. “Worldwide, we have over a thousand ammonia compressors running at any one time. Thanks to this asset base, we see the issues,” says Grass.

“In developed countries, the availability of service technicians is quite good, though it depends where you go. Elsewhere in the world, training can be a big issue. In a number of developing countries, if you want to install an ammonia chiller, then finding technicians and operators who already have experience of ammonia is a challenge. You’ll have to train them,” he says.

“Alone, we can’t do much to change this. We pushed manufacturers to open service centres in remote areas, because we told them that we’re not ready to pay for overseas assistance every time,” Grass admits.

“For component manufacturers, offering training is potentially a big opportunity for their business model. There is a huge shortage of training facilities,” he argues.

Another obstacle to wider use of natural refrigerant-based technologies is the cost gap with HFCs. “Non-natural systems often tend to be cheaper to acquire. This is one of the biggest challenges today. We have to continuously fight the battle of convincing our people that it still makes sense to do this, even if it would be cheaper to do something else,” says Jaggy.

“We’ve seen some reduction. When we installed the ammonia heat pump in the Nest [Nestlé’s discovery centre in Vevey], I was surprised because it was the first time that I had seen an ammonia system at the same price as an HFC system. It’s more efficient and it is cost-competitive, so there was nothing else to say!”

“The efforts we’re making save us a lot of money too. Yes, the initial investment may be more, for example after budgeting for safety considerations. But an industrial ammonia plant usually lasts for 30-40 years. When we opt for ammonia, we know there won’t be any deadlines to phase out or replace it later,” Jaggy says. ■ AW



Low-charge ammonia chiller (Chillpac product from Sabroe).
Nestlé data centre, Bussigny, Switzerland



Accelerate Europe at the Nescafé Factory (Orbe).



Riding the sustainability wave

Inspired by the natural beauty of its New South Wales home, award-winning Australian craft brewer Stone & Wood is banking on natural refrigerants to deliver its environmentally friendly philosophy as it continues to grow.

— By Andrew Williams & Caroline Rham



Nick Cornish, engineering manager, Stone & Wood

Photography by Vibrant Imaging

The beaches surrounding the town of Byron Bay and the nearby headland of Cape Byron, mainland Australia's easternmost tip, are considered by some to offer the best surfing in the world.

The local beer's not bad either. Stone & Wood Brewing Co. is an Australian independent craft brewery based in the Northern Rivers of New South Wales (NSW).

Founded in 2008 by Jamie Cook, Brad Rogers and Ross Jurisch, Stone & Wood is going from strength to strength. It won the 'Regional Award' at the 2014 Telstra NSW Business Awards and its Pacific Ale won the silver medal in the 'English-Style Summer Ale' category at the 2016 World Beer Cup.

Its year-round craft beers are Pacific Ale, Green Coast Lager, Garden Ale

and Jasper Ale. The 'Beers from Our Backyard' range celebrates the natural beauty of the Northern Rivers area and includes Big Scrub lager and Cloud Catcher, inspired by the towering peak of nearby Wollumbin (Mt. Warning), the indigenous word for cloud catcher.

As a keen surfer himself, Nick Cornish – Stone & Wood's engineering manager – draws inspiration from his surroundings on a daily basis. "I like getting up early, getting in the van and cruising – sometimes it's not even about the surf and how good it is, but just about getting out there, getting in the water, and enjoying it," he says.

The company's first brewery in Byron Bay has a capacity of 25 hectolitres. In 2014, it opened a second, 50-hectolitre brewery in nearby Murwillumbah, 40 minutes up the road.

"I like getting up early, getting in the van and cruising – sometimes it's not even about the surf and how good it is, but just about getting out there, getting in the water, and enjoying it."

– Nick Cornish, Stone & Wood

Cornish puts it like this: "Stone & Wood was a company started nine years ago by three guys in a little shed down in Byron Bay. Very quickly – within the first four years – they started running out of space due to demand outweighing supply."

"Capacity became tight, so we went, 'this isn't sustainable, we can't do this,'" Cornish says.

Fast-forward to 2017, and growing demand for Stone & Wood's beer means that most of it is brewed some 50 kilometres up the road in Murwillumbah. The Byron Bay site remains a working brewery and is open to the public for tours.

Treading lightly

A commitment to integrating into the local environment counts among one of Stone & Wood's founding principles and continues to guide all its activities even as the company grows.

It is in this context that the brewery is adopting natural refrigerants.

"We place high importance on supplier partnerships, energy efficiency, and treading lightly on this Earth. After all, this is the only planet with beer!" Cornish says.

"We're an environmentally-conscious business that likes to look after the environment," he adds.

Refrigeration is the biggest energy load in a brewery. "Everything from cooling



Beers from our backyard: Stone & Wood's Cloud Catcher is named after the towering peak of Wollumbin (Mount Warning), the indigenous word for cloud catcher.

down fermentation to making cold liquor – it's a huge load," Cornish explains.

By choosing ammonia as the refrigerant in the new installation, Stone & Wood hopes to achieve a significant reduction in energy use, high reliability, and a consistency of cooling performance throughout the brewing process.

"As we've grown and taken that next step, we really wanted to jump into that next phase of refrigeration and go to an ammonia plant, basically because of the efficiency that it has," he says.

"With the business in growth, we could foresee that we were going to max out a Freon chiller plant," Cornish recalls. "So we took the opportunity to see if we could find a more energy-efficient plant to align with our environmental philosophy."

Ammonia was the obvious choice. "It was an easy decision to switch to ammonia, given that it's the industry standard refrigerant for high-efficiency plants, with less environmental impact," Cornish says.

Reducing environmental footprint

Stone & Wood keep track of every aspect of their environmental footprint, from their water consumption to beer production ratio down to their power usage to beer ratio. "We really wanted to see that figure come down with the ammonia plant, and we hope it will," Cornish says.

"The businesses of yesterday cared only about the dollar," he says. "For us, we strive to add value to all our communities – not just our shareholders – and to care for the environment."

"We see this as our responsibility as a conscious business," Cornish says.

As *Accelerate Australia & NZ* tours the Murwillumbah site, the scale of Stone & Wood's expansion becomes clear. Many of the site's existing fermenting vessels are 40,000 litre tanks, or 400 hectolitres, in brewing industry terms.

"We've just purchased some additional vessels for outside, as well as having 200-hectolitre, 100-hectolitre and 50-hectolitre tanks as well. The larger tanks are for the beers we brew all year round, and the smaller ones are for our limited releases and experimental brews," Cornish says.

The fermenters demand a huge refrigeration capacity. "Taking a beer fermenting at, say, 23°C, and dropping it down to zero degrees in X amount of time is a massive load," he says.



The fermenting process begins with whort. "Now the massive refrigeration load that we have in the brewery is taking out 90-100°C whort, and chilling it down to a temperature that we're actually able to ferment at," Cornish explains.

"So that's the sort of shock load that we see back at the chiller. With the new ammonia chiller, hopefully we're going to smoothen that out, and not get these huge spikes of electricity," he enthuses.

Gordon Brothers Industries Pty Ltd. is Stone & Wood's industrial refrigeration contractor. Founded in 1917, Gordon Brothers is Australia's oldest industrial refrigeration business and has been working with ammonia since the beginning.

"Stone & Wood have previously used Freon packages for their refrigeration

needs, and have gone through a period of very high growth," says Scott Clydesdale, Projects Leader – Northern Region at Gordon Brothers Industries.

Every six to twelve months, the brewer was purchasing another Freon chiller to serve its growing cooling needs.

"Just recently, there's been a step change. We were fortunate enough to secure the order to install an ammonia-based refrigeration plant to replace the Freon packages that they had on site," Clydesdale explains.

"The great benefit of ammonia is obviously that it's environmentally friendly, and it has an efficiency advantage over the Freon," he says.

Discussions with Stone & Wood began in mid-2016, when it became clear that rapid sales growth would surpass

the capacity of the Murwillumbah site's refrigeration plant.

"Stone & Wood are a very environmentally and socially aware company," Clydesdale says. "They do things that may cost them more in the short term, because it's the right thing to do."

Strong business case for NatRefs

Previously, Gordon Brothers had been servicing the Freon packages for a couple of years.

Rather than adding another Freon chiller every time a new load increase was required, Clydesdale made the case for switching to ammonia.

"We went through the figures and said, 'look, you can keep putting Freon





packages in there and it will only cost you this much, but if you were to install an ammonia plant, you'd find that your dollars per kilowatt – your bang for your buck – improves to the point that your carbon footprint is lower," he explains.

"You go from using something that's not particularly friendly to the environment to something that's quite benign. They were really sold on those ideas," he says.

The company priced the ammonia system in late 2016. Stone & Wood placed the order in February 2017

and installation began in July 2017. Final commissioning and fine-tuning took place in September.

The ammonia system has been up and running since 1 October 2017.

"It was definitely a step change for them. But they understand that two, three or four years from now, they'd have looked back and said, 'why are we still putting these things in? They cost us a fortune to run, and now we've got 10 of them!' Clydesdale quips.

"We place high importance on treading lightly on this Earth."

"After all, this is the only planet with beer!"

– Nick Cornish, Stone & Wood



Fermenting tanks inside Stone & Wood brewery, Murwillumbah, NSW.



▶ “They’ve got a full-blown ammonia plant in there now, which is a much better option going forward.”

The Byron Bay area has a humid subtropical climate, with hot summers and mild winters. The daily average temperature in summer is 27°C, with the mercury frequently hitting the mid-30s. Winters have daily maximums of around 19°C.

What kind of challenges do these high summer temperatures pose for the natural refrigerant system?

“There are no real challenges for ammonia, other than a large evaporative condenser to account for the higher ambient wet bulb compared to more southern locations,” Clydesdale says.

“The existing ammonia plant is currently designed for 1 MW, but all

the infrastructure is geared around 2 MW,” he further explains.

The plate heat exchanger is expandable to a second megawatt. “The drum is big enough. All of the pipework and connections are 2 MW-rated, so it’s at its halfway point at the moment,” Clydesdale says.

Gordon Brothers is confident that its customer made the right decision in opting for natural refrigerants.

“Stone & Wood have definitely seen an end point that they want to go to – they’ve seen that the power absorbed from the ammonia vs. the Freon gives a massive benefit to the ammonia,” Clydesdale says.

“There’s a real benefit to making that change now, rather than having continued along that path for some years to come,” he adds.

Clydesdale sees a bright future for natural refrigerants in Australia. The lion’s share of Gordon Brothers’ turnover comes from ammonia plants.

“No real volume of HFC plants exists in our market, as NH₃ has always been preferred,” he says. “In the past, ammonia has been the weapon of choice for any reasonably sized refrigeration plant, so the vast majority of our market has used ammonia.”

Competing with HFCs

Gordon Brothers sees ammonia becoming more competitive with HFCs even at smaller capacities.

“In the past, small cold stores would have been HFCs,” Clydesdale says. “But there is definitely some penetration of ammonia into that market now, because it’s becoming more cost-effective to install smaller ammonia plants.” ▶

NEW REFRIGERATION PLANT

Technical specifications

- ▶ 1,050 kW Mycom 200 VLD ammonia screw compressor package fitted inside a 20' shipping container with sound attenuation, ammonia detection, ventilation system, lighting, and full access doors on three sides.
- ▶ Stainless steel evaporative condenser for long life and improved operating efficiency compared to air-cooled and water-cooled Freon systems.
- ▶ Liquid receiver with appropriate valves and controls.
- ▶ 1,050 kW Alfa Laval welded plate heat exchanger package provides glycol chilling. Fitted with oversized surge drum and heat exchanger frame, allowing future upgrade to 2.1 MW (with a second screw compressor and condenser).
- ▶ Electrical package (with variable speed drive) for optimising compressor and condenser fan speeds, floating head pressure control, and floating suction pressure control.
- ▶ Danfoss leak detection system with auto-dialler and audible/visual alarms.
- ▶ Total ammonia charge: 600 kg.



Plate heat exchanger package

In the past, he argues, ammonia compressors were too large and too expensive to be viable alternatives to HFCs for smaller scale operations.

"Now, there are smaller compressors available," he observes. "This has been the change in the past five years and which will continue into the next five – it's no longer ammonia if you're big, and Freon if you're small."

Clydesdale argues that it is now financially viable to install ammonia systems in small cold stores too. "It means the line in the sand between ammonia and HFCs is disappearing."

"Price drives everything," Clydesdale says. "As soon as there is a price reason for choosing natural refrigerants, then that will be what everyone does," he adds.

Among its other flagship natural refrigerants projects, Gordon Brothers boasts the largest CO₂-based freezer plant in Australia in its portfolio. "We do CO₂ and we know CO₂. Yet there is a certain amount of misinformation out there," Clydesdale argues.

"Clients see CO₂ as the 'be all and end all'," he says. "But CO₂ is only cost-effective if you have to make it really, really cold, like -50°C. If you can get away with -30°C, then it swings back to the ammonia model as being the most cost-effective."

Clydesdale argues that there are "a few gaps" between perception and reality in this debate. "Carbon dioxide is good" – well, yes it is, but in some applications, it's not as good as ammonia," he says.

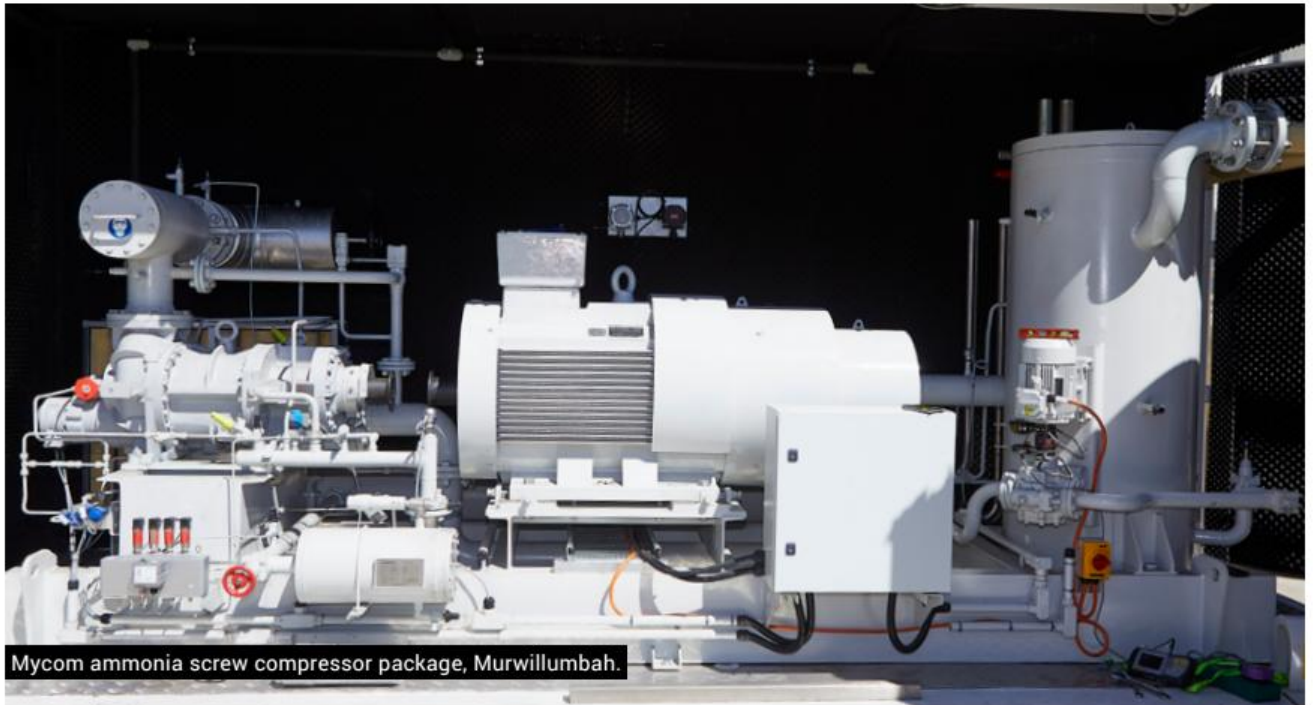
As natural refrigerants become increasingly mainstream HVAC&R

options to help businesses to comply with the global HFC phase-down taking place under the Kigali Amendment to the Montreal Protocol, closing the so-called 'training gap' by making sure that enough technicians are trained to use them is crucially important.

"There's plenty of training out there for those who want to find it," Clydesdale insists.

As the biggest contractor in Australia, Gordon Brothers itself plays a key role in closing the training gap. "We train our clients. We did a bunch of ammonia safety training with Nick and his crew," Clydesdale says.

In the United States, the Ammonia Safety & Training Institute (ASTI) is dedicated to making ammonia the safest managed hazardous material in the world, according to its mission statement.



Mycom ammonia screw compressor package, Murwillumbah.



Scott Clydesdale, Gordon Brothers Industries (L) & Nick Cornish, Stone & Wood (R).

“The line in the sand between ammonia and HFCs is disappearing.”

— Scott Clydesdale, Gordon Brothers

“We’ve sponsored ASTI to come to Australia and give ammonia safety seminars around the country,” Clydesdale says.

Apprentices also come through Gordon Brothers. “We tend to be more on the front foot with training than others might be,” Clydesdale says.

He observes that installers are becoming more comfortable with the technology and suppliers are more supportive.

“About 10-15 years ago when CO₂ was only just becoming a thing here,

we built a CO₂ test rig so that our own technicians could get a feel for what it’s like,” Clydesdale says.

“There was a certain fear attached to CO₂ because ‘the pressures are massive,’” he recalls. “They’re not really massive. They’re a bit higher than what you’re used to dealing with on an ammonia or a Freon rack, but they’re not so high that the world’s going to end!”

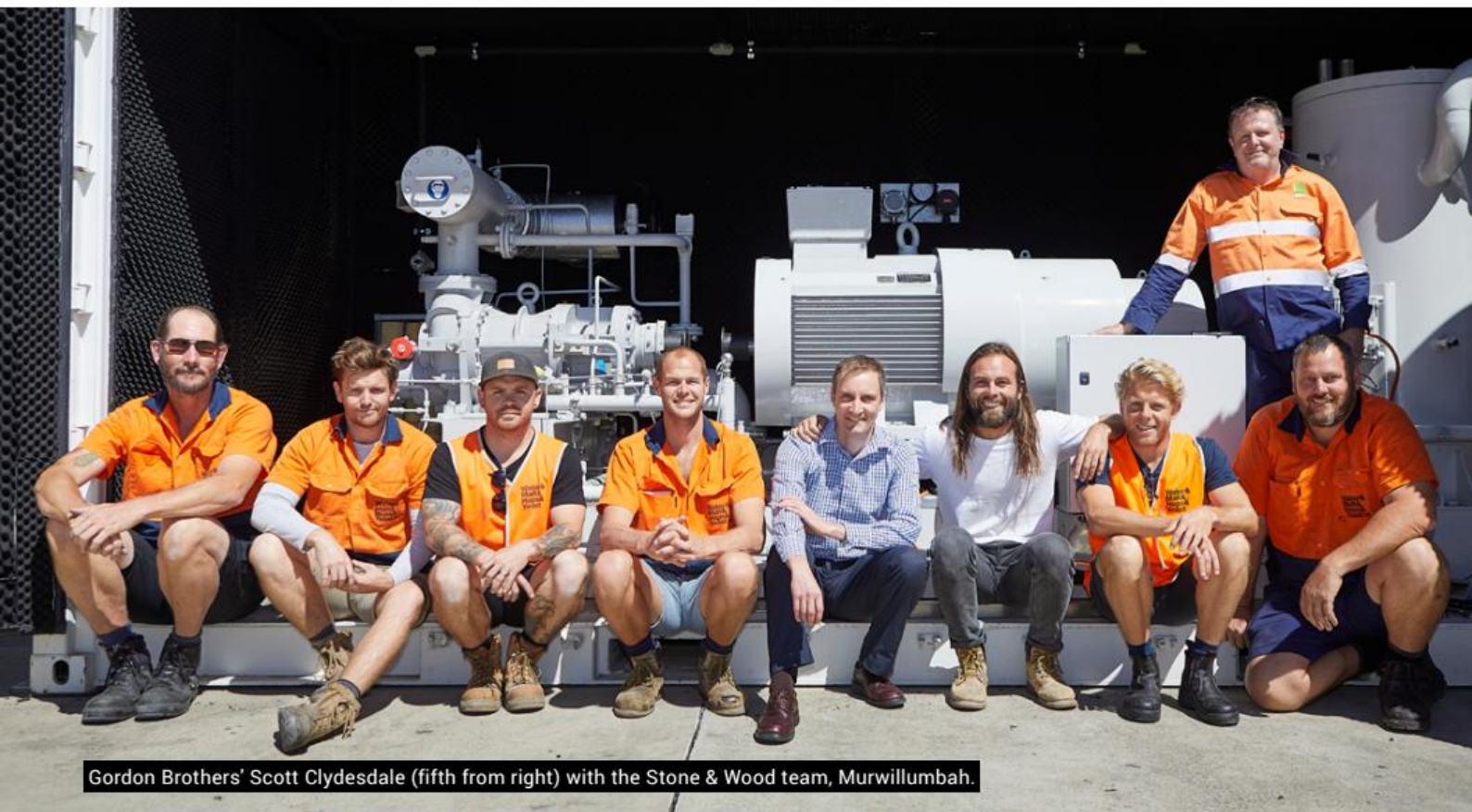
“Having the test rig that we built was helpful for our people – that’s gone around the country a few times and

it’s actually now residing at RMIT in Melbourne,” Clydesdale says.

Ammonia: A future-proof solution

Although HFCs only make up 2% of Australia’s greenhouse gas emissions, they have become the fastest-growing emission source.

In October 2016, world nations adopted an amendment to the Montreal Protocol in Kigali that foresees a global phase-down of HFCs by 85% by 2047, with the first



Gordon Brothers' Scott Clydesdale (fifth from right) with the Stone & Wood team, Murwillumbah.

reduction steps in developed countries, including Australia, in 2019.

Australia, as one of the Parties to the Montreal Protocol, has adopted legislation at national level to help achieve the targets of the Kigali amendment. In June 2017, the Australian government passed legislation to phase down HFCs from 2018 and deliver an 85% reduction by 2036.

The new bill, entitled the Ozone Protection and Synthetic Greenhouse Gas Management Legislation Amendment Bill 2017, obliges Australia to start phasing down HFC imports from 1 January 2018. No HFCs are manufactured in Australia itself.

While the legislation is in line with Australia's commitments under the Montreal Protocol, different laws in place in other countries are accelerating the industry transition through additional measures.

Australia could take inspiration from other regions or countries that are considering or have adopted more ambitious measures to stay ahead of the global competition.

In Europe, for example, bans on the use of HFCs in certain sectors adopted under the EU F-Gas Regulation have proven to be a very effective measure for moving the industry away from HFCs by giving the industry clear signals as to where they should focus their investment and by when.

"In Australia, we tend to follow what Europe does quite soon after Europe does it," Clydesdale said.

Asked whether Australia is likely to emulate the EU's F-Gas Regulation any time soon, he replies, "I think there'll be some movement in that direction, but I don't know how long it'll take or how robust it'll be".

Clydesdale draws personal satisfaction from the contribution made by Gordon Brothers' natural refrigerant plants to protecting the atmosphere. "As per Stone & Wood's email signature... this is the only planet with beer, so we should look after it!"

What does he enjoy most about his current job? "I get to do a massive range of things," he replies.

His role involves working on different plant types (ammonia, CO₂, glycol) in a variety of sectors including meat, beverage, dairy, petrochemical and mining, from design and tender to project management and commissioning.

As for Stone & Wood, what's next for them?

"Being a sustainable brewery is one of the company's goals," Cornish says. "While we are not perfect, we are always looking at ways to improve the way we do things and how we can tread more lightly on the Earth."

"Independence is important to us. As a business looking to be intergenerational, it's important that we do our part to minimise our footprint for future generations," he says.

As the sun sets over northeastern New South Wales, Nick can be confident that Stone & Wood is doing its part. ■ AW & CR



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Coop Group's new production site in Pratteln, near Basel

Coop Group flying high with ammonia

Swiss retail giant the Coop Group is putting natural refrigerants at the heart of its strategy for becoming CO₂-neutral by 2023. *Accelerate Europe* visits the group's new production site in Pratteln to find out how ammonia is helping to deliver this target.

– By Andrew Williams

Exiting the motorway at Pratteln, near the Swiss border city of Basel, drivers cannot miss the proud 'coop' sign adorning the roof of the buildings below.

At its factory in the suburbs of Basel, Swiss retailer the Coop Group produces chocolate, wine and foodstuffs such as dried fruit and nuts for sale in its own stores and for export around the world.

The Coop Group consists of a retail arm comprising Coop supermarkets and other specialist formats such as pharmacies, petrol stations and DIY stores in Switzerland, and a European wholesale and production business.

Group sales in 2016 amounted to CHF 28,322 million (AUD 36,933 million). The group employs some 85,000 people and boasts 2,250 retail stores and 226 wholesale outlets in its portfolio.

The Pratteln site is home to three of the Coop Group's own brands: Chocolats Halba (premium Swiss chocolate), Sunray (foodstuffs) and Cave (wine). The factory produces over 13,000 tonnes of premium Swiss chocolate for retail, industry and export every year – US retail giant Walmart is a big customer.

Under the Sunray banner, 32,500 tonnes of foodstuffs sourced from around the world are processed into 600 different products

including dried fruit, nuts, sugar, herbs and spices. 74 million packets per year leave the factory doors.

Cave, the Coop Group's winery, is the largest in Switzerland. Whites, reds, rosés and dessert wines are among the 36 million bottles produced in Pratteln every year. Cave vinifies must from seven Swiss cantons, and refines and bottles wine from all over the world.

Ammonia: the factory's beating heart

All this requires a lot of cooling. *Accelerate Europe* toured the site with Georg Weinhofer – assistant to the head of the logistics department at the Coop Group – and Thomas Fischer, senior project manager at Swiss refrigeration consulting and engineering company Frigo-Consulting Ltd., which has been supporting the retailer with its transition to natural refrigerants.

"The main motivation to adopt natural refrigerants was (and still is) the reduction of CO₂ emissions, and hence to contribute to our ambition to become CO₂-neutral by 2023," says Weinhofer, who is responsible for sustainability in logistics.

The Coop Group has been working with natural refrigerants since the mid-2000s. In tune with its commitment to become CO₂-neutral by 2023, all its new and refurbished supermarkets have used natural refrigerant CO₂ since 2009.

400 of Coop's 850 supermarkets use CO₂ as the sole refrigerant. 90% of the 400 systems are CO₂ transcritical.

Coop uses ammonia in all new or refurbished production sites and distribution centres in Switzerland. What led Coop to choose ammonia in particular?

"Ammonia has outstanding thermodynamic properties, and is therefore the perfect fit for high-refrigeration capacities. It has been used for over 130 years. Ammonia is also climate-neutral and reasonably priced," Weinhofer says.

Another important factor is the availability of technology. "So far, CO₂ systems haven't been available in the capacities we need for our distribution centres and production sites," Weinhofer says.

"We're aware that our daughter company Transgourmet is using CO₂ in some distribution centres and cash & carry markets. We're in exchanges with colleagues there on that topic," he said.

Six refrigeration chillers and two heat pumps, all of which use ammonia, were installed on the site in spring 2016. The cooling capacity of each chiller is 1,000 kW. Likewise, the heat pumps each contribute 1,000 kW of heating.

The six chillers are flexible enough to provide cooling for the site's different needs. They provide cooling in temperature ranges of +2/+8°C and +6/+12°C, and heat recovery (+19/+25°C and +30/+40°C).

"In addition, we have two large cold rooms served by CO₂ refrigeration installations," Fischer says.

Producing chocolate, cooling wine storerooms, and air conditioning and dehumidifying the premises are among the onsite processes that require cooling.

"The six refrigeration units can be run individually and their cooling energy can be passed on to two cooling grids," Fischer explains.

Each of the six refrigeration systems runs independently from the others, helping to minimise the ammonia refrigerant charge and providing guaranteed backup.

The refrigeration units are able to recover heat at temperatures of up to 40°C. The heat pumps can achieve temperatures of up to 60°C. "This waste energy is used to heat the chocolate pipes, to heat the facility, and for dehumidification operations," Fischer says.

The facility's production divisions require individual cooling and customised temperature levels, for example during the conching process. A conche is a surface-

Photography by Anna Salhofer



Georg Weinhofer, Coop Group, responsible for sustainability in the logistics department



Air-cooled ammonia condenser

scraping mixer and agitator that evenly distributes cocoa butter within chocolate. Conching is the key to giving chocolate its final flavour and texture.

'Ammonia outruns all synthetic refrigerants'

Synthetic refrigerants were never in the picture. "Compared to ammonia, HFOs have disadvantages in terms of sustainability. Ammonia outruns all synthetic refrigerants with regard to energy efficiency, and is therefore a forward-looking and sustainable solution," Fischer says.

The Coop Group already operates ammonia systems in other locations. This experience, together with the low charge of ammonia and round-the-clock monitoring, means that "there were never any safety concerns" in opting for an ammonia solution, Fischer says.

"At the moment, the installation is being monitored around the clock by a surveillance system from the refrigeration company. The technical service staff will be trained to do specific checks and maintenance work. Thanks to the full-service contract, the installation is serviced monthly," he explains.

The refrigeration system is just one part of the sustainability picture in Pratteln. To produce heat and steam for industrial processes, woodchips are burned instead of natural gas. A rooftop 550 kW solar photovoltaic system provides some of the site's electricity. ■ AW





Coop Group: Pratteln production site – main features:

- ▶ **Installation type:** 6 chillers and 2 heat pumps
- ▶ **Refrigerant:** Ammonia
- ▶ **Refrigeration capacity:** 1,000 kW per chiller (6,000 kW total)
- ▶ **Heating capacity:** 1,000 kW per chiller (2,000 kW total)
- ▶ **Refrigeration temperature ranges:** +2/+8°C and +6/+12°C
- ▶ **Heat recovery temperature ranges:** +30/+40°C and +40/+60°C
- ▶ **Heat pump and refrigeration unit manufacturer:** RV Cooling Tech
- ▶ **Screw compressors (refrigeration units):** Howden
- ▶ **Piston compressors (heat pumps):** Mayekawa
- ▶ **Commissioning, assembly, installation:** SK Systemkälte





Photography by Ben Beech

Southeast Asia's industrial leaders eye **NatRefs**

Leading industrial HVAC&R users in Southeast Asia are increasingly turning to natural refrigerant solutions to help them deliver on their business goals. International technology suppliers and leading global retailers joined local end users, on stage and in the audience, at ATMOsphere Asia 2017 to discuss the opportunities and challenges for natural refrigerants in the region.

— By Devin Yoshimoto

“In Thailand today, ammonia seems to be the very best solution especially in large industrial systems.”

– Pattra Chotchuangchutchaval, Patkol

Held in Bangkok, Thailand for the first time, ATMOsphere Asia 2017 served as a barometer of interest in natural refrigerants in Southeast Asia.

The event was held on 6 September at the exquisite five-star Sofitel Sukhumvit hotel. A total of 172 attendees were present, including over 50 representing end users – the highest proportion of end users of any ATMOsphere event organised by shecco in 2017.

End users representing a wide range of industry sectors – from commercial retail to industrial food processing and cold stores, including representatives from well-known hotel chains such as Sofitel, Accor, and Marriott – were present to share and discuss their experiences with natural refrigerants.

International and local technology suppliers were also present to provide information on the latest natural refrigerant market trends and case studies in the region.

Industrial end users seek NatRef knowledge

Key representatives from Southeast Asia's largest industrial food processing companies took to the stage during the end user panel to demonstrate how natural refrigerants play a key role in their firms' ambitious sustainability initiatives.

The Thai Union Group, a large Thailand-based global seafood processing and distribution conglomerate, is aiming to reduce its greenhouse gas emissions by 30% by 2020.

Comgrit Sorchom, the Thai Union Group's environmental health and safety director,

emphasised the importance of sustainability to the company's overall business goals.

"This is good for the company, customer, and employee as well," said Sorchom. "Our company is turning into a green organisation and it makes everyone happy."

According to Sorchom, the company is currently looking at improving the safety of its ammonia usage in its cold storage facilities and food processing plants globally.

Going forward, however, he stressed the company's openness to learning about the most up-to-date knowledge and trends.

"Today, we want to do something different, so that's why we are here. We want to have some input from you all," said Sorchom.

CPF Group, a Thailand-based, leading global industrial food processing conglomerate with operations in more than 25 countries, discussed its experience with how natural refrigerant systems are helping it to achieve its sustainability targets.

The company is committed to "reducing greenhouse gas [emission] intensity by 5% by 2020" compared to its 2015 baseline, according to CPF Group's vice-president for corporate engineering, Thanarak Kosalwitr.

"We did some heat recovery with Mayekawa's CO₂ Ecocute heat pump," said Thanarak. "The project's internal rate of return was about 14%, with a payback period of six years. We were able to achieve a CO₂ emissions reduction of 1,170 tons per year."

Asked what CPF Group is currently interested in, Thanarak replied, "from what I heard this



morning about CO₂ transcritical, that is in our interest as well".

Kosalwitr also spoke enthusiastically about his personal motivation for pushing sustainable solutions within the organisation.

"I want to prove something," he said. "That it is good, not only for the organisation but good for all the stakeholders. That is the key. You have to sacrifice something – then you can get something."

Dr. Tul Manewattana, speaking on behalf of Betagro Group, discussed the company's extensive use of NH₃-CO₂ systems.

Betagro Group, headquartered in Bangkok, is Thailand's second largest agro-industrial and food-export company.

Of the organisation's entire operational refrigeration capacity, Dr. Manewattana explained, the largest portion consists of industrial refrigeration running on NH₃-CO₂ systems – equal to roughly 31,000 kW of its total 56,400 kW of refrigeration capacity.

Dr. Manewattana highlighted several benefits of using the NH₃-CO₂ system, including safety, energy efficiency and ease of installation and maintenance.

"In a food factory, if you use CO₂, it is very safe. It will be safe for the worker, and the manager can sleep very well," he said. "The packaged NH₃-CO₂ system is also very easy to install and maintain."

Signalling further interest in CO₂ for industrial applications, Dr. Manewattana said, "in the future, we will probably go for CO₂ more because of safety reasons. A good machine these days could produce 20-30% less energy consumption".

Global retailers increase Asia presence

Joining the representatives from Southeast Asia in the end user panel were global retail giants METRO AG and Ahold Delhaize, to provide an international perspective.

METRO AG's director of energy management, Olaf Schulze, via video message, informed the audience about the company's progress with its F-Gas Exit Program.

"In 2013, we decided to [replace] our HFC and HCFC systems with natural refrigerants," said Schulze. "By 2030, we would like to reduce the carbon impact from our HFC [systems] by 95%."

Schulze highlighted the focus the company is placing on transcritical CO₂ systems to help them achieve this goal.

"We started with this program in 2014," Schulze continued. "Until now, in mid-2017, we have [replaced] the systems in more than 120 stores. Every year, we are installing transcritical or sub-critical cooling systems in more than 30 stores."

Schulze also highlighted the progress the company has made in China, announcing plans for their first transcritical CO₂ installation in the country.

"Until now, we have installed in China, 28 [pieces of] equipment with sub-critical technology. And I hope, in the next few months, we can start with the installation of our first transcritical system in the northern part of China," he said.

Accelerate Australia & NZ has since confirmed the details of METRO AG's first transcritical installation in China.

The transcritical CO₂ system will be installed in a METRO Wholesale store in Beijing, China, by the end of this year, and will be supplied by Italy-based CO₂ system manufacturer, SCM Frigo.

International representation was strengthened further during the end user panel with the presence of Ahold Delhaize, an international retailer headquartered in the Netherlands.



Comgrit Sorchom, group environmental health and safety director, Thai Union Group



Thanarak Kosalwitr, vice-president corporate engineering, CPF Group



Dr. Tul Manewattana, Betagro Group



Pattra Chotchuangchuchaval, senior sales engineer, Patkol

“Our company is turning into a green organisation and it makes everyone happy.”

— Comgrit Sorchom,
Thai Union Group



David Schalenbourg, director of department – building projects, format & maintenance, Delhaize Belgium

▶ David Schalenbourg, director of department – building projects, format & maintenance at Delhaize Belgium (part of Ahold Delhaize Group), highlighted the reduced energy consumption the company has achieved by installing transcritical CO₂ systems.

Schalenbourg's arguments for the business case for natural refrigerant systems echoed the sentiments made by the end-user representatives from Southeast Asia.

"For me and for Ahold Delhaize, NatRefs and CO₂ is a case where doing the right thing makes good short- and long-term business sense," he said.

“I want to prove something. That it is good, not only for the organisation but good for all the stakeholders.

That is the key. You have to sacrifice something then you can get something.”

— Thanarak Kosalwitr, CPF Group



Kousuke Yamamoto, managing director, Mayekawa Thailand

Ammonia trending in Southeast Asia

During the market trends panel, Thailand-based industrial refrigeration system supplier Patkol shared its knowledge of ammonia systems in that country with the audience.

"In Thailand today, ammonia seems to be the very best solution, especially in large industrial systems," said Pattra Chotchuangchutchaval, senior sales engineer for Patkol.

Explaining the popularity of ammonia systems, Chotchuangchutchaval said: "First things first, we know that it is a natural refrigerant with a Global Warming Potential (GWP) and Ozone Depleting Potential (ODP) value of zero."

"Secondly," she continued, "the advantage that ammonia gives us is the coefficient of performance (COP). The COP or efficiency of systems that use ammonia is very high. I think that those are the two biggest reasons why ammonia is very popular in Thailand".

Chotchuangchutchaval highlighted the fact that there is definitely strong interest among end users in Thailand to consider using newer types of ammonia systems that are more energy efficient and safe, such as NH₃-CO₂ cascade systems and low-charge ammonia systems.

Kousuke Yamamoto, managing director of Mayekawa Thailand, spoke in detail about the company's NewTon NH₃-CO₂ systems, which are already widely used in Southeast Asia.

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“Here in Asia, it’s coming to this region,” he said. “In Taiwan, already, we installed 26 sets (of the NH₃-CO₂ systems). In Indonesia, we’ve installed 14 sets: two machines with subsidies and 12 without subsidies. Here in Thailand, we have 11 sets now.”

Yamamoto also made an important announcement about Mayekawa’s first installation in Myanmar.

“In Myanmar, we are planning to install four new machines which will be operating from May 2018,” he said.

Regarding this installation, Yamamoto explained that the end user intended to reduce overall operating costs by using Mayekawa’s system, not only through energy efficiency, but by also removing the need for any human personnel in the machine room.

Large potential for CO₂ heat pumps and condensing units

Several presentations during the technology case study session showed the potential for CO₂ solutions in Southeast Asia.

CO₂ heat pump manufacturer JMM-Likido demonstrated the advantages of heat pumps over natural gas boilers and HFC-based systems.

“Payback of our CO₂ heat pump system in Malaysia is under two years. In Singapore, it’s about six months,” said JMM-Likido CEO Stuart Cox, referring to the energy efficiency gains of the system.

In addition to CO₂ heat pumps, Hidekazu Tachibana, general manager for Panasonic, showed that the company’s CO₂ condensing units were a good fit for end users in Southeast Asia.

“There are many types of CO₂ systems, but we believe the future is the decentralised condensing unit,” said Tachibana.

Tachibana was clear about Panasonic’s intention to continue expanding its business in this region.

“We’re looking for a customer in Thailand for our CO₂ transcritical condensing units,” said Tachibana. “Based on our positive experience in Malaysia and Indonesia (see ‘Kigali implementation underway in Southeast Asia’, p. 54), we’re confident the technology should perform well also in Thailand.”

With such broad representation from all key stakeholders present at ATMosphere Asia 2017, the discussion among participants proved to be stimulating and informative.

Participants left the event looking forward to the exciting opportunities for growth with natural refrigerant systems in Southeast Asia over the next year. ■ DY



Hidekazu Tachibana, general manager,
Panasonic Refrigeration Systems Department



Stuart Cox, chief executive officer, JMM-Likido



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Europe turning to future-proof natural refrigerants

With the new EU F-Gas Regulation reducing HFC consumption in Europe by 79% by 2030, now is the time to invest in natural refrigerants as energy-efficient, environmentally friendly and future-proof alternatives. *Accelerate Europe* reports from ATMOsphere Europe in Berlin.

— By Andrew Williams & Charlotte McLaughlin



Jonas Schönenberger, Frigo-Consulting

Natural refrigerants are becoming increasingly mainstream HVAC&R options to help European companies to comply with the HFC phase-down taking place under the EU's new F-Gas Regulation, heard participants in the eighth annual ATMOsphere Europe conference, held in Berlin, Germany on 25-27 September.

In Europe, the new EU F-Gas Regulation, which entered into force in 2015, is progressively banning the use of certain HFCs in different types of new equipment.

Commercial refrigeration is one area in which the EU F-Gas Regulation is already beginning to bite. In 2022, bans on using certain HFCs with GWPs above 150 in new centralised and plug-in commercial refrigeration equipment will come into effect.

"We're focusing on natural refrigerants as the future-proof solution. The synthetic alternatives aren't particularly good – especially in light industrial applications. There are good natural choices there," said Jörgen Rogstam, managing director of Swedish firm Energi & Kylanalys (EKA), which specialises in refrigeration engineering.

Staying ahead of the regulatory curve

Rogstam believes the EU F-Gas Regulation is already having a market impact above and beyond what the Kigali Amendment to the Montreal Protocol, agreed in the Rwandan capital last year, has put in place at global level.

"We don't need to mention Kigali. It's more obvious than that," he told conference participants. "In Europe we have the F-Gas Regulation. Things are happening much more quickly than expected. I think it's enough to talk about the F-Gas Regulation and say 'these are natural [refrigerants], they're going to stay,'" he said.

Vincent Grass, refrigeration team leader in the Corporate Operations – Engineering Services department at Nestlé, argued that the Swiss multinational is one step ahead of the global regulatory curve.

“We moved directly to natural refrigerants before Kigali. We moved to natural refrigerants to improve our energy efficiency and to limit our climate change impact,” Grass said.

“We still have HCFC and HFC systems to phase out, but 90% of our refrigerant charge is in industrial – and 90% of our industrial refrigeration is already natural refrigerants,” he said.

For Austria’s AHT Cooling Systems, the regulatory developments merely serve as confirmation that the company is on the right track. “Kigali didn’t change anything for us, because we’ve already been using propane since the 1990s,” said Reinhold Resch, vice-president for R&D at AHT. “People come to AHT because they want to have hydrocarbons in their equipment.”

For European retailers with operations outside of Europe, though, the Montreal Protocol remains an important driver for natural refrigerant adoption.

“Kigali has helped us to make the case for natural refrigerants internally,” said Olaf Schulze, director of energy management for retail giant METRO AG, which has operations as far afield as China.

METRO’s F-Gas Exit Program is phasing out f-gases and replacing them with natural refrigerants worldwide where technically and economically feasible.

Growing market share for NatRefs

HVAC&R manufacturers from around the world were asked in Berlin what market share they predict for natural refrigerants as a proportion of Europe’s total HVAC&R market in the future. The current rate is commonly thought to be around 10%.

A majority of participants saw the total share as growing to 30-40% (29% of the vote), with 23% – the next largest section of the audience – voting for over 40%.

Andreas Meier, managing director of German manufacturer TEKO, said: “This year we will have 60-70% natural refrigerants” as a proportion of total sales.

Carrier’s Guillaume Burvingt said the firm is charting a similar course. “90% of our cabinets have been converted to R290,” Burvingt said.



Vincent Grass, Nestlé



Olaf Schulze, METRO AG



Barbara Gshrey, Öko-Recherche

Photography by Ben Beech & Anna Salhofer



Jörgen Rogstam, EKA

Reinhold Resch, AHT

“It’s not a belief natural refrigerants are better. It’s a fact,” he said, citing the energy efficiency of such systems.

Johnson Controls’ Alexander Cohr Pachai added: “I have been working a lot with hydrocarbons [...]. They are a present from the gods.”

Little market threat from HFOs

Asked whether HFOs – the new generation of synthetic refrigerants – pose a market threat to natural refrigerants, EKA’s Rogstam said: “HFOs are a risky, short-term solution. We don’t yet understand all the risks. Don’t let history repeat itself.”

METRO AG is equally convinced of the business case for natural refrigerants. “We have one pilot HFO store in the Czech Republic – it will remain just that, a pilot, forever!” said Schulze.

Nestlé’s Grass agreed with these sentiments. “There are a lot of uncertainties about HFOs and their impact on the atmosphere. The Nestlé policy is to use efficient, natural refrigerant alternatives, and we’re sticking to it,” he said.

Grass predicts a bright future for natural refrigerants not just in Europe, but worldwide. “We don’t have a crystal ball, but natural refrigerants are abundant in the biosphere, they are stable, and the technology to harness them is already out there,” he said.

“It’s also about cost avoidance – we don’t know what the future holds. In many places, we moved directly from HCFCs to naturals, and we know that we saved money by doing that,” he said.

German leadership

Policy leadership and high levels of technological knowhow and environmental awareness are putting Germany at the forefront of natural refrigerant adoption and innovation in Europe.

Germany has a firm greenhouse gas reduction pathway in place until 2050, while a recent report

assessing the impact of legislative and non-legislative measures under the Climate Action Programme 2020 and National Climate Initiative indicates that efforts to slash emissions are already bearing fruit, Hans-Peter Klein from the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) told the Hotel Mercure MOA audience.

Germany first began investigating the use and emissions of ozone-depleting substances (ODS) in the 1970s and had been publicly funding research on ODS alternatives including non-HFC options since 1989.

“Natural refrigerants are no longer a niche product,” argued Barbara Gshrey of Öko-Recherche, an independent environmental research institution and consultancy based in Frankfurt-am-Main.

Jonas Schönenberger of Frigo-Consulting – a Swiss refrigeration consulting and engineering company – said the firm had played a pioneering role in rolling out ejectors in Europe, with 80 ejector projects in operation throughout Europe in 2017.

“What are the accelerating arguments for natural refrigerants? We all know about their fantastic physical behaviour. We just need to design systems that use them in the most effective way,” Schönenberger said.

“We all know that the environment impact is lower with natural refrigerants. They’re here to stay, that’s for sure. It’s a future-proof technology, and it’s the way to go,” he said.

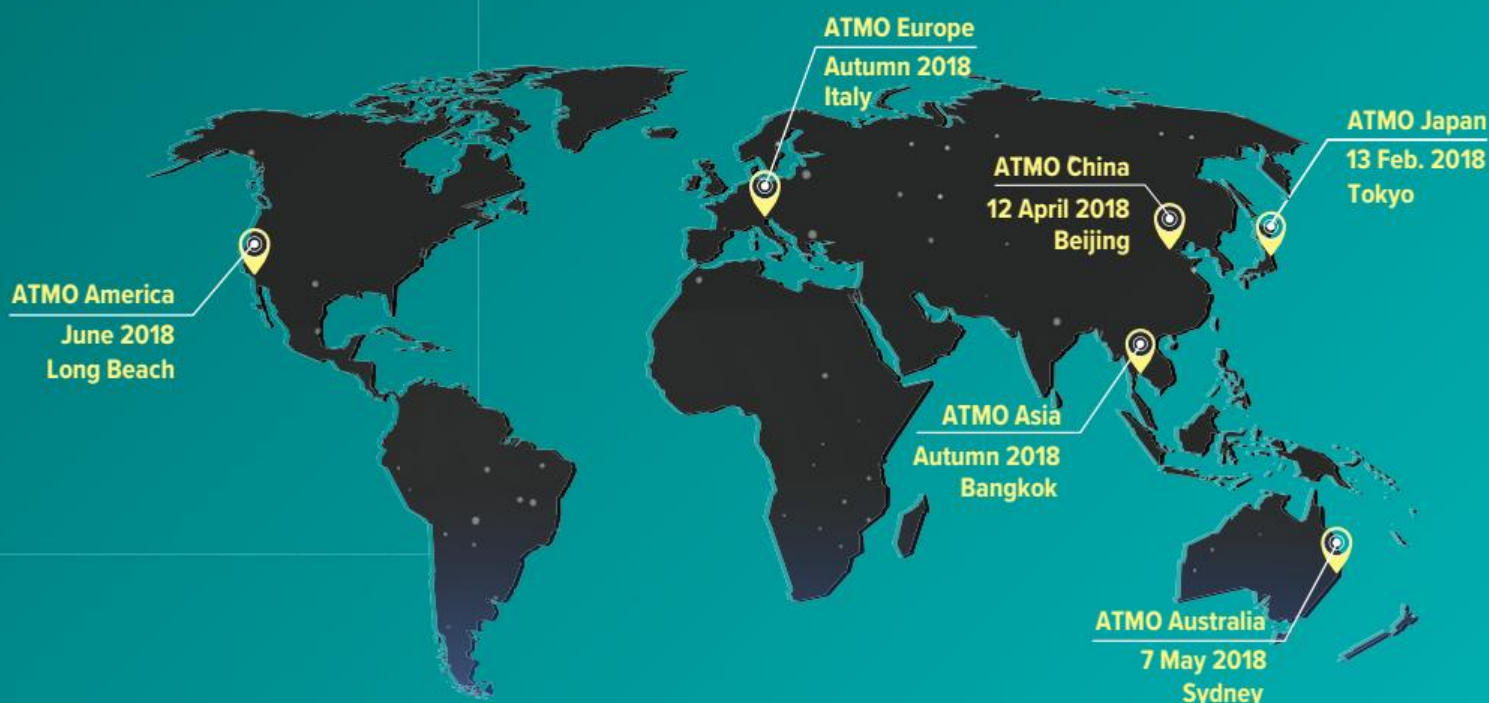
“There is no business case for the chemical brothers,” Schönenberger quipped.

Austria’s AHT has been committed to natural refrigerants since the 1990s. It has sold 700,000 propane cabinets in Europe – mostly in Germany – and around one million worldwide.

“Acceptance of natural refrigerants is very high in Germany, Switzerland and Austria. Sustainability and ‘thinking green’ are important market drivers in these countries,” Resch said. ■ AW & CM

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From left to right: Jaana Tiura (Viessmann), Jens Kallesøe (Advansor), Jean-Michel Fleury (Carrefour), Menno van der Hoff, Vincent Grass (Nestlé).

Photography by Ben Beech

Accelerate Europe awards recognise NatRef leadership

Carrefour, Nestlé, the Staay Food Group, Viessmann and Menno van der Hoff received awards for advancing natural refrigerant adoption at a Berlin ceremony held alongside the ATMOsphere Europe conference. *Accelerate Europe* reports.

— By Andrew Williams

Accelerate Europe magazine announced the winners of its first annual awards programme, which recognises excellence in advancing natural refrigerant adoption in Europe, at an evening ceremony on 26 September during ATMOsphere Europe, organised by shecco – publisher of the *Accelerate* magazine series – and held in Berlin, Germany.

The award winners in the three Best in Sector categories were the Carrefour Group (food retail), Nestlé (light commercial) and the Staay Food Group (industrial). The Innovation of the Year award went to Viessmann for its Click4Food propane and isobutane-

based cooling system. And the winner of the Person of the Year award was Menno van der Hoff, head of R&D and HVAC manager at Uniechemie.

Person of the Year

Van der Hoff played a key role in developing the Triple Aqua, an energy-efficient heat pump employing propaene (R443A), a mixture of the hydrocarbons propane (R290) and propene (R1270), with a global warming potential (GWP) of three and a charge of less than 11 lbs. (5 kg).

TripleAqua has the ability to store heat and cold in buffers for later use in the building, providing heating and cooling simultaneously or individually. It uses three water-loop pipes to distribute heat and cold, and to return water at ambient temperatures.

Uniechemie is a division of Swedish HVAC&R distributor Beijer Ref, which is marketing TripleAqua. According to Beijer Ref, TripleAqua can save up to 50% in heating and cooling costs in commercial buildings (including office buildings, hotels and hospitals) compared to traditional heat pumps, with a coefficient of performance between four and 10.

Inspirational leadership

To reduce refrigerant emissions, Carrefour is phasing out HFCs and replacing them with CO₂ for commercial refrigeration. Overall the Carrefour Group is aiming to reduce carbon emissions by 40% by 2025 and by 70% by 2050 (compared to 2010 levels). There are around 12,300 stores under the Group banner in 35 countries and five continents.

Carrefour boasts over 400 stores with technologies using natural refrigerants worldwide, around 175 of which are fitted with CO₂ transcritical racks. Assets Project Director Jean-Michel Fleury received the award on the group's behalf.

Vincent Grass, Refrigeration Team Leader in the Corporate Operations – Engineering Services department at Nestlé, collected the Swiss multinational's award. In 2011, Nestlé debuted its first hydrocarbon-based ice-cream chest freezer. Since 2014, all Nestlé's new ice-cream chest freezers in Europe have been HFC-free (and since 2015, worldwide). Since 2016, all its new island and upright freezers worldwide have been HFC-free.

Jens Kallesøe, director (internal sales and projects) at Advansor, the Danish manufacturer of transcritical CO₂ refrigeration systems, collected the award on behalf of the Staay Food Group. This year, Advansor completed the installation of a transcritical system at a Dutch lettuce processing plant managed by Staay; the capacity of the system exceeds 3.36 MW, making it the largest CO₂ refrigeration project in the world.

The nominees in the Person of the Year category were Menno van der Hoff, Sergio Giroto (enEX), Andy Pearson (Star Refrigeration), Reinhold Resch (AHT), and Olaf Schulze (METRO AG). Advansor's Mini Booster, Epta's FTE concept, Green & Cool's CO₂ Y MC condensing unit, Viessmann's 'Click4Food' and the TripleAqua were nominated for Innovation of the Year.

For Best in Sector: Food Retail, the nominees were Carrefour, Ahold Delhaize and Aldi Süd, while Nestlé, Heineken and Unilever were nominated for light commercial. The nominees for Best in Sector: Industrial were the Staay Food Group, Nestlé and the London Underground. ■ AW



Menno van der Hoff, Person of the Year

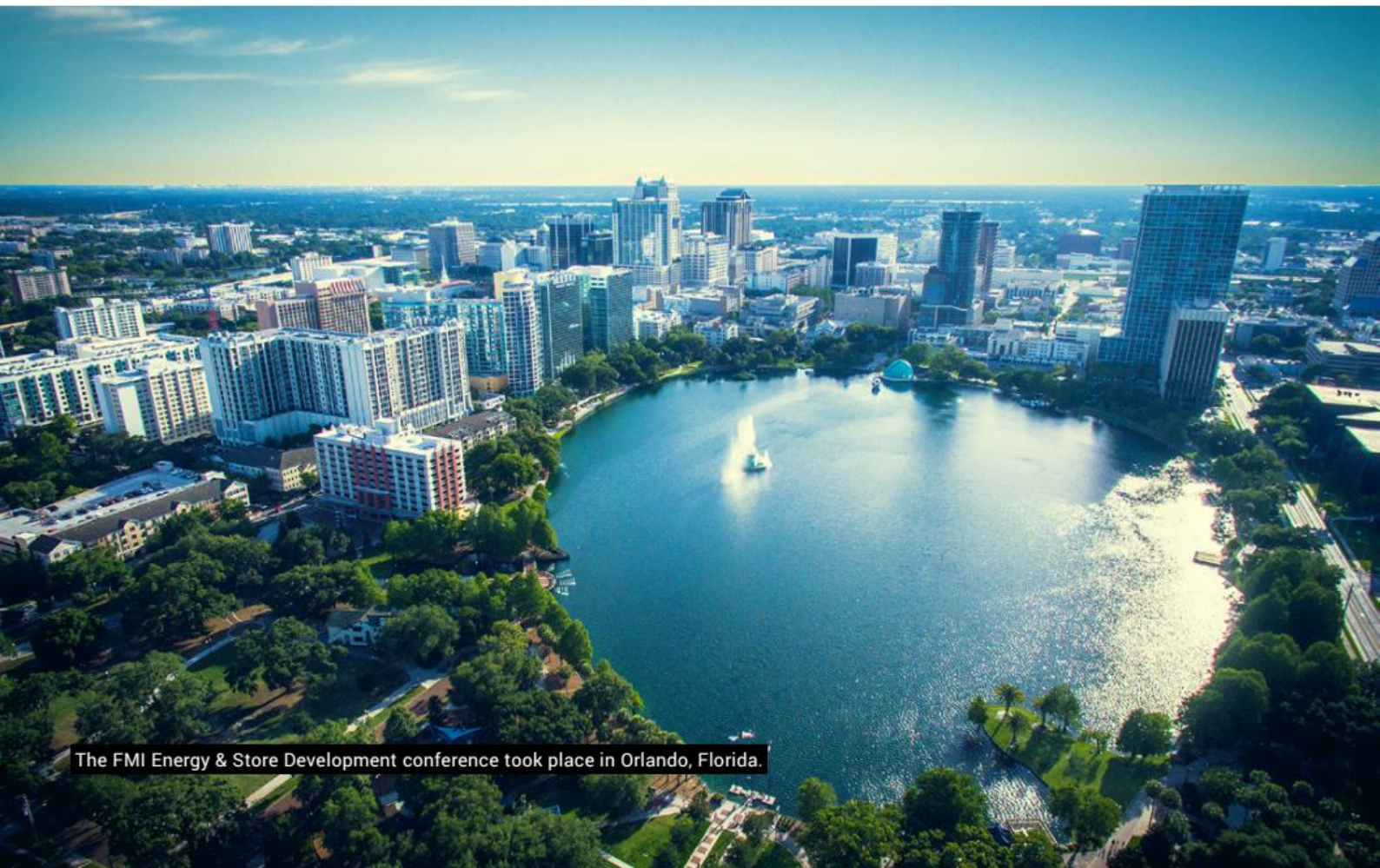
Retailers take lead at FMI Energy

Target and Delhaize America were on hand during the event to share their experiences with natural refrigerants, with the US Environmental Protection Agency's (EPA) GreenChill programme rewarding retailers for committing to reducing refrigerant emissions.

— By Michael Garry & Elise Herron

Hurricane Irma's destructive force that hit the United States a week before the event raised some questions about whether the 2017 FMI Energy & Store Development Conference — slated for September 24-27 in Orlando, Florida at the Hilton Bonnet Creek — would take place.

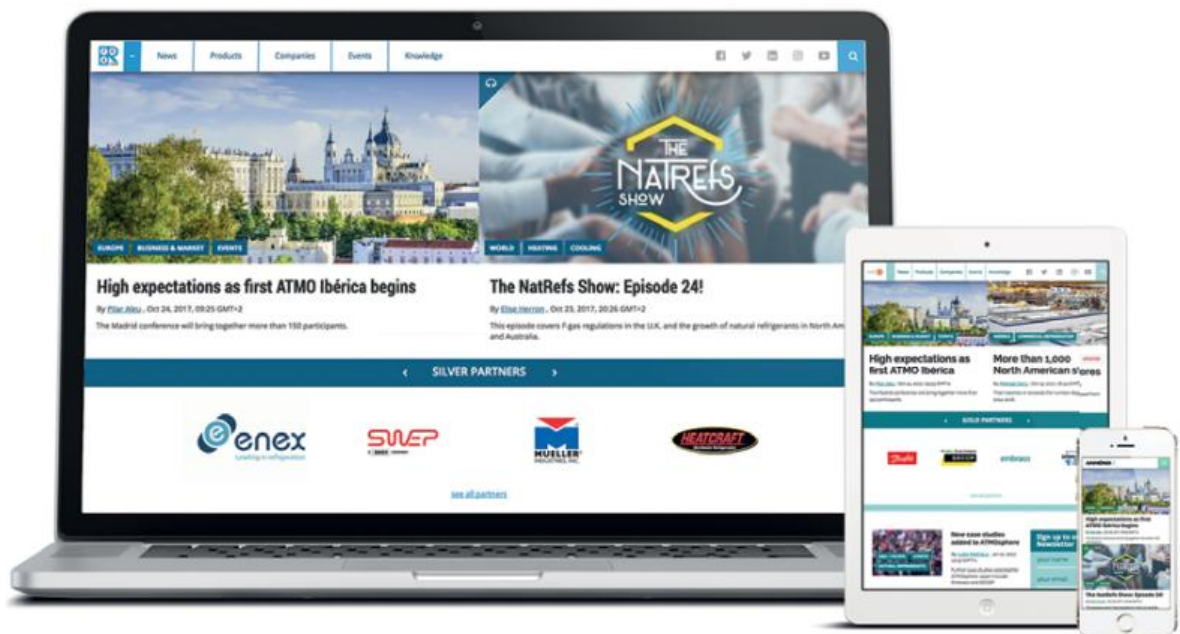
Fortunately, the annual conference went ahead as planned. It highlighted energy efficiency and best practices on the equipment side of the food retail industry. Over 600 directors, managers and vice-presidents in energy, refrigeration and store development at supermarket companies attended.



The FMI Energy & Store Development conference took place in Orlando, Florida.

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▶ Retailers moving forward

US-based retailer Target Corp. announced during the conference that it has self-contained display cases using propane (R290) refrigerant in more than 1,000 stores.

"Target has been evaluating alternative refrigerants for several years and has determined that R290 is the preferred self-contained refrigeration solution," said Paul Anderson, the company's senior director of engineering.

The reasons for this determination include:

- ▶ Propane has the lowest energy consumption of all HFC and natural refrigerants and a GWP of only three.
- ▶ Most manufacturers are supplying or are committed to supplying propane cases.
- ▶ Contractors offer service capability for propane equipment.

Target's propane cases include larger units it purchases for stores as well as smaller beverage coolers provided by brands like PepsiCo, Coca-Cola and Red Bull. Anderson also discussed Target's other natural refrigerant installations, including its prototype CO₂ cascade system deployed in 12 stores and two transcritical CO₂ stores (in Marin City, California, and Minneapolis) opened this year.

Harrison Horning, director of energy & facility services for Delhaize America (who focuses on Hannaford Supermarkets in the state of New England) noted that the company plans to install self-contained propane display cases for low-temperature foods in a new small-format store. These cases would use a water-loop to remove heat; Hannaford also employs air-cooled propane cases in several configurations in a number of stores.

As propane cases have developed, "they are getting quieter, lower-maintenance and more plug-and-play, so they're easy to replace," said Horning. "Will there come a day when we buy self-contained cases for the whole store? I don't know, but I'm excited to see where this is headed."

Also at the session, Michael Lehtinen, director of marketing for Heatcraft Worldwide Refrigeration, described the energy savings experienced by a Piggly Wiggly store in Columbus, Georgia, using the OEM's ammonia-CO₂ cascade system. The natural refrigerant-based store measured a 33% energy saving over nearly two years compared to an HFC store (including all energy consumption).

GreenChill awards

ALDI US accepted the 'Best of the Best' GreenChill award as part of a Tuesday morning awards ceremony at the conference.

The GreenChill awards are a voluntary programme administered by the EPA. It aims to encourage supermarkets and retailers to use climate-friendly refrigeration systems and reduce their HFC emissions.

As of August 2017, 43 of ALDI's 69 transcritical CO₂ stores had been awarded GreenChill Platinum certification (the highest certification under the awards), with more new and remodelled transcritical stores in the process of receiving this certification. The Best of the Best award applies to all of ALDI's Platinum stores.

Leaders in low emissions (leak rates) and store certification were also recognised with GreenChill awards.

In addition, Price Chopper, a Schenectady, NY-based supermarket chain, took home the 'Distinguished Partner' award, which recognises stores that have demonstrated innovation in achieving GreenChill's mission in the last year.

Recognition of the supermarket with the most GreenChill store certifications in the last year, the 'Store Certification Excellence' award, went to Sprouts Farmers Market, which had 69 GreenChill certifications last year. For non-supermarkets, the same award went to Hillphoenix for supplying equipment to 181 certified stores.

Five supermarkets achieved acclaim for 'Store Re-Certification Excellence', which celebrates stores that successfully renewed GreenChill certifications five years in a row. Those supermarkets were: ShopRite in Brodheadsville, Pennsylvania, Sprouts Farmers Market in Grand Junction, Colorado and in Whittier, California, Weis Market in Windsor Mill, Maryland, and Whole Foods Market in Santa Rosa, California.

Winners of the 'Best Emissions Rate' award were Giant Eagle – with a 2016 corporate-wide emission rate of 7.3% – and Port Townsend Food Co-op. The 'Most Improved Emissions Rate' went to Hanover Co-op Food Stores.

GreenChill partners that went above and beyond corporate emissions reduction goals and won the 'Exceptional Goal Achievement' were Giant Eagle, Weis Markets, Brookshire Grocery Company, and City Market Onion River Co-op.

"Achieving GreenChill certification is very difficult," says Tom Land, manager of the GreenChill Partnership at the EPA. "But even with the stringent criteria, the number of stores seeking certification continues to grow. For the first time this year we broke 200." ■ MG & EH

#GoNatRefs





Ricardo García, Frialisa

Ammonia-CO₂: A bold leap forward

Mexican cold storage operator Frialisa is leading Mexico's adoption of NH₃-CO₂ systems that are safer and 15%-20% more energy efficient than conventional ammonia equipment. *Accelerate America* reports.

— By Michael Garry

Two natural refrigerants, ammonia and carbon dioxide, have each proven to be highly effective working fluids: with NH₃ favouring the industrial sector, and CO₂ the commercial sector.

A growing number of end users in North America in both sectors are finding that the marriage of the two natural refrigerants within a single refrigeration system can offer advantages that each refrigerant can't necessarily deliver alone.

The first North American cold storage operator to embrace the concept of a combined NH₃-CO₂ cascade refrigeration system, United States Cold Storage, now has them in 12 of its 36 facilities (see 'Shaking Up Industrial Refrigeration,' *Accelerate America*, April 2015).

On a smaller scale, two food-processing companies, Imuraya and Wholesome Harvest Baking, are using Mayekawa's NewTon NH₃-CO₂ packaged system for freezing applications (see 'Freezing Bread with the NewTon,' *Accelerate America*, February 2017). Even in food retail, four US supermarkets

have installed an ammonia-CO₂ cascade system, including a Piggly Wiggly store in Columbus, Georgia (see 'Saving Energy with Ammonia-CO₂,' *Accelerate America*, September 2016).

Frialisa Frigoríficos, Mexico's largest cold storage operator, has made NH₃-CO₂ its standard refrigeration system. Starting in 2010, Frialisa now uses this technology at five of its 24 facilities (see map on opposite page).

Four of the five plants – in Monterrey, Tepeji del Rio, Toluca, and Veracruz – were constructed with an NH₃-CO₂ cascade system from US-based M&M Refrigeration, while at the fifth – in Culiacán Sinaloa – an expansion of the facility has been equipped with a packaged NH₃-CO₂ unit from US manufacturer Tewis (installed by Bohn).

Frialisa plans to install an NH₃-CO₂ cascade system this year at two new plants encompassing 26 million cu. ft. (736,238 m³). In Tepeji, the main, 9.8-million-cu.-ft. (277,505 m³) building and its NH₃-CO₂ system were constructed in 2014, and Frialisa is working on a 5-million-cu.ft. (141,584 m³) expansion of the facility expected to open this summer.

Frialsa's NH₃ / CO₂ plants



The expansion will also be served by the main building's NH₃-CO₂ system. Overseeing Frialsa's transition to NH₃-CO₂ technology is Ricardo García, director of engineering and projects, who joined Mexico City-based Frialsa in 1994. He is responsible for all of Frialsa's environmental projects, including management of energy generated at wind farms, and delivering 50% of electricity needs at 12 Frialsa warehouses.

Appeal of NH₃-CO₂

Comprising 66.2 million total cu. ft. (1.87 million m³) across its 24 facilities, Frialsa is not only the leading cold storage operator in Mexico and Latin America, but also one of the largest in North America.

Frialsa is a member of The World Group, a North American partnership of independent refrigerated/frozen food warehousing companies. The 34-year-old company offers refrigerated and frozen storage and transport for a wide range of products, including fruit and vegetables, dairy, meat, seafood, deli, bakery and ice cream – “every kind of food you can imagine,” said García.

Its extensive logistics network makes about 150,000 deliveries annually. The temperatures produced at the Tepeji plant in four convertible freezing/cooling rooms range from -13°F (-25°C) for freezing (beef, poultry, pork, ice cream and seafood) to 40°F (4.4°C) for cooling (milk, yoghurt) and 40°F (4.4°C) at the dock. The capacity of the plant runs between 700 tonnes of refrigerant (2,450 kW) and 800 TR (2,800 kW). At its Monterrey, Mexico, warehouse, Frialsa's NH₃-CO₂ system handles blast freezing down to -30°F (-34.4°C). With its vast

holding capacity, the potential for energy savings greatly attracted Frialsa to NH₃-CO₂ cascade refrigeration, said García.

“We have to freeze a lot of product,” he said in an interview with *Accelerate America*. “We were hearing that if you go to low temperatures, the energy efficiency of CO₂-ammonia would be better than regular ammonia systems.” Frialsa's conventional ammonia systems include two-stage and gravity-flooded recirculated systems. It also operates some plants with R507A or R404A. US Cold Storage has reported that its NH₃-CO₂ cascade systems are on average 5.8% more energy efficient than a conventional ammonia system.

Frialsa has found the average energy efficiency of its NH₃-CO₂ systems to be even greater – between 15% and 20%, depending on local electricity rates, said García, noting that the lower the temperature, the greater the efficiency of the system.

“Consumption of energy will be lower working with CO₂-ammonia,” he said. Moreover, as García started bidding for NH₃-CO₂ cascade systems vs. regular ammonia equipment, he found to his surprise that capital costs were comparable. “You may buy more equipment with CO₂-ammonia but at the end of the day the cost is real similar [to a conventional system],” he said.

Installation costs are also about the same. García noted that Frialsa did not receive government incentives or loans for installing the NH₃-CO₂ equipment. Mexico's government offers low-interest loans to help finance the installation of energy-efficient equipment.



García checking on the ammonia screw compressor in Tepeji del Río

Less ammonia, less risk

In $\text{NH}_3\text{-CO}_2$ cascade systems, ammonia, a potentially toxic chemical, is confined to the engine room, vastly reducing the charge compared to what is used in conventional ammonia systems, and greatly improving the safety of plant employees. Ammonia is employed simply to condense CO_2 into a liquid, which is the only refrigerant channelled to the cooling and freezing areas.

For example, at the Tepeji plant, the engine room, which is located next to – but outside of – the main storage building, employs about 1,100 lbs. (500 kg) of ammonia (in concert with about 30,000 lbs. (13,608 kg) of CO_2), compared with 10,000–15,000 lbs. (4,536–6,803 kg) of ammonia at conventional facilities. (Frialisa's other $\text{NH}_3\text{-CO}_2$ cascade systems use a similar amount of ammonia and CO_2 .) This year, Frialisa installed its first ultra-low-charge ammonia- CO_2 packaged unit to support the expansion of its Culiacán Sinaloa plant.

The packaged unit contains only about 200 lbs. (90.7 kg) of ammonia and roughly 10,000 lbs. (4,536 kg) of CO_2 ; like the M&M system, it confines ammonia to the high side and uses only CO_2 in the cooling/freezing areas. "It could be on the roof, but we are putting it on the ground outside the building," said García. In addition to cost and energy considerations, it is very important for Frialisa to remove ammonia from cooling and freezing rooms.

"When you think about ammonia leaks, we decided to put it just in the engine room – there is less ammonia, and less risk,"

said García. "We're fine with ammonia, but if you can reduce the amount, it is a great relief." Using CO_2 in the freezing and cooling areas rather than ammonia also helps safeguard stored food products in the event of a refrigerant leak.

"A lot of our customers are happy about that," said García. "Our insurance company is, too."

Some of Frialisa's customers specifically request storing their products at facilities that use $\text{NH}_3\text{-CO}_2$ refrigeration. Government regulations are another factor favouring adoption of $\text{NH}_3\text{-CO}_2$.

In Mexico, anything over 10 kg of ammonia can qualify an industrial facility as "high risk" by the Ministry of Labor and Social Welfare (STPS), said García. But low-charge systems require less documentation and less demanding emergency plans than a conventional ammonia plant. "If we have a leak, we have just ammonia in the engine room; we don't have to move all the people outside the building, as we would do if there was an ammonia leak in the building."

STPS's safety requirements and enforcement are very similar to those set in the US by the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA). And, as in the US, governmental inspections at facilities that use ammonia have been stepped up in Mexico, García noted.



Electrical room with 1,000 kW emergency plant



Ricardo Garcia, in the NH₃/CO₂ engine room at Frialsa's cold storage facility in Tepeji del Rio, Mexico

Local training

When M&M Refrigeration installed Frialsa's first NH₃-CO₂ system in Toluca in 2010, M&M trained Frialsa's internal and third-party technicians on how to maintain the technology. Since then, said Garcia, "we're dealing only with Mexican technicians" (contractor Watco S.A. de C.V.) who know how to work with NH₃-CO₂ systems. One key maintenance consideration is the upkeep of the cascade condensers that condense CO₂ by evaporating ammonia.

They are designed to keep the two refrigerants from mixing; however, if they did come in contact, they would form ammonium carbamate, a white, powdery salt that tends to clog pipes and valves. "We have not experienced this problem," said Garcia.

Another technical requirement is eliminating moisture, which reacts with CO₂ to create corrosive carbonic acid. To accomplish that, Garcia pulls a vacuum during the start-up of the equipment that lasts for several days. The interest in NH₃-CO₂ systems among cold storage operators is growing in Mexico, said Greg Robison, vice-president of sales for M&M Refrigeration.

In addition to the four Frialsa plants, a La Vista facility in Zamora, Mexico, is using M&M's technology, and M&M has received four to five more bids in the country, he said. "Requests in Mexico are pretty strong. That's mainly because we got our foot in the door at Frialsa. People down there are starting to say, 'This is a good thing; let's think about switching.'" ■ MG

System Specs

Frialsa's NH₃-CO₂ system at its plant in Tepeji del Rio has the following characteristics:

- ▶ Size of plant (with expansion): 14.8 million ft³ (419,089 m³).
- ▶ No. of convertible freezer/cooling rooms: 4.
- ▶ Temperatures: -13°F (-25°C) (freezing); 40°F (4.4°C) (cooling); 40°F (4.4°C) (dock).
- ▶ NH₃ charge: 1,100 lbs (3,805 kg).
- ▶ CO₂ charge: 30,000 lbs (13,603 kg).
- ▶ Capacity: 700-800 TR (2,450-2,800 kW).
- ▶ NH₃-CO₂ system (M&M Refrigeration).
- ▶ NH₃ screw compressors (Howden).
- ▶ CO₂ reciprocating compressors (Sabroe).
- ▶ NH₃-CO₂ cascade condenser (Vahterus).
- ▶ Evaporative NH₃ condenser (Evapco).
- ▶ Rain collector tank (generally used May to September) for evaporative condenser.
- ▶ Controls (M&M Refrigeration).
- ▶ CO₂ and ammonia sensors in the engine room.
- ▶ CO₂ sensors in the cooling and freezing rooms.



CO₂ reciprocating compressors



Kigali implementation underway in Southeast Asia

Funding schemes and pilot projects are already underway in Southeast Asia as governments in the region begin planning to phase down HFCs. *Accelerate Australia & NZ* reports from ATMOSphere Asia 2017.

— By Devin Yoshimoto

During the policy session at ATMOSphere Asia 2017, attendees learned how governments in Southeast Asia are co-operating with UN agencies and overseas industry players to tackle the HFC phase-down requirements put in place by the Kigali Amendment to the Montreal Protocol.

ATMOSphere Asia 2017 – which took place on 6 September and was held in Bangkok, Thailand for the first time – brought together representatives from the governments of Indonesia and Malaysia and different UN agencies along with manufacturers and end users to discuss case studies, opportunities, and challenges with natural refrigerant technology in the region.

HFC phase-down in Indonesia and Malaysia

Representing Indonesia's Ministry of Environment and Forestry was Bitul Zulhasni, head of the Sub-directorate for Ozone-Depleting Substances Control – Indonesia's national focal point for the implementation of the Montreal Protocol.



Bitul Zulhasni, head of the Sub-directorate for Ozone-Depleting Substances Control, Indonesia



Yahya Bin Atan, Department of Environment, Malaysia

Asked why she was interested in attending ATMOsphere Asia, Zulhasni replied, "I'm looking for information on what direction natural refrigerant [technology] will go".

Zulhasni said that for Indonesia to come up with an effective HFC phase-down strategy, she would need more information on the technology roadmap and major market trends for natural refrigerants.

With respect to the major technology providers, Zulhasni asked: "What is their plan? Especially since they already know that our goal is to phase down HFCs soon – so how will they make [the technology] available for us? That is what we want to know."

During her presentation, Zulhasni outlined Indonesia's HFC phase-down targets. "Under the Kigali Amendment, Indonesia is classified as a Group 1 country," she said.

For Group 1 countries, the baseline years for measuring reduction targets are from 2020 to 2022. Compared to developed countries, they have about a ten-year grace period.

Indonesia's phase-down will begin with a freeze in 2024 followed by a 10% HFC reduction target by 2029, explained Zulhasni.

"Although it is still a long way to go, we have to think now because the baseline year begins in 2020. That's very fast," she said.

Representing the Department of Environment of Malaysia was Yahya Bin Atan, who joined Zulhasni in speaking during the policy session.

Atan explained that Malaysia is also a Group 1 country whose baseline years are from 2020 to 2022.

Both countries are yet to ratify the Kigali Amendment. However, both Zulhasni and Atan stated that they are

focused on monitoring the ongoing natural refrigerant pilot projects in their countries, while forming their preliminary strategies for the HFC phase-down.

Pilot projects boast results

The first CO₂ condensing unit in Malaysia was installed and commissioned in May 2017 at a supermarket of Malaysian retailer Jaya Grocer.

Chai Chun Leong, a representative from project installation contractor and partner Coolcare, spoke during the end user session about this installation.

Two Panasonic 20 HP CO₂ outdoor condensing units were installed at the supermarket, providing cooling for a total of 23 medium temperature CO₂ display cases.

The project was carried out under the framework of Stage 1 of Malaysia's HCFC Phase-out Management Plan, which included funding assistance from the Multilateral Fund for the Implementation of the Montreal Protocol.

Though cost challenges remain, feedback from the end user so far has been positive, according to installation contractor Coolcare.

"For the energy savings, we have saved about 12.8% (in energy consumption costs compared to HFC-based systems)," said Leong.

Masaaki Kanbe, senior manager for Japan-based retailer Lawson, Inc., took to the stage during the end user session to provide details of CO₂ pilot projects in Indonesia.



Chai Chun Leong, Coolcare

“Although it is still a long way to go, we have to think now because the baseline year begins in 2020. That’s very fast.”

– Bitul Zulhasni

▶ To date, Lawson has assisted with project management for the installation of a total of 26 Panasonic CO₂ condensing units at 12 Alfamidi grocery store locations in Jakarta, Indonesia.

The installations are part of a programme that began in 2013, called the ‘Joint Crediting Mechanism Model Project’.

The programme is a joint collaboration between the Japanese and Indonesian governments, which aims to introduce energy-efficient technology to retailers, while contributing to the emissions reduction targets of both countries.

Though challenges such as high installation costs and the need for training remain, the project so far boasts impressive results.

Combined with the installation of LED lighting and inverter-type air conditioning, the installation of Panasonic’s CO₂ systems has allowed all 12 stores to achieve an average 40.3% reduction in total yearly power consumption.

Zulhasni said several other projects were underway in Indonesia, including the installation of propane (R290) chillers at the University of Indonesia and in a hotel in Bali.

These projects are all part of a larger push to raise awareness of natural refrigerants, especially among end users, in the rest of Southeast Asia.

Anshu Kumar, technical advisor for the United Nations Development Programme, underscored this point by saying: “The end user does not know about this change from synthetic to natural [refrigerants] and multilateral funding, so we need to work harder to increase this awareness among end users.”

However, it is certain that the direction for the industry is set and the support infrastructure is there for the beginning of the transition away from HFCs in Southeast Asia.

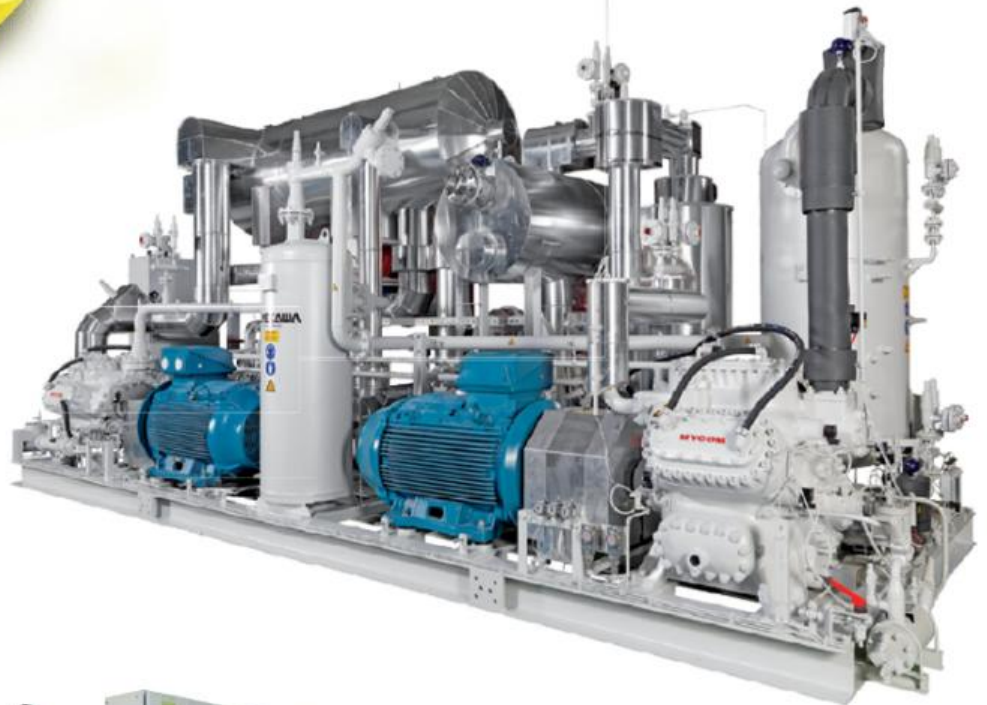
“We are working to remove all the barriers for adoption of the new generation of refrigerants,” said Shaofeng Hu, regional network coordinator for the United Nations Environment Programme.

“With the Kigali Amendment, you will see more examples of natural refrigerant adoption in Southeast Asia.” ■ DY



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Ammonia refrigeration system, Bakers Maison, Revesby, NSW

Wat Als Photography/OEH, © State of New South Wales and Office of Environment and Heritage 2017

New guide to improving industrial plant efficiency

The New South Wales Office of Environment and Heritage has released a new industrial refrigeration guide, outlining 15 technologies that help save on energy costs.

— By Devin Yoshimoto

Modern HVAC&R systems, whether used at home, commercially or industrially, contribute to CO₂ emissions in two main ways: direct emissions and indirect emissions.

With respect to industrial refrigeration technology, new natural refrigerant-based systems are becoming increasingly popular alternatives to HFC-based systems, which are now being phased down worldwide.

These systems, with their low to zero levels of global warming potential, dramatically reduce the amount of direct emissions from an industrial refrigeration plant.

New systems ranging from low-charge ammonia technology and NH₃-CO₂ cascade systems to CO₂ transcritical and heat pump solutions also contribute to reducing a plant's indirect emissions, and they are becoming increasingly competitive in terms of energy efficiency as the technology matures.

The future of industrial refrigeration is clearly heading towards low-GWP and high-efficiency systems, and the New South Wales government has released an industrial refrigeration guide to help owners, operators and suppliers of industrial systems to get the most energy efficiency out of their refrigeration plants.

The guide points out that, "industrial refrigeration and process cooling plants are substantial energy users, yet businesses often give little consideration to a plant's energy efficiency and operating costs or its environmental impact".

The guide specifically outlines 15 energy-saving technologies to assist system owners in optimising their industrial systems so that they perform as efficiently as possible.

Each entry covers the basic technology principle, benefits of the system, measured energy saving amounts, specific case studies, and implementation

15 ways to improve the efficiency of your industrial plant

- ▶ Variable head pressure control and variable inter-stage pressure control
- ▶ Automated compressor staging and capacity control
- ▶ Water and air purging from ammonia systems
- ▶ Heat recovery from discharge gas and oil cooling
- ▶ Variable defrost timing and termination
- ▶ Variable cold store temperatures
- ▶ Variable evaporator fan speeds
- ▶ Condensate sub-cooling techniques
- ▶ Ammonia plant process design review
- ▶ Improved industrial screw compressor oil feed control and oil cooling
- ▶ Screw compressor degradation check
- ▶ Fluid chiller selection for energy efficiency
- ▶ Improved chiller fluid circuit design and control
- ▶ Variable chiller fluid temperatures
- ▶ Variable cooling water temperatures

requirements. Estimated cost savings in financial terms are also included in some of the examples.

Opportunities for energy savings particular to natural refrigerant-based systems are also specifically covered in the guide.

NatRef systems offer large energy-saving potential

Technology 4 in the guide outlines the benefits of implementing heat recovery from discharge gas and oil cooling.

Heat recovery, especially when implemented at facilities where both refrigeration and hot liquid are required, can provide several benefits such as free hot water generation or significant savings on running costs for compressors due to lighter loads on gas boilers.

According to the guide, this technology is especially useful when dealing with chillers that use natural refrigerants NH_3 or CO_2 .

"The chiller units, in particular those using ammonia (R717) or carbon dioxide (R744), offer significant potential to recover otherwise wasted heat at useful temperature levels," the guide says, as more heat recovery is possible at higher temperatures compared to traditional HFC systems.

In addition to heat recovery, 'Technology 12: Fluid chiller selection for energy efficiency', gives specific advice on optimising chiller performance by making sure the type of chiller used best matches its application.

For example, the use of 'air conditioning'-style chillers for industrial process applications, where the conditions and chilling requirements are significantly different, will come at a very high energy cost.

In selecting which type of chiller to use for certain applications, the guide reminds readers that the choice of refrigerant is a large factor in the decision.

According to the guide:

"Natural refrigerants such as ammonia (R717), carbon dioxide (R744) and hydrocarbons (R600a, R290, R1270) offer a future-proof option, as these refrigerants have no environmental impacts and will be unaffected by any carbon price in the future."

"HCFC-based chillers (R22) should not be considered for new applications at all, as these gases are ozone-depleting and have been phased out (from 1 January 2016). HFC-based refrigerants (R134a, R407C, R404A and R507) are all high global warming potential gases, and will be severely affected by the upcoming HFC phase-down commencing in 2018, which will potentially increase the maintenance costs of these units."

The guide is an easy-to-use reference designed to help industrial refrigeration system consultants provide better service, owners to increase their knowledge, and operators to better run their plants.

With the introduction and development of new technology and the increasing focus on energy efficiency, the guide serves as yet another valuable resource in this quickly changing industry.

Incentives available for energy-efficiency improvements

The guide includes information on financial incentives that are provided by the NSW government's Energy Savings Scheme (ESS).

To qualify for the incentives, operators must measure before and after energy use data through Accredited Certificate Providers (ACPs). A list of ACPs can be found at http://www.ess.nsw.gov.au/Accredited_Certificate_Providers/List_of_Accredited_Certificate_Providers.

An appendix summarising measurement and verification plans for each of the 15 technologies is also included in the guide.

The guide in PDF format is available for free online at <http://www.environment.nsw.gov.au/business/industrial-refrigeration.html>. ■ DY

Photonic Innovations foresees ammonia demand growth

Photonic Innovations Ltd. – a New Zealand-based manufacturer of ammonia detection equipment – recently partnered with two Australia-based companies, Gordon Brothers Industries and Aegis Sales and Service, to continue its expansion in the region.

– By Devin Yoshimoto



Ammonia Open Path leak detector 4000

Following a partnership with New Zealand-based ammonia system supplier Active Refrigeration in June, Photonic Innovations Ltd. is now aiming to expand in Australia, announcing partnerships with Australia-based companies Gordon Brothers Industries and Aegis Sales and Service.

The announcement signals an increase in demand for ammonia detection systems as the popularity of ammonia-based refrigeration systems continues to increase in the region.

"It is fine timing. Ammonia's popularity as a refrigerant has increased dramatically due to its green credentials," Dr. Ojas Mahapatra, CEO of Photonic Innovations, said earlier this year.

For industrial end users, high-efficiency and low-GWP refrigerant systems are becoming increasingly attractive options as Australia prepares to begin phasing down HFC imports from 1 January 2018.

Additionally, increasingly strict health and safety regulations have driven companies to be more proactive in managing the safety risks associated with ammonia plants.

"The end result is strong demand for high quality, reliable and affordable ammonia sensors," said Dr. Mahapatra.

Photonic Innovations Ltd. manufactures laser-based ammonia detectors and has seen considerable interest in its products from large and small food processing businesses concerned with safety.

"The focus is definitely more on risk mitigation rather than waiting for an accident to happen," Dr. Mahapatra added.

Photonic Innovations' partners also share the same vision for growing the market for ammonia systems in the region.

"We are proud to partner with Photonic Innovations for nationwide distribution," said Craig Duff, New Zealand-based Active Refrigeration's managing director.

"Active Refrigeration has a history of promoting and installing natural refrigeration solutions with a focus on energy efficiency and sustainability."

Gordon Brothers is Australia's biggest supplier of ammonia-based refrigeration systems. It just completed an ammonia installation at Stone & Wood Brewery's Murwillumbah location (see cover story: 'Riding the Sustainability Wave', p.18).

Rob Hughes, national merchandise manager for Gordon Brothers, shared the same sentiments.

"With the rise in popularity of ammonia as a refrigerant, it is critical that organisations are confident in their leak detection equipment," he said.

"Photonic Innovations use advanced and proven technology that solves some of the shortcomings of traditional sensors, such as false alarms from cross gas sensitivity and sensor head depletion. It's an exciting solution for a well-known problem and we're very pleased to be working with them." ■ DY

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Lofty potential for CO₂ heat pumps in Australia

Mitsubishi Heavy Industries Air-Conditioners Australia (MHIAA) has completed its first Q-ton CO₂ air-to-water heat pump installation in Australia. Now WaterMark-certified, the Q-ton is demonstrating its cost effectiveness and potential to replace traditional hot water production systems around the country.

– By Devin Yoshimoto & Jan Dusek

Mitsubishi Heavy Industries Air-Conditioners Australia (MHIAA) has completed its first Q-ton CO₂ air-to-water heat pump installation at the Matterhorn Lodge Perisher Valley, New South Wales (NSW) – the first of its kind in the alpine region of Australia.

MHIAA received the WaterMark certification in June 2017, a mandatory certification issued by the Australian Building Codes Board that approves the Q-ton for use in Australia. Soon after this, the installation at Matterhorn Lodge was completed.

Accelerate Australia & NZ spoke to Trent Miller, air-to-water (A2W) manager for MHIAA in Australia, about the installation and the wider potential for CO₂ air-to-water heat pumps in Australia.

CO₂ in the mountains

"This Q-ton installation is a great example of an environment where natural refrigerants, such as CO₂, excel in performance over every other alternative," says Miller, detailing the installation at Matterhorn Lodge.

The lodge is located in the alpine region of Australia in Perisher Valley, where ambient temperatures can reach -20°C.

The owners of the lodge were looking for a safe and cost-effective solution to replace their existing diesel boiler and supply hot water to their hotel guests.

"Matterhorn Ski Lodge is looking to reduce reliance on liquefied petroleum gas (LPG) and potentially phase out the use of their boiler, which performed very poorly and inefficiently, accumulating considerable running costs," says Miller.

The lodge is located in the Kosciuszko National Park, so the owners were also looking to invest in reducing the long-term environmental impact of the facility.

"They want to make sure the lodge is there for a long time to come and are quite forward-thinking and environmentally conscious in all the things that they do," says Miller.

MHIAA first approached Matterhorn Lodge about 12 months ago, Miller explains. The idea was to install the Q-ton and update the diesel boiler to an LPG boiler, as a hybrid system, with the goal of slowly phasing out the boiler.



Mount Hotham in winter, Australian Alps

Currently, the single Q-ton unit receives water at an inlet temperature of 2°C and can heat about 1,000 litres of water in two hours, in ambient conditions of -5°C.

Miller says that the Q-ton, however, has already exceeded Matterhorn Lodge's expectations and that the owners have been very happy with its performance.

"They've really seen that what we've been able to deliver so far has been exceptional. The 200 kW [LPG] boiler is only running for about three minutes and then shutting off every three or four hours, which is quite remarkable," says Miller.

"They are already looking at replacing their LPG boiler by next year," he adds.

The Q-ton is demonstrating how effectively CO₂ can outperform traditional boilers in that environment.

"If there is any environmental condition that natural refrigerants are made for, it's definitely in the alpine region," says Miller.

Cost savings: the bottom line

Though Matterhorn Lodge Perisher is a great example of an end-user company that is forward-thinking and environmentally responsible, the number one reason it chose to go with the Q-ton, Miller explains, was the cost savings that it delivers.

MHIAA predicts that by using the Q-ton, Matterhorn Lodge will cut 50% of its energy costs versus a traditional gas boiler. Though ambitious, Miller is confident in this figure and now he is seeing actual results.

"We were under a lot of pressure to deliver major savings," he says, "but [Matterhorn Lodge] has already been taking readings for gas usage and we've been able to deliver on those savings so far".

Miller says the impacts of these savings are even more apparent considering the limited period of time each year during which the system is actually in use.

▶ “They only get three months where the lodge is fully booked and it’s a four-month season,” he says. “So for these guys to be saving enough money to invest in us to begin with is quite a big deal,” he adds.

Burgeoning market for CO₂ heat pumps

Miller says demand for the Q-ton has already exceeded expectations, leading the company to revise its projections for the coming year.

Additionally, external factors such as rising natural gas costs in Australia and HFC phase-down regulations are likely to drive other end users like Matterhorn Lodge to justify investing in CO₂ heat pumps for similar applications.

Miller discussed the likely possibility of natural refrigerant rebates for food manufacturing in Australia in the near future.

The rebates, Miller predicts, will be necessary as the government looks to encourage efficient energy use to handle Australia’s electricity grid issues, and as demand for Australia’s food products increases from China.

Though cost savings and energy efficiency have ultimately driven Matterhorn Lodge to use the Q-ton, Miller warns against underestimating the growing sustainability awareness of environmentally conscious business owners.

“These guys, they really saw the benefit to the environment, and that’s what brought them home,” Miller says. ■ DY & JD



Trent Miller, MHIAA



Mitsubishi Heavy Industries' Q-ton Air-to-Water CO₂ heat pump

“ If there is any environmental condition that natural refrigerants are made for, it’s definitely in the alpine region. ”

– Trent Miller, MHIAA

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Mayekawa (Mycom) ammonia heat pump, Colruyt Fine Food factory

Colruyt puts ammonia at heart of new factory

In deciding between a combined heat and power (CHP) plant or a heat pump to save energy at its new meat processing facility, Belgian retailer the Colruyt Group decided an ammonia heat pump was the most efficient option. *Accelerate Europe* reports.

— By Andrew Williams & Charlotte McLaughlin



Mayekawa (Mycom) ammonia heat pump, Colruyt Fine Food factory

Cross the bridge from the train station in the small town of Buizingen, just south of Belgian capital Brussels, and you cannot miss the row of wind turbines lining the canal alongside the Colruyt Fine Food factory. The site belongs to the Colruyt Group, one of Belgium's biggest retailers.

Founded in 1925, the Colruyt Group – headquartered in the town of Halle, also near Brussels – boasts annual revenue of over €9.1 billion (A\$13.7 billion). Employing over 29,000 staff, it boasts 516 shops. Three shop formats in Belgium have product cooling: Colruyt supermarkets (237), OKay convenience stores (120) and Bio-Planet (19) organic stores (autumn 2016 figures).

The Colruyt Group's official target is to reduce its relative CO₂ emissions by 20% by 2020 compared to 2008 levels. It runs its own energy company, Eoly, to help deliver this target. Electricity from solar panels, wind turbines and CHP (combined heat and power) plants powers Colruyt Group stores and distribution centres.

With the Belgian retailer having already switched to electricity from 100% renewable sources, refrigeration now makes a proportionally larger contribution to its carbon footprint. Choosing the right refrigerants, therefore, is crucial for meeting its sustainability targets.

The Colruyt Group's ultimate goal is to become HFC-free. In 2012, it launched a feasibility study. This led to the adoption in December 2014 of the official target of using 100% natural

refrigerants for all its cooling needs. Since the end of 2016, Colruyt is no longer building HFC cooling systems in its stores.

Harnessing an ammonia heat pump

The Group is also innovating in its factories. Colruyt Fine Food's new meat processing facility in Buizingen opened in September 2016.

Having been cut down to size and cleaned elsewhere, pieces of meat arrive in the building for processing into sausages, bacon, smoked meat, meatballs in sauce and packaged meat. The products are packaged on site and sent to a central fridge in nearby Halle for distribution to supermarkets.

"We had two ideas. One was a heat pump and the other was a combined heat and power (CHP) plant," Project Engineer Kristof Lauwereys told *Accelerate Europe*.

The facility operates in two eight-hour shifts: from 6:00am to 2pm, and from 2pm to 10pm. During the night, production shuts down for the plant to be cleaned with hot water at 55°C. Hot water is also required for the production process and air-handling units.

The site's hot water consumption, together with the fact that most of its electricity demand is already satisfied by wind, ultimately led Lauwereys to opt for a heat pump over CHP.

“Our electricity production is more sustainable with a wind turbine than with CHP, because the CHP still needs to use gas,” Lauwereys explains.

“The heat pump that is installed here is 1 MW. During peak periods, we do use a small amount of gas, but not that much. During the day, the heat pump runs on three compressors with a frequency drive, making 200-250 kW. During the night, at its peak during the cleaning process, it peaks at a little over 1 MW,” he says.

From factory to shop

Upon arriving at the factory, the meat is briefly stored in fridges at 2°C before processing begins. “We have one freezer for peak moments, but usually we always produce fresh meat,” Lauwereys says.

At the end of the process, the meat is kept in fridges at -6°C to -10°C for 8-10 hours. “We leave it in there long enough to freeze a bit but not entirely, so that it can be easily sliced,” he explains.

To speed up the process during peak moments, the meat is placed in shocking cells for up to 20 minutes at -25°C to -30°C. “That’s why we need the subcritical CO₂ system. The rest of the time, the meat stays at an ambient temperature of -2°C to +2°C,” Lauwereys says.

Ammonia ticks all the boxes

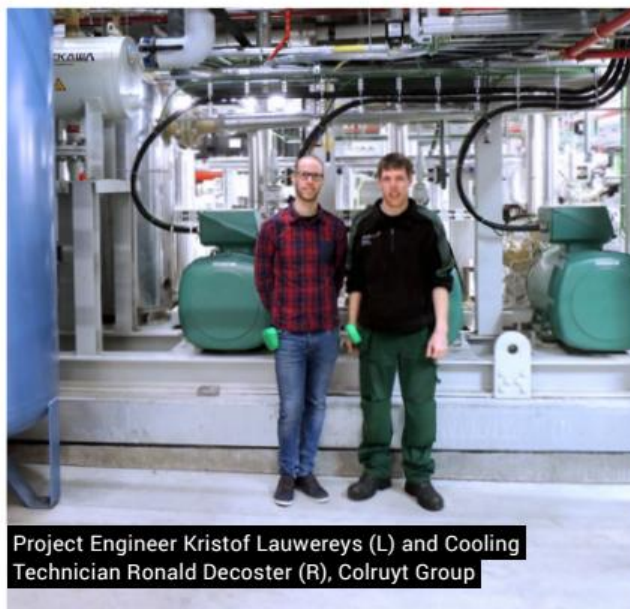
Mayekawa (Mycom) provided the cooling system, the heat pump and the eight compressors. “There is 3,500 kg of ammonia in the cooling system and 850 kg of ammonia in the heat pump. For this big cooling capacity, ammonia is the best,” Lauwereys argues.

Colruyt worked with local installer SKT, based in Ieper (Ypres) in West Flanders, Belgium, to put together the system. “They build a lot of cooling projects with ammonia,” he says.

At the Buizingen facility, the ammonia heat pump satisfies most of the HVAC&R demand. “Ammonia produces most of the cooling. We have three little cooling productions with CO₂. In this factory, we need very low temperatures to shock the meat,” Lauwereys explains.

The ammonia heat pump is also used to upgrade low-temperature heat produced as a by-product of the cooling process to high-temperature heat that can be used in other processes.

“We don’t want to work with Freon. We don’t believe in it any more,” he declares.



Project Engineer Kristof Lauwereys (L) and Cooling Technician Ronald Decoster (R), Colruyt Group

Addressing safety concerns

No ammonia enters the production zones, where the majority of the staff members are based. “The ammonia is housed separately from the people. Only the glycol goes into the factory,” Lauwereys says.

Access to the machine room is restricted via an electronic badge system. Only technicians and project engineers qualified to work with ammonia are allowed to enter.

Belgian law does not require round-the-clock monitoring of ammonia installations onsite. Instead, it is monitored at the Colruyt Group’s security centre. The staff there will call the technicians if necessary.

In the event of a leak, safety procedures kick in automatically. “We have six detectors and we constantly monitor the amount of ammonia that is in the air. But sometimes if there is a leak, the amount increases. If it gets too high, ventilation units will automatically start extracting the ammonia and pushing fresh air back in,” Lauwereys says.

All the pipes in which ammonia circulates are brazed. The brazing is regularly checked to assess degradation. Ammonia is lighter than air, so in the event of a leak, it rises up and out of the building with the help of the ventilation system.

“Any leak is detected directly and fixed as quickly as possible,” he says.

Regulation: An 'extra stimulus' for NatRefs

In Europe, natural refrigerants like CO₂, hydrocarbons and ammonia will have a key role to play in the HFC phase-down taking place under the EU's F-Gas Regulation, which since 2015 has been reducing the total amount of HFCs that can be sold in Europe. In 2020, a ban on using certain HFCs in new equipment comes into effect, accompanied by bans on servicing and maintaining existing equipment.

"We were already adopting natural refrigerants before the EU F-Gas Regulation came into force. The F-Gas Regulation was not the primary driver, but it does give us an extra stimulus," Collin Bootsveld, a project engineer at the Colruyt Group, told *Accelerate Europe*.

After considering which natural refrigerant would best match their needs, Bootsveld and his team opted for propane (R290) for in-store cooling. "It's not that we think CO₂ is bad. After an honest evaluation, we think propane is the best solution for us," Bootsveld says.

His team installed their first propane system in an OKay store in Roeselare in 2013. It took a year to secure the necessary paperwork – even though the 14 kg of propane was housed outside. "We couldn't go through that 40 times a year to comply with the regulations," Bootsveld says.



Collin Bootsveld in Bio-Planet, Mons

At the system's heart are compact chillers containing less than 2.5 kg of propane or propene. With a refrigeration capacity of 30-50 kW, one chiller can cool the Group's smaller OKay (convenience) and Bio-Planet stores. Colruyt supermarkets need to run two compact chillers. An extra chiller is always added redundantly, ready to step in should one chiller fail.

All new Colruyt Group cooling installations have used natural refrigerants from 2017 onwards. Currently there are around 50 new refrigeration systems in the pipeline, a mix of new shops and refits of existing stores. So when will the Group achieve the target of using hydrocarbons for 100% of its in-store cooling needs? "At the current pace we will be ready in 2027," says Bootsveld.

The Colruyt Group has "no regrets" about the switch to hydrocarbons. Indeed, this success is what led Bootsveld and his team to innovate with other natural refrigerants too. The Group's distribution centres, for example, are cooled with ammonia. It opened its first ammonia plant in 1999.

In the wake of the Kigali Amendment to the Montreal Protocol – which put in place a global HFC phase-down trajectory – Bootsveld is even more convinced that adopting natural refrigerants is the right way to go. "There is always a learning curve, and we've started that curve early. We've moved to a new technology, and we've done it in a reliable manner," he says.

Towards fossil fuel-free stores

Bootsveld argues that early adoption of natural refrigerants is already putting Colruyt at a competitive advantage compared to retailers that are yet to begin their transition away from HFCs.

By 2018, Colruyt hopes to be building shops without any fossil-fuel connections at all. "In September, our CEO decided that every time we remodel a shop, we'll insulate it to the same level as our new shops. Within the next 10-12 years, all our shops will be well insulated," Bootsveld says.

Such insulation reduces heat demand to the extent that the store's heating needs can be entirely served by waste heat from the cooling system. "The shops will be 100% electric. Fossil fuel-free!" Bootsveld says.

With innovations such as these, the Belgian retailer looks well placed to meet its sustainability targets. ■ AW & CM

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