

SPRING 2016

ACCELERATE

ADVANCING HVAC&R NATURALLY

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

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HFCs agreed at Kigali

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UK chill descending on
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Coca-Cola targets 100%
natural refrigerants for
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Wholefoods eyes
propane/CO₂
refrigeration

p. 28

GREG LEWIS,
National Engineering Manager,
Countdown

p.22

*Countdown leading the
CO₂ way in New Zealand*

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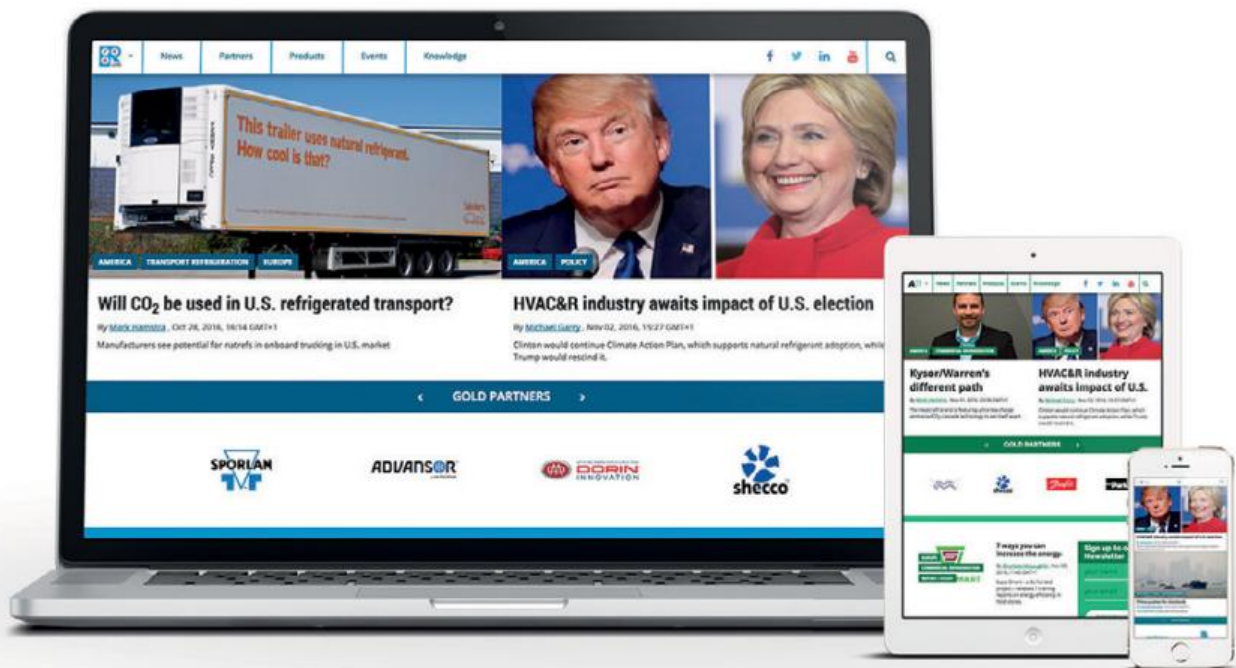
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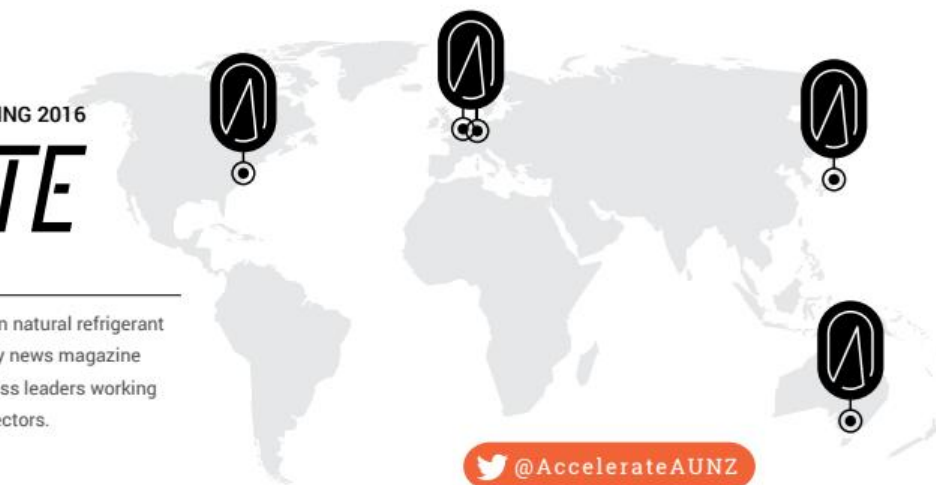
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ACCELERATE

ADVANCING HVAC&R NATURALLY

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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Greg Lewis

National Engineering Manager

Countdown

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Whole Foods pushes the propane envelope

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Natural refrigerants steal the show at Chillventa 2016

Over 180 companies among close to 1,000 exhibitors at Chillventa – taking place from 11-13 October in Nuremberg, Germany – were showcasing natural refrigerant technologies. This marks a 50% increase since the last edition of Chillventa in 2014, where only 120 companies were showcasing hydrocarbons, CO₂ and ammonia solutions.

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Publisher's note by
Marc Chasserot



GLOBAL POLICY, INNOVATION PUTTING SQUEEZE ON HFCs

The recent global HFC phase-down deal struck in Kigali, Rwanda proves that no nation is immune from the clean-up required in our HVAC&R sector.

While the collective mitigation step serves as a telling, symbolic moment for global industry, innovations in New Zealand are paving the way for what's to come in Australia and helping to fast-track the market for natural refrigerants in the Southern hemisphere.

In the cover story, Greg Lewis – lead engineer at Countdown (part of Progressive Enterprises) – is driving the retailer's holistic approach to sustainability, which includes a target to install 10 CO₂ transcritical stores per year. The company's first refurbished CO₂ store is set to be completed in 2017 ([see full story on p. 22](#)).

While rival retailer Foodstuffs has made a significant transition to CO₂ transcritical technology ([see the full story in the winter edition of Accelerate Australia & NZ](#)), Countdown, too, has shown great determination to 'green' the chain and design adaptable, climate-resilient stores.

In the third edition of Accelerate Australia & New Zealand, we assess the implications of the landmark global HFC phase-down agreement struck by over 150 countries in Kigali in October for Australia, New Zealand and global regions ([p. 16](#)).

The agreement to help reduce global warming by 0.5 degrees will, hopefully boost affect the market-led transition to natural refrigerants in both Australia and New Zealand.

The 19 substances listed in the amendment by world leaders have an average GWP of nearly 2,500 and are mainly blended (e.g. R410A, R404A). However, these blends are explicitly listed as substances that must be phased down.

Australia and New Zealand have been assembled in a first group of developing countries along with China and South American, Asian, Pacific and African nations – which will freeze consumption of HFCs by 2024 and implement the first reduction steps in 2029.

The Kigali agreement is certainly not ambitious enough given the urgency of reducing greenhouse gas emissions. But it puts the HVAC&R in the public sphere, and hence provides an excellent opportunity for the Industry to profile natural refrigerants as the only sustainable solution going forward.

ARMA CEO Kim Limburg, who is chairing a working group on a national skills-based license initiative, welcomed the recent global agreement to cease using HFCs but is calling on the Australian government to adopt a more aggressive domestic phase-down, also citing concerns over the rate at which refrigerant blends, particularly R32, are flooding the Australian market ([p. 14](#)).

It remains to be seen how these measures will encourage the adoption of firmer policy measures in Australia and New Zealand. Whatever the outcome, it is clear that near-sited commercial interests can no longer be obliged. **MC**

EVENTS GUIDE NOVEMBER 2016



1

November 3-4, Sydney, Australia
ISER-27th International Conference on Heat Transfer and Fluid Flow
<http://iser.co/conference/2016/SydneyAustralia/ICHTFF/>

2

November 3-5, Kuala Lumpur, Malaysia
LogisWare 2016
<http://www.oneinternational.com.my/1build/index.asp?subid=20>

3

November 3-4, Auckland, New Zealand
Facilities Integrate
<http://www.facilitiesintegrate.nz/about/>

4

November 3-5, Kuala Lumpur, Malaysia
OneBuild 2016
<http://www.oneinternational.com.my/1build/index.asp?subid=21>

5

November 3-5, Bangkok, Thailand
BUS & TRUCK '16
<http://www.ttfintl.com/2016/>

6

November 3-6, Surabaya, Indonesia
MEGABUILD Surabaya 2016
<http://www.megabuild.co.id/>
twitter: @MegaBuildExpo

7

November 9-11, Jakarta, Indonesia
THE BIG 5 CONSTRUCT Indonesia 2016
<http://www.thebig5constructindonesia.com/>
twitter: #Big5Exhibition @Big5Exhibition

8

November 9-12, Jakarta, Indonesia
SIAL Interfood
<http://sialinterfood.com/>
twitter: @interfoodexpo

- 9** November 9-12, Hanoi, Vietnam
Vietfood & Beverage – ProPack 2016
<http://hn.foodexvietnam.com/en>
- 10** November 10-12, Yangon, Myanmar
BUILD Myanmar 2016
<http://www.build-myanmar.com/>
- 11** November 10-12, Yangon, Myanmar
GREENPOWER Myanmar 2016
<http://www.greenpowermyanmar.org/>
- 12** November 10-13, Manila, Philippines
HVAC/R PHILIPPINES 2016
<http://10times.com/hvac-r-philippines>
- 13** November 10-13, Manila, Philippines
PHILCONSTRUCT 2016
<http://gesi.com.ph/philconstruct/>
- 14** November 12-13, Wellington, New Zealand
Gogreen expo
<http://www.gogreenexpo.co.nz/>
twitter: #gogreen #gogreennz @GoGreenExpoNZ
- 15** November 14-15, Singapore
GSUS 2016 SINGAPORE, 21th International Conference on Green and Sustainable Technology
<http://singaporeicrets21.com/>
- 16** November 15-16, Sydney, Australia
National Energy Efficiency Conference 2016
<http://www.eec.org.au/events/national-energy-efficiency-conference/2016-conference#/2016-conference>
- 17** November 15-17, Penang, Malaysia
FOOD & HOTEL Penang 2016
<http://www.foodandhotelpenang.com/home/index.php>
twitter: #FoodandHotelPenang @FoodHotelPenang
- 18** November 16-19, Jakarta, Indonesia
Drinktec Indonesia
<http://10times.com/drinktec-indonesia>
- 19** November 16-17, Auckland, New Zealand
Auckland Build Expo
<http://www.aucklandbuildexpo.com/>
twitter: #AucklandBuild
- 20** November 16-19, Ho chi Minh, Vietnam
VIETNAM FOODEXPO 2016
<https://foodexpo.vn/en/index.php>
- 21** November 17-18, Sydney, Australia
SBE16 Sydney
<http://www.sbe16sydney.be.unsw.edu.au/index.html>
twitter: @CRC_LCL
- 22** November 18-21, Singapore
Asia Pacific Food Expo 2016
<http://www.asiapacificfoodexpo.org.sg/>
- 23** November 20-24, Brisbane, Australia
ICEERB 2016
<http://healthyhousing2016.com/>
- 24** November 23-25, Jakarta, Indonesia
HVACR Southeast Asia 2016, the 5th International Heating, Ventilation, Air-Conditioning & Refrigeration Exhibition
<http://www.hvacr.merebo.com/>
- 25** November 23-25, Jakarta, Indonesia
INDO RETAIL expo 2016
<http://indoretailexpo.com/>
twitter: @KristaExhibit
- 26** November 24-26, Bangkok, Thailand
CTECH 2016
<http://ecolight-tech.com/chiller/>
- 27** November 24-26, Yangon, Myanmar
FOODTEC Myanmar / MYANFOOD / MYANHOTEL
<http://10times.com/myanmar-foodtec>
<http://www.myanhotel.com/>
- 28** November 30- December 2, Surabaya, Indonesia
IIBT 2016
<http://www.iibt-exhibition.net/#axzz4Nce03AeT>
twitter: @PTGEMIndonesia
- 29** November 30- December 2, Surabaya, Indonesia
SOLARTECH Indonesia
<http://www.solartech-exhibition.com/#axzz4NcdZ3eBT>
twitter: @PTGEMIndonesia
- 30** November 30- December 3, Ho chi Minh, Vietnam
EcoTech Vietnam 2016
<http://ecotechvietnam.com/home/en>



DECEMBER 2016

- | | |
|---|---|
| <p>1 December 1-3, Yangon, Myanmar
MIVAR'16
http://mivarexpo.com/</p> <p>2 December 1-3, Yangon, Myanmar
MYANBUILD 2016
http://www.myanbuild.net/</p> <p>3 December 5, Adelaide, Australia
IAARHIES 37th International Conference on Engineering & Technology ICET – 2016
http://iaarhies.org/icet-2016-adelaide-australia/</p> | <p>4 December 5-7, Melbourne, Australia
EETSE'16
http://eetse16.org/</p> <p>5 December 7-10, Melbourne, Australia
Vinamac Expo
http://vinamacexpo.vietfair.vn/</p> <p>6 December 15-19, Ho chi Minh, Vietnam
VIETBUILD HOME
http://www.vietbuildafc.com.vn/en/Default.aspx</p> |
|---|---|

JANUARY 2017

- | | |
|---|--|
| <p>7 January 9-11, Portland, Australia
Northwest Food and Beverage Manufacturers EXPO
http://www.cvent.com/events/northwest-food-beverage-expo-conference/event-summary-c163e4e7b59b4f6bbf13e2a7606ef828.aspx</p> <p>8 January 12-14, Kuala Lumpur, Malaysia
CAFE Malaysia 2017
http://www.cafe-malaysia.com/</p> | <p>9 January 17-19, Kuching, Malaysia
IEW - International Energy Week 2017
http://www.expodetail.com/iew-international-energy-week-2017</p> <p>10 January 20-22, Gold Coast, Australia
Gold Coast Food And Wine Expo
http://foodandwineexpo.com.au/shows/gold-coast/
twitter: #foodandwineexpo @foodandwineexpo</p> |
|---|--|



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SHORT TAKES

— By James Ranson & Andrew Williams

CCN AWARDS SUSTAINABLE LEADERS

Climate Control News has acknowledged Brad Semmler and Stefan Jensen for showing sustainability leadership through their work with natural refrigerants, at the online media outlet's CCN Live event.

Cold Logic Technical Director Semmler was announced as the winner of the Sustainability Leader of the Year Award, while Scantec Refrigeration Technologies' managing director, Jensen, took home the Emerging Leader in Energy Savings Award.

Cold Logic was involved in the concept, design and installation of an ammonia refrigeration project at Sundrop Farms, a project indicative of Semmler and Cold Logic's passion to see more natural refrigerants used in more applications across Australia.

"A sustainability leader needs to be passionate about our industry and especially passionate about environmentally friendly and sustainable solutions," Semmler told CCN.

Semmler expects much greater reliance on CO₂ and ammonia in the coming years, in particular low-charge ammonia systems.

"I am particularly excited by the safer and more sustainable low-charge NH₃ systems," he said. "It makes the introduction into non-industrial applications more suitable."

Jensen, meanwhile, was lauded for his pioneering work with ammonia systems in Australia and overseas and his expertise in energy efficiency.

Originally from Denmark, Jensen settled in Australia in 1983 and more recently has overseen the design and installation of Scantec's dual-stage, low-charge, state-of-the-art ammonia refrigeration plants.

"Peer recognition is always pleasant because work activities should be more about satisfaction than merely financial rewards," Jensen said.

"Hopefully this award will encourage others to develop new technologies and share these initiatives so that they can also enjoy peer recognition and at the same time contribute to lifting the industry as a whole."

AMMONIA GROWTH FORECAST

The Australian ammonia market is expected to grow at a rate of 5.8% on 2015 figures forecasting further proliferation of ammonia systems in the HVAC&R sector.

Anhydrous ammonia, a compound used commonly in low-charge, two-stage and cascade ammonia systems, accounted for a 96.8% value share in the Australia ammonia market in 2015, according to research conducted by Persistence Market Research.

Figures project market growth for ammonia to reflect a compound annual growth rate (CAGR) of 6.3% from 2016-2024, topping \$891.6 million by the end of 2016.

Ammonia is used as a refrigerant in industrial, and increasingly in commercial, applications as an alternative to harmful hydrofluorocarbons (HFCs), which is helping drive growth.



GREEN & COOL LAUNCHES COMPACT CO₂ UNITS

Green & Cool has unveiled its compact CO₂Y condensing unit, offering an environmentally friendly alternative in the 2-9 kW segment.

The technology, launched at Chillventa 2016, has the potential to service market gaps for smaller format stores in Australia and New Zealand, such as petrol stations, express supermarkets and liquor stores.

Woolworths Limited, New Zealand subsidiary Progressive Enterprises (see cover story p. 22) and Foodstuffs NZ have all installed Green & Cool's larger CO₂ systems.

The CO₂Y is a small stand-alone condensing unit suited to less demanding refrigeration applications such as small cold rooms and display cases and includes a DC rotary compressor as well as a control system that allows the user to monitor the unit's operation from a mobile phone.

Green & Cool Sales Engineer Johan Hellman said the simple and cheap 'state-of-the-art' condensing units have the potential for natural refrigerants to fill another niche market segment.

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

"The 2-9 kW segment, which CO₂Y falls into, has enormous future potential since there has not been an economical environmentally friendly alternative until now," said Joakim Westerberg, responsible for refrigeration appliances at Kylkvalitet, a Swedish supplier of Green & Cool systems.

Green & Cool expects to launch a stand-alone CO₂ freezing unit by January 2017, before other CO₂Y models follow. "Next year we will have five units in a size of up to 10 kW," Hellman said.



TIME TO TAKE THE HINT

– By Kim Limburg



While the recent global agreement to cease using HFC refrigerants via amendments to the Montreal Protocol has been met with widespread industry support, much more aggressive proposals can, and should, be implemented by the Australian government.

The timeframes adopted continue to show a diluted and very weak phasing down of these refrigerants and the Australian Refrigeration Mechanics Association (ARMA) calls on the Australian government to take initiative and develop a much more robust national proposal.

Having failed to actively promote the positive use of natural refrigerants to industry and consumers, and having failed to provide funding to upskill trade qualified HVAC&R tradespeople, the time for leadership from the government is now.

The Australian government is yet to actively communicate with and educate the wider community on the benefits of natural refrigerants and their relationship with energy efficiency via a website. Little more than lip service is given at a time when industry requires government to be decisive and show strong leadership.

While ARMA embraces the schedule of the HFC phase-down, we are concerned with the rate of refrigerant blends containing R32 flooding the market and will continue to do so for many years to come unless action is taken. Given the average life of HVAC&R equipment is 15-20 years the period of this high-GWP refrigerant (675) is the phase-down period plus a further 15-20 years. Why then has there been a failure to address the 20-year GWP of synthetics given the average 20-year GWP of HFCs is twice their average 100-year GWP?

R32 is a toxic fluid, yet very little study has been carried out to highlight just how toxic it is. DuPont's Material Safety Data Sheet (MSDS) on its own website tends to gloss over the dangers of exposure despite Attachment "A" warning that acute toxicity inhalation may cause death without warning symptoms, due to cardiac effects.

ARMA is looking into a laboratory experiment to highlight the level of toxicity from exposure to R32 blends as we have grave concerns for technicians' health in the field. We would also like to test the hypothesis that smokers exposed to leaks are at greater risk of organ failure and cancer.

One manufacturer anonymously quotes the following, "Plumbers installing R32 refrigerant and not knowing the damage caused by improper installations. This includes, incorrect flare connections causing leaks due to high pressure in the heating cycle. Customers being charged by authorised and licensed installers to rectify this issue." Refer to Attachment "B".

ARMA highlights the following as one example of the Australian government failing to ensure a successful outcome. The EU's F-Gas Regulation Guidance, Information Sheet 5 for stationary air-conditioning and heat pumps for qualified technicians to conduct leak checking and refrigerant handling operations. Yet, in Australia this often means non-technically competent technicians operating outside the scope of their environmental licences on even larger equipment having undertaken Certification II courses in split systems. **KL**

Kim Limburg, CEO of the Australian Refrigeration Mechanics Association (ARMA), is currently chairing a working group on the national licence; a national skills-based licensing initiative ensuring competent persons carry out refrigeration maintenance.

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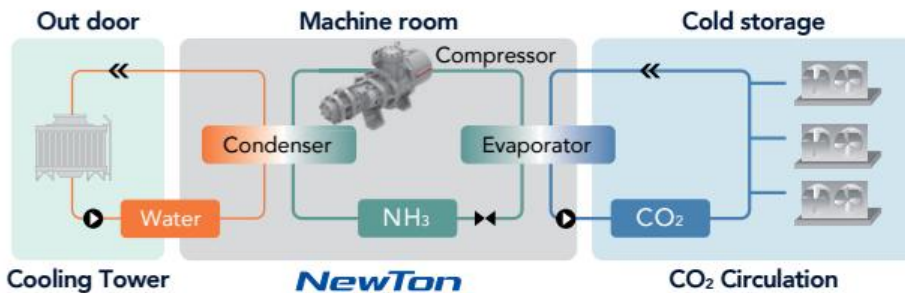
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CLIMATE CHANGE'S GREAT LEAP FORWARD

Over 150 countries got together in Rwanda between 8 and 15 October 2016 and agreed on a global phase down of HFCs. The agreement could reduce global warming by 0.5 degrees

– By Ermenegilda Boccabella



World leaders created the most effective mechanism to mitigate greenhouse gas emissions from the HVAC&R sector by listing 19 HFC substances for phase-down. Based on the amendment countries have a baseline (average HFC consumption over three years), freeze date and reduction steps whereby they are required to reduce their HFC emissions over two year increments eventually arriving at 15% of the emissions of their baseline.

The amendment will enter into force on 1 January 2019 if it has been ratified into domestic legislation by 20 countries.

WHAT IS ON THE LIST?

The 19 substances listed in the amendment represent the bad and the ugly used in air conditioning, refrigerants and heating. These substances are mainly blended (e.g. R410A, R404A) when used, but their blends will still be part of the list of substances that must be phased down. The average GWP of the 19 substances is nearly 2500.

PHASE-DOWN

Developed countries (referred to as 'Article 2' or 'A2' countries under the Montreal Protocol) will start phasing down HFCs in 2019 and will arrive at 15% of their baseline by 2036 with developing countries phasing down to the same level by 2047.

A first group of developing countries – which includes China, South American, Asian, Pacific and African nations – will freeze consumption of HFCs by 2024, with their first reduction steps starting in 2029. A second group including India, Iran, Iraq, Pakistan and the Gulf countries will meet a later deadline, freezing their use of these gases in 2028 and reducing consumption from 2032.

EXEMPTIONS

The Montreal Protocol has provided some exemptions to the use of HFCs. These include essential and critical use exemptions, emergency use exemptions, and laboratory and analytical uses.

In Dubai Pathway meetings, the lead up meetings to Kigali, it was decided that there would be a high ambient temperature exemption for countries with warm climates. This decision was then reflected in the Kigali Amendment. Countries can apply to have an exemption if they have had two months of the year with a daily average temperature above 35 degrees Celsius over the last decade.

SHORTCOMINGS

According to industry and policy experts during the negotiations, difficulties stem from the lack of flexibility of the Kigali Amendment, as the only way of adding substances to the list would be by creating another amendment to the Montreal Protocol.

Moreover, there is no limit on the number of years for which a country can apply for a high ambient exemption. Though exemptions are given four years at a time, they can continue to be assessed and given.

Finally, the agreement lacks definition of two key terms: low-GWP values and high ambient exemptions. This leaves significant ambiguity for technical implementation of the amendment and will result in significant differences in the standards and regulations coming from domestic laws. Additionally it is not clear whether the current list of countries that operate under the high ambient exemptions can expand to developed countries.



WHAT DOES THIS MEAN?

The Kigali Amendment is the most practical step the international community has taken at mitigating climate change. The Kigali Amendment opens the pathways for natural refrigerants to enter the market by providing a viable clean, energy-efficient solution to replace harmful HFCs. [EB](#)



Group 1		100-year Global Warming Potential
CHF_2CHF_2	HFC-134	1,100
CH_2FCF_3	HFC-134a	1,430
CH_2FCHF_2	HFC-143	353
$\text{CHF}_2\text{CH}_2\text{CF}_3$	HFC-245fa	1,030
$\text{CF}_3\text{CH}_2\text{CF}_2\text{CH}_3$	HFC-365mfc	794
$\text{CF}_3\text{CHFCF}_3$	HFC-227ea	3,220
$\text{CH}_2\text{FCF}_2\text{CF}_3$	HFC-236cb	1,340
$\text{CHF}_2\text{CHFCF}_3$	HFC-236ea	1,370
$\text{CF}_3\text{CH}_2\text{CF}_3$	HFC-236fa	9,810
$\text{CH}_2\text{FCF}_2\text{CHF}_2$	HFC-245ca	693
$\text{CF}_3\text{CHFCF}_2\text{CF}_3$	HFC-43-10mee	1,640
CH_2F_2	HFC-32	675
CHF_2CF_3	HFC-125	3,500
CH_3CF_3	HFC-143a	4,470
CH_3F	HFC-41	92
$\text{CH}_2\text{FCH}_2\text{F}$	HFC-152	53
CH_3CHF_2	HFC-152a	124
$\text{CH}_3\text{CH}_2\text{F}$	HFC-161	12
Group 2		
$[\text{CHF}_3]$	HFC-23	14,800]"

COLRUYT FINDING FAVOUR WITH HYDROCARBONS

Belgian retailer Colruyt Group is saving money and making history by moving to hydrocarbons for 100% of its in-store cooling needs.

– By Andrew Williams



Having already switched to 100% renewable sources for its electricity needs, the Colruyt Group's ultimate goal is to become HFC-free to reduce the proportionally larger contribution that refrigeration now makes to its carbon footprint.

In 2012 the group 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.

The man charged with delivering this vision is Project Engineer Collin Bootsvelde. *Accelerate Australia & NZ's* sister publication *Accelerate Europe* met Collin and his team at the Colruyt Group's headquarters in the town of Halle near Brussels.

"By end 2016, we will no longer build HFC cooling systems in our stores. The final ones are being built right now, because we couldn't change our planning," Bootsvelde explains.

Founded in 1925, the Colruyt Group is one of Belgium's biggest retailers – with annual revenue of over AUD \$13.6 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.

The Colruyt Group's official target is to reduce 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.

REGULATION: AN 'EXTRA STIMULUS' FOR NATREFS

Natural refrigerants like CO₂, hydrocarbons and ammonia will have a key role to play in the HFC phase-down taking place under the European Union's F-Gas Regulation, which since 2015 has been reducing the total amount of HFCs that can be sold in



Collin Bootsveld, Project Engineer at Colruyt



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," says Bootsveld.

After considering which natural refrigerant would best match their needs, 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 14kg of propane was housed outside. "We couldn't go through that 40 times a year to comply with the regulations," Bootsveld says.

The current blueprint is based on two or three small refrigerant circuits each with a maximum propane charge of 2.5kg, and a secondary system that uses propylene glycol to bring the cold to where it is needed.

At the systems' heart are compact chillers containing less than 2.5kg of propane. With a refrigeration capacity of 30 to 50 kW, one chiller can cool the smaller OKay and Bio-Planet stores. The Colruyt supermarkets need to run two compact chillers. An extra chiller is always added redundantly, ready to step in should the other fail. Using a smaller refrigerant charge means they can be placed inside the store.

The principle of the plug-and-play system was devised in August 2014. The system was first installed in a Bio-Planet store in Mons in November 2015. It has since been installed in three further Bio-Planet stores in Hasselt (January 2016), in Jambes (February 2016) and in Braine l'Alleud (April 2016).

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WORLD FIRST: LIQUID ICE

The refrigerated transport of goods to shops accounts for 33% of the Colruyt Group's CO₂ emissions. To reduce these emissions by 50%, the company has developed an innovative solution: liquid ice – a mixture of ice, ethanol and water – to cool special containers.

The group's new liquid ice-making plant at its distribution centre in Halle is a world first. "This is a completely new concept – no other retailer in the world is doing this," enthuses Peter De Bonte, a colleague of Bootsvelde's.

Suppliers to the Colruyt Group deliver to distribution centres rather than stores, with the exception of goods like bread. Carrying the containers – which offer 48 hours of cooling – reduces the total number of kilometres driven and ensures that 98% of Colruyt's trucks are dispatched full.

Colruyt currently operates 600-800 liquid ice containers, each of which offers 48 hours of cooling. The Group is aiming to fit all 7,000 of its containers with liquid ice by the end of 2018.



NO MORE NEW HFC SYSTEMS FOR COOLING FROM 2017

"We are going to accelerate this. We will not place any more HFC systems for cooling in the three store formats from 2017 onwards. That is a board-level strategic decision," says Julien Meert, a project engineer in Bootsvelde's team.

Colruyt supermarkets feature large walk-in cold rooms in which customers choose fruit, vegetables and other products from shelves. There are no refrigerated cabinets.

Bootsvelde's team calculates that this is not just cheaper but also five times more efficient than using display cabinets. "Cabinets lose a lot of cold when customers open the doors," Bootsvelde says.

Air handling units above the cold room remove the air inside, cool it down with glycol, and put it back in through perforated walls, creating a temperature of 3-4 degrees Celsius on the shelves and 7 degrees Celsius in the room. Constantly circulating cold air negates the heat given off by customers and the surrounding shop.

Colruyt's chest freezers have been using the natural refrigerant R600a (isobutane) for over 10 years. They are stand-alone, giving store managers flexibility regarding layout.

High outside ambient temperatures are of little concern. "Propane installations can easily handle it. Our system was designed to operate in temperatures of up to 35 degrees Celsius, but we've recorded 42 degrees in Braine l'Alleud and it's still running fine," Bootsvelde says.

OVERCOMING SAFETY CONCERNS

Safety is often cited as an obstacle to wider use of hydrocarbon systems. But the Colruyt Group is working hard to overcome flammability concerns.

"Our systems are fitted with propane and propylene detectors, and there is a fan which will extract any flammable substances. The amount of propane is also so low that it is very difficult for anything bad to happen," Bootsvelde argues.

Leakages from HFC refrigerants currently represent 12% of the Colruyt Group's greenhouse gas emissions in Belgium. "This 12% will be completely eliminated by the propane cooling project within 10 years," Bootsvelde says.

In the event of a leak, the new systems shut themselves down automatically. Risk is kept to minimum by limiting the number of connections.

All new Colruyt Group cooling installations will use natural refrigerants from 2017 onwards. Currently there are 50 to 60 new refrigeration systems in the pipeline, a mix of new shops and refits of existing stores. "At the current pace we will be ready in 2027," says Bootsvelde.

AW



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COUNTDOWN ON THE FRONT FOOT IN NEW ZEALAND

Driven by a holistic sustainability approach, retailer Countdown is taking the lead in New Zealand's market and planning to open 10 CO₂ transcritical stores per year as part of an ambitious sustainability strategy.

– By James Ranson

Countdown's lead engineer Greg Lewis is putting natural refrigerants at the forefront of efforts to reduce energy consumption in new fully integrated stores. His success in New Zealand may lead to a wider deployment of CO₂ systems in the rest of the country and Australia.

Countdown operates 184 supermarkets in New Zealand and is the country's largest private sector employer, with around 18,000 employees across its stores, support offices, processing plants and distribution centres.

Progressive Enterprises, part of Australian group Woolworths Limited, owns Countdown and is also the franchisor of the Super Value and Fresh Choice supermarkets, which represent a further 62 stores around New Zealand.

It has been an organic rise up the ladder at Progressive Enterprises for Greg Lewis. Currently Countdown's national engineering manager, Lewis spent several years 'on the tools' as an apprentice before moving into a management role that eventually evolved into an engineering one.

When Woolworths Australia came on board in 2010, Lewis was taken under Michael Englebright's wing as the group's senior field engineer. An influential figure in Australia, Englebright, like Lewis, was eager to use New Zealand as a transcritical testing ground.

"That's where Michael and I are working together because he's using New Zealand to test CO₂ transcritical systems and then he's doing a lot of trials with waterloop systems," Lewis says.

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Greg Lewis, Countdown's National engineering Manager



→ "If anything the relationship has got better with Michael on board. What's helped us with the reporting side of things is that about 12 months ago we went through a lot of changes in the way we were designing our supermarkets and a lot of it was coming from the construction arm. So our goal was to come up with solutions."

"When I first started at Progressive what we're doing now wasn't even thought about. The way we approached putting together a supermarket wasn't coordinated the way it is now."

Lewis speaks of having the resources now to 'pull everything together' in a comprehensive manner: from installing LEDs in all stores to changing the AC systems, and most importantly, transitioning the company's refrigeration portfolio. "We've been doing some serious work on our refrigeration systems over the last six years with the hybrid [CO₂] systems and now we're taking that next step to pull everything into one [CO₂ transcritical] system."

The aim for 2020 is to open or retrofit at least 10 CO₂ transcritical stores per year while Lewis expects there to be 250 systems in the whole of New Zealand.

COUNTDOWN'S NEW INTEGRATED STORES AS A TESTING GROUND

When Lewis spoke to *Accelerate Australia & NZ*, Countdown was planning to install its first transcritical CO₂ plant in a refurbished store as part of its ambitious retrofit program. Its Glenfield, Auckland store is set to become Countdown's first fully refurbished CO₂ transcritical store.

Aside from Countdown's first CO₂ transcritical store at Cable Car Lane in Wellington (2016), the company is in the planning and design stages of a further six transcritical stores, of which five are expected to be completed in 2017, including the Glenfield refurbishment.

Moreover, Countdown has been increasing its store share of cascade CO₂/R134a plants since 2008, with 47 new stores completed and five currently in construction. "We've been very determined," says Lewis, who sees great scope to retrofit the company's fleet of stores still using harmful HFCs like R404A and R22 (92 in total). "There's definite potential to retrofit these HFC stores," confirms Lewis, using either a cascade systems or leapfrogging straight to CO₂ transcritical systems.

However, the transition needs to be manageable. "We still have plant systems that are 10 years old, and hybrid systems the oldest of which are 7-8 years old, so we will utilise the shelf life of these systems for another 10-12 years or so."

"Fully integrated systems is a concept that we've really only seriously considered doing since new stores have come up. I've started learning and dabbling in the heat reclaim and cooling... but what's helped us is that in New Zealand we are able to make changes a little bit faster [than Woolworths Australia]" explains Lewis.

"Woolworths Limited has supported us really well for the past five years of the whole process, we were reporting through to them while using their specifications. If it weren't for them we really wouldn't be where we are now," Lewis acknowledges.





SUSTAINABILITY IN THE BLOOD

A self-professed 'fridge', Lewis understands the balancing act required to install the best system for a given store while reducing the impact on the environment. "Most fridges are passionate about working with refrigeration and I'm maybe not as passionate about that 'nuts and bolts' side of the operation but I am very passionate about developing strategies to achieve our sustainability goals, that's what really interests me," he says.

A father of three young children, Lewis' sense of responsibility and care for his profession is clear. "I genuinely love the job and sustainability excites me," he says. A young man in his mid-thirties, Lewis is perhaps an atypical case in an ageing industry. He jokes about growing up on Waiheke Island – situated just out of Auckland – with a bunch of 'greenies' as well as the unnerving enthusiasm that helped him work his way up the ranks.

"Most of the guys that I'm working with now, seven or eight years ago, were my boss," he says. "I started on the tools and did my time, became a service engineer for a while, but it was guys that are now building the supermarkets with me that put me into the design office and got me project managing them."

"The more I've learned about our international climate agreements I've found it really interesting to figure out ways to work with other people to achieve our targets", he adds.

New Zealand has a long history of promoting innovation and fostering environmental stewardship, for evidence you only need look at its 100% Pure New Zealand ad campaign from recent years with pristine turquoise waters lining breathtaking mountainscapes.

"I think it's really important. Just about every Kiwi you ask will tell you that it (the environment) is a very important topic to them," he says. "You look at the nuclear treaty in the 1970s, New Zealanders were really proud of that. They like this whole green,

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FLYING THE GREEN RIBBON

Greg Lewis, national engineering manager of Progressive Enterprises, admits that Countdown's extensive sustainability initiatives haven't been well documented in the past. "We have a great story to tell, and we are starting to talk about this more, which is great."

In the 2015 financial year, the company saw a decrease in carbon emissions of 1.8% on 2006 levels and a 26% reduction in energy consumption per square metre, despite new store openings increasing total floor space by 37%.

As a result, the Ministry of the Environment awarded Countdown a Green Ribbon award in the Resilience to Climate Change category for its 'significant practical steps for carbon emissions reductions' in 2014/15.

"We were really proud to win the Resilience to Climate Change category at the 2016 Green Ribbon Awards for our work in increasing energy efficiency and reducing carbon emissions," Lewis says.

Countdown was also a finalist in the Minimising Our Waste category for its Food Rescue Programme.



ENGAGING YOUTH

Lewis understands the important role he can play in enthusing potential young apprentices in New Zealand and re-establishing HVAC&R as a dynamic, attractive industry to enter.

"I think we have a very skilled refrigeration industry in New Zealand, it's a small community, everyone knows everyone," he says. "There's a very high level of skill with our service technicians. We're very lucky that we can rely on our contractors to deliver on what we want."

"The process of training apprentices, when done well in New Zealand, is really quite good. It's just a matter of whether there are enough apprentices coming through at this stage. It's an ageing industry and we would love to see more enthusiastic young blood coming through."

Skill level is a key factor Lewis considers when selecting a certain type of plant design, along with the ambient temperature in the given region, and various council requirements.

→ clean image because that's how New Zealand markets itself to the world and Kiwis are really proud of that."

Lewis is adamant that goal-driven collective attitude carries over to the country's HVAC&R sector.

"There are a lot of passionate people working in the industry in New Zealand who want to deliver good solutions for their clients. The point of difference for us is that we're trying to deliver everything; for our operations team to sell baked beans but also meet business sustainability targets at the same time. And it's quite neat to go out and find new ways to do it."

"I think traditionally supermarkets have been painted as the bad boys who don't really care about the environment but we actually do, we think a lot about how we design stores and how we put it together," Lewis said.

JUGGLING SUPPLIERS

Part of the juggling act for Countdown is supporting the smaller suppliers in New Zealand while trialing systems from established global manufacturers entering the market.

The company has installed one SCM Frigo transcritical unit and plans a further four Green & Cool units. Heatcraft and Bitzer are among the other suppliers vying for business as Countdown seeks solutions for its planned transcritical stores at Glenfield and Wellington Central.

"We don't mind trialing a range of suppliers but we just want a similarly specified system. We've got an SCM

Frigo unit, we've got some Green & Cool and we'd like to see Advansor units, we'd like to see the Heatcraft solution, Bitzer..."

"We have Engie Refrigeration and McAlpine Hausmann systems, our two main local service contractors and installation contractors, and we see some smaller local contractors that we'd like to help because it will help us down the track as well."

Lewis confirms it's been exciting to see the level of interest from global suppliers. "Some of these big players are making two transcritical racks a day. Green & Cool are building around 47 a week. That SCM Frigo unit came down and we turned it on and it just started running like that!"

"We can buy these systems off the shelf in Europe and we're looking to them as the people who can help us achieve what we want to achieve."

HOLISTIC APPROACH TO EMISSIONS REDUCTION

Lewis insists on the need to adopt a broad look at sustainability and emissions reductions, praising Japan as a fine example of a country using simple measures such as enforcing doors on open showcases and controlling which refrigerants you can and cannot import.

"We've been working closely with New Zealand's Energy Efficiency and Conservation Authority (EECA) and they have supported us with capital to get some projects off the ground. Until we started talking to them I don't think they had any idea of how determined we were with our sustainability plans."



The EECA offers subsidies for new sustainable technologies to 'get the projects over the line' as Lewis puts it. For instance the EECA may provide funding for projects such as transcritical refrigeration, which helps retailers move forward.

The company's proactive stance and ongoing dialogue with the EECA is embodied by improved lighting controls, LEDs and natural refrigeration plant rollout in its stores, as well as various other sustainable initiatives including the introduction of recyclable produce and meat trays, and the company's Love Food Hate Waste and Plastic Bag Free Waiheke Island campaigns.

In July 2015 Countdown also became a foundation member of the Soft Plastics Recycling Programme, a new initiative to encourage customers to recycle soft plastics in specially marked bins. The programme has been rolled out to Auckland, Hamilton and Christchurch, with plans to introduce soft plastics recycling to 70% of New Zealand over the next two years.

Countdown's Food Rescue Programme supports New Zealanders in need by donating food to foodbanks around the

country. The retailer donates food that is still fit for consumption, but not for sale, to food charity partners. Countdown has struck up partnerships with local farmers at community level to help minimise food waste by diverting food from landfill.

Further, Countdown's Foodbank Project (www.foodbank.org.nz), which enables donors to choose items that are most-needed by The Salvation Army's foodbanks, was launched in December 2015 as New Zealand's first online food donation initiative. Countdown delivers the donated items to the nearest participating Salvation Army food bank through their online shopping network free of charge.

After trials in September 2015 the food bank project has been rolled out in Auckland, Hamilton, Wellington, Christchurch, Dunedin, Nelson, Gisborne and Whangarei, providing more than 1,600 food parcels for New Zealanders in need.

The new integrated stores, the efforts to minimise food waste and the transition to natural refrigerants are part of Countdown's ambitious sustainability strategy, which Lewis is supporting while ensuring that business is still running successfully. **© JR**

ETS THE CATALYST

Lewis describes New Zealand's Emissions Trading Scheme (ETS) as a major catalyst for wholesalers of HFC refrigerants to rethink trading in increasingly less profitable commodities.

"Two years ago the carbon credit was around NZD \$1 and you had the two-for-one scheme... it was the governments way of minimising the economic effect of the emissions trading scheme on the industry," Lewis says.

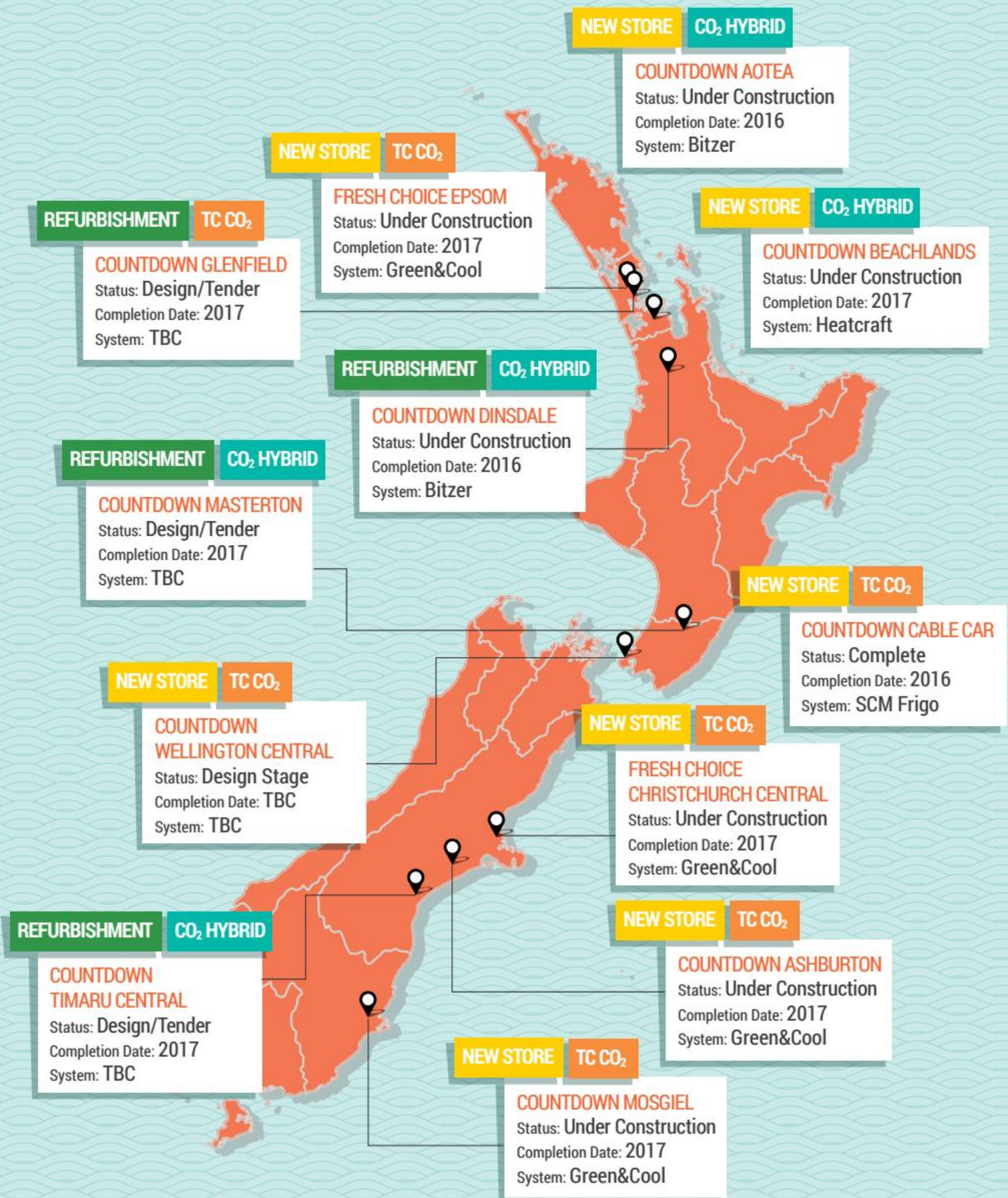
"Now the price is up over [NZD \$18] and rising, and not only that, the government is in the process of removing the 'two-for-one' clause that essentially halves the price of the carbon credits HFC wholesalers are forced to pay. The wholesalers need to figure out how that's going to affect their business over a period of 12 months."

"Now for us it's the right time to jump on board with natural refrigerants. The final catalyst for that was the ETS," Lewis says.

Countdown has 92 existing stores running on R404A, which need to be phased out. "We don't have a structured phase-out programme, like some of the major European retailers have, but we are working to become the first company to do a R404A phase-out and we are going to commit to this over the next 10-15 years."

Lewis encouraged other end users to generate greater awareness of the cost benefits over time of making the transition to natural refrigerants compared to current systems.

Countdown's New Stores and Refurbishments



Ejector technology for the biggest Italian Hypermarket

*In a historic place of technology
as the former Alfa Romeo factory in Arese (MI),
Arneg has launched the Ejector technology
for CO₂ transcritical systems
where the biggest Shopping Center in Italy
and Europe was inaugurated last April 14th.*



Arneg, in collaboration with Danfoss, Dorin and Luve, has developed two innovative CO₂ transcritical systems that supply more than 150 cabinets and cold rooms for an amount of 290 kW of MT refrigerating power and 30 cabinets in LT range for 38 kW of refrigerating power. Both racks are designed to work with a MultiEjector system.

It is well known that, above 30°C of ambient temperature, the efficiency of a simple transcritical system drops. MultiEjector technology target is able to recover the energy of the high-pressure gas discharge line, instead of wasting it in the common expansion valve. The recovered energy is given to the MT suction fluid, in order to raise its pressure. The work spent to bring the fluid from the lowest pressure of the system to higher pressure is lower than a simple transcritical system. In this way the Ejector technology allows CO₂ system to be competitive with a conventional R404A system even in warm climates. It is estimated that it is possible to reach up to 10% energy saving than a R404A system using a CO₂ Ejector rack, even in warm places as Arese, where in summer temperature can reach more than 38°C. Arneg implemented the MultiEjector block in a parallel compressor transcritical system, in order to maximize the

work of the parallel compressors. The main advantage of this system is to compress the flash gas before it reaches the lowest pressure of the cycle. With the MultiEjector system there are more advantages as more gas is compressed from the intermediate pressure stage and not from the lowest one. Moreover, to optimize the energy recovery, the intermediate pressure can be modulated depending on the gas cooler pressure.

In order to contribute to the building energy demand, both systems are able to produce up to 120 kW of hot water.

With this new further development within CO₂ technology, this natural gas can be considered, without any doubt, the best refrigerant, also in South of Europe, being able to guarantee both a reduction of the environment impact of the retail industry both energy savings. We have not to look to the Store Iper – La Grande in Arese as a single pioneering project, but as the starting point of a technology that can be widespread in warmer locations as Italy as well.

With this project Arneg shows that it is up to date with the newest and advanced technology that can be offered to the Retail Market and is looking at the future with really innovative eyes.



WHOLE FOODS PUSHES THE PROPANE ENVELOPE

The organic/natural food retailer, which has installed small-charge propane cases in many stores, is the first in the United States to test a centralised propane/CO₂ cascade system.

– By Michael Garry & Andrew Williams

Propane, usually thought of as a fuel for everything from barbecues and portable stoves to engines and residential heating, is finding a growing niche as a natural refrigerant (R290) worldwide.

In North America, it has so far been largely limited to self-contained cases, which are able to derive cooling power from the hydrocarbon gas even though its charge is restricted by law to a maximum of 150 g (5.3 oz.) in commercial applications.

Manufacturers of self-contained cases for supermarkets and foodservice operations like True Manufacturing, AHT Cooling Systems USA and Novum Refrigeration Technology are seeing growing interest in their wares.

Propane's miniscule global warming potential (three), its effectiveness as a working fluid, the improved efficiency of the refrigeration systems in which it operates, its relative affordability, and the safe operation of those systems despite its flammability are attracting more end users every day.

Efforts are also underway to address what is perhaps propane's biggest drawback, its charge limitation. In February, UK firm Carter Retail Equipment submitted an application to the EPA to increase the maximum charge of propane in commercial refrigerated stand-alone equipment to 1 kg (35.3 oz.), which would expand propane's potential to economically refrigerate many more cases in a store. The request is still pending. Other industry standards related to charge size (UL 471 and ASHRAE-15) would also need to be updated.

But what if propane could be used in much larger quantities than even 1 kg, like other refrigerants? Could it then serve as a viable primary refrigerant in a centralised supermarket rack system, emulating the performance it shows in stand-alone equipment? Whole Foods Market is about to find out.

Whole Foods, based in Austin, Texas, in August opened a 49,000-square-foot store in Santa Clara, California that is the first in the US to employ a propane/CO₂ cascade refrigeration system. The system, provided by Quebec-based Carnot Refrigeration, contains about 265 lbs. of propane, spread across seven separate chillers on the roof, including three for low-temperature and four for medium-temperature applications.

Whole Foods applied for and received permission from the EPA to test market the system in this store, and is requesting approval – together with Carnot – to use propane in rack systems generally under the EPA's Significant New Alternatives Program (SNAP).

The propane at the Santa Clara store, which never leaves the roof, is used strictly to condense its refrigeration partner, CO₂ (about 1,700 lbs. in total), which is piped up from a rack directly below, inside the building. The liquid CO₂ is then piped down to DX evaporators in low-temperature cases, and pumped to liquid overfeed coils in medium-temperature cases.

"It's a very clean, sharp design," said Tristram Coffin, director of sustainability and facilities for Whole Foods' Northern California division, which encompasses 44 stores (and one distribution centre) out of Whole Foods' more than 400 stores in the US, Canada and the UK.

The system's structure is not unlike some other CO₂ cascade systems that Whole Foods is testing, except that it uses propane on the "high side" rather than NH₃ or HFCs, and the propane is spread across multiple chilling units.

A major purveyor of organic and natural foods, Whole Foods has carved out a reputation as a pioneer in natural refrigerant applications in the US. Since 2009, the chain has piloted every natural refrigerant system, from transcritical CO₂ and ammonia/CO₂ to propane cases, as well as HFC/CO₂ cascade and secondary units, in an effort to see what works best in various store formats and climates.

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→ Now it's taking its most audacious step yet by testing propane in quantities that have never been seen in US commercial refrigeration. "There is precedent for this type of system in North America and Europe, but this is the first installation of the technology in the US," said Coffin, who has helped lead many of Whole Foods' green initiatives since joining the company in 2008.

Like its other natural refrigerant ventures, the propane/CO₂ cascade project represents another chapter in Whole Foods' relentless quest for real-world understanding of natural refrigerant technology. "We know there's no silver bullet for natural refrigerant systems," said Coffin.

"We need different choices for climate zones and building types so that we can make an educated decision rather than rely on outside lab data that may or may not be applicable to the actual operating environment in our stores. That's my goal for the company and my personal goal."

While new technologies are making transcritical CO₂ systems more efficient in warmer climates, "we're not necessarily 100% there yet," Coffin said. That leaves ammonia – which Whole Foods is testing in an NH₃/CO₂ cascade system at a store in Dublin, California – and hydrocarbons as other natural refrigerant candidates to replace synthetic refrigerants, which are coming under growing regulatory scrutiny.

"Ammonia and hydrocarbons are going to play a special role in how we go forward in the introduction of a broader natural environment in the US and worldwide," said Coffin.

Whole Foods needed an OEM willing to partner with it in the design of the propane cascade system. Of the six manufacturers Whole Foods contacted, only two were willing to move forward with the chain's preferred design, and Carnot was ultimately selected "for their flexibility, unique and innovative design, excitement and dedication," said Coffin. The Carnot propane system, he added, "is pretty much plug-and-play".

Whole Foods regards the Santa Clara outlet as a flagship store featuring the chain's many environmental features – reclaimed building materials, wood from Forest Stewardship Council-certified sources, and LED fixtures throughout the store, among others. The propane system represented an opportunity to "do something different and be able to talk about it," said Coffin. To that end, the store features a décor board in its "beer garden" describing the system in a "cool, fun way".

SAFETY MEASURES

Though propane is safely used in a host of everyday applications in larger quantities than those allowed for refrigeration, the flammability of the gas remains a concern. Thus Whole Foods has taken special pains to ensure the safety of its cascade system, especially given its relatively large charge.

For example, the chain has set up a "very comprehensive leak detection system" for the seven rooftop propane modules that has several leak sensors on each unit as well as on other "points of possible ignition," including a generator and two HVAC units, explained Coffin.

Given the miniscule probability of more than one of the seven propane modules leaking at the same time, the probability of the gas combusting is equally remote. "The chance of having a leak that would hit the LEL [lower explosive limit – the least amount of a flammable substance that can ignite in a given space] has too many zeroes," said Coffin. This analysis will be included in Whole Foods' EPA SNAP application.

The propane system and other equipment on the roof have also been designed to shut down in the unlikely event that a propane leak comes within 25% of the LEL, removing any source of ignition. "We are very confident that there would never be any potential for a [flammability incident] because of the R290," he said.

VETTING EFFICIENCY

A growing number of supermarkets and foodservice outlets have launched their investigation of propane with energy-efficient, self-contained display cases. Whole Foods has installed horizontal 'bunker' units from AHT in about 68 stores, including the new Santa Clara outlet.

As part of its analysis of the propane/CO₂ cascade system, Whole Foods will be comparing it to other CO₂ cascade systems it uses that employ an HFC or ammonia on the high side. "Our expectation is that it is going to be more efficient than those systems," Coffin said. He also expects the propane system to be "in line with, if not more efficient than, a transcritical system without any [energy-improving] bells and whistles".

Whole Foods is hoping that the efficiency of the propane cascade system will be similar to that of a standard DX HFC

system. "But even if the energy impact is a little more, we'll settle for that because the leak impact is going to be that much less," Coffin said. The chain considers Total Equivalent Warming Impact (TEWI), which combines direct greenhouse gas emissions from leaks with indirect emissions from electricity usage, as "really the most important thing". For all evaluations, he is seeking at least one year of data to account for ambient temperature swings before coming to any conclusions.

Another energy-saving factor is the heat reclaim achieved with the propane system; waste heat captured by glycol is used to preheat domestic water and to supplement space heating, as per Title 24 of the California Code of Regulations.

The first cost of the propane/CO₂ (as well as Whole Food's NH₃/CO₂ system) is about 50% more than that of a conventional HFC DX system, and 20% more than the cost of some of the chain's early transcritical systems, Coffin said. The marked uptick in adoption of transcritical technology, along with the greater number of suppliers, has driven down the cost of those systems significantly, but the relative newness of propane and ammonia cascade systems means their costs are still high.

"We went into this knowing that we would pay a premium for a propane system, but also knowing that if the system works – and, of course, we get SNAP approval – this could be a viable option for the future, and you would expect prices to drop as they have with transcritical," said Coffin.

Carnot spent time at the store educating service technicians on maintaining the system. Coffin doesn't believe it will require much maintenance because it is "so straightforward". But there will be safety protocols to follow. **MG & AW**



NATURAL REFRIGERANTS STEAL THE SHOW AT CHILLVENTA 2016



Over 180 companies among close to 1,000 exhibitors at Chillventa – taking place from 11-13 October in Nuremburg, Germany – were showcasing natural refrigerant technologies. This marks a 50% increase since the last edition of Chillventa in 2014, where only 120 companies were showcasing hydrocarbons, CO₂ and ammonia solutions.

– By Charlotte McLaughlin, Andrew Williams, Christine Noël & Michael Garry



For natural refrigerants, we're well beyond the point of no return," Eric Delforge, corporate business and policy officer at Mayekawa Europe, told *Accelerate Australia & NZ* at the biannual Chillventa – one of the world's largest shows for refrigeration, air-conditioning and heat pumps – at the Exhibition Centre in Nuremberg.

The concept at the heart of Mayekawa's product portfolio is the 'Natural Five': a range of HVAC&R solutions based on the five natural refrigerants – ammonia, CO₂, hydrocarbons, water and air – that will help drive the phase-out of harmful HFCs.

"We have a lot of experience in different applications and in different industries. This carries us forward to proclaim that propane, ammonia and other natural refrigerants are the solution – especially for industrial refrigeration," Delforge said.

Natural refrigerants were certainly on the radar of many of the 32,206 visitors and 982 companies participating in this year's Chillventa.

AMMONIA: 'A MARKET THAT WILL NEVER DIE'

Stephan Leideck, project engineer at compact Kältetechnik GmbH, told *Accelerate Australia & NZ* that, "ammonia is never new but the market [in Europe] is showing big demand for large ammonia plants, and lately for smaller machines up to 200 kW. We never really have a supermarket request but storage, supermarket distribution centres, ice rinks and so on – this is a market that will never die".

Ulrich Klauck, manager for Europe and the Middle East at Hansen Technologies – a global manufacturer of controls and valves for ammonia – echoed this sentiment. "Ammonia is a solid market and a long-term business. Now we are growing even more."

Signs that the ammonia market is growing were everywhere. German manufacturer compact was exhibiting, "one [of the biggest ammonia machines on the market] with the biggest Bitzer screw [compressor] on the market, that delivers 600 kW of refrigeration capacity. It's big, so it's for storage cooling," Leideck said.

Compact were also exhibiting, "one of the smallest ammonia machines on the market – with a piston compressor from GEA Bock. Complete with control panel and a capacity of about 25 kW [for the system]. Both machines go to -10 degrees Celsius," he said.

GEA and Bitzer – who are major competitors in the global compressor market – were showing huge ammonia compressors at their Chillventa booths to keep up with demand for a wider spectrum of ammonia solutions. "We have the biggest and smallest ammonia compressor on the market currently [part of their HG line], and we are constantly pushing ammonia as an answer to our customers for most uses," said Dirk Oschetzke, project engineer at GEA.

At Chillventa, much interest was shown in GEA's new Red Astrum ammonia heat pump, which will be used to heat Islington station on the London Underground by reclaiming hot air from a ventilation shaft at a constant temperature of 24-30 degrees Celsius.



compact Kältetechnik at Chillventa



"Ammonia is the safest refrigerant," said Isolde Dobelin, director of the Open Trade Training Centre (OTTC) – which trains technicians on using ammonia in HVAC&R applications in South Africa – at a Chillventa event organised by EU trade association Eurammon (which promotes natural refrigerants).

Dobelin believes a combination of regulation and technological innovation has successfully addressed safety fears regarding the toxicity of ammonia. The OTTC offers training courses leading to diplomas in Springs, near South African capital Johannesburg, on safely using ammonia for refrigeration and air conditioning in commercial and industrial applications.

"If you have training and maintenance plans in place, no accidents will happen. Once you're trained in its use, ammonia is much safer than other refrigerants," said Dobelin.

Some observers see China as the next big market for natural refrigerant technologies. "We should never underestimate the efforts that China is making to support the uptake of natural refrigerants," said Mayekawa's Delforge.

"I think we may be surprised by bold and pragmatic decisions in China, where some industries may decide to go full-steam ahead for natural refrigerants. These will be the game-changers in niches. This will then spread all over," he said.

EJECTORS: CUTTING-EDGE CO₂ INNOVATION

Ejectors were on the tip of tongue for CO₂ watchers at Chillventa, with the technology ranking among the most promising innovations for improving the efficiency of transcritical CO₂ systems in warmer climates. Ejectors use a high-pressure motive to compress a low-pressure suction to discharge at an intermediate pressure. They are capable of boosting or compressing the discharge pressure accordingly.

"[Ejectors are] most applicable in supermarkets with CO₂ and [are] directly addressing CO₂ in warm climates," Torben Funder-Kristensen, vice-president (public and industry affairs) at Danfoss, told *Accelerate Australia & NZ*.

Danfoss is at the forefront of this innovation, exhibiting at Chillventa a multi-step ejector that stacks ejectors on top of each other to improve efficiency still further. "The multi-ejector is not commercially available but we have several prototypes that are just built for purpose and can be ordered [by customers]," Funder-Kristensen said.

"We now have to get a good foot in the market. We will [...] push in North America [...] and then we will go to other markets," he said.

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Green & Cool's Johan Hellmann

Green & Cool's CO₂Y condensing unit

→ As reported in the last *Accelerate Europe*, CAREL and Carrier Commercial Refrigeration Europe have jointly developed an electronic modulating ejector (EmJ), which is capable of increasing system efficiency by up to 25% – with average annual efficiency gains of 10% in typical southern European climates. This attracted a lot of interest at Chillventa.

Following in their footsteps, Compact Kältetechnik's Stephan Leideck told *Accelerate Australia & NZ* that the company's ejector for transcritical CO₂ systems would hit the market by 2017.

The German manufacturer assembles custom-built CO₂, ammonia and propane solutions according to market demand. "The examples [at Chillventa] are made for our customers and they will go to them after the show," said Leideck. It is this philosophy that led Compact to develop its own ejector. "Due to the market situation we decided to manufacture our own ejector," Leideck said.

The company is currently testing a prototype at its test site. It plans to bring to market by 2017 a gas and liquid ejector system with a built-in controller, developed together with German controls manufacturer Eckelmann AG.

BRINGING JAPANESE KNOW-HOW TO EUROPE

CO₂ condensing units for convenience stores (CVS) are already well established in Japan, while in Europe many small stores use hydrocarbons. During Chillventa many innovative companies launched their CO₂ condensing units and air-conditioning for smaller applications, pushing CO₂ in a new market direction.

"We dream only CO₂," Advansor Managing Director Kim G. Christensen told *Accelerate Australia & NZ* at Chillventa 2016. The Danish manufacturer is ready to capitalise on the European food retail sector's move towards smaller stores by providing integrated heating and cooling systems.

Advansor were particularly excited to be showcasing their new CO₂ cassette for air conditioning. Driven from the refrigeration rack, the unit is capable of providing cooling or heating as required.

"In Europe, all the retailers are investing in small supermarkets. You have to go where the money is. So that's why we're offering our cassette system, together with the ValuePack" refrigeration system, Christensen explained.

The Danish company has also identified a gap in its portfolio between the larger ValuePack and its small condensing unit. It will launch a new 'mini-booster' product for medium capacities of up to 25 kW at Euroshop – Europe's biggest tradeshow for the retail sector – in March 2017.

Christensen remains convinced that Advansor's decision to focus 100% on CO₂ technology was the right one. "We want to be the best in the [CO₂] market. If you want to be a professional tennis player, you wouldn't try to play football too," he said.

CO₂ was on the radar of other companies at Chillventa too. Green & Cool – part of the Carrier Transicold Group – formally launched its compact CO₂Y condensing unit designed for convenience stores, petrol stations and other small businesses. The small stand-alone unit is suited to less demanding refrigeration applications such as small cold rooms, display cases and petrol stations.

The CO₂Y is "basic and cheap, but still bears state-of-the-art eco-performance," Johan Hellman, sales engineer at Green & Cool, told *Accelerate Australia and NZ*. With a maximum capacity of 5.5 kW at ambient temperatures of up to 30°C, the unit features a DC rotary compressor



that can be regulated at various speeds of up to 100 rotations per minute.

"The 2-9 kW segment, which CO₂Y falls into, has enormous future potential since there has not been an economical environmentally friendly alternative until now," said Joakim Westerberg, responsible for refrigeration appliances at Kylvalitet, a Swedish supplier of Green & Cool systems.

With other companies like Sanden, Panasonic and Advansor also rolling out CO₂ condensing units in Europe, are Green & Cool ready to rise up to the challenge?

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

EUROPE AT THE FOREFRONT OF HYDROCARBONS DEVELOPMENT

With global HFC phase-down discussions and the drive for energy efficiency improvements picking up speed, the market for hydrocarbon technology is ripe for growth – particularly in the United States, according to SECOP CEO Mogens Søholm.

"There are three key topics for us at Chillventa: natural refrigerants, energy efficiency, and the variable speed aspect – going electronic with these products," said Søholm.

SECOP was at Chillventa to showcase its new variable speed drive 'DLV' and 'NLV' series compressors for use in commercial cooling systems.

"We believe the whole market is changing focus, especially in light commercial. Where we're putting our development money these days for light commercial is a full range of hydrocarbon compressors – mainly R290 (propane)," said Søholm.

"If you convert a traditional R134a system to hydrocarbons, you gain a lot of efficiency by changing the refrigerant alone. If you add variable speed technology on top of that, then you see improvements – in terms of energy efficiency and noise, for example – that are tremendously large," the SECOP boss said.

The variable speed drive enables needs-based adjustment of cooling capacity and delivers high efficiency even in partial load operations. Compared to fixed speed refrigeration compressors, variable speed drives can achieve energy savings of up to 40%.

Huayi Compressors Barcelona S.L also launched variable speed compressor models for propane and isobutane – more will be launched in the coming year, when they will expand into their whole capacity range. Their factory in China exclusively makes R600a (isobutane) models.

"In the US with the new regulation [DOE energy conservation standards], a lot of customers are worried about energy efficiency. They believe the only way to meet these energy standards is with variable speed," said Pedro Olalla, sales director at Huayi.

Embraco, the Brazilian compressor maker, is also banking on a combination of hydrocarbon refrigerants and variable-speed compressors to maximise energy efficiency.

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SECOP CEO Mogens Sørensen

→ According to Peter Bukšár, technical support senior specialist for Embraco, isobutane or propane (at a maximum charge of 150g) will alone boost the energy efficiency of a commercial self-contained refrigeration unit by 5% to 15% over traditional refrigerants, but adding a variable-speed compressor further increases the overall efficiency.

Bukšár gave several examples of this combination at work, including an ice cream freezer (more than 25% energy reduction vs. HFCs/on-off compressor unit), and a bottle cooler (an almost 50% energy drop).

Variable-speed compressors are costlier than traditional compressors, but with energy savings, "it's easy to calculate how much you are able to save on the lifetime of the application to justify the additional investment," he said.

REGULATORY CHANGE BOOSTING HYDROCARBONS

In some parts of the world, use of hydrocarbons is restricted by regulation imposing charge limits for certain applications. But as knowledge of the technology grows, this is beginning to change.

"The best example of these recent big changes is the United States. A couple of years ago, you'd have never believed the US would change this quickly. But today they are very focused both on improving energy efficiency and phasing out HFCs," said Sørensen.

In 2011, the US Environmental Protection Agency approved R290 for commercial food refrigeration, and R600a (isobutane) and R441A (a hydrocarbon blend) for domestic refrigeration.

Last year, the agency expanded the regulations, allowing R290 in domestic refrigeration and R600a and R441A in commercial

refrigeration. But the charge limits for commercial and domestic applications, in line with UL standards, were set at 150g and 56g respectively.

"I strongly believe that with more insight into and knowledge of the technology, regulators will figure out that today's charge limit of 150g should probably increase," Sørensen said.

He believes the advantages of moving to hydrocarbons are so significant in terms of energy efficiency and environmental impact that the only conceivable obstacle to their wider uptake is flammability. "But [...] today's technology knowhow limits those risks," he said, pointing out that hydrocarbons have already been used safely in household domestic appliances in Europe and Asia for many years.

Huayi's Pedro Olalla is in no doubt as to the boost that a charge limit increase would bring. "If it moves from 150g to 500g or 350g, this challenge of refrigerant charge for some types of application would be solved. There would be no challenge in light commercial applications for hydrocarbons then."



Compressor by SECOP



Accelerate Australia & NZ also heard about the development of the hydrocarbon heat pump market in Europe. Swedish manufacturer Beijer Ref has developed a highly efficient hydrocarbons-based heat pump, the TripleAqua, which is already running in two offices and a supermarket in the Netherlands.

The company plans to build a factory, which will be used in part to construct TripleAqua units. "We are building a unit for bigger buildings for end users with a policy of using natural refrigerants, and for government buildings like town halls," said Menno van der Hoff, manager of R&D HVAC for Dutch supplier Uniechemie (Union Chemicals), a division of Beijer Ref.

Beijer Ref argue that the TripleAqua can save up to 50% in heating and cooling costs in commercial buildings compared to traditional heat pumps, with a COP of between four and ten.

The system employs 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). "Propane is known for its efficiency and propene outperforms propane at negative temperatures," said van der Hoff. "And propene has a strong smell, which people like for safety."

The 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 (82°F-97°F), cold (54°F-64°F) and return water at ambient temperature.

As Chillventa 2016 drew to a close, participants were left in no doubt as to the natural refrigerant industry's position at the forefront of developing innovative HVAC&R solutions, pushing the boundaries of what CO₂, ammonia and hydrocarbons can achieve. **CM, AW, CN & MG**



Beijer Ref's TripleAqua heat pump at Chillventa



Menno van der Hoff, from TripleAqua



MARKED GAINS FOR NATREFS IN NORTH AMERICA

At ATMOsphere America in June, industry vendors reported significant strides for CO₂ transcritical, low-charge ammonia and hydrocarbon applications, though like in Australia, cost and other challenges persist.

– By Charlotte McLaughlin, Michael Garry and Andrew Williams

Original equipment and component manufacturers of natural refrigerant equipment – the companies that have made the biggest investment in this technology and which are on the front lines of marketing it to end users – are well placed to assess the state of the industry in North America while it still grapples with core challenges.

CO₂ GAINING MARKET SHARE

Dustan Atkinson, manager of product strategy at Hillphoenix, expressed confidence in the prospects for CO₂ transcritical refrigeration in the U.S. “We think that CO₂ is going to gather a pretty significant share of the market for commercial, industrial and light commercial – it is a truly future-proof solution, and it’s easy to install,” Atkinson said.

“Transcritical booster systems are no longer just being trialed – this is becoming mainstream, and it is very viable moving forward,” he added.

He cited several “measurable savings” for transcritical technology, including refrigerant charge, installation, case performance and energy, as well as “intangible benefits” such as HFC retrofit cost avoidance, relief from leak and record-keeping requirements, better quality products and evidence of social responsibility. But persistent challenges include capital costs, technician availability, energy evaluation, understanding the ROI and impact on total cost of ownership, and refrigerant management.

At the same time, he sees equipment costs falling over time, greater availability of incentives and rebates, the growth of training programs like Hillphoenix’s own learning center, and investment in new technologies like parallel compression and ejectors that improve efficiencies “even in extremely warm climates”.

James Knudsen, North American food retail segment leader for Danfoss, cited shecco data in pointing out that by the end of 2016, there would be an estimated 350 transcritical systems installed in North America (an 84% increase from 2015), and



6,000 deployed in Europe (a rise of 15%). He cited government regulations as a key driver of growth. "OEMs are adapting designs to meet new refrigerant and efficiency requirements," he said.

VARIED NH₃/CO₂ APPLICATIONS

Ammonia is also experiencing a period of growth in the United States. Carnot has seen great success with ammonia/CO₂ systems for industrial refrigeration, and its latest project is a large-scale, 1,500TR installation in a food production and distribution center.

The main challenges confronting ammonia/CO₂ systems include technician skill level, national and local regulatory codes and the availability of components. He recommended that the industry "expand and promote industry training to improve the CO₂ and ammonia knowledge base."

Joe Sanchez, engineering manager for Bitzer U.S., reported that his company had recorded a 60% increase in the number of ammonia compressors sold in North America in each of the last three years.

Meanwhile, propane may also be on the brink of large-scale U.S. expansion. Marek Zgliczynski, product manager for Embraco, said he expects the efficiency of hydrocarbon systems, which exceeds that of many other refrigerants, to trigger a wider rollout; he predicts that 20% of Embraco's U.S. sales in 2016 will be in hydrocarbon units, mainly propane.

TARGET'S PROPANE POLICY

Over the past year, hydrocarbons have emerged as a natural refrigerant of great interest to food retailers, especially for self-contained cases.

For example, Minneapolis-based Target Corp. has sent out notifications to its suppliers of self-contained refrigeration equipment indicating that its policy is to use only propane as the refrigerant in self-contained units.

"Target asked its suppliers, 'Where do you stand on that? Do you need help?'" said refrigeration consultant Keilly Witman, owner of Boise, Idaho-based KW Refrigerant Management Strategy, who participated in the food retail panel at ATMO America. "The suppliers said that's already where we're going, so it's no problem at all."

In addition to using propane cases on a spot basis in stores, Target has a few stores opening in the next six to eight months that will use only propane self-contained systems, added Witman.

Witman also disclosed that a major U.S. food retailer, which asked not to be named for publication, is testing a propane/CO₂ cascade system, the first in North America.

NORTH AMERICAN TRANSCRITICAL LEADERS

European retailers have had great success with CO₂ transcritical refrigeration, with over 5,500 stores installing the technology to date. Now, CO₂ transcritical is making inroads in the North American food retail sector as well.

In Canada, Sobeys has established itself as the "leader in CO₂ [transcritical] refrigeration in North America," said Patrick Gareau, refrigeration specialist for Sobeys.

The supermarket chain currently has 82 supermarkets using CO₂ transcritical systems throughout Canada, with nine more on the way (this includes 22 retrofit stores). Since Sobeys first transcritical installation in 2009, the systems "have evolved and are now mature," he said. Its four transcritical suppliers are Carnot Refrigeration, Systemes LMP, Hillphoenix and Zero-C. Sobeys is also testing CO₂ in air conditioning.

Gareau said CO₂ transcritical systems had allowed Sobeys to reduce energy consumption by 8%-10% compared to stores fitted with HFC-based technology. He also described the systems as low maintenance, with CO₂ being much less expensive than HFCs.

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→ James Hyland, vice-president of corporate communications & public affairs for Milwaukee-based Roundy's (which merged with Kroger last December), explained how Hillphoenix's Advansor transcritical CO₂ booster system had reduced the chain's environmental footprint and efficiently covered both medium- temperature and low-temperature loads. Its transcritical program is the most aggressive for a supermarket retailer in the U.S., and second to Sobeys in North America.

INDUSTRIAL'S NEW PATHWAYS

Ammonia in large quantities has been the dominant refrigerant in industrial refrigeration for many decades, but now it is finding use in an array of low-charge applications.

Some end users are reducing their ammonia charge by employing low-charge rooftop packaged units. For example, Western Gateway Storage, Ogden, Utah, has installed two low-charge packaged Evapcold units, from Evapco, each containing only 132kg of ammonia and delivering a capacity of 70TR to a freezer room at -20.6 degrees Celsius or below. This is the first installation of the Evapcold technology.

Another low-charge packaged unit, from NXCOLD, is being deployed at Los Angeles Cold Storage and at a 30,480m² plant belonging to Lineage Logistics in Oxnard, California, among other places. John Scherer, engineering manager at Los Angeles Cold Storage and the developer of the NXCOLD unit, said at ATMOSphere America that 75 units would be installed by the end of the year, including multiple units at a single location.

The Oxnard unit has 11.3kg of ammonia and delivers a capacity of 50 tons (or 8 oz./TR). The unit saves 9% in kWh compared to the central ammonia system, or about \$131,220 per year; in an optimum scenario that includes demand control, it saves 13% in kWh, over \$206,000 per year.

AMMONIA AMBITIONS THWARTED

Gerard von Dohlen, president of Newark Refrigerated Warehouse, Newark, N.J., had planned to convert his warehouse from R22 to low-charge ammonia.

Working with industry officials, he developed a plan with the state of New Jersey to avoid the state requirement to have engineers on the premises 24/7 if ammonia refrigeration is used (at a cost of \$918,500/year); the state would waive that requirement if the ammonia charge were 2,359kg or less; the system complied with the IIAR-2 safety standard; and the facility hired one full-time engineer certified by RETA.

Von Dohlen was set to meet those requirements when New Jersey's Department of Labor decided to abandon the plan and stay with the existing system. "So now I'm in a quandary," he said. "I'd like to change R22 to ammonia, but I'll have to do something else."

For now, he intends to use R32 as a primary refrigerant with CO₂ brine in one building, and with calcium chloride brine (also used as a liquid desiccant) in two others. But he leaves open the possibility of using ammonia and asking for an exemption from the Department of Labor. ■ CM, MG & AW



ACCELERATE AMERICA AWARDS

In the first annual Accelerate America Awards program, Sobeys, Red Bull, Campbell Soup, True Manufacturing and Marc-André Lesmerises of Carnot Refrigeration have been recognized for advancing the uptake of natural refrigerants.

All The Winners:

- Person of the Year: Marc-André Lesmerises, Carnot Refrigeration
- Best in Sector/Food Retail: Sobeys
- Best in Sector/Food Service: Red Bull
- Best in Sector/Industrial: Campbell Soup
- Innovation of the Year: True Manufacturing



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COCA-COLA TARGETS 100% NATURAL REFRIGERANTS FOR VENDING EQUIPMENT

Global beverage giant the Coca-Cola Company is aiming to be 100% HFC-free for all new cold drinks equipment by the end of 2020. It plans to achieve this target by primarily adopting natural refrigerants CO₂ and hydrocarbons – with its Japanese branch leading by example. *Accelerate Japan* reports.

– By Andrew Williams & Jan Dusek



Stan Mah, president, Coca-Cola Tokyo Research & Development Inc.

Globally, the Coca-Cola Company is already adopting natural refrigerants propane and CO₂ in bottle coolers and vending machines on a grand scale. By the end of 2015, the Coca-Cola Company had deployed more than 1.8 million HFC-free units worldwide.

Antoine Azar, the firm's global programme manager, set the scene at the ATMOsphere America conference in Chicago in June. "We have natural refrigerant equipment everywhere in the world where we operate today. Our equipment is distributed among developed and developing countries and in hot, humid or cold climates. Wherever you find a Coca-Cola can, there is possibly HFC-free equipment working in that country," he said.

The Coca-Cola Company overall is striving to be 100% HFC-free in all new equipment purchases – primarily bottle coolers and vending machines – within two years (except for certain speciality equipment).

By HFC-free, the Coca-Cola Company means 100% natural refrigerants. It currently has 280 CO₂ cooler, vending machine or fountain machine models certified and ready for use. Overall, its percentage of HFC-free new equipment is already high – in some markets more than 75% of cooling system purchases are HFC-free.

COCA-COLA JAPAN LEADS THE WAY

In Japan, the objective is slightly different: the beverage giant has adopted an official target of moving to 100% natural refrigerants – meaning CO₂ or hydrocarbons – in all vending equipment on the Japanese market by 2020.

Accelerate Japan met with Stan Mah, representative director and president of Coca-Cola Tokyo Research & Development Inc. – a subsidiary of the Coca-Cola Company – at his renovated R&D facility in Odaiba, Tokyo to find out more.

"Our plan is to move out of HFCs. We continue to be on track for that. Specifically for Japan, we are definitely on our way," says Mah.

Local Coca-Cola bottling companies operate 980,000 vending machines in Japan. Estimating that the lifecycle of this equipment is eight years, Mah says, "we should be able to replace our entire fleet by 2020".



At Coca-Cola Japan headquarters in Shibuya, Tokyo

Mah's team is currently using natural refrigerants in over 500,000 Japanese vending machines. At present, the majority of these are CO₂ (roughly 80%; shecco estimate) rather than hydrocarbons (roughly 20%; shecco estimate).

His team started to go down the natural refrigerants route in 2002. "When we look at HFC-free, we look at CO₂ and also hydrocarbons. Our HFC-free commitment is definitely on the way. We will deliver it through a combination of CO₂ and hydrocarbons," he says.

Asked to outline the main drivers of Coca-Cola Japan's decision to start using natural refrigerants in 2005, Mah declared: "Before 2005, as a big corporation we were still serious about social responsibility. The 2005 announcement was about showing our commitment to energy savings and environmental sustainability."

Mah remains committed to adopting natural refrigerants despite the extra cost of CO₂ or hydrocarbon vending machines compared to conventional HFC technology. "I don't think we made a mistake – social responsibility isn't a mistake. It's a commitment we take very seriously," he says.

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Mah (left) and his team



→ New Coca-Cola can and plastic bottle vending machines in Japan have been using natural refrigerants since 2011. “We’re actually trying to consolidate more. Wherever possible, we’re using HFC-free machines. A lot of these are CO₂. But for certain small sizes, CO₂ cannot be an option currently – so we use something else,” Mah explains.

Coca-Cola Japan works with other Coca-Cola Company branches worldwide to help ensure that each country adopts the technology that is most suited to its domestic market. Having originally established that CO₂ would be the standard refrigerant for new beverage coolers, vending machines and fountain equipment, in the United States the Coca-Cola Company “will open the door” to hydrocarbon refrigerants for smaller cooler equipment, Azar told the ATMosphere America conference in June.

Azar defined smaller equipment as units with a volume at or below 300 litres, which accounts for 10% of its equipment. “Everything above 300 litres must still be CO₂. Below 300 you can go with either CO₂ or hydrocarbons [either propane or isobutane],” he said.

Ultimately, bottlers will make the decision locally. But the Coca-Cola Company will no longer allow R134a to be used in smaller units. Company HQ has therefore strengthened safety requirements for hydrocarbon equipment. The charge limit is 50g; all electronic components must be spark-free; and condenser fans must remain on in case of leaks.

Azar left open the possibility that the Coca-Cola Company would one day allow hydrocarbons to be used in larger units too. “Our only concern with hydrocarbons has been safety. We know it’s a great refrigerant,” he said.

Commenting on these developments, Mah says: “Currently our position in Japan is that we’re open to hydrocarbons in vending machines. We’re open to hydrocarbon models, but we prefer

CO₂. For bottle coolers too, we can use hydrocarbons but we prefer CO₂ as well.”

Pragmatism is king. “We want to make sure we don’t limit ourselves too much. We have a preference for CO₂,” he says.

Mah believes Coca-Cola Japan is already reaping the benefits of its 11 years using natural refrigerants. “Our commitment hasn’t changed. Consumers do know we’re using them. We’re on a journey with CO₂ and hydrocarbons, and the choices have been correct,” he said.

HFOS ‘NOT IN OUR SCOPE’

Many companies are responding to f-gas regulations by adopting synthetic refrigerants – so-called HFOs – which have a lower GWP than traditional HFCs. Did Coca-Cola Japan also consider going down this road?

Mah is resolute in his response. “Right now, HFOs are not in our scope. I know other industry players are looking into it, but currently our position is CO₂ or hydrocarbons. HFOs are not an option currently.”

Natural refrigerants are not limited to light commercial applications. They are widely used for cold storage in warehouses and distribution centres, and can also be used in transport refrigeration. Does Coca-Cola Japan plan to adopt natural refrigerant technologies in other areas of the business?

“HFC-free is one of our key initiatives. But we’re also looking at total energy savings and sustainability. That might not be about HFC-free – we have hybrid trucks, for example,” Mah says.

Coca-Cola Japan’s sustainability strategy addresses many different areas – the cold chain is just one aspect. “We look at it as an entire environmental sustainability platform. HFC-free is part of that,” Mah says.

Lack of training among maintenance technicians and installers – particularly on handling flammable refrigerants like hydrocarbons – is often cited by potential users of natural refrigerants as a barrier to their wider uptake. Mah, however, says Coca-Cola Japan is yet to experience such frustrations.

"A lot of the maintenance is done by our supplier. They are really good, so there are no problems. We don't see any issues, whether CO₂ or hydrocarbons," he says.

"The supplier provides maintenance for the compressor. Our people handle the machine itself, and disposal of our machines is handled separately. No issues with maintenance – the supplier has been really good, and does the training for natural refrigerants."

The Coca-Cola Company does not appear to have encountered the so-called 'training gap' elsewhere either. At ATMosphere Chicago in June, Azar confidently declared: "So far we haven't faced any major issue in servicing CO₂ equipment. Frankly speaking, CO₂ today can be serviced either in the field or in some cases in the service centre."

POLICY HELPING TO DRIVE INCREASED NATREF UPTAKE

Many countries have put in place incentive schemes to encourage wider uptake of natural refrigerant-based alternatives to climate-damaging HFC technologies. Japan is a leader in this regard. Its Top Runner Programme seeks to encourage companies to target the highest energy efficiency possible in beverage vending machines. Companies that meet specified targets are given the Top Runner label.

From 2000-2005, the Top Runner Programme delivered energy efficiency improvements of 37.3% for vending machines for canned and bottled beverages. From 2005-2012, efficiency was improved by 48.8% compared to 2005.

To help companies switch to eco-friendly goods and services, the Japanese Ministry of Environment actively facilitates supply and demand for eco-friendly technologies via its own purchasing. This has had a direct impact on the installation of



Driving change: Stan Mah

beverage vending machines, with public institutions purchasing energy-efficient, natural refrigerant-based units.

Yet despite the significance of this regulatory activity, Mah insists that corporate sustainability targets were the biggest driver of Coca-Cola Japan's decision to embark on its natural refrigerants journey.

"For us, this has always been a corporate commitment, rather than something that the Japanese government is pushing," he explains.

A true global citizen, Mah holds U.S. citizenship, has a Japanese wife and has lived in Japan on and off for 21 years – interspersed with spells in Singapore and Shanghai. How have these experiences shaped his view of his adopted country? "Japanese culture is very respectful of people and the environment," he says. He takes his cue from that. "I drive a hybrid car, and I recycle," he says.

Having graduated from university with a degree in environmental engineering, Mah has long been interested in environmentally friendly technology. "As an engineer, how can I not be curious about it," he jokes.

Yet he is quick to adopt a more serious tone. "I wouldn't be supportive of anything that isn't environmentally friendly – as an individual or as part of a management team."

Is that what motivates him to go to work each morning? Mah replies: "I have kids. I'll be gone in a few years, but I want to make sure things will be the same or even better for them."

AW & JD



Inside the Coca-Cola Japan headquarters in Shibuya, Tokyo

SCALING NEW HEIGHTS IN ROMANIA

Charting a course beyond the Carpathians, European food retail giant the Transgourmet Group sees natural refrigerant technology playing a central role in delivering its goal of becoming CO₂ neutral by 2023.

– By Andrew Williams



Marcus Hoepfl, of Frigo-Consulting, and Hans-Dieter Bruss, of Transgourmet

 We have been set a target by our shareholders. We have to be CO₂ neutral by 2023, across the whole Transgourmet Group,” Hans-Dieter Bruss, vice-president in the group’s Central and Eastern European arm, told *Accelerate Australia & NZ’s* sister publication *Accelerate Europe*.

Based in Germany, Bruss is responsible for construction and facility management at Transgourmet Central and Eastern Europe (CEE), which operates cash & carry and wholesale stores in Germany, Poland, Romania and Russia.

With an annual turnover of €4.5 billion and 17,000 employees, Transgourmet CEE is part of the wider Transgourmet Holding AG, which also includes business divisions in France and Switzerland.

Together, Transgourmet Holding AG is the second-largest cash & carry and food service company in Europe. It is part of Coop, one of Switzerland’s largest retail and wholesale companies.

TARGETING 100% CO₂

Bruss, who has been at the firm since 1985, is acutely aware of the responsibilities that multinational companies of this size have in terms of minimising environmental impact. He is putting HVAC&R – and natural refrigerants in particular – at the centre of Transgourmet CEE’s strategy for delivering its sustainability targets. “The target is 100% CO₂,” he says.

The group is adopting CO₂ for all refrigeration, air conditioning and heating applications, not only in new and updated stores but also in distribution centres. “In every new store and every remodelled store, we’re changing from traditional cooling to CO₂,” Bruss explains.

There is not yet a precise timetable in place for delivering this transition. “We’re trying to change four, five or six installations to CO₂ every year.” Currently, Transgourmet has 15 stores that use CO₂ transcritical.

Since 2015, the European F-Gas Regulation has been restricting the total amount of HFCs that can be sold in Europe. In 2020, a ban on using certain HFCs on new equipment comes into effect, accompanied by bans on servicing and maintaining existing equipment.

Parent company Coop has been working with natural refrigerants since 2000. As of 2009, all Coop’s new system installations have used CO₂ as the refrigerant. Coop is committed to becoming CO₂-neutral by 2023, too.

“Transgourmet has the ambition and target to apply CO₂ technology whenever possible – for refrigeration, air conditioning and heat pumps. When we say CO₂, we mean ‘full CO₂’. No hybrid systems that still use HFCs,” Bruss declares.

Marcus Hoepfl, managing director of Frigo-Consulting International Ltd., a Swiss refrigeration consulting and engineering company, has been helping the Transgourmet Group to make the transition to natural refrigerants for two years now.

Bruss and Hoepfl met with *Accelerate Europe* at the brand new Selgros Cash & Carry store – which operates under the Transgourmet banner and boasts a sales area of 3,500m² – in the Transylvanian town of Târgu Mureş, located just over 100km southwest of the city of Cluj-Napoca in Romania.



"I'm interested in taking care not to do the same thing all the time," Bruss says. "I need motivation," he says. What kind of motivation? "Something new, something that you can change, something that you can improve. That's why I like this job. I've been doing it for 31 years now."

TOTAL HEAT RECOVERY

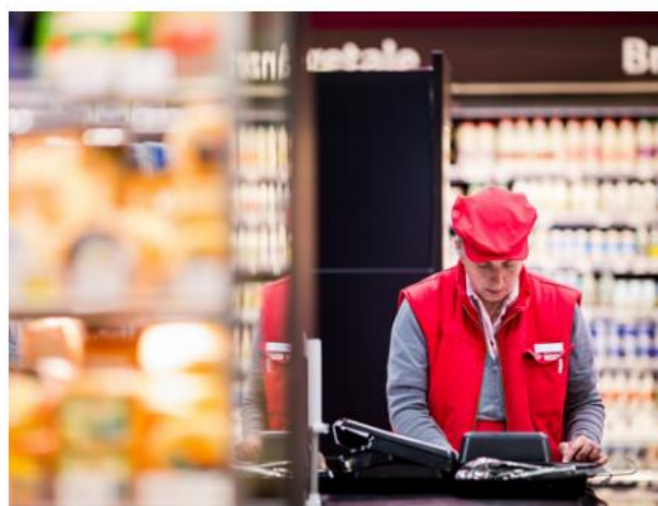
The Târgu Mureş store is fitted with a CO₂ transcritical rack that relies on a booster system, parallel compression, and ejector technology. The concept also includes the first-ever CO₂ transcritical chiller for air-conditioning with overfeed flooded evaporators.

A heat recovery system delivers hot tap water and heating for the sales and office areas. "All the waste energy is used to heat the store and to heat the water," Hoepfl explains.

"This is quite new. It's the first such system that we've done for an air conditioning application. We were calculating how we could reach at least the same level of energy consumption as the common systems that we all know about."

The CO₂ booster rack – serving 127 metres of low- and medium-temperature cabinets, as well as 268m² of cold rooms and freezers – delivers up to 145 kW of medium temperature and 44 kW of low temperature cooling capacity to the store.

The system harnesses gas and liquid ejectors together with parallel compressors to recover the energy released during high-pressure expansion and to reduce internal throttling



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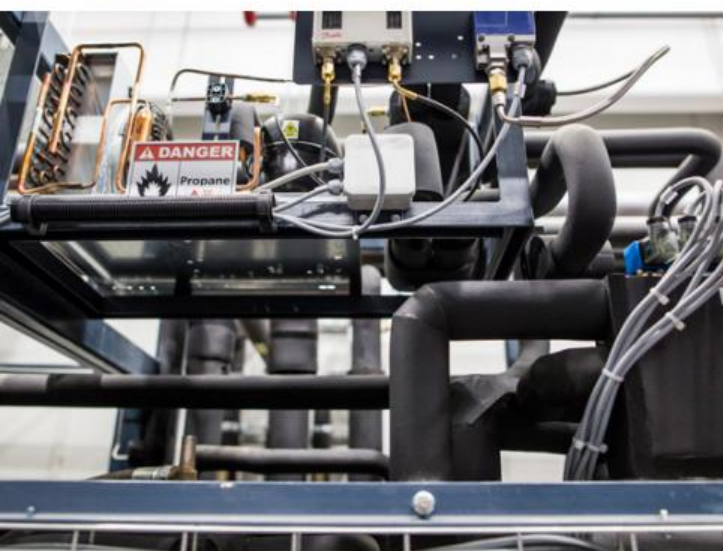


losses. Driven by the pressure difference in the refrigeration system between high and receiver pressure, the ejectors convey either liquid or gaseous refrigerant.

The first CO₂ transcritical chiller for air-conditioning with overfeed flooded evaporators, meanwhile, provides air-conditioning for the entire sales and office area. The system harnesses ejectors to increase system efficiency, raising the medium suction pressure of the medium temperature (MT) range from -8 degrees Celsius up to -2 degrees Celsius.

Performing expansion in partially flooded mode "increases the properties of CO₂ tremendously, this allowing the increase in the evaporation temperature," says Hoepfl.

Thanks to the liquid separator on the suction side of the low temperature (LT) range, the evaporation temperature from the low-temperature side can be raised from -30 degrees Celsius to -26 degrees Celsius.



"All this is possible with the use of partially flooded evaporators. Energy savings reach up to 25% compared to traditional CO₂ systems. We measured this for over a year in two similar installations in Switzerland," states Hoepfl.

JUST THE BEGINNING

The Transgourmet Group is excited to be playing a starring role in bringing natural refrigerant technology to Central and Eastern Europe. "This is not the end. It's just the beginning," Bruss says.

The 21st and newest Selgros Cash & Carry store in Romania, which opened in Alba Iulia at the end of September, will mirror the concept in place in Târgu Mureș.



TÂRGU MUREȘ STORE TECHNICAL DATA:

CO₂ transcritical rack:

- Supplier: Enex
- Multi-Ejectors: 6 gas and 2 liquid
- Cooling capacity: 154 kW at t0 -2 degrees Celsius (MT): 44 kW at t0 -26 degrees Celsius (LT)

CO₂ transcritical chillers:

- Capacity: 225 kW at t0 +6 degrees Celsius
- Chiller rack features: 4 x HT compressors
- Evaporators: 2 x gravity overfeed
- Designed pressure HT/IP/HP: 80 bar/80 bar/130 bar

At present, Selgros Cash & Carry serves almost one million customers in Romania across its store network and via its goods delivery service. The firm continues to expand its presence in the country, with Bruss revealing that another “two or three” stores are in the pipeline there for 2017.

Meanwhile, the paint has barely dried on the Târgu Mureș store and Frigo-Consulting is already looking into how this kind of system can be improved for future locations. “We’re looking to advance the solution further in combination with a heat pump. Then you will have one concept that makes the air conditioning and the heating too – completely,” says Hoepfl.

With temperatures hovering around 34 degrees Celsius for *Accelerate Europe’s* visit, Hoepfl is very much aware of the importance of ensuring system efficiency in warmer climates – particularly given the long-standing debate surrounding the performance of CO₂ transcritical systems in high ambient temperatures.

To Hoepfl’s mind, this debate has already been consigned to the past. “In combination with new technologies like ejectors, we achieve a comparable level of efficiency to traditional systems – also on the hottest days,” he insists. Moreover, operational concerns on the very hottest days can be overcome by reducing capacity.

CO₂ ‘IN EVERY STORE’

In Germany, Transgourmet Deutschland encompasses 15 companies. It boasts a total warehouse area of 600,000m² and operates over 600 trucks. 40% of its German business is in communal catering, 30% is in hotel catering and 30% other customers.

In Poland, Selgros Cash & Carry operates 17 stores in 13 cities, serving some one million customers. The firm is also expanding its presence in Russia. “We’re building a store in Tula now. In autumn we want to start building another store in Moscow,” Bruss says.

With new stores and new refurbishments planned in many different countries, Selgros Cash & Carry – and the Transgourmet Group as a whole – are well placed to drive the rollout of natural refrigerant technology across Central and Eastern Europe.

Transgourmet is building distribution centres using CO₂ as the refrigerant for their cold storage facilities. “CO₂ is an excellent alternative to ammonia, particularly in small and medium-sized distribution centres,” he argues.

“Whatever the project or application, we first check the feasibility with CO₂. We try to apply CO₂ in every store and country, but we must always consider local circumstances like availability of spare parts, infrastructure, and existing know-how about CO₂,” Bruss explains.

“We’re building huge new delivery warehouses – one in Hamburg and one in Munich. With the help of Frigo-Consulting, those will also be 100% CO₂,” he says.

“My estimate is that by 2020, the market share for CO₂ in Transgourmet Central and Eastern Europe will be above 50%,” Bruss concludes. **AW**



Geoff Amos, former Sales & Marketing Director, Carter

UK CHILL DESCENDING ON AUSTRALIAN SHORES

Carter Retail Equipment is one of an increasingly long line of international suppliers making inroads into the Australian market.

– By James Ranson

The company is fully committed to natural refrigerants with its vast range of CO₂ and hydrocarbon equipment.

Former Technical Director Ian Garvey and former Sales & Marketing Director Geoff Amos have been an integral part of the mission to expand into new territories. Both have since moved on to establish a private natural refrigerant venture together – NRMS Global Ltd. – but the company is continuing its “natural refrigerant-only initiative”.

A jovial atmosphere reigns between the duo from Birmingham as they chat to *Accelerate Australia & NZ*. They bounce between one another recalling their business travels to the US, South East Asia and more recently Australia. “What

we’re [Carter] doing around the world is we’re only promoting natural refrigerants. In Australia and South East Asia, and Geoff’s been doing a lot of work in the States,” says Garvey.

Considered an ‘alternative technology’ in Australia, Carter’s hydrocarbon showcases run on a chilled water-loop system and have received a swathe of tenders from supermarkets in the United Kingdom since food retail giant Waitrose approached them looking for a contained natural refrigerant solution in 2007.

Back then CO₂ was not yet widespread solution it is today. Waitrose initially had some reservations about the high pressure at which this natural refrigerant operates.

They were generally cautious of leakage problems associated with DX systems. As a result they opted for Carter's factory-assembled water-loop systems, requiring no work on site."

To date, Carter has built over 20,000 of the systems throughout Europe. It has also moved into Asia, laying the foundations for a significant market shift in Australia and New Zealand.

NOW FOR AUSTRALIA...

The company is excited about the potential to develop strong relationships with Australia's major food retailers. The depth of their enthusiasm was clear to see.

"Some of the most advanced retailers in the world are here in Australia. What they've done with the cascade [CO₂] systems actually predates many other markets, so they're getting ahead of the curb of legislation," Amos says. "So that's another pull to be down here."

Hydrocarbons are used for all plug-in showcases at Coles' state-of-the-art Coburg North store, a retailer Carter had been negotiating with for a couple of years. An adjacent Liquorland store, operated by Coles' parent company Wesfarmers, runs on a closed-loop condenser water-loop system with three propylene (R1270) showcases, each with an 850g charge and an adiabatic spray system.

The company recently secured further business with Coles, while talks about its hydrocarbon-based water-loop systems and transcritical CO₂ solutions are ongoing with Woolworths and independent retailer IGA.

"They're interested. Coles want to do a costing model on a full retail store," Garvey says. "They also want to look at petrol sites like Coles Express for these hydrocarbon water-loops, and [we've] definitely [had] interest from other independent supermarkets as well as independent liquor stores."

A 'VERY SIMPLE SYSTEM'

Garvey describes the water-loop system as a very simple system that "gets all your refrigeration done and rejects the heat out of the store". With few moving parts, the hermetically sealed plug-in system is very much based on a traditional HFC system using R404A or R407, for example.

The hydrocarbon water-loop system, in light of the refrigerant's superior thermodynamic properties and lower density, is approximately 16% more energy efficient than comparable HFC models.

"For us hydrocarbons are very good refrigerants, better refrigerants than any of the HFCs we used to use, in terms of capacity, in terms of energy efficiency," Garvey says. "So because we've designed the system correctly, manufactured correctly, there's no real chance of anything going wrong with a hydrocarbon system. It would have to be something going wrong with the training."

Most systems in the UK use a mechanically chilled water loop to maintain the compressors at maximum temperatures, using what Garvey describes as 'free cooling'. Essentially this means that when the ambient temperature falls below 17°C, no mechanical cooling is required.

The simple design of the system's dry air cooler allows water levels to float with the ambient temperature. "We can drop down to 10°C but still go up to 35-40°C," Garvey says. "In higher ambients, that can affect the efficiency of the compressors but on the whole it's fine. There haven't been any issues."

The lack of maintenance required is another key benefit of the system. It essentially only requires basic water treatment every six months or so. "It's actually just water treatment. From the cabinet point of view there is nothing to be done," Amos says.

If servicing is required, contractor Melbourne Refrigeration Services is on the ground to assist as it did with installation. "[The partnership] shows the investment we're making in Australia, because we're committing to people on the ground here," Garvey says.

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Amos and Ian Garvey

→ SAFETY FIRST

Carter started manufacturing its water-loop systems in 2009; and only recently have other manufacturers in Europe adopted the technology. Garvey says there is often confusion among end users as to the correct charge limits applicable for hydrocarbon systems.

"It's usually just a misapplication of the standard [AS/NZS 60335] as there isn't a standard for retail showcases. Only A3 refrigerants with under 150g charge relate to this standard."

"When you go above 150g another standard will apply e.g. ISO 5149, AS 1677. It clearly states for category 1 environments (including supermarkets) that the charge can go up to 1.5 kg if you meet the necessary leakage and safety requirements, with which the Carter water-loop systems are fully compliant."

Carter's systems contain between 350-800g of refrigerant, prompting Garvey to point out the relative absurdity of the prevalence of large BBQ gas containers sold in supermarkets and petrol stations around Australia.

"An 8 kg gas [container]... that's over 10 cabinets worth and there are rows of these sitting in stores and even outside the stores... just sitting in the heat!"

"If you actually applied the logic of refrigeration safety to supermarket aisles then the aerosol cans, the hair sprays, they would all be sold behind cages," Amos adds. **JR**

'ESTABLISHED' CO₂ STILL A CARTER HALLMARK

After installing its first CO₂ store in 2004 and first CO₂ transcritical store in 2007 (both in the UK), Carter still works predominantly with CO₂. It accounts for roughly 70% of the company's sales portfolio because, as Garvey says, "it's the established [natural] refrigerant on the marketplace".

The viability of CO₂ water-loop systems is now being investigated in regions like Australia but Amos says the jury is still out on what COPs are possible. "They're a few years behind the hydrocarbon systems and it's just not on the market yet. But I wouldn't discount it."

According to Amos, "you get the high energy savings with CO₂ but you also need a high level of technicians to maintain and provide support for the systems".

"Offsetting that with the hydrocarbon system is much simpler but you may not get the same level of energy savings."



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F-GAS REGULATION SHAKING UP EUROPEAN INDUSTRY, REPORT FINDS

Findings from a new report commissioned by the European Parliament on the F-Gas Regulation reveal a seismic shift in the market for natural refrigerant solutions with 650 organisations now manufacturing HFC-free technologies in Europe alone.

– By Klára Skačánová and James Ranson

In 2014, the EU took regulatory action to limit the use of these gases through a combination of measures. A recent report by shecco, commissioned by the European Parliament, analyses the impact of the F-Gas Regulation and what's next to come.

Based on a survey among leading European manufacturers and end users, combined with a qualitative assessment, the report, entitled 'F-Gas Regulation: Shaking up the HVAC&R industry', pinpoints a number of areas where the regulation has had the greatest impact while highlighting important industry feedback.

The report confirms the sizeable influence of the F-Gas Regulation on European Industry less than two years since it came into force in 2015. It also anticipates that its imprint on industry is set to become even more far-reaching as stricter measures are introduced in the years to come.

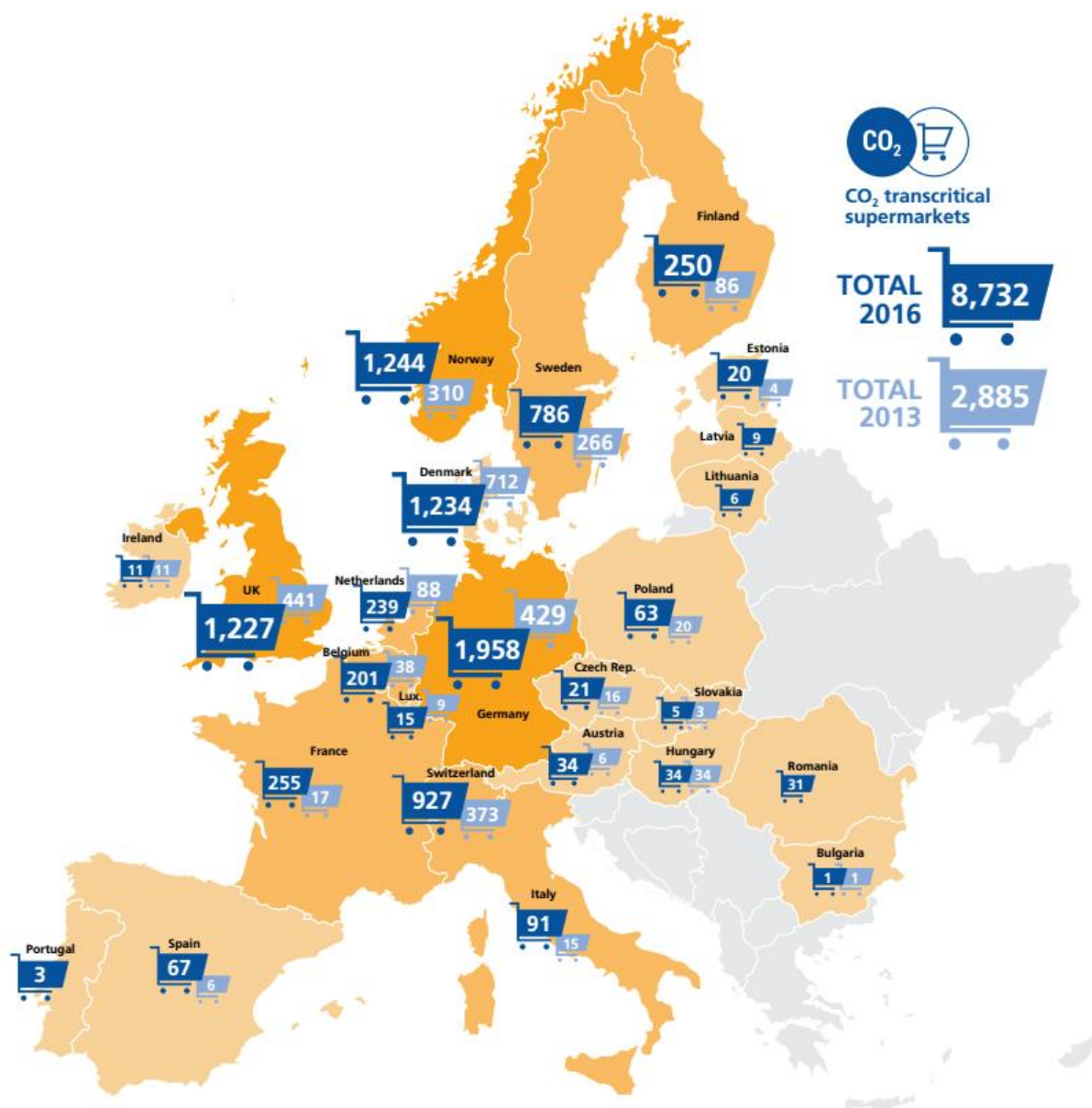
HFC ALTERNATIVES GROWING

Building on shecco's earlier research, the data collected shows the number of companies working with natural refrigerant technologies in Europe has grown from 400 in 2013 to 650 organisations in 2015.

This indicates that the Regulation has helped create new green jobs in the heating and cooling sector and has subsequently contributed to the growth of HFC-free technologies and services available to the market.

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Stores using CO₂ transcritical systems in Europe in 2013 / 2016

→ Besides traditional markets such as Germany, Switzerland, and the Netherlands, the report cites the number of companies working with natural refrigerants in Southern Europe as expanding.

Here, 'first movers' who invested in future-proof HFC-free solutions before the F-Gas Regulation are now reaping the benefits while either new companies are emerging or existing ones are increasingly shifting their product and R&D focus towards environmentally friendly technologies.

HFC BANS PROVE MOST EFFECTIVE MEASURE

Tellingly, 50% of respondents surveyed believe that the overall phase-down of HFCs will have the most significant impact on the shift away from high-GWP refrigerants. Nevertheless the findings indicate that the phase-down alone does not create enough pressure in the market to move towards future-proof low-GWP technologies, such as natural refrigerants.

Industry respondents indicated a strong growth in the availability of HFC-free technology over the last five years as well as an important shift in R&D investments and employment with regard to this type of product. Similarly, the heat pump and air-conditioning sector could benefit from further regulatory action to spur innovation and increase the availability of HFC-free equipment.

Nearly two-thirds of companies that participated in the survey are headquartered in five European countries – the Netherlands, Germany, Italy, Belgium and the United Kingdom. The remainder are located in other markets such as France, Denmark, Portugal and Sweden.

Half of the respondents also believed the level of ambition of the F-Gas Regulation is satisfactory. Overall, more than two-thirds of the industry experts expressed their support for the current legislative requirements; 20% of the respondents specified they would like to see more ambitious measures introduced; while close to 30% noted the new rules could pose some challenges.

MAJOR FINDINGS OF THE SURVEY INCLUDE:

1. The number of HFC-free stores using cutting-edge technology has tripled between 2013-2016.
2. Further natural refrigerant growth is expected in supermarket refrigeration with a ban on HFCs (GWP > 150) to enter into force as of 2022.
3. All companies surveyed active in this food retail sector indicated growth in availability of equipment using natural refrigerants in the past five years.
4. The number of stores using CO₂ transcritical technology, the mainstream HFC-free technology for the food retail sector, has tripled over the past three years, reaching more than 8,730 such stores, or 8% of the European food retail sector.
5. Worldwide, there are 11,000 stores using CO₂-based technology worldwide.

REGULATION PROMPTED PRE-EMPTIVE ACTION

The survey clearly shows that the industry anticipated the legislative change, with almost three-quarters (72.6%) of respondents indicating that they started taking action to comply with the regulation before it was implemented.

"The EU F-Gas Regulation helped us enormously as it provided a clear direction of what we have to do," said Michel de Rooij, senior manager technology & process innovation, Ahold.

"It's evident that the F-Gas Regulation has increased – and will continue to increase – pressure on industry to use CO₂ and other natural refrigerants, such as hydrocarbons and ammonia," added Alessandro Greggio, group head of marketing – retail & refrigeration, CAREL Industries S.p.A.

While most companies pre-empted the F-Gas Regulation, some 20% indicated that they began to consider taking steps to comply with its requirements in 2015-2016. A small share of the industry does not anticipate taking action before 2017-2018 (3.2%), or 2019-2020 (4.2%), while some will even wait beyond 2020 before taking action (1.1%).

Asked to describe the effect on the market, Akira Ogushi, sales director at Hoshizaki, argued that regulations alone are not enough to change people's way of thinking. "There are still a very limited number of customers who have a special request for natural refrigerants. The majority, like small restaurants and pizzerias, are not very much taking care of that."

MORE PROHIBITIONS NEEDED

The HFC phase-down is the most significant game-changer for the HVAC&R industry. However, there is a risk that the phase-down will not trigger a move to future-proof HFC-free solutions, especially in sectors with no clear HFC bans.

Findings indicate that HFC bans are the most effective measure for industry to avoid intermediary and costly steps as it will reduce the availability and increase the cost of HFCs and provide a clear indication to companies as to which technology they need to invest in.

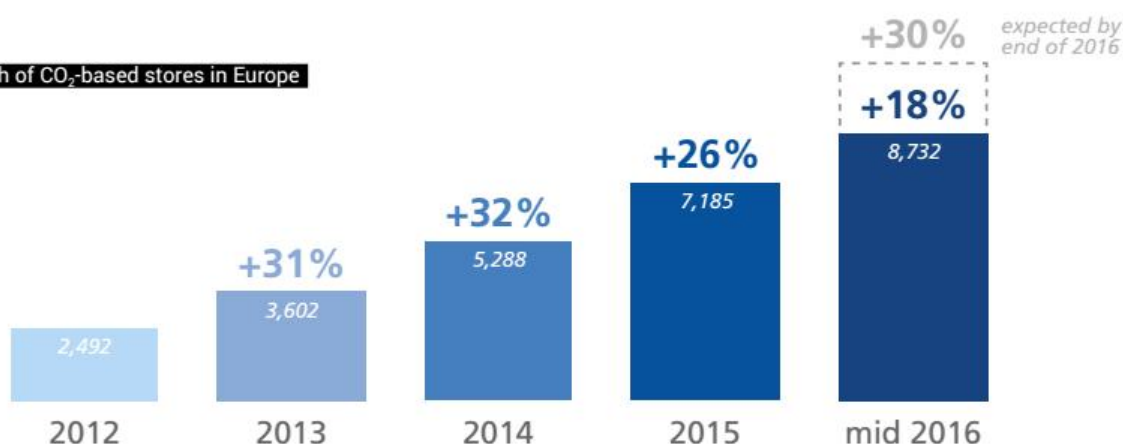
However, the Regulation does not seem to give sufficient clarity to the industry on where they need to focus their technology development. The effects of the phase-down might become more evident as further reductions are implemented in the coming years.

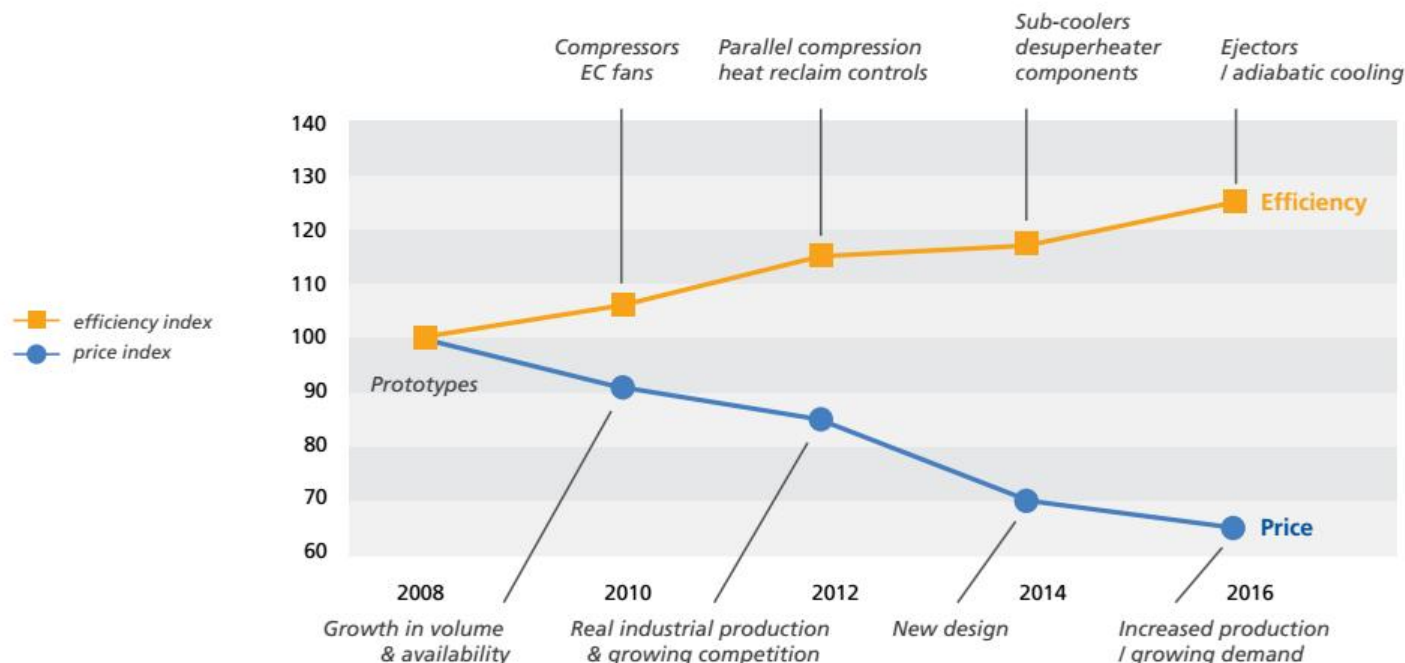
The inclusion of HFCs contained in pre-charged equipment under the phase-down is also expected to trigger an increase in the price of HFCs, which will have an effect on the adoption of HFC-free technologies.

Some company representatives argued that the phase-down will, in reality, not reduce the use of HFCs in terms of quantity but will instead trigger a shift towards a new generation of HFCs or HFC blends, especially in sectors such as heat pumps and air-conditioning, where the regulation has not prohibited the use of HFCs.

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Growth of CO₂-based stores in Europe





Evolution of CO₂-based units in efficiency / price (Source: Advansor, ATMOSphere Europe 2016)

→ Provided the GWP targets are ambitious enough (lower than 150), they have the effect of pushing the market away from HFCs. With a clear deadline and indication of what kind of technology will not be allowed in the market, companies can make timely investment decisions.

HFC prohibitions in specific applications are seen as the most effective measure to drive the adoption of natural refrigerants (instead of intermediary lower-GWP HFCs) and they were rated as the second most important measure overall for shifting the industry away from high-GWP HFCs.

Unlike the phase-down, the market prohibitions are sector-specific and affect only targeted applications (domestic refrigeration, commercial refrigeration, moveable air-conditioning, small self-contained air-conditioning).

TECHNOLOGY WARMING TO HIGH AMBIENTS

When the F-Gas Regulation was adopted, some industry figures warned that in certain sectors the requirement would be challenging for the warmer climates of Southern Europe. In reality, the F-Gas Regulation has in fact provided a strong boost to innovation in technologies for warmer ambient regions, with a number of companies introducing HFC-free solutions that have proven to work efficiently in temperatures of up to 44°C.

While it had been previously argued that CO₂ technology is not a viable solution for the Southern European regions, the expansion of stores using cutting-edge HFC-free technology in Europe clearly shows that the industry has been able to

overcome the challenge, with the number of stores equipped with energy-efficient technology using CO₂ as a refrigerant registering strong growth in countries like Spain, Italy and Romania.

GLOBAL IMPACT

A large number of the companies surveyed operate in the global HVAC&R sector with business interests all around the world. As such, the regulation has influenced how they do business and what types of products they offer outside of Europe.

Moreover, the regulation has had an impact on other legislative frameworks by inspiring regulators from different regions and countries designing their own rules to limit the use of HFCs.

For the state of California in the US, the F-Gas Regulation is "the best programme in the world to reduce f-gas emissions". With regulatory work ongoing, the California Air Resources Board has announced plans to introduce measures that would exceed the ambition of EU's current legislation.

At international level, the work that the EU has done domestically serves as a great example of what is possible on a global scale to reduce HFC emissions and thereby avoid 0.5°C of global warming by 2100.

Early legislative measures help industry to gain a competitive advantage in local and global markets, the report shows, a fact heightened by the recent global HFC phase-down deal struck in Kigali. **KS & JR**

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PIGGLY WIGGLY'S AMMONIA/CO₂ EXPERIMENT

US retailer Piggly Wiggly has recorded energy savings averaging 28.5% over a seven-month period in a Georgia store, thanks mainly to its NH₃/CO₂ refrigeration system.

– By Michael Garry

Piggly Wiggly operates over 750 self-service grocery stores in 18 states across the Midwestern and Southern regions of the United States.

When Keith Milligan received the first utility bill for his new 36,000-square-foot Piggly Wiggly store in Columbus, Georgia last year, he was flabbergasted at how low it was.

"I called the lady at the power company [Georgia Power] and said, 'I just want to make sure you got this right,'" said Milligan, CIO for JTM Corp., a US family-owned retailer that operates 19 Piggly Wiggly stores along the border separating central Alabama and Georgia. He chuckled at the memory. "I didn't want her to come back in two years and say, 'I billed you wrong and you owe us \$200,000.' But she checked it, and it was correct."

The linchpin of this Piggly Wiggly – and the biggest contributor to its energy-saving capacity – is an ammonia/carbon dioxide cascade system made by Heatcraft Worldwide Refrigeration at its plant in Columbus, about 2.4km from the store.

The store, which opened in September 2015, is just the fourth in the US to use an NH₃/CO₂ refrigeration system. But its superior energy efficiency, even in a warm climate like central Georgia, makes NH₃/CO₂ one of the more promising natural refrigerant technologies in the world.

The Piggly Wiggly store uses an ultra-low charge (24kg) of ammonia – less than any of the other NH₃/CO₂ stores – which is confined to the roof in the ammonia rack.

The ammonia condenses the CO₂, which circulates throughout the store; cooling low-temperature cases via direct expansion and medium-temperature through pumped liquid overfeed. For energy comparison purposes, an HFC (R407A) rack alternates every few weeks with the ammonia rack in condensing the CO₂.



Keith Milligan, JTM Corp. (Piggly Wiggly)

Milligan's data comes from a comparison between the Columbus store's power consumption and an R407A Piggly Wiggly store in La Grange, Georgia. For the period ranging from October 2015 to April 2015, the new Piggly Wiggly consumed 23% to 33% less energy than the conventional outlet, for an average energy saving of 28.5% (AUD \$44,200 in total).

The new store was equipped with a number of other energy-saving elements, including LED lights, skylights, occupancy and daylight controls, doors on display cases, and heat reclaim for hot water. But the NH₃/CO₂ system, accounting for 60% of the store's electricity consumption, was by far the most impactful on efficiency.

Between 2 February and 22 May 2016, the NH₃ rack consumed 22% less energy on average than the HFC rack, ranging between 18% and 25% depending on ambient temperature.

AMMONIA'S BIG POTENTIAL

Ammonia poses its own challenges, notably its toxicity in certain concentrations and its pungent odour. "I asked a lot of questions about that," said Milligan. "But because there is such a small amount, I didn't see much danger. I'm very comfortable with it."



The Piggly Wiggly distribution centre in Bessemer, Alabama, he noted, uses thousands of kilograms of ammonia.

Heatcraft conducted a plume study at the store that assessed the risk in the event of a “catastrophic leak” of the 24kg of ammonia in 10 minutes, and found overall that “there was no identified risk”.

Milligan said he considered installing a transcritical CO₂ system, offered by Heatcraft, Hillphoenix and other OEMs, instead of the NH₃/CO₂ system, but decided not to because of central Georgia’s warm climate. “The [transcritical] technology is improving

[for warm climates] but at the time it would have increased my power bill.”

By contrast, ammonia systems are unaffected by high ambient temperatures. “The ammonia system has worked very well,” Milligan said. “Ammonia has been around forever as a refrigerant, though not in such tiny quantities.” Masood Ali from Heatcraft added that in warmer climates, the NH₃/CO₂ system offers “the biggest bang for the buck”.

The environmental benefits of his Columbus store are aligned with Milligan’s values as well. “We wish all of our stores were like that,” he said. “I have

grandkids and I want to leave a good place for them. As a nation and a world we are making progress, but we still have a long way to go.”

Now he would like to see more supermarkets follow his lead. “Every store you change makes a big difference.” To that end, he invites other retailers, including competitors, to tour his Columbus store.

Milligan intends to use NH₃/CO₂ systems in future stores. As for existing outlets, he is hoping Heatcraft will come up with a retrofit solution that encompasses natural refrigerants. **OMG**

CHINA BECOMING MORE INVESTED IN NATURAL REFRIGERANTS



A recent workshop held in Beijing centred on the natural refrigerant technologies that are beginning to be introduced to the Chinese commercial and industrial refrigeration markets.

- By Lauren Clark

The International Workshop on Green Cold Chain Technologies, held on 9-10 September and attended by over 120 delegates, discussed the need to decrease HCFC use by using alternatives such as natural refrigerants.

During his opening remarks Xiao Xuezhong, deputy director-general of the Foreign Economic Cooperation Office (FECO) in the Ministry of Environmental Protection, detailed how China had met its 10% HCFC phase-out reduction target in 2015, ahead of schedule. He noted that to keep on progressing, it would be necessary to combine regulatory measures with incentives to reduce the use of HCFCs.

Patrick Haverman of the United Nations Development Programme (UNDP) highlighted the introduction of ammonia and CO₂ technology for cold storage and freezing applications as one of the milestones that had helped the country reduce its reliance on HCFCs in the sector of industrial and commercial refrigeration.

POTENTIAL FOR CO₂/AMMONIA GROWING IN COLD STORES

While foreign multinational companies have mostly introduced natural refrigerant technologies to China, Chinese firm the Yantai Moon Group – represented at the workshop by Chief Engineer Jiang Shaoming – is pushing for natural refrigerant systems to be used in industrial refrigeration. In May 2011,

the UNDP, the UN Multilateral Fund and the Ministry of Environmental Protection listed the Yantai Moon Group's ammonia/CO₂ cascade refrigeration technology as a suitable substitute for R22-based equipment.

The project was successfully accepted in June 2013. Since then, the Yantai Moon Group has signed 84 NH₃/CO₂ projects in China, with 40 of these completed and 20 still under construction. The group has been working to make CO₂ the first choice in refrigerant options to reduce the ammonia charge in industrial refrigeration applications, while increasing energy efficiency.

COMMERCIAL REFRIGERATION ALSO EYEING USE OF NATURAL REFRIGERANTS

The commercial refrigeration sector has also seen important developments in China. Anhui Hongfu, a local food retail chain, detailed their plan to introduce a first R134a/CO₂ system to replace the current R22 system in a 4,000 m² store. While international retailers such as Tesco and Metro have introduced more than 30 hybrid CO₂ stores in China already, Anhui Hongfu is one of two local retailers to have gained first-hand experience with the technology.

The new system should be completed in December. It will reduce energy consumption by 23% and total equivalent warming impact (TEWI) by 22%. Hongfu hopes the project will encourage others to implement similar technology.

Carrefour is looking to implement its first transcritical CO₂ system in China next year. According to Harry Chen, Carrefour China's national engineering director, the retail giant is looking for a possible location to install the system. However, he notes that many challenges must still be overcome before implementation is possible. These include pressure design requirements and standards. Carrefour wants to use a simple system, manufactured in Europe and shipped to China for installation. **LC**



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PROJECTS SHOWCASE NATREFS IN EMERGING ECONOMIES AT GUSTAV LORENTZEN

Global efforts to secure a historic agreement to phase down HFC consumption under the Montreal Protocol are creating opportunities for natural refrigerants to thrive. Meanwhile a plethora of projects are demonstrating technological solutions to deliver this potential in emerging economies worldwide.

– By Andrew Williams



Ahead of the event, 155 experts reviewed 203 abstracts before selecting 147 papers penned by 317 co-authors to be presented in Edinburgh.

Overcoming technical barriers to wider uptake of natural refrigerants is particularly crucial in developing countries, whose infrastructure may not be ready to support greater rollout of unfamiliar HVAC&R systems.

To address this, the Multilateral Fund for the Implementation of the Montreal Protocol was established in 1991.

The fund's main objective is to assist developing country parties to the Montreal Protocol whose annual per capita consumption and production of ozone-depleting substances (ODS) is less than 0.3kg in complying with the Protocol's control measures.

At present, 147 of the 196 Parties to the Montreal Protocol qualify for assistance from the Fund. They are referred to as Article 5 countries.

Despite this funding, many barriers to the adoption of natural refrigerants in Article 5 countries remain. These include a lack of trained installers or technicians, and concerns related to the complexity or safety of natural refrigerant-based systems resulting from lack of awareness or familiarity with the technology.

PSYCHOLOGICAL AND PRACTICAL BARRIERS TO NATREF UPTAKE

"The barriers to greater uptake of natural refrigerants in developing countries are psychological as well as practical," Daniel Colbourne, a member of the UNEP Refrigeration Technical Options Committee (RTOC) for the Montreal Protocol, told a workshop held during the Gustav Lorentzen conference.

To highlight the problem, Colbourne warned that customers interested in switching their rooftop-condensing unit from R22 to CO₂ or R290 (propane) often find their efforts thwarted by a lack of technical capacity among local installers or technicians, or the absence of standards allowing hydrocarbons in this application.

Another problem is that some companies – particularly in Southeast Asia – are marketing hydrocarbons as drop-ins. "Technicians are dropping refrigerants into existing systems without understanding what they're doing. This is to the detriment of everyone," said Colbourne. This practice is particularly damaging to companies that have invested time and resources in doing things properly, he added.

Colbourne cited legislative and standardisation bodies, national ozone units, trade associations and technical institutes among the entities with the biggest role to play in helping to overcome barriers to wider uptake of natural refrigerants.

Organisations like GIZ Proklima are already playing such a role. Philipp Münzinger, its project manager for environment and climate change, told the Edinburgh audience how the 'Green Chillers' project is supporting Indonesia in creating framework conditions to support energy efficiency and environmental improvements in the industrial and commercial refrigeration and air-conditioning sectors.

Among the barriers to wider uptake of natural refrigerants in Indonesia, Münzinger cited low electricity prices (resulting in inefficient system design), a lack of qualified installation and service technicians, misuse of locally produced R290 (which can cause accidents or damage systems if dropped into existing HFC-based equipment), and discrepancies between perceived risk and actual risk among potential users of hydrocarbon systems.

In Ghana, meanwhile, GIZ Proklima is facilitating the installation of 30 propane-based, 30 kW split-system air-conditioners at the Ghanaian Environmental Protection Agency. It is also training technicians and local trainers in the safe use of hydrocarbon systems.

In Münzinger's view, a lack of locally available technology, inappropriate servicing infrastructure, and limited local awareness of energy efficiency – not to mention poor understanding of the properties of different refrigerants – are holding up market penetration of hydrocarbon air-conditioners in Ghana.

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→ OPPORTUNITIES FOR R290 IN COLOMBIA

Over in South America, Colombia is working hard to encourage wider use of natural refrigerants in its flower industry – which requires refrigeration systems in cold stores, used for post-harvest processing and exports.

Angelica Antolinez from the Colombian national ozone unit told the Edinburgh audience that the country's flower industry requires 31.1 million kW of cooling capacity for cold storage. Currently, 99% of these facilities use R22 and the remaining 1% uses R134a. "There is a huge opportunity here to convert to R290," Antolinez said.

The national ozone unit is currently running a demonstration project to convert a flower storage facility from R22 to R290. Other natural refrigerant projects in Colombia include district cooling in La Alpujrra, Medellin, and the promotion of district cooling in five major Colombian cities.

Obstacles to adopting R290 in the South American country include a lack of national experts (both to design and implement projects, and to conduct risk assessments), a lack of trained technicians, and a lack of locally available components.

Colombia also suffers from a lack of technical standards governing hydrocarbon safety, a lack of public funding for projects, the failure of end users to trust service technicians, and a lack of adequate legal and procedural structures governing the installation and use of natural refrigerant-based systems, Antolinez lamented.

REGULATORY CHANGE TO BOOST NATREFS

Earlier this summer, representatives of close to 200 countries met in Vienna to discuss amending the Montreal Protocol to address growing emissions of HFCs in developed and developing countries. Confidence was high that the nations will adopt a deal on phasing down HFCs globally at the next Meeting of the Parties to the Montreal Protocol in Kigali, Rwanda in October.

"It looks like 2016 will be the year for locking down an international agreement to phase down HFCs," said Alexander von Bismarck of the Environmental Investigation Agency, who expressed hope that a global deal would be in place by the end of 2016.

Adopting an agreement would just be the first step, however. "So much depends on the implementation of the phase-down and the speed at which replacements for HFCs penetrate the market," Von

Bismarck warned.

With the prospects for an HFC phase-down deal in Kigali looking good, it is imperative for natural refrigerants to step in as market-ready alternatives. "The replacement of HFCs is a huge business opportunity," said Carole Bond of Carbon Data Resources, a UK-based environmental consultancy.

"We need to understand the inherent connections between our industry and the world outside," said Bond. Only by interacting with one another can stakeholders deliver the dramatic change required to transition away from HFCs, she argued.

Bond urged industry, end users and academics to collaborate on innovative solutions to deliver UNFCCC climate targets agreed at COP21 in Paris in December 2015. The Paris Agreement set out a global action plan for putting the world on track to avoid dangerous climate change by limiting global warming to well below 2°C.

GETTING OFF 'THE CHEMICAL TREADMILL'

Natural refrigerants will play a key role in delivering the Paris goals but raising awareness will be crucial to ensuring that they fulfill their potential, according to Bond. "We need to communicate the



benefits of natural refrigerants much more effectively to the world at large – including governments, industry, end users and NGOs,” she said.

Bond singled out natural refrigerants’ lack of patentability, however, as a barrier to their wider uptake. “They are perceived to have less value,” she said. To address this, she called for greater recognition of natural working fluids’ potential to deliver COP21 objectives.

Von Bismarck agrees. “We need to increase the piece of the pie that goes to natrefs, which aren’t patent-protected,” he said. “We have a chance now to leapfrog HFCs and get off this chemical treadmill,” the EIA representative argued.

Efforts by large emitters will play a crucial role in the success of any phase-down deal. It is a good sign, therefore, that experts attending Gustav Lorentzen were optimistic that China’s HCFC phase-out plan will trigger wider uptake of natural refrigerants across the Asian powerhouse.

Under the Montreal Protocol, China has agreed to completely eliminate the production and consumption of HCFCs by 2030. “China is now on the road to phasing out HCFCs,” said Professor Guangming Chen of the Ningbo Institute of Technology at Zhejiang University.

As the world’s biggest producer and consumer of refrigerants, China’s efforts to reduce HCFC consumption will have a major global impact. “38% of world refrigerant demand comes from China. 65% of the world’s total refrigerant production capacity is in China too,” said Chen.

“We are increasing our use of natural refrigerants. China is under pressure to phase out HCFC refrigerants,” said Chen. “By 2020, the average GWP of refrigerants used in the industrial and commercial sectors will be 300,” he argued. The

professor admitted, however, that China’s status as the world’s biggest producer and consumer of refrigerants poses “great challenges” in charting a more sustainable course.

OVERCOMING STANDARDS BARRIER

Some conference participants expressed hope that China’s HCFC phase-out may trigger wider use of natural refrigerants in room air-conditioning, heat pumps, and commercial and industrial refrigeration applications. For natural refrigerants to thrive, however, they called on China to revise national standards regulating the extent to which they can be used in specific refrigeration and air-conditioning applications.

“The main barrier to uptake of R290 for room air-conditioners in China is national standards. Companies stand ready to promote R290 for room air-conditioning once new standards have been adopted,” said Professor Chen.

Indeed, as technological innovation continues apace, the pressure is on regulatory authorities worldwide to update standards that allow these new products to enter the market.

“All the major players in China are ready and waiting. I’m counting on 2017 to be the breakthrough year in terms of sales,” said Ole Reinholdt Nielsen of the United Nations International Development Organisation (UNIDO). For this to happen, China must put an end to restrictive standards governing the use of hydrocarbons, he argued.

UNIDO runs similar projects that help to covert HFC-based air-conditioner production lines to propane in Algeria, Bahrain and Pakistan, among other countries.

The mood among delegates streaming out of the conference centre into the summer night, however, was buoyant. The future for natural refrigerants would appear to be equally bright.. **AW**



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