

SPRING 2017

ACCELERATE

ADVANCING HVAC&R NATURALLY

EUROPE

Natrefs in food retail

p. 26

German regulation to
support natrefs

p. 52

Technology focus:
Condensing units

p. 62

ALBERT HEIJN

p.18

All smiles in the
CO₂ playground



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All Dimensions of Success

Shopping for the most efficient HVAC&R system

— Editor's note by Andrew Williams



As supermarket bosses gear up for next month's EuroShop, the world's biggest retail trade show, the spring edition of *Accelerate Europe* highlights how some of Europe's biggest retailers are increasingly investing in environmentally friendly and energy-efficient natural refrigerants for stores of all sizes.

Albert Heijn – part of the Ahold Delhaize group – is leading by example. The Dutch retail giant is banking on natural refrigerants to help deliver its goal of becoming CO₂-neutral by 2025. *Accelerate Europe* saw at first-hand how visionary colleagues Alfard Clerc and Vincent van Dijk are testing a host of innovative new ideas at 'Europe's most sustainable supermarket' in Purmerend (p. 18).

Many of Europe's 110,000-115,000 supermarkets sadly still appear to be contributing to global warming by using hydrofluorocarbon (HFC) refrigerants. Yet Albert Heijn is not alone in taking early action to rectify this. Other retail giants – including Carrefour S.A., METRO AG, Aldi Süd and the Colruyt Group – are also turning to natural refrigerants like CO₂ and hydrocarbons to comply with the continent's HFC phase-down and to benefit from the efficiency savings on offer. *Accelerate Europe* asked about their plans for 2017 (p. 26).

Training and legislation are crucial to supporting natural refrigerant uptake. Two important new reports from the European Commission look at how standards and legislation governing the HVAC&R sector must be adapted – and training on operating natural refrigerant systems improved – to encourage wider rollout of HFC alternatives in Europe (p. 48).

Germany is already taking action. An amended refrigeration and air conditioning directive – which entered into force at the turn of the year – will subsidise natural refrigerant-based systems in Europe's economic powerhouse (p. 52).

Thanks to the condensing unit, CO₂ refrigeration is reaching areas of application that some did not believe possible. Japanese and European manufacturers are already overcoming the challenge of bringing CO₂ to smaller stores (p. 62).

Vendors are showing that hydrocarbons will also play an important part in tomorrow's HVAC&R landscape. Italian family company Euroklima is eyeing the commercial refrigeration market as a potential growth area for its propane chillers (p. 68). Features on the HORECA sector in the UK (p. 40) and the launch of our *Accelerate Europe* Awards recognising the companies and individuals doing the most to support natural refrigerant technologies in Europe (p. 17) add to this spring edition.

EuroShop will feature a vast array of natural refrigerant solutions for supermarket operators. To help you navigate the show, taking place on 5-9 March in the German city of Düsseldorf, don't forget to pick up a copy of GUIDE EuroShop – your essential guide to new natural refrigerant technologies on offer there. See you in Düsseldorf! ■ AW



ACCELERATE

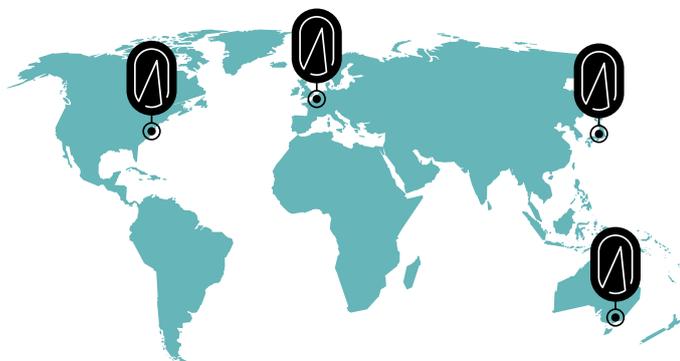
ADVANCING HVAC&R NATURALLY

EUROPE

ABOUT ACCELERATE EUROPE

Brought to you by shecco, the worldwide experts in natural refrigerant news, *Accelerate Europe* 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.

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Time for retailers to take f-gases off the shelves!

As the world's second-largest food retail market, Europe boasts between 110,000-115,000 supermarkets and hypermarkets. This figure excludes convenience stores and corner shops; formats that are expected to grow rapidly in the next few years. Hypermarkets and large supermarkets still represent 60% of Europe's food retail landscape. Yet urbanisation means space is at a premium in our cities. Other trends, such as smaller households and the growing popularity of convenience food for busy lifestyles, will also favour smaller, more flexible store formats.

Most of Europe's 110,000+ stores still use fluorinated gases in their HVAC&R systems. This matters. Fully 2% of total greenhouse gas emissions in Europe – and the wider world – are attributable to food retail. The refrigeration system alone can account for up to half of a typical store's energy consumption.

Natural refrigerants can help retailers to reduce both their energy bills and their carbon footprint. As of early 2016, 8,732 stores were believed to be equipped with CO₂ transcritical

systems in Europe. Given the huge potential of technologies using ammonia, CO₂ and hydrocarbons, this number is far too low. Many of Europe's biggest retailers have put in place policies to adopt natural refrigerants as alternatives to f-gases. Their leadership is paving the way for others to follow.

According to current forecasts, the number of food retailers in Europe will halve by 2025. If this consolidation of the market coincides with wider uptake of natural refrigerants, the food retail sector will clearly make a huge contribution to achieving Europe's f-gas reduction targets. Yet the journey is only just beginning. Getting there will require firm commitment over many years and several investment cycles. Retailers who are yet to anticipate this revolution must step up to the plate now!

One initiative that is already helping the food retail industry to reduce its environmental impact while maximising economic benefits is SuperSmart. This EU-funded three-year project brings together nine partners from eight European countries, most of them experts in refrigeration, energy management, lifecycle assessment or HVAC&R contracting. The project has developed seven reports covering how to map and reduce non-technological barriers, how to build new stores and refurbish existing ones, and how to select the right tools and methods to operate supermarkets as efficiently as possible. The team also provides free training sessions for the people building the supermarkets of the future.

Natural refrigerants are at the heart of SuperSmart's strategy for boosting the energy performance of Europe's food retail industry by making the right technology choices. Being smarter is not just about choosing the right working fluids for heating and cooling in supermarkets. It is also about integrating HVAC&R systems into the rest of the building and its surroundings.

EuroShop, the world's largest tradeshow for the food retail industry, is about to take place in Germany, where the government has just upgraded its incentive scheme for commercial refrigeration systems. 'Non-halogenated' natural refrigerants now have an even more important role to play, with Germany rewarding financially those who go beyond the required legal minimum regarding smarter technology choices. It will therefore be no surprise to see more efficient natural refrigerant technologies on show at EuroShop. See you there! [■ NM](#)

Nina Masson is chief strategy adviser – special projects at shecco. shecco is the publisher of Accelerate Europe.



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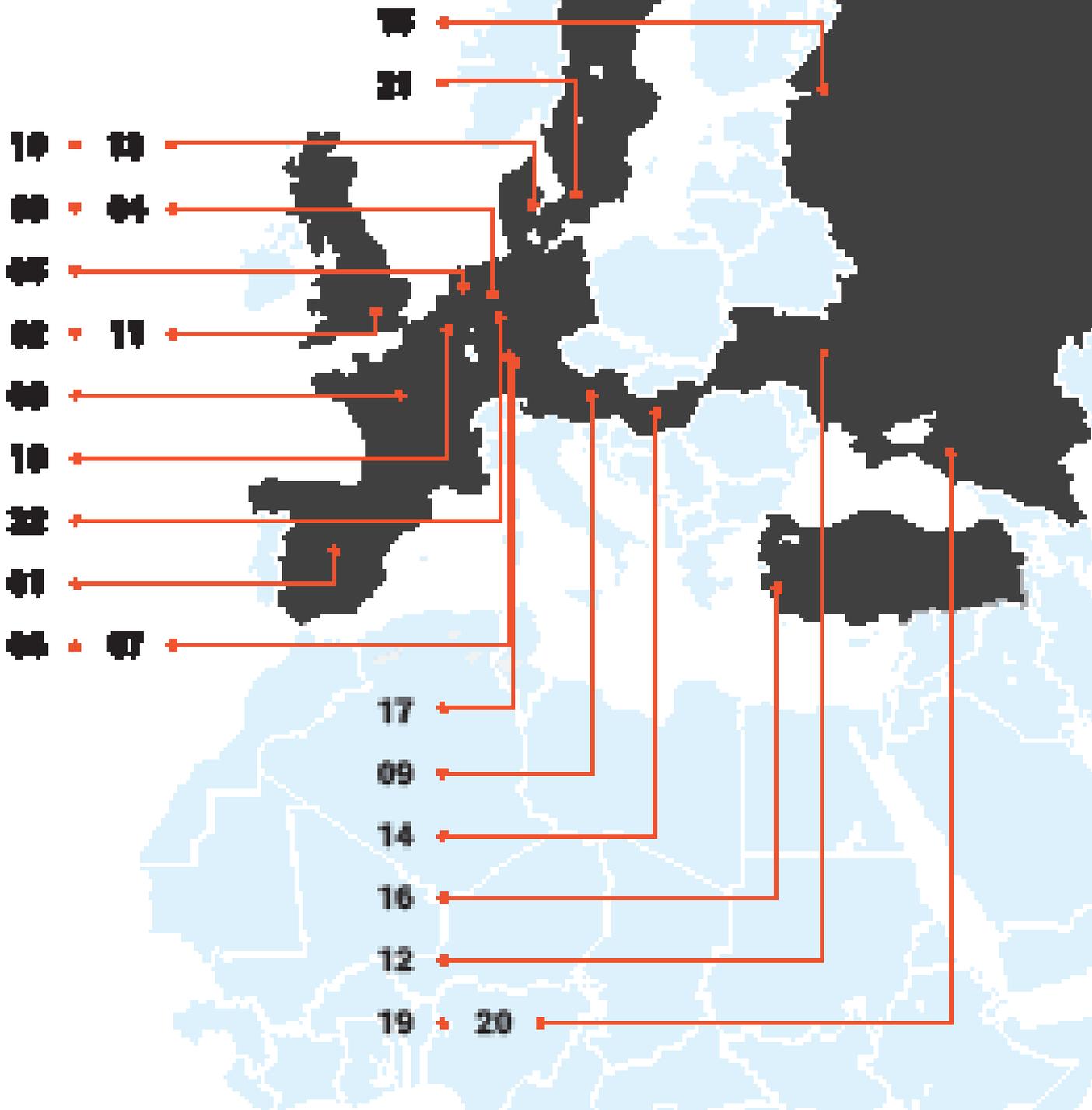

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EVENTS GUIDE

February 2017

March 2017

April 2017



- **01** 28 February-3 March, Madrid SPAIN
Climatización & Refrigeración
www: www.ifema.es/climatizacion_06
twitter: @Feria_CR
- **02** 2 March, London UK
Gaining Business Advantage from 20-20-20 targets
www: www.ior.org.uk/briefing20
twitter: @thecoolinghub
- **03** 5-9 March, Düsseldorf GERMANY
EuroShop
www: www.euroshop-tradefair.com
twitter: #EuroShop @EuroShop
- **04** 6 March, Düsseldorf GERMANY
SuperSmart Training on Energy-Efficient Food Retail Stores @EuroShop
www: <http://bit.ly/2lKQqBo>
- **05** 8-10 March, Amsterdam NETHERLANDS
20th European Cold Chain Conference
www: www.gcca.org/20th-european-cold-chain-conference
- **06** 14-18 March, Frankfurt GERMANY
ISH 2017
www: www.ish.messefrankfurt.com
twitter: #ish17 @ish_frankfurt
- **07** 15 March, Frankfurt GERMANY
SuperSmart workshop on EU Ecolabel criteria for food retail stores @ISH
www: <http://bit.ly/2krTGiz>
- **08** 15-17 March, Paris FRANCE
Vending Paris
www: www.vendingparis.com
twitter: @VendingParis
- **09** 16-17 March, Kremsmünster AUSTRIA
TÜV Austria Kälte Klima Fachtage
www: <http://bit.ly/2ks1D7N>
twitter: @TUEV_Austria
- **10** 16-17 March, Aarhus DENMARK
Advansor CO₂ Refrigeration Competency Training
www: www.advansor.dk/en/news/co2-refrigerating-competency-training-program
- **11** 15-16 March, London UK
Data Centre World
www: www.datacentreworld.com
twitter: @DataCentreWorld
- **12** 21-23 February, Kiev UKRAINE
Industrial Cold
www: promholod.euroindex.ua/index_e.php
- **13** 19-20 April, Aarhus DENMARK
Ammonia Systems of the Future
www: <http://bit.ly/2lF2YNG>
- **14** 5-9 April, Budapest HUNGARY
Hungarotherm
www: hungarotherm.hu/en
- **15** 19-21 April, St. Petersburg RUSSIA
Aquatherm St. Petersburg
www: www.aquatherm-spb.com/en/Home/
- **16** 19-22 April, Izmir TURKEY
Teskon + SODEX Izmir
www: www.teskonsodex.com
twitter: #TESKONSODEX @ISK_Sodex
- **17** 25-26 April, Darmstadt GERMANY
Future Thinking Darmstadt
www: future-thinking.de
twitter: #futurethinking17
- **18** 25-27 April, Brussels BELGIUM
Seafood Expo Global
www: www.seafoodexpo.com/global
twitter: @euroseafoodw
- **19** 25-27 April, Krasnodar RUSSIA
Foodtech & Interfood Krasnodar
www: foodtech-krasnodar.ru
- **20** 25-27 April, Krasnodar RUSSIA
Interfood Krasnodar
www: www.inter-food.su
- **21** 26-27 April, Malmö SWEDEN
Bygg & VVS-mässan Syd
www: <http://www.easyfairs.com/?id=97529>
- **22** 27-29 April, Cologne GERMANY
EuVend & coffeena
www: www.euvend-coffeena.com/EuVend_coffeena/index-2.php

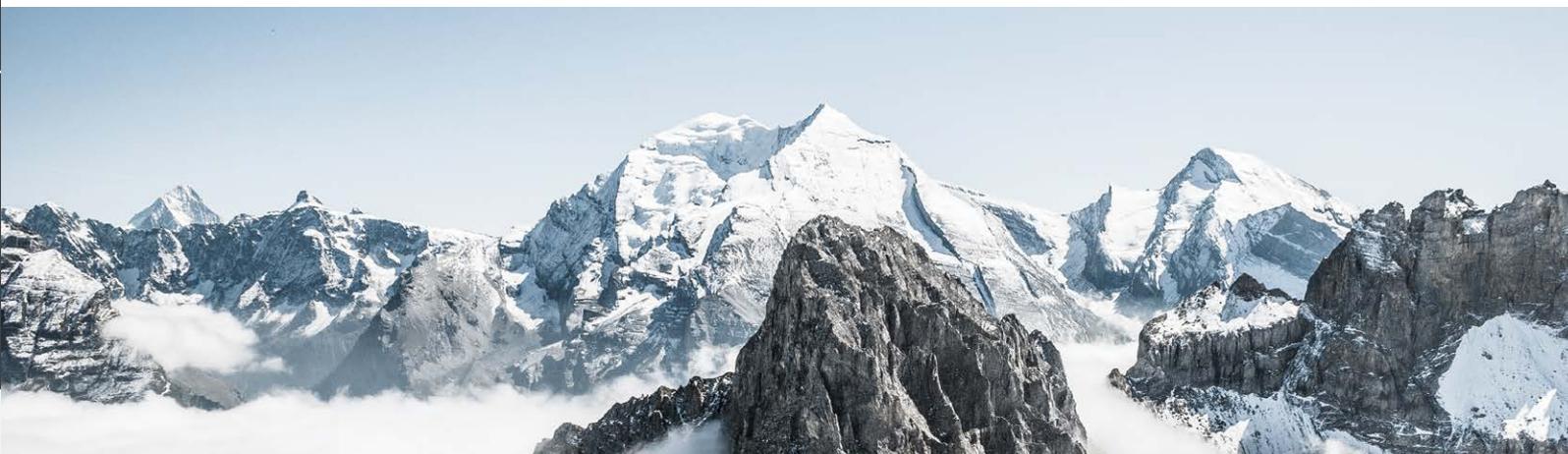
EVENTS GUIDE

May 2017

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- 07
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- 04
- 01
- 05
- 09 10
- 02
- 08
- **01** 10-12 May, Brussels BELGIUM
DecarbHeat
[www: decarb2017.eu](http://www.decarb2017.eu)
[@DecarbHeat @helloheatpumps](https://twitter.com/DecarbHeat)
 - **02** 11-13 May, Ohrid MACEDONIA
Ammonia and CO₂ Refrigeration Technologies
[www: www.mf.edu.mk/web_ohrid2017/about_conference.html](http://www.mf.edu.mk/web_ohrid2017/about_conference.html)
 - **03** 14-17 May, Glasgow UK
Euroheat and Power Congress
[www: www.ehpcongress.org/](http://www.ehpcongress.org/)
[#17EHPcong](https://twitter.com/17EHPcong)
 - **04** 15-18 May, Rotterdam NETHERLANDS
12th IEA Heat Pump Conference
[www: hpc2017.org](http://hpc2017.org)
[@HeatPump2017](https://twitter.com/HeatPump2017)
 - **05** 30 May-2 June, Kiev UKRAINE
Aquatherm Kiev
[www: aqua-therm.kiev.ua/en-GB](http://aqua-therm.kiev.ua/en-GB)
 - **06** 16-19 May, Krasnojarsk RUSSIA
ClimatAquaTEx
[www: www.krasfair.ru/en/events/climat_en/](http://www.krasfair.ru/en/events/climat_en/)
 - **07** 23-25 May, Moscow RUSSIA
Refrigeration Industry Moscow
[www: www.holodexpo.ru/fr/en/](http://www.holodexpo.ru/fr/en/)
 - **08** 10-13 May, Ankara TURKEY
SODEX
[www: www.sodexankara.com/en](http://www.sodexankara.com/en)
[#SODEXANKARA2017 @ISK_Sodex](https://twitter.com/SODEXANKARA2017)
 - **09** 10-11 May, Matera ITALY
Beyond nZEB Retrofit of Existing Buildings
[www: tinyurl.com/NZEB2017](http://tinyurl.com/NZEB2017)
[@AiCARR](https://twitter.com/AiCARR)
 - **10** 12-13 May, Matera ITALY
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EUROPE IN BRIEF

POLICY

UK FUNDS LIQUID NITROGEN REFRIGERATED TRANSPORT

The funding, announced at the Sustainable Road Transport Conference on 11 January 2017 in London, is being given to 20 firms for the deployment of low and zero-emission vehicles.

UK-based Air Liquide Group received the largest amount of funding – £2.57 million (€3 million) – to trial biogas in 86 lorries ranging from 26-44 tonnes. In addition, five refrigeration units will use a prototype liquid nitrogen system.

Air Liquide's blueeze solution for cold storage in truck transportation is based on nitrogen cryogenics.

The air that circulates inside the refrigerated container is cooled by circulating liquid nitrogen cooled to -196°C in one or more hermetically-sealed exchangers before the nitrogen is released as a gas into the atmosphere.

■ [Charlotte McLaughlin](#)

RESEARCH

HYDROCARBONS 'COULD REPLACE' MOST SYNTHETIC REFRIGERANTS

A new paper from European natural refrigerant advocates Eurammon argues that hydrocarbons have huge potential to replace HFCs due to their economic feasibility and environmental friendliness.

"They have application-specific advantages when selected correctly," Eurammon writes.

Hydrocarbons are feasible in many fields as an alternative to synthetic refrigerants because they feature similar pressure levels and similar specific refrigeration capacities.

They also have excellent thermodynamic properties, which reduce the amount of energy input needed to generate a certain refrigeration capacity. This, in turn, also reduces their indirect global warming effect.

"Hydrocarbon-based systems are one step ahead in terms of operating costs," says Eurammon. Propane, for example, is considered to be one of the most efficient refrigerants.

Eurammon concludes, "due to their beneficial properties, hydrocarbons have the potential to develop new areas of application. For this reason, hydrocarbon-based refrigeration is the way to go. They are not only ecologically but also economically sustainable".

■ [Charlotte McLaughlin](#)

TECHNOLOGY

NEW REFRIGERATION SYSTEM TO USE AIR

Swiss manufacturer MIRAI has developed a refrigeration system using air (R729) as the refrigerant.

Air cycle refrigeration technology works by compressing or expanding air as a gas, creating a hot or cold effect.

The hot or cold air produced from this technology system can then be used for ventilation, heating and air conditioning purposes. MIRAI has produced two products: MIRAI COLD – a refrigerating machine suitable for long-term storage of biomaterials, pharmaceuticals and food at ultra-low temperatures, and MIRAI CLIMATE – an air conditioner for ventilation, air conditioning and heating of private residences and public facilities with floor space upwards of 300 m².

MIRAI is the first company to manufacture both commercially effective refrigeration and microclimate units based on air cycle technology. This technology also makes it possible to cut energy consumption by 30% compared to standard systems.

■ [Charlotte McLaughlin](#)



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EUROPE IN BRIEF

TECHNOLOGY

MITA LAUNCHES 'ALCHEMIST' ADIABATIC COOLER

Italian manufacturer Mita's adiabatic extra cooler is designed to improve the efficiency of the CO₂ refrigeration cycle, mainly in the commercial sector, by combining two physical principles: the sub-cooling of the refrigerant and the adiabatic cooling of the air.

"Its position in the system is at the gas cooler outlet, with minimal impact on the whole plant," says Tommaso Fontana, sales manager at Mita.

The Alchemist works by employing a fan system to draw ambient air through the adiabatic area. In the adiabatic section, the air temperature decreases thanks to the adiabatic cooling effect.

The field test results are promising. Across northern Europe, adding the Alchemist to a refrigeration system has delivered seasonal COP increases of 9.5% in Paris, 9.1% in London and 10.1% in Nuremberg. In southern Europe, it has recorded COP improvements of 13.5% (Madrid and Athens), 10.5% (Milan) and 9.9% (Rome).

■ [Andrew Williams](#)

MARKET

LOW-CHARGE AMMONIA TO COME OF AGE IN 2017

Manufacturers are expecting low-charge ammonia, self-contained systems and ammonia/CO₂ cascade systems for distribution centres to solidify their position in the refrigeration market in 2017.

In the United States, for example, a growing number of industrial refrigeration end users are installing low-charge ammonia packaged units, in a major break from traditional refrigeration technology.

John Scherer, chief technology officer for the NXCOLD low-charge ammonia system, thinks there are lots of opportunities for "low-charge ammonia and ammonia/CO₂ cascade systems for larger cold storage and food distribution operations" and "supermarket applications".

Companies are beginning to market systems that require far less ammonia than the conventional systems they have been using for decades.

UK-based Star Refrigeration's Rob Lamb sees "ammonia moving down into medium-scale applications (100-300 kW)". Star currently offers low-charge options under its Azane range, which it plans to develop further.

■ [Charlotte McLaughlin](#)

END USER

UK SAUSAGE MAKER SWITCHES TO AMMONIA

James T. Blakeman & Co., the meat wholesaler behind popular British brand Supreme Sausages, has switched from R404A to ammonia.

Star Refrigeration upgraded an existing refrigeration system at Blakeman's production site in Newcastle-under-Lyme to make it compatible with ammonia.

Blakeman's objective was to reduce its carbon footprint by replacing R404A – a widely used refrigerant accounting for 46% of worldwide f-gas consumption – with ammonia, which has zero global-warming and ozone-depleting potential.

Star installed a new inverter-driven Glacier GP2 and spiral freezer system, which uses less than 25% of the ammonia charge of traditional solutions.

"The spiral system has been designed to maximise uptime and requires minimal ongoing maintenance. In addition, the temperature control and unique airflow is specially designed for our delicate products, such as skin on sausages, ensuring product quality is maintained for our customers," says Kevin Moller, factory manager at Blakeman's.

One of the key benefits of the upgrade was energy efficiency. The Glacier GP2's use of ammonia boosts efficiency by 25% compared to HFCs.

■ [Charlotte McLaughlin](#)

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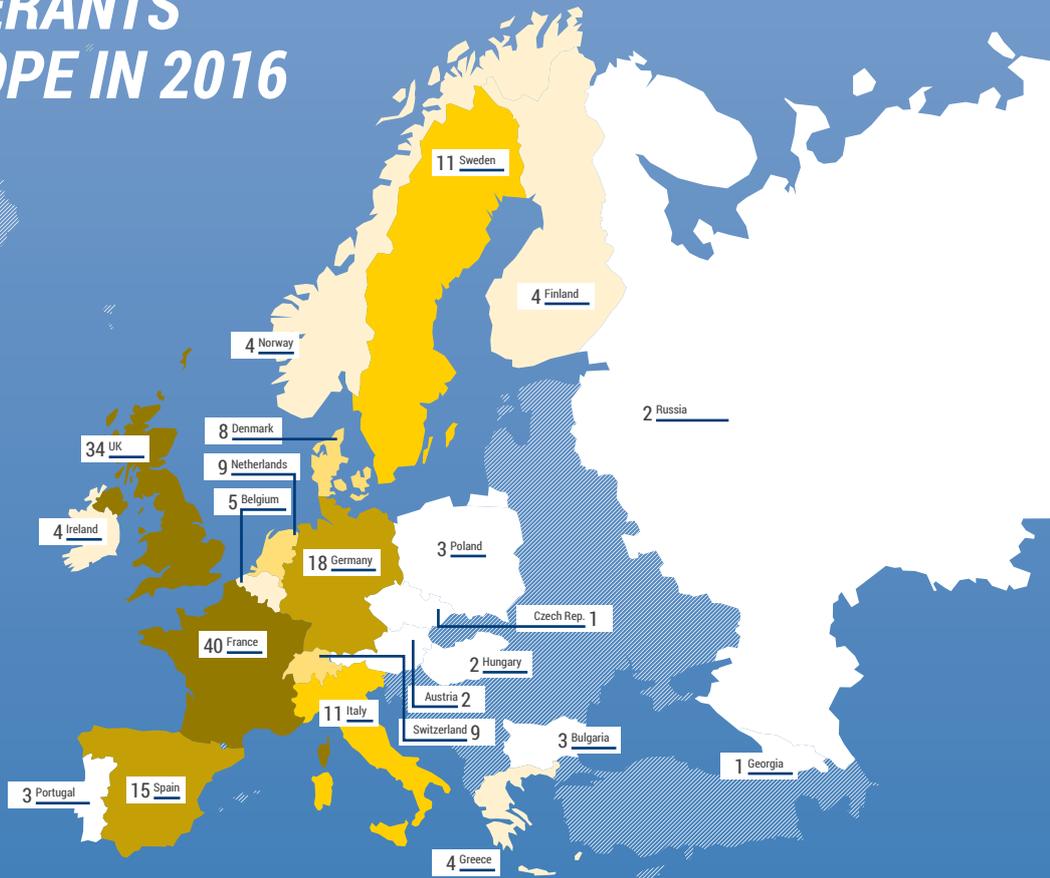


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NATURAL REFRIGERANTS TRAINING IN EUROPE IN 2016

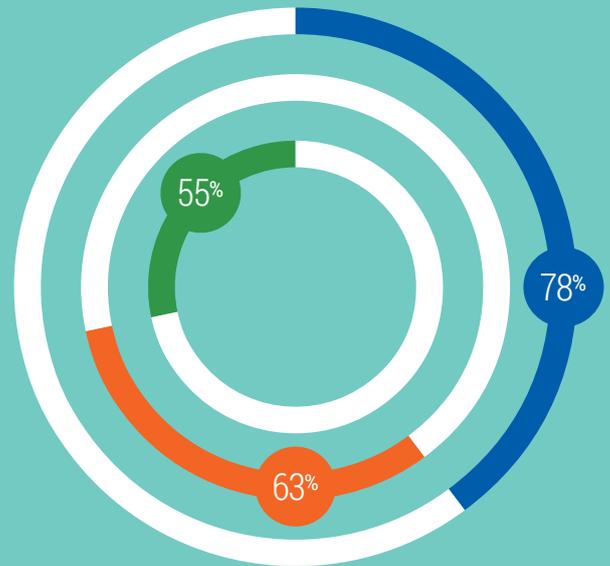
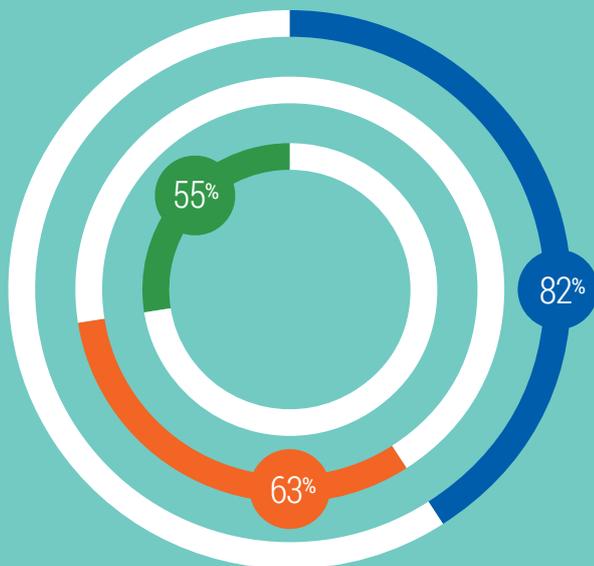
Organisations in Europe that provide training by country



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

Natural refrigerant training providers:

Natural refrigerant training receivers:





Accelerate Europe launches awards programme

The awards will recognise end users of commercial and industrial refrigeration that are doing the most with natural refrigerant solutions in Europe. A Person of the Year will also be named.

— By Andrew Williams

Since its launch in December 2015, *Accelerate Europe* has been highlighting the most progressive individuals and organisations working with natural refrigerants in HVAC&R applications in Europe. To take this a step further, the magazine announced at ATMOsphere Europe 2016 a new awards programme to recognise three end-user companies and one individual for doing the most to drive the adoption of natural refrigerants.

The awards, which will be presented at the next ATMOsphere Europe conference in Berlin in September 2017, comprise two categories: Best in Sector and Person of the Year.

A Best-in-Sector award will go to one end-user company in each of three sectors – food retail, light commercial and industrial – that has gone far in advancing the adoption of natural refrigerant technologies in HVAC&R applications in the previous 15 months.

Companies will be recognised for natural refrigerant technologies or systems that are part of new builds or remodels completed between April 2016 and July 2017. Nominations must include system performance studies completed during this time period; the studies can refer to systems installed prior to April 2016, provided that system performance data covers part of the period April 2016 to July 2017.

Criteria for assessing systems and companies for the Best in Sector Awards include:

- ▶ A reduction in energy consumption.
- ▶ A reduction in greenhouse gas emissions.
- ▶ Ease of reproduction.
- ▶ A business case including installation, operation, maintenance and training, and return on investment.
- ▶ Commitment to future natural-refrigerant installations.
- ▶ Industry leadership.
- ▶ Innovation and perseverance.

Complementing the Best in Sector Awards, the Person of the Year Award will honour the single individual who has done the most to advance the adoption of natural refrigerant technologies in HVAC&R applications in Europe between April 2016 and July 2017. The award is open to individuals from end users, manufacturers, policymaking, academia and research.

Criteria for assessing individuals include:

- ▶ Impact on development and/or implementation of natural refrigerant solutions.
- ▶ Leadership within their organisation and/or their industry.
- ▶ Innovation and perseverance.

“This will be someone who has driven the market,” said Alvaro de Oña, head of media at shecco, the publisher of *Accelerate Europe*. “It’s going to be tough one to choose, but we want to single out and honour someone who has done a particularly special job.”

The nominating process for the awards will open in March 2017, and will run until July 2017. Nominations may be submitted by anyone involved with HVAC&R; companies and individuals may nominate themselves. From July to September 2017, a panel of experts assembled by shecco will review the nominations, and select winners.

During ATMOsphere Europe 2017, to be held in Berlin on 25-27 September, shecco will host a special ceremony honouring the *Accelerate Europe* Award winners. The December 2017 issue of *Accelerate Europe* will profile the winning companies and individual. ■ AW

All the fun of the playground

Albert Heijn is banking on natural refrigerants to help deliver its goal of becoming CO₂-neutral by 2025. *Accelerate Europe* saw at first-hand how the Dutch supermarket giant is testing innovative new ideas at 'Europe's most sustainable supermarket' in Purmerend.

– By Andrew Williams

Smiling broadly as he crosses the imposing atrium of the Ahold Delhaize group's Zaandam headquarters, Alfard Clerc is a man who clearly loves his job. Lucky for him, for there is much to do – the senior manager (store engineering) in Albert Heijn's Real Estate & Construction department plays a central role in delivering the supermarket chain's ambition of becoming CO₂-neutral by 2025.

Albert Heijn is part of Ahold Delhaize group, a global supermarket giant with 22 market-leading local brands. Together, the group accounts for over 6,500 stores serving more than 50 million customers per week, in 11 countries around the world. Ahold merged with Belgian retailer Delhaize in July 2016 to create a new group with a combined workforce of over 375,000 associates.

Albert Heijn boasts 950 supermarkets across the Netherlands and Belgium. It also counts the Etos drugstore and Gall & Gall, a beverage vendor, among its store portfolio. The company harbours lofty ambitions. "By 2025, we want all our supermarkets to be CO₂-neutral. That's a big aim for the future," says Clerc.

At the heart of Albert Heijn's strategy are plans to become HFC-free. Vincent van Dijk, a store-engineering consultant for the Dutch retailer, sets the scene. "We're looking at an HFC phase-down. That's the main route we're following – and making our installations a little bit better every day," he says.

Clerc nods. "We have a strong focus on how we're going to develop or change our chemical refrigerants to natural refrigerant CO₂ installations. We have a very clear goal there – we're aiming to make that shift over time," he says.

Since 2015, Albert Heijn's policy is to fit all new and remodelled stores with fully CO₂ transcritical installations. As an intermediate step, the company installed 350 hybrid CO₂-HFC systems between 2010 and 2015, while the first pilot fully CO₂ transcritical store opened in 2012.

"First of all we are a supermarket – we create stores for our customers to buy groceries. We also have an ambition to do the right thing. Here at Albert Heijn, we say, 'Do a little bit better every day'. Making the shift to CO₂ refrigeration is very obvious for us," Clerc says.



Vincent van Dijk

Alford Clerc

Fast forward to 2017, and Albert Heijn has 110 CO₂ transcritical stores (including franchises) – about 10% of its total store portfolio. It is currently remodelling stores to CO₂ transcritical systems at a rate of 60-80 per year.

In adopting natural refrigerant systems, total cost of ownership (TCO) and life-cycle climate performance (LCCP) are important considerations for Albert Heijn. “We have the ambition to work faster, but it’s also about cost. The remodelling sequence is about 10 years, so that’s a very important consideration in speeding up towards going completely CO₂ neutral,” van Dijk says.

Nowhere is the extent of their ambition more obvious than at the brand new Albert Heijn XL in the small town of Purmerend, north of Amsterdam and just a short drive from Ahold Delhaize’s

Zaandam HQ. Self-styled as ‘Europe’s most sustainable supermarket’, a glance at the huge information panel on the wall in Purmerend makes it easy to see why.

The Purmerend store is 100% CO₂-neutral. 50% of the energy used in the Albert Heijn XL, Etos and Gall & Gall on site is provided by a combination of 700 solar panels (on the roof and sides of the building) and a combined heat and power (CHP) plant in the car park.

The CHP is fired by biogas and provides in-store heating and electricity. “It’s very special. Normally we wouldn’t have any electricity production. When you get electricity from the grid, you lose more than 60% in distribution. With the CHP, you only lose 11%,” van Dijk explains.

Albert Heijn’s use of fully closable refrigerator doors saves 25% of electricity

for cooling purposes. Smarter design of the fixed cabinets in Purmerend delivers another 10% saving on top of that.

“The rack does all the cooling and the air conditioning. Above it, you also have absorption machines for the in-store air conditioning. We prepare the rack in advance, pack it up, drop it in and simply connect all the piping – then it’s ready to work!” van Dijk enthuses.

The rack itself is a CO₂ transcritical booster system with parallel compression (Bitzer). It is one of only a handful in Europe to use ejectors (Danfoss). An adiabatic gas and a dry-cooler on the roof complement the rack. The 6K evaporators alone deliver energy savings of 10% compared to the previous cabinets. The addition of the evaporators and design of the cabinets are the result of intensive collaboration with partners.



Ahold Delhaize headquarters, Zaandam



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

Customers cannot miss the row of charging points for electric vehicles in front of the store entrance. “Of course, we’re in the Netherlands – so you can pump up your bicycle tyres” for free in the car park too, Clerc says with a smile.

Wander around any Dutch city and it soon becomes clear that Albert Heijn is a fixture of the landscape. Around three-quarters of the population of the Netherlands visit an Albert Heijn store at least once a year. “We can have an enormous impact. This makes [Albert Heijn] beautiful to work for,” Clerc enthuses.

“In rebuilding and remodelling our stores, every day we have the opportunity to make them a little bit better. That’s really driving me – that we’re in a position to make that change, and that we’re given the space to innovate,” Clerc says.



700 solar panels adorn the roof and sides of the Purmerend store

What led Albert Heijn to describe the Purmerend store as Europe’s most sustainable? “It’s our own assessment based on the technology we’ve put inside the store. We’ve put a lot of new innovations into it,” van Dijk says.

He is confident that Purmerend has no equal in terms of sustainability and reducing CO₂ emissions. “We’ve looked around Europe to see if there are comparable supermarkets – we don’t think there are any.”

For Albert Heijn, claiming to have built Europe’s most sustainable supermarket is a massive step. “Normally we’d hold back a little bit. We’d say, ‘OK, we have to do this, because it’s in the genes of our company to do a little better every day,’” van Dijk says. “But in Purmerend, we did so many innovations that for this store, we said, ‘let’s make that call!’”

“Vincent put a lot of effort into developing Purmerend. His drive made this store bigger and bigger – and bigger! It’s great to see the snowball effect that this had – eventually leading us to put up the ‘Europe’s most sustainable supermarket’ sign,” Clerc adds.

The man of the moment expands further. “It’s a combination of producing energy, buffering the storage, and the energy savings that we’re making with the refrigeration installation. Nobody else in Europe is making installations in this combination. This is why we can make that call,” van Dijk says.

His enthusiasm is infectious. “It’s getting through to the people working here too. We gave them this present – the infographic on the wall. It’s also in their back office. Now the people working here are telling customers that they’re shopping in Europe’s most sustainable supermarket!”

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



'Europe's most sustainable supermarket', Purmerend

“ Here at Albert Heijn, we say, 'Do a little bit better every day'.

Making the shift to CO₂ refrigeration is very obvious for us. ”

– Alfard Clerc, Albert Heijn

All the fun of the playground

Excitedly hopping from one feature to another at Purmerend, Clerc stresses that this Albert Heijn XL store is very much a pilot for new ideas. “This is really a playground. It's the best spot to do it, because we can try everything here,” he says.

“Here it's about learning what's happening with our innovations. If we do a normal remodelling, then we use another format for our current new store template,” he explains.

“In Purmerend, we have certain innovations that we want to use, like biogas. But in a normal remodelling – the other stores which are fully CO₂ – we don't use gas,” Clerc says, stressing the importance of distinguishing between Purmerend and their standard CO₂ store template.

Albert Heijn chose Purmerend as the location to pilot all these ideas in February 2016. By November, they were ready to close the previous store. The new one opened just 10 days later. “In that time, we took everything out of the store – the floor, the ceiling, everything!” Clerc marvels.

Albert Heijn's standard stores are fitted with matching CO₂ systems regardless of location, keeping investment costs down. “We try to put the same installation and the same components in every store. The capacity can differ. But the standard installation is the same in all the stores,” Clerc says.

Between 2009 and the end of 2015, Albert Heijn reduced overall CO₂ emissions per square metre from 420m³ to 245m³, a decrease of 42%. By 2015, refrigerant leakage had decreased by 48% compared to 2010, equalling 4.3% of the total installed based compared to 8.3% in 2010. ▶



Pump up your bicycle tyres for free at Purmerend

Cooling for the wall-mounted cabinets and in-store climate comes from the CO₂ rack – even in smaller ‘AH to go’ convenience stores. “This is possible because our stores contain a lot of cabinets, so we have more heating that we can use for the climate inside the stores too,” van Dijk says.

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

What is the main motivation for adopting natural refrigerants? First and foremost, Clerc says, “the drive came from Albert Heijn itself”. The company wanted to become greener and more efficient.

Politics plays a role too. The European Union’s new F-Gas Regulation, which entered into force in 2015, aims to reduce HFCs by 79% by 2030, as compared to average levels in 2011-2013. To help deliver this target, it is progressively banning the use of certain HFCs in different types of new equipment. In 2022, for example, bans on using certain HFCs with GWPs above 150 in new centralised and plug-in commercial refrigeration equipment will come into effect.

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

The world’s adoption in Rwandan capital Kigali last October of a Montreal Protocol amendment limiting the production and use of HFCs has only strengthened Albert Heijn’s resolve in this regard.



The Kigali amendment – which is legally binding for all 197 Parties to the Montreal Protocol – sees developed countries take the lead on phasing down these potent greenhouse gases, starting with a 10% reduction in 2019 and delivering an 85% cut in 2036 (compared to the 2011-2013 baseline).

“Kigali confirmed that we’re going in the right direction. It’s also helping us to raise awareness that we need to remodel our stores,” Clerc says.

Yet he is keen to stress that Albert Heijn first embarked on its natural refrigerants journey long before Kigali entered the HVAC&R lexicon. The founding father of the firm’s natural refrigerants strategy, Michel de Rooij, sadly passed away in 2016. A plaque commemorating de Rooij’s achievements adorns the side of the CHP at Purmerend.



Propane-cooled, stand-alone cabinets (foreground), Purmerend



Self-service herb area, Purmerend store

▶ Albert Heijn has contracted four companies – Retail Technics, Frimex, Carrier and Veld – to install and maintain the CO₂ transcritical systems in its stores. These firms monitor and adjust the systems remotely as required. “The people in the stores do nothing on the installations,” Clerc says, instead calling the relevant company if they feel that something is awry.

“These companies are very much part of our innovation and the improvements that we’re making to our installations,” van Dijk says.

What challenges has the company encountered in remodelling stores to CO₂? Availability of components and training are both crucially important. “Educating people plays an important role in determining how fast you can go,” Clerc says. ▶

▶ Clerc is quick to pay tribute to the transformative role played by his predecessor. “The policy of Michel de Rooij was to always be ahead of what the government expects from us,” he says.

Investment cycles are long in the world of supermarket refrigeration. Clerc makes a nautical allusion: “It’s like a very big ship. To change your course, you have to start steering early – because otherwise you won’t reach your destination.”

What about synthetic refrigerants, which some industry players are touting as replacements for HFCs? Van Dijk is disdainful. “We considered HFOs, but a couple of years ago, we started to do 100% CO₂ installations – that’s the road we’re going down now,” he says.

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

Van Dijk has the lowdown. “We make a document listing all the components. We make the calculation up front and know exactly what has to go in. Then the installers know exactly what to build,” he says. This is important for future maintenance of the systems. “Sometimes the maintenance people are maintaining stores they didn’t build. So you have to have the same type of installation,” he explains. ▶



Combined heat and power plant, Purmerend store



CO₂ transcritical booster system, Purmerend store

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

In Purmerend, owning the real estate made it easier to make the business case for investing in environmentally friendly innovations. "We had a unique opportunity [in Purmerend] to do this. Now we're learning, and looking at which of the technologies at Purmerend we can develop and put into the normal remodelling of our other stores," Clerc says.

Just like Albert Heijn's standard remodels, the Purmerend store features LED lighting as the default option. Elsewhere, the firm is piloting other innovations like adiabatic gas coolers.

The new Albert Heijn XL is 30% more energy efficient than the previous store on the Purmerend site, and 10% more efficient than the company's previous standard-bearer – a remodelled Eindhoven store that opened in 2015. "If we improve like that every year, that'll be very nice," van Dijk says.

They are justifiably proud of 'Europe's most sustainable supermarket'. And their efforts are not going unnoticed. "More and more, we're telling people what we're doing," Clerc says.

Ahold Delhaize publishes a Responsible Retailing Report detailing the group's progress on environmental and other CSR initiatives. Clerc believes consumers in the Netherlands pay more attention to businesses' sustainability efforts these days. "We're the market leader in the Netherlands. We simply have to do this kind of innovation, like building the best store!" he says.

This commitment to improved communication extends to government level, too. Van Dijk and a colleague recently travelled to The Hague to tell government officials about the retailer's environmental initiatives. "Everyone said, 'wow, that's a lot – but you don't communicate it!'"

Clerc puts this down to a general lack of awareness at government level of the huge strides that Dutch retailers are making to reduce CO₂ emissions. "But this is starting to change. We're starting to tell the government what we're doing and what we're going to do. The government is also changing its perspective," he argues.

Delhaize – which merged with Ahold last summer – is aiming to reduce its CO₂ emissions by 20% by 2020. A key part of Delhaize's own strategy for achieving this is to replace HFC installations with natural refrigerant alternatives, namely CO₂ and hydrocarbons.

Clerc is excited about the prospect of meeting his new colleagues at Delhaize in the coming weeks. "We can learn so much from each other," he enthuses.

As a resident of Belgium himself, Clerc will no doubt have plenty to discuss with them. "Personally, I find Belgium and the Netherlands very similar. Both governments put a lot of effort into sustainability," Clerc says. Rows of wind turbines on his commute up and down the Netherlands remind him of this every day.

It is too early to say precisely what the future holds. New sustainability objectives are in the pipeline. "All the different brands are coming together. At the holding group level, we're getting new goals and targets on sustainability," Clerc says.

All that is for another day. With these two at the helm, however, one thing looks certain – Albert Heijn is in good hands.

■ AW



Albert Heijn's dynamic duo: Vincent van Dijk (l.) and Alfard Clerc (r.)

Europe's supermarkets embrace natural refrigerants

Europe's biggest retailers are increasingly investing in environmentally friendly and energy-efficient natural refrigerants for supermarkets of all sizes. *Accelerate Europe* spoke to some of them to hear their plans for the months ahead.

— By Andrew Williams

Technological innovation, regulatory change and the drive to reduce energy consumption are driving leading European retailers to adopt natural refrigerants.

Europe is home to 110,000-115,000 supermarkets. Most still appear to be using hydrofluorocarbon (HFC) refrigerants that contribute to global warming. Yet some of Europe's biggest retailers – including the Schwarz Group (which operates the Lidl and Kaufland brands), Sainsbury's, Carrefour S.A., METRO AG and Ahold Delhaize – are turning to natural refrigerants like CO₂ and hydrocarbons to comply with the HFC phase-down taking place under the EU's F-Gas Regulation and to benefit from the efficiency savings on offer.

The EU F-Gas Regulation aims to reduce the bloc's HFC use by 79% by 2030, compared to the baseline of average levels in 2009-2012. To help deliver this target, it is progressively banning the use of certain HFCs in different types of new equipment. In 2022, for example, bans on using certain HFCs (GWP ≥ 150) in new centralised and plug-in commercial refrigeration equipment will come into effect.

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

HFCs to become more expensive

While certain effects of the EU's HFC phase-down are yet to be felt by end users and manufacturers, this will change within the next three years. The first significant cut in HFC quotas in 2018 – of 37% – is expected to have a major impact on the cost of HFCs, which will become less widely available.

Since the turn of the year, the EU's HFC phase-down has incorporated HFCs pre-charged in equipment like ice cream freezers and commercial freezers used in supermarkets.

Supermarkets are also preparing for a January 2022 ban on the use of HFCs with a GWP higher than 150 in multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW (with the exception of the primary refrigerant circuit of cascade systems, where f-gases with a GWP of less than 1,500 may be used).

A recent report commissioned by the Greens/European Free Alliance Group in the European Parliament, entitled 'F-Gas Regulation shaking up the HVAC&R industry' and authored by shecco – showed that natural refrigerants have already increased substantially in the commercial refrigeration sector.

The report notes that the total number of transcritical CO₂ supermarket installations in Europe – cutting-edge systems that use CO₂ without a secondary refrigeration circuit using an HFC – stood at 8,732 as of early 2016, marking a 58% increase compared to 2014.



The number of companies now working with natural refrigerants, the report says, has significantly increased too. In 2014 there were only 418 companies working with air, CO₂, hydrocarbons, water, and ammonia in the EU. As of mid-2016, a total of 655 companies were working with natural refrigerants, marking an increase of 36% (see Figure 1, page 32).

Carrefour testing smaller systems in 2017

Major end users like Carrefour are driving this dramatic change in the market. Overall, the Carrefour Group is aiming to reduce carbon emissions by 40% by 2025 and by 70% by 2050 (compared to 2010 levels).

To reduce refrigerant emissions, Carrefour is phasing out HFCs and replacing them with CO₂ for commercial refrigeration. Carrefour has even started using CO₂ systems in stores in warmer locations like Spain and Brazil, proving that CO₂ refrigeration technology can now operate efficiently everywhere.

In 2017, Carrefour plans to progress on using natural refrigerant solutions in its smaller Express stores. Last September, Carrefour Belgium opened its first ever Express store fitted with a propylene water-loop refrigeration system, located in the Brussels neighbourhood of Laeken.

"We're also seeing an interesting evolution in small CO₂ systems," says Paolo Martini, refrigeration & HVAC manager for international support at the Carrefour Group – which boasts 12,296 stores under the Group banner across the world.

Companies like Green & Cool, Advansor, Sanden and Panasonic are all beginning to offer CO₂ condensing units in Europe (see p. 62). "We're interested in testing these systems. For smaller stores, we're going pilot and evaluate hydrocarbons and CO₂ in parallel," Martini says.

Carrefour is also currently considering wider use of hydrocarbon plug-in cabinets.

Factors ultimately influencing the decision to go for CO₂ or hydrocarbons will include store size, equipment cost, and legislation in each country, Martini explains.

Carrefour is hoping to install CO₂ racks in supermarkets in new countries too, having fitted transcritical systems in two Brazilian stores in April 2016.

In the wake of the Kigali Amendment to the Montreal Protocol, Martini is even more convinced that Carrefour's decision to divest from HFCs was the right one. "Our strategy is to achieve the goal of HFC-free installations for commercial refrigeration, without retrofitting to HFC-HFO mixtures," Martini says.

Carrefour wants to avoid the "double investment" of investing in HFC-HFO or HFO systems only to have to switch to natural refrigerants at a later date. "We don't want to use HFOs," he declares.



Carrefour's Paolo Martini



Hypermercado Carrefour, L'Ametlla del Vallès

Impressive progress at Delhaize

Leading Belgian retailer Delhaize – which merged with Ahold to form Ahold-Delhaize in July 2016 ([see cover story, p. 18](#)) – is aiming to reduce its CO₂ emissions by 20% by 2020. A key part of Delhaize's own strategy for achieving this is to replace HFC installations with natural refrigerant alternatives, namely CO₂ and hydrocarbons.

"We're looking forward to seeing within the new Ahold Delhaize group where we all are in terms of level of ambition and on a technical level," says David Schalenbourg, director – technical department, Affiliated Stores & Real Estate, Delhaize.

Delhaize operates about 760 stores in Belgium and Luxembourg. 140 of these are Delhaize-operated, while the others are run by affiliates. 74 Delhaize-operated stores use natural refrigerants, of which 14 are CO₂ transcritical systems. "In 2016, we added six," Schalenbourg says.

In September 2016, Delhaize opened a new store in Denderleeuw, 30 km from Brussels. "It has a new full CO₂ transcritical installation, with refrigeration, heating and air conditioning coming from the same rack. It uses heat reclaim, so heating and hot water are both centralised. In consumption, when everything's operational, previously we used about 350 amperes. Now we use 170A. So we reduced [energy consumption] by half. That's a tremendous result and shows that we're going in the right direction," Schalenbourg enthuses. "We have a number of supermarket rebuilds, where we put in

place a new building with a new technical installation. We have five such projects that we'll deliver this year. For us, 2017 is about continuity. We'll keep on investing in our stores to make our installations more efficient, with fewer leaks," he vows.

"The rhythm that we're following is stable. From 2015-2016, we added 18 stores with natural refrigerants, bringing us to 74. Of the 18 that we added, six were CO₂ transcritical and 12 were hybrid installations," Schalenbourg says. "We lowered our average GWP to around 2,300 for all Delhaize-operated stores. The final aim is to arrive at a GWP of 1," he adds.

Smaller plug-in cabinets using hydrocarbons often complement the CO₂ racks. This gives Delhaize the flexibility to run temporary product promotions in prominent areas of the stores.

One exciting project in the pipeline for 2017 is an urban farm, to be built on the roof of a store in the Brussels suburb of Boondael. Salad grown on the rooftop will be sold in the commercial space below.



Delhaize's new Denderleeuw store

Transgourmet targets 100% CO₂

European cash & carry giant the Transgourmet Group sees natural refrigerant technology playing a central role in delivering its goal of becoming CO₂-neutral by 2023.

"We have been set a target by our shareholders. We have to be CO₂-neutral by 2023, across the whole Transgourmet Group," says Hans-Dieter Brüß, a vice-president in the group's Central and Eastern European arm, which operates cash & carry and wholesale stores in Germany, Poland, Romania and Russia.

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.

Parent company Coop, one of Switzerland's largest retail and wholesale companies, 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.

Brüß 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, estimating that by 2020, the market share for CO₂ in Transgourmet CEE will be above 50%.

The group is adopting CO₂ for all refrigeration, air conditioning and heating applications, not just 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," Brüß explains.

"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," he says.

There is not yet a precise timetable in place for delivering the transition. Brüß says that the Transgourmet Group's goal is to become HFC-free "in the near future". "We're trying to change four, five or six installations to CO₂ every year," he says. At this pace, will the Group achieve its goal of becoming CO₂-neutral by 2023? He answers with an emphatic "yes!"

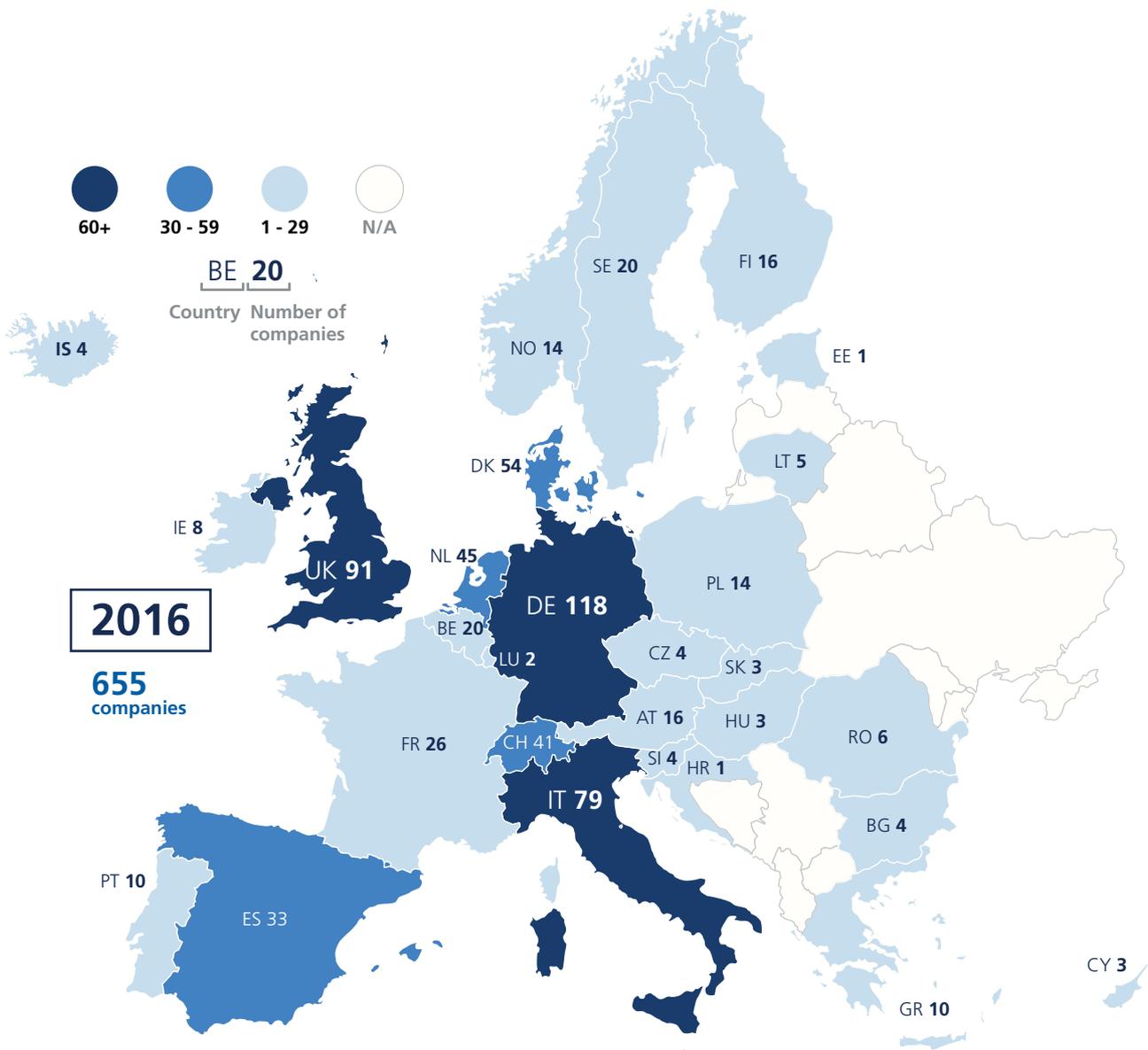
Currently, Transgourmet has 16 stores that use CO₂ transcritical systems. It plans to install seven new CO₂ systems in 2017, across supermarkets and distribution centres in Poland, Romania, Russia and Germany.

These projects include a huge distribution centre in Hamburg, and local distribution centres in Polish capital Warsaw and the city of Bistrita, Romania. "CO₂ is an excellent alternative to ammonia, particularly in small and medium-sized distribution centres," Brüß argues. He is confident that the decision to opt for CO₂ over ammonia for warehouses will deliver energy savings to the tune of at least 20%.

Figure 1

European natural refrigerant supplier map

These figures are based on analyses of leading component and system suppliers, contractors and service providers in 2016. While reasonable efforts have been made to denote the number of companies as accurately as possible, these figures are not exhaustive and serve as an indication of the market for natural refrigerants.



Source: F-Gas Regulation Shaking Up the HVAC&R Industry, produced by shecco and commissioned by The Greens/European Free Alliance group in the European Parliament, October 2016.

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Hans-Dieter Brüss, Transgourmet Group

“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,” Brüss says.

CO₂ ‘the best solution for Transgourmet’

Transgourmet opted to go down the natural refrigerants route six years ago. “The main factors were to have a long-term solution with regard to the f-gas issue, energy efficiency, reliability and last but not least, sustainability,” Brüss explains. “It’s easy for us, because it’s what our shareholders want.”

With so many CO₂ projects under construction and in the pipeline, did he consider adopting other natural refrigerants such as hydrocarbons or ammonia? “Yes, we looked into other natural refrigerants, but found that CO₂ was the best solution for Transgourmet,” he says.

The Group adopted its sustainability targets at board level long before the adoption of the Kigali agreement on phasing down HFCs under the Montreal Protocol. Brüss is aware of which way the wind is blowing but he is ahead of the curve. Kigali did not give any fresh impetus to Transgourmet’s journey.

CO₂, hydrocarbons jostle to become leading HFC alternatives

Competition between different natural refrigerants is intensifying as retailers seek tailor-made solutions that best suit their needs. While some big names have chosen CO₂, other retailers are opting for hydrocarbons. Propane, propylene and isobutane are now seen as standard solutions for self-contained ‘plug ‘n’ play’ refrigeration cabinets in stores, providing simple and flexible options for retailers who are already familiar with HFC-based plug ‘n’ play systems.

A major barrier to wider uptake of hydrocarbons is that the equipment is limited to a 150-gram charge. This limits the refrigeration capacity that hydrocarbon systems can achieve.

With this in mind, the European Commission and an international standards body have recommended increasing the charge limit. A working group of the international standards body – the International Electrotechnical Commission (IEC) – is beginning to look at preparing a new standard of 500g for plug ‘n’ play cabinets.

If adopted, this would significantly change the market. Standards from the IEC, a worldwide body that proposes rules governing how to use electrical, electronic and related technologies, influence the development of the

market by providing manufacturers and customers with guidelines as to what is safe to use and buy.

Countries are nonetheless free to go beyond what the IEC suggests. The UK is already using charges above 150g in commercial refrigeration cabinets, with some units reaching as much as 1,000g.

Innovation, made in Belgium

The Colruyt Group’s ultimate goal is to become HFC-free too. In December 2014 the Belgian retailer adopted the official target of using 100% natural refrigerants for all its cooling needs, investing in hydrocarbons to deliver this vision.

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

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



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Colruyt's Collin Bootsveld at Bio-Planet Mons

In the past, supermarket customers would request what they wanted from the butcher's counter and return when their order was ready. "But the market has changed. Customers want to walk in, be spontaneous, and grab whatever they need," Bootsveld says.

The way Colruyt sells meat is changing along with customer habits. "The market has changed to people taking things directly from the shelves. So we've physically changed our shops – this has changed the demand for cold," he says.

Colruyt stores are usually characterised by a cold room housing fruit, vegetables, dairy and other products, stand-alone freezer cabinets for frozen goods, a butcher's counter, and vertical refrigerators with doors to display processed meat.

Fossil fuel-free stores

The Colruyt Group has "no regrets" about the decision to adopt 100% natural refrigerants for all its cooling needs. Indeed, Bootsveld and his team are continuing to innovate and to improve their existing systems.

"We're going to test a CO₂ heat pump, specifically designed for hot tap water," he says. This would eliminate the need for a natural gas connection to provide hot tap water and again see the company place its trust in natural refrigerants.

In the wake of the Kigali agreement to phase down HFCs, Bootsveld is even more convinced that adopting natural

refrigerants is the right way to go. "There is always a learning curve, and we've started that curve early. We've moved to a new technology, and we've done it in a reliable manner," he says.

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

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

Heat demand is thus reduced to the extent that the stores' heating needs can be entirely served by waste heat from the cooling system. "The shops will be 100% renewable electricity. Fossil-fuel free!" Bootsveld says.

CO₂ still going strong

Alongside the growth of hydrocarbons, CO₂ is clearly in a prime position to continue its impressive rise.

Aldi Süd committed to using only CO₂ in its stores in 2010. Having reached the landmark of 1,000 installations in early February 2017, the German retailer estimates that some 54% of its stores are already running on CO₂.

Agnes Macherey, head of refrigeration at Aldi Süd Germany, told *Accelerate Europe*: "We're delighted and proud to be able to set standards on such an important issue as sustainability in the commercial cold market in Germany."

Since the beginning of 2016, Aldi Süd has invested exclusively in CO₂ systems for its stores. The company is complementing this effort with investment in hydrocarbon cabinets. Since 2016, all stand-alone units at Aldi Süd have operated 100% on propane.

Düsseldorf-based METRO AG (also known as METRO GROUP), one of the world's largest retail and wholesale companies, operates over 2,000 stores in 29 countries – including more than 700 METRO stores and 284 Real hypermarkets (2016 figures). In addition to METRO/MAKRO Cash and Carry stores and Real hypermarkets, its sales divisions include Media Markt and Saturn, its commercial electronics arms.

Cementing the Group's reputation is its F-Gas Exit Program, a cornerstone of the firm's emissions reduction strategy. It will see METRO AG phase out f-gases by 2030, replacing them with natural refrigerants in all store locations worldwide – where it is technically feasible and economically reasonable to do so.

"We're on track in our programme. Every year we're executing it a little bit more," Olaf Schulze, director (energy management) at METRO AG, told *Accelerate Europe*.

The policy in Europe is to fit every new and remodelled METRO Cash and Carry store with a CO₂ transcritical system. "This year, we're doing it in two stores in France, two stores in Spain, three or four in Germany, and one in Austria. Country-by-country, we're changing stores – usually from R404A to CO₂ transcritical systems," Schulze says.

Under the F-Gas Exit Program, the METRO Group is fitting its stores with CO₂ transcritical systems and its distribution centres with ammonia. For plug-in cabinets, it uses propane. Innovations like ejectors are helping the Group to bring CO₂ transcritical systems to warmer climates.

Of Real's 284 supermarkets, six are currently fitted with transcritical CO₂ systems and 25 have subcritical CO₂ systems – meaning around 10% of Real's store portfolio uses natural refrigerants. "We would like to increase that," Schulze says. The strategy is the same as METRO Cash and Carry – every new and remodelled Real supermarket will use a CO₂ transcritical system.

Russia and China have proved more difficult to crack. The METRO Group hoped to have installed CO₂ transcritical systems in these countries by now, but thus far has only managed to fit a dozen or so subcritical systems. "We underestimated how difficult it would be to find local manufacturers," Schulze admits.

The Kigali Amendment to the Montreal Protocol has further convinced the METRO Group that adopting natural refrigerants is the way to go. "We're happy that we were already on track before Kigali. We have done our homework and we have a future-proof strategy," he says.

Synthetic refrigerants are not part of the picture. "Pure HFOs are not our recommended technology – we have just one such store, in Brno, Czech Republic, with R1234ze. It was a pilot," Schulze says.

While natural refrigerants themselves do not cost much, the price of HFCs has always been higher because chemical



METRO's Olaf Schulze

companies make them. Also, the price of CO₂ systems and components is falling as uptake and competition between manufacturers increases, due in part to the impact of the EU F-Gas Regulation and taxes on HFCs introduced in countries like Spain and Norway.

Energy efficiency improvements as a result of technology advancements and falling equipment costs due to economies of scale are therefore helping to reduce the cost of CO₂ systems at a time when their HFC counterparts are coming under increasing pressure.

The graph below indicates developments in CO₂ supermarket refrigeration as Advansor, a major European equipment supplier, has registered them. While efficiency has increased by 25% between 2008-2016, the cost of equipment has fallen by 30% in the same period.

Scrambling to follow Europe's lead

The global agreement to phase down HFCs reached in Kigali, Rwanda in October under the Montreal Protocol framework was directly inspired by the EU's F-Gas Regulation. The Kigali Amendment will see HFCs phased down over the next 30 years by all parties to the Montreal Protocol.

"The EU F-Gas Regulation is the best existing programme in the world to reduce f-gas emissions. It is the role model

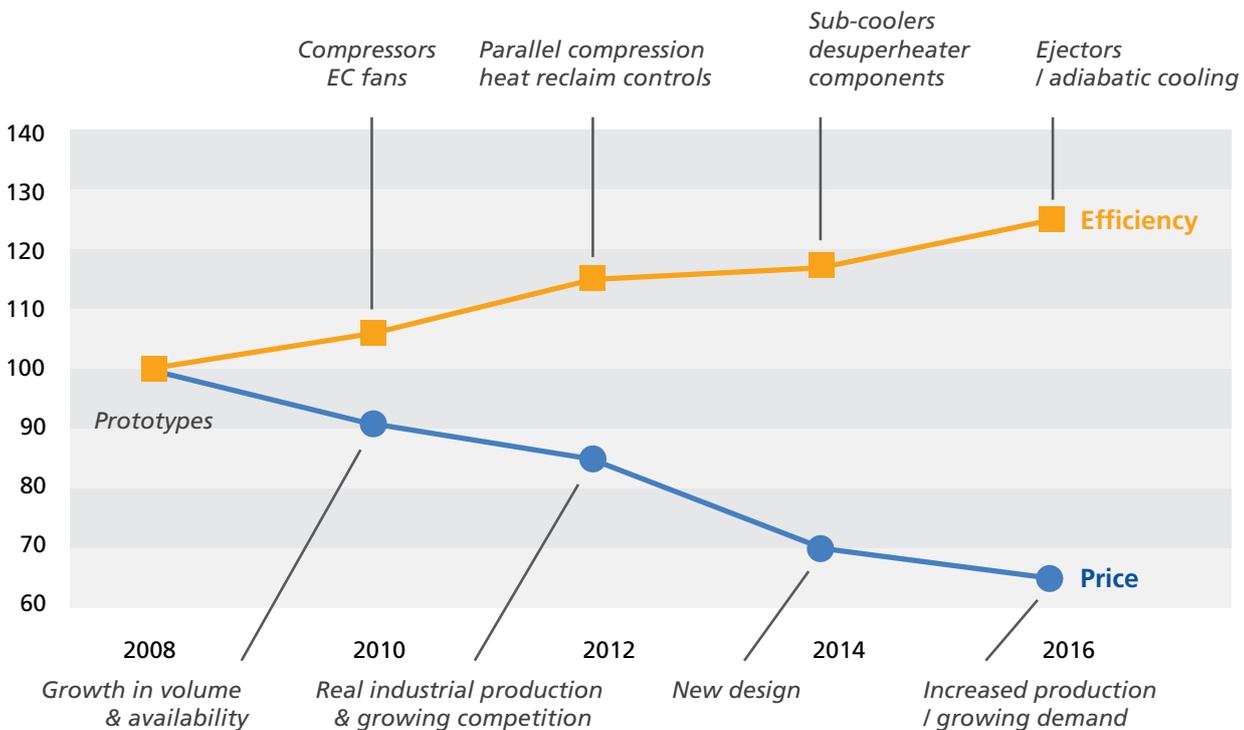
for everybody else to follow at this time," according to Glenn Gallagher of the California Air Resources Board, which regulates on climate and energy in California. By end 2016, over 118 CO₂ transcritical systems and numerous CO₂ cascade systems had been installed in the United States.

In Japan, the Ministry of the Environment (MOE) has been funding natural refrigerant projects since 2014. This has encouraged retailers to adopt natural refrigerants more quickly, especially as the budget for subsidising projects has increased every year.

Japan's three largest convenience store chains – Lawson, 7-Eleven and Family Mart – all have CVS (convenience stores) that use CO₂ systems. Currently, Japan is estimated to boast 1,800+ stores with CO₂ transcritical technology.

In the retail sector, therefore, the future is bright. Natural refrigerants are already playing a significant role in meeting HFC phase-down commitments the world over. 83% of industry surveyed in the f-gas report stated that natural refrigerants are growing, with 53% reporting particularly strong growth.

As equipment costs continue to fall and drive for energy efficiency picks up steam, the adoption of natural refrigerant solutions in European retail is clearly a trend that's here to stay. ■ AW



Source: Advansor, ATMosphere Europe 2016

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CO₂ freezing new Aldi distribution centre

Aldi UK approached SCM Frigo to design a CO₂ transcritical system capable of cooling a large distribution centre. After overcoming initial challenges, the system's success is encouraging the retailer to consider installing more.

— By Charlotte McLaughlin

Italian rack manufacturer SCM Frigo worked with British installers Integral to provide a large distribution centre in Cardiff, Wales with a complete CO₂ system.

It took almost one-and-a-half years before delivery was complete, Mirko Bernabei, technical director at SCM Frigo, told *Accelerate Europe*.

SCM Frigo provided the unit and then worked with Integral to customise it, because none of its standard units were the right size for the centre.

The 30m³ distribution centre features 1.6 MW of cooling capacity, 900 kW on the medium-temperature side and 500 kW on the low-temperature side, where temperatures reach as low as -35°C. As such it is one of the biggest in the world, according to Bernabei.

The biggest challenge for SCM Frigo was, “to have a compressor that was big enough. For this we worked together with GEA on this project, who provided us with the biggest compressor on the market,” he explains. Each of the CO₂ compressors boasts 80 kW of cooling capacity.

The system includes four booster racks with parallel compression. It also recovers heat to provide hot water and to heat the offices of Aldi staff, saving on energy and heating costs.

It has been successfully operating since October 2016. “Good feedback so far – performance is much better than expected, according to Aldi sources,” says Bernabei.

Aldi planning more facilities

Aldi is currently focusing on warehouses and distribution centres before testing CO₂ in supermarkets in the UK.

“All platforms for industrial first on CO₂, and then if successful, roll it out in stores across all of the UK. Aldi has now launched a tender to install CO₂ in supermarkets in the UK, so the results so far are positive and have encouraged them to go further,” Bernabei concludes.

■ CM



SCM Frigo CO₂ transcritical racks, Aldi UK distribution centre, Cardiff



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GEA Bock HG compressors for supermarket applications

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In supermarkets nothing should be left to chance: Customers always want to fill their shopping carts with fresh produce and optimally cooled food. GEA compressors are used in various areas of the cooling chain and always ensure the right temperature of the food. The main focus is on compressors, which have been specially developed for natural refrigerants. For use with the refrigerant CO₂, GEA offers compressors, optimally suited for the application with CO₂, not

only in terms of pressures, but in many other respects as highest efficiency in the market. Furthermore, the compressors of the hydrocarbon series GEA Bock HG HC as well as the series GEA Bock HG CO₂ (T) fulfill all the requirements of the F-gases regulation. GEA offers compressor solutions for the entire cold chain – starting from the food production to transport, food processing and storage in the cold store, to cooling in the supermarket.

Britain open for business!

The Great Hospitality Show – an international HORECA tradeshow held in Birmingham, UK on 23-25 January – shed light on how UK industry is responding to the EU's F-Gas Regulation and the looming shadow of Brexit.

– By Charlotte McLaughlin

At the National Exhibition Centre (NEC) in Birmingham, visitors to the Great Hospitality Show were treated to the enticing smell of freshly baked bread, the tempting aroma of chocolate brownies and the efficient hum of hydrocarbon compressors.

Many refrigeration exhibitors at the show have begun to adopt hydrocarbons as a way of meeting the objectives of the European Union's new F-Gas Regulation.

The EU F-Gas Regulation entered into force on 1 January 2015 and aims to reduce the bloc's HFC use by 79% by 2030. Moreover, as of 2017, the phase-down needs to incorporate HFCs that are pre-charged in equipment, which will put further pressure on the availability and cost of fluorinated refrigerants.

The director of British firm Ice Cool Services, Bruce Jennings, told *Accelerate Europe*: "Hydrocarbons are key to meet the objectives of the Energy Efficiency Directive and EU F-Gas Regulation set out by the European Union."

To shift towards hydrocarbons, Jennings consulted UK refrigeration trainers Cool Concerns, managed by former IOR President Jane Gartshore. He was worried about the flammability posed by the refrigerant.

Now Jennings is much less concerned. "We just had to train our technicians [to use hydrocarbons] and now when they go to do servicing, they take another ice machine and take the old one back to our offices, which does not involve extra cost for us," he says. "R290 is future-proof," he enthuses.

UK-based Lowe Refrigeration and Victor Manufacturing had initially been hesitant to adopt hydrocarbons, but now both companies are in the process of rolling them out.

"At the moment we are using R404A but now we are testing [hydrocarbons] at our facilities for health and safety. We know they are very efficient," Peter Brewin, marketing communications manager at Victor Manufacturing – a refrigerated display cabinet manufacturer – told *Accelerate Europe*.

Lowe Refrigeration does not manufacture cabinets but buys, sells and rents them out to HORECA companies and supermarkets worldwide. Their fleet so far features only a small percentage of hydrocarbons, but they expect this proportion to grow.

Are hydrocarbon limits too restrictive?

“We have a small percentage at the moment, and for our smaller equipment, we think this will change,” says Jon Carn, commercial director at Lowe Refrigeration.

However, Carn fears that the regulatory hurdles facing hydrocarbons are increasing the cost of larger equipment beyond what some customers are willing to pay. Hydrocarbon charge sizes are restricted to 150g for plug ‘n’ play equipment in most European countries. For larger cooling capacities, two hydrocarbon compressors are therefore needed to achieve the same effect you would get with one at a higher charge.

Amid pressure from industry to raise hydrocarbon charge limits, this is likely to change. Various bodies, including the International Electrotechnical Commission (IEC), and the Fire Protection Research Foundation and the Environmental Protection Agency in the United States, have pledged to reconsider current safety standards in 2017.

Standards from the IEC, a worldwide body that proposes rules governing how to use electrical, electronic and related technologies, influence the development of the market by providing manufacturers and customers with guidelines as to what is safe to use and buy.

An IEC working group on household and similar electrical appliances has begun to prepare a draft to increase the charge limit on hydrocarbons. The new limit is expected to change from 150g to 500g; this could shift the market towards bigger, more efficient hydrocarbon cabinets once it is adopted by the full IEC.

Meanwhile, a 2016 European Commission report – published under the EU’s F-Gas Regulation on phasing down HFC use – argues that regulation governing hydrocarbons must be adapted to encourage their wider rollout for refrigeration, air conditioning and heat pump applications.

Local building codes and fire regulations, as well as transport and storage-related codes, can “severely restrict” the use of flammable refrigerants in many EU countries, the report finds.



▶ End users push for change

Another key driver for many companies is end users' desire to cut emissions. "We have a lot of supermarket companies that just want R290," says Victor Manufacturing's Brewin.

Ice Cool Services, meanwhile, sells its larger icemakers for indoor commercial use in supermarkets – using hydrocarbon R1270 – at the upper refrigerant charge of 150g.

"End users like [UK supermarket] Waitrose want [these] environmentally friendly refrigerants," Jennings says.

Similarly, Robert Cox of Adande Refrigeration – also based in the UK – says, "KFC, McDonalds and top Michelin-starred chefs, who were thinking about their running costs, order a lot of our A+ cold drawers".

Cox thinks using hydrocarbons in combination with insulating cold drawers – primarily used in food preparation activities – yields significant energy savings, as the compressor does not have to work so hard.

Independent tests of the ADANDE A+ fridge drawer estimate that the technology saves up to 239 kW/annum compared to a normal system. It can also prevent 25% of food waste, as it keeps food cool for longer.

On 26 January this year, Adande won the energy systems award at the National ACR and Heat Pump Awards for its "energy-saving, efficient and sustainable" product.

A representative of Toney Minchella Ice Cream in South Shields in northeast England said that since switching from HFCs to Adande's hydrocarbon fridges, they had noticed improved energy savings and reduced food waste.

"We have had no more waste due to low melting points [...] The Adande holds the ice cream at its optimum temperature, meaning our valued customers can experience superb quality ice cream every time," the representative said.



Ice Cool Services' ice maker

Pushing back the barriers

Most of Adande's European line now uses hydrocarbons. But progress has been less smooth in the US. "Unlike Europe, the US is just not as green [and] they still seem to want to use R404A [...] We're having more success in Australia, South America and Asia with hydrocarbons," Cox says.

Lowe Refrigeration's Carn echoed these sentiments. "We're not even trying to roll them out in the US yet. It's a little soon".

Cox welcomed the recent move by the US Environmental Protection Agency (EPA), under the SNAP scheme, to increase the charge limit of hydrocarbons from 80g to 150g.

Elsewhere, Wayne Phillips of Rexmartins – a HORECA kitchen supplier and refrigeration manufacturer – with over 30 years of experience in the industry does not think all sectors are moving equally towards climate-friendly alternatives to HFCs.

"The chemical companies often have a lot of influence on the refrigeration sector," Phillips told *Accelerate Europe*, adding: "It's all about profits."

"I would like to see the whole industry going back to naturals like ammonia, CO₂ and hydrocarbons [but] I often see the air-conditioning industry using R407A," he says. With a GWP of 2,107, R407A makes a significant contribution to global warming.

He laments that preventable leaks are still a big problem in the refrigeration sector. "They just top up refrigerants and do not take care about leaks," he says.



He would like to see the HVAC&R sector more micro-managed. "I would like small installers to have to show training cards [in f-gas and natural refrigerant management] when they pull up to a job [...] I also think the white van man [small HVAC&R contractors] should be fined as some of them do not perform the job properly and are not properly trained," he told *Accelerate Europe*.

Brexit brings its own challenges

Meanwhile, the United Kingdom's decision to leave the European Union in an in-out referendum on 23 June 2016 has thrown into the air a lot of questions about which EU legislation will be retained and how this will impact UK industries.

UK Catering Equipment Suppliers Association (CESA) Director Keith Warren regrets decision to leave. "Manufacturers will still be producing for the European market. So, we have just lost our right to have a say on a lot of that [EU] legislation," he told *Accelerate Europe*.

Warren points out that CESA will continue to be part of the European Federation of Catering Equipment Manufacturers (EFCEM), which works at European level, and in this way it will retain some degree of influence on EU legislation.

Victor Manufacturing's Brewin thinks the decision to leave the EU may help Britain to stay competitive, as the price of British goods relative to European goods should decrease – allowing UK firms to remain competitive internationally. This was a sentiment echoed by many UK-based manufacturers at the show.

The Great Hospitality Show 2017 revealed that many companies are putting innovation first. Brexit may be both a blessing and a curse for UK manufacturers.





Osborne Refrigeration stand

Spotlight on Osborne Refrigeration

Family-run business Osborne Refrigeration – a manufacturer of beer cabinets, freezer drawers, and milk and wine chillers – decided to start using hydrocarbons for refrigeration four years ago.

Director John Osborne has been in the business for over fifty years and still remembers the environmental problems caused by manufacturers using chlorofluorocarbons (CFCs), which put a hole in the ozone layer. “When we found this out we decided to research into using more environmentally friendly refrigerants and settled on R134a. Then we realised this wasn’t good for the environment either,” Osborne says.

Now they use hydrocarbons across their range. “We decided that this time we would go for something that we know is definitely environmentally friendly,” he told *Accelerate Europe*. “We look at it this way. If you don’t do something environmentally friendly now, the legislation will come eventually – it’s just common sense.”

Currently Osborne uses low-voltage fans, heavily insulates its products with chemical free polystyrene, installs LED lighting – which does not give out waste

heat into the cabinets – and uses efficient hydrocarbon compressors. This has significantly maximised the cooling capacity of its products and reduced energy demand.

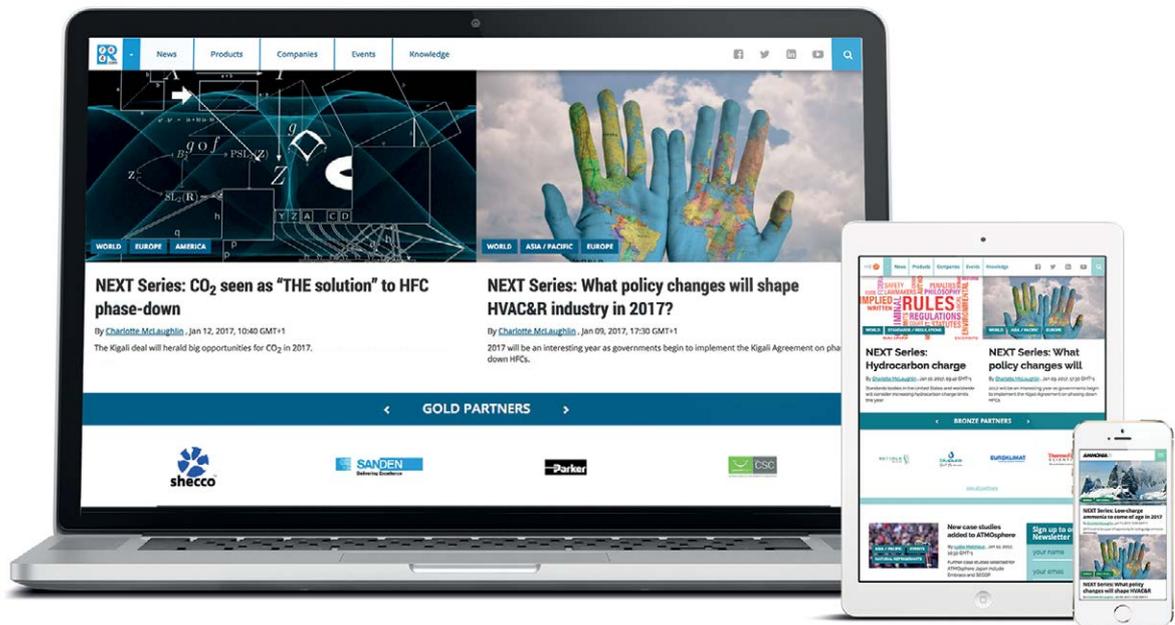
Osborne uses isobutane compressors from SECOP across most of its hydrocarbon range. “We have been working with Danfoss for over forty years and when they became Secop compressors, we already had a good relationship there,” he says.

He believes Brexit may impact the sector a little bit, but not to any strong degree. “Manufacturers will still be selling to Europe. So even if the EU F-Gas Regulation does not last, they will still have to switch if they want to sell to European customers,” he says. ■ CM

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HVAC&R efficiency in shop window at EuroShop 2017

Amid regulatory pressure to phase down the use of HFCs and rising energy prices, retailers are evaluating their HVAC&R investment decisions more carefully than ever. A vast array of natural refrigerant innovations will be on show at EuroShop 2017, helping them to meet sustainability targets and save on energy costs.

– By Alvaro de Oña

The world's biggest retail tradeshow, EuroShop 2017, will feature close to 90 companies exhibiting the latest natural refrigerant solutions from 5-9 March in Düsseldorf, Germany.

With over 2,200 exhibitors confirmed from 60 different countries, retail solutions on show will range from store design to lighting and smart services. For food retailers, refrigeration can represent up to half of their running costs. Access to innovative technologies that help them to reduce their energy bills is vital.

STRONG FOCUS ON CO₂

Proving that natural refrigerants and high efficiency can coexist even in warm climates, Italian manufacturer CAREL is presenting the concept of 'natural efficiency'. "For CAREL, EuroShop represents a very important opportunity to promote the concept that our solutions can provide added value to supermarket chains in terms of energy saving and efficiency," says Alessandro Greggio, CAREL's Head of Marketing – Retail & Refrigeration.

"The use of natural refrigerants must also be accompanied by energy efficiency, easy installation and remote monitoring," Greggio says. CAREL will be showcasing new solutions for natural refrigerant-based commercial refrigeration and concept units for food & beverage retail. It will also host a live demo of local and remote supervision tools for analytics at its booth.

To complement its strong position on larger capacity CO₂ transcritical systems, Danish system supplier Advansor will present its brand new compSUPER mini-booster, designed for medium cooling capacities in the 25 kW range.

SCM Frigo will be showcasing new smaller units for medium and low temperatures (CuBO₂ smart and CuBO₂ plus), covering cooling capacities from 0.6 to 30 kW.

Green & Cool, part of the Carrier Group, will be exhibiting its CO₂Y condensing units, optimised for smaller store formats. Danfoss will showcase its 'smart store' concept, featuring innovations for CO₂ transcritical systems like compressor racks with heat recovery, variable speed drives and ejectors, which boost efficiency in warm climate conditions. The concept store includes integrated electronic controls.

"With smart and integrated solutions for compressors, refrigerated display cases, cold rooms, HVAC, lighting and connections to external grids, we can prove energy savings of up to 50%," says Henrik Schurmann, vice-president (food retail) at Danfoss.

The firm will also showcase its mobile training unit for CO₂ refrigeration systems.

Compressor manufacturers GEA, Bitzer and Dorin, equipment suppliers like Epta and Zanotti, engineering firm Frigo Consulting and component manufacturers such as Güntner, Compact Kältetechnik, Emerson and Castel will all be showcasing products and services.

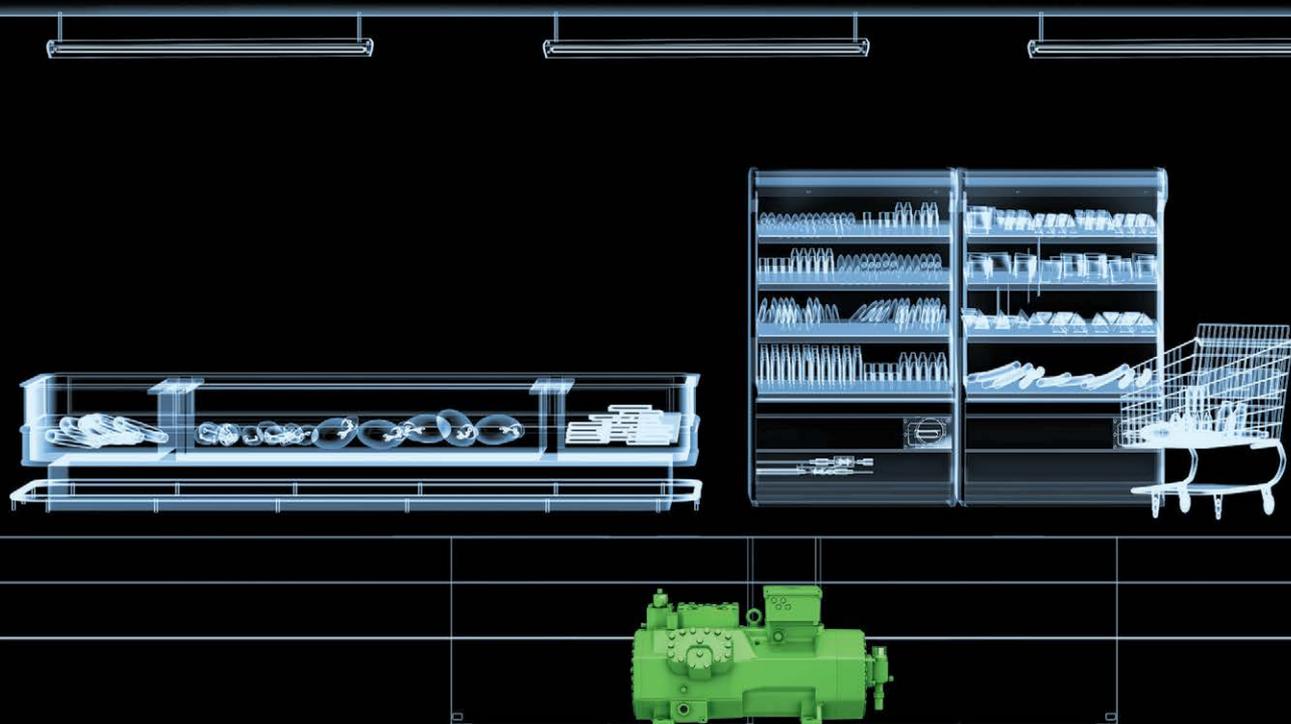
TREND TOWARDS SMALLER STORES

Refrigeration equipment based on hydrocarbons will also be on display, with growth driven by the increasing popularity of small stores. AHT, True, Rivacold, Galillei, Teko, Viessmann and Maja are just some of the companies exhibiting.

Side events will discuss energy issues in food retail. ATMOSphere Network events organised by shecco on 7 and 8 March, for example, give participants the chance to informally exchange views on natural refrigerant efficiency.

Pick up your copy of our GUIDE EuroShop at the tradeshow or read it online to hear more about natural refrigerant technologies on display in Düsseldorf! ■ [AdO](#)

Visit us at EuroShop:
5–9 March 2017, Stand D65, Hall 17



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THE HEART OF FRESHNESS



EU calls for removal of barriers to adoption to natural refrigerants

Standards, codes and legislation governing the HVAC&R sector must be adapted to encourage wider rollout of HFC alternatives, while more must be done to train technicians to operate natural refrigerant systems, argue two new reports from the European Commission.

– By Charlotte McLaughlin & Andrew Williams

Regulation must be adapted to encourage wider rollout of HFC alternatives like natural refrigerants for refrigeration, air conditioning and heat pump applications, according to a report published on 1 January 2017 by the European Commission – the EU’s executive arm – under the EU’s F-Gas Regulation on phasing down HFC use.

The first report, on barriers posed by codes, standards and legislation to using climate-friendly technologies in the HVAC&R sector, argues: “While safety levels should be maintained and risks minimised, standards, codes and legislation should be adapted to technological progress and, in the context of a phase-down of HFCs [...], allow the use of more climate-friendly alternatives where it is safe to do so.”

It encourages EU countries with restrictive national codes, standards or legislation, “to consider a review in light of technical developments that would allow the safe use of alternative refrigerants”.

The report identifies flammability, poor material compatibility, toxicity and higher operating pressures among the limitations of HFC alternatives including natural refrigerants CO₂, ammonia and hydrocarbons, but argues that these “can usually be addressed through suitable product design and proper maintenance of equipment”.

The EU executive surveyed 24 member states representing 95% of the EU population. Countries “did not report any significant national restrictions going beyond European requirements for refrigeration, air conditioning and heat pumps related to the use of ammonia or CO₂”. However, certain stakeholders complained of “restrictive rules on ammonia use in France”.

EU urges easing of hydrocarbons restrictions

In contrast, regulations governing the adoption of hydrocarbons are identified by the European Commission report as being particularly restrictive.

National decrees in Italy, France and Spain “severely restrict the use of flammable refrigerants for air conditioning equipment in certain types of public access buildings,” the report says. Moreover, it adds, “these requirements go well beyond the rules permitting such use by European and international standards”.

Philip Owen, who heads the unit responsible for Montreal Protocol issues in the European Commission’s directorate-general for climate action, told *Accelerate Europe*: “The challenge with standards is the multi-layered approach: global, European, national and local level. You get down to local building regulations in certain member states, and find that you’re blocked there. It’s an issue, and we’re working hard at EU level to do something about it.”

Some national regulations simply ban flammable refrigerants in certain applications.

“The challenge with standards is the multi-layered approach: global, European, national and local level.”

– Philip Owen, European Commission

The report identifies the following specific barriers for hydrocarbons as requiring attention:

- ▶ European standards “unnecessarily restrict charge sizes beyond what is needed to guarantee safe use of the equipment”. Charge size limits for human comfort cooling and belowground applications in particular are “over-restrictive”.
- ▶ Risk minimisation approaches in system design and use are not sufficiently considered for all flammable refrigerants to determine safe charge size.
- ▶ Standards tend to be updated only at intervals of five years or more, “thus making the necessary changes in a timely manner is a real challenge”.
- ▶ European policymakers and companies can only partly influence the outcome of product safety standards like EN 60335-2-40 (governing electrical heat pumps, air conditioners and dehumidifiers) and EN 60335-2-89 (governing commercial refrigeration appliances) because they are based on IEC standards set at global level.
- ▶ SMEs find it difficult to allocate resources to participating in standard-setting processes and “only a few experts on hydrocarbons” are currently involved in them.
- ▶ Perception of risk differs from actual risk. End users may be reluctant to install flammable refrigerants and manufacturers may be wary of liability laws and public perception. Also, “the issue of risk is generally divisive as it can be used to promote the commercial interests of one technology versus another”.



The European Commission must remain technologically neutral and cannot back one option over another as long as they all comply with existing legislation. “We wouldn’t want to pick winners,” Owen says. Nonetheless, he predicts that natural refrigerants will continue to grow. “They have to increase to make the phase-down work,” he says.

Owen notes that standards do not fully reflect recent technological progress on the safe use of climate-friendly alternatives. “In particular, there is a need to maximise charge sizes without compromising safety, as well as allowing more general use of risk management approaches for all refrigerants,” he says.

The Commission report calls on European standardisation bodies CEN and CENELEC to update standards at EU level and invites companies to contribute by collecting evidence enabling better risk minimisation approaches for all flammable refrigerants.

Owen says the EU will also, “facilitate an exchange of information on standards at an international level, their review and related processes between Parties to the Montreal Protocol, standardisation bodies, industry as well as other stakeholders involved in standard setting” during meetings in 2017.

Despite the Commission’s best efforts, Bas Eickhout, a member of the European Parliament in the Greens/European Free Alliance Group, warns that it may take more than dismantling regulatory barriers to increase uptake of natural refrigerants.

“It’s because you’re moving the market to other players. The chemical industry plays less of a role in this natural refrigerant world. But the chemical industry is a very well-organised, well-established world with big players. Big voices get heard,” Eickhout says.

Training uptake ‘low’

Low uptake of natural refrigerant training is creating its own problems. Currently there are medium- to long-term shortages of technicians trained to operate natural refrigerant systems, making it harder to deliver the EU’s f-gas phase-down targets, warns the second Commission report, on the availability of training to use climate-friendly technologies that replace fluorinated greenhouse gases.

The report reveals that just 0-2.3% of f-gas-trained technicians in the 22 countries surveyed are also trained to use natural refrigerants.

The EU executive surveyed 22 member states representing over 91% of the EU population. Ammonia training is available in 71% of them, but this natural refrigerant has been in use for decades. “Availability is much lower for other alternative refrigerants,” the report warns.

CO₂ training is available in 52% of the 22 countries surveyed. Training on small hermetic hydrocarbon systems is on offer in 48%, while just 35% offer training on using hydrocarbons in larger systems.

“A number of players need to take responsibility for addressing the shortcomings on training and give a prominent role to relevant authorities, industry trade bodies, equipment manufacturers as well as training organisations,” Owen says.

In some regions, the lack of trained service providers is directly leading some end users to opt against converting from HFCs to alternative refrigerants – and particularly to the use of CO₂ for commercial refrigeration.

The Commission cites uneven geographical distribution of training centres and the fact that “micro-enterprises [are] so dominant” among other barriers to wider training in CO₂ and hydrocarbons. “It is relatively hard for very small companies to fund the training required in the wide range of alternatives that are becoming available,” the report states.

Despite reporting “good availability” of materials for theoretical training, the Commission identifies “a considerable shortage of practical training facilities for hands-on training on relevant equipment in some regions”.

To help solve the issue, the Commission calls for the introduction of ‘train-the-trainer’ programmes to address geographic imbalances. It also hopes to introduce “proposals to support stakeholders in setting up such schemes” as part of the LIFE programme, a funding programme designed to help member states achieve the EU’s climate goals, Owen told *Accelerate Europe*.

The Commission, he says, “may also facilitate exchanges between the member states and spread awareness as well as best practice examples”. The EU-funded project ‘REAL alternatives’ provides eLearning and certification training freely. The European association of refrigeration, air conditioning and heat pump (RACHP) contractors – AREA – has also helped member states and stakeholders to some extent through various programmes.

“National authorities are also aware of the issue and are beginning to take action,” Owen points out.

Among existing national initiatives are efforts to include alternative refrigerants in training qualifications in the UK and Spain, and setting up additional specific training facilities in Germany and the Netherlands. Bulgaria and Estonia are even going as far as to fund projects on training know-how, promotion of alternative refrigerants, and company awareness of training needs in their countries.

Many national training organisations are also planning to improve training on alternative refrigerants for the future, like Finland has already.

The report also stresses the key role to be played by major end users like supermarkets, for example by requiring only trained technicians to work with their systems.

Key manufacturers taking action

Manufacturers of natural refrigerant systems and components are already demonstrating that they are part of the solution.

Carrier opened a training facility for CO₂ refrigeration, the CO₂OLAcademy, in the German city of Mainz in March 2015. Also in Germany, compressor giant Bitzer inaugurated the SCHAUFLEER Academy, an international training centre located in Rottenburg, in February 2016.

Kim G. Christensen, managing director of Danish CO₂ system manufacturer Advansor – which also conducts training – refutes the notion that lack of training is a barrier to wider uptake of CO₂ solutions in particular.

“The story that there isn’t enough CO₂ training capacity is a lie,” Christensen insists. He urges retailers and contractors in areas without access to local training to visit existing facilities elsewhere.

Alongside offerings from Bitzer, Carrier and Advansor, he cites courses at universities in France and Belgium and refrigeration schools in Denmark and Sweden among the options currently available.

The Commission report, meanwhile, concludes that measures in place governing the use of HFC replacements are sufficient to ensure their safety.

“The legislative framework complemented by existing standards at the European level appears appropriate to assure safe handling of such equipment where these rules are followed,” states the report. It concludes that further EU legislative action is “not appropriate at this time” for training. ■ AW, CM



Carrier's CO₂OL Academy



Updated German regulation to support natural refrigerants

An amended refrigeration and air conditioning directive, which entered into force at the turn of the year, will subsidise natural refrigerant-based systems in Germany.

– By Andrew Williams

The updated version of Germany's refrigeration and air conditioning directive, which entered into force on 1 January 2017, will subsidise the installation of refrigeration systems based on “non-halogenated and low-GWP refrigerants”.

Natural or non-halogenated refrigerants like CO₂, ammonia and hydrocarbons (such as propane, isobutane and propene/propylene) are naturally occurring and do not need to be chemically synthesised.

Subsidy scheme comes into play

The subsidy scheme seeks to reduce the energy consumption of refrigeration and air-conditioning systems and runs from 1 January 2017 until 1 January 2019.

“With regard to refrigerant use, the guideline focuses on a wider rollout of non-halogenated refrigerants,” Rolf Engelhardt – from the unit responsible for fundamental aspects of chemical safety

and chemicals legislation in the German Environment Ministry – told *Accelerate Europe*.

Applicable throughout German territory, the scheme is open to companies, not-for-profit entities, schools, hospitals, and municipalities and other local authority bodies, among others.

“One of the objectives of the amended directive is to simplify the application procedure. The guideline provides potential applicants with an easy formula to calculate the level of possible financial support,” Engelhardt says.

The amended directive extends funding to partial retrofits in addition to new system installations and full retrofits or replacements. Applicants can hope to be awarded a maximum of 150,000 EUR per installation, calculated on the basis of installation type (new installation or full or partial retrofit), cooling capacity and the refrigerant used rather than system cost.

- ▶ “Using the formula, it should be easy for the user to decide to install a non-halogenated refrigerant system with the financial support of the German government,” Engelhardt says.

All new installations must use natural (non-halogenated) refrigerants, with the exception of small compression refrigeration units of 2-5 kW (which can use refrigerants whose GWP is below 750).

Systems that adopt halogenated refrigerants with a higher GWP than the previous installation or where the switch is from a non-halogenated to a halogenated refrigerant are ineligible for subsidies.

Installations cannot take place until the applicant has received the grant notification. Under the previous regime, installation could begin following submission of the funding request.

Applications received on or since 1 January 2017 will be evaluated on the basis of the new criteria.

The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) first introduced the subsidy scheme in 2008 under the auspices of the National Climate Protection Initiative. The Federal Office for Economic Affairs and Export Control (BAFA) operates it.

Four system types to receive funding

There are four asset categories eligible for basic funding:

- ▶ Small compression refrigeration and air conditioning systems with 2-5 kW electrical power consumption;
- ▶ Compression refrigeration and air conditioning systems with 5-300 kW electrical power consumption (except ammonia plants);
- ▶ Ammonia plants with electrical power consumption of 5-200 kW, and;
- ▶ Sorption systems with 5-500 kW cooling capacity.

To help promote energy efficiency, applicants qualify for a bonus if the new or updated systems include the following features:

- ▶ Heat accumulator with heat exchanger for waste heat utilisation of the refrigeration or air conditioning system.
- ▶ Heat pumps for storing waste heat from the refrigeration or air conditioning system.
- ▶ Cold store with heat exchanger.
- ▶ ‘Free cooling’ equipment with pipes, pumps, tank, measuring technology and, if necessary, additional heat exchanger.

‘Free cooling’ refers to the concept of harnessing cold from the surrounding environment to provide cooling without involving a mechanical process. It can be used to improve the efficiency of the mechanical refrigeration cycle or be harnessed as a stand-alone cooling method.





Delivering Germany's *Energiewende*

The amended refrigeration and air conditioning directive is a key element of the German government's strategy for reducing f-gas emissions.

Germany's targets for delivering the energy transition – its *Energiewende* – require reducing overall greenhouse gas emissions by 80% to 95% in CO₂e by 2050 compared to 1990. The commitment to phasing down HFC use – centred on Germany's implementation of the EU F-Gas Regulation – is enshrined in the government's Climate Action Programme 2020, adopted by the cabinet on 3 December 2014.

The Action Programme facilitates the f-gas phase-down by providing for “diversified preparatory and flanking measures” to implement the F-Gas Regulation ahead of the deadline.

Promotion of natural refrigerants is one of these measures. The Programme pledges to “promote greater use of non-halogenated refrigerants (such as CO₂ or hydrocarbons) in vehicle air-conditioning systems, transport, and stationary refrigeration and air-conditioning units”.

Other activities introduced by the Action Programme include wider rollout of technical advisory services, training and continued professional development. Gradual implementation of all the measures enshrined in the Programme began in 2015. ■ **AW**

Throughout the EU, natural refrigerants will have a key role to play in the context of the HFC phase-down taking place under the bloc's new F-Gas Regulation, which entered into force in 2015 and aims to reduce Europe's HFC use by 79% by 2030.

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

The amended refrigeration and air conditioning directive stipulates that subsidised installations must be independently monitored for a minimum of five years to ensure efficient operation.

The scheme has thus far proven successful in triggering wider uptake of natural refrigerant-based systems in Germany. In 2015, it subsidised 253 more efficient cooling and refrigeration systems to the tune of €17.7 million, triggering investment of €93.5 million. During the programme's eight years of operation, it has supported 1,300 projects with subsidies totalling some €114 million – triggering investment of €600 million.



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California: *America's shining light*

The Golden State's national leadership on environmental issues – never more important given January's change of administration in Washington, D.C. – includes its latest plan to reduce emissions of HFCs and spark adoption of natural refrigerants.

– By Michael Garry



California Governor Jerry Brown, a longtime environmental advocate who acquired the moniker ‘Governor Moonbeam’ in the 1970s, came out swinging at a meeting of the American Geophysical Union in San Francisco in December 2016.

The 2,000 or so Earth and climate scientists in attendance were anxious about the incoming Trump Administration’s penchant for downplaying or denying the science behind climate change. But Brown sought to reassure them that his state – the most populous in the United States and one of the 10 largest economies in the world, as well as the 12th largest carbon emitter – would not backtrack on its ambitious climate goals regardless of national policy.

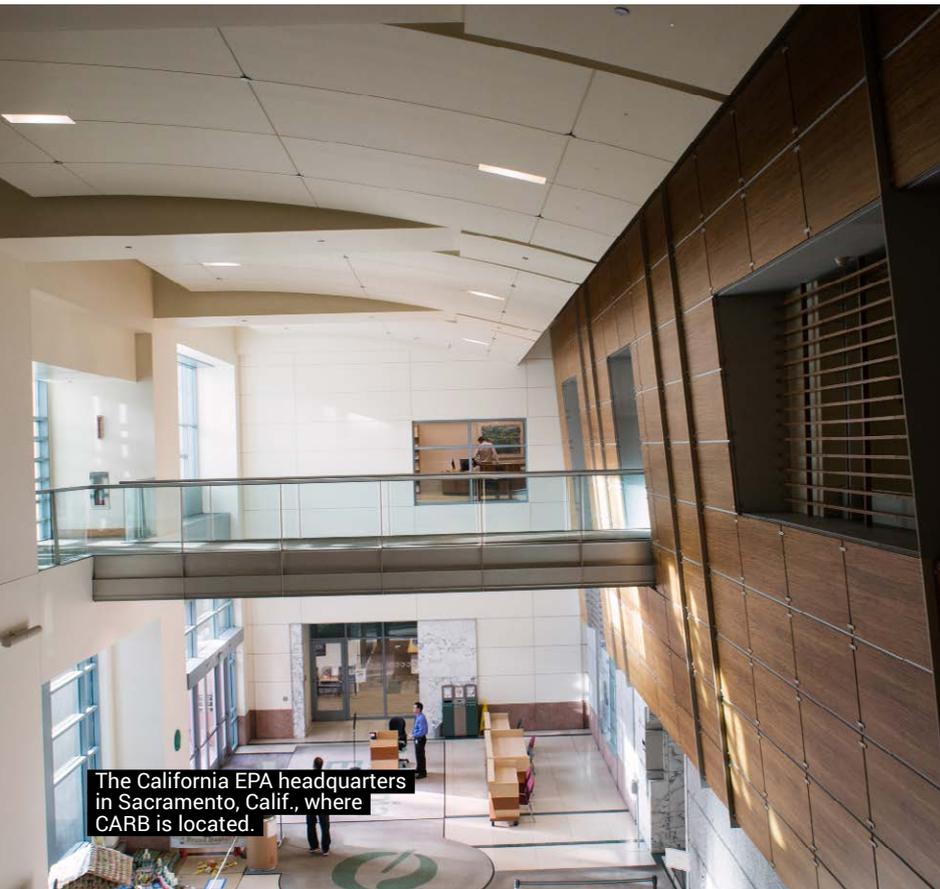
“We have the scientists, we have the lawyers and we are ready to fight!” declared Brown to thunderous applause. And he reminded them of California’s traditional and expected future role in leading the way for environmental progress in the US. “Our emission standards, our energy rules, drove US policy. We will set the stage, we’ll set the example, and whatever Washington thinks it is doing, California is the future.”

With regard to fighting climate change, California led the nation in 2006 with the passage of the Global Warming Solutions Act, or Assembly Bill (AB) 32, which established a comprehensive programme to reduce greenhouse gas emissions from all sources. Since then, the state government has adopted a cap-and-trade programme for emissions and updated its emissions reduction goal to 40% below 1990 levels by 2030.

On a global level, California has spearheaded the Under2MOU, an unprecedented alliance of 165 subnational jurisdictions (states and regions) representing more than one billion people and more than one-third of the global economy, which is focused on limiting global warming to below 2°C. The state has also signed a number of agreements to work with other countries on actions to fight climate change, including China and Mexico.

The state agency responsible for formulating and executing AB 32’s emission-reduction rules is the Sacramento-based California Air Resources Board (CARB). “California is determined to continue to play a leadership role in fighting climate change and ensuring that all Californians breathe clean air,”





The California EPA headquarters in Sacramento, Calif., where CARB is located.



Glenn Gallagher, CARB

says Glenn Gallagher, air pollution specialist at CARB. “We know there are other like-minded states that will continue to join with us in these efforts.”

In addition to CO₂ emissions, CARB is also targeting greenhouse gases known as short-lived climate pollutants (SLCPs) – notably methane, black carbon (soot) and HFCs (hydrofluorocarbons). These ‘super pollutants’ remain in the atmosphere for a relatively brief time but pack a powerful warming punch compared to CO₂, the most common greenhouse gas.

“Science tells us that controlling [SLCPs] will buy time for countries to make the transition to clean energy while continuing to grow their economies,” says Mary D. Nichols, chair of CARB.

With regard to HFCs (the fastest-growing source of greenhouse gas emissions), California’s Senate Bill (SB) 1383, enacted 31 August 2016, sets a target for a statewide reduction of 40% below 2013 levels by 2030. By phasing down HFC emissions from refrigeration, air conditioning and other sources, the state is surpassing the US Environmental Protection Agency (EPA) and helping to shape the course of the HVAC&R industry in California and beyond, opening the door for environmentally friendly alternatives like natural refrigerant technologies.

MIXED SIGNALS FROM AUSTRALIA

Australia, which infamously became the world’s first developed nation to repeal carbon laws that put a price on greenhouse gas emissions, has committed to reducing HFCs by 85% by 2036 as well as greenhouse gas emissions by 26-28% below 2005 levels by 2030. But it is yet to disclose how exactly this will be achieved.

Further mixed signals were sent to industry in the shape of the carbon equivalent levy on HFC refrigerants introduced in 2012, which was abolished in 2014. In addition, Australia is yet to put in place a robust national energy plan similar to those of EU-based energy agencies.

Meanwhile, California began regulating HFCs and HCFCs in 2011 with its Refrigerant Management Program, which requires end users of more than 50 lbs. of high-GWP refrigerants to conduct leak inspections, repair leaks and keep records; the US EPA only updated its leak inspection programme to include HFCs last year.

But the state will go much further in reducing emissions of HFCs and other SLCPs, as outlined in its Proposed Short-Lived Climate Pollutant Reduction Strategy. CARB will hold a public meeting of its governing board on 23-24 March 2017, when it will consider approving a final draft of the SLCP Strategy.

The Strategy calls for SLCP emission reduction to take place through a combination of voluntary and regulatory measures, including some that can promote adoption of low-GWP alternatives such as natural refrigerants. Among the proposed measures are: a ban on refrigerants with GWPs of 150 or more in new stationary non-residential refrigeration equipment and new residential refrigerator-freezers; a ban on refrigerants with a GWP of 750 or greater in air conditioning (non-residential and residential); and a prohibition on sales of high-GWP refrigerants (2,500 or more).

“CARB will focus on measures that can move low-GWP alternatives and technologies forward both nationally and internationally,” said the November edition of the Revised Proposed SLCP Climate Pollutant Reduction Strategy. With its wide range of climates, California “could be instrumental as a proving ground for low-GWP refrigeration and air-conditioning technologies that can be used in extreme environments across the world”.

The revised edition of the SLCP takes into account recent developments, notably the mid-October announcement in Kigali, Rwanda of an amendment to the Montreal Protocol, which calls for a global phase-down of HFCs. CARB will sponsor a third-party assessment of the impact of the Kigali amendment on HFC emissions and reductions in California.

CARB does not anticipate conducting its own HFC phase-down, “as long as the Kigali Agreement schedule proceeds as originally planned for the developed countries such as the US,” says Gallagher. Pending further review and analysis, he anticipates that the Kigali Agreement will result in HFC emissions reductions that could cover approximately 55% to 75% of California’s requirements (40% below 2013 levels by 2030).

A MULTITUDE OF NATREF INSTALLATIONS

With specific HFC regulations looming in the next few years, California’s food retailers, foodservice providers and industrial operators have been motivated to start implementing HFC alternatives, including many examples of natural

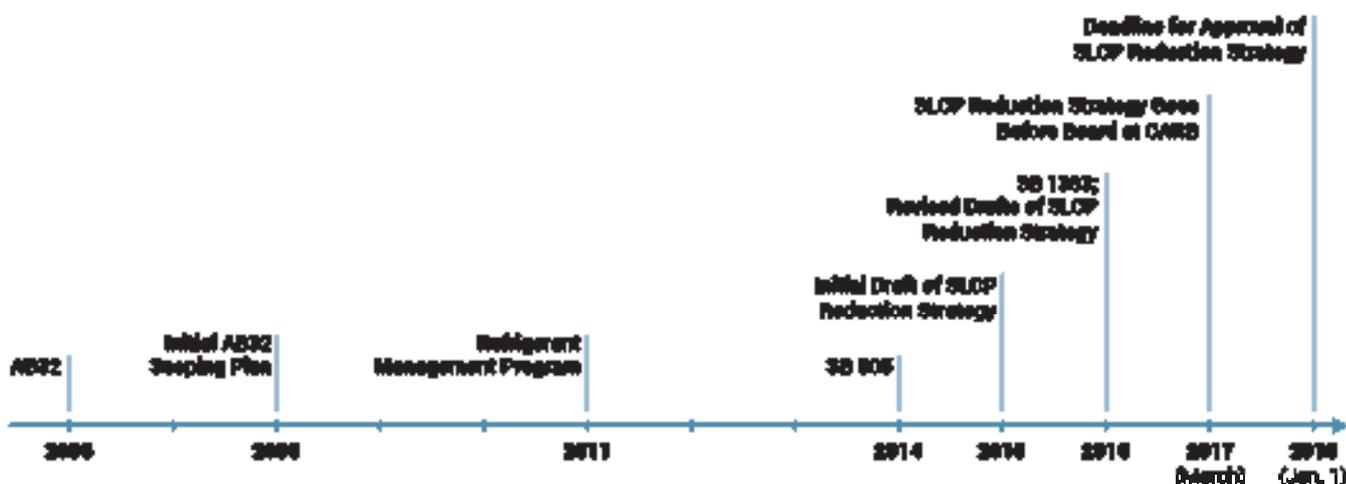
One indication of California’s leadership not just in natural refrigerant installations, but also leak prevention and charge reduction, is the number of stores that have received certification from the EPA’s GreenChill Partnership; three of the nine current platinum-certified stores and 16 of the 31 gold stores are located in the Golden State.

The US retailer with the most diverse array of natural refrigerant installations in California is Whole Foods Market. In addition to three HFC/CO₂ cascade stores in northern California, the organic/natural foods giant operates four stores with transcritical CO₂, one with ammonia/CO₂ cascade and one with propane/CO₂ cascade (see ‘Whole Foods Pushes the Propane Envelope,’ *Accelerate America*, October 2016).

Also, the majority of the approximately 68 Whole Foods stores nationwide that use self-contained propane cases are located in California. Whole Foods was “an early adopter of the True and AHT [propane] spec” for self-contained systems, says Tristram Coffin, director of sustainability & facilities in Whole Foods Market’s Northern California division.

Coffin estimates that 80%-90% of Whole Foods’ natural refrigerant stores are in California. “California is a champion for progressive environmental legislation, which is a further incentive for us to move toward naturals quicker,” he says.

Howell Feig, sales director for strategic accounts with AHT Cooling Systems US, estimates that of the more than 1,000 US stores equipped with the company’s propane display cases, about 100 are located in California.



Timeline for California Laws/Programs Impacting Natural Refrigerant Adoption



NXTCOLD low-charge-ammonia unit and cooling tower, on the roof of the Baker Cold Storage Facility, Long Beach, Calif.

US ENERGY UTILITY INCENTIVES

Another factor supporting the adoption of natural refrigerant systems in California is the availability of energy incentives from utilities to defray the initial cost of the technology. One of the more active utilities in this regard is SCE, led by Senior Engineer Paul Delaney.

“For Southern California Edison and other California utilities, it is about market potential and energy/demand savings opportunities,” Delaney said. Most of the incentives are of the ‘custom’ variety tailored to a particular system, though SCE is also working on developing ‘deemed’ incentives given for classes of equipment.

Delaney is seeing more interest in natural refrigerant systems among food retailers and industrial operators than he did several years ago. “The usual players are still investigating and trying to understand ammonia/CO₂, CO₂, propane and other systems,” he said. But the most activity with incentives has been with low-charge ammonia systems.

For example, SCE provided support from its ‘Emerging Technologies’ fund for evaluating a NXTCOLD low-charge ammonia system’s performance in comparison to a traditional flooded ammonia system at a Lineage Logistics plant. “This funding essentially paid for about half of a retrofit system, engineering analysis and report,” said Delaney.

The installation of 46 NXTCOLD units at a new Baker Cold Storage facility (overseen by Lineage Logistics)

in California will be receiving incentives through SCE’s ‘Savings by Design’ programme, which uses a “whole building” approach.

SCE is comparing the performance of low-charge ammonia systems “with more and more refrigerant baselines,” including R22, R404A, R134a, and R507A.

SCE is also in the process of developing deemed incentives for propane self-contained cases. The process involves validating performance, followed by custom-incented projects “where we collect enough data to make the CPUC [California Public Utilities Commission] happy,” Delaney said.

SCE has been less receptive to CO₂ transcritical, though it is now trying to work with interested customers in this space. “I am adding CO₂ transcritical systems to the laboratory efforts with EPRI,” said Delaney. “With national interest from other utilities I see expanding, what started as a low-charge ammonia system evaluation, to as many configurations and refrigerants that make sense.”

Delaney does not expect the change in administrations in Washington to deter what SCE and other utilities are trying to accomplish with energy-efficient natural refrigerant systems. “I would be very surprised considering the very large amount of money in EPIC [Electric Program Investment Charge] research funding and the CARB funding projects that reduce greenhouse gases,” he said.

“There is every indication that we are not slowing down our efforts to evaluate and influence market transformation.”



Low-temperature propane chillers on the roof of Whole Foods Market in Santa Clara, Calif.

Feig confirms the openness of California retailers to the technology. “No California retailer we have spoken with has objected to AHT’s propane systems,” he says. “In fact, they have been pleased to learn that we are providing a solution that uses a natural refrigerant which provides greater efficiency.” He attributes this to “the general population’s view of the environment, progressive/forward-looking legislation, and energy concerns”.

In the industrial refrigeration sector, California has been a hub for the installation of low-charge ammonia packaged systems, particularly those developed by NXTCOLD. While these systems are designed to replace refrigeration systems with much larger ammonia charges, they can also be used in lieu of industrial HFC systems.

The NXTCOLD system, developed by Chief Technology Officer John Scherer, is installed at 50 cold storage facilities operating across the US. In 2017, NXTCOLD units will be installed at a further 27 facilities, with the capacity of the units ranging from 15 TR to 75 TR.

Another industrial system, Mayekawa’s NewTon NH_3/CO_2 unit, was installed at the company’s Imuraya USA plant in California, which manufactures desserts for Japanese restaurants. Southern California Edison (SCE) and Mayekawa have been tracking the energy efficiency of the system and expect it to provide a 20-50% energy saving compared to an existing refrigeration system at the plant.

Though it is technology and chemical-neutral as far as low-GWP refrigerants are concerned, CARB recognises that natural refrigerants “are quickly proving themselves viable alternatives to high-GWP HFCs,” says Gallagher. He cites several natural refrigerant technologies as being among those that “compete in a growing market for low-GWP refrigeration,” including transcritical CO_2 , low-charge ammonia, self-contained propane cases, ammonia- CO_2 cascade systems, and propane- CO_2 cascade systems.

“The rapid development of low-GWP refrigeration and air conditioning equipment in the past few years has been remarkable, and a very welcome advance in technology,” Gallagher says. “We expect low-GWP options to become even better and less expensive in the next few years.”

Among low-GWP options, CARB includes HFO chillers and air-conditioning, and low-GWP HFO-HFC blends for refrigeration and air-conditioning, deferring to the EPA SNAP programme’s designation of HFOs/HFO blends as acceptable in certain applications. But CARB is aware of HFOs’ conversion to trifluoroacetic acid (TFA) in the atmosphere, with resulting TFA accumulations in surface waters.

“At this time, it is not clear if HFOs will lead to significant environmental harm or not, with some studies indicating that HFOs will not increase TFA levels to toxic levels, and other studies indicating great potential harm from HFOs,” says Gallagher. “However, CARB will continue to look into the potential long-term impact of HFOs contributing to increasing TFA concentrations to toxic levels in surface waters, and we have identified as a top f-gas research priority the potential HFO contribution to increasing TFA levels and any subsequent environmental impacts.”

California’s national leadership regarding natural refrigerants is reflected in its AU \$660,000 contribution last year to industry research on safety standards for A3 refrigerants (such as hydrocarbons) and A2Ls. Other entities in the project include the Air-Conditioning, Heating, and Refrigeration Institute (AHRI), the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), Johnson Controls, and the US Department of Energy. ■ MG



CO₂ condensing units blending Japanese, European know-how

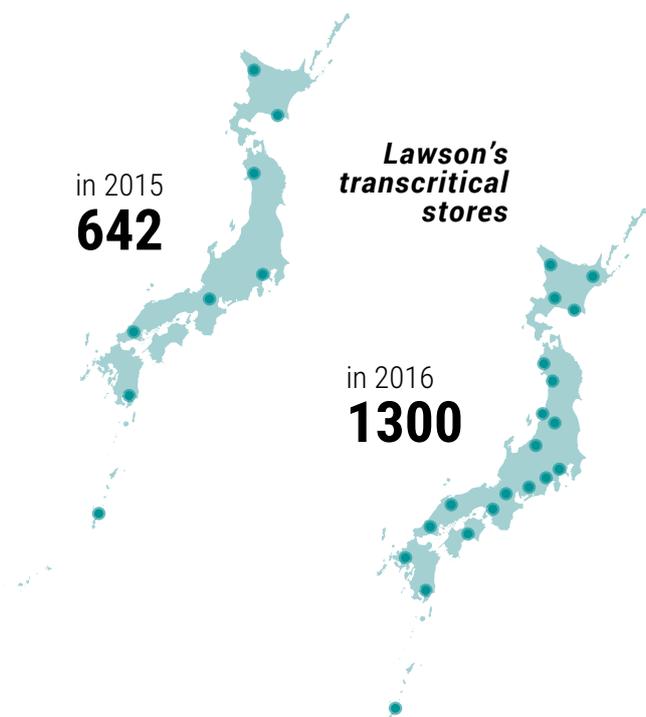
CO₂ refrigeration is reaching areas of application that some did not believe possible – thanks to the condensing unit. *Accelerate Europe* looks at how Japanese and European manufacturers are overcoming the challenge of bringing CO₂ to smaller stores.

– By Charlotte McLaughlin, Jan Dusek & Andrew Williams

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

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

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



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

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

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

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

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

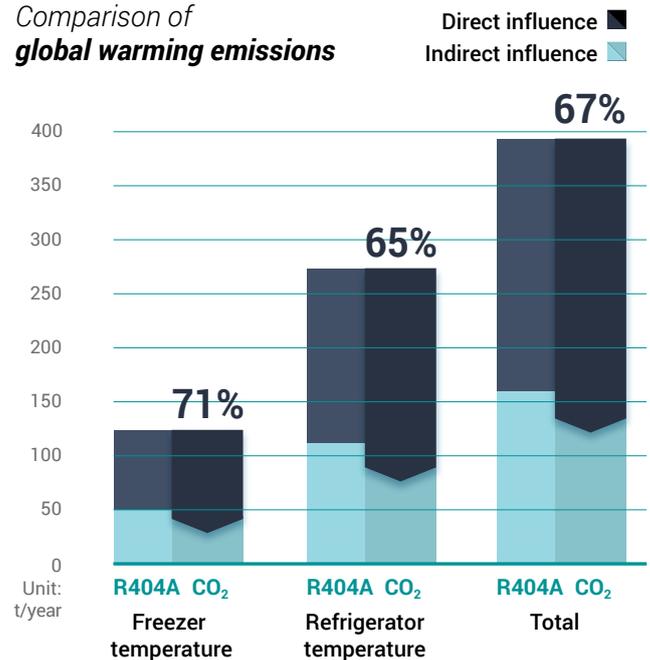
A 2016 report into the retail sector by management company Nielsen revealed strong growth globally, as well as in the European Union, for small format stores in particular. “Perhaps the new retail mantra should be ‘go small or go home,’ as the ‘bigger is better’ paradigm has been challenged virtually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

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

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

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

Comparison of global warming emissions



Source: Panasonic presentation at ATMOSphere Europe 2016, Barcelona

CO₂ vs. HFCs: Challenges and benefits

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

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

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

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

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

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

These and other manufacturers of tubes, fittings and valves for HVAC&R applications such as Wieland and Carly already provide equipment for pressures of up to 120 bars.

Panasonic, however, is taking a different approach by reducing the pressure of the CO₂ itself.

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

"In addition, our store controller optimises the refrigerant flow" to maintain the correct pressure, says Panasonic's Tachibana.

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

Condensing units vs. racks

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

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

SANDEN Europe's Gillaux believes condensing units could actually be more beneficial for stores than alternative CO₂

solutions. "Easy and versatile installation, limited footprint and weight, excellent sound pressure level, and unmatched flexibility are the main advantages quoted by clients," he says.

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

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

Making inroads into warm ambient climates

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

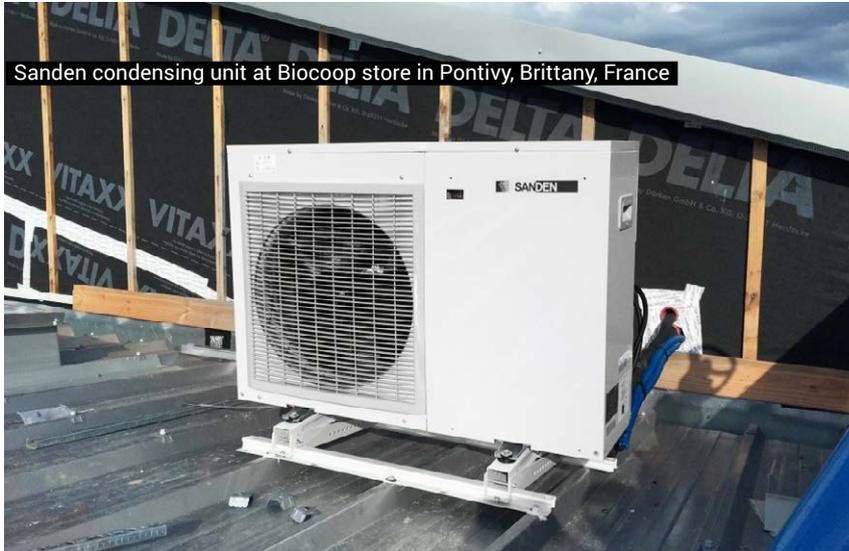
"Traditionally, warm ambient climates have not been particularly friendly towards CO₂ applications," says SANDEN Europe's Gillaux. "We've had good experience of three years in Japan where temperatures reach up to 45°C during summer [and] good operations in France last summer where temperatures were over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

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

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

Advansor compSUPER XXS CDU





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



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

Market on the up...and up!

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

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

SCM Frigo Managing Director Nicola Pignatelli believes that the market has developed significantly in recent years. "We have noticed an increasing demand for low-capacity units, so we are very near to reach cost parity and to have almost

a full switch to CO₂ products on these products," he says.

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

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

"We are already largely expanding sales [for other CO₂ applications] in the Pacific region (Australia, New Zealand) and also in South America (especially in Chile). We are also looking at the US market,

hoping that new political trends will keep on supporting the use of natural refrigerants," Pignatelli says.

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

Training and sales: two sides of same coin

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

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

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

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

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

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



Johan Hellman presenting Green and Cool's CO₂Y at Chillventa

“We are going to sell our condensing units through Panasonic Home Appliance Air-conditioning Europe (‘PAPAEU’). We hope to utilise some of the product training centres of PAPAEU that are currently in 11 countries in Europe to launch the product,” Panasonic’s Tachibana told *Accelerate Europe*.

“We have already been approaching installers and will hold installation training this March before launching the product this spring in Europe,” Tachibana concludes.

CO₂ race heating up

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

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

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

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

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

“The 2-9 kW segment, which CO₂Y falls into, has enormous future potential since there has not been an economical

environmentally friendly alternative until now,” says Joakim Westerberg, responsible for refrigeration appliances at Kylkvalitet, a Swedish supplier of Green & Cool systems.

With other companies already getting a foothold in Europe, is Green & Cool ready to rise up to the challenge?

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

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

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

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

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

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

MHI is expected to introduce its new CO₂ condensing unit at the upcoming ATMOsphere Japan 2017 conference, taking place in Tokyo on 20 February 2017. ■ CM, JD & AW

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Euroklimat's factory in Sizano, Italy

Hydrocarbons making inroads into supermarket sector

Italian family company Euroklimat S.p.A. is eyeing the commercial refrigeration market as a potential growth area for its wide range of propane chillers.

– By Charlotte McLaughlin

“In our opinion the most interesting sector is commercial refrigeration, but potentially many other sectors could use hydrocarbons too,” Matteo Gaggianese, marketing manager at Euroklimat, told *Accelerate Europe*.

Euroklimat's range of EKO propane chillers and refrigerated units are commonly used in cold storage or to refrigerate food in supermarkets at a controlled temperature. These machines cover medium (-8°C) and low (-25°C) temperature applications.

Currently, the company has seen great success with large retail chains, installing systems throughout Europe. In Italy, Romania and the UK, Euroklimat has installed its EKO chillers in stores belonging to multinational retailers METRO AG and Carrefour, along with UK supermarket chain Waitrose.

Gaggianese applauds the retail industry's forward-thinking resolve to use natural refrigerants. “The sector of large retail chains is certainly one of the most attentive to natural refrigerant solutions. We believe that there may be many opportunities for development in this area.”

In addition to air-cooled water chillers, Euroklimat manufactures air conditioners and heat pumps for comfort as well as process applications.

The company has resolved to invest more in getting the technology out there. “We definitely plan other installations in this market, where we can consider ourselves the leader in terms of number of installed units and by offering the more complete product range,” Gaggianese argues.

Old history, bold new future

During most of Euroklimat's fifty years of activity, it has been located in Siziano, Pavia province, in the industrial heart of the Lombardy region in Italy.

In Siziano, the firm still produces many of the chillers destined for the European market. Its technical design, research and development teams for its chillers are located there.

Euroklimat is also becoming increasingly active in the Middle East, opening up a regional office in Dubai last year. Located in the High Bay Complex in Dubai Silicon Oasis, the office will support the Italian company's customers and distribution network across the region.

The company reports growing demand for consultancy work and assistance from customers and partners in the Middle East. “Euroklimat strongly believes that its presence in such a dynamic area will allow [it] to better support [...] growth and the acquisition of new business opportunities,” the Italian manufacturer said.

Exciting times for commercial refrigeration

At the moment HFCs represent more than 90% of Euroklimat's portfolio, with hydrocarbons accounting for approximately 10%. The company expects this to change in a big way, particularly once HFCs in centralised commercial refrigeration systems above 40 kW are phased down under the new EU F-Gas Regulation in 2020 (with the exception of the primary refrigerant circuit of cascade systems, where f-gases with a GWP of less than 1,500 may be used).

“Euroklimat is investing heavily in developing [hydrocarbons-based] products through laboratory and field tests, both to check the performance and the effectiveness of the security systems used in chillers,” Gaggianese says.

“In our view, hydrocarbons are attracting a lot of interest – what we think is important is to make clear to experts that the industry could quickly adopt these solutions without upsetting the entire production chain,” he says.

Training and charges limits can pose challenges for end users wishing to switch from HFCs to natural refrigerants. He fears that, “the overall market is not yet ready for the massive use of propane as a refrigerant”.

Increased training would turn this around. “Adequate training centres could certainly accelerate this process, which otherwise threatens to become too long and difficult [...]. This could ensure adequate technical expertise, so that machines and plants are kept safe,” Gaggianese says.

Much relies on industry as a whole becoming more aware of the “advantages of using this technology,” he argues. “It would require greater support on the part of designers and consultants.”

Most countries in Europe and worldwide impose a maximum charge limit for hydrocarbons of 150 grams. This raises the cost of the installation, because two compressors must be used and the machines must be housed in a separate room.

Gaggianese believes this will change soon: “We expect the current rules to be revised to allow more widespread examples of propane cooling systems. This represents a strong opportunity for us to grow, even in areas where there are today low charge limits.”



Euroklimat's Prima W propane chiller



Matteo Gaggianese, marketing manager at Euroklimat

New applications for hydrocarbons

The energy-efficient performance of hydrocarbons and especially propane is widely recognised. A recent report on hydrocarbons by natural refrigerant industry group Eurammon stated: “Propane, for example, is considered to be one of the most efficient refrigerants [...]. Due to their beneficial properties, hydrocarbons also have the potential to develop new areas of application.”

In 2015, Euroklimat committed to investing 1.5% of its annual turnover in natural refrigerant-based R&D. “Our mission for the future is to become the market leader in the construction of R290 chillers,” said Euroklimat CEO Michele Bedin upon unveiling the company's portfolio of natural refrigerant-based technologies for 2017.

“Our air-cooled solution, with axial fans for outdoor installation, is much in demand due to its efficiency,” Gaggianese says.

Euroklimat hopes to roll them out in chemical and pharmaceutical applications. “This solution is highly appreciated as it allows multinational companies to maintain a level of environmental sustainability in line with their policies,” he says.

Roche, a large pharmaceutical company, has collaborated with Euroklimat in Mannheim, Germany. Roche makes products there for people with diabetes and cardiovascular diseases, as well as in-vitro diagnostics.

Euroklimat's air-cooled water chiller with 30 kW cooling capacity, using a semi-hermetic compressor, was installed in the Roche facility. It was equipped with an inverter for precise temperature control.

“This involved special software designed specifically for this customer, as well as an electrical part that conformed to the specifications provided by Roche,” Gaggianese explains. The unit was installed in 2014 and has been working perfectly since then.

Euroklimat is going to launch new chillers and other products for hydrocarbons this year. “At the moment we are creating a range of high-efficiency propane heat pumps,” Gaggianese says. ■ CM

Natrefs Down Under: What to expect in 2017

In Australia and New Zealand, local vendors are optimistic about the technological innovations, policy developments and evolving standards that are creating new opportunities for natural refrigerants in industrial applications. *Accelerate Australia & NZ* reports.

– By Devin Yoshimoto, James Ranson & Andrew Williams

Australia's uniquely remote landscape and strong agricultural sector has produced a long history of large-scale industrial plants using ammonia.

In modern times, the focus has been on optimising energy efficiency and reducing the ammonia charge, and as a by-product, carbon emissions, by harnessing cutting-edge technology.

It's no surprise that the convergence of these two goals has given rise to the proliferation of low-charge ammonia technology not just in Australia but all around the globe, as updated regulatory guidelines pave the way for increased uptake of this historic natural refrigerant.

In the US, for example, a growing number of industrial refrigeration end users are installing packaged low-charge ammonia units, in a major break from traditional refrigeration technology.

The NXCOLD low-charge packaged ammonia refrigeration system has already been installed in several big cold storage facilities like LA Cold Storage, Lineage Logistics, Baker Cold Storage and Neptune Foods.

The beauty of the technology is that low-charge NH₃ systems can be applied in much smaller applications than conventional NH₃ 'liquid overfeed' systems, typically used in semi-industrial applications of 30-50 kW and above.

Low-charge ammonia taking hold Down Under

Scantec, a leading Australian supplier of low-charge ammonia systems, recently commissioned two new projects, in Melbourne and Brisbane.

Scantec Managing Director Stefan Jensen argues that low-charge NH₃ systems can deliver 3-4 times as much cooling capacity per kilogram of charge than liquid overfeed systems.

"We recently commissioned our new low-charge NH₃ ScanPAC in Melbourne; this has an alcove evaporator with automatic ambient air defrost," says Jensen.

The Brisbane project, for a Japanese end user, was recently completed under significant time pressure, the Scantec boss reveals. The end user relocated from other premises to meet increasing demand for its product and was after a premium system.

"In Brisbane, the first stage compressors operate at -27°C saturated suction temperature, and the corresponding freezer store temperature is -22°C. This particular plant employs Japanese compressors and custom-engineered evaporators with special circuiting and distributors from a German manufacturer," Jensen says.

He is quick to point to the various benefits of low-charge systems compared to industry standard HFC-based systems, and for good reason. "The only feedback from the end user we've had is happiness."

"The initial capital investment differential between an industry-standard HFC-based, single-stage compression system (with air-cooled condensers and electric defrost) and a state-of-the-art low charge NH₃ system is usually returned in three years," Jensen says.

"The documented annual energy consumption difference between the two scenarios described above is 40 to 67%, depending on the circumstances, with the low-charge NH₃ system being the best performing," he reveals.

Jensen was discreet regarding confidential new projects but mentioned three more low-charge systems currently under construction in Sydney, Brisbane, and Dongguan in China.

In the US, meanwhile, the market continues to see impressive demand for low-charge technology.

"Owners and contractors are rapidly learning about the success of recent low-charge ammonia projects and their inherent benefits," says Kurt Liebendorfer, vice-president at Evapco.



Scantec's recently commissioned low-charge ammonia ScanPAC system, Melbourne



Three multi N6HK heat pump units, meat processing plant, South Australia

► Cascade technology steps up to the plate

While stand-alone ammonia systems cater to various industrial applications, the market is currently marked by another trend – the adoption of NH_3/CO_2 cascade systems.

United States Cold Storage (USCS) – a refrigerated storage and logistics company – has now fitted 12 of its 36 cold storage facilities across the US with NH_3/CO_2 technology.

Mike Lynch, vice-president of engineering at USCS, is convinced. “The use of natural refrigerants such as ammonia and carbon dioxide, when used in a cascade refrigeration system, allows [companies] to operate very safe and highly-efficient refrigeration systems. We expect to bring another two to three new NH_3/CO_2 cascade refrigeration systems on line in 2017.”

Ian Wilson, project engineer and co-owner of Australia-based Strathbrook Industrial Services, has worked on his fair share of large-scale CO_2 systems, including some of the first CO_2 transcritical systems in the country.

The company provides bespoke CO_2 and ammonia refrigeration plants for industrial end users and sees a combination of both refrigerants as a clear path forward.

“We currently hold two patents. The first is for our transcritical CO_2 system with the high demand, post-gas cooler chiller; and the second is an innovative freezer floor heating system,” Wilson says.

“The transcritical system basically ensures the plant never runs in supercritical mode – therefore it maintains the best possible energy efficiency. The floor heating technology extracts heat from the liquid refrigerant and passes the heat into glycol that is pumped through the freezer floor.”

As Wilson explains, this warms the freezer floor and sub-cools the liquid at the same time, essentially ensuring free floor heating. “Who do you know that has a freezer floor that pays you to provide the under-floor heating, rather than gives you a power bill?!”

The global demand for industrial transcritical CO_2 is such that Danish manufacturer Advansor has now dedicated a team to the industrial sector. “We’ve realised that the demand for transcritical [in the industrial sector] has grown to the level where we can go in that direction,” says Advansor’s industrial sales manager, Mark Kristensen.

Most of Advansor’s industrial transcritical systems operate in cold storage facilities. “But blast freezing for food processors is a growing area, because you can operate the systems down to -48°C ,” says Kristensen. “You don’t need a more complex cascade system; it’s purely CO_2 .”

US-based Hillphoenix, Advansor’s parent company, has installed 250 CO_2 transcritical racks in the last three years, while Dorin S.p.A, Systemes LMP and Green & Cool (Carrier Group) are among the manufacturers expanding their global reach and overcoming performance challenges facing CO_2 transcritical systems in warm climates like Australia’s.

Japanese manufacturer Mayekawa, known for its NewTon NH_3/CO_2 systems for small and large industrial applications, offers its Unimo CO_2 heat pump on the Australian market.

Mayekawa’s Australian arm has already installed five UnimoAWW dual heat source CO_2 heat pumps Down Under. Mike Ono, senior consultant – industrial automation at Mayekawa Australia, confirmed the fifth installation for the King International Group’s soy product processing centre in Brisbane at the end of 2016.



Evaporator coil, low-charge DX ammonia system

NewTon NH₃/CO₂ system

A bridge to ammonia

Strathbrook's Wilson – a man who clearly embraces a challenge – says ammonia will be central to the company's plans.

"Natural refrigerants require interesting systems, and I like a challenge. If everyone waits for someone else to do a thing, it doesn't get done. If you do the numbers and the theory stacks up, have some confidence in yourself and have a go!" he says.

"I think ammonia is a great gas. If it didn't smell so bad, it would be everywhere! That's not to say it's always the best choice, because it isn't, but it certainly performs very strongly in particular application ranges. It's a no-brainer if the system is in the megawatt range," Wilson says.

Strathbrook is looking at cold storage and distribution centres, namely clients who are looking for long-term gains with systems that are not carbon-intensive and thus insulated from climate change regulation.

"Our super low-charge ammonia chillers are being further developed to simplify the build process and see if we can lower the cost. The fact that the COP is more than twice as good as a Chinese-assembled R134a chiller doesn't mean everyone wants one!" Wilson says.

Like Strathbrook, Scantec sees a significant role for ammonia if manufacturers can persuade end users of the greater long-term energy efficiency and cost gains available.

What sets Scantec's systems apart is that instead of pumping the refrigerant around, they utilise the normal pressure differences in the system – between condensing and evaporating pressure – to facilitate the process. "We've redesigned the way the evaporators are circuited, we have refined the way the temperature, pressure and quality sensors are positioned, and we have paid particular attention to the thermal conductivities of the evaporator materials," Jensen says.

Scantec has also developed a new control system that modulates injection into the evaporators. The control methodology relies on a combination of super-heat signal and quality signal at the evaporator exit. "We believe this control principle can be applied very broadly and very cheaply to a range of applications, including air conditioning. It's simply a matter of numbers to get the price down," Jensen says.

Standards and regulations

Safety regulations govern the use of ammonia in Australia.

"Once it becomes known what additional safety measures the new 4,500 kg ammonia inventory threshold in AS/NZS 5149 triggers, then the impact on systems with large charges could become as significant as PSM/RMP compliance is in the US. The latter is triggered by an ammonia inventory of 10,000 pounds (4,536 kg) – 5,000 pounds in some jurisdictions," Jensen explains.

In response, Scantec is continuing to test new concepts that place the issue of future regulatory compliance firmly in the rear-view mirror.

"Suffice to say that 2017 will most likely be the year where a totally new hot gas defrost concept will be tested and verified," Jensen says. "This has the potential to further reduce ammonia inventories in low-charge NH₃ systems of the central type."

"There will also be an expansion of low-charge NH₃ technology into areas other than refrigerated warehouses," the Scantec boss says.

"Similar trends are visible in other jurisdictions – in particular in the US. It will not be possible, however, to sacrifice energy efficiency in return for ammonia inventory reduction. This would go against the intent of [climate objectives]," says Jensen.

Low-stage CO₂ system for freezer roomHigh-stage CO₂ system

Herein lies the real engineering challenge. “This is where the new hot gas defrost system mentioned previously can contribute further to additional charge reductions,” he argues.

Strathbrook’s Wilson, meanwhile, points out that the elephant in the room – R22 (with a GWP of 1,700) – still lingers on the market. “R22 is still out there in large volumes and most of the systems we have removed have been replaced with chemical refrigerants,” he says.

State of the market

For Scantec’s Jensen, one of the most significant challenges facing the HVAC&R sector is shortsightedness. “Unfortunately, large sections of the ammonia industry are quite conservative and want to keep providing the same proven solutions year-in and year-out, with minimum risk and innovation,” he says.

“Owners and operators of warehouses are, to a significant extent, unaware of what is emerging globally and what the

consequences will be for them. Often their local service provider is unable to offer future-proof solutions based on natural refrigerants, and most owners rely completely on local service providers for refrigeration advice,” Jensen says.

Charting a more environmentally friendly course can be problematic if service providers are reluctant to transition away from the HFC systems they are familiar with.

“New cycles of synthetic low-GWP refrigerants do very little for energy efficiency but will gain temporary market share based on convenience, lack of skills and short investment horizons. The result will be that end users pay twice, when they should only pay once to get a future-proof system,” Jensen argues.

Strathbrook’s Wilson believes that some end users and operators are simply unaware of the benefits of looking ahead that little bit further.

“The biggest obstacle is that there is a lack of understanding of how much cheaper it is to own a natural refrigerant system than

an HFC system," Wilson says. "We are seeing power reductions of 60% compared to a conventional R404A system. The payback is usually about five years between the two, so it's not for everyone. Power is not going to get cheaper, ever! Less power is the only way to reduce your cost and higher power cost shortens the payback."

Policy dimension

While government can play a key role in helping, managing, and encouraging change, Jensen sees lack of government aid as the biggest failure in Australia's case. "To ensure the long-term survival [of the industry] this needs to change, but it needs to happen without individual business entities accepting excessive technical and commercial risks. For instance, the industry could be assisted by government with funding for demonstration projects."

One way government can help is by implementing a change management process. "This should be put in place rather than merely leaving it to industry to deliver what is needed for compliance with the COP21 agreement this government ratified, as well as the amended Montreal Protocol," Jensen argues.

"This is, to a very large extent, a function of how change is managed. This is a responsibility that rests with government. The Australian government has issued conflicting signals previously in relation to environmental issues. One example was the carbon tax. Another was the carbon equivalent levy on HFC refrigerants introduced in 2012 and abolished in 2014," he says.

Wilson, too, admits that the carbon tax helped a great deal. "Since its removal, most of our competitors offer R134a and R404A, and in the majority of cases the end user wants the cheaper option. The industry has a long way to go before it's ready for the HFC phase-out that's inevitably coming."

What's next?

Jensen urges the Australian government to move quickly to implement the Kigali amendment to the Montreal Protocol, which obliges developed nations to phase down HFCs by 85% by 2036.

"It is also worth observing that Australia does not appear to have a national energy plan similar to some of the EU-based energy agencies that were implemented following the energy crisis way back in 1974," he says.

"Now that the Australian government has joined with 196 other parties in amending the Montreal Protocol and also finally ratifying the COP21 agreement, it is time to send a clear signal to industry as to what the direction for HVAC&R will be," Jensen believes.

The market needs clear signals as to which way the wind is blowing. "A ban on the use of HFC refrigerants in all new



CO₂ gas cooler & two ammonia chillers, Melbourne

refrigeration and air conditioning systems effective as of 2025 (with a charge exceeding 5 kg and all new systems with a charge less than 150g) would send such a signal," he argues.

Jensen believes there are huge opportunities for the industrial refrigeration sector to improve performance through more active engagement and co-operation with the private sector and all levels of government.

"Replacing the bulk of the HVAC&R stock in Australia is a must. The very significant energy savings that will potentially flow from that (if the government plays its cards right) represent an opportunity for the nation to improve its competitiveness internationally," he argues.

As attention turns to the longer term, it is clear that Australian industry has an opportunity to capitalise on its technological knowhow to bring natural refrigerant solutions to a wider audience. ■ **DY, JR & AW**

Going for a drive in a water-cooled home

Travelling around the UK in his self-built mobile home, Richard Perkins has prototyped a complete cooling system with water as the refrigerant.

— By Charlotte McLaughlin

Mechanical engineer Richard Perkins left his job two years ago in Glasgow, UK to follow his dream of building a more sustainable mobile home.

The journey was a long time in the making. “I left work two years ago to follow my dreams which, incidentally, are pretty much the same dreams I had when I was six years old: to make life better and more fun for myself and others,” Perkins says.

His dream was a simple one. “I had a desire for minimalist surroundings, but would feel claustrophobic in a traditional tiny house - I’m 6’3” (1.92m) tall! I wanted water without having to be connected to municipal services. I wanted a way to grow food all year round within arm’s reach. And I wanted ways to recycle all organic waste and to cook and heat with renewable energy sources...and for all of this to be incorporated into a transportable unit,” he explains.

As an ex-employee of Star Technical Solutions (a division of UK-based Star Refrigeration), Perkins has over 10 years of experience in designing refrigeration systems. This came in handy when he started to design and construct his very own folding house called the NoHA BiOS or No Home Address, as he currently has no home address and is travelling around the UK nomadically.

The 800 square-foot folding structure only costs £16,000 to build and aims to provide a self-sufficient and sustainable lifestyle.



Harnessing a water generator unit

The South African engineer developed a solar-powered, off-grid atmospheric water generator unit to cool and collect water for his new home.

The unit captures the moisture in the air to provide “an optimised air-conditioning system to condense moisture from the air to provide water for drinking, washing and cultivation of plants. Besides allowing complete freedom of movement without having to worry about a local water source, having such a unit installed in the house will provide refrigeration for food as well as cooling and heating for the inside space,” he says.

The four-room, two-story house comes complete with a roof garden, which can be used for growing fruit, vegetables and herbs.

He sees it as, “a living platform designed to challenge the norms, to redefine the idea of a house as a home...a vision to create a spacious, light and airy structure that provides the benefits of mobile living without the limitations of mobile homes, and offers the advantages of traditional static homes without the associated costs and disadvantages”.

He originally paid for part of the folded house by selling his own Glaswegian home but now he aims to complete the prototype of the two-story folding house, and produce the necessary documentation for plans and assembly instructions, via a Kickstarter campaign.

“My aim is to make the design available to as many people as possible in both developed and developing countries so that anybody can build it for themselves at minimum cost, as most of the structure is made from off-the-shelf materials and components,” he says. ■ CM



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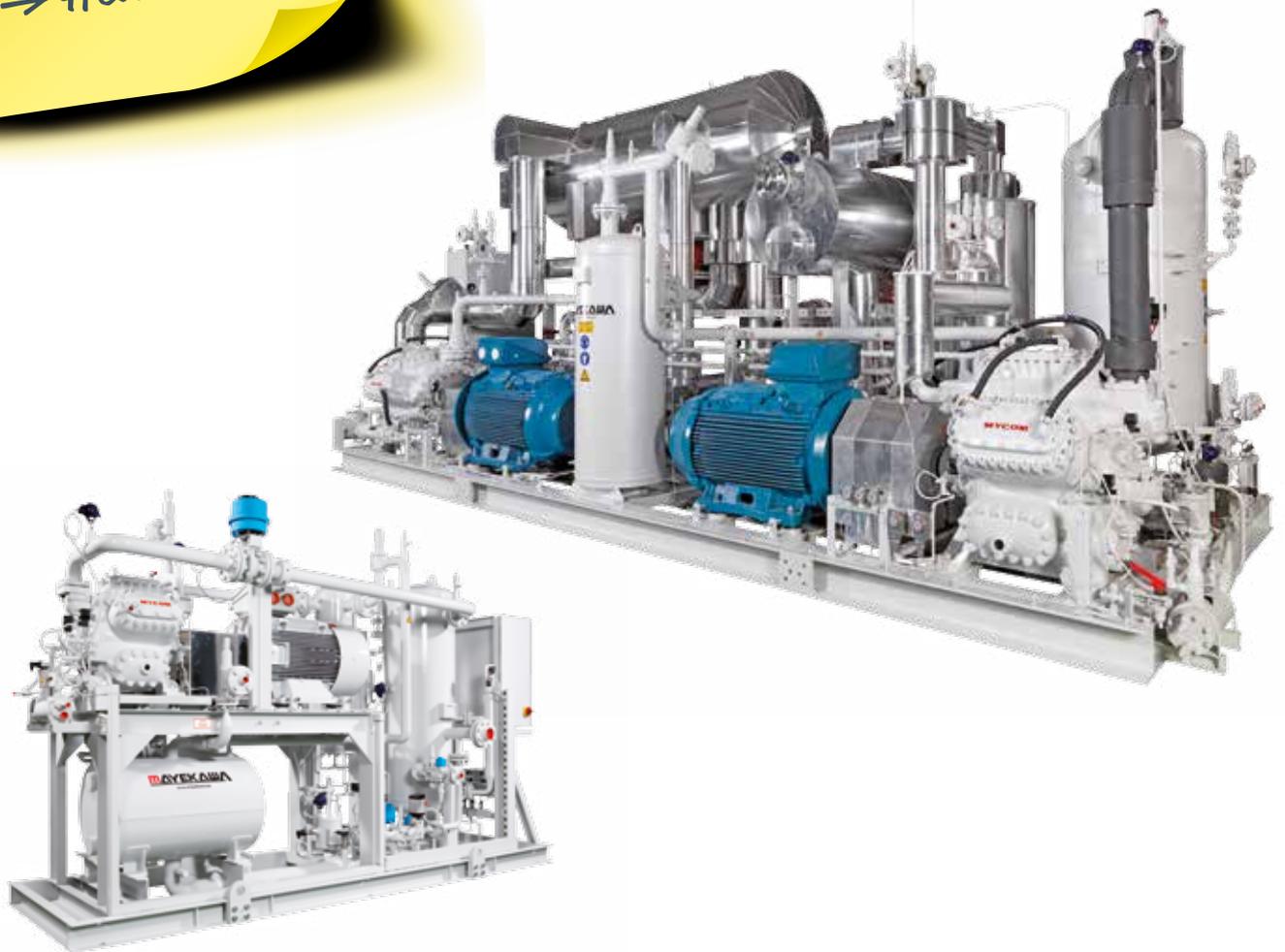
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