

AUTUMN 2016

ACCELERATE

ADVANCING HVAC&R NATURALLY

EUROPE

HANS-DIETER BRUSS

Vice-President
Construction &
Facility Management
TRANSGOURMET CEE

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Editor's note by
Andrew Williams

A BOLD NEW DAWN FOR NATURAL REFRIGERANTS



As the HVAC&R industry prepares for key events in Nürnberg and Kigali in October, the autumn edition of *Accelerate Europe* captures the momentum of leading industry players who are putting natural refrigerant solutions on the radar of manufacturers and users throughout Europe.

While industry experts browse the latest technology innovations at the Chillventa tradeshow in the German city of Nürnberg on 11-13 October, the countries of the world will come together for the 28th Meeting of the Parties of the Montreal Protocol in Kigali, Rwanda. With an agreement to phase-out HFCs globally looking likely, there is not a second to lose in ensuring that the natural refrigerant sector seizes this unique opportunity to provide market-ready alternatives to climate-damaging HFC systems.

Many key market players in Europe are already doing just that. Food retail giant the Transgourmet Group is putting natural refrigerant technology at the heart of its strategy for becoming CO₂ neutral by 2023. Hans-Dieter Bruss, vice-president in the group's Central and Eastern European arm, explains how the group is adopting CO₂ for all refrigeration, air conditioning and heating applications, not only in new and updated stores but also in distribution centres ([p. 24](#)).

Another major European retailer is pioneering natural refrigerant solutions too. The Colruyt Group is saving money and achieving its environmental targets by adopting 100% natural refrigerants for all its cooling needs. Project Engineer Collin Bootsvelde and

his team have opted for a custom-built propane solution for in-store cooling ([p. 34](#)).

With a historic HFC phase-down agreement seemingly imminent, researchers worldwide are working hard to find the future-proof technological solutions that will allow natural refrigerants to thrive for decades to come. At the 12th IIR Gustav Lorentzen Natural Working Fluids Conference in Edinburgh, over 270 HVAC&R industry experts gathered to discuss the latest technological and policy developments driving wider uptake of natrefs worldwide ([p. 16](#)).

The French refrigeration market – with end users turning to consultants in order to commission new systems – is somewhat unique. The natural refrigerant sector in France looks set to thrive as customers look to install future-proof solutions ([Sifa tradeshow report; p. 40](#)).

Reports from our recent ATMOsphere America conference, held in Chicago ([p. 56](#) and [p. 60](#)), and a preview of our new GUIDE to natural refrigerant technologies on display at Chillventa ([p. 68](#)) also feature in this autumn edition of *Accelerate Europe*.

I thank you for your continued interest in our magazine and wish you a successful Chillventa. Please visit us there from 11-13 October at Booth 7-6161, Hall 7. I look forward to seeing you in Germany!

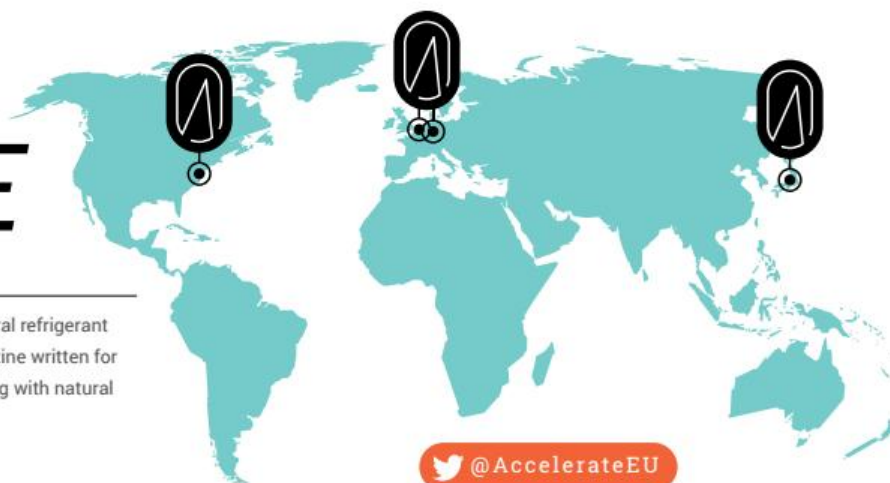
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ACCELERATE

ADVANCING HVAC&R NATURALLY

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.

<http://accelerateEU.com>



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Scaling new heights in Romania

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

HANS-DIETER BRUSS

Vice-President
Construction & Facility Management
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Publisher

Marc Chasserot

marc.chasserot@shecco.com

[@marcchasserot](https://twitter.com/marcchasserot)

Editor

Andrew Williams

andrew.williams@shecco.com

[@a_williams1982](https://twitter.com/a_williams1982)

International Editors

Michael Garry

michael.garry@shecco.com

[@mgarrywriter](https://twitter.com/mgarrywriter)

James Ranson

james.ranson@shecco.com

[@jranson_shecco](https://twitter.com/jranson_shecco)

Contributing Writers

Alvaro de Oña

Charlotte McLaughlin

Klára Skačánová

Justina Tamasiunaite

Lauren Clark

Advertising Manager

Alvaro de Oña

Events Coordinator

Anastasia Papagiannopoulou

Art Director

Mehdi Bouhjar

Graphic Designers

Charlotte Georis

Anna Salhofer

Photographers

Scott Chasserot

Ben Beech

Dan Câmpian



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CHILLVENTA
11 – 13 October 2016

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COOLING DOWN GLOBAL WARMING: TIME TO SHOW AMBITION IN HFC PHASE-DOWN NEGOTIATIONS



An agreement to phase down hydrofluorocarbons (HFCs) is within reach as we approach the 28th Meeting of the Parties to the Montreal Protocol in Kigali – but will it be ambitious enough?

The right agreement could avoid more than 100 billion tonnes CO₂ equivalent emissions by 2050 and double that climate mitigation through energy efficiency improvements. To maximise success, developed countries need to lead by example and commit to early, strong reduction measures that will drive the global market for climate-friendly alternatives and give confidence to developing countries that early action on HFCs is technically and economically feasible.

HFCs are the fastest growing greenhouse gases in the world, primarily due to their use in air-conditioning; a whopping 700 million air-conditioning units are expected to be installed globally by 2030, rising to 1.6 billion by 2050. But an ambitious HFC phase-down agreement can ensure that developing countries maximise opportunities to install energy-efficient equipment with climate-friendly refrigerants.

Although HFC use is widespread in developed countries, most developing countries are still dependent on hydrochlorofluorocarbons (HCFCs) for their cooling and can avoid much of the HFC phase-in. For this reason, Parties to the Montreal Protocol must consider an early action scenario for developing countries and near-term funding to allow them to leapfrog HFCs as they implement the HCFC phase-out.

An ambitious phase-down schedule for developed countries with an early freeze date and strong near-term reduction steps will build credibility and confidence for developing countries to follow suit and incentivise a strong uptake of future-proof

cooling technologies. But certainty related to adequate financing – with incentives for early movers, technology transfer and capacity-building – must also be part of the support package for developing countries.

An ambitious amendment will signal huge opportunities for the natural refrigerant industry, especially the rapidly expanding air-conditioning sector which will have to switch to very low- or zero-GWP alternatives. Hydrocarbons are currently the most attractive alternative on the table; unlike new low-GWP HFC options, they are cost-effective, work efficiently at high ambient temperatures and are free of potentially costly intellectual property issues.

To make this change to sustainable cooling, governments and industry must now work together to revise outdated industry standards which currently prevent a greater uptake of propane and other flammable refrigerants.

A vast and incontrovertible body of evidence shows that climate change is advancing at an unprecedented pace. After the historic Paris Agreement, the cooling industry now needs to play its part in turning down the heat.

Parties to the Montreal Protocol, the most successful environmental treaty to date, can once again demonstrate genuinely progressive global leadership by agreeing an amendment in Kigali that will maximise our chances of limiting the global temperature rise to 1.5°C and meet our future cooling needs in a sustainable way. **CP**

Clare Perry is senior campaigner at the Environmental Investigation Agency.

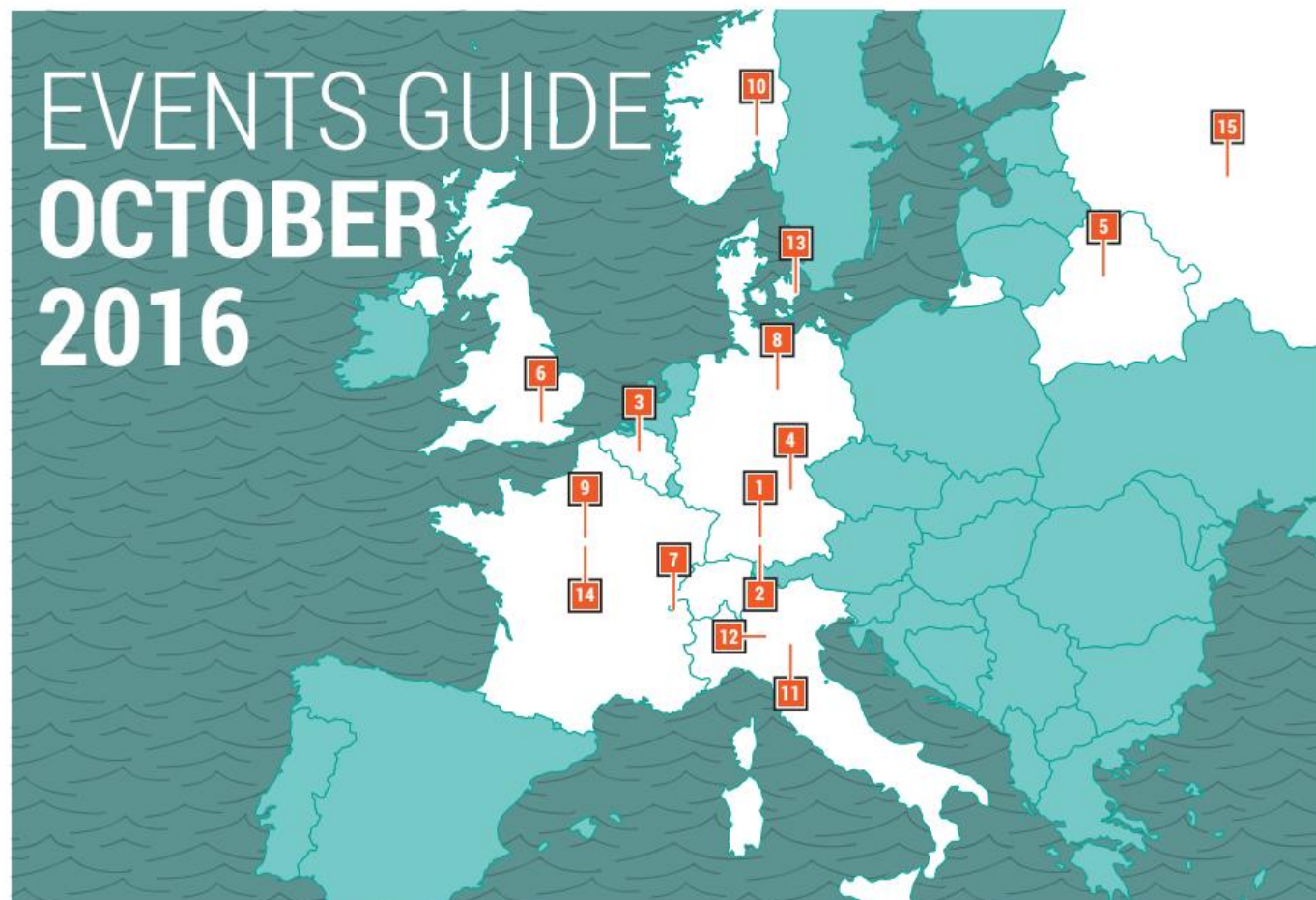


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1

6-9 October, Augsburg, Germany
Renexpo Augsburg
<http://www.renexpo.de/en.html>
 twitter: @RENEXPO

2

10-12 October, Stuttgart, Germany
World of Energy Solutions
<http://www.world-of-energy-solutions.de/en/startpage.html>

3

11-12 October, Brussels, Belgium
2016 Euroheat & Power District Energy Days
<https://www.euroheat.org/events/16ehpautumn/>

4

11-13 October, Nuremberg, Germany
Chillventa
<https://www.chillventa.de/en>

5

11-14 October, Minsk, Belarus
Energy Expo Minsk
<http://www.tc.by/exhibitions/energyexpo/>

6

13-14 October, London, UK
Transfrigoroute International AGM London 2016
<http://www.fsdf.org.uk/event/transfrigoroute-international-agm/>

7

13-15 October, Geneva, Switzerland
Utilexpo Geneva
<http://www.utilexpo.ch/>

8

14-16 October, Wolfsburg, Germany
IZB Wolfsburg
<http://www.izb-online.com/home.html>

9

16-20 October, Paris, France
SIAL Paris
<https://www.sialparis.com/>
 twitter: #SIALParis @sial_paris

10

19-21 October, Lillestrom, Norway
VVS Dagene
<http://www.vvs-dagene.no/>

11

19-22 October, Bologna, Italy
SAIE Bologna
<http://www.saie.bolognafiere.it/home/4279.html>

12

25-28 October, Parma, Italy
Cibus Tec
<http://www.cibustec.it/en/>

13

27-28 October, Copenhagen, Denmark
Danish District Heating Association Convention 2016
<http://www.danskfjernvarme.dk/kurser-og-moeder/moeder/dansk-fjernvarmes-landsmoede-2016>

14

27-28 October, Paris, France
CGF Sustainable Retail Summit
<http://www.tcgfsrs.com/>
 twitter: #CGFsummit @CGF_The_Forum

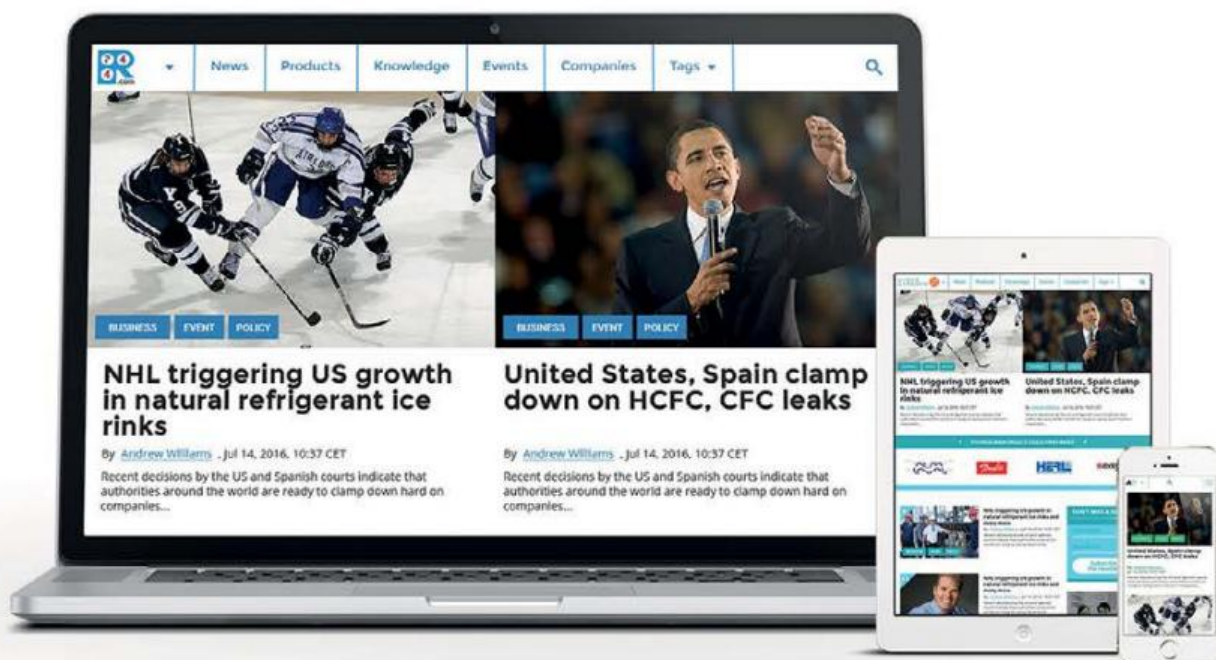
15

27-30 October, Moscow, Russian Federation
PCVExpo Moscow
<http://www.pcvexpo.ru/ru-RU>

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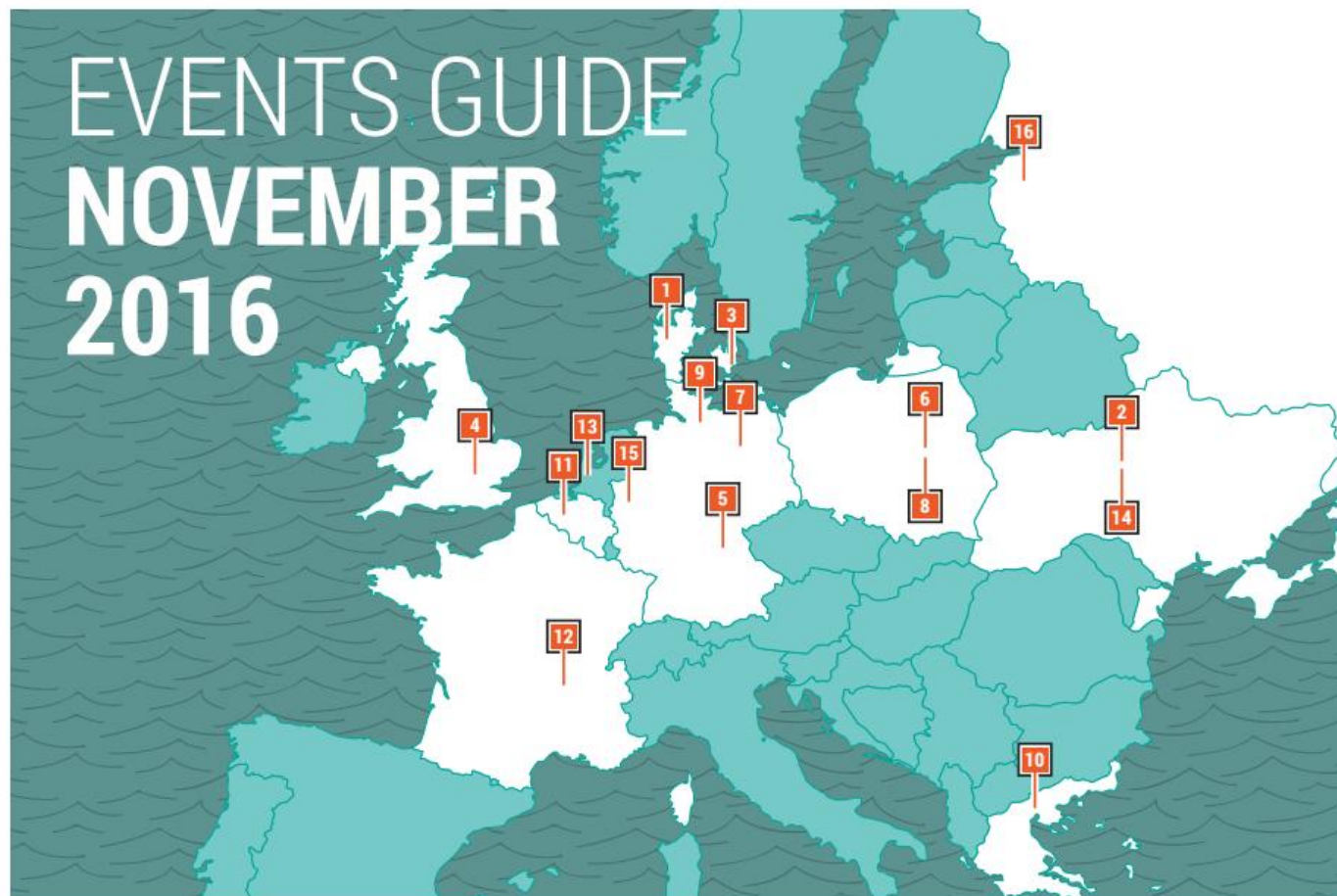
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FoodTech Herning
www.foodtech.dk</p> <p>2 1-3 November, Kiev, Ukraine
Vending Expo Ukraine
http://www.kmkyu.kiev.ua/exhibitions</p> <p>3 2-3 November, Copenhagen, Denmark
Building Green
http://buildinggreen.eu/
twitter: @BuildingGreenDK</p> <p>4 3-4 November, London, UK
Future Food Tech
http://www.foodtechlondon.com/
twitter: #FutureFoodTech @foodtechinvest</p> <p>5 8-10 November, Nuremberg, Germany
BrauBeviale 2016
https://www.braubeviale.de/en</p> <p>6 16-17 November, Warsaw, Poland
RetailShow Warsaw
http://www.retailshow.pl/</p> <p>7 16-17 November, Berlin, Germany
Retail World Berlin
http://www.handelskongress.de/
twitter: @handelskongress</p> <p>8 16-18 November, Warsaw, Poland
Aqua-Therm Warsaw
http://www.aquatherm-warsaw.com/exhibition/</p> | <p>9 17-19 November, Hamburg, Germany
GET Nord
http://www.get-nord.de/</p> <p>10 18-20 November, Thessaloniki, Greece
Hotelia
http://hotelia.helexpo.gr/
twitter: @TIFHelexpo</p> <p>11 20-24 November, Ghent, Belgium
HORECA EXPO 2016
http://www.horecaexpo.be/en
twitter: @HorecaExpo</p> <p>12 22-23 November, Lyon, France
Health Cold Days
http://www.healthcarecoldays.com/acces-au-congres/</p> <p>13 29-30 November, Rotterdam, Netherlands
Transport & Logistics Rotterdam
http://www.easyfairs.com/events_216/transport-logistics-2016_75152/transport-logistics-20162015_75154/</p> <p>14 29 November-1 December, Kiev, Ukraine
Fresh Business Expo
http://www.freshbusinessexpo.com/uk/
twitter: @FreshBusinessUA</p> <p>15 29 Nov-1 Dec, Düsseldorf, Germany
10th Biennial Valve World Conference and Exhibition
http://www.valveworldexpo.com/</p> <p>16 30 Nov-2 Dec, Saint Petersburg, Russian Federation
TransBaltic Expo
http://www.transbaltic-expo.ru/?lang=en-GB</p> |
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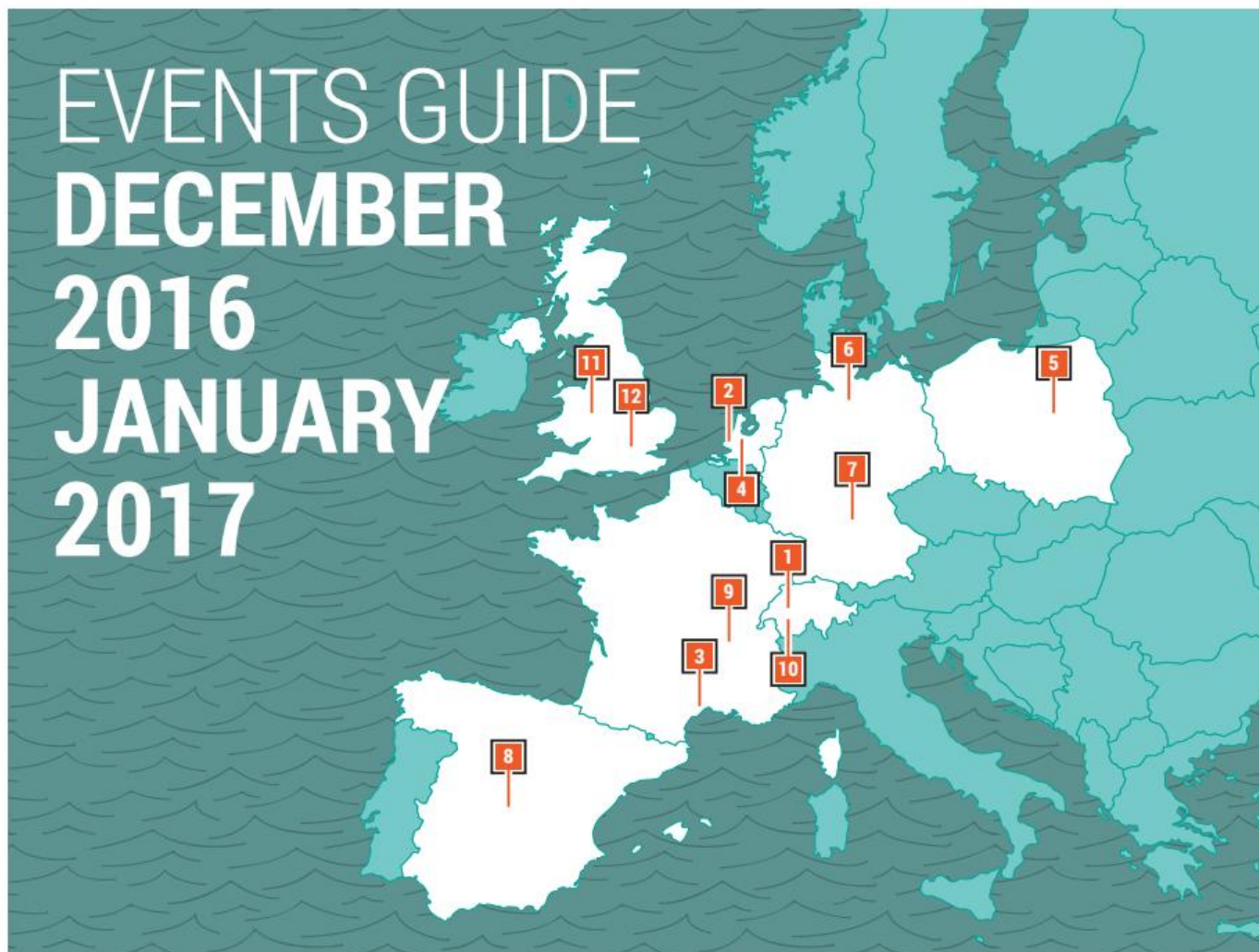
EVENTS GUIDE

DECEMBER

2016

JANUARY

2017



1

8-11 December, Bern, Switzerland
Bau+Energie Messe
<http://www.bau-energie.ch>

3

14-15 December, Montpellier, France
enerGaia Forum
<http://energaia.fr/>
 twitter: #energaia16 @Energaia_

2

13 December, The Hague, Netherlands
EUREKA 2016
<http://www.eureka-hvacr.eu/>

JANUARY 2017

4

9-12 January, Amsterdam, Netherlands
HORECAVA 2017
<http://www.horecava.nl/>
 twitter: @Horecava

9

21-25 January, Lyon, France
Sirha 2017
<http://www.sirha.com/en>
 twitter: #Sirha @Sirha_Lyon

5

11-12 January, Warsaw, Poland
TSW 2017
<http://en.tsw.targi.pl/>

10

22-25 January, Bern, Switzerland
FBK 2017
<http://www.fbk-messe.ch>

6

13-15 January, Hamburg, Germany
Hamburger Energietage
<http://hamburger-energietage.com/>
 twitter: @HambEnergietage

11

23-25 January, Birmingham, UK
Great Hospitality Show
<http://www.hospitalityshow.co.uk/>
 twitter: #GreatHosp17 @HospShow

7

15-17 January, Nuremberg, Germany
HOGA - Trade Fair Hotel, Gastronomy & Catering
<http://www.hoga-messe.de/home.htm>

12

30-31 January, London, UK
Facilities Management Forum- UK 2017
<http://facilitiesmanagementforum.co.uk/>
 twitter: #FMForum @FMForum

8

18-20 January, Madrid, Spain
HOREQ 2017
http://www.ifema.es/horeq_06/

Ejector technology for the biggest Italian Hypermarket

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



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

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

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

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

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

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

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FUTURE-PROOF NATREF SOLUTIONS SHINE AT GUSTAV LORENTZEN

Global efforts to secure a historic agreement to phase down HFC consumption under the Montreal Protocol are creating opportunities for natural refrigerants to thrive. Researchers worldwide stand ready to find technological solutions that deliver this potential – both now and in the future. *Accelerate Europe* reports from the 2016 Gustav Lorentzen conference in Edinburgh.

– By Andrew Williams

The 12th IIR Gustav Lorentzen Natural Working Fluids Conference, held at Heriot-Watt University on the edge of the Scottish capital from 21-24 August, brought together 272 HVAC&R industry experts, academics, students and other interested parties from 31 countries to discuss the latest technological and policy developments driving wider uptake of natural refrigerants such as hydrocarbons, CO₂ and ammonia worldwide.

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

"R744 (CO₂) and hydrocarbons like R600a (isobutane) and R290 (propane) are all naturally occurring, low-GWP, non-toxic, low-cost fluids whose environmental effects are fully understood," said Stefan Elbel, a professor at the University of Illinois at Urbana-Champaign and chief engineer at Creative Thermal Solutions.

continued on p.18







SuperSmart project workshop

→ Hydrocarbons show promise because technology designed for other refrigerants can be easily adapted for use in hydrocarbon systems. Elbel cited the low engineering effort required to produce efficient refrigeration systems capable of working with hydrocarbons among their main advantages. "Conventional components can be used in hydrocarbon systems with only minor adjustments," he said.

The efficiency benefits of hydrocarbons are clear. Research carried out by Elbel together with Pega Hrnjak of the University of Illinois showed that "the fluid density of R600a and R290 is approximately 45% of that of R134a, resulting in a much lower overall system refrigerant charge". "The coefficient of performance of a hydrocarbon system is often better than for R134a," Elbel said.

Among the barriers currently preventing wider uptake of CO₂ and hydrocarbons, the professor cited the "temporary challenge" of the relative lack of availability of dedicated R290 and R744 components compared to those designed for HFCs.

INNOVATING WITH AMMONIA

The natural refrigerant ammonia has long been used in industrial refrigeration applications. But despite this success story, its use is strictly regulated due to its toxicity. Researchers working on modern ammonia technology, therefore, tend to focus on developing low-charge systems that easily comply with regulations – as well as using ammonia in conjunction with other refrigerants in cascade or secondary systems.

Control measures to mitigate cross-contamination between cascade CO₂-NH₃ refrigeration systems, as well as the development of electrochemical ammonia compressors, are two innovations presented at Gustav Lorentzen that may help to boost uptake of ammonia for HVAC&R applications.

"CO₂-NH₃ industrial refrigeration plants can be very reliable if designed correctly. But CO₂ leakage into an ammonia circuit can be a problem," said Angus Gillis of UK-based Star Refrigeration.

With this in mind, he considered three options for mitigating the risk of cross-contamination. Option one is to install an ammonium carbonate detector and emergency isolation valves. Option two is to use a double-wall heat exchanger, and option three is to use twin ammonia circuits that allow continued operation should one of the ammonia circuits need repairing.

His paper concluded that option three is the way to go. "Twin ammonia circuits are a cost-effective and robust control measure that can be implemented without incurring a significant efficiency penalty," said Gillis.

He stressed the importance of using high-pressure components designed for natural refrigerant systems to ensure maximum reliability.

Researchers led by Yunho Hwang of the Center for Environmental Energy Engineering in the Department of Mechanical Engineering at the University of Maryland found that using an electrochemical ammonia compressor improves the efficiency of the vapour compression cycle.

The electrochemical compressor, based on a proton exchange membrane fuel cell, utilises hydrogen as a carrier gas to transfer ammonia across the membrane. "Ammonia was selected as the working fluid because of its high latent heat and electrochemical interaction with hydrogen and the proton exchange membrane," the researchers explain.

By using ammonia, they argue that their electrochemical compressor is an environmentally friendly option that can boost system efficiency.

"The ammonia electrochemical compressor consumes less power than mechanical compressors since its process approaches an isothermal gas compression process without using any moving parts or lubrication oil," the paper states.

It concludes that the vapour compression system using the electrochemical compressor "has a much higher coefficient of performance than conventional mechanical compressors".

BOOSTING EFFICIENCY OF CO₂ SYSTEMS

The efficiency of CO₂ refrigeration systems in warm climates has long been a matter of intense debate among experts. Yet researchers attending the Edinburgh conference were convinced that technological innovation is already making a success of CO₂ technology in higher ambient temperature regions.

Vikrant Aute, an associate research scientist in the Department of Mechanical Engineering at the University of Maryland, presented a paper demonstrating the efficiency gains in warmer climate delivered by system improvements such as mechanical sub-cooling and parallel compression. "With CO₂, there is a lot of room for creativity," he said.

Aute's research team, based in the department's Center for Environmental Energy Engineering, has developed a simulation tool capable of assessing the performance of different system builds. It could potentially be applied by supermarket managers.

Technological innovation is boosting the competitiveness of CO₂ technology compared to other refrigerants and opening the door to its wider rollout in a variety of HVAC&R applications and industry sectors, ranging from supermarkets and transport to beverage vending machines.

Next on the radar is sports arenas. CO₂ will become the refrigerant of choice for ice rinks, argued Swedish refrigeration engineering consultants Energi & Kylanalys (EKA).

CO₂ ice rinks have been slow to reach the commercialisation phase, according to EKA – despite the technological capability having already existed for at least 20 years.

The first ice rink to use CO₂ was installed in 1999 – using CO₂ as a secondary refrigerant and ammonia as the primary refrigerant – by Sulzer in Dornbirn, Austria. The first transcritical CO₂ ice rink was installed in 2010 in St Gedeon in Canada, as a retrofit of an R22 system.

MOVING IN THE RIGHT DIRECTION

In 2002, the International Ice Hockey Association called for the adoption of CO₂ as the primary refrigerant in ice rinks.

"Today the number of CO₂ ice rinks is growing rapidly," Jörgen Rogstam, managing director of Energi & Kylanalys, told the Edinburgh audience. "There are now 25-30 CO₂ ice rinks in the world."

The majority of these (20-25) are in North America, approximately 20 of which are in Canada (mostly in Quebec) and three in Alaska, USA.

Europe has been struggling to keep up the pace. EKA installed the continent's first CO₂ transcritical ice rink in Gimo, Sweden in 2014. "There are now five in operation in Sweden, two more later this season, one project underway in Norway, and interest in Finland and the UK," according to Rogstam.

CO₂ SERVES BOTH HEATING AND COOLING NEEDS

"CO₂ can provide more heat at higher temperatures compared with other refrigerants," he said. Compared with ammonia, which can only provide 15% of heat above 35°C, CO₂ can deliver 60% above 35°C.

"CO₂ has favourable properties for heat reclaim," said Rogstam. CO₂ systems installed for ice rinks can be used to heat adjacent sports facilities too. He argues that CO₂ is the ideal choice for integrated systems that deliver refrigeration, heating and hot water, dehumidification, lighting, and ventilation.

The system in Gimo, Sweden was not just able to cool the ice rink but also heat a swimming pool in an adjacent facility via a secondary loop system. "It is self-sufficient with heat," Rogstam said.

EKA is now seeking to improve the geothermal storage control, and to build more CO₂ ice rinks in Europe.

REGULATORY CHANGE TO BOOST NATREFS

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



shecco's Jan Dusek presenting in Edinburgh

continued on p.20 →

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

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

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

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

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

GETTING OFF 'THE CHEMICAL TREADMILL'

Natural refrigerants will play a key role in delivering the Paris goals but raising awareness will be crucial to ensuring that they fulfill their potential, according to Bond. "We need to communicate the benefits of natural refrigerants much more effectively to the world at large – including governments, industry, end users and NGOs," she said.

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

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

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

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

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

"We are increasing our use of natural refrigerants. China is under pressure to phase out HCFC refrigerants," said Chen. "By 2020, the average GWP of refrigerants used in the industrial and commercial sectors will be 300," he argued. The professor admitted, however, that China's status as the world's biggest producer and consumer of refrigerants poses "great challenges" in charting a more sustainable course.

OVERCOMING STANDARDS BARRIER

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

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

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

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



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WATER-BASED eCHILLER DELIVERS YEAR-ROUND COOLING...NATURALLY

German company Efficient Energy is breaking new ground by developing a cooling solution that harnesses water (R718) as a refrigerant – saving 80% electricity costs compared to HFC technology. *Accelerate Europe* spoke to CEO Jürgen Süß to find out more.

– By Charlotte McLaughlin

Water is the most natural of refrigerants. It is readily available, odourless, colourless, non-toxic and non-flammable. It also has zero ozone-depleting potential (ODP) and zero global warming potential (GWP). Nonetheless, is not yet widely used in HVAC&R applications.

Munich-based Jürgen Süß is determined to change this with his new centrifugal chiller.

The eChiller has a cooling capacity of 35 kW and delivers 80% efficiency gains compared to conventional HFC systems. The coefficient of performance (COP) of the first model used in a field trial ranged from 1.4 to 22 depending on operating mode. Meanwhile the efficiency of the machine was further increased.

HOW DOES IT WORK?

Water chillers usually use absorption technology. But the eChiller uses a centrifugal system instead.

"Using water as a refrigerant isn't a new idea. What's new is the way that we do it," Süß explains.

His system uses a turbo motor to evaporate and condense the water in a vacuum to provide cooling and reject waste efficiently.

Field tests have shown that it provides 35 kW refrigeration capacity even in warm ambient conditions – and is therefore capable of providing year-round cooling. Process pressures are low, from 10 to 100 mbar, eliminating safety concerns.

The eChiller is a self-contained system, meaning installers just have to hook it up. It serves a wide range of applications except for those below 0°C as water freezes at this temperature. So far 11 units have been tested, mostly in data centres, but also in plastic modelling and the chemical industry.

Süß says, "there are basically no limits to the fantasy. So wherever you use air conditioning or need to generate cold water, this machine can be used. It is just a question of scaling it to the application".

Its COP is four times higher than an R410A system, offering electricity savings of 50,000 kWh, electricity cost reductions of €7,000 and emissions reduction of 31 tonnes CO₂e, as demonstrated over the course of the year 2015 in a data centre application: namely the server cooling racks.

THE ROAD TO COMMERCIAL VIABILITY

The plan is to prove by the third quarter of 2017 that the chiller is commercially and technically viable. This schedule is not without its challenges, particularly for a team of just 50 people.

"Cost-wise I would say, the material we are using is not expensive. The problem is we are not building enough," he says. Moving to mass production would reduce costs significantly. At the moment "it costs about as much as a small house in northern Germany," he says, an estimate based on the number of manufactured machines in relation to the total project cost.

Süß warns that the market is often hesitant to adopt new technology. "Imagine you work for a data centre, and your boss comes and says you need to install a new system. Then why should an employee hire a contractor that puts in a prototype? He just wants the problem solved cheaply and in the most reliable way, keeping technical risks and uncertainties to a minimum. The contractor also doesn't want to promise anything he is not sure about. So you have two people hesitating to use a new technology because they are just unsure."

If Efficient Energy were a big player in the HVAC&R world, he believes there would be less such hesitation. "We should really forget that the system is different. We should instead talk about the special performance and the energy efficiency advantages," he concludes. **CM**



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SCALING NEW HEIGHTS IN ROMANIA

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

- By Andrew Williams



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

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

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

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

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→ Founded in 2008 by Coop and German retail giant REWE, the Transgourmet Group – wholly owned by Coop since January 2011 – includes Fegro/Selgros, Germany's second biggest cash & carry firm.

As well as operating supermarkets under a variety of brand names, Transgourmet is a market leader in supplying and servicing professional kitchens, hotels and company catering.

Its product range comprises approximately 15,000 products, 1,700 of which are its own brands – TG Premium, TG Quality, TG Economy and Ursprung.

'THE TARGET IS 100% CO₂'

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

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

There is not yet a precise timetable in place for delivering this transition. "We're trying to change four, five or six installations to CO₂ every year."

With HFC phase-down deadlines under the EU's F-Gas Regulation on the horizon, Bruss is firmly convinced that natural refrigerants like CO₂, hydrocarbons and ammonia will play a crucial role in providing future-proof HVAC&R solutions.

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

Asked whether policymakers could do more to accelerate the uptake of natural refrigerants, Bruss was cautiously optimistic about the phase-down trajectory currently in place in Europe. "You need time to change things. It's not possible to change everything in one year."

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

Bruss says that the Transgourmet Group's goal is to become HFC-free "in the near future". Currently, Transgourmet has 15 stores that use CO₂ transcritical systems.

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

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

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



A German national born in Braşov – another Transylvanian city – Bruss left Romania in April 1985 and began working for Selgros in June of that year. “It was my first job in Germany,” he says.

As a Transylvanian Saxon fluent in German and Romanian, Bruss is ideally placed to bring the Transgourmet Group’s HVAC&R strategy for the Central and Eastern European region to life.

He is certainly no stranger to the multilingual and cross-cultural exchanges that are a fixture of daily life in Târgu Mureş. Like Transylvania as a whole, the picturesque town is home to large numbers of native Hungarian speakers and all signage in its Selgros store is bilingual.

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

Selgros Cash and Carry operates 20 stores in Romania, putting it among the top five food retailers in the market. The Târgu Mureş store – which opened on 27 May – uses the natural refrigerant CO₂ for refrigeration, air conditioning and heating purposes.

‘ALL THE WASTE ENERGY IS USED TO HEAT THE STORE’

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

A heat recovery system delivers hot tap water and heating for the sales and office areas. This reduces the supermarket’s carbon footprint, recycling waste heat that would otherwise be emitted to the atmosphere.

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

What about cost? “Of course, we’ll spend a little bit more money on the first projects, but we’re sure that the cost of this concept will come down,” he argues.

“It’s important to know that it’s always in combination with heat recovery systems. All the waste energy is used to heat the store and to heat the water,” Hoepfl explains.

The Transgourmet Group is looking at other means of reducing its environmental footprint. All the group’s new and remodelled stores are fitted with LED lighting, and it is also buying electric trucks.

POLICY, EFFICIENCY, RELIABILITY, SUSTAINABILITY

Transgourmet opted to go down the natural refrigerants route six years ago. “Frigo-Consulting convinced us to use CO₂, particularly in terms of energy efficiency and reliable operation of the systems,” Bruss says.

“But 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,” he explains. “It’s easy for us, because it’s what our shareholders want.”

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

continued on p.28 →

→ The system harnesses gas and liquid ejectors together with parallel compressors to recover the energy released during high-pressure expansion and to reduce internal throttling losses. Driven by the pressure difference in the refrigeration system between high and receiver pressure, the ejectors convey either liquid or gaseous refrigerant.

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

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

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

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



Hans-Dieter Brüss (L) and Marcus Hoepfl (R)

'JUST THE BEGINNING'

What led Selgros to opt for this particular combination in Târgu Mureş?

Brüss explains: "The motivation is that we have a target as a company, of course. Another motivation is that when you do something new, you want to do it well or do it better. We discussed with planners, architects, Mr. Ernst Blatter (president of Frigo-Consulting), and Mr Hoepfl to find a solution."

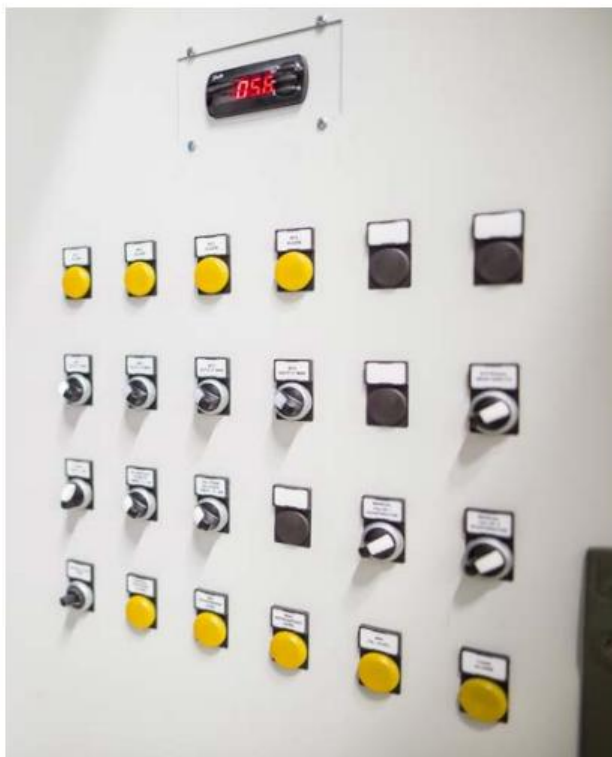
The Transgourmet Group is excited to be playing a starring role in bringing natural refrigerant technology to Central and Eastern Europe. "This is not the end. It's just the beginning," Brüss says.

The 21st and newest Selgros Cash & Carry store in Romania, set to open in Alba Iulia at the end of September, will mirror the concept in place in Târgu Mureş.

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

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

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



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

Yet Hoepfl is not sitting still. Together with manufacturers, Frigo-Consulting is working to research and develop a range of new solutions that can improve system efficiency in warm climates even more dramatically. "We are quite sure that we have more potential, also for the future, to achieve the best efficiency level on the market," Hoepfl says.

CO₂ systems operate at high pressure, requiring careful design. This attention to detail helps to keep them running smoothly. "Our experience is that CO₂ systems are more reliable than traditional systems, because they have no high pressure issues," he says.

CO₂ 'IN EVERY STORE'

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

Selgros Cash & Carry is a leading player in the German market. It serves 1.6 million customers across its 43 outlets and employs some 4,000 people.

The commitment to CO₂ extends to every new and remodelled store under the Transgourmet Group banner, in every country. In 2016, the Group is investing €10 million euros in delivering the transition.

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

At present Selgros Cash & Carry operates eight stores in Russia, serving approximately 1.6 million customers.

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

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

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

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

continued on p.30





A system with a view: on the roof in Târgu Mureş

→ Transgourmet also operates CO₂-based cold storage warehouses in Romania and Poland. Bruss is confident that the decision to opt for CO₂ over ammonia for warehouses will deliver energy savings to the tune of at least 20%.

With so many CO₂ projects under construction and in the pipeline, did Bruss 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.

What about synthetic refrigerants, which some industry players are touting as replacements for HFCs? Transgourmet’s Bruss is dismissive. “There was a discussion of whether it was necessary to make an intermediate step with retrofit refrigerants [HFOs]. But regarding Transgourmet’s strategy of making all remodels and all new plants with CO₂, it is not necessary to think about such installations,” he says. The only exceptions to this way of thinking are a limited number of very old stores, he explains.

BREAKING DOWN BARRIERS...

The Transgourmet Group’s journey down the natural refrigerants route has not always been plain sailing. What are the main challenges facing Transgourmet in adopting natural refrigerant technologies? “Firstly, motivating installers to turn to natural refrigerants. This means leaving their existing ‘comfort zone’ and investing in staff training,” Bruss says.

One oft-cited obstacle to greater market penetration of natural refrigerant-based systems is an alleged lack of technicians trained in using the technologies.

“It’s like farming. First you have to sow before you can harvest. I very much expect manufacturers and installers alike to become more proactive and invest in training,” Bruss says.

Some manufacturers of natural refrigerant system components are already doing so. In Germany, for example, Bitzer inaugurated a new international training centre – the SCHAUFLEER Academy – in February 2016. Also in Germany, Carrier opened its CO₂OLacademy in 2015.

The Transgourmet Group itself is allocating R&D investment to natural refrigerant technologies too. “Together with trusted partners, we always try to push the boundaries. The air-conditioning system in Târgu Mureş, which uses CO₂, is a typical example of our commitment to investing in sustainable technologies,” Bruss says.

He has not encountered significant differences in the standard of training from country to country. “There are differences but not big differences. Russian companies train their staff in Germany, Switzerland or Austria, for example.”

Bruss puts responsibility for ensuring smooth running of the systems squarely at the feet of manufacturers. “It is important for our partners, who build these installations, to have trained personnel. They are very close to our stores, and we prepare and take care [of the systems] together,” he explains. “What they do at our stores – we don’t have trained personnel for that.”

...AND OVERCOMING ‘KNOWLEDGE BOTTLENECK’

Bruss expects the main proponents of natural refrigerant training to remain the manufacturers themselves. But he also believes, “the authorities should look into creating some sort of incentive or reward for installers and store owners” to accelerate uptake of naturals.

CO₂ systems are reliable and “very energy efficient compared to traditional systems using HFCs,” argues Bruss. He admits that price and availability continue to pose challenges, “but we see a steady improvement on both counts as the number of installations increases”.

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

Frigo-Consulting is well aware of the importance of ensuring that trained service personnel are close to hand. Technological innovations like ejectors and parallel compression are helping to improve the efficiency of CO₂ transcritical systems, but they are also making them more complex.

Ensuring that maintenance personnel from the service companies are familiar enough with the technology for it to be promptly serviced in the event of a breakdown is thus critically important for the technology's continued success.

"You can see their interest, but you have to push them to train their entire staff, and not just one or two people," Hoepfl says.

"This is the biggest issue, that we have a sort of bottleneck – a knowledge bottleneck in the companies. They must change their mindset, to say 'OK, the market is changing. And we must change too'," the Frigo-Consulting International managing director adds.

GOING 'ALL NATURAL'

With new innovations helping to improve efficiency and make natural refrigerant solutions more cost-competitive vis-à-vis traditional HFC systems, Bruss sees "no reason" not to go "all natural".

"Retailers could do more. A lot more could be done to adopt natural refrigerant technologies. But we look at our company. We're doing our best," he says.

As the number of installations in Europe steadily increases, so does the number of service personnel capable of servicing the equipment. Bruss talks of a "big change" having taken place in the market in the past two years: "Step-by-step, they have changed a lot. They are training their staff."

Asked what the Transgourmet Group is doing to communicate its natural refrigerant strategy to customers, Bruss said, "we communicate it but not in detail". Do they put stickers on their display cases to show that they use natural refrigerants? "No, nothing. But maybe that's a good idea!" he quips.

Frigo-Consulting's Hoepfl is quick to react. "That's an understatement!" he says. "In our opinion, companies aren't advertising this enough. You can't find much about it."

Hoepfl suggests that in multinationals of Transgourmet's size, the more streamlined decision-making processes at play compared to those in place at the world's biggest companies may make it easier to take bold decisions like switching to CO₂ for HVAC&R applications.

As for Bruss, he maintains cultural links to Romania and enjoys his frequent return visits to bring natural refrigerants to the nation's Selgros stores.

"My favourite region is of course Braşov. I was born there," he says with a smile.

The Transgourmet Group would appear to be in good hands.

AW



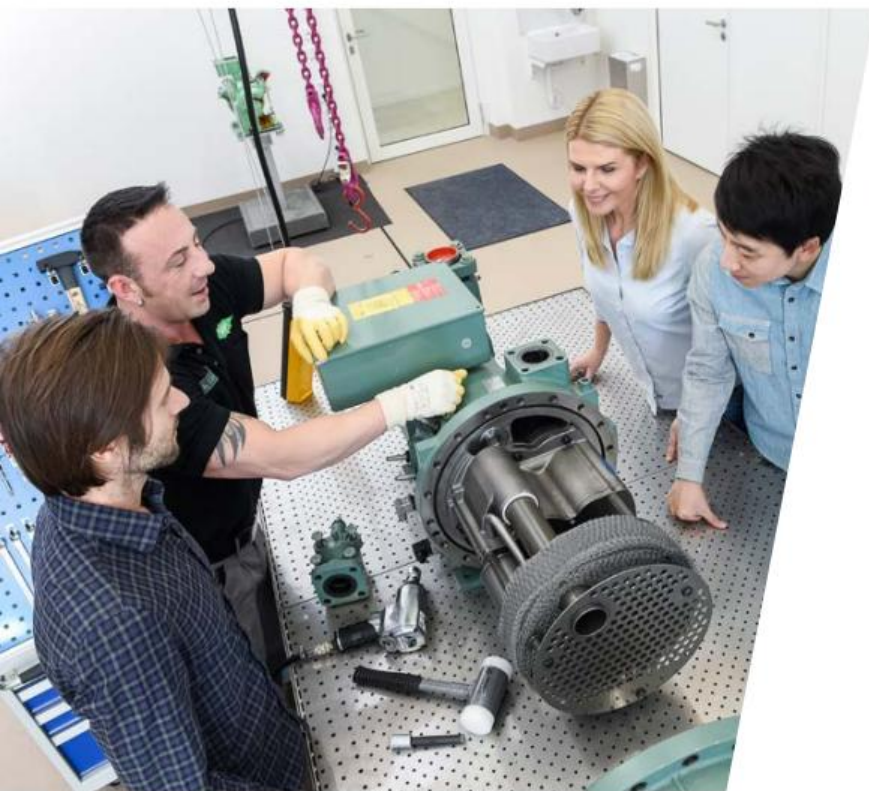
TÂRGU MUREŞ STORE: TECHNICAL DATA

CO₂ transcritical rack:

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

CO₂ transcritical chillers:

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



SCHAUFLE ACADEMY WELCOMES 2,000th VISITOR

Training in the use of natural refrigerants has long been considered a major barrier to wider market penetration. German compressor manufacturer BITZER seeks to bridge this gap by offering courses in hydrocarbons, ammonia, CO₂ and frequency inverter technologies at its SCHAUFLE Academy.

– By Charlotte McLaughlin

Just six months after opening, the new 1,500 m² training centre in the German town of Ergenzingen-Rottenburg welcomed its 2,000th visitor in July.

"I actually planned on 1,200 for the year. So I was extremely happy with this exposure. It shows there is a real need out there for [natural refrigerant] training," says Volker Stamer, director of the SCHAUFLE Academy.

GLOBAL AUDIENCE

The training has attracted a worldwide audience beyond the ranks of Bitzer employees and technicians. People from diverse countries and backgrounds, including HVAC&R engineers, students, and academics, have passed through the academy's doors.

"We have already had Australians, a group from Indonesia, we had guys from South Africa and Russia. A big attendance from the Middle East, including from Oman," Stamer told *Accelerate Europe*.

The academy offers training on using compressors more generally in addition to courses on working with natural refrigerants CO₂, ammonia and hydrocarbons. Bitzer has run 40 courses and 15 special training sessions this year, and expects to hit the 100-event mark at the academy by the end of 2016.

Using modern refrigeration systems, the application engineers will provide instruction and training for specialist personnel and service staff from all over the world at the new SCHAUFLE Academy.

"The fact is that modern technology is only truly sustainable if it is used correctly. Having competent staff is an absolute prerequisite for the reliable and efficient operation of refrigeration and air conditioning systems," Stamer says.

Most training sessions are two-day seminars but the SCHAUFLE academy also hosts courses for people who have a longer journey to reach Ergenzingen-Rottenburg, for example those travelling from America or Asia. For them, combined training covering all aspects can be organised. These courses last one week.

At the beginning the age range was typically around 30. "There are a lot of older guys who think they do not need to learn any more, so basically before the older people go, they send the younger people to see if there is anything they need to learn." Apparently there is: "We are now seeing that half the attendees are more experienced guys."

"Training is nothing new for Bitzer. The main goal is cooperation. Our goal is not to compete with big training centres or universities. They work with the fundamentals. We're about providing applied and technical lessons," Stamer remarks.

COURSES HOME IN ON NATREFS AND REGULATION

Besides internal Bitzer training, the academy hosts training on regulatory change – for example, giving system designers and decision-makers insight into the constraints of the EU's F-Gas and Eco-Design Regulations..

All the ammonia, CO₂ and hydrocarbon workshops are focused on providing practical demonstrations about fixing and installing the systems.

"We have a lot of technical stuff, so we have three practical rooms; a big container standing outside with a 1.5 MW ammonia plant, two CO₂ systems – one transcritical and one subcritical. So there is a lot to play with. I'm an engineer too, so I'm always coming in with a smile on my face."

"We're particularly keen to inspire younger people to take an interest in refrigeration and air conditioning technologies," Stamer says. **CM**



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COLRUYT CHARTS COURSE FOR 100% HYDROCARBONS IN STORES

Natural refrigerants are helping the Colruyt Group to save money and deliver its environmental targets, with the leading Belgian retailer moving to hydrocarbons for 100% of its in-store cooling needs. *Accelerate Europe* reports.

– By Andrew Williams

Counded in 1925, the Colruyt Group is one of Belgium's biggest retailers – with annual revenue of over €9.1 billion. Employing over 29,000 staff, it boasts 516 shops. Three shop formats in Belgium have product cooling: Colruyt supermarkets (237), OKay convenience stores (120) and Bio-Planet (19) organic stores.

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

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

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

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

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



REGULATION: AN 'EXTRA STIMULUS' FOR NATREFS

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

"We were already adopting natural refrigerants before the EU F-Gas Regulation came into force. The F-Gas Regulation was not the primary driver, but it does give us an extra stimulus," says Bootsvelde.



Trucks line up in Halle

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

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

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

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

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

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→ NO MORE NEW HFC SYSTEMS FOR COOLING FROM 2017

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

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

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

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

At the entrance of the cold room, an air curtain stops the cold air from escaping by blowing air at room temperature from a vent above the cold room's open doorway. Rather than mixing together, the warm and cold air roll against and away from one another – creating an 'air door' that pushes the cold air back into the cold room. This principle will be used in all new OKay and Colruyt stores.

Colruyt's chest freezers have been using the natural refrigerant R600a (isobutane) for over 10 years. They are stand-alone, giving store managers flexibility regarding layout. Pictures on the lid depict what's inside, so customers do not need to open them to discover their contents. "They are plug 'n' play. If one freezer breaks down, just swap it with another. They also use five times less energy than display cabinets," says Meert.



Project Engineer Julien Meert



Collin Bootsveld in Bio-Planet, Mons

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

OVERCOMING SAFETY CONCERNS

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

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

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

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

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

Propane is not the only natural refrigerant being harnessed by the Belgian retailer. Its distribution centres are cooled with ammonia, and the first ammonia plant opened in 1999.



During the visit of *Accelerate Europe*, a third-generation propane system was being tested at the Halle headquarters. Offering 20% more refrigeration capacity yet smaller than the previous configuration, the third-generation system was first installed on 1 September 2016 at a Bio-Planet in Huy. Factory-assembled for ease of installation, it will be rolled out across all store formats.

LIQUID ICE – A WORLD FIRST

33% of the Colruyt Group's CO₂ emissions are from refrigerated transport of goods to shops. At the distribution centre in Halle, *Accelerate Europe* toured the Colruyt Group's new liquid ice-making plant. To reduce these emissions from refrigerated transport by 50%, the company uses liquid ice – a liquid mixture of ice, ethanol and water – to cool special containers.

"This is a completely new concept – no other retailer in the world is doing this," enthuses Peter De Bonte, a colleague of Bootsvelde's.

Suppliers to the Colruyt Group deliver to distribution centres rather than stores, with the exception of goods like bread. By carrying the containers, Colruyt trucks carry frozen, refrigerated and non-refrigerated products to the store in one trip.

The containers – which offer 48 hours of cooling – allow the distribution centres to match their loads to each store's needs. This reduces the total number of kilometres driven and ensures that 98% of Colruyt's trucks are dispatched full.

The ice itself is generated in an ammonia plant. Small flakes of ice in a mixture of ethanol and water are constantly recycled within a closed-loop system.

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

De Bonte hopes to use liquid ice for deep-freezing too, but ethanol is not suitable for that. "We hope to find a solution within three years," he says.

LEAPFROGGING HFOs

Many companies are responding to f-gas regulations by adopting synthetic refrigerants – so-called HFOs. Why did the Colruyt Group opt for natural refrigerants instead?

"We briefly considered HFOs, but we decided not to go there because we wanted to target our resources on natural refrigerants. If we had spent time on HFOs, it would have delayed the introduction of propane," Bootsvelde says.

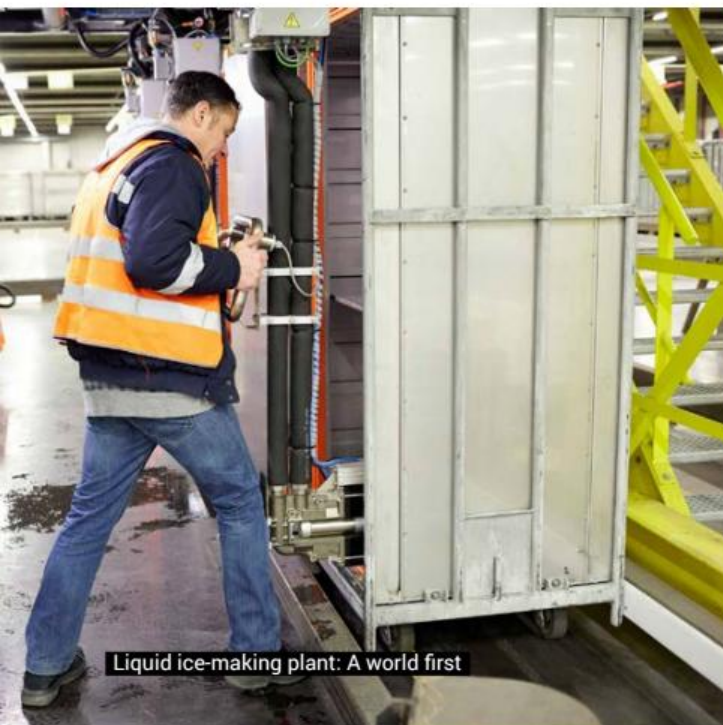
"Any intermediate step is exactly that – an intermediate step. We're working on a ten-year schedule to remodel all our shops by 2027, so we can't go for an intermediate solution," he explains.

"The HFC industry tends to focus on HFCs. Now they're also promoting HFOs, which have a little bit less global warming potential. For me, it makes no sense. We don't want to be in the position of being dependent on people selling us new technologies again and again," he says.

Mindful of F-Gas Regulation deadlines, Bootsvelde is surprised by the conservative nature of many technology manufacturers. "We're not going to invest in new technologies that use old-fashioned refrigerants that will need to be replaced by 2020," he says.

"We don't know the environmental risks related to HFOs. They're telling us there are none, but the industry told us that twice before already. So we're not going to buy that," says Bootsvelde. HFOs are also somewhat flammable. "You need to take the same measures that you do for R290," he says.

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Liquid ice-making plant: A world first

→ His colleague Meert agrees. "You still have a risk. First it was all about ODP. Now it's GWP. With HFOs, it's possible that in five or ten years they'll discover something else. F-gas regulations may also become more stringent."

The decision to leapfrog HFOs in favour of natural refrigerants was a no-brainer for Bootsvelde. "We're switching from 100-150kg of R507 to a few kilograms of propane – we're going from a GWP of 4,000 to three. And we're going from a leakage rate of 5% to [negligible]."

What barriers did the Colruyt Group face in adopting natural refrigerants? "The biggest challenge is to get everybody on board internally. We need about 1,000 people within the company to come on this journey with us, because they'll all be affected by it," Bootsvelde says.

Some people relate to being first-movers in Belgium. Others are excited to be ahead of the regulatory curve. The legal department care about complying with rules. The finance department like hearing about added value and long-term returns. "It's about communicating in a manner that's relevant to people," he says.

And on the technology side? "I'm very disappointed with the level and quality of the equipment available on the market," says Bootsvelde. No-one in the market could supply his vision of a bespoke propane system, instead trying to convince him to adopt CO₂.

Undeterred, in April 2015 he decided to write to potential suppliers – asking two of them to build a test installation. Only German manufacturer Futron GmbH responded with a fitting proposal.

The Colruyt Group is not the only supermarket chain to have opted for natural refrigerants. Does Bootsvelde share ideas with colleagues elsewhere?

"As far as I know, we're the only supermarket chain in Belgium going in this direction. We do know that a couple of other supermarket chains are showing an interest. We welcome that and we'd be willing to share knowledge. We want the market to take off, so we want to see more of our competitors go in the same direction," he says.

A chemical engineer by training, Bootsvelde has worked on energy-saving and cooling technologies throughout his career. Starting out at a small energy consultancy in the Netherlands, he later worked on natural refrigerant projects at a research institute.

Having devoted his career to improving sustainability, Bootsvelde's commitment to the environment extends outside the office – to his natural gas-fired car and beyond. His wife helped him to renovate their century-old apartment. "We have won Belgian environmental prizes for it. We were also the first people in Belgium to install a certain type of mineral insulating plaster!" he quips.

Should he ever leave, how would he like to be remembered by the Colruyt Group? "I hope they recognise that I have been able to get a variety of difficult projects moving," he says.

Of that, there would appear to be little doubt. **AW**



Bio-Planet, Mons

Report on Natural Refrigerants Training in **Europe**



2016

GUIDE TO NATURAL REFRIGERANTS TRAINING IN EUROPE — STATE OF THE INDUSTRY

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SLOW AND STEADY WINS THE RACE

Having demonstrated the benefits of natural refrigerant technologies to end users, consultants and installers, system manufacturers in France are well placed to grow the French cooling market. At the *Salon Interprofessionnel du Froid et de ses Applications* (Sifa), a French refrigeration show in Nantes, *Accelerate Europe* learnt that it pays to be patient.

- By Charlotte McLaughlin



Sifa, Nantes, France



On 14-15 September, Sifa brought together over 100 companies active in the French cold chain to exhibit the latest HVAC&R technologies and saw over 1,500 participants attend a series of panel discussions on the future of refrigeration in France.

CO₂ MARKET PICKING UP

Nantes, the largest city in Brittany, is renowned for embracing technological innovation – from the enormous mechanical elephant that shoots water at passing tourists on the Île de Nantes in the middle of the Loire river to France's first installation of a CO₂ cascade system, back in 2002 by Bitzer.

Nevertheless, the CO₂ market in France has been slow to pick up compared to other European countries – due in part to the uniqueness of the French refrigeration sector. End users go through consultants (so-called *bureaux d'études*), who recommend which system to choose before passing their recommendations on to the installer in charge of installing the system.

The installers hold a lot of sway. "The French system is very specific: you need to market the product to the installer," says Vittorio Iormetti, a technical support specialist at Brazilian compressor manufacturer Embraco.

"There are three large national installation companies in France: Engie Axima, MCI and Cesbron. These three companies, in terms of installations, are managing a major share of all installations and maintenance work

on the French [refrigeration] market," explains Sylvain Gilliaux, European Sales & Marketing Manager at Sanden Environmental Solutions. Sanden is listed as a supplier to all three, but is also supporting smaller installation companies that distribute its condensing units all over Europe.

The installers are increasingly working with CO₂. MCI works closely with rack manufacturers including Advansor, SCM Frigo and Epta to install CO₂ transcritical refrigeration systems in supermarkets across France. Their retail clients include Carrefour, Colruyt, Picard and Intermarché.

"The market for CO₂ transcritical in France is picking up. We already have around 50 transcritical installations and we expect to install more," Remy Reval, technical director of MCI, told *Accelerate Europe*.

Dominique Giraud of French manufacturer Profroid says, "the French market was slow to get started but now – for us at least – it is going really fast. Customer demand for CO₂ technology is increasing, and that's making installers sit up and take notice too".

Profroid, part of the Carrier Transicold group that also includes Sweden's Green & Cool, was at Sifa to exhibit its CO₂ gas coolers and the MiniCO₂OL. The MiniCO₂OL is a transcritical CO₂ booster system with two to six positive compressors at 20-300 kW and one to four negative compressors at 2-130 kW. It can deliver energy savings of up to 10% compared to traditional HFC refrigeration systems, even in temperate climates.

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Bitzer compressor at their Sifa booth

ejector (EmJ), which is designed to increase the energy efficiency of transcritical CO₂ systems in warmer climates. This is made possible by continuous electronic modulation on the EmJ ejector, which is capable of increasing system efficiency by up to 25% – with average annual efficiency gains of 10% in typical southern European climates.

“New technology development, like ejectors, can be very successful if any actor (from installer to final customer) has expertise working with this technology. That is the reason why we at CAREL are present worldwide and locally to give our customers support,” Guignier says.

Giraud from Profroid expects the CO₂ market to expand even further. “CO₂ is the future. We welcome increased interest from [other market players] because it helps to bring prices down and increase familiarity,” he insists.

→ CO₂ DEVELOPING IN MANY DIRECTIONS

Accelerate Europe heard throughout Sifa that big supermarket chains are driving growth of the French CO₂ market. “All supermarket brands have tested or used CO₂ as the first option. Carrefour just wants CO₂ solutions. Nothing else,” says Rodolphe Cox, sales manager at BITZER France.

Technological innovation is helping to overcome the so-called CO₂ equator: the previously accepted geographical limit for cost-effective and efficient performance of CO₂ systems in all food retail store formats.

“We’re planning to move the CO₂ equator as far south as possible to enlarge the zone in which it can be used,” Cox says. To achieve this, Bitzer offers 17 subcritical and 13 transcritical compressors – all of whose performance data has been certified by

the Association of European Component Manufacturers (ASERCOM).

The German manufacturer was exhibiting new condensing units and compressors at their Sifa booth. They are also embracing the new trend towards using heat reclaim in supermarkets, using the heat given off from compressors and other components in the refrigeration system to heat the store.

Pascal Guignier, managing director of CAREL France, stressed the importance of technological advancement in developing the CO₂ market further. “The ejector technology has huge potential also in France. Some installations have already been done in Europe. This will make the CO₂ sector grow substantially in warmer climates”.

As reported in the last *Accelerate Europe*, CAREL and Carrier Commercial Refrigeration Europe have jointly developed a new electronic modulating

Training is becoming increasingly important in ensuring that installers are familiar with the technology. This is why Bitzer founded the SCHAUFLEER Academy, which has been well attended by technicians (over 2,000 visitors) seeking training in natural refrigerant technology since it opened in February 2015.

“It takes time to train everyone, and it’s something that is not easy to do. We’re helping our customers to go in this direction, organising training in our plant using simulators to give them the necessary knowledge for successful installations,” says CAREL’s Guignier.

“CO₂ is the leader in France. As manufacturers, we are working to improve the technology, and, on the other side, final customers like supermarket chains are potentially interested and looking for innovative solutions. So [training’s] an efficient way to expand the technological know-how and we see the benefits of this every day,” he says.

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Pascal Guignier, managing director, CAREL France, at Sifa booth

→ SYNTHETIC REFRIGERANTS 'NOT A SOLUTION'

Many presentations at Sifa focused on so-called hydrofluoroolefins or HFOs, synthetic refrigerants marketed by the chemical industry as replacements for HFCs in the context of the f-gas phase-down taking place under the EU's F-Gas Regulation, which since 2015 has been reducing the total amount of HFCs that can be sold in Europe. In 2020, a ban on using certain HFCs in new equipment comes into effect, accompanied by bans on servicing and maintaining existing equipment.

The attention given to synthetic refrigerants was not well received by many exhibitors and attendees.

A representative of a large European refrigeration component manufacturer attending the show said: "The battle with HFOs is fierce in France. Synthetic refrigerant manufacturers have a vested interest in ensuring that the switch is to HFOs and not natural refrigerants." He went to say, "big end-users are driving CO₂ demand but for small users, who are not aware of other technology, they try to sell them HFOs."

Profroid's Giraud continued in a similar vein. "Customers realise that HFOs are not a solution. CO₂ is more efficient and has a much better environmental performance," he said.

AMMONIA: A STANDARD SOLUTION

"The market for ammonia technology in France is picking up, particularly due to the influence of the EU F-Gas Regulation," Jean-Pierre Lissandre, market manager (refrigeration) at Alfa Laval France, told *Accelerate Europe*.

Lissandre said Alfa Laval is looking forward to installing two big ammonia systems in France this autumn, harnessing their new Arctigo series of industrial air coolers. The first is in a logistics centre in Paris for supermarket giant Carrefour, and the second is in a frozen food distribution centre in Brittany.

Alfa Laval's air coolers are designed to keep fresh and frozen goods refrigerated from +20 to -35°C for the double discharge system, and +10 to -40°C for the single discharge system. They are capable of cooling large distribution centres.

Bitzer's Cox believes, "the ammonia business is very big in France". "We have also just finished 10 ammonia/CO₂ hypermarchés in France. That's why we are exhibiting the new OSA95," he says.

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Alfa Laval's new Arctigo series of industrial air coolers: the IS and ID



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Patrice Guignet, sales manager,
GEA Refrigeration France



Embraco compressor at Sifa booth

→ Pierrick Lucas of Axima Refrigeration identified overly stringent regulation as a barrier to wider uptake of ammonia in France. Lucas believes these regulatory constraints make little sense. "Ammonia has a superb safety record in France," he says.

"Ammonia has impressive refrigeration capacity and a great coefficient of performance for industrial applications compared to other refrigerants, but it is still too constrained by regulation, especially in France," Lucas argues.

Patrice Guignet, sales manager at GEA Refrigeration France (Grasso components division) – the French arm of German equipment manufacturer GEA – told a similar story. "The French ammonia market is well-established in industrial refrigeration applications such as food processing or cold storage. But ammonia safety regulations in France are more strict than in other EU countries, which can dissuade some smaller customers from investing in ammonia technology," Guignet says.

Vincent Bitsch, Güntner's sales director for France and Luxembourg, disagreed. "We see the market for ammonia in England and France as exactly the same. It has the same legislation. It's not complicated," Bitsch says.

Güntner was previewing several products developed ahead of Chillventa to make end users' lives easier. Modern systems, for example, combine several units with different technologies for heat dissipation: dry coolers, adiabatic units, hybrid dry coolers or evaporative condensers, each of them equipped with an individual control specifically adjusted to the respective unit.

These industrial coolers usually use ammonia, which makes the need for proper safety management all the more critical. New

Güntner technology allows all these pieces of equipment to be integrated into a new building management system (BMS), called the Masterpanel, instead of dealt with separately.

LARGER HYDROCARBON SYSTEMS NEEDED

Hydrocarbon technology was also on the radar on the Nantes tradeshow floor.

"Propane [R290] is coming to France. It's the future for domestic and light commercial refrigeration," argues Embraco's Iormetti. French frozen food retailer Picard has installed many Fricon chest freezers and display cabinets fitted with Embraco's R290 and R600a compressors.

At Sifa, the Brazilian compressor manufacturer was showing their latest line of R290 and R600a (isobutane) compressors for the French market. The NEU6220U compressor provides the biggest cooling capacity, with a 50 HZ voltage.

Tecumseh was also presenting an updated version of their AJ2 compressor series for R290. The company argues that propane can deliver efficiency improvements of 10% to 45% compared to R134a.

Hydrocarbons in Europe are subject to a charge limit of 150g per unit, which means they cannot be used for larger applications. However this is beginning to change.

"Italian vending machines are a new market for Embraco. The installers are asking for a higher charge limit. They are the ones driving this," says Iormetti. He expressed hope that this would soon be the case in France. **CM**

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Keith Milligan, JTM Corp.

US RETAILER PIGGLY WIGGLY'S AMMONIA/CO₂ EXPERIMENT

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

— By Michael Garry

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

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

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



The linchpin of this Piggly Wiggly – and the biggest contributor to its energy-saving capacity – is an ammonia/carbon dioxide cascade system made by Heatcraft Worldwide Refrigeration at its plant in Columbus, about 1.5 miles from the store.

The store, opened in September 2015, is just the fourth in the US to use an NH_3/CO_2 refrigeration system. But its superior energy efficiency, even in a warm climate like central Georgia, makes NH_3/CO_2 one of the more promising natural refrigerant technologies in the world.

The Piggly Wiggly store uses an ultra-low charge (53 pounds) of ammonia – less than any of the other NH_3/CO_2 stores – which is confined to the roof in the ammonia rack.

The ammonia condenses the CO_2 , which circulates throughout the store; cooling low-temperature cases via direct expansion and medium-temperature through pumped liquid overfeed. For energy comparison purposes, an HFC (R407A) rack alternates every few weeks with the ammonia rack in condensing the CO_2 .

Milligan's data comes from a comparison between the Columbus store's power consumption and an R407A Piggly Wiggly store in La Grange, Georgia. For the period ranging from October 2015 to April 2015, the new Piggly Wiggly consumed 23% to 33% less energy than the conventional outlet, for an average energy saving of 28.5% (\$33,170 in total).

The new store was equipped with a number of other energy-saving elements, including LED lights, skylights, occupancy and daylight controls, doors on display cases, and heat reclaim for hot water. But the NH_3/CO_2 system, accounting for 60% of the store's electricity consumption, was by far the most impactful on efficiency.

Between 2 February 2016 and 22 May 2016, the NH_3 rack consumed 22% less energy on average than the HFC rack, ranging between 18% and 25% depending on ambient temperature.

AMMONIA'S BIG POTENTIAL

Ammonia poses its own challenges, notably its toxicity in certain concentrations and its pungent odour. "I asked a lot of questions about that," said Milligan. "But because there is such a small amount [53 lbs.], I didn't see much danger. I'm very comfortable with it." The Piggly Wiggly distribution centre in Bessemer, Alabama, he noted, uses thousands of pounds of ammonia.

Heatcraft conducted a plume study at the store that assessed the risk in the event of a "catastrophic leak" of the 53lbs of ammonia in 10 minutes, and found overall that "there was no identified risk".

Milligan said he considered installing a transcritical CO_2 system, offered by Heatcraft, Hillphoenix and other OEMs, instead of the NH_3/CO_2 system, but decided not to because of central Georgia's warm climate. "The [transcritical] technology is improving [for warm climates] but at the time it would have increased my power bill."

By contrast, ammonia systems are unaffected by high ambient temperatures. "The ammonia system has worked very well," Milligan said. "Ammonia has been around forever as a refrigerant, though not in such tiny quantities." Masood Ali from Heatcraft added that in warmer climates, the NH_3/CO_2 system offers "the biggest bang for the buck".

The environmental benefits of his Columbus store are aligned with Milligan's values as well. "We wish all of our stores were like that," he said. "I have grandkids and I want to leave a good place for them. As a nation and a world we are making progress, but we still have a long way to go."

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

Milligan intends to use NH_3/CO_2 systems in future stores. As for existing outlets, he is hoping Heatcraft will come up with a retrofit solution that encompasses natural refrigerants. **OMG**

OPPORTUNITIES FOR CO₂ IN SMALL EUROPEAN STORES



Sanden has experienced great success with its CO₂-based heat pumps, vending machines and refrigeration solutions for small convenience stores (CVS) in its home market of Japan. Now the company is targeting the CVS market in Europe.

– By Charlotte McLaughlin

There is a clear market trend towards smaller format stores or convenience stores. Such stores in Europe are bit larger than the ones in Japan,” Sylvain Gillaux, European Sales & Marketing Manager at SANDEN Environmental Solutions, told *Accelerate Europe* at Sifa – le Salon Interprofessionnel du Froid et de ses Applications – a French refrigeration show in Nantes on 14-15 September.

“The interesting thing is that retailers a few years ago decided that they wanted to go CO₂, thinking mainly about large stores. Now they’re ‘positively trapped’ and want to use CO₂ for small stores, but they couldn’t find a solution – so that is our key market,” Gillaux said.

Since the beginning of 2016, Sanden has fitted more than 20 stores in Europe, mostly in France, with their small CO₂ remote condensing units. Many of these are for Biocoop, a French organic food retailer. The units are listed in their 2016 catalogue of EU F-Gas Directive-compliant solutions. They also supply to the three biggest installers that together

cover 75% of the French refrigeration market, while promoting directly to the end user as well.

“Most of them are not aware of the advantages of CO₂. If they are aware, they come directly to us. It’s quite simple,” Gillaux explains.

“We bypass our partners [the installers in the French market]. We directly promote [our technology] to the retailers or store owners. More than promoting, we simply inform them that CO₂ solutions adapted to their small format stores exist, so that they then request their installers or technical advisors to give them a quotation with Sanden CO₂ solutions,” he says.

JAPAN TO EUROPE: OPPORTUNITY AND COMPETITION

Sanden’s plug n’ play CO₂ systems have been very successful in the small convenience store market in Japan. Now they hope to bring this know-how to Europe. “In the last eight months [since their launch in Europe] we have installed

plug ‘n’ play units in 200 stores 200 stores – that’s huge in Europe. In Japan, we have a bit more than 200 stores too,” he says, expressing satisfaction with the speed at which the European market is developing.

Panasonic has also launched a pilot project using CO₂ plug n’ play systems, at a small COOP store in Randers, Denmark. Gillaux is not afraid of the competition. “In Japan we are behind Panasonic, but in Europe we are the pioneers. We are manufacturing in Europe, we have a local team of engineering experts, and we want to keep this leader position. We have built key partnerships with highly recognised companies to achieve this already. And we will keep doing so all over Europe.” **CM**

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GEA's new RedAstrum heat pump series: to be launched at Chillventa in capacities from 1200 kW to 2200 kW

GEA PUTS FAITH IN INNOVATIVE AMMONIA TECHNOLOGY

Heat pumps for potato chip driers and the London Underground are just two of the innovative new projects keeping German manufacturer GEA at the forefront of Europe's market for ammonia-based industrial refrigeration technology.

— By Andrew Williams

Eadquartered in Düsseldorf, Germany, GEA provides process technology and components for production processes in the food and energy sectors. Its portfolio includes equipment designed for natural refrigerants ammonia, CO₂ and hydrocarbons.

Accelerate Europe spoke to Kenneth Hoffmann, the company's product manager for heat pumps, to hear how the drive for a more sustainable energy system is creating new opportunities for natural refrigerants in Europe.

TOWARDS PLUG 'N' PLAY: MAKING NATREFS MORE ACCESSIBLE

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

"You see customers getting fed up of replacing their HFC systems over and over again because of legislation. What we're seeing is that natural refrigerants are creeping into new markets," Hoffmann says.

He is confident that natural refrigerant uptake will pick up in future. Ammonia is already the main refrigerant in GEA's industrial equipment portfolio and the company currently holds 30% of the ammonia market in Europe. Nonetheless, he freely admits that natural refrigerants are not advancing as quickly as GEA had hoped.

"With the f-gas reductions that are coming up in future, I think there will be much higher uptake – when people suddenly realise that now they actually do need to do things differently to what they have been doing so far," he argues.

Whereas responsibility for assembling refrigeration plants was once left with the customer, Hoffman believes current market trends favour ready-to-use solutions. "What we're doing is trying to make it easier to install natural refrigerants. We're packaging our products more as plug 'n' play," he explains.

Over the past year, GEA has put in place a new strategy focusing on R&D. "It's about trying to stay ahead of the market by developing new products that are more efficient and that meet market demand. Products that are easier to install," he says.

OPENING DOORS TO NEW MARKETS

Hoffmann believes that making the technology more accessible will help broaden the appeal of natural refrigerants. "Just add power and water, and you're up and running. Hopefully this will open doors to new markets," he says.

Several new GEA products are already delivering just that. At the European Heat Pump Association's annual forum, held in Paris on 18-20 May, Hoffmann presented a new ammonia-based, air-to-air heat pump for potato chip driers.

With an annual coefficient of performance of 7.0, the heat pump is capable of delivering hot water at up to 80 degrees Celsius and delivers greenhouse gas emission reductions of up to 70% compared to conventional gas boiler heating.

"It's a combined heating and cooling solution," Hoffmann explains. Rather than rejecting the heat used to dry the potatoes, the new system dehumidifies the air in a closed loop before it is reused to heat the next batch. "We're recovering the energy within the system and thereby using a lot less energy," he says. Using a closed loop system minimises the risk of refrigerant leakage.

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2-stage high efficiency ammonia heat pump (1,000 kW) for London Underground project

→ ALL ABOARD! HARNESSING THE LONDON UNDERGROUND

The ammonia heat pump for the London Underground, meanwhile, will reclaim hot air from a ventilation shaft at a constant temperature of 24-30 degrees Celsius. The system is ready and will be installed as soon as other sections of the project have been completed.

The installation, for Islington Council, will supply cooling capacity for London Underground trains as well as providing hot water for nearby buildings.

Islington Council installed a district-heating network in 2013. At the heart of the project is the Bunhill Energy Centre, comprising a gas-fired combined heat and power (CHP) engine and thermal store that provide heat and power to around 850 homes and two leisure centres.

In 2016 the network is being extended to serve the King's Square housing estate. The extension includes a new energy centre that incorporates the heat recovered from the London Underground, thanks to the ammonia heat pump.

"There is also an additional gas CHP as backup and to boost the heat on the coldest days. They can also work in combination, so the electricity produced by the gas CHP can be used to feed the heat pump," Hoffmann explains.

He believes the project may inspire similar schemes in other densely populated areas.

Hoffmann is also excited about another new ammonia heat pump, the RedAstrum, which will be officially launched at Chillventa in Nuremberg on 11-13 October. The RedAstrum offers a combined heating and cooling solution for industrial applications and district heating.

"In the food industry today, we're seeing requests from customers for bigger and bigger capacities. We're getting to a size that our piston compressor can't handle any more – and if you need multiple piston compressors, then it becomes a more expensive solution," Hoffmann explains.

"The RedAstrum is able to do more than 2 MW in a single heat pump. That is attractive to customers. We've already supplied a few of them. Most requests have come from Scandinavia," he says.

CHANGING THE GAME WITH NEW TECHNOLOGY

Alongside flagship projects like the new heat pumps, GEA is also working hard to eliminate safety fears related to ammonia. Using a low charge keeps potential safety issues inside the plant room. The company has also developed an ammonia absorber.

The absorber, which will make its debut on the London Underground project, cleanses the air of ammonia before it passes through a ventilator to leave the plant room. Hoffmann believes this is a potential game changer: eliminating risk will have a positive psychological effect on users of ammonia technology.

"Before, in the plant room, people were using a scrubber solution where you scrub the air with water or citric acid. You can scrub the air to down below the safety limit, but you can't completely eliminate ammonia. An absorber is basically a carbon material, so it completely absorbs all the ammonia," he explains.

Training can also play a crucial role in overcoming the perception among some potential customers that natural refrigerant technologies are more complicated than more conventional alternatives.

GEA sends its own staff to maintain equipment installed in the field. "Internally, we're making sure that our people are trained to be able to handle natural refrigerants. You need to make sure that people understand how the systems work," Hoffman said.

Ten years from now, he expects the market to be dominated by standard packages, with fewer systems requiring assembly on site. "That's the way things are evolving. All our products are going that way," Hoffman says.

Will there be a bigger piece of the pie for natural refrigerants? "Definitely!" **AW**

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PIONEERING SPIRIT: EUROPEAN FIRMS BRING NATREFS TO UNITED STATES

With leading HVAC&R experts and end users attending this year's ATMOsphere America foreseeing a bright future for natural refrigerant applications in North America, European manufacturers seized the opportunity to showcase their technologies on US soil.

– By Andrew Williams

While many speakers at the fifth annual ATMOsphere America conference – held at the Westin Michigan Avenue in Chicago on 16-17 June – hailed increased uptake of CO₂, others were upbeat about the prospects for hydrocarbons and low-charge ammonia.

EUROPEAN INNOVATION ON SHOW IN THE WINDY CITY

European manufacturers with long experience of working with natural refrigerants are keen to capitalise on the increased interest being shown in natref technologies stateside.

Ammonia is experiencing a particularly strong period of growth in the United States, led by increased demand for innovative new low-charge equipment. Joe Sanchez, engineering manager in the US division of German compressor manufacturer Bitzer, reported that the company had recorded a 60% increase in the number of ammonia compressors sold in the United States in the last two years.

Sanchez believes the boundaries between technologies designed for the commercial and industrial refrigeration sectors will dissipate in future. This trend, he predicts, will produce “industro-mercial” solutions – the development of equipment suitable for both industrial and commercial applications.



Daniel Clark, founder,
Hamilton-Clark



John Gallaher, Hillphoenix



Marek Zgliczynski, Embraco

He reported impressive overall growth in demand for CO₂ and ammonia compressors in the North American market in recent years.

HYDROCARBONS FOR BOTTLE, WATER-COOLERS

Propane may also be on the brink of large-scale US expansion. Marek Zgliczynski, from the European arm of Brazilian compressor manufacturer Embraco, expects the impressive efficiency of hydrocarbon systems to help trigger their wider rollout. He predicted a 20% increase in hydrocarbon technology sales in the United States this year.

However, barriers to increased uptake of hydrocarbons in the US include an excessively low charge limit and a lack of trained technicians, Zgliczynski warns.

Blupura is undeterred by potential regulatory hurdles. The Italian water vending machine and water cooler manufacturer is putting natural refrigerants at the heart of its business model and eyeing growth in the US market.

"We've officially decided to use R290 [propane] in all our units," said Debora Screpanti, Blupura's marketing manager, ahead of ATMOsphere America. Since June, all their units run on R290 only.

Blupura has decided to focus solely on natural refrigerants when many of their competitors continue to produce HFC technologies too. "We're just doing it! Our philosophy is to be environmental-oriented, and we couldn't have done anything differently from what we're already doing," Screpanti explains.

"Furthermore, our water coolers are more efficient with the natural refrigerant R290. So, there is only to gain from this choice," she adds.

"We're creating the culture, and it will be normal in the future. During our first efforts it was not so easy to explain it, but now more and more people are starting to look for it. So it will be a standard technology [going forward]," Screpanti asserts.

Blupura sees itself as a pioneer of R290 water cooler technology not just in Europe but also in the US. "We got official authorisation in January – so we're now the only company in the US authorised to sell units with this kind of gas [R290]," said Screpanti in June.

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Steve Trulaske, True Manufacturing

→ “They’re starting to write the regulations based on our first installations. We have already installed some in the US. We’re growing a lot in the US. Our forecast is to become very soon the leaders in point-of-use water coolers also in the US, especially in the hospitality sector,” she said.

CO₂ ‘THE NEW NORMAL’ IN EUROPE

Danish company Advansor – which was acquired by US firm Hillphoenix in November 2011 – is also benefitting from the growing popularity of natural refrigerants, and particularly CO₂, in the United States.

In Chicago, Hillphoenix’s John Gallaher presented three examples of Advansor CO₂ transcritical cold storage facilities in Illinois, at Caputo’s, House of Spice and Best Foods. Hillphoenix has also fitted three CO₂ ice rinks in Anchorage, Alaska.

“Natural refrigerant systems are becoming needs, not wants,” said Gallaher.

Although CO₂ transcritical systems are initially more expensive than their HFC counterparts, manufacturers are working hard to bring costs down, Gallaher explained. Moreover, “these costs are offset by lower refrigerant costs,” he said.

Gallaher argued that CO₂ is particularly well suited to ice rinks, helping to improve the quality of the ice as well as system efficiency. “We plan to improve our learning centre and participate in industry associations that promote natural refrigerant systems,” he said, highlighting CO₂ booster technology as one way in which efficiency can be improved.

Daniel Clark, founder of UK-based Hamilton-Clark Refrigeration Design & Management, told ATMOSphere America about the implementation of CO₂ transcritical systems by Booths, a 28-store grocery chain in northwest England. Starting in 2010, Booths now has these systems in 40% of its stores. “Transcritical CO₂ is the new norm,” Clark told the Chicago audience.

Each Booths store uses two independent transcritical booster CO₂ systems encompassing Advansor racks, Bitzer compressors, Hauser cabinets, Wieland tubing and Resource Data Management controls.

The CO₂ racks offer 12% energy savings, and in Booths’ northern English climate, can take advantage of free cooling. Doors on the multi-deck cases add 38% savings, while heat recovery contributes 5% savings in comparison to traditional HFC systems, said Clark.

The cost of the system is “getting nearer” to that of HFC technology. But due to CO₂’s higher pressures, which require more metal, “you are never going to get to cost parity,” he said. However, capital cost uplift is “dwarfed by lifecycle savings”.

Clark also noted that the total equivalent warming impact (TEWI) of Booths’ CO₂ system is 82% less than that of an R404A system with open multi-decks and no heat recovery.

US food retailers installing CO₂ transcritical systems can benefit from the “intensive development of CO₂ refrigeration technology over the past 10 years,” said Clark. “CO₂ is the ‘new normal’ in Europe.” **AW**



ACCELERATE AMERICA AWARDS RECOGNISE NATREF PIONEERS

At the Chicago conference, shecco announced the winners of its first annual Accelerate America Awards. The awards recognise the companies and people who have done most to accelerate the marketplace for natural refrigerant technology in North America.

The winners were:

- Sobeys in the food retail category;
- Red Bull in the foodservice category;
- Campbell Soup in the industrial refrigeration category;
- True Manufacturing for Innovation of the Year, and;
- Marc-André Lesmerises, CEO of Carnot Refrigeration, for Person of the Year.

Sobeys, the second largest chain in Canada with around 1,800 stores, has more than 80 transcritical CO₂ stores and will end the year with about 90, by far the most of any food retailer in North America. Every year, 15-20 stores are equipped with CO₂ transcritical, including both new stores and retrofits.

Red Bull has committed to installing Eco-Cooler beverage merchandisers with a hydrocarbon refrigerant (largely isobutane) as its standard model wherever legally and technically feasible. So far, it has more than 700,000 installed globally. In North America, Red Bull expects to order 54,000 hydrocarbon coolers this year.

Campbell Soup, led by its long-time head of refrigeration engineering Bob Czarnecki (who retired last year), pioneered the use of safe, environmentally friendly low-charge ammonia systems in the industrial sector, starting in the late 1980s.

Since 2011, low-charge packaged systems have been

replacing R22 systems at Campbell's Pepperidge Farm plants, a project now overseen by Czarnecki's successor, Bing Cheng – Campbell's principal utilities engineer – who accepted the award at the ATMOsphere America ceremony. The ammonia packages have been found to be more energy efficient than the R22 systems they replaced.

True Manufacturing, whose owner, Steve Trulaske, accepted the Innovation of the Year award at the ceremony, was the first foodservice equipment supplier to respond to impending Department of Energy and Environmental Protection Agency regulations by transitioning its merchandising and refrigeration equipment to propane; in many cases, True is dropping HFC models from its inventory.

Carnot Refrigeration, co-founded by Marc-André Lesmerises, has become one of Sobeys' principal suppliers of CO₂ transcritical refrigeration systems for its supermarkets. Carnot has supplied over 50 of Sobeys' 80+ transcritical stores. Carnot has also added more retail customers for transcritical, becoming one of the leading manufacturers in North America in terms of the number of transcritical systems installed in supermarkets. Carnot even installed the very first CO₂ transcritical store in the US, at a Hannaford supermarket in Turner, Maine.

Lesmerises also helped to pioneer the adoption of CO₂ transcritical for cold storage and food processing, ice rinks, and data centres.

Next year's Accelerate America Award ceremony will be held at ATMOsphere America in San Diego in June 2017. The winners of the first ever Accelerate Europe Awards, meanwhile, will be revealed at the 2017 edition of ATMOsphere Europe in Berlin. **AW**



Tom Land of US EPA in action

GRAPPLING WITH HFCs IN THE AMERICAS

As the world awaits a global framework for dealing with HFCs, Canada has developed its own plan while Mexico is seeking funding to support its phase-down objectives.

– By Michael Garry and Justina Tamasiunaite

In November 2015, 197 countries committed to work within the Montreal Protocol to find an agreement in 2016 on a global phase-down of HFCs. This marked a major breakthrough after seven years of unsuccessful attempts to bring HFCs under the treaty.

The most recent Montreal Protocol meeting on this issue took place in Vienna in July, and the final meeting of the year is scheduled for October in Rwanda.

“2016 is the key year for making progress towards a global HFC phase-down,” said Klára Skačánová, deputy manager – market development at shecco, during the ATMOsphere America conference in Chicago in June. “The global HFC phase-down will soon become a reality – whether it’s this year or next year, it’s going to happen.”

One proposal for an HFC phase-down plan came from the United States, Canada and Mexico, which were all represented at the ATMOsphere event. Each has been trying to reduce the use of HFCs in advance of a global agreement.

“Regulatory action at the national level to reduce emissions of HFCs is intensifying across the world,” said Skačánová, adding that this presents “opportunities for natural refrigerants”.

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CARB's Glenn Gallagher addresses delegates

→ CANADA PROPOSES HFC RULES

René Desjardins of Environment Canada – the Canadian government's environmental agency – outlined Canada's HFC phase-down strategy.

HFCs are not manufactured in Canada but are imported in bulk and in pre-charged cooling equipment and other products. Currently, federal, provincial and territorial regulations prohibit the release of HFCs in refrigeration, air-conditioning, fire-extinguishing and solvent systems. But Canada does not prevent the entry of HFCs into the market or limit their usage.

However, the Canadian government has proposed several regulatory measures to reduce HFC consumption. The first is a phase-down measure for companies that import bulk HFCs. It would establish reduction steps (calculated in CO₂ equivalent) from a baseline level (HFC imports in 2014 and 2015), starting with a 10% reduction in imports in 2019; a 35% reduction in 2024; a 70% reduction in 2030; and an 85% reduction in 2036.

"HFCs in pre-charged equipment would not be included in this phase-down," said Desjardins.

However, imports and manufacture of pre-charged equipment and other products containing HFCs would be targeted under another proposal that establishes product-specific controls. This would prohibit, by a specific year, the import and manufacture of specific systems that contain or are designed to contain any HFC or HFC blend with a GWP greater than a designated limit.

For example, centralised refrigeration and stand-alone low-temperature commercial refrigeration could not contain HFCs with a GWP above 1,500 starting in 2020; the GWP limit for stand-alone medium-temperature refrigeration would be 650 in 2020; and the GWP limits for domestic refrigeration and mobile air conditioning would be 150, by 2025 and 2021 respectively.

"People could continue to use equipment currently in use," said Desjardins. "We're targeting manufacture and imports."

Pre-publication of a proposed final regulation, followed by a 75-day public comment period, is expected in late 2016 or early 2017.

MEXICO LOOKS TO MONTREAL PROTOCOL

Mexico has received funding from the Montreal Protocol's Multilateral Fund to transition away from CFCs and HCFCs. Mexico is now looking forward to an agreement within the Montreal Protocol on HFCs that would enable a similar phase-down, said Agustín Sánchez Guevera, national coordinator of Mexico's Ozone Protection Unit.

"To control HFC emissions, the best way is to phase down consumption and production as we do [with CFCs and HCFCs] in the Montreal Protocol," he said.

Mexico passed a Climate Change General Law in 2012 that aims to reduce overall greenhouse gas emissions by 30% (compared to 2000 levels) as of 2020 and by 50% as of 2050. The goals "could be reached if an international regime like the Montreal Protocol is established for the technology, and financial support to developing countries," said Sánchez Guevera.

Mexico has established a programme targeting short-lived climate pollutants such as HFCs, as well as a national emissions registry requiring companies to report emissions of greenhouse gases like CFCs, HCFCs and HFCs. It has also developed codes to monitor HFC imports and safety standards for flammable gases.

A key barrier to the adoption of natural refrigerants in Mexico, said Sánchez Guevera, is the lack of a trained service sector. "If manufacturing companies don't have servicing in the market, they can't put their products in the market. So they are waiting until we have well-trained technicians in the service sector."

He hopes that a potential HFC amendment in the Montreal Protocol will "give us funding to train technicians and allow the government to set rules in order to use alternatives like natural refrigerants". **MG & JT**

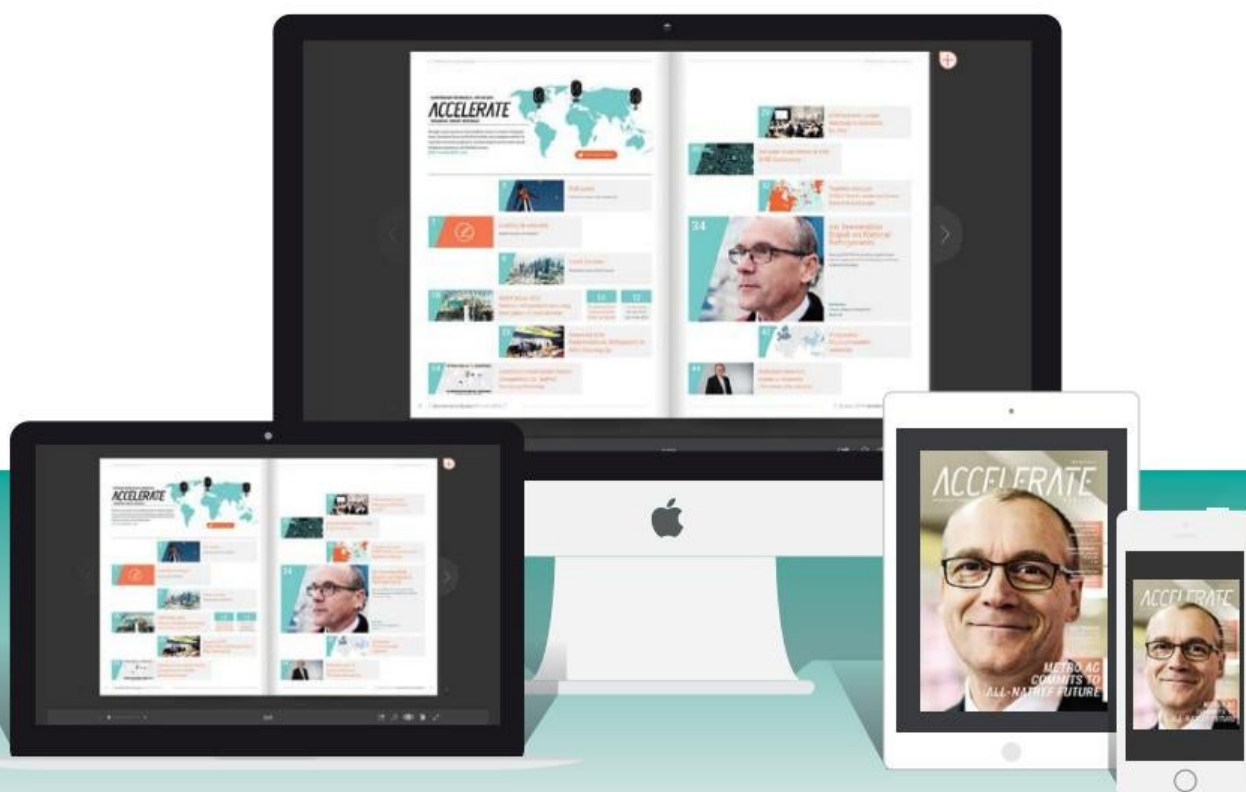


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RWANDA COULD MARK BEGINNING OF THE END FOR HFCs

In October, close to 200 countries around the world are expected to reach a binding agreement to put HFCs on the list of controlled substances under the Montreal Protocol – and therefore subject to gradual reductions.

– By Klára Skačánová

After some seven years of unsuccessful negotiations on whether or not HFCs should be phased down under the Montreal Protocol, expectations among the international community are now high that an historic amendment can be agreed at the next Meeting of the Parties on 10-14 October in Kigali, Rwanda.

“Amending the Montreal Protocol to phase down HFCs is one of the single most important unitary steps that we could possibly take at this moment to stave off the worst impacts of climate change and to protect the future for people in every single corner of the globe,” said US Secretary of State John Kerry at the last Montreal Protocol meeting, in July in Vienna.

HFC PHASE-DOWN OF 'EQUAL IMPORTANCE' TO FIGHTING TERRORISM

Kerry compared the importance of tackling HFC emissions to the global fight against terror.

"Yesterday, I met in Washington with 45 nations – defence ministers and foreign ministers – as we were working together on the challenge of Daesh, ISIL, and terrorism. [...] What we are doing here right now is of equal importance because it has the ability to literally save life on the planet itself," he told the July gathering.

Last year, the Parties to the Montreal Protocol pledged to reach a deal on phasing down HFCs globally by the end of 2016. To get there, countries agreed to intensify negotiations – triggering several extraordinary meetings and intersessional discussions. This culminated in July's meeting in Vienna, which made progress towards a global deal that would address growing emissions of HFCs in developed and developing countries.

CHALLENGES REMAIN AHEAD OF OCTOBER GATHERING

Countries were able to make progress on challenges including funding, exemptions not related to high ambient temperature regions (such as essential use exemptions), and links to the existing phase-out of HCFCs.

The Parties discussed consumption freeze dates and reduction schedules for both developing and developed countries, and possible baseline years against which these targets would be set. Developing countries demanded higher levels of ambition from rich nations, to help speed up the adoption and increase the availability of HFC replacements.

The draft agreement sets developed nations a target of almost eliminating HFCs by 2030, while giving developing countries 10 or more years to reach the same stage. While there appeared to be broad agreement on the baseline, freeze date and first reduction steps for developed countries in Vienna, the proposals currently on the table for developing countries differ widely and more work will be needed to overcome these differences before or at the October meeting.

India tabled the least ambitious proposal, suggesting a freeze in consumption of HFCs in 2031. The EU, Japan, the US, Switzerland, Canada, Australia, New Zealand and Norway

were joined by the African group, Pacific island countries and some Latin American nations in a proposal to freeze HFC consumption in developing countries in 2021. Other countries, including China, Brazil, Argentina and Indonesia, supported freeze dates between these two dates.

HYDROCARBON SAFETY STANDARDS HIGH ON THE GLOBAL AGENDA

Outdated international standards that arbitrarily restrict the use of hydrocarbons in refrigeration and air conditioning equipment are increasingly seen as a barrier to wider uptake of climate-friendly alternatives to HFCs.

In Vienna, China formally called on the Parties to establish regular consultations on safety standards with a view to accelerating the revision of relevant standards in a neutral manner. This should enable the safe use and market adoption of low-GWP alternatives required by the future HFC amendment.

The proposal triggered much discussion, with representatives requesting time to consider possible action. Formal discussion of the proposal was deferred to the Meeting of the Parties in October.

Several side-events held on the margins of the Vienna meeting drew attention to archaic charge limits set for hydrocarbons in international safety standards. Daniel Colbourne, a consultant for German international development company GIZ, argued that the current standards fail to take account of mitigation measures. Integrating mitigation measures into system design can reduce risks related to increasing the charge to acceptable levels.

TOWARDS A LEGALLY-BINDING DEAL

The Parties agreed that further intersessional work would be needed before October to narrow down the remaining differences and secure alignment on the future shape of a global HFC phase-down. Expectations are now high that a deal will be sealed in Rwanda.

The amendment – which would be legally binding on the 197 Parties to the Montreal Protocol – could potentially make a greater contribution to reducing greenhouse gas emissions than the UNFCCC's Paris Agreement struck at the end of 2015. Countries' emission reduction pledges in the Paris Agreement are voluntary. **KS**

EU, US REGULATION DRIVES HVAC&R INNOVATION AT PURDUE

This year's Purdue conference series demonstrated how technological and regulatory developments are helping to boost uptake of natural refrigerants in the HVAC&R sector worldwide.

– By Charlotte McLaughlin

Purdue Conferences 2016, covering research in the HVAC&R sector, took place at West Lafayette in the US state of Indiana from 11-14 July.

This year's conference series included the 23rd International Compressor Engineering Conference, the 16th International Refrigeration and Air Conditioning Conference, and the 4th International High Performance Buildings Conference.

The sessions gave participants an insight into how innovative new technological developments could be harnessed in the future.

LEGISLATION BECOMING DRIVER OF CHANGE

With hopes high that a global agreement to phase down HFCs will be struck at October's Montreal Protocol meeting in Rwanda, the HVAC&R industry is under pressure to switch to alternative refrigerants. In Europe, the EU's F-Gas Regulation has already triggered such change, with many European supermarkets opting for CO₂ or hydrocarbons.

Key speakers like Drusilla Hufford – Director, Stratospheric Protection Division, Office of Atmospheric Programs, US EPA – and Viraj Vithoontien, Program Leader at the World Bank Montreal Protocol Program, were on hand to provide policy advice to complement the technological innovations showcased by some of the world's leading researchers in the HVAC&R field.

Conference chair and Reilly Professor of Mechanical Engineering Eckhard Groll said this year's Purdue came "at a time when key international decisions are helping to define the

direction of issues related to the environment, climate change, solar and other technologies".

The US Environmental Protection Agency's Significant New Alternatives Policy (SNAP) programme and the European Union's F-Gas Regulation, which seek to phase down f-gas emissions, are also forcing the HVAC&R industry to improve the energy efficiency of their products.

"The question is, where is all of the energy coming from to operate these additional systems?" Groll said. "This expansion in air conditioning and refrigeration will drive greater needs for energy efficiency and environmental considerations."

R744 PERFORMING IN WARM AMBIENT TEMPERATURES

Participants heard how CO₂ has been successfully applied in warm ambient conditions in southern Europe as a means of meeting the demands of the F-Gas Regulation.

CO₂ can even be combined with other natural refrigerants, such as ammonia or water.

Research by Steven Lobregeti, Jan Broeze and Carlos Infante Ferreira found that 30% energy savings could be achieved by flash freezing via a water-CO₂ refrigeration system. Test results at a fruit and vegetable processing plant have been promising.

Extremely warm or cold ambient temperatures may pose problems for CO₂, whose effective temperature range is relatively narrow.

Researchers at the University of Dresden nevertheless explored 'CO₂ as an Alternative Refrigerant for Applications Below -50°C'. Langebach et al. found that, "a CO₂ sublimation cycle can compete with the cycle efficiency of the R404A/R23 cascade system or even exceed it" if compared below the transcritical point. Concerns over the temperature range of CO₂ can be overcome with innovations like heat transfer and ejectors, they argue.

'IMPROBABLE AND IMPRACTICAL' TO ADOPT R32 IN PLACE OF AMMONIA

Dr. Andy Pearson, from UK-based Star Refrigeration, presented his comparative analysis of ammonia and new gases like R32, a synthetic HFC with a GWP of 650 which some are touting as an alternative to R410a. Pearson, an ASHRAE fellow, concludes that it would not just be improbable for R32 to replace ammonia for industrial applications, but also impractical.

His Purdue paper cited the EU's F-Gas Regulation as a major barrier to swapping natural refrigerant ammonia for R32 in industrial refrigeration.

Despite similarities between the two refrigerants, R32 is more expensive than ammonia, according to Pearson – with R32 prices only expected to increase. "In comparison, ammonia for use in industrial refrigeration systems has been very stable for many years," he says.

Ammonia and R32 are toxic and should only be used if safety precautions are respected, Pearson writes. The problem with R32, he warns, is that little is known about how to run effective safety checks.

Ammonia, by contrast, has been used in industrial refrigeration for so long that "[it] has a good track record of safety, efficiency, ease of maintenance and reliability".

Other ammonia-based case studies at Purdue focused on electrochemical compressors in ammonia systems and ammonia-water absorption chillers.

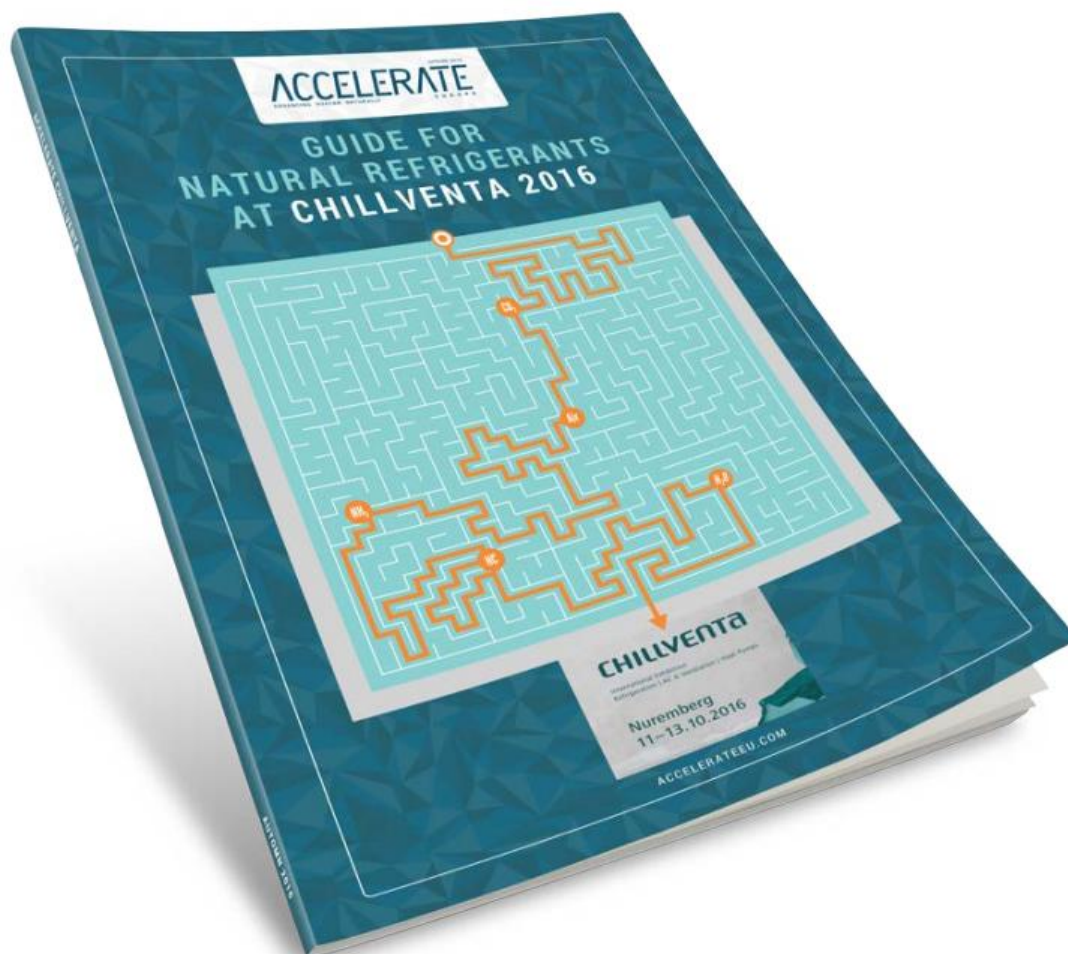
HIGH-EFFICIENCY PROPANE HEAT PUMPS ON SHOW

Environmental performance is playing an increasingly important role alongside energy efficiency and safety considerations when designing heat pumps, argues a Purdue paper from Miquel Pitarch et al., from the University of Valencia, Spain.

The Spanish researchers set about designing a propane heat pump based on a water-to-water system to heat or cool as necessary, using the water inlet as a temperature reference point.

By operating in a subcritical cycle for sanitary hot water production and harnessing sub-cooling, their system has been shown to be 31% more efficient than conventional technology.

Purdue, which saw 600 participants from over 30 countries present a record 476 papers this year, demonstrated once again a plethora of HVAC&R innovations that could soon find commercially viable applications. **CM**



CHILLVENTA: THE PLACE TO BE FOR NATURAL REFRIGERANTS

This year's edition of the Chillventa tradeshow, taking place in the German city of Nürnberg from 11-13 October, will see the world's biggest display of natural refrigerant technology so far.

– By Alvaro de Oña

Think of Germany, and the association with efficient and reliable technology inevitably comes to mind. Thanks to a fairly decentralised structure, Germany boasts several innovation hotspots across the country in different sectors, from automotive to machinery or from IT to electronics.

Germany's strong focus on adopting innovative energy and environmental technologies to help reduce greenhouse gas emissions is setting the direction for all these sectors. It is thus no surprise that Chillventa, held every second year, has become the reference event for the HVAC&R sector globally, with an increasing focus on natural refrigerant technology.

Chillventa 2016 will see the biggest ever showcase of natural-refrigerant technology. Some 188 companies will exhibit natural-refrigerant based solutions, up from 120 in 2014. This increase reflects the rapid evolution of natural refrigerants over the last two years worldwide.

This year's edition is expected to beat all previous records, attracting around 1,000 exhibitors and over 30,000 trade visitors from all over the world.

continued on p.70 →

LEADING CO₂ TECHNOLOGY FOR COMMERCIAL AND INDUSTRIAL REFRIGERATION

Advansor is an internationally leading manufacturer of sustainable refrigeration for supermarkets, industrial refrigeration, food processing industry, chemical industry and air conditioning with CO₂ as the only refrigerant.



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→ Despite the tradeshow's German orientation, nearly 70% of exhibitors and 55% of the visitors are of international origin.

Over 200 presentations will be on offer at various side events during the tradeshow, starting with the Chillventa Congress discussion forum on 10 October. Among the 30 educational sessions dedicated to natural refrigerants are presentations and case studies from Colombia, South Africa, Romania and China.

Among the major themes of this year's presentations will be current climate targets, eco-design, choice of refrigerant, efficiency through control systems, innovation in heat transfer, limits of refrigeration technology, and climate control in data centres.

Daniela Heinkel, director of Chillventa, describes the event as, "the international hub for refrigeration, air-conditioning, ventilation and heat pump technology, for advances and optimisations as well as current trends, new paths and innovative products".

On 11 October, the all-new Chillventa Awards will be presented, recognising expert teams (planners, plant engineers, owners and operators) in four categories: commercial refrigeration, industrial refrigeration, air-conditioning technology and heat pumps.

INNOVATIONS ON DISPLAY

CO₂ will be a major trend at the show, with several new product launches lined up. Bitzer's new reciprocating CO₂ compressors will surely attract plenty of attention, as well as Danfoss' capacity controller for CO₂ systems. Also new will be CAREL's Hecu CO₂ high-efficiency control solution for CO₂ condensing units.

Güntner will present its new adiabatic gas cooler for transcritical CO₂ plants, whereas Baltimore Air Coil will reveal its new CO₂ hybrid transcritical condenser. Henry Technologies, for its part, will showcase its new CO₂ safety devices, including electronic oil controllers and level sensors.

Ejectors are poised to attract a lot of attention for their potential to improve the performance of CO₂ systems in warm climates.

As for hydrocarbons, Secop is ready to announce a whole new line of variable-speed compressors, from the smallest propane-based model for light-commercial applications to their range suitable to household applications.

Ammonia solutions will also be easy to spot at Chillventa, with Alfa Laval set to launch a whole new set of products. Their new series of industrial air coolers will be on display, namely two new products: single and dual discharge industrial air coolers respectively. The Swedish manufacturer will also present a new generation of plate heat exchangers, with one model specifically designed for different pressure levels, making it suitable for low-charge ammonia in food retail applications.

Finally, water used as a refrigerant (R718) will also be on display at Chillventa, with ILK's vacuum ice slurry technology in the spotlight after winning first place in the German Refrigeration Awards 2016.

Chillventa will be an excellent occasion to see the latest trends towards more efficient, smarter, and integrated HVAC&R systems, with natural refrigerants at the forefront.

To help visitors to the tradeshow navigate their way through the vast array of natural refrigerant solutions, shecco (publisher of *Accelerate Europe*) is issuing its 'GUIDE Chillventa 2016'. The GUIDE will be distributed free of charge during the event and is also available online.  AO



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THE HVAC&R INDUSTRY JUST GOT A WHOLE LOT SMARTER!

Technology has moved on leaps and bounds in recent years. Ten years ago, mobile phones were only for making calls. Now you can order food, transport or whatever else you could possibly want at the touch of a button. There is an app for everything and if it doesn't exist yet, someone will build it soon.

— By Charlotte McLaughlin

Modern fridge design has not changed that much in the last 50 years. But this is about to change, as the HVAC&R industry steps up to the plate and embraces the all-new, ever smarter world of technology.

Manufacturers are natural refrigerant systems and components are at the forefront of this innovation. Gustav Lorentzen only developed the modern thermodynamic transcritical CO₂ refrigeration cycle in 1988-1991. Now it is a staple feature of the global HVAC&R market.

Fast-forward to 2016, and many players in the natural refrigerant sector have apps to help technicians to install and maintain systems and components. The apps aim to save technicians the hassle of calling a company or leafing through an operating manual.

Here is a snapshot of the apps and remote monitoring tools that are already helping to transform the industry today.

DANFOSS TRANSFORMS YOUR SMARTPHONE...

Denmark's Danfoss is leading the charge. Their Refrigerant Slider app transforms your smartphone into an intuitive pressure-to-temperature refrigerant converter. The app – available for Android and iPhone systems – covers 76 natural and other refrigerants, providing data like their global warming and ozone-depleting potential.

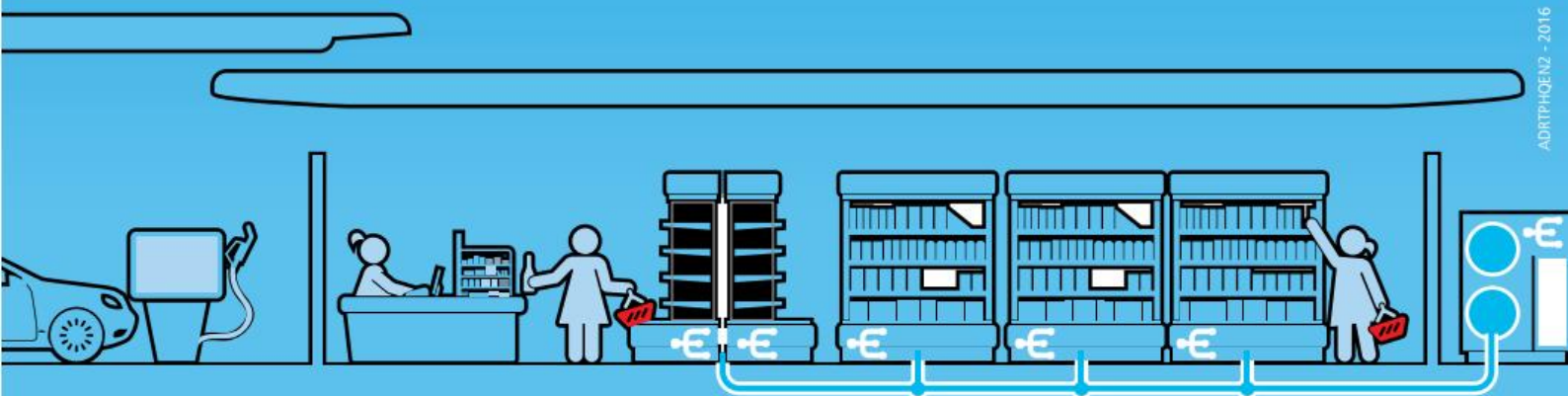
With the Refrigerant Slider app, you can easily switch between different pressure and temperature units. The app is based on NIST refrigerant property data and uses Antoine equations. It also informs users of the total temperature glide of refrigerant blends.

continued on p.74 →



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→ The Trouble Shooter app, also from Danfoss, is a handy pocket-guide that helps technicians to identify and solve common issues that arise on the job.

Upon launching the app, Trouble Shooter displays a refrigeration system diagram divided into four main areas: low pressure, high pressure, compressor, and liquid line components. Select the area you need and review the symptoms in the system. Once you identify the issue, the app suggests possible causes and solutions.

Technicians have embraced it – an American user said it is, “great with assistance in tracking down and quickly assessing the problem to identify what’s wrong and what our options are”.

Danfoss offers a total of eight different cooling apps, including an app for people working with industrial refrigeration, a Site Service app that enables service technicians to remotely connect to a Danfoss control system, and a low-GWP tool for those looking to retrofit a new refrigerant.

...WHILE TECUMSEH HELP YOU REPLACE A PRODUCT

Tecumseh Products Company’s mobile app is also available on Android or iPhone systems. It helps refrigeration and air conditioning contractors to quickly and correctly identify service replacement compressors, condensing units and applicable electrical components, reducing the time required to get the job done.

It serves as a ‘guidebook’ or cross-referencing tool whereby you scan the component’s serial label bar code or QR code with your smartphone or tablet, directing you to a choice of equivalent Tecumseh parts.

You can also search for any component in the app’s database. Information about all Tecumseh’s compressor and condensing units is there, as well as info on compressor motor types, start and run motor resistance ratings, replacement start and run capacitor part numbers (where applicable) and replacement relay and overload kits for virtually every Tecumseh compressor on the market today.

LIEBHERR APP TELLS YOU WHAT’S IN YOUR FRIDGE

German company Liebherr is not shy to embrace new technology, switching completely to refrigerants propane (R290) and isobutane (R600a) for its entire range of refrigerators and freezers for commercial use in Europe before most companies had even thought about it.

Its new range of intelligent fridges is based on Microsoft know-how. Windows 10 IoT Core software allows customers to access their fridges and freezers remotely via an app connected to Liebherr’s SmartDeviceBox.

The refrigerators are also fitted with an integrated camera that establishes an inventory of all items stored inside, which can be accessed via the application. With help of the voice recognition tool Media Intelligence Assistant, customers can add items to the inventory and prepare their shopping list.

In future, Liebherr plans to integrate a recipe comparison tool into the app, so that missing food items will be automatically added to the shopping list. Other data listed in the app include temperature, compressor runtime and door opening time. The goal is to help consumers to achieve more efficient food storage and refrigeration management. **CM**



38°C

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Italy's largest hypermarket opts for CO₂ refrigeration

The use of CO₂ transcritical refrigeration in warm climates has been a hot topic for many years. The tables are turning, however, and CO₂ refrigeration is advancing across Southern Europe as an efficient and viable solution. In April 2016, the largest hypermarket in Italy opened its doors in Milan.

The 10,000 m² brand new Iper Hypermarket is part of the new Arese Shopping Center. Sustainability is a key pillar of the building design. As a LEED Gold certified shopping center, it is designed and constructed to use less water and energy and reduce greenhouse gas emissions.

This installation, featuring several hundred cabinets and cold rooms, is a pioneer in CO₂ transcritical refrigeration system using ejector technology to enhance efficiency with outdoor temperatures up to 38°C. Danfoss has devised new ways to use the ejector technology in refrigeration applications to increase the energy efficiency of parallel compression. The turnkey refrigeration system is supplied by Arneg.



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SHORT TAKES

By Andrew Williams, Charlotte McLaughlin and Lauren Clark

BUILDING AN ECO-FRIENDLY SUPERMARKET

SuperSmart aims to achieve both decisive environmental benefits through the fast implementation of efficient heating and cooling solutions, as well as significant economic benefits through reduced energy use in the supermarket sector across Europe.

Efficient solutions for supermarket heating, cooling and refrigeration – like integrated systems or the use of natural refrigerant-based equipment – are already technically available in Europe. However, non-technical barriers, including a lack of awareness or expert knowledge, have prevented the market from growing more quickly.

The EU-funded 'SuperSmart' project – which brings together nine European partners – aims to change this through information campaigns, workshops and dedicated training for supermarket stakeholders.

Ultimately the goal is to develop a European Ecolabel for food retail stores. A workshop on 21 August – held alongside the 12th IIR Gustav Lorentzen Natural Working Fluids Conference in Edinburgh – revealed preliminary results of a stakeholder survey

to help determine the label's scope and criteria for inclusion.

Results from 54 completed surveys saw 91% of respondents agree that at least 50% of a store's annual turnover must be groceries if it is to be defined as 'food retail' and thereby qualify for the new label.

Armin Hafner, professor of refrigeration technology in the Department of Energy and Process Engineering at the Norwegian University of Science and Technology (NTNU), told Edinburgh workshop participants how opting for a state-of-the-art CO₂ refrigeration system using the latest innovations such as ejectors and parallel compression will help supermarkets to reduce their energy consumption – as well as ensuring that CO₂ systems perform efficiently in warm climates.

He called on supermarkets to opt for a CO₂-only system as "the most energy-efficient and eco-friendly solution".

For more information about SuperSmart, please visit the project website: www.supersmart-supermarket.info. @ AW



SuperSmart workshop at Gustav Lorentzen

ADVANSOR TO DELIVER WORLD'S BIGGEST CO₂ SYSTEM SO FAR

Danish manufacturer Advansor is working on the biggest CO₂ industrial refrigeration system known in the world, in a lettuce plant in the Netherlands.

The brand new lettuce processing plant, by the Staay Food Group, will use state-of-the-art refrigeration technology and city farming-type structures to grow the lettuce indoors under special LED lights.

Mark Kristensen, Advansor's industrial sales manager, expects this to be "the biggest CO₂ refrigeration project known in the world," boasting a total capacity over 3.36 Megawatts (MW).

"Advansor is very proud to be partner in this project, which again proves that transcritical CO₂ systems are not only for commercial use," said Kristensen.

Working with local contractors Huijbregts Koeltechniek BV, Kristensen said Advansor is "looking forward to the commissioning and expecting full operation during January 2017".

KEY FEATURES

Advansor has already designed the CO₂ refrigeration system to reach a capacity of 3.36 MW, split between seven transcritical CO₂ racks.

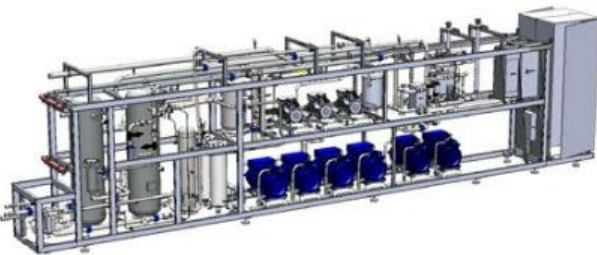
The evaporating capacity of the system will reach a range of temperatures with different charges; including 0.53 MW at -7°C, 1.87 MW at -5°C, 0.78 MW at 0°C and 0.03MW at -28°C. In addition the systems

will also provide 0.15 MW of cooling for air conditioning purpose cooling.

In total the system will use 45 Bock compressors, made up of 28 medium-temperature compressors, 14 parallel compressors, and three frost compressors.

"Advansor has [also] equipped the CO₂ transcritical systems with plate heat exchangers providing around 600 kW of heat reclaim," Kristensen says. "This free heat source is to provide heating for the office facilities."

"It is not the first time we are providing systems in the MW range, but this is probably the world's largest project to date," he explains. "Our dedicated industrial team realises a significant growing interest from contractors, consultants and end users." **CM**



GLOBAL REFRIGERATED WAREHOUSE CAPACITY INCREASES

On 11 August, a survey by the Global Cold Chain Alliance found that global refrigerated warehouse capacity grew to 600 million cubic metres from 2014 to 2016. Growth was mostly from emerging markets such as China.

Many emerging markets lacked the necessary network of cold-storage warehouses and vehicles, which decreased their capacity for fresh food trade.

The survey from the Global Cold Chain Alliance – an industry group representing temperature-controlled logistics companies – revealed significant market change in newly industrialised countries.

AMMONIA IN DEVELOPING COUNTRIES

Richard Tracy, vice-president of international programmes for the Global Cold Chain Alliance, said, "what really causes the growth of the cold chain in developing and emerging markets is the growth of disposable income".

Tracy said this could potentially be an opportunity for natural refrigerants in developing countries if technology manufacturers can scale up.

He also stated, "as low-charge systems become more and more mainstream,

as emerging markets grow capacity, the change that needs to occur to natural refrigerants will happen. It is only a matter of time".

NEW TECHNOLOGY HELPING CORNER AMMONIA, CO₂ MARKET

New technologies are also driving a further increase in natural refrigerants, according to him, "there has been a good deal of exploration into CO₂ and into low-charge ammonia systems".

Tracy stated: "The cost needs to drop in order for the low-charge systems to compete with alternative systems available for that size range, but I think that it will take off when that price point is reached, as most businessmen want to have a more efficient, more cost-effective and natural solution, if possible." **LC**



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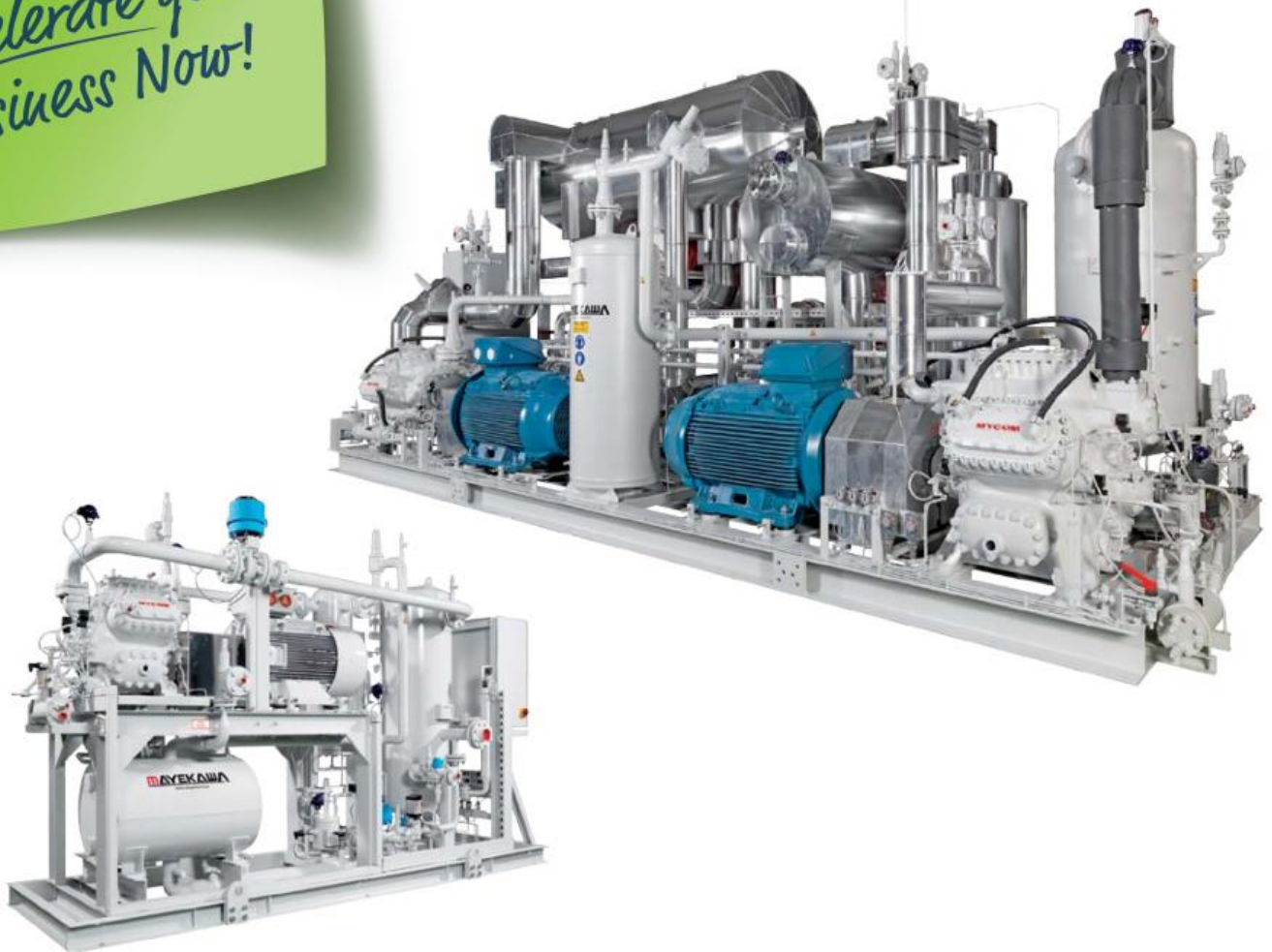
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