

FEBRUARY 2017

ACCELERATE

ADVANCING HVAC&R NATURALLY

A M E R I C A

Will the EPA's
RMP Rule
Survive?

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Embracing CO₂
In Transylvania

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Highlights

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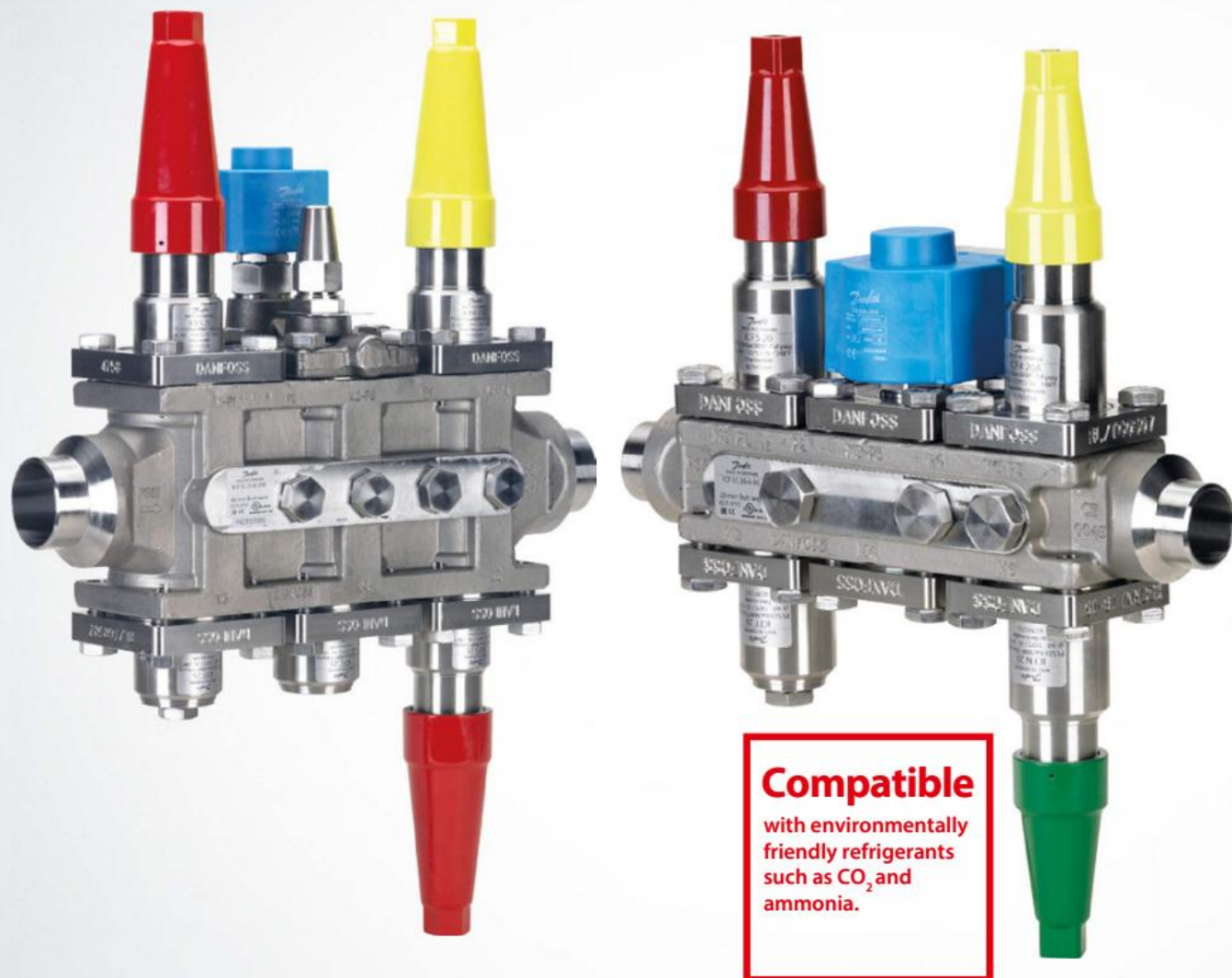
Frank Barrese,
Wholesome Harvest
Baking

*Freezing
Bread
with the
NewTon*

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The Scientific Method Trumps Alternative Facts

— by Michael Garry

“In the end the Party would announce that two and two made five, and you would have to believe it.”

— From “1984” by George Orwell



In recent weeks, I have attended two of the North American HVAC&R industry's major trade shows, AHR Expo in Las Vegas and the NAFEM Show in Orlando, Fla. As I learned about the latest developments in natural refrigerant technology, I felt reassured – not just to see further progress in environmentally friendly refrigeration and air-conditioning systems, but to realize that I worked in an area where science, engineering, and the application of the scientific method were still valued and rewarded.

At the AHR Expo (see story, page 42), there were some notable products on display or under discussion, such as Mayekawa's new ammonia/CO₂ chillers – an extension of its ammonia/CO₂ NewTon system – and large CO₂ compressors suitable for industrial applications. At the NAFEM Show (which will be described in-depth in next month's issue), the big news was the growing number of foodservice equipment companies that have continued to shift from HFC refrigerants to propane or isobutane in order to meet the Department of Energy's new efficiency guidelines.

Speaking of the NewTon, our cover story (see page 34) shows how Wholesome Harvest Baking, a division of baking giant Grupo Bimbo, is using that packaged, low-charge ammonia system to safely and efficiently freeze its bread products.

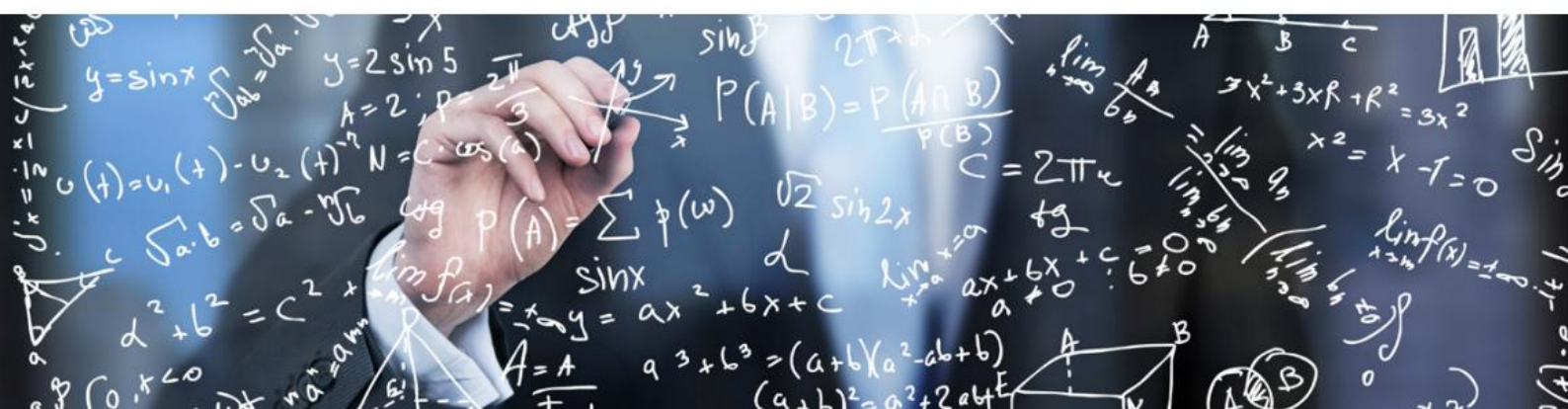
All of these applications of natural refrigerants are based on a rigorous examination of their thermodynamic effectiveness and efficiency. Their growing importance to the global HVAC&R industry is based on countless laboratory and field tests – with an accumulation of data that can be observed, tested, analyzed and repeated – testifying to their business and environmental value; we at shecco try to accurately describe these efforts in *Accelerate America* and its sister publications, on the websites R744.com, Hydrocarbons21, and Ammonia21.com, through our market research publications, and at our ATMOSphere conferences. With hard-earned facts on their side, natural refrigerants can be counted on to get the job done.

Contrast that to some of the chatter emanating from Washington, D.C., since the Trump administration took over

on January 20 (and before). Whatever one's politics, I don't think anyone should condone “alternative facts” as an acceptable part of rational discourse about important issues.

To cite one important example among many, climate change has been subjected to the utmost scrutiny by scientists around the world, and the overwhelming consensus is that greenhouse gases (including HFC refrigerants) are warming the planet. Yet the new administration, including recently confirmed Environmental Protection Agency chief Scott Pruitt, would have you believe otherwise, backed by no verifiable evidence. This is not how science or industry works, and it shouldn't be how policy decisions are made.

In the coming months and years, the U.S. body politic, as well as individual businesses and citizens, will have to decide whether to listen to emotional appeals divorced from factual reality, or to follow the harder road of independent inquiry and a reliance on data, in making the critical decisions that lie ahead.



ACCELERATE

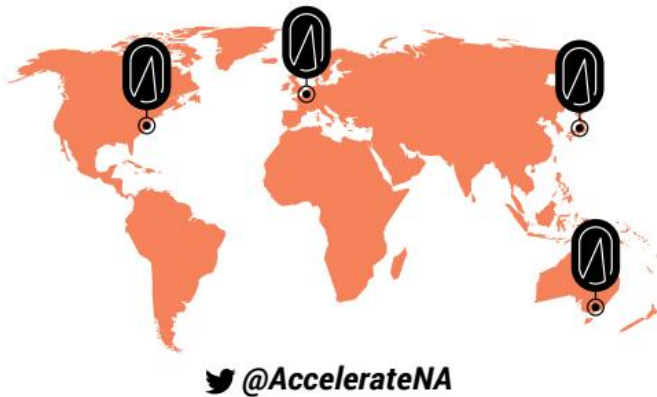
ADVANCING HVAC&R NATURALLY

AMERICA

About Accelerate America

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

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- by Avipsa Mahapatra, EIA



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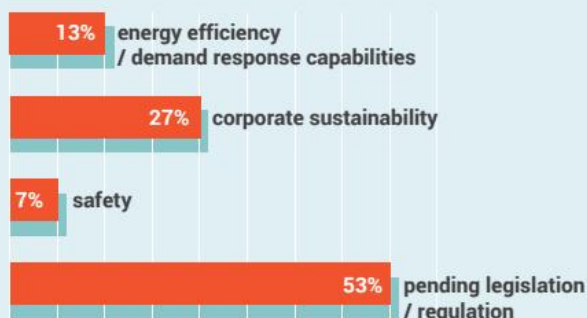
EMBRACING CO₂ IN TRANSYLVANIA



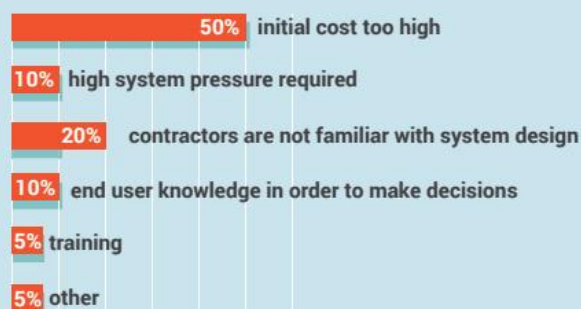
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Factors Impacting CO₂ Refrigeration

Drivers of CO₂ in Commercial Refrigeration



Barriers to CO₂ in Commercial Refrigeration



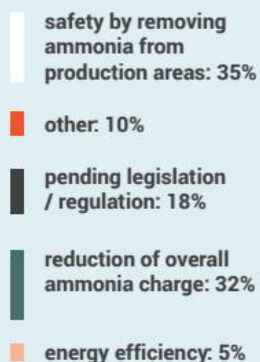
Drivers of CO₂ in Industrial Refrigeration



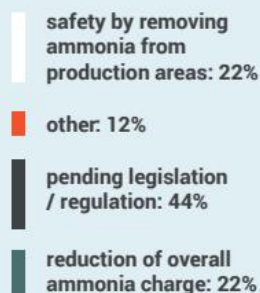
Barriers to CO₂ in Industrial Refrigeration



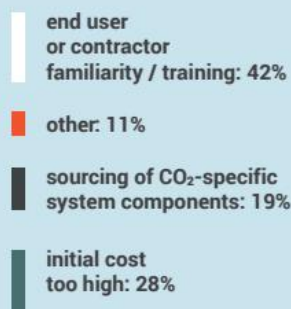
OEMs & Contractors:



Consultants & End Users:



OEMs & Contractors:



Consultants & End Users:



Percentage of respondents who see CO₂ as a viable mainstream technology for commercial refrigeration:

OEMs: 82%

Consultants and End Users: 91%

Percentage of respondents who either have been involved in an industrial CO₂ refrigeration project or plan to be:

OEMs and contractors: 57%

Consultants and end users: 43%

Source: Danfoss online survey sent to approximately 1,100 individuals doing business in commercial or industrial refrigeration in North America, including OEMs, contractors, consultants and end users.

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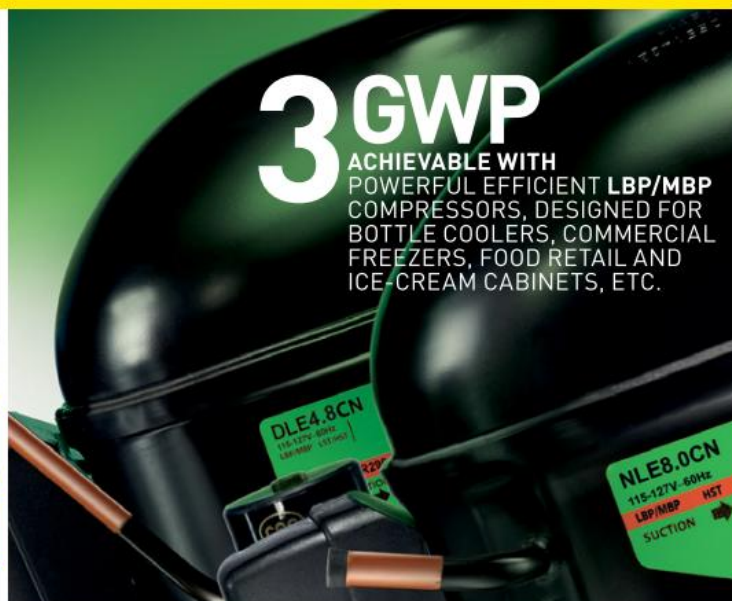
R290

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NLE-CN/CNL/MN, NLY-CN COMPRESSORS
SCE-MNX COMPRESSORS



3 GWP

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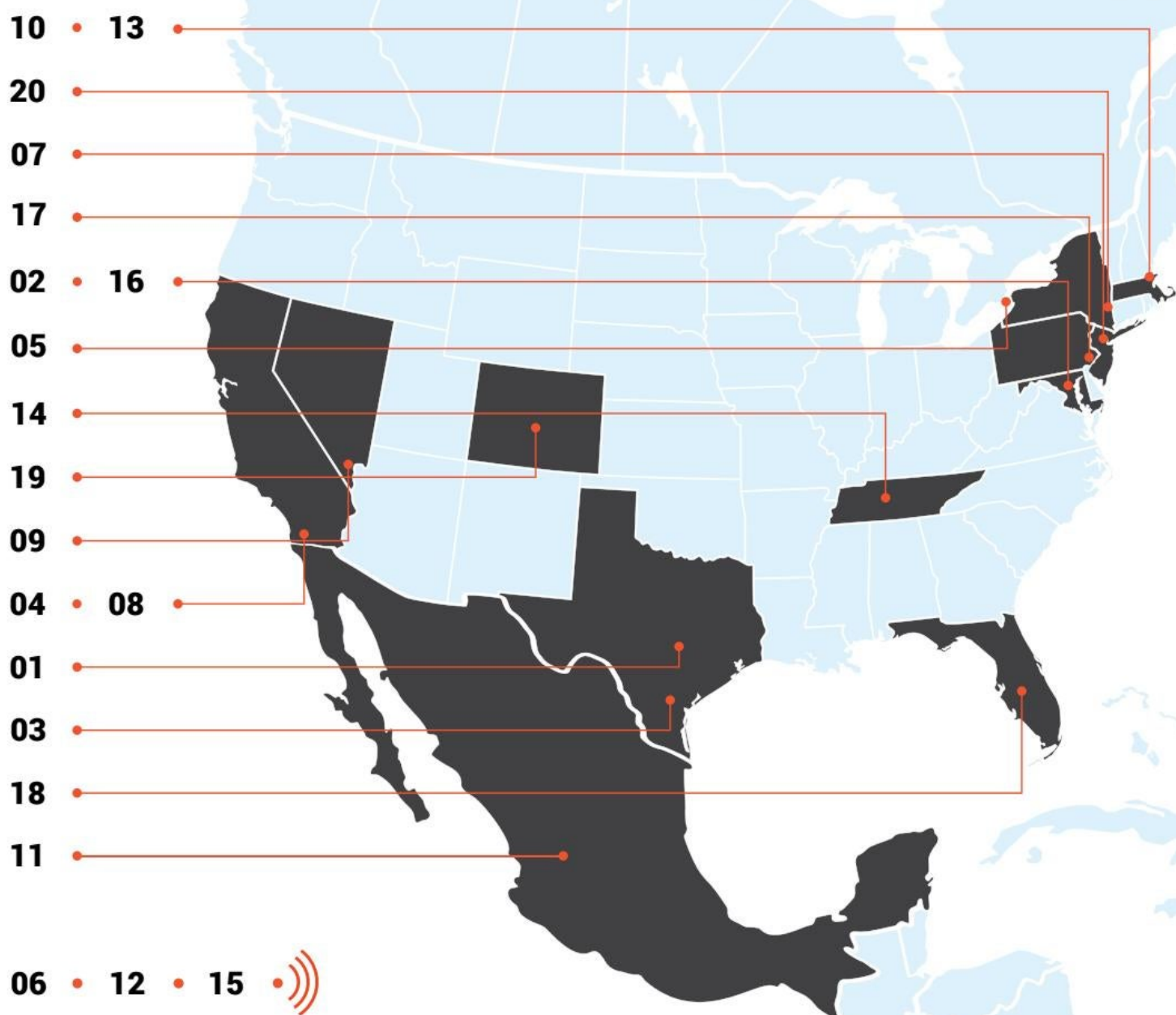
For more than 25 years, Secop has been developing highly efficient working with hydrocarbons (R290 and R600a).

The new **DLE**, **NLE/NLY** and **SCE** compressors for R290 are tailored for commercial use and capable of replacing products made for high global warming potential (GWP) refrigerants such as R404A and R134a.

With these compressors, Secop perfectly meets the increasing market demand for the highest efficiency while utilizing natural refrigerants with very low GWPs.

EVENTS GUIDE

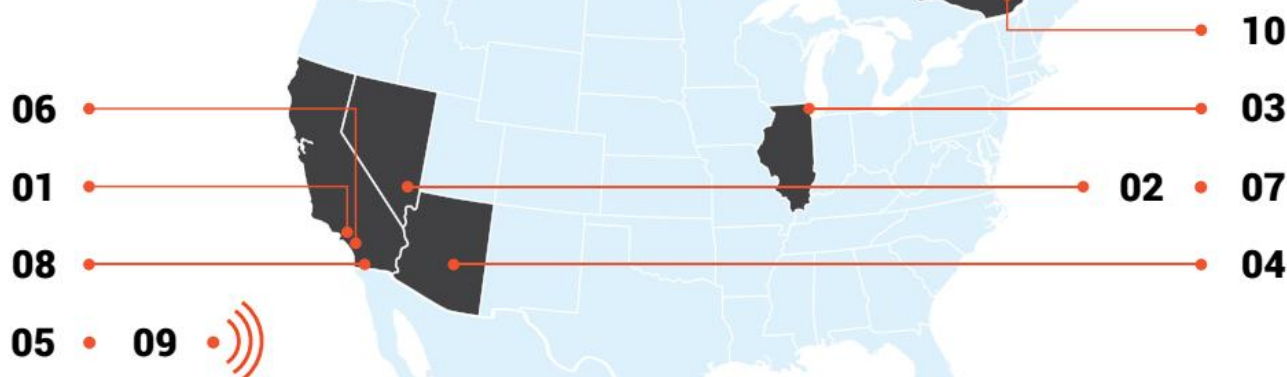
February 2017 / **March** 2017



- **01** February 20-22, Austin, Texas
Smart Energy Summit
www: [www: www.parksassociates.com/events/smart-energy-summit](http://www.parksassociates.com/events/smart-energy-summit)
- **02** February 22-24, Washington, D.C.
USBvX 2017 - U.S. Wine & Beverage Expo
www: [www: www.usbevexpo.com/](http://www.usbevexpo.com/)
twitter: @USBvX
- **03** February 26- March 1, San Antonio, Texas
IIAR Natural Refrigeration Conference and Expo
www: <http://bit.ly/2lqYuJw>
- **04** February 27-March 1, San Diego, Calif.
VIBE
www: [www: www.vibeconference.com/](http://www.vibeconference.com/)
- **05** February 27- March 2, Toronto, Ont.
15th Cold Chain GDP & Temperature Management Logistics Summit
www: [www: www.coldchainpharm.com/](http://www.coldchainpharm.com/)
- **06** February 28, Online at 2 pm EST
Efforts to Reduce Refrigerant Emissions through the Consumer Goods Forum
www: epawebconferencing.acms.com/cgf_greenchill/
- **07** March 5-7, New York, N.Y.
The International Restaurant & Foodservice Show of New York
www: [www: www.internationalrestaurantny.com/16/ny-home.htm](http://www.internationalrestaurantny.com/16/ny-home.htm)
twitter: @TheFoodShows @NESEA_org
- **08** March 5-9, San Diego, Calif.
MCAA Convention
www: [www: www.mcaaconvention.org/](http://www.mcaaconvention.org/)
#MCAA2017 @MCAANews
- **09** March 7-8, Henderson, Nev.
Ice Cream Technology Conference
www: [www: www.dairyfoods.com/events/1185-ice-creamtechnology-conference](http://www.dairyfoods.com/events/1185-ice-creamtechnology-conference)
twitter: @NESEA_org
- **10** March 7-9, Boston, Mass.
BuildingEnergy Boston 2017
www: [www: nesea.org/be-event/buildingenergy-boston-2017](http://nesea.org/be-event/buildingenergy-boston-2017)
twitter: @NESEA_org
- **11** March 7-9, Guadalajara, Mexico
Alimentaria Mexico
www: [www: www.alimentaria-mexico.com/en/home](http://www.alimentaria-mexico.com/en/home)
- **12** March 8, Online at 2 pm EST
EPA's GreenChill Program: Resources for the Supermarket Industry
www: epawebconferencing.acms.com/gc-overview/
- **13** March 19-21, Boston, Mass.
Seafood Expo North America / Seafood Processing North America
www: [www: www.seafoodexpo.com/north-america/](http://www.seafoodexpo.com/north-america/)
- **14** March 20-22, Nashville, Tenn.
IE3 show: Indoor Environment & Energy Expo
www: [www: www.ie3show.com/](http://www.ie3show.com/)
- **15** March 21, Online at 2 pm EST
Leak Detection: Tools and Best Practices for Supermarkets
www: [www: www.epa.gov/greenchill/events-and-webinars](http://www.epa.gov/greenchill/events-and-webinars)
- **16** March 21-22, Washington, D.C.
AHRI: Air-Conditioning, Heating & Refrigeration Institute Public Policy Symposium
www: [www: www.ahrinet.org/News-Events/Meetings-and-Events.aspx](http://www.ahrinet.org/News-Events/Meetings-and-Events.aspx)
- **17** March 22-23, Philadelphia, Pa.
GLOBALCON 2017
www: [www: www.globalconevent.com/](http://www.globalconevent.com/)
twitter: #globalcon
- **18** March 27-29, Orlando, Fla.
2017 National HVACR Educators and Trainers Conference
www: [www: www.escogroup.org/hvac/nhetc/](http://www.escogroup.org/hvac/nhetc/)
- **19** March 29-31, Denver, Colo.
IEEE Green Technologies Conference
www: ieeegreentech.org/
- **20** March 30, Tarrytown, N.Y.
AAA Refrigeration / Hillphoenix 8th Annual Symposium
www: [www: www.aaarefrig.com/symposium](http://www.aaarefrig.com/symposium)

EVENTS GUIDE

April 2017



- **01** April 3-6, Los Angeles, Calif.
Data Center World
web: <http://global.datacenterworld.com/>
twitter: #DCWLA17 @DataCenterWorld
- **02** April 4-6, Las Vegas, Nev.
IFMA Facility Fusion Conference & Expo - International Facility Management Association
www: <http://facilityfusion.ifma.org/las-vegas/>
twitter: #facilitiesmanagement @IFMA
- **03** April 4-6, Chicago, Ill.
ProFood Tech
www: <http://bit.ly/2lPpRL1>
twitter: #ProFoodTech @packexposhow
- **04** April 10-12, Tempe, Ariz
National Frozen & Refrigerated Foods Association (NFRA) Executive Conference
www: <https://nfraexecutiveconference.org/>
- **05** April 18, Online at 2 pm EST
International Institute of Ammonia Refrigeration's Resources for Using NH₃ and CO₂
www: www.epa.gov/greenchill/events-and-webinars
- **06** April 19-20, Anaheim, Calif.
Southern California Facilities Expo
www: <http://www.fesc.facilitiesexpo.com/>
twitter: @Facilities_Expo
- **07** April 19-21, Las Vegas, Nev.
National Automatic Merchandising Association (NAMA) OneShow
www: <http://www.namaoneshow.org/>
twitter: #NAMAOneShow @NAMAvending
- **08** April 22-25, Dana Point, Calif.
IARW-WFLO Annual Convention and Expo
www: <http://www.gcca.org/126th-iarw-wflo-convention/>
- **09** April 25, Online at 2 pm EST
Using Refrigeration Batteries to Manage Energy Use
www: www.epa.gov/greenchill/events-and-webinars
- **10** April 26-27, Montréal, Québec
MCEE
www: <http://www.mcee.ca/>
twitter: @MCEE2017

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IN BRIEF

CO₂

STUDY: CO₂ BETTER ON ENERGY THAN HFCs

AMSTERDAM, Netherlands – “CO₂ systems have higher COP [coefficient of performance] than HFC systems,” concludes a study authored by Sawalha et al. and published in the January 2017 edition of *Applied Thermal Engineering*. The paper compares CO₂ transcritical systems to HFC systems in Sweden. In their paper “Field measurements of supermarket refrigeration systems: Part I and Part II,” the authors analyze three HFC systems for supermarkets, all of which use a regular indirect loop system. They compared the COP to results from five CO₂ transcritical systems over four to 18 months.

More information at: <http://bit.ly/2IAU618>

HYDROCARBONS

TRAINING OFFERED ON HYDROCARBON HEAT EXCHANGERS

BELTSVILLE, MD. – The International Copper Association (ICA) and Optimized Thermal Systems have launched a new technology outreach program on the design and use of heat exchangers made with MicroGroove smaller-diameter copper tubes. Smaller-diameter tubes increase energy efficiency and reduce overall costs of heat exchangers. They allow for refrigerant-charge reduction and higher operating pressures, making them well-suited for natural refrigerants, including hydrocarbons and CO₂. The program will be conducted from March through May 2017.

More information at: <http://bit.ly/2IFRKYT>

AMMONIA

MONTREAL SWITCHES FROM R22 TO NH₃ IN 47 ICE RINKS

MONTREAL – Claude Dumas, an engineer in the City of Montreal’s department of strategy and real estate transactions, won an award at the ASHRAE winter conference in Las Vegas for spearheading the conversion of 47 municipal skating and hockey rinks from R22 – with a GWP of 1,700 – to ammonia. Montreal’s switchover is underway and will be complete in 2020. The design being implemented uses less ammonia at reduced pressures compared to conventional ammonia-based refrigeration plants, improving system efficiency.

More information at: <http://bit.ly/2kTma5I>

CO₂

ALDI SÜD INSTALLS 1000TH CO₂ SYSTEM

MÜLHEIM, Germany – Building on a 2010 commitment to use only CO₂ in its stores, German retailer Aldi Süd, which owns Aldi US, is making strong progress in implementing natural refrigerant solutions. It estimates that 54% of its stores are already using CO₂ systems. Agnes Macherey, head of refrigeration at Aldi Süd Germany, said: “We’re delighted and proud to be able to set standards on such an important issue as sustainability in the commercial cold market in Germany.” A company release hailed its 1,000th installation. Aldi has also installed CO₂ systems in the U.S.

More information at: <http://bit.ly/2IoT8wE>

HYDROCARBONS

MINUS FORTY TECHNOLOGIES SWITCHES TO PROPANE

GEORGETOWN, Ontario – To meet environmental sustainability targets and stay ahead of regulatory change, Minus Forty Technologies, a manufacturer of freezer and refrigerated cabinets, has converted all but one of the 36 products in its portfolio to natural refrigerant propane (R290). “We’ve been working towards converting our entire product line to R290 for two years now,” said Chris Strong, the company’s vice-president of sales and marketing, at the recent NAFEM Show in Orlando, Fla. “We have a small quantity of R404A systems remaining. In the interest of not scrapping parts, basically we’re just getting through our remaining inventory. Pretty much everything else is R290 now.”

More information at: <http://bit.ly/2I22JZ7>

AMMONIA

PEARSON RECOGNIZED FOR AMMONIA HEAT PUMP

LAS VEGAS – Star Refrigeration’s Andy Pearson, the lead engineer behind the biggest ammonia heat pump for any district heating and cooling scheme, won ASHRAE’s “Comfort Cooling Award for Project Excellence” at the group’s winter conference in Las Vegas. The high-temperature district heating and cooling system uses a water-source 13-MW heat pump to deliver cooling and heating to businesses, schools, hospitals and buildings in the coastal town of Drammen in Norway.

More information at: <http://bit.ly/2m6x5uA>

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The Future of Cooling: **Incremental Change vs. Fundamental Transformation**

The Kigali Amendment offers a new path to sustainable cooling, but will companies seize the opportunity?

— By Avipsa Mahapatra

The Kigali Amendment to the Montreal Protocol, adopted in October 2016, was a historic milestone as nearly 200 countries committed to phase down hydrofluorocarbons (HFCs), potent greenhouse gases used in cooling.

If implemented properly, this will be one of the fastest, most cost-effective ways to avoid more than 70 billion metric tons of CO₂-equivalent emissions by 2050, giving the world a fighting chance to meet the goal set in the Paris Agreement to keep global temperature rise this century to well under 2°C.

But to fulfill the potential of the Kigali Amendment, companies need to start making smart strategic decisions.

Earlier this month I attended the Sustainable Technologies for Stationary Air Conditioning Workshop, which was held on the margins of the International Air-Conditioning, Heating, Refrigerating Exposition (AHR Expo) in Las Vegas. The workshop and the Expo provided a window to the future of cooling. What I saw were two paths: one that tweaks business-as-usual, using slightly-less-global-warming fluorochemicals. The second path bypasses fluorochemicals completely, thus fundamentally transforming the way the world can cool without warming itself.

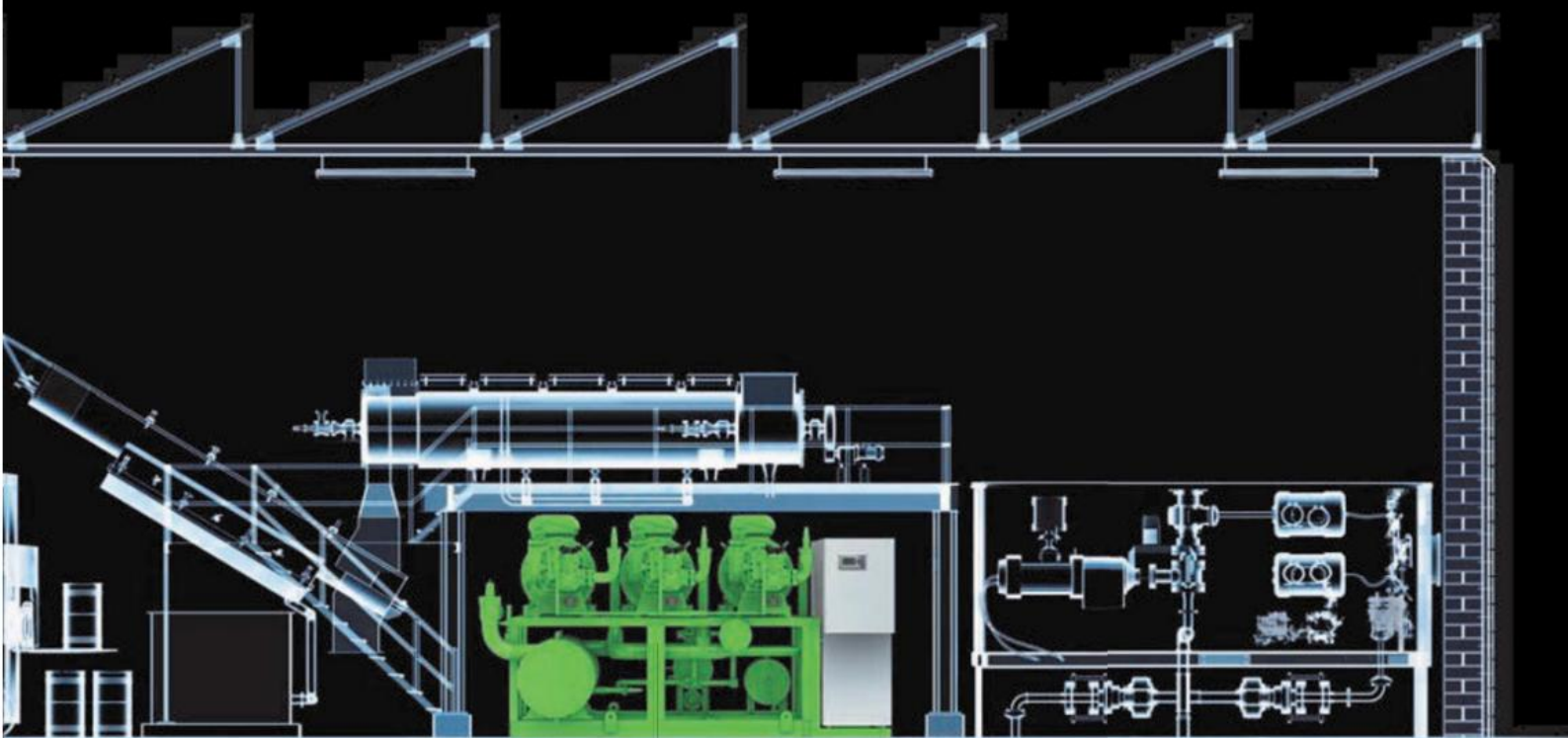
The need for a fundamental transformation

Cooling needs are growing exponentially across the globe, particularly in air conditioning. Cooling is not merely a luxury, but also a developmental need in a significant part of the world.

For instance, in about 15 years AC ownership rate in urban China rose from almost 0% in the 1990s to nearly 100%. Similarly, AC unit sales are increasing by 10%-15% annually in several large, rapidly growing hot countries, such as India, Indonesia and Brazil. This exponential growth not only needs a larger quantity of refrigerants, but also increases the energy load. The U.S. already uses as much electricity to keep buildings cool as the entire African continent uses for everything.

Over the last three decades, countries, including very poor ones, have had to switch out the chemicals used for cooling from one fluorinated compound to another, per at the Montreal Protocol: CFCs to HCFCs, and then HCFCs to HFCs. While this switch was necessary to protect our ozone layer and our climate, it was also expensive and avoidable.





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▶ Inexpensive refrigerants that don't harm the ozone layer or the climate, such as hydrocarbons, ammonia and carbon dioxide, have been available for decades. As we eliminate HFCs, smart companies and countries are now looking for future-proof technology that they don't have to transition from again.

What we do in this decade is, therefore, crucial. Laggard companies, which are trying to profit as long as they can from selling and using climate-destroying chemicals, can seriously undermine the path the global community has mapped to transition away from HFCs.

What fundamental transformation looks like

Clayton Christensen, who coined the term disruptive innovation, defined it as "disrupting an existing market, industry, or technology to produce something new ... more efficient and worthwhile."

The good news is that we don't have to wait for this to occur in the cooling industry. Refrigeration and air-conditioning technologies around the world already use hydrocarbons, carbon dioxide, air, water, ammonia, and "not-in-kind" technologies (e.g., solar or lake-source cooling) instead of HFCs. Significant research is underway – and has been applied in several pilots across the world – that tremendously reduces or altogether bypasses traditional refrigerant usage, including passive cooling techniques like green roofs and facades.

An interesting example of a market left behind as a result of choosing an incremental path is the U.S. domestic refrigerator market, which lags behind most other regions in the world. Virtually all of the approximately 10 million new refrigerators purchased in the U.S. each year use HFCs, while 700 million hydrocarbon refrigerators have been sold safely around the world over the last two decades.

In the absence of leadership in U.S. air conditioning manufacturing, it is entirely possible that air-conditioning manufacturers in this country will lag behind by using technology that will only last in the market for a few more years; this will not only hinder global efforts to phase down HFCs but also impede U.S. industry's ability to compete as global leaders in the transition to natural refrigerant technologies.

Who can bring this transformation about?

At the forefront of this transformation will be smart companies. Companies everywhere from Europe to India to China are racing to claim a share of this high-growth market. An Indian manufacturer, for example, has already sold more than 200,000 hydrocarbon domestic air conditioning units under 1.5 metric-ton cooling capacity. Although these units are about 5% to 8% more expensive than comparable HFC units in the local markets, concomitant energy-efficiency benefits have aided their sales.

The range of cooling capacity in several end uses is currently limited when using non-fluorinated refrigerants, mainly due to flammability concerns. But these concerns can be addressed with the help of already available technological safety features, and efforts are underway around the world to remove these obsolete barriers to climate-friendly cooling. Stakeholders need to work towards ensuring global industry standards are updated to account for additional safety features that enable the safe introduction of truly climate-friendly alternatives to HFCs.

Transformation of this scale can only be achieved with true collaboration between industry, governments and non-governmental organizations. There is a need for leaders and policy-makers to not only provide clear regulatory signals, but also create an environment that fosters healthy competition, along with incentives to generate increased market penetration. With scale, energy-efficient HFC-free cooling can become cost-effective for individual owners.

Cooling has been warming our planet for decades, and the Kigali Amendment signals that we've reached a critical turning point in that relationship. We have agreed to change the course our planet has been on. Smart companies will see this as an opportunity to invest in transformational technology that bulwarks against yet another chemical transition. Myopic ones will irresponsibly try to lock the world into dead-end technology that doesn't do enough for the climate, and will need to be switched out again, very soon. This is neither in their interest, nor the climate's. ■ AM

Avipsa Mahapatra is the Climate Campaign Lead at the Environmental Investigation Agency (EIA), based in Washington, D.C.

Premium NH₃/CO₂ Refrigeration System

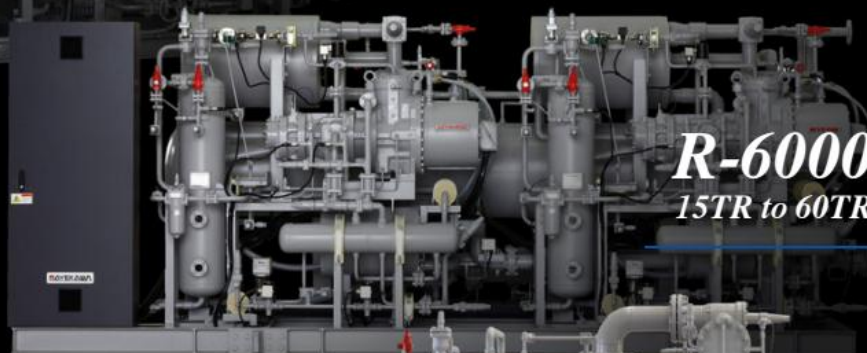
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HFCs' Lasting Impact on the Oceans



F-gases contribute to thermal expansion in the ocean, and thus higher sea levels, far longer than originally thought – and long after they have decayed in the atmosphere

– By Ermenegilda Boccabella

Greenhouse gases like HFCs and other short-lived climate pollutants (SLCPs), in addition to their impact on atmospheric warming, make a larger contribution to rising sea levels than previously believed, according to a joint paper published in January in the *Proceedings of the National Academy of Sciences*

SLCPs, which also include black carbon, methane, tropospheric ozone, as well as other F-gases like CFCs and HCFCs, have relatively short atmospheric lifetimes, ranging from a year to a few decades, but a significant warming effect on the climate, particularly in the Arctic and other vulnerable regions. Unlike CO₂, which can remain in the atmosphere for centuries, SLCPs offer a path to short-term drops in warming – the impetus for the Kigali Amendment to the Montreal Protocol phasing down the use of HFCs.

However, researchers at the Massachusetts Institute of Technology and Simon Fraser University, using climate modelling, have shown that SLCPs contribute to thermal expansion in the ocean, and thus higher sea levels, far longer than originally thought – and long after they have decayed in the atmosphere. The study noted an ongoing link between HFCs and thermal expansion in the ocean for up to 500 years.

The researchers included lead author Kirsten Zickfeld of Simon Fraser University; Susan Solomon, professor of atmospheric chemistry and climate science at MIT; and Daniel Gilford, a graduate student in MIT's department of Earth, Atmospheric and Planetary Sciences. The research was supported, in part, by the Natural Sciences and Engineering Research Council of Canada, and NASA.

Ocean inertia

The reason for the persistence of sea-level rises is “ocean inertia,” according to Solomon, who was quoted in an article posted by the MIT News Office. As the atmosphere heats up due to greenhouse gases, ocean waters also heat up and expand, causing sea levels to rise.

Removing the ocean heat caused by even SLCPs is an extremely slow process that can take hundreds of years; the process, she explained, involves reversing the movement of heat that has been absorbed deep into the ocean and releasing it back into the atmosphere.

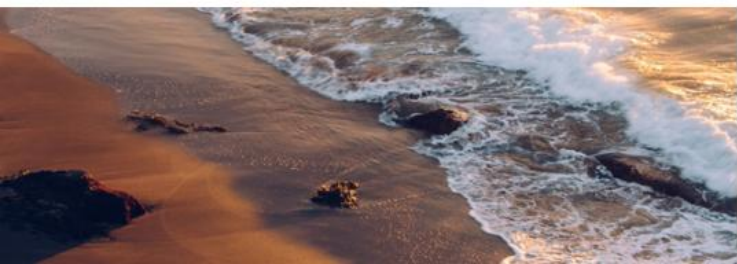
“Amazingly, a gas with a 10-year lifetime can actually cause enduring sea-level changes,” said Solomon in the MIT article.

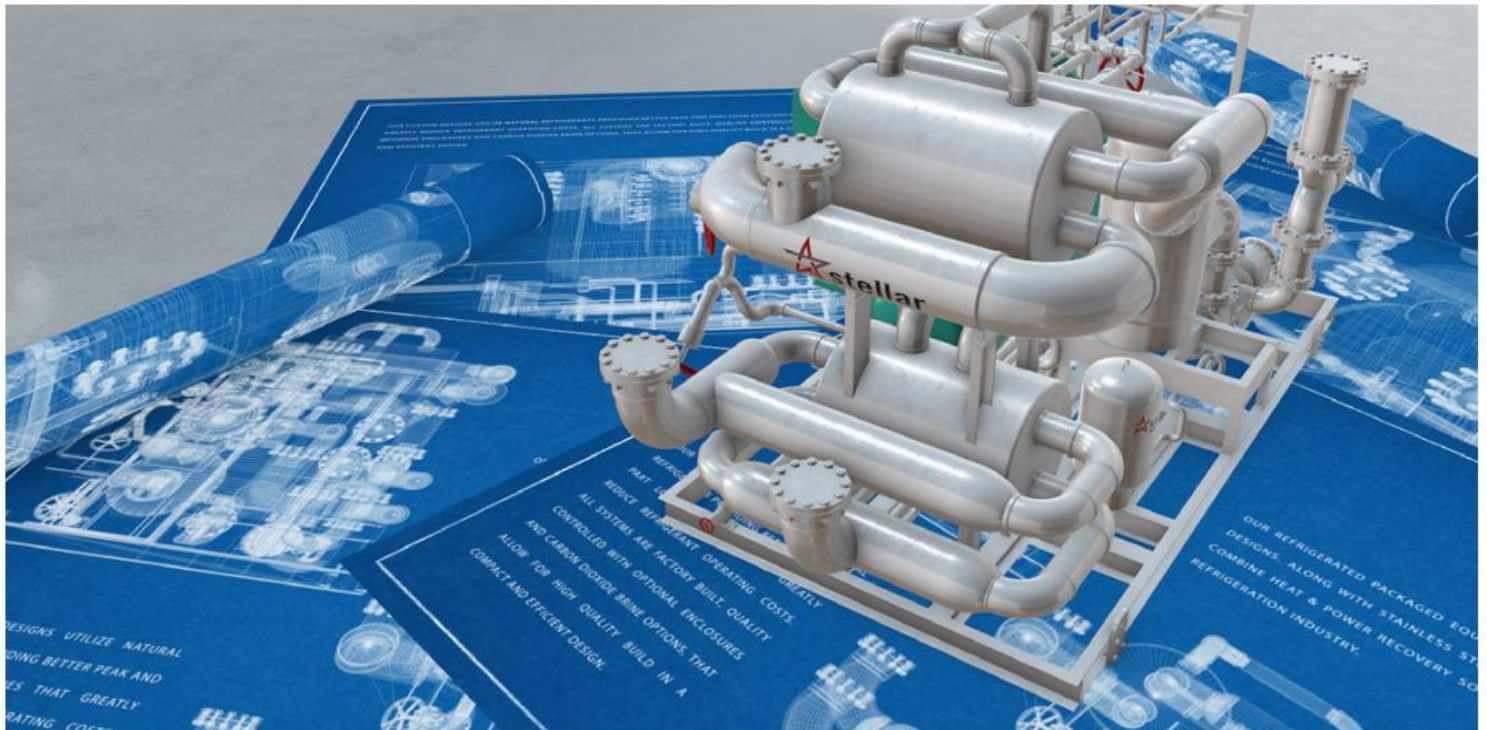
The study demonstrated that climate mitigation measures, like the phase-down of ozone-depleting substances, are needed to protect the oceans just as much as they are to protect the atmosphere. It pointed out that without the landmark Montreal Protocol agreement phasing down ozone-depleting CFCs and HCFCs, a considerable amount of additional sea-level rise would have occurred (approximately 5.5 inches by 2050).

The modelling also highlights the critical importance of taking early action if future warming and sea-level rises are to be limited.

Oceans – and particularly mitigating and adapting to sea-level rises – are the focus this year of COP (Conference of the Parties) 23, the UNFCCC (United Nations Framework Convention on Climate Change) meeting. Taking place in Bonn, Germany, November 6-17, the meeting will be organized by Fiji – the first time a member of the “Small Island Developing State” group will host the COP.

Fijian President Voreqe Bainimarama recently drew attention to the effect of rising sea levels on low-lying areas, highlighting the recent devastation caused by tropical cyclone Winston. ■ EB





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Scantec's ScanPAC low-charge DX ammonia system, in Melbourne, Australia

Low-Charge Down Under

Scantec is bringing low-charge ammonia systems to cold-storage operators in Australia

– By Devin Yoshimoto, James Ranson & Andrew Williams

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

But the U.S. is not the only country seeing the development of low-charge ammonia technology. Australia is another.

Australia's uniquely remote landscape and strong agricultural sector has produced a long history of large-scale industrial plants using ammonia. But more recently, the focus has been on optimizing energy efficiency and reducing the ammonia charge.

One advantage of the technology is that low-charge ammonia systems can be applied in much smaller applications than conventional NH_3 liquid-overfeed systems that are typically used in semi-industrial applications of 30-50 kW and above.

Low-charge NH_3 systems can also deliver three to four times as much cooling capacity per kilogram of charge as liquid overfeed systems, said Stefan Jensen, managing director of Scantec Refrigeration Technologies, a major Australian refrigeration OEM. "The only feedback from the end user we've had is happiness."

Low-charge systems are also used in place of industry-standard HFC-based systems in industrial applications, and for good reasons.

Notably, the initial capital investment differential between an industry-standard HFC-based, single-stage compression system (with air-cooled condensers and electric defrost) and a state-of-the-art low-charge NH_3 system "is usually returned in three years," Jensen said.

That return is based on "the documented annual energy-consumption difference between the two scenarios," he said, putting it at 40% to 67% in favor of low charge.

New projects

Scantec recently commissioned two projects for its new low-charge NH_3 ScanPAC system, in Melbourne and Brisbane.

The Melbourne installation has an alcove evaporator with automatic ambient air defrost. The Brisbane project, for a Japanese end user, was recently completed under significant





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time pressure, said Jensen. The end user relocated from other premises to meet increasing demand for its product and was after a premium system.

In Brisbane, the first-stage compressors operate at -27°C (-17°F) saturated suction temperature, and the corresponding freezer store temperature is -22°C (-8°F). "This particular plant employs Japanese compressors and custom-engineered evaporators with special circuiting and distributors from a German manufacturer," Jensen said.

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

Scantec's low-charge systems deliver ammonia to the evaporators in the cold storage area. However, the operating charge in the evaporators is so low that in a typical cold-storage facility with three evaporators, loss of charge in one coil will not increase the NH₃ concentration in the freezer beyond about 200 ppm. It takes 5,000 ppm to pose a significant safety risk to humans. The systems typically contain between 17 lbs. to 22 lbs. per TR.

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

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

2017 predictions

Jensen sees 2017 as the year when it is likely that "a totally new hot-gas defrost concept" for ammonia systems will be tested and verified. "This has the potential to further reduce ammonia inventories in low-charge NH₃ systems of the central type."

He also expects an expansion of low-charge NH₃ technology into areas other than refrigerated warehouses. "Similar trends are visible in other jurisdictions – in particular in the U.S.," he said. "It will not be possible, however, to sacrifice energy efficiency in return for ammonia inventory reduction. This would go against the intent of [climate objectives]."

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

"Owners and operators of warehouses are, to a significant extent, unaware of what is emerging globally and what the consequences will be for them," he continued. "Often their local service provider is unable to offer future-proof solutions based on natural refrigerants, and most owners rely completely on local service providers for refrigeration advice."

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

Government can play a key role in helping, managing, and encouraging change, and Jensen sees lack of government aid as the biggest failure in Australia. "The industry could be assisted by government with funding for demonstration projects."

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

■ DY, JR & AW



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Industry Asks Congress to Vacate EPA's New RMP rule

In letter to Congress, GCCA and IIAR encourage the use of the Congressional Review Act to nullify changes to the Risk Management Program

— By Michael Garry



Anticipating the more lenient regulatory stance of the Trump Administration and the Republican-controlled Congress, a coalition of 21 industry associations asked Congress last month to apply the little-used Congressional Review Act (CRA) to the Environmental Protection Agency's new rule amending its Risk Management Program (RMP).

If the House of Representatives and the Senate act on the request within 60 legislative days – giving it until about late March/early April – and President Trump lends his signature, then changes made to the RMP in the final rule would be vacated, noted Lowell Randel, vice president, government and legal affairs, Global Cold Chain Alliance (GCCA).

The GCCA and the International Institute of Ammonia Refrigeration (IIAR) were among the associations that signed a letter to Congress asking it to cancel the new rule via the CRA, said Randel. Even if the rule

is repealed, the RMP's original, underlying provisions, which impose safety requirements on U.S. cold storage and food processing facilities using at least 10,000 lbs. of ammonia in refrigeration processes, would remain in effect.

Issued by the Obama administration in late December 2016, the new rule strengthens the RMP in three broad areas: ensuring that local responders and community residents are prepared for an accident; preventing catastrophic accidents; and third-party audits. ([See "EPA Releases Final RMP Rule," Accelerate America, January 2017.](#))

In the industrial refrigeration industry, the most controversial part of the new RMP rule involves third party audits. The rule requires industrial refrigeration operators to get an independent third party – rather than use its own internal resources – to conduct a compliance audit within a year following

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▶ a reportable accident. The industry also believes “the EPA didn’t meet its burden on the cost-benefit of the rule,” said Randel. “And there are some security concerns on public information sharing.”

The expansion of the RMP, as well as greater enforcement of the program, has led many operators to implement low-charge ammonia systems that use far less than 10,000 lbs. of ammonia and are thus held to the EPA’s less restrictive General Duty Clause.

Effective date postponed

The original effective date of the new RMP rule, March 14, was postponed one week by the Trump Administration last month in a memorandum for the heads of executive departments and agencies that called for a “regulatory freeze pending review.” The RMP rule was among 30 EPA rules whose effective dates were postponed until March 21. For the RMP rule, the one-week delay is inconsequential since the deadline for compliance for many of its provisions is four years from the effective date, Randel pointed out.

More consequential would be the application of the CRA to the rule. “It would not surprise me if we see a member of the House or Senate put forward a proposal to use the CRA to disapprove of the RMP rule,” said Randel. “Whether it would make it through the process [and be enacted] is uncertain, since there are competing priorities.”

In the Senate, James Inhofe (R-Okla.) “has raised concerns about the rule and mentioned consideration of the CRA,” said Randel. “Other members are looking at it.” (In the environmental arena, Inhofe is known as a leading skeptic of the science behind climate change.)

Other EPA rules that went into effect in the latter stages of the Obama administration – such as changes to refrigerant management under Section 608 of the Clean Air Act, and the EPA’s latest refrigerant evaluations under the Significant New Alternatives Policy (SNAP) – would also be subject to the CRA. However, they have not been singled out by industry groups, and are not considered a priority item for the new administration or Congress.

Since its enactment in 1996, the CRA has been successfully used once, when President George W. Bush signed a CRA disapproval resolution in 2001 invalidating an ergonomics rule issued by the Occupational Safety & Health Administration (OSHA) during the Clinton administration.

Even if the CRA is not used to repeal the new RMP rule, the rule faces other hurdles, including a legal challenge or efforts by newly appointed officials at the EPA to delay the effective date further or propose new notice-and-comment rulemaking.



“It would not surprise me if we see a member of the House or Senate put forward a proposal to use the CRA to disapprove of the RMP rule.”

- Lowell Randel, Global Cold Chain Alliance

“There are a lot of options and tools people are considering,” Randel said. “These could result in revision of the rule, nullification or a negotiated settlement. Or it could stand the way it is – it takes a lot to change a final rule.”

Moreover, he noted, the Trump administration has paid more attention to higher profile EPA regulations like the Clean Power Plan and the Waters of the U.S. rule. “Where RMP fits, I don’t think anybody fully knows yet.”

Randel was more certain about the status of proposed changes to the Occupational Safety and Health Administration’s Process Safety Management (PSM) program, which also regulates plants with more than 10,000 lbs. of ammonia. “The pause button has been hit; I wouldn’t expect activity on the PSM rule for the foreseeable future.” ■ MG

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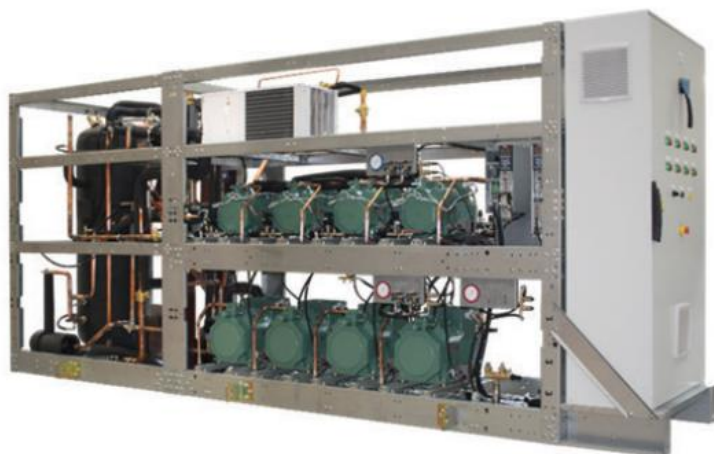


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From left: Hans-Dieter Bruss, Transgourmet CEE, and Marcus Hoepfl, Frigo-Consulting International

Embracing CO₂ in Transylvania

European cash & carry retailer Transgourmet CEE is bent on rolling out transcritical CO₂ systems with ejectors across its stores and warehouses in Central and Eastern Europe, and linking them to CO₂ chillers and heat pumps

– By Andrew Williams

When it comes to transcritical CO₂ refrigeration, European retailers have led the world with more than 5,500 installations as of 2016, according to research by shecco, publisher of *Accelerate America*. By contrast, there are about 400 stores using transcritical CO₂ systems in North America.

Part of what drives the adoption of natural refrigerants in Europe is the regulatory stance taken by the European Union (EU). Since 2015, the EU's 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 in new equipment goes into effect, accompanied by bans on servicing and maintaining existing equipment.

One of the more ambitious European retailers in the pursuit of CO₂ refrigeration is Transgourmet Central and Eastern Europe (CEE), a division of Switzerland-based Transgourmet Holding AG. (See story, page 29, for more on this company.)

Transgourmet CEE, which operates 94 cash & carry and wholesale stores in Germany, Poland, Romania and Russia, along

Transgourmet in a Nutshell

Transgourmet Central and Eastern Europe (CEE) is a division of Transgourmet Holding AG, based in Basel, Switzerland, Europe's second-largest cash & carry and wholesale supplies company.

Transgourmet Holding AG, which also includes divisions in France, Austria and Switzerland, is a wholly owned subsidiary of Basel-based Coop. Coop founded Transgourmet in 2008 with German retailer REWE, and took sole control in 2011.

In 2015, Transgourmet had revenues of \$8 billion and more than 24,000 employees.

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

Transgourmet's Selgros Cash & Carry stores are geared to both consumers and businesses, whereas Transgourmet-branded stores target businesses.



Grand opening last year of Selgros Cash & Carry in Târgu Mures, Romania

with delivery services, is adopting transcritical CO₂ for all refrigeration, air conditioning and heating applications, not only in new and remodeled stores but also in distribution centers.

"The target is 100% CO₂," Hans-Dieter Bruss, vice president Transgourmet CEE, told *Accelerate Europe*, a sister publication to *Accelerate America*.

Based in Germany, Bruss is responsible for construction and facility management at Transgourmet CEE.

Transitioning away from HFCs to CO₂ is helping the parent company, Transgourmet Holding AG, become carbon-neutral by 2023, a target "set by our shareholders," said Bruss.

There is not yet a precise timetable in place for delivering the transition to transcritical CO₂. "We're trying to change four, five or six installations to CO₂ every year," he said, adding that Transgourmet's goal is to become HFC-free "in the near future."

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

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

Chief among these projects for 2017 is a huge distribution center in Hamburg, as well as local distribution centers in Polish capital Warsaw and the city of Bistrita, Romania. "CO₂ is an excellent alternative to ammonia, particularly in small and medium-sized distribution centers," Bruss noted. He is confident that the decision to opt for CO₂ over ammonia for warehouses will deliver energy savings to the tune of at least 20%.

"Whatever the project or application, we first check the feasibility with CO₂," said Bruss. "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."

What sets Transgourmet apart from other retailers is that its CO₂ goals are not confined to refrigeration, but extend to air conditioning and even heat pumps "Transgourmet has the ambition to apply CO₂ technology whenever possible," said Bruss. "When we say CO₂, we mean "full CO₂." This also means excluding hybrid systems that still use HFCs, he added.

▶ 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 said.

"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 added. "It's easy for us, because it's what our shareholders want."

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. But maybe that's a good idea!"

Visit to Transylvania

Bruss and Marcus Hoepfl, managing director of Frigo-Consulting International, met with Accelerate Europe at a 37,674-sq.-ft. Selgros Cash & Carry store, part of Transgourmet CEE, in the Transylvanian town of Târgu Mureș, located just over 62 miles southwest of the city of Cluj-Napoca in Romania.

Frigo-Consulting, a Swiss refrigeration consulting and engineering company, has been helping Transgourmet make the transition to natural refrigerants for two years.

Selgros Cash & Carry operates 20 stores in Romania, putting it among the top five food retailers in the market. The Târgu Mureș store – which opened last May – uses CO₂ for refrigeration and air conditioning and captures waste heat for hot tap water and heating for the sales and office areas.

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

The CO₂ booster rack – serving 417 ft of low- and medium-temperature cabinets, as well as 2,885 sq. ft. of cold rooms and freezers – delivers up to 145 kW (41 TR) of medium-temperature and 44 kW (12.5 TR) of low-temperature cooling capacity at the Selgros store.

Notably, the transcritical rack system harnesses six gas and two liquid ejectors together with parallel compressors to recover the energy released during high-pressure expansion; the ejectors convey either liquid or gaseous refrigerant. While gas ejectors are prevalent in Europe and beginning to be adopted in North America, liquid ejectors are still a relatively new technology in the global HVAC&R marketplace. ▶



System Specs

Here is some data on the two CO₂ systems running at a Selgros Cash & Carry store in Târgu Mureș, Romania:

CO₂ transcritical rack:

- ▶ Supplier: Enex
- ▶ Ejectors: Six gas and two liquid
- ▶ Cooling capacity: 154 kW at t0 -2°C (MT): 44 kW at t0 -26°C (LT)

CO₂ transcritical chiller:

- ▶ Supplier: Enex
- ▶ Capacity: 225 kW at t0 6°C
- ▶ Chiller rack features: 4 x HT compressors
- ▶ Evaporators: 2 x gravity overfeed
- ▶ Designed pressure HT/IP/HP: 80 bar/80 bar/130 bar

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▶ The CO₂ transcritical chiller, also provided by Enex, provides air conditioning for the store's sales and office area. The system employs ejectors to increase system efficiency. Performing expansion in partially flooded mode "increases the properties of CO₂ tremendously," said Hoepfl. "Energy savings reach up to 25% compared to traditional CO₂ systems. We measured this for over a year in two similar installations in Switzerland."

Transgourmet allocated R&D funds for the development of the CO₂ chiller. "Together with trusted partners, we always try to push the boundaries," said Bruss.

Hoepfl acknowledged that the transcritical systems at the Selgros store carry a higher price, "but we're sure that the cost of this concept will come down."

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

With temperatures hovering around 93°F for Accelerate Europe's visit, Hoepfl was 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 said.

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.

The training challenge

The Transgourmet Group's natural refrigerants journey has not always been smooth sailing. What are the main challenges? "Firstly, motivating installers to turn to natural refrigerants," said Bruss. "This means leaving their existing 'comfort zone' and investing in staff training."

An oft-cited obstacle to greater market penetration of natural refrigerant-based systems is the lack of technicians trained in using the technologies. Nonetheless, "I very much expect manufacturers and installers alike to become more proactive and

“Whatever the project or application, we first check the feasibility with CO₂.”

- Hans-Dieter Brüss, Transgourmet CEE

invest in training," Bruss said.

He has not encountered significant differences in the standard of training from country to country. "There are differences but not big differences," though training has been a bigger challenge in Russia. "Russian companies train their staff in Germany, Switzerland or Austria," he said.

Bruss puts particular responsibility for ensuring smooth running of the systems at the feet of manufacturers. "It is important for our partners, who build these installations, to have trained personnel," he said. "What they do at our stores – we don't have trained personnel for that."

Frigo-Consulting is well aware of the importance of ensuring that trained service personnel are close at 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.

"You can see the interest [of service companies], but you have to push them to train their entire staff, and not just one or two people," Hoepfl said.

Hoepfl described the problem as a "knowledge bottleneck." Companies "must change their mindset, to say 'OK, the market is changing. And we must change too.'"

But as the number of installations in Europe steadily increases, so does the number of service personnel capable of servicing the equipment. Bruss spoke 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."

Bruss also sees a role for government. "The authorities should look into creating some sort of incentive or reward for installers and store owners" to accelerate uptake of naturals. ■ AW

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Impressed by its safety, environmental friendliness and energy efficiency, Wholesome Harvest Baking is the first industrial operator in Canada – and only the second in North America – to install Mayekawa's NewTon low-charge NH_3/CO_2 packaged refrigeration system.

— By Michael Garry



Frank

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Frank Barrese, Wholesome Harvest Baking



Frank Barrese, in the freezer room at Wholesome Harvest Baking's Etobicoke plant in Toronto



Ciabatta rolls made by Wholesome Harvest Baking

What makes a company decide to invest in a refrigeration system never before tried in its country?

Last September, Wholesome Harvest Baking, a division of Mexican baking giant Grupo Bimbo, became the first company in Canada to operate the NewTon, Mayekawa's ammonia/CO₂ packaged refrigeration system, in an expansion of a bread-making plant in the Etobicoke section of Toronto. The project included the refrigeration system, a spiral freezer, installation and building modifications.

The NewTon is one of a growing breed of low-charge ammonia packaged refrigeration systems that keep the

ammonia charge well below the 10,000-lb. threshold triggering greater regulatory scrutiny. The factory-made system uses the ammonia to condense gaseous CO₂, which is the only refrigerant providing the cooling in operating areas.

The NewTon has established a considerable track record outside of North America, particularly in Mayekawa's home market of Japan, where many of the more than 1,000 NewTon installations worldwide are located. Mayekawa is installing the NewTon at the rate of about 300 per year, mostly in cold storage and food processing facilities, said Len Puhacz, sales manager, green systems, at Mayekawa's Toronto office.

In the North American continent, Mayekawa has partnered with Toronto-based CIMCO Refrigeration to market the NewTon. (See "Coming to America, *Accelerate America*, February 2016.) So far the companies have deployed one other NewTon at an operating facility — an Imuraya confectionary plant in Irvine, Calif. (See story, page 41.) The Garden City Ammonia Program (GCAP), a training facility in Garden City, Kan., has also installed the NewTon, but only for training purposes.

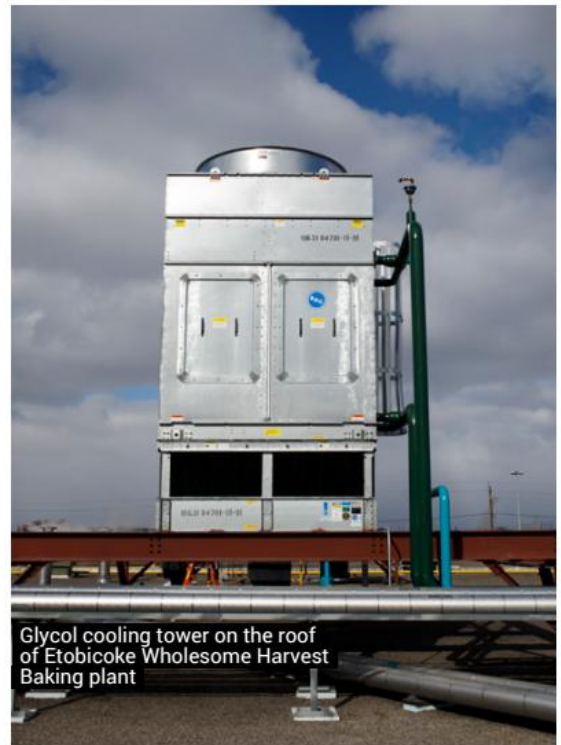
The Etobicoke plant is one of three facilities that Wholesome Harvest operates in the Toronto area, along with one other in Calgary, Canada, and three in the U.S. (See story, page 40, for more

on Wholesome Harvest.) The Etobicoke facility runs two 45-TR NewTon F-600 packaged NH_3/CO_2 units, each with two ammonia compressors, 120 lbs. of ammonia and about 1,150 lbs. of CO_2 ; the units serve as the freezing agent for a spiral freezer added to the existing facility. CIMCO handled the installation of the refrigeration system.

The Etobicoke plant is the kind of mid-sized food processing facility suitable for the NewTon, said David Fauser, Ontario sales manager for CIMCO, who worked with Wholesome Harvest on the NewTon project. Mayekawa sees a great opportunity for the NewTon in North America as a replacement for R22 systems in those facilities as R22 enters the final chapter of its phase-out, said Puhacz. The same opportunity would apply to HFC systems once HFCs' phase out accelerates. Large plants that would normally employ direct ammonia systems represent another target; in Japan, such plants have installed up to 12 NewTons.

WALKING THE TALK

Part of the appeal of the NewTon to Wholesome Harvest resides in its environmental friendliness. In contrast to HFC condensing units, the NewTon's working fluids, ammonia and CO_2 , are natural refrigerants; if they escape, they "return to nature; there's zero impact to the environment," said Frank Barrese, engineering and maintenance manager for Wholesome Harvest's Etobicoke plant, who was recognized for his work on the NewTon installation with a President's Award from Wholesome Harvest. Moreover, the NewTon's energy efficiency is far greater than that of an HFC system, further reducing greenhouse gas emissions.



Glycol cooling tower on the roof of Etobicoke Wholesome Harvest Baking plant

“We were very careful to make the equipment a good fit to the people and the culture.”

– Frank Barrese, Wholesome Harvest Baking

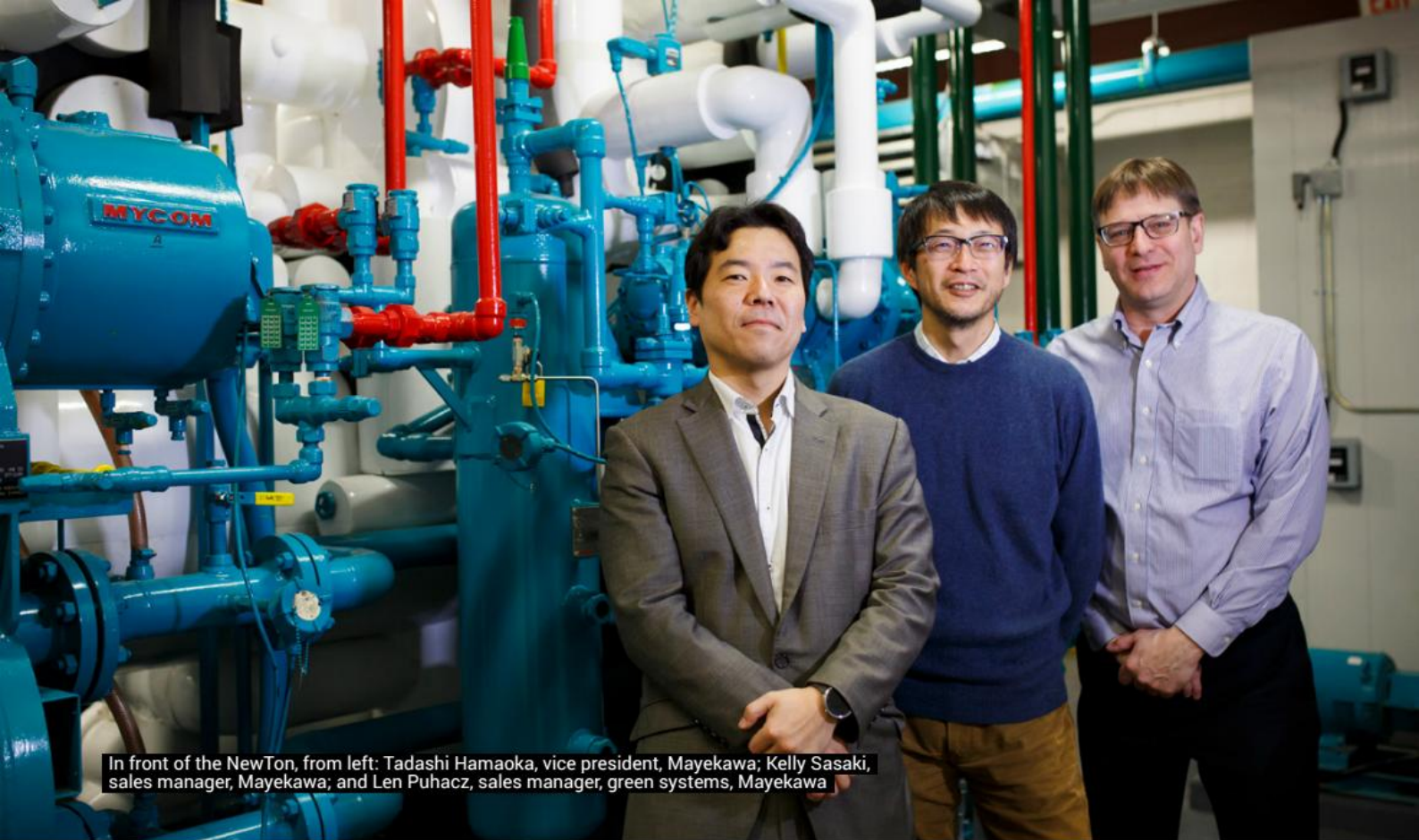


Wholesome Harvest Baking plant in the Etobicoke section of Toronto

Grupo Bimbo also emphasizes sustainability in its corporate policies. “Companies may state they have strong environmental and safety policies” said Barrese. “Grupo Bimbo is committed to these policies as it is demonstrating through this investment.”

“Grupo Bimbo seems focused on environmental sustainability as part of their business case,” said Fauser, adding, “I feel really lucky that I was involved with this.”

Wholesome Harvest opted not to install a conventional direct-ammonia overfeed system – which would have been slightly less expensive than the NewTon with about the same efficiency – for safety reasons. Unlike a conventional system, the two NewTon units use a small amount of ammonia and confine it to the mechanical room, preventing any potential exposure of the gas to employees. “The [conventional] ammonia systems we purchase are safe, but the NewTon gives an added



In front of the NewTon, from left: Tadashi Hamaoka, vice president, Mayekawa; Kelly Sasaki, sales manager, Mayekawa; and Len Puhacz, sales manager, green systems, Mayekawa

measure of safety," said Barrese. Puhacz noted that safety has been a major driver of the NewTon's adoption overseas. "The attraction is that it's green without using ammonia in the storage space."

Enclosed in the NewTon units, liquid ammonia goes into a plate-and-shell heat exchanger where it condenses CO₂ gas returning from the spiral freezer evaporators. The liquid CO₂ is then pumped to, and across, the roof, and down into the freezing room, about 45 feet from the mechanical room. The now gaseous ammonia is liquefied by glycol in another plate-and-shell heat exchanger inside the NewTon units. (The glycol regains its low temperature from a water tower on the roof.) "The ammonia never leaves the mechanical room," emphasized Barrese.

At the Etobicoke plant, redundancy was built into the two-NewTon, four-compressor design so that the system would run "as continuously as possible," noted Barrese. "We can still maintain the temperature with one of the compressors down." But to ensure that the CO₂ gas continues to be condensed if more than one of the ammonia compressors fails, CIMCO installed a back-up 7-TR R404A

condensing unit. "So, if there's any interruption, the [HFC] unit takes over from the ammonia compressors to keep the CO₂ cool. Everything is automatic."

Ease of use is a key aspect of the NewTon. In adding spiral freezing to the Etobicoke plant, Wholesome Harvest wanted to employ a refrigeration system that would be comfortable for longtime employees to run. The NewTon, with its "one-button-type" operation and intuitive controls, matched that description, running continuously even under different loads, said Barrese. "We were very careful to make the equipment a good fit to the people and the culture. It's peace of mind for me, our managers and Wholesome Harvest."

"It runs itself," added Fauser.

EFFICIENCY WINNER

The NewTon has a reputation for energy efficiency; this was born out at the Etobicoke plant in a study conducted by I.B. Storey, a third-party energy consultant, to qualify Wholesome Harvest for an energy incentive. The study compared the NewTon to an HFC system.

"As an indirect ammonia system, the NewTon is close to the same energy efficiency as a direct ammonia system, without any of the hazards of direct ammonia," said Barrese. "And it's heads and tails more efficient than Freon." Fauser pointed out that the NewTon minimizes the energy penalty normally associated with an indirect system that uses two refrigerants. "That's what makes it so unique."

As its baseline, I.B. Storey estimated the annual energy performance of a standard HFC refrigeration system by using energy metering of its compressors during a 28-day period. A similar estimate was done for the NewTon. The conclusion: The NewTon generated 588,063 kWh annually, compared to 1,200,931 kWh for the conventional HFC system, a savings of 612,868 kWh. In addition, the annual savings in peak energy consumption achieved with the NewTon was 122 kW. Based upon these savings, I.B. Storey recommended an energy incentive from the SaveONenergy Retrofit Program run by Toronto Hydro-Electric System, which conditionally approved the application in late January.

“The attraction is that it’s green without using ammonia in the storage space.”

- Len Puhacz, Mayekawa

The NewTon is monitored remotely from Mayekawa’s Japanese headquarters, which does predictive maintenance. “If they see something and we choose to ignore it, they’ll still be knocking on your door,” said Barrese. Fauser noted that the NewTon is very low-maintenance and leak-tight, while Puhacz pointed out that the NewTon’s compressors have no shaft seals, making them less likely to leak.

Though the NewTon is a new technology for Barrese, he has worked with Mayekawa and its MYCOM compressor brand during his 10-year career at Wholesome Harvest/Canada Bread. “I’ve refurbished compressors using MYCOM,” he said. I understand MYCOM and I know the quality of their work; it’s fantastic.” He has also successfully collaborated with CIMCO on integrating and commissioning MYCOM equipment. Consequently, Barrese had “absolutely no concerns” about being the first Canadian user of the NewTon.

Barrese also praised Mayekawa’s customer service. During the commissioning process, Mayekawa “made sure [the NewTon] was working 100% the way we needed it to work,” he said, echoing the philosophy Mayekawa describes on its website. “In most cases, they have a better understanding of what we need than we do ourselves.” At his request, Barrese was given a visual diagram of all of the components of the NewTon. “They said, ‘we’ve never done that before, but if that’s what you want, we’ll do it for you.’”

In North America, the NewTon follows in the footsteps of other low-charge packaged ammonia systems offered by NXTCOLD, Evapco, Azane, Stellar and CIMCO, among others. Some operators are reducing the ammonia charge in conventional industrial systems using DX coils or other methods. In addition, M&M Refrigeration has installed large-scale ammonia/CO₂ systems for cold storage operators like U.S. Cold Storage (see “Shaking Up Industrial Refrigeration,” *Accelerate America*, April 2015.)

But for a spiral freezer application, “there’s not a better solution [than the NewTon] if you don’t want ammonia in the plant,” said Fauser. ■ MG



CO₂ liquid storage vessel (white); condenser and economizer vessels (blue)



The NewTon, including emergency and controlled venting lines (red and yellow); glycol supply and return lines (dark green, at right)



The two NewTons, each including main electrical control cabinet (black) and VFDs (two gray boxes) for each MYCOM ammonia compressor



Evaporator coil in the spiral freezer

BREADS GALORE

Wholesome Harvest Baking, based in Des Plaines, Ill., makes an exceptional array of bread products.

These include crusty and artisan breads and rolls, sourdough and sandwich breads, muffins, baguettes, pretzel rolls, Ciabatta rolls, hamburger buns, pizza crusts, croissants, scones and biscuits. Its brands include such well-known names as Thomas' English muffins, Sara Lee bagels, Arnold sandwich thin rolls and Boboli pizza crusts. The company provides products to both foodservice and food retail outlets.

Wholesome Harvest, under the Canada Bread name, was originally part of the Canada Bread company, founded in 1911. When Grupo Bimbo acquired Canada Bread from Maple Leaf Foods in 2014, it renamed its frozen division Wholesome Harvest Baking while keeping the Canada Bread name for the fresh bread division (though Wholesome Harvest also produces some fresh bread).



Etobicoke, Toronto location



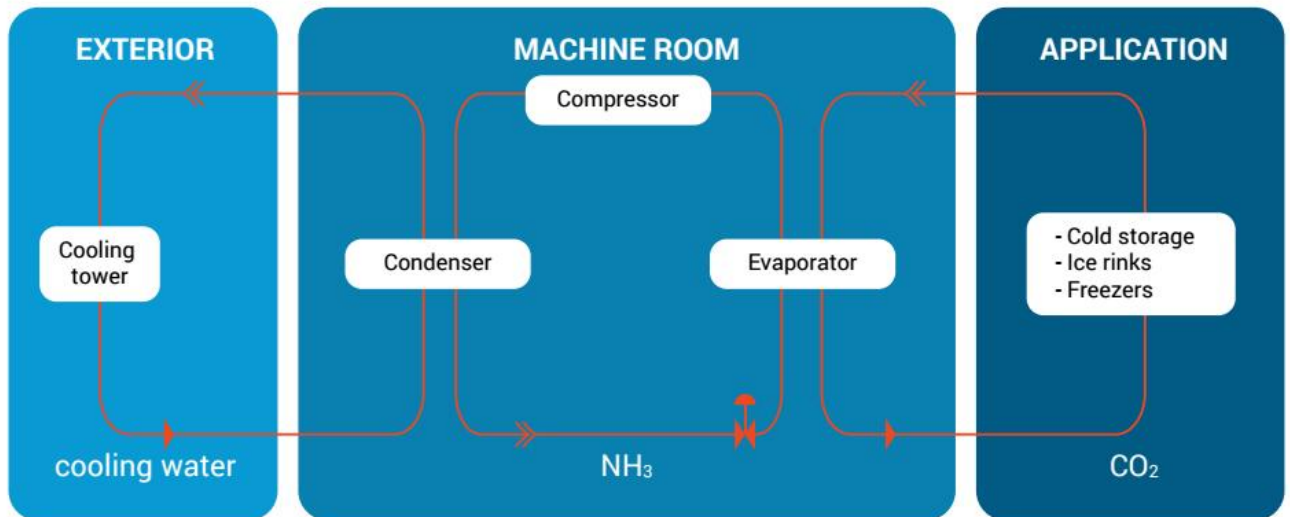
A section of the NewTon

SYSTEM SPECS

The Wholesome Harvest Baking facility in the Etobicoke section of Toronto employs two NewTon F-600 NH₃/CO₂ units, made in Lebanon, Tenn. Here are specifications for each unit:

No. of ammonia compressors: two
Ammonia compressors: semi-hermetic compound screw
Compressor drive method: VFD
Compressor motor type: IPM motor
Ammonia charge: 120 lbs.
Cooling capacity: 45 TR
CO₂ charge: approximately 1,150 lbs.
Typical operational temperature: -15°F
CO₂ supply temperature: -44°F
Heat exchangers: shell-and-plate
Net weight: 16,976 lbs.

Format of the NewTon



SAVING ENERGY IN CALIFORNIA

A study of the energy performance of Mayekawa's NewTon ammonia/CO₂ refrigeration system (model R-3000) at a candy manufacturing facility in Irvine, Calif., concluded that the NewTon consumes 32% less energy than a baseline R507A system running in the same facility.

The study, which took place last year, is described in the February issue of *ASHRAE Journal*.

The study was funded by Southern California Edison (SCE), and took place at a plant operated by Imuraya USA, a manufacturer of Japanese-style mochi (rice paste) snacks. The funding was sourced from California's Emerging Technologies Program.

According to the *ASHRAE Journal* article, the combined energy consumption of all monitored refrigerating equipment has been 1,046 kWh per day with the R507A system, and 715 kWh per day with the NewTon.

The NewTon was installed in an existing freezer as a partial replacement of the facility's existing R507A system, which was left in place for baseline comparison testing.

The mochi at the Imuraya plant is stored in a -20°F freezer, with a load of 12.2 TR (42.9 kW). The water-cooled NewTon, which uses a screw compressor with a variable frequency drive, has a capacity of 25.6 TR (90 kW), allowing it to provide cooling for the facility's planned freezer expansion; it has an ammonia charge of 55 lbs.

The price premium compared to conventional systems for the NewTon installed at the plant was about 30%, the article said, adding that the installation costs were about the same as for the HFC system.

The article did not identify the NH₃/CO₂ system as the NewTon. However, last July, CIMCO Refrigeration, on its website, announced that CIMCO, Southern California Edison and Mayekawa Manufacturing had installed the NewTon ammonia/CO₂ system at the Imuraya USA plant. CIMCO also stated that Mayekawa would monitor the refrigeration system in real time for the operator while SCE would gather and analyze the performance data on both the NewTon and the legacy refrigeration system.

"Reducing the carbon footprint and decreasing overall energy consumption is of significant value to commercial and industrial consumers and to the surrounding electric grid, especially during times of peak demand and warm, summer days," Jose Mergulhao, CIMCO's vice president of US Operations, said in the CIMCO announcement.



Highlights from AHR Expo

The event, which broke attendance records, featured major new natural refrigerant systems, including ammonia/CO₂ chillers and industrial-scale CO₂ compressors

— By Michael Garry

The International Air-Conditioning, Heating, Refrigerating Exposition (AHR Expo) — the HVAC&R industry's largest exhibition in North America — set several records for size and attendance at its 2017 edition in Las Vegas, held January 30 through February 1.

With 68,615 attending the event (including exhibitors), the AHR Expo exceeded its former attendance record of 61,674, set at the 2015 show in Chicago, by 11.2 percent. Additionally, the 2017 Show's 1,968 exhibitors occupied a total of 500,159 net square feet, breaking the AHR Expo record set in 2015 at 486,600 net square feet.

Amid all of the people and exhibits were scattered numerous examples of natural refrigerant-related components, though far less than at the Chillventa show held in Nuremberg, Germany in October 2016. (See "News from Across the Pond," *Accelerate America*, November-December 2016.)

The following reports delineate some of the natural refrigerant highlights from the AHR Expo.

Mayekawa's low-charge ammonia chillers

Building on the success of its water-cooled NewTon ammonia/CO₂ packaged system ([see story, page 34](#)),

Japanese manufacturer Mayekawa showcased two new air-cooled, low-charge ammonia packaged chillers for higher temperature applications at the AHR Expo.

The chillers were designed for the North American market, said Troy Davis, energy manager for Mayekawa USA MYCOM, during a presentation at the AHR Expo.

The BoReas is an ammonia/CO₂ chiller delivering CO₂ at 22°F (at 95°F ambient) for medium-temperature loads in supermarkets, cold-storage facilities, pharmaceutical companies and other applications. The other unit, the AuRa, is an ammonia/water-glycol chiller offering water/glycol at 45°F (at 95°F ambient) for air-conditioning in commercial buildings like hotels and hospitals.

In supermarkets, Mayekawa envisions the BoReas used on the roof for medium-temperature cases in concert with a low-temperature CO₂ rack, Davis said.

"Small packaged chillers with a low ammonia charge have the potential to address a lot of the market using HFCs right now," especially given the phase-out plans for many HFCs, said Davis. "We feel they have wide potential, especially here in the U.S. Instead of R407C or HFOs, why not make the step to naturals?"

“Now [transcritical racks] can use fewer compressors and save the cost of components, frame, piping, and installation.”

— Joe Sanchez, Bitzer US

The BoReas, with a COP of 2.65, comes in three versions: a 21 TR unit with 38 lbs. of ammonia; a 31 TR unit with 58 lbs. of ammonia, and a 42 TR unit with 76 lbs. of ammonia. The AuRa, with a COP of 4.16, also has three versions: 41 TR/82 lbs.; 61 TR/122 lbs.; and 81 TR/162 lbs. The units are suitable for varying temperature ranges, the Boreas from about 7°F to 35°F, the AuRa from 20°F to 50+°F

Both chillers come with 4-, 6- and 8-cylinder semi-hermetic reciprocating MYCOM compressors, with no mechanical shaft seals, which helps prevent leaks; leaks are also mitigated by the small charge. The factory built, plug-and-play units are more welded than field-built ammonia systems, also helping to avoid NH₃ leaks. Even with a leak, ammonia, added Davis, rises into the air and “dissipates rapidly.”

The chillers are unusual for an ammonia system in that they are air-cooled, he noted. “Most chillers use evaporative condensers, and some are water-cooled.”

In contrast to large ammonia systems, the chillers, located outdoors, “keep ammonia out of the occupied space,” Davis noted. “And you get away from an engine room for smaller applications.”

And while the BoReas pumps liquid CO₂ into refrigerated areas – requiring very little horsepower and small-diameter piping – CO₂ compressors are not used in the system. “There are a number of ammonia/CO₂ cascade systems that use CO₂ compressors and that requires using oil but it can be a problem getting the oil back,” Davis noted. In addition, oil can leave a film on evaporators in the cooling areas, degrading their heat transfer.

In the event of a leak, CO₂ “won’t damage products,” he added.

Ammonia/CO₂ packages that pump liquid CO₂ “are the least complex, least troublesome systems we’re finding out there right now,” he said. “They are very simple to employ.”

Mayekawa improved the efficiency of the chillers by using microchannel condensers as well as a VFD for the compressor and EC variable-speed condenser fans, Davis said. In addition, the NH₃/CO₂ cascade heat exchanger is designed with a low approach temperature (4-5°F) to optimize efficiency. “We’re not running the ammonia [suction temperature] artificially low just to cool a secondary [CO₂] circuit,” said Davis. “And we’re getting more efficiency using reciprocating compressor at medium temperatures rather than a screw.”

The BoReas is about 15% more efficient than an R22 system, and 25%-30% more efficient than an R404A/R507 system, said Davis. In first cost, the BoReas is 15%-20% higher than a comparable HFC system but offers a two-to-four-year payback; the AuRa’s cost is on par with that of similar HFC chillers, he said.

Large CO₂ Compressors Showcased

At least three major compressor manufacturers displayed or discussed transcritical CO₂ compressors large enough to accommodate industrial applications.

Dorin

The Blissfield Manufacturing booth at AHR Expo promoted Dorin’s CD600 six-cylinder semi-hermetic reciprocating compressors for transcritical CO₂ systems, which are still under development.



Bitzer’s new 50-HP CO₂ compressor, model 6DTEU-40LK, at the AHR Expo

▶ Dorin currently markets CD500 six-cylinder semi-hermetic reciprocating transcritical CO₂ compressors, which come in 10 models, with horsepower ranging from 40 HP to 100 HP, and capacities from 120 kW (34 TR) to 170 kW (48 TR) at -8C evap/35C gas cooler outlet/90 bar. They will be available in June in the U.S. if UL approval is not required; otherwise availability will depend on "UL protocols," said Giacomo Pisano, sales manager, CO₂ compressors, for Dorin.

Bitzer

German compressor maker Bitzer showcased its ECOLINE+ six-cylinder, 50-HP semi-hermetic reciprocating compressor line for transcritical CO₂ systems for the first time in the U.S. market at the AHR Expo.

The five-model ECOLINE+ compressor line, which made its global debut last October at Chillventa in Germany, is the next generation of Bitzer's five-model OCTAGON Transcritical six-cylinder, 35-to-50 HP line.

The six-cylinder OCTAGON Transcritical models, rated for 2,300 psi, received approval in early February from Underwriters Laboratories (UL) for use in the U.S.; they will be manufactured at Bitzer's Atlanta factory and released immediately. This brings to 13 the number of UL-approved Bitzer transcritical models, with nine more expected in the next few months, said Joe Sanchez, engineering manager, Bitzer US, in an interview with *Accelerate America*.

The capacities for the six-cylinder transcritical OCTAGON compressors range from 272,000 BTU/hr (23 TR) to 397,300 BTU/hr (33 TR), at 23F SST, 95F gas cooler outlet, and 1,300 psia. The capacities of the ECOLINE+ compressors will increase from those levels "on the order of 2%," said Sanchez.

The ECOLINE+ units are currently in field trial, with more models coming out this year, said Sanchez, adding that UL approval is "in process and we hope to have it within the next year."

Both the ECOLINE+ and OCTAGON Transcritical six-cylinder, 50-HP compressors "give us more economical choices for our customers for supermarket racks and also allows them to break into big industrial applications like cold storage," said Sanchez.

The reason the 50-HP compressors are more economical, explained Sanchez, is that fewer of them are required for a rack. "Some of the [transcritical] racks in the U.S. have had up to eight or more compressors because of the size limitation. Now they can use fewer compressors and save the cost of components, frame, piping, and installation."

“If you’ve got one CO₂ compressor that can do almost 200 tons for medium temperature, that changes the face of industrial refrigeration.”

— André Patenaude

Building on the features of the OCTAGON Transcritical line, the ECOLINE+ version includes an integrated compressor module "to make [the compressor] simpler to install and monitor," said Sanchez. The integrated compressor module is part of Bitzer's IQ platform, which is designed to simplify wiring, commissioning and troubleshooting, and can vary the unloader to match the capacity a system requires.

The ECOLINE+ compressors also come with a line-start permanent-magnet motor that improves their efficiency under "all conditions," said Sanchez. This technology has been undergoing testing at Bitzer and in selected systems in the field for more than five years. The motors can be operated directly and with frequency inverters.

Bitzer has offered compressors for transcritical systems since 2004. It also markets two- and four-cylinder transcritical compressors under OCTAGON Transcritical.

Emerson

"I probably spend more time talking to people about industrial applications for CO₂ than I ever have," said André Patenaude, director — CO₂ business development, Emerson Commercial and Residential Solutions, in a conversation with *Accelerate America* at the AHR Expo.

"Because of OSHA regulations for 10,000 lbs. or more of ammonia, they are not going to automatically default to ammonia, and they don't want to use HFCs," he added. "CO₂ can fit a lot of these applications."

Given this interest in CO₂, Emerson, through its Vilter subsidiary, is preparing to offer transcritical and subcritical CO₂ compressors for industrial end users. Its new 550 series of open-drive reciprocating compressors, to be released in the next two months, will accommodate capacities ranging from 50 TR to 225 TR for low-temperature applications (-20°F). They will come in two-, four- and eight-cylinder models.

The 550 series compressors have been running for the past year at Emerson's Helix Innovation Center in Dayton, Ohio. "It's pretty exciting stuff," said Patenaude.

Emerson is also developing screw compressors for medium- or low-temperature transcritical CO₂ applications, up to 188 TR of

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capacity at 20°F, Patenaude said. The compressors will be offered in three displacements – 128 CFM, 145 CFM and 160 CFM. They can also be used in low-charge ammonia applications.

A screw compressor of this size provides almost eight times as much capacity as Emerson's 25 TR unit, previously its largest offering. "If you've got one CO₂ compressor that can do almost 200 tons for medium temperature, that changes the face of industrial refrigeration," he said. Emerson will be seeking a field test site for the industrial screw compressor this year.

The screw compressors will include vapor injection, which can be used in place of parallel compression to improve efficiencies. "It takes the bypass flash gas vapor, and instead of sending it to suction like traditional systems, it sends the gas to the mid-compression part of the screw compressor," said Patenaude, adding that this would eliminate the need for a parallel compressor. "This is going to improve high ambient efficiency tremendously" compared to a standard transcritical booster set-up.

New Hydrocarbon Systems

Tecumseh

At a press conference held at AHR Expo, Tecumseh Products Company unveiled several new fractional-horsepower compressors designed for hydrocarbon and other refrigerants, while maintaining its preference for propane (R290) for stand-alone commercial refrigeration equipment with capacities less than ½ HP.

"We are reinvesting in our core products, which are our fractional horsepower compressors," said Douglas Murdock, president and CEO of Tecumseh, based in Ann Arbor, Mich. "Tecumseh's back in the game."

The new compressors include the AE2, TC and VA units, which have already been launched, and the AK2, AEX and VTC units, which will be launched in the next six months. The compressors, which range in horsepower from 1/5 to 1.25, can all use propane, while the TC and VA compressors can also employ isobutane (R600a).

In addition, all of the new commercial refrigeration compressors are being incorporated into condensing units, which will be launched later this year.

The AK2 and AEX are more energy efficient than their predecessors, said Bill Merritt, Tecumseh's vice president, global product management and marketing.

The VTC and VA units incorporate variable-speed technology, which will be added to the other compressors next year. "When you look at energy requirements, you are going to run out of efficiency with just single-speed," said Merritt.



Douglas Murdock, CEO of Tecumseh, with new compressors



Geoclima chiller with adiabatic condenser, which can be designed with propane refrigerant



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Geoclima

Making its first appearance in the U.S. market at the AHR Expo, Italian chiller manufacturer Geoclima promoted its environmentally friendly systems, including medium-temperature propane (R290) chillers used by supermarkets and cold storage warehouses.

Geoclima has previously sold chillers in the U.S. without any marketing effort. "We said, maybe we can do better here if we focus on it," noted Fabian Lant, sales manager for the company. "We don't have any big aim or target. We want to see what is possible. Then if business increases, we will introduce manufacturing here."

Geoclima currently has factories and sales operations in Italy, Russia and Thailand, and does business throughout Europe as well as Southeast Asia, India, China and Australia. The company is currently seeking sales offices in the U.S.

Natural refrigerant-based chillers using propane, CO₂ or ammonia represent 15% to 20% of its business, said Lant. Its propane chillers range in capacity from 3 TR to 300 TR and come in air- and water-cooled models; using water as a secondary coolant, they have been applied in supermarkets such as Waitrose in the U.K. and in vegetable warehouses. The chillers normally do not exceed 10 kg of propane charge per circuit, said Lant.

The propane chillers, which "have been very well accepted in Europe," are equipped with adiabatic condensers that use a unique water distribution method that avoids spraying, he said. ■ MG



From left: Joshua Goin and Troy Davis, Mayekawa, with new NH₃/CO₂ chiller

Modine Unveils New Division

Modine Manufacturing introduced its Commercial and Industrial Solutions (CIS), formerly Luvata Heat Transfer Solutions, at the AHR Expo.

Modine acquired Luvata, whose products include CO₂ gas coolers and CO₂ unit coolers, last December. "A strong proponent for using natural refrigerants, Luvata has held a leading position in the use of CO₂ for the refrigeration and air-conditioning sectors," the company said on its website.

"Because Luvata HTS is the largest independent producer of HVAC&R coils and coatings globally, the AHR Expo is an ideal platform to introduce the newly created Commercial and Industrial Solutions (CIS), to the industry," said Matt McBurney, vice-president, Integration Management Office, Racine, Wis.-based Modine.

At the AHR Expo, Modine also showcased ECO CO₂ refrigeration coolers and Heatcraft aluminum microchannel CF evaporators and PF condensers.

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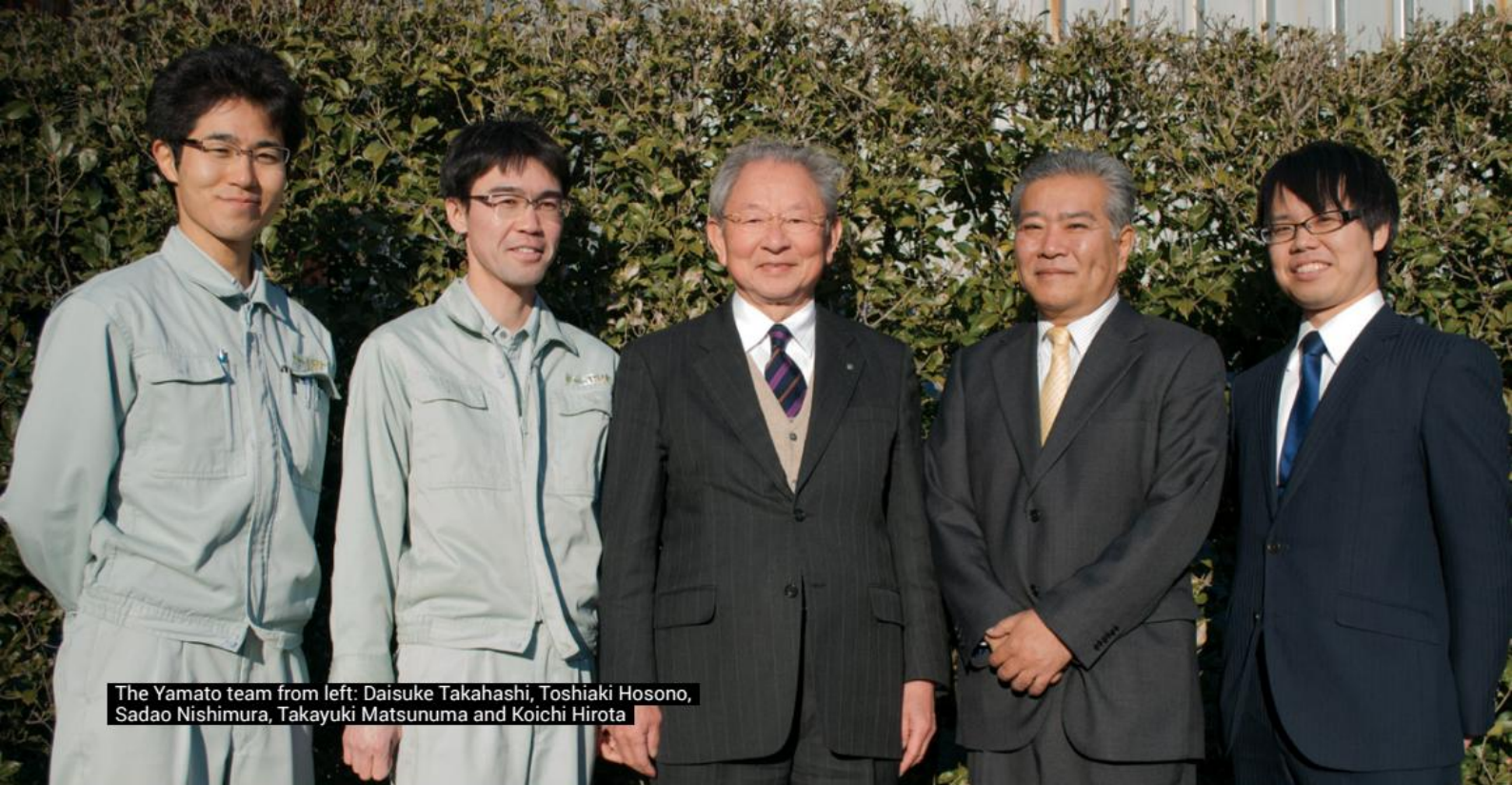
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The Yamato team from left: Daisuke Takahashi, Toshiaki Hosono, Sadao Nishimura, Takayuki Matsunuma and Koichi Hirota

Reinventing the CO₂ Condensing Unit

Yamato has combined its brine-ice thermal storage tank with Panasonic's condensing unit to produce a system that cuts energy consumption by 15% for small-format stores

— By Rena Okabe and Jan Dusek

Seeking to improve the efficiency of CO₂ condensing units for small retail outlets, Yamato Co. Ltd., a Japanese HVAC&R engineering company, has developed and tested a new CO₂-based brine-ice thermal storage refrigeration system.

The system combines Yamato's patented Ultra Eco-Ice (UEI) brine-ice thermal tank and Panasonic's 2nd generation 10-HP CO₂ outdoor condensing unit, which delivers CO₂ at a pressure of 6 MPa (60 bar). Yamato calls the complete system the CO₂UEI Unit. The brine-ice thermal storage tank contains multiple spiral coils of high-pressure stainless

steel piping used to evaporate CO₂ and generate the brine-ice.

In essence, the brine-ice, created overnight, is used as a secondary fluid to cool medium- and high-temperature cases during the day. Case temperatures are also maintained at night with a precool unit that delivers cool brine through a night-cooling defrost line, bypassing the storage tank.

Yamato's use of CO₂ is a recent development, improving upon Yamato's past models, which used a combination of HFCs and thermal storage. The

company will continue to develop and improve the CO₂UEI Unit, which it sees as a key offering in the growing market for natural refrigerant solutions. It is attempting to secure its first partner for field tests.

Panasonic is not involved in the marketing of the CO₂UEI Unit. Separately, however, Panasonic hopes to use U.S.-based Hussmann, which it acquired in late 2015, to introduce its CO₂ refrigeration technology to foodservice and small-format food retailers throughout North America.

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Yamato's CO₂UEI Unit, which includes a brine-ice thermal storage tank and a Panasonic CO₂ condensing unit (also at right)

▶ (See "Panasonic's Hussmann Acquisition Signals Confidence in CO₂," *Accelerate America*, April 2016.)

The CO₂UEI Unit has a minimal footprint and could be installed to replace existing supermarket or convenience store HFC direct expansion (DX) systems quickly and easily without the need to close down the store, according to Yamato. It has been shown to perform significantly better than CO₂ DX systems, increasing efficiency, reducing electricity demand and reducing required refrigeration capacity.

"The combination of the UEI thermal storage tank and the CO₂ refrigeration unit is the key innovation that has improved performance and efficiency over our past iterations of HFC-based thermal storage systems," said Sadao Nishimura, managing executive officer for Yamato. "We believe the CO₂UEI system has the potential to reduce energy costs for a number of retailers who wish to transition away from their legacy F-gas based systems."

Accelerate Japan, a sister publication of *Accelerate America*, got exclusive access to Yamato's R&D facility to learn more about the system as well as its development history.

Path to CO₂

The story of the CO₂UEI system goes back a number of years.

In 1996, Nishimura began developing the UEI thermal storage system and saw its potential to solve the two biggest problems with commercial refrigeration: refrigerant loss and high environmental impact.

Supermarkets are among the most energy-intensive commercial buildings. The standard refrigeration system for supermarkets is the multiplex direct expansion (DX) system, which is characterized by centrally located condensing units or racks, long connecting lines, several connection joints and large refrigerant charges, with typically 4-5 kg/kW of refrigeration capacity.



As a result, these systems can typically see refrigerant loss rates of anywhere from 15%-30% of total charge annually. This, in turn, results in a Total Equivalent Warming Impact (TEWI) of over 1.6 million kg of CO₂ annually for a single large system. By using the original HFC-UEI unit as a secondary loop system, end users were able to match the energy efficiency of DX systems while significantly reducing TEWI.

However, Nishimura was not satisfied. He knew he was on the right track but saw that the system could be improved further by replacing the use of HFCs with CO₂.

Beginning in 2009, with the help of local and national government subsidies, Yamato began testing CO₂ compressors from Bitzer and GEA Bock with its UEI thermal storage system, eventually settling on Panasonic's 10-HP CO₂ unit in 2014.

Test at the Conbini

At Yamato's R&D facility in Gunma prefecture Japan, *Accelerate Japan* saw the test CO₂UEI Unit sitting outside of Yamato's simulated convenience store environment, affectionately named Yamato Conbini (convenience store).

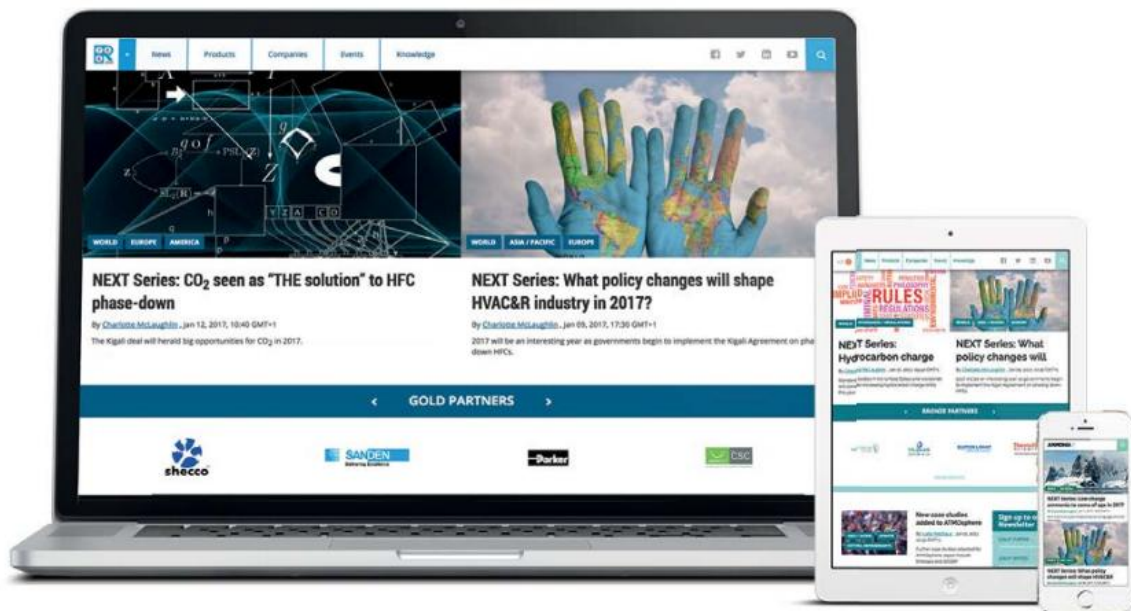
The unit's operation was described as follows: CO₂ evaporates in the UEI thermal storage tank at around 14°F. and at a pressure of 6 MPa. The brine, which is a combination of propylene glycol and water, begins to freeze at 21°F. Brine-ice is then generated and accumulated overnight.

During the day, the brine fluid exits the thermal storage tank and is circulated throughout Yamato's simulated indoor retail

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environment at 21°F. This configuration guarantees zero chance of CO₂ leakage inside the store as the refrigerant never enters the building and is kept outside.

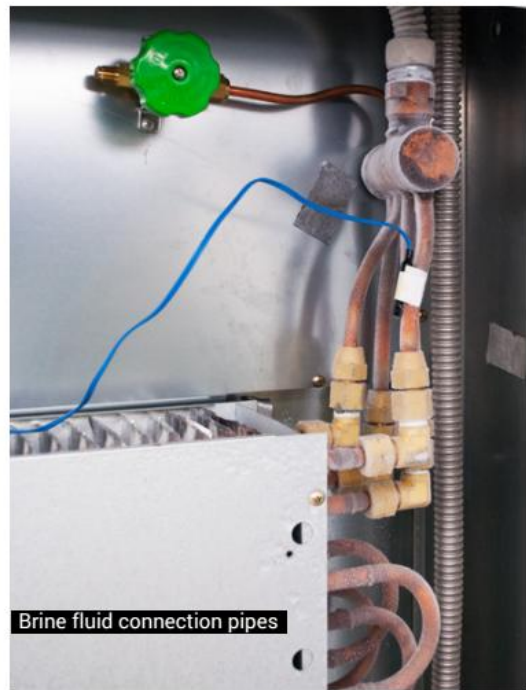
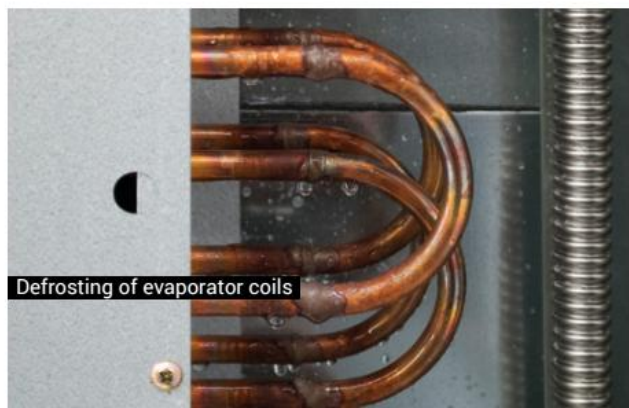
Yamato's simulated retail environment consists of four refrigerated display cases: two display cases at 21°F, suitable for fish and meat, and two display cases at 27°F, suitable for fruits, vegetables, and other daily consumables. The 27°F cases are cooled by brine leaving the lower-temperature cases (warmed to about 27°F).

Inside the store, Yamato personnel demonstrated the ease of converting the original HFC cases simply by removing the expansion valves and directly connecting the brine supply.

This is an additional benefit to end users since the process of changing existing HFC- or HCFC-based display cases can be done without closing the store once the CO₂UEI Unit is installed outside. Moreover, the cost of the Unit is reduced by 20% compared to a CO₂ DX condensing unit since the store's original cases do not have to be replaced.

Yamato has been testing the system since September 2016, in various conditions, to see how it would perform in different simulated environments.

Some of the initial challenges encountered were finding the appropriate amount of refrigerant and controlling the circulation of oil, especially in summer conditions. Once these issues were resolved, the team then collected data and measured performance over the next several months.



Higher COP

Yamato has found that the CO₂UEI system outperformed standard CO₂ DX condensing units in three main areas:

- ▶ **Energy efficiency (kWh):** The average coefficient of performance (COP) for the CO₂UEI system was 2.78 compared to 2.55 for standard direct expansion – an improvement of 9%. This resulted in an energy savings of 15%.
- ▶ **Electric power consumption (kW):** The use of the UEI thermal storage unit to produce and store ice overnight also reduces peak daytime electric power demand, saving 30% in electric power.
- ▶ **Refrigeration capacity (kW):** Increasing COP and lowering electricity consumption resulted in the reduction of refrigerator capacity by 30%.

In addition to cutting operating costs, the system minimizes maintenance costs and increases its overall reliability by using high-pressure refrigerant piping only between the CO₂ refrigeration unit and the UEI thermal storage tank.

The use of the Panasonic 10-HP refrigeration unit reduces the overall size and weight of the system, which means the space needed for installation, outside the store, is minimized.

With these benefits, Yamato expects the system to provide supermarkets and convenience stores who wish to transition away from F-gases another option – one it believes will reduce their costs, future-proof their operation, and contribute to environmental sustainability. ■ RO, JD

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Focus: Hydrocarbon refrigeration in foodservice applications

Ad submission deadline: March 15

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Focus: Industrial Refrigeration

(low-charge ammonia and CO₂)

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Issue #25

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Focus: NatRefs vs. HFOs

Distribution at ATMosphere America, June 5-7

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Issue #26

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Focus: Accelerate America Award Winners

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Issue #27

July-August 2017

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Focus: Utilities & Incentives

Ad submission deadline: July 19

Issue #28

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Focus: Food retail: CO₂ vs. propane-Distribution at FMI Energy & Store Development Conference, Sept. 24-27
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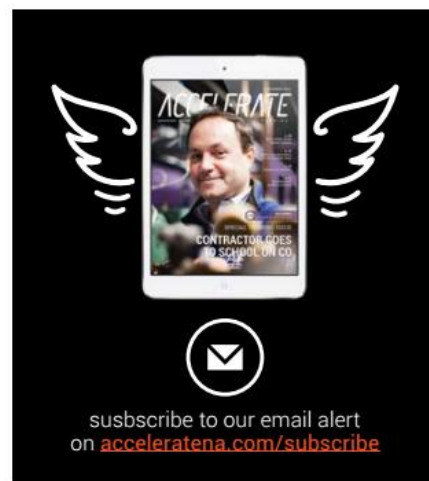
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