

JANUARY 2017

ACCELERATE

ADVANCING HVAC&R NATURALLY

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Roll Out CO₂

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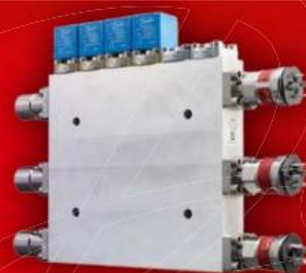
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California Dreamin'

— By Michael Garry



*“Your task is not to foresee the future,
but to enable it.”*
— Antoine de Saint-Exupéry

During the two-plus-year history of *Accelerate America*, five of our 21 cover stories have featured people or places in California, reflecting the Golden State's prominent role in the development and adoption of natural refrigerant technology in the U.S.

As the climate-science-denying Trump Administration takes the reins of power this month, the media spotlight has focused on California's importance as a champion of the environment in the absence of federal leadership. It will be up to California and like-minded states and countries to continue fighting for a sustainable planet.

In this issue's cover story ([page 46](#)) we delineate the ways California is battling climate change, not just by reducing emissions of carbon dioxide but by targeting short-lived climate pollutants (SLCPS), the other greenhouse gases that contribute mightily to global warming.

One of those SLCPS turns out to be HFC refrigerants, the fastest growing green-

house gas, much of which consists of fugitive emissions from refrigeration and air-conditioning systems. Cutting down on those and other SLCPS emissions buys the planet some time as it transitions from fossil fuels to cleaner forms of energy.

The best alternative to HFCs is the natural refrigerant technology that has gained so much traction in California ([see map, page six](#)) and is picking up speed across the country and the world.

California's Air Resources Board (CARB) has put together an ambitious plan to reduce HFC emissions in the state by 40% below 2013 levels by 2030. The plan will incorporate an HFC phase-down plan modeled on the Montreal Protocol's Kigali Amendment, as well as bans on HFCs above a certain GWP in particular applications, and an across-the-board ban on high-GWP HFCs. All of this will pave the way for more adoption of natural refrigerants, serving as a model for other states and regions.

Another force behind natural refrigerant technology in California is its utility sector, particularly Southern California Edison. SCE is engaged in a wide range of projects intended to make energy incentives available to users of natural refrigerant equipment, modeling how utilities across the country can take similar steps.

California is not the only state making moves to protect the environment. Like California, New York plans to cut overall greenhouse gas emissions to 40% below 1990 levels by 2030. New York and eight other Eastern states belong to the Regional Greenhouse Gas Initiative (RGGI), which has a cap-and-trade system for emissions generated by power plants.

Meanwhile our neighbors to the north, Canada, has proposed an HFC reduction plan and intends to apply carbon pricing next year. ([See page 30.](#))

But all eyes will be on the Golden State. Join us there at ATMOSphere America, scheduled for June 5-7 in San Diego.



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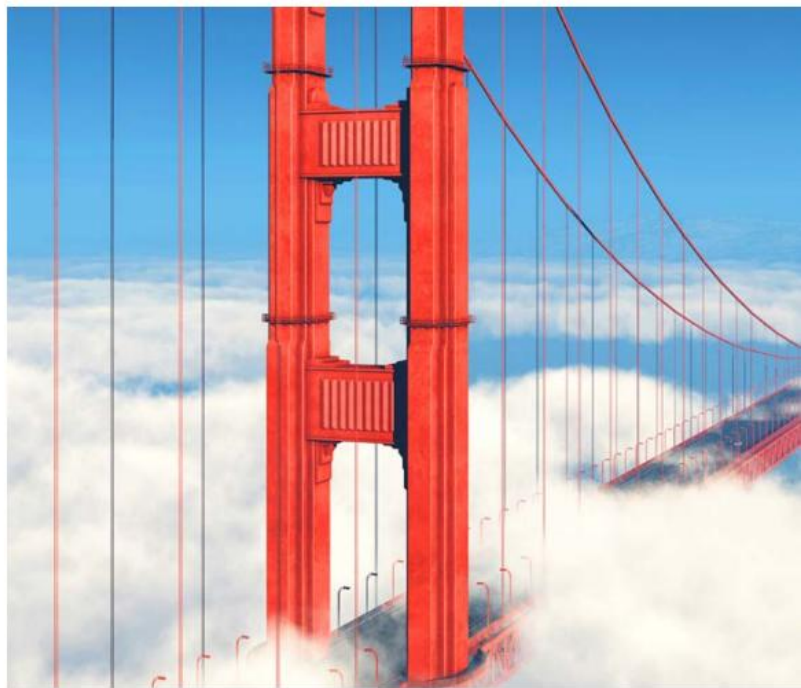
ACCELERATE

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.

<http://acceleratenas.com>

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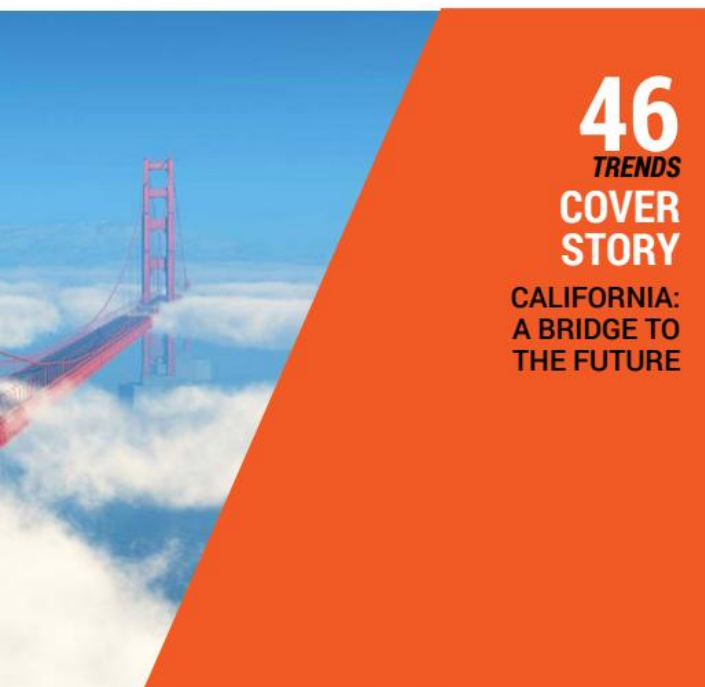
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Types of installations:

- Ammonia/CO2
- Transcritical CO2
- Propane/CO2
- Low-Charge Ammonia

End Users**WFM** - Whole Foods Market**365** - 365 by Whole Foods Market**A** - Albertsons**I** - Imuraya**BCS** - Baker Cold Storage**LL** - Lineage Logistics**NF** - Neptune Foods**USCS** - US Cold Storage**LACS** - LA Cold Storage

NATURAL REFRIGERANT INSTALLATIONS in California





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 ATMosphere - Natural Refrigerants Faster to Market

Accelerate America Opens Awards Program



To be presented at ATMOsphere America 2017, the awards will recognize end-user companies in food retail, foodservice and industrial refrigeration, Innovation of the Year and Person of the Year

Accelerate America is pleased to open the nominating process for its annual awards program, which recognizes companies and individuals doing the most to drive adoption of natural refrigerants over the past year.

The awards are divided into three categories: Best in Sector, Person of the Year, and Innovation of the Year. The awards will be presented at ATMOsphere America 2017, to be held June 5-7 in San Diego. The winning companies and the Person of the Year will be profiled in the June 2017 issue of *Accelerate America*.

A Best in Sector award will go to one end-user company in each of three sectors – food retail, foodservice and industrial – that has gone above and beyond in advancing the adoption of natural refrigerant technologies in HVAC&R applications in the previous 12 months.

Criteria for assessing nominated companies will include:

- ▶ Number of installations of natural refrigerant systems
- ▶ Energy efficiency of equipment
- ▶ Reduction in greenhouse gas emissions
- ▶ A business case encompassing capital, installation, operation, maintenance and training, and a return on investment
- ▶ Commitment to future natural-refrigerant installations
- ▶ Industry leadership
- ▶ Innovation and perseverance

The Person of the Year Award will honor a single individual who has forged new pathways for natural refrigerants – someone without whom the natural refrigerants business in North America

would be much less developed than it is. This award is open to any individual, including end users, manufacturers, policy makers, academics and researchers.

Criteria for assessing nominated individuals will include:

- ▶ Impact on development and/or implementation of natural-refrigerant systems
- ▶ Leadership in organization as well as the industry
- ▶ Innovation and perseverance

The Innovation of the Year award will go to a company that developed a particular technology having a significant impact on the market.

The nominating process for the awards will remain open through March 30. Nominations may be submitted by end users, manufacturers, contractors, consultants, academics, policy makers and others involved with HVAC&R applications using natural refrigerants; companies and individuals may nominate themselves. Nominations, which should cite a particular category of award and include details supporting the company or person nominated, can be emailed to: michael.garry@shecco.com.

The awards program was launched in 2016. The winners of the 2016 awards were: Marc-André Lesmiersies of Carnot Refrigeration (Person of the Year), Sobey's (Food Retail), Red Bull (Foodservice), Campbell Soup (Industrial) and True Manufacturing (Innovation of the Year). See, [*"The Best & The Brightest," Accelerate America, July-August 2016.*](#) ■ MG

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- **01** January 22-24, San Francisco, Calif.
Winter Fancy Food Show
www: <https://www.specialtyfood.com/shows-events/winter-fancy-food-show/>
twitter: #WFFS17 , #specialtyfoods @craftcarejoy
- **02** January 24-26, Myrtle Beach, S.C.
41st Annual Hotel, Motel & Restaurant Supply Show Of The Southeast (HMRSSS)
www: <http://www.hmrsss.com/>
twitter: #HMRSSS @HMRSSS
- **03** January 28- February 1, Las Vegas, Nev.
ASHRAE Winter Meeting
www: <https://www.ashrae.org/membership--conferences/conferences/2017-ashrae-winter-conference>
- **04** January 29-30, Columbus, Ohio
Mid-America Restaurant Expo
www: http://www.midamericarestaurantexpo.com/aws/MARX/pt/sp/home_page
twitter: @MidAmResExpo
- **05** January 29-31, Las Vegas, Nev.
BITAC Food & Beverage 2017
www: <http://www.bitac.net/Event/FoodBeverage/2017>
- **06** January 30- February 1, Las Vegas, Nev.
AHR Expo 2017
www: <http://ahrexpo.com/>
twitter: #AHRExpo @ahrexpo
- **07** January 30- February 1, Las Vegas, Nev.
IAQA 20th Annual Meeting
www: <http://www.iaqa.org/annual-meeting/>
twitter: @IAQAssociation
- **08** January 31- February 2, Atlanta, Ga.
International Production & Processing Expo
www: <http://ippexpo.com/>
- **09** February 4, Long Beach, Calif.
FLOW EXPO
www: <http://www.flowexpousa.com/>
twitter: #flowexpousa @flowexpo
- **10** February 5-9, New Orleans, La.
CTI 2017 Annual Conference
www: <http://www.cti.org/meeting.php>
- **11** February 9-11, Orlando, Fla.
NAFEM Show
www: <https://www.thenafemshow.org/>
- **12** February 12-15, Orlando, Fla.
Retail Supply Chain Conference 2017
www: <https://www.rila.org/events/conferences/supplychain/Pages/default.aspx>
twitter: #RILASupplyChain @RILAtweets
- **13** February 12-15, Las Vegas, Nev.
The NGA Show 2017
www: <http://www.thengashow.com/>
twitter: @NationalGrocers
- **14** February 13-15, Orlando, Fla.
Convenience Distribution Marketplace
www: <https://cdaweb.net/Events/Marketplace2017.aspx>
twitter: @CDA_01
- **15** February 13-17, Charlotte, N.C.
Industrial Refrigeration Workshop
www: <http://conferences.k-state.edu/industrial-refrig/>
- **16** February 20-22, Austin, Texas
Smart Energy Summit
www: <https://www.parksassociates.com/events/smart-energy-summit>
twitter: #SmartEnergy17 @SmartEnergySmt
- **17** February 20-22, Duluth, Minn.
2017 Energy Design Conference & Expo (EDC)
www: <http://www.duluthenergydesign.com/>
- **18** February 22-24, Washington, D.C.
USBevX 2017 - U.S. Wine & Beverage Expo
www: <http://www.usbevexpo.com/>
twitter: @USBevX
- **19** February 26- March 1, San Antonio, Texas
IIAR Natural Refrigeration Conference and Expo
www: https://www.iiar.org/IIAR/WCM/Events/Annual_Conference
- **20** February 27- March 2, Toronto, Ont.
15th Cold Chain GDP & Temperature Management Logistics Summit
www: <https://www.coldchainpharm.com/>

EVENTS GUIDE

March 2017



- **01** March 5-7, New York, N.Y.
The International Restaurant & Foodservice Show of New York
web: <http://www.internationalrestaurantny.com/16/ny-home.html>
twitter: @ECFisheriesExpo

- **02** March 7-8, Henderson, Nev.
Ice Cream Technology Conference
www: <http://www.dairyfoods.com/events/1185-ice-cream-technology-conference>

- **03** March 7-9, Boston, Mass.
BuildingEnergy Boston 2017
www: <http://nesea.org/be-event/buildingenergy-boston-2017>
twitter: @NESEA_org

- **04** March 7-9, Guadalajara, Mexico
Alimentaria Mexico
www: <http://www.alimentaria-mexico.com/en/home>

- **05** March 14-16, Denver, Colo.
IGSHPA Conference & Expo
www: <http://www.igshpa.okstate.edu/conf/>

- **06** March 19-21, Boston, Mass.
Seafood Expo North America / Seafood Processing North America
www: <http://www.seafoodexpo.com/north-america/>

- **07** March 20-22, Nashville, Tenn.
IE3 show: Indoor Environment & Energy Expo
www: <http://www.ie3show.com/>

- **08** March 21-22, Washington, D.C.
AHRI: Air-conditioning, Heating & Refrigeration Institute Public Policy Symposium
www: <http://www.ahrinet.org/News-Events/Meetings-and-Events.aspx>

- **09** March 27-29, Orlando, Fla.
2017 National HVACR Educators and Trainers Conference
www: <https://www.escogroup.org/hvac/nhetc/>

KYSOR / WARREN

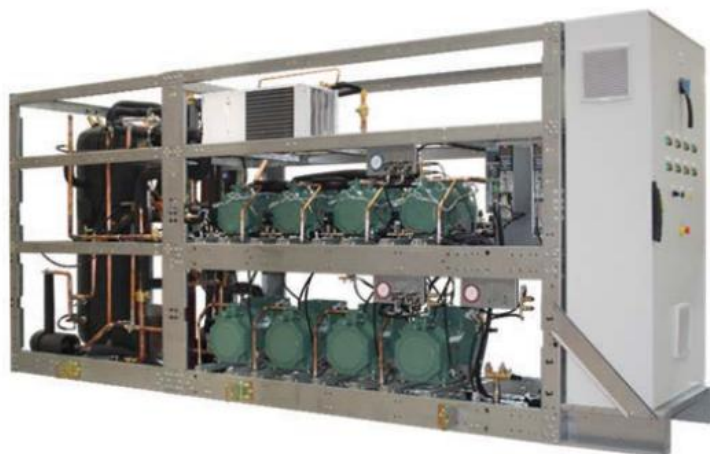
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In Brief / B

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Ammonia CO2 Cascade

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KYSOR / WARREN

www.kysorwarren.com



IN BRIEF

CO₂

MAJA UNVEILS HYBRID FLAKE ICE MAKER

OMAHA, Neb. — MAJA, a German manufacturer of flake ice machines, has launched a "hybrid" unit that allows an end user such as a supermarket to initially use an HFC refrigerant but ultimately transition to CO₂. MAJA makes CO₂-only ice machines with evaporators that link to commercial CO₂ refrigeration racks. The new machine (RVH-CO₂ HYBRID) is the first that accommodates either R404A or CO₂. "It's a solution for customers who can't invest in a CO₂ refrigeration rack at the moment, but can switch over in two years," said Joachim Schelb, global sales director, MAJA. More information at: <http://bit.ly/2jJFq5f>

AMMONIA

IIAR CONFERENCE RUNS FEB. 26-MARCH 1

SAN ANTONIO, Texas — IIAR will hold the Annual IIAR Natural Refrigeration Conference & Heavy Equipment Expo (previously called the IIAR Industrial Refrigeration Conference & Exhibition) February 26 to March 1 at the Henry B. Gonzalez Convention Center in San Antonio, Texas. The Technical Program includes "Applying NH₃ Design Principles to CO₂ systems" and "Study of the Energy Consumption of CO₂/NH₃ Cascade Industrial Refrigeration Systems Operating in Costa Rica and Comparison with Direct Ammonia Systems in One- and Two-Stage Configurations." More information at: <http://bit.ly/2jbQoBk>

HYDROCARBONS

TARGET USES PROPANE CASES IN 580 STORES

MINNEAPOLIS, Minn. — U.S. discount Target Corp., which has made a commitment to installing self-contained cases using propane as the refrigerant, now has them in 580 of its more than 1,800 stores throughout the United States, according to Paul Anderson, Target's director of engineering. In 2017, Target plans to operate some stores that use nothing but propane cases for refrigeration, Anderson said. More information at: <http://bit.ly/2ixg78D>

CO₂

ADVANSOR DEDICATES TEAM TO INDUSTRIAL SECTOR

AARHUS, Denmark — Hillphoenix subsidiary Advansor, a manufacturer of transcritical CO₂ refrigeration systems, has dedicated a team to the industrial sector that is separate from its traditional commercial refrigeration team, said Mark Kristensen, industrial sales manager. "We've realized that the demand for transcritical [in the industrial sector] has grown to the level where we can go in that direction," he said in an interview with *Accelerate America*. More information at: <http://bit.ly/2jj3vDy>

AMMONIA

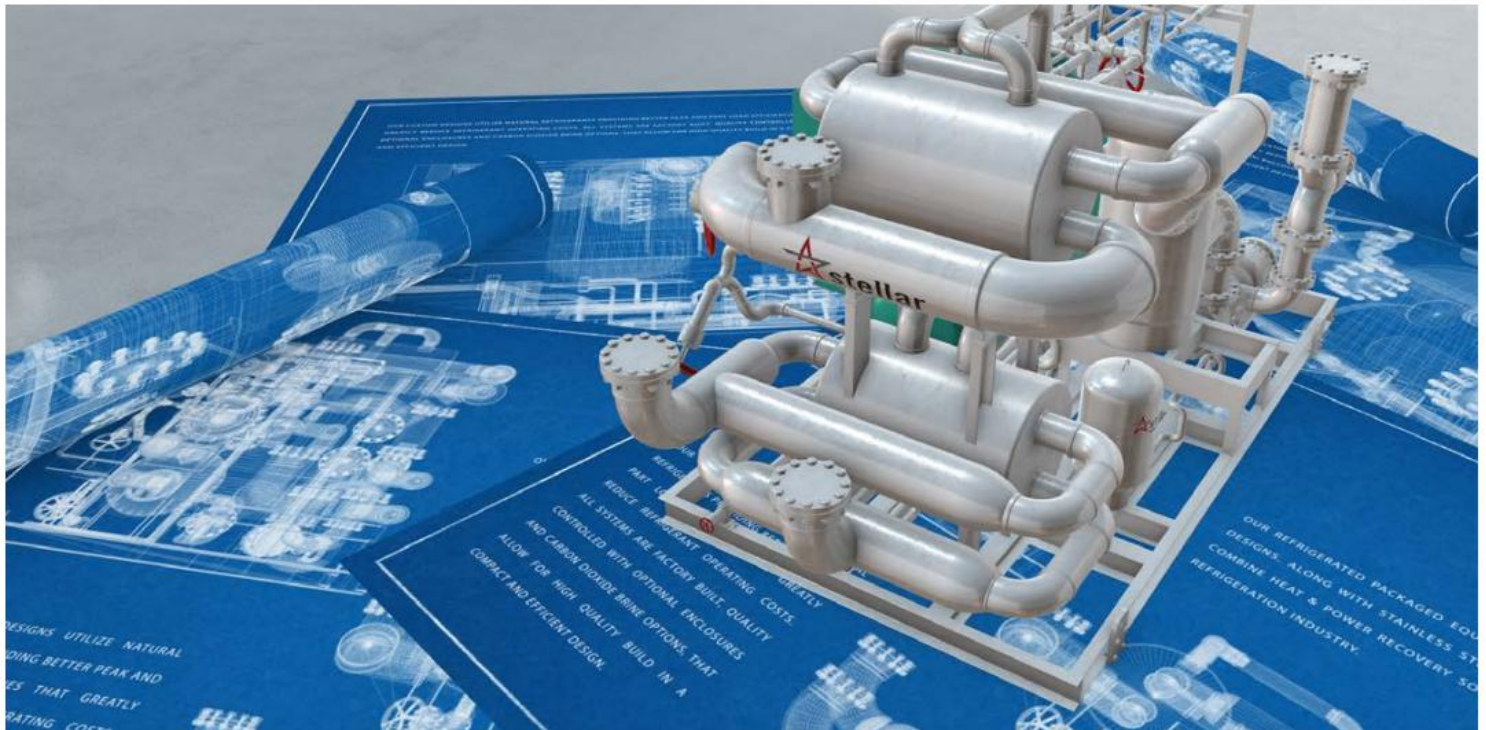
BITZER DEBUTS SEPARATOR FOR SCREW COMPRESSORS

FLOWERY BRANCH, Ga. — Compressor manufacturer Bitzer has launched a horizontal oil separator designed to work with ammonia screw compressors, part of its OS compressor series. The OAH horizontal separators are a new family of 3-step separators for NH₃ applications up to 4200 m³/h (compressor theoretical displacement). They can be connected to several open screw compressors in parallel. Bitzer is currently researching oil separation solutions for applications using other natural refrigerants. More information at: <http://bit.ly/2iU20x6>

HYDROCARBONS

FLAMMABILITY RESEARCH GOES FORWARD

QUINCY, Mass. — Having secured sufficient financing via a fund-raising effort, the Fire Protection Research Foundation is proceeding with a research project aimed at evaluating the fire hazard posed by ASHRAE Class A3 (flammable) refrigerants. The \$170,000 project, expected to be completed in June 2017, would lay the groundwork for increasing the 150g federal charge limit on hydrocarbon refrigerants in the U.S. Target Corp. is a co-leader of the project. More information at: <http://bit.ly/2jldZCL>



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Natural Selection

Refrigeration systems continue to evolve toward natural refrigerants as a sustainable and future-proof alternative to synthetics

Part One of a Series

— By André Patenaude

The food retail, foodservice and industrial cooling industries are in the midst of a momentous transition in their refrigeration system architectures.

In an era driven by historic regulatory activity and the necessity to deploy sustainable systems, the number of refrigeration options available to these operators seems to be growing exponentially — and with that, an equal amount of confusion about what is the best future-proof system alternative. To get to what many call the “end game” of achieving compliance and meeting corporate sustainability objectives, more businesses are looking at systems based on natural refrigerants.

The term “natural refrigerant” refers to substances that naturally occur in the environment. Unlike the synthetic refrigerants that have commonly been used in refrigeration applications — including hydrofluorocarbons (HFCs) and chlorofluorocarbons (CFCs) — ammonia (NH₃ or refrigerant name R717), propane (refrigerant name R290) and carbon dioxide (CO₂ or refrigerant name R744) are three naturally occurring refrigerants that pose very little threat to the environment.

The emergence of natural refrigerants must be looked at from a historical perspective, because in many ways it is a re-emergence. In the 1980s, scientists discovered that CFC usage was causing a hole in the ozone layer. An international treaty was quickly formed called the Montreal Protocol to phase out the use of these substances. However, in recent years, the HFCs that succeeded CFCs were found to be a significant source of global warming. As a result, the environmental impacts of refrigerants are measured by these two key factors: global warming potential (GWP) and ozone depletion potential (ODP).

While new synthetic refrigerants are being developed that offer lower GWP and no threat to the ozone layer, many of these are either largely untested or yet to be deemed as acceptable substitutes by global environmental regulations, such as those set forth by the U.S. Environmental Protection Agency (EPA). In contrast, natural refrigerants are not only the benchmark for ultra-low GWP and ODP, they’re also acceptable for use in most refrigeration applications (subject to use conditions).

KNOW YOUR NATURALS

Ammonia

Ammonia was among the first refrigerants used in refrigeration applications. While its superior thermodynamic properties made it a logical first choice for early refrigeration systems, its toxicity requires the careful adherence to safe application procedures to ensure operator and customer well-being.

With the advent of CFC refrigerants in the mid-20th century, the refrigeration industry moved away from R717 in favor of lower-risk synthetic alternatives that offered comparable performance characteristics. Even so, ammonia’s suitability in low-temperature applications has made it a mainstay in industrial, process cooling, cold storage and ice rink applications.

Propane

Propane is a hydrocarbon that was also identified in the early days of refrigeration as an effective refrigerant. Its high-capacity, energy-efficient performance and very low GWP are offset by

Natural Refrigerant Synopsis

NATURAL REFRIGERANT	GWP	ODP	SPECIAL CONSIDERATIONS	SYSTEM TRENDS
Ammonia (R717)	0	0	• Potentially toxic • Slightly flammable	• Very low charge applications • Used in the high stage to absorb heat and/or cool R744 • Far removed from occupied spaces
Carbon dioxide (R744)	1	0	• High pressure • Low critical temperature • High triple point	• Very little danger to occupants in the event of leaks • Used in medium and low stages • Pumped into fixtures used in occupied spaces, rather than R717
Propane (R290)	3	0	• Highly flammable	• Very low charge requirements (currently 150 grams max)

its classification as an A3 (highly flammable) substance. But as synthetic refrigerants became available for many refrigeration applications, R290 was largely abandoned in lieu of its CFC-based counterparts.

Since the 2000s, R290 has been regaining global popularity as a lower-GWP, effective alternative to HFCs like R404A and R134a — especially in a wide range of low-charge, reach-in displays.

Carbon dioxide

CO₂ is non-toxic and has proved to be a very effective alternative to HFCs in both low- and medium-temperature applications. CO₂-based refrigeration systems have been successfully deployed in commercial and industrial applications in Europe for nearly two decades.

Because of its low critical point and high operating pressure (around 1,500 psig or 103 bar), CO₂ refrigeration strategies — such as cascade, secondary and transcritical booster — must be designed to account for its unique characteristics. In light of current environmental regulations, the popularity of these systems has increased significantly in North America in recent years.

When reviewing the brief application history of these refrigerants and their synthetic counterparts, it's apparent that the search for the perfect refrigerant is an ongoing quest. It's important to keep this in mind when evaluating natural refrigerants. Yes, efforts are needed to mitigate their associated risks and ensure their safe use, but natural refrigerants represent true sustainable alternatives without sacrificing performance.

NECESSITY IS THE MOTHER OF INVENTION

Today, the use of natural refrigerants is on the rise. Companies are taking a fresh look at them to achieve their sustainability objectives, whether that's complying with environmental regulations or aligning with their customers' green sensibilities.

As technology continues to improve, equipment manufacturers are working closely with these forward-thinking companies to develop innovative solutions. This has resulted in several creative natural refrigeration applications that belie their traditional uses — like ammonia being used in supermarket systems and CO₂ playing a larger role in industrial process cooling.

Ammonia trials in food retail

In September 2015, the Piggly Wiggly supermarket company opened a new 36,000-square-foot store in Columbus, Ga., that utilizes an NH₃/CO₂ cascade system manufactured by Heatcraft Worldwide Refrigeration. The all-natural refrigerant system uses an ultra-low charge of ammonia (53 lbs.) located on the facility's roof. The ammonia condenses the CO₂, which is circulated to the store's low-temperature cases via direct expansion; the medium-temperature circuit is cooled by a CO₂ liquid pump overfeed.

Since the total refrigerant charge of the system has a GWP under 150, this store is one of 10 supermarkets in the U.S. to receive the highest certification level (platinum) from the EPA's GreenChill Partnership. It's also only the fourth supermarket in the U.S. to use this NH₃/CO₂ cascade architecture.

“When major retailers like Target publicly announce their intentions to use only propane in their self-contained units, it’s an indication that the perceptions about the mainstream viability of R290 are shifting.”

▶ In its first six full months of operation, this store consumed 28.5% less energy than a conventional outlet, translating into reduced energy costs of \$33,170. The use of natural refrigerants also offsets the rising costs of traditional synthetic HFCs, which will only continue to rise as supplies dwindle. While the system does come in at a higher initial cost than a conventional system, the energy savings combined with the lower refrigerant costs for the life cycle will likely result in a lower total cost of ownership. And with the growing number of utility incentives available for green technology, there will also be opportunities to mitigate these first costs.

From a safety perspective, it’s important to point out that this ultra-low charge of ammonia never comes into proximity with staff or customers in the store’s occupied space. A safety study performed by Heatcraft confirmed that there was no identified risk in the event of a catastrophic leak of the small 53 lbs. of charge.

CO₂ adoption in industrial cooling

In cold storage applications, where ammonia has been the preferred refrigerant for decades, companies are also seeking to lower ammonia charges. As older ammonia systems near replacement, many operators are evaluating the best option to expand their facility’s low-temperature capabilities. They’re accomplishing both objectives by adopting NH₃/CO₂ cascade systems that not only utilize very low charges of ammonia, but also keep the R717 circuit out of occupied spaces. There’s also a regulatory driver behind this trend.

To ensure the safety of systems that require more than 10,000 pounds of ammonia, the Occupational Safety and Health Association (OSHA) created the Process Safety Management of Highly Hazardous Chemicals standard. In recent years, these systems have been subject to rigorous inspections enforced by OSHA’s National Emphasis Program (NEP) on process safety management regulated industries. For owners and operators of these large ammonia systems, this means the added responsibility — and expense — of continuous record-keeping in preparation for NEP inspections.

Propane in food retail

When major retailers like Target publicly announces their intention to use only propane in their self-contained units, it’s an indication that the perceptions about the mainstream viability of R290 are shifting. The smaller charge limits make R290 a logical fit for Target’s smaller, stand-alone refrigerated display cases and coolers. All of this is part of the retailer’s pledge to become a sustainability leader in the food retail space.

In making this shift, Target has also asked contractors who might be working on the propane-based equipment to seek the necessary training. Over the next six months, Target plans on opening a few stores that will use only stand-alone propane systems.

NEW ARTICLE SERIES

Sustainability objectives, first costs, energy efficiency, safety, maintenance requirements and regulatory compliance: there are myriad factors to consider when choosing a modern refrigeration system — often eliciting conflicting opinions among decision makers within an organization.

To help your organization wade through the confusion and make these difficult decisions, I’ll be authoring an article series over the next several months that will look at the potential of natural refrigerants in modern refrigeration equipment.

This informative series will start next month by focusing on R290, taking a closer look at its applications in small, stand-alone systems and other emerging architectures. Then, we’ll work our way to increasingly larger retail and industrial architectures — all the while keeping you updated on the latest regulatory changes and sustainability drivers shaping this dynamic refrigeration landscape. ■ AP

André Patenaude is director - CO₂ business development, Emerson Commercial and Residential Solutions (which now incorporates Emerson Climate Technologies). He was selected last year as one of Accelerate America’s 25 Movers & Shakers driving adoption of natural refrigerants.

“To get to what many call the ‘end game’ of achieving compliance and meeting corporate sustainability objectives, more businesses are looking at systems based on natural refrigerants.”

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Will the Trump Administration be a Wet Blanket for Natural Refrigerants?

The new president's positions on climate change and regulatory reform raise concerns, but the growing demand for natural refrigerants worldwide as a replacement for HFCs should continue

— By Mark Menzer and James Knudsen



James Knudsen, Danfoss

In recent times, the trend towards more sustainable air conditioning and refrigeration equipment has been steady and even accelerating. Department of Energy (DOE) and Environmental Protection Agency (EPA) regulations have helped drive refrigeration equipment towards higher efficiencies using low-GWP (global warming potential) refrigerants. World-wide acceptance of the Kigali Amendment to the Montreal Protocol, which set a global schedule for an HFC phase-down, seemed to seal the deal.

But few predicted the sea change of politics in Washington taking place with the election of Donald J. Trump. Will the move to natural refrigerants be slowed or even reversed in the coming years? Although the political winds have changed, there are reasons to be optimistic that the momentum achieved in phasing down the use of high-GWP refrigerants will continue.

There are also reasons for concern. The Obama policy engine that pushed for carbon reductions, energy efficiency, and movement to low-GWP gases is being replaced by an EPA administrator, Scott Pruitt, who questions the effects that humans have on climate change, and by a DOE secretary, Rick Perry, whose stated goal is to eliminate the department he was appointed to lead. Ominous, indeed, for those working to promote the use of efficient, climate-friendly refrigerants. Further, some of the climate change initiatives were accomplished by unilateral executive orders, some of which can be almost as easily undone by the new president.

One thing that hasn't changed is the continuing, mounting evidence of human-induced climate change. Adding to the abundance of existing evidence, NASA recently reported that each of the first six months of 2016 set a record as the warmest respective month globally on record.

“The SNAP program has brought a degree of certainty for refrigerant manufacturers, equipment manufacturers and end users alike and has helped them solidify their long-term plans.”

Nor have the laws of physics changed. Natural refrigerants still exhibit excellent thermodynamic and low-GWP properties that were the reason for their consideration in the first place. Ammonia, propane, isobutane and CO₂ exhibit high performance in many refrigeration and space-cooling applications.

THE ROLE OF GOVERNMENT

But before we get too crazy about the changes inside the Beltway, how important has the federal government's role been in the push for naturals, anyway?

Certainly, it has been a factor. The EPA's Significant New Alternatives Policy (SNAP), has provided consistent leadership in listing and delisting refrigerants for certain uses. In December, the EPA published its SNAP rule allowing propane use in ice machines, water coolers and very-low-temperature refrigeration equipment.

While not all of the EPA's decisions have been met with universal approval, the SNAP program has brought a degree of certainty for refrigerant manufacturers, equipment manufacturers and end users alike and has helped them solidify their long-term plans, which are necessary, particularly since the investments needed are large. Federal leadership also discourages individual states from developing their own, perhaps conflicting, phase-out schedules.

But other recent events at the international level also point to the significant momentum that natural refrigerants enjoy. These include the Kigali Amendment and the European Union's call for removal of barriers to more climate-friendly refrigerants like naturals. At a regional level, the California Air Resources Board (CARB) is recommending a ban on refrigerants with a GWP of 150 or greater in new non-residential and residential refrigeration.

Moreover, activities in the private sector have been critical as well. By now, any follower of the natural refrigerants movement has heard of the success in the commercial sector: Whole Foods Market's propane/CO₂ cascade system in Santa Clara, Calif.; Target's use of self-contained propane cases that consume 53% less energy than R134a units, and Sobeys' installment of over 80 transcritical CO₂ systems in Canada, to name just a few examples.

In part, food retailers are implementing environmental initiatives like natural refrigerant systems in response to consumer trends. As one grocer notes in its annual report, sales are being driven by “a highly influential younger generation that values ... sustainability.”

To attract these shoppers, every major grocer reports on its sustainability activities, many of which revolve around refrigeration and air conditioning.

Supporting this trend, equipment manufacturers continue to offer growing lines of products using natural refrigerants. The number of hydrocarbon refrigerators and freezers worldwide is now over 1.5 billion!

Challenges, of course, remain. At this early stage in their development, natural refrigerant systems used in commercial refrigeration still carry a cost premium. But there has been major progress on this front; with the continued development of technology and increases in sales volume, both investment costs and operational costs of these systems continue to decline. In fact, in European food retail markets, natural refrigerant systems now cost the same as, or less than, HFC systems.

Safety standards and building codes, which are conservative by nature, still allow only small quantities of flammable natural



Mark Menzer, Danfoss

▶ refrigerants to be used in equipment. However, as end users gain experience using these refrigerants safely, some of those restrictions will undoubtedly be loosened. The shortage of technicians trained to work with natural refrigerants in a safe manner offers another challenge. But again, as more equipment becomes available, the number of trained service people should increase.

On balance, the opportunities for natural refrigerant systems are more numerous than the challenges. Maybe the biggest bright spot is the ongoing momentum and growing demand for the technology, which is causing all leading equipment manufacturers to offer a line using natural refrigerants. These products meet today's and tomorrow's efficiency and GWP regulations.

RATIFY THE KIGALI AMENDMENT

Recognizing these advantages and the need for certainty in planning for the future, the HVAC&R industry will seek from the Trump Administration and Congress continuing federal leadership in the HFC phase-down. This includes ratifying the Kigali Amendment – a position taken by the HVACR Industry Alliance – and continuing to use the SNAP program to phase out the use of HFCs in many applications. Adhering to the same phase-down schedule as the rest of the world will allow U.S. companies to maintain their global competitiveness.

This last item is particularly important, since manufacturers are served well when they can satisfy a global market with similar equipment. It minimizes costs, makes those markets attractive and quickens the pace of adoption of new technologies. If the U.S. were to adopt a phase-down schedule different from that of the Kigali Amendment, manufacturers' costs would rise and so would the price of new equipment.

While the incoming administration has been vocal with regard to climate change and regulations in general, they have a very demanding agenda that includes immigration reform, infrastructure improvements, health care reform, and trade. All of these items are contentious and will require focused resources from the White House. It would be difficult to imagine that changes in the EPA's refrigerant regulations will be a top priority – especially considering the general agreement domestically, internationally, and within the industry to continue the phase-down of HFCs.

But this is a time for action for the U.S. Senate, which should ratify the Kigali Amendment to the Montreal Protocol so that the U.S. can remain a leader in employing new refrigerant technologies. Industry

“This is a time for action for the U.S. Senate, which should ratify the Kigali Amendment to the Montreal Protocol so that the U.S. can remain a leader in employing new refrigerant technologies.”

players need to let their elected representatives know that the Kigali Amendment and the EPA SNAP rules enable companies to plan ahead with certainty, make investments in new low-GWP technology, and become global leaders in HVACR.

The bottom line is this: There is a growing market demand for low-GWP refrigerants. While initially fueled by government phase-downs, this demand is now due to market pull. Any equipment manufacturer would rather sell to a willing buyer than to one who is just complying with regulations. It is this prospect that keeps us optimistic about the future of natural refrigerants – for the next four years and beyond. ■ JK & MM

James Knudsen is North American segment leader for food retail at Danfoss. He joined Danfoss in September 2015 after a long career in the refrigeration business and other segments. In 2016, he was named one of Accelerate America's 25 Movers & Shakers driving natural refrigerant adoption in North America.

Mark Menzer is director of public affairs for Danfoss. In this position, he works with representatives from government, industry and other stakeholders to further the development of HVAC&R technologies.

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INNOVATION

What's in Store for 2017?

Here are some previews from two end users and five OEMs about natural refrigerant developments expected this year



Mike Lynch

MIKE LYNCH

Vice President - Engineering, United States Cold Storage

United States Cold Storage has led the cold storage industry in the installation of NH_3/CO_2 cascade systems, now operating 12 of its 36 plants with the technology. Lynch provided the following look ahead:

"In 2017, I will continue to help drive and support sustainability-development initiatives within United States Cold Storage. The use of natural refrigerants, such as ammonia and carbon dioxide, when used in a cascade refrigeration system, allows my company to operate very safe and highly efficient refrigeration systems. We expect to bring another two to three new NH_3/CO_2 cascade refrigeration systems on line in 2017. This will not only drive down our carbon footprint but also lower our inventories of anhydrous ammonia, making our warehouses safer for our employees, customers and the communities in which we operate."

HARRISON HORNING

Director of Energy & Facility Services, Hannaford Supermarkets

Hannaford Supermarkets installed the first transcritical CO_2 system in a U.S. supermarket in Turner, Maine, in July 2013, and followed with a transcritical store in North Berwick, Maine in 2015. According to Horning, in 2017 Hannaford plans to replace an old R22 system and display cases with a new transcritical CO_2 system and new display cases in an existing Hannaford supermarket in Raymond, N.H., its first retrofit project. The chain will also expand the use of R290 display cases in Hannaford stores.

SCOTT MARTIN

Director of Sustainable Technologies,
Refrigeration Systems Division, Hillphoenix

Hillphoenix, the refrigeration OEM based in Conyers, Ga., finished 2016 having manufactured 250 transcritical CO_2 racks over the past three years, including at least 75 in 2016 alone. According to



Harrison Horning



Scott Martin



John Scherer

Martin, Hillphoenix anticipates that the pace of market growth for transcritical systems experienced in 2016 will continue in 2017.

JOHN SCHERER

Chief Technology Officer, NXCOLD

NXCOLD has installed low-charge packaged ammonia refrigeration systems at Los Angeles Cold Storage, Lineage Logistics, Baker Cold Storage and Neptune Foods. Here's Scherer's take on what's coming in 2017 for natural refrigerants:

"End users are becoming aware of 'sweet spots' for natural refrigerant system types in most applications. In broad strokes and in no particular order, these include:

- ▶ "Low-charge ammonia and ammonia/ CO_2 cascade systems for large cold storage and food distribution operations. This also applies to many supermarket applications.
- ▶ "A number of manufacturers are developing ammonia chiller systems for a range of purposes, including 1,000-sq.-ft. produce rooms as well as office air conditioning units where each chiller can handle 500,000 sq. ft. or better. In these chillers, pumped CO_2 volatile brine is proving suitable for a great number of large and small applications.
- ▶ "Transcritical (and non-transcritical) CO_2 systems typically work well in northern latitudes for supermarkets and, soon, convenience stores. With heat recovery, CO_2 territories will expand to most latitudes.
- ▶ "Hydrocarbons are performing almost flawlessly in smaller display case and related applications. More hydrocarbon applications are coming.

"I estimate that in 2017 North America and Latin America will see several hundred of the medium- to large-size systems installed. Smaller hydrocarbon systems will go in around the world by the thousands in 2017."



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Heatcraft is marketing transcritical CO₂ and ammonia/CO₂ cascade systems. Ali looks at the political climate in 2017:

"The market for natural refrigerants in North America will continue to see growth, despite lack of incentives/regulations. There will be a lull for some time in the U.S. till the new administration's Environmental Protection Agency (EPA) sets its direction. In the meantime, I guess that California will continue to push for reductions in greenhouse gas emissions, and there will most likely be pressure on the EPA not to make drastic changes to the policy implemented by the previous administration.

"Even if we assume, under rare circumstances, that the new administration will change the EPA policy (by applying brakes or through a reversal of decisions), I do not see any impact to the growth of natural refrigerants that has been taking place, as the retailers who are implementing natural refrigerant technology were doing so on a voluntary basis.

"Even though in 2017 natural refrigerants may not be mainstream technology, it will continue to evoke interest from retailers for field trials, and continue to be adopted by those who are already implementing the technology."

JEFFREY GINGRAS

President, Systems LMP

Systems LMP has distinguished itself in the marketplace with a transcritical system that uses mechanical subcooling to operate more efficiently in warmer climates. Here's Gingras's take on 2017:

"The upcoming year should be a particularly interesting one for natural refrigerant technology on the Canadian front, due in part to the Prime Minister's recent announcement (October 2016) that all provinces would need to establish a cap-and-trade system or set a price on carbon pollution that meets the federal 'floor price.' The government's proposed price per ton of

carbon dioxide pollution is \$10 in 2018, climbing to \$50 per ton in 2022. This will no doubt have a significantly positive impact on the Canadian market as we prepare for this change.

"I expect the American market will continue to flourish, particularly in the retrofitting of existing supermarket or warehouses systems, in warmer climates especially. We are working diligently with our partners at Hussmann to develop innovative technologies that meet these challenges and to train our installers accordingly to ensure that we are ready for the inevitable rise in demand.

"Systems LMP presently has 90 transcritical installations in North America and many more scheduled for 2017.

"As people become increasingly aware of natural refrigerants and their indisputable benefits, demand will skyrocket. I am convinced that 2017 will be a breakout year for natural refrigerants and for Systems LMP"

KURT LIEBENDORFER

Vice President, Evapco

Evapco's first low-charge packaged ammonia systems, called Evapcold, were installed last year on the rooftop of Western Gateway Storage in Ogden, Utah. Liebendorfer expects more installations this year.

"I expect the pace of adoption and application of natural refrigerant technologies will quicken in 2017.

"Owners and contractors are rapidly learning about the success of recent low-charge ammonia projects and their inherent benefits. Evapco closed out 2016 with new orders for the Evapcold low-charge ammonia systems and a robust list of active projects in development.

"We also come into 2017 with new products that are part of the growing Evapcold family of products. We anticipate this combination to create a breakout year for Evapcold and we're working hard on a new contractor training program to support this growth."



Masood Ali



Jeffrey Gingras



Kurt Liebendorfer

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EPA Releases Final RMP Rule

The Obama administration rule updates safety regulations for large-charge ammonia refrigeration under the Risk Management Program – but will Trump reverse it?

– By Michael Garry

U.S. cold storage and food processing facilities using at least 10,000 lbs. of ammonia in refrigeration processes will be subject to new regulations in 2017 under the Environmental Protection Agency's final rule amending its Risk Management Program (RMP), issued in late December. It goes into effect March 14.

The new rule, designed to improve safety at facilities that use hazardous chemicals, came about as a result of the Obama administration's Executive Order 13650, issued in August 2013 in response to a catastrophic explosion at a Texas fertilizer facility earlier that year. It expands upon previous RMP regulations, which include submitting a document called a risk management plan to the EPA outlining a facility's safety program.

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; this enables them to be held to the EPA's less restrictive General Duty Clause.

According to a questions-and-answer document on the RMP final rule issued online by the EPA, the new rule covers three broad areas: ensuring that local responders and community residents are prepared for an accident; preventing catastrophic accidents; and third-party audits. In a preliminary version of the rule, the EPA states that it "believes that revisions [of RMP regulations] could further protect human health and the environment from chemical hazards through advancement of process safety management based on lessons learned."

However, the election of Donald Trump as U.S. president in November has led to speculation that the new administration, prodded by industry, could try to reexamine and even reverse the rule, particularly because it was released very late in Obama's presidency. "While the EPA made several improvements in the final rule, industry still has concerns over some of the provisions," said

Lowell Randel, vice president, government and legal affairs, Global Cold Chain Alliance (GCCA). "I think that some of these concerns will be communicated to the incoming administration and Congress as they consider whether, and how, to address some of the major regulations finalized during the last weeks of the Obama administration."

THIRD-PARTY AUDITS

In the industrial refrigeration industry, the most controversial part of the new rule involves third-party audits, noted Randel. The rule requires industrial refrigeration operators to use an independent third party – rather than its own internal resources – to conduct a compliance audit within a year following a reportable accident. An owner or operator must also engage a third-party auditor if the EPA determines that conditions at the facility could lead to an accidental release of a regulated substance, or if a previous third-party audit "failed to meet the competency or independence criteria specified in the rule," the document said.

The third-party audit may be conducted by "a team of auditors" led by a third-party auditor. The team may include "experts from the [facility] who understand the chemical plant design and process," thereby providing "due consideration to a facility's professional personnel involvement in the audit," the document said. The third-party requirement provision must be followed by March 14, 2021.

The final rule also increases coordination between facilities using hazardous chemicals like ammonia and Local Emergency Planning Committees (LEPCs). It requires facilities to "conduct annual coordination with LEPCs or local emergency response officials to clarify response needs, emergency plans, roles and responsibilities," said the Q&A document.

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▶ The coordination requirements “improve the information available to emergency planners and responders, making it more relevant and accessible, to help ensure responders understand the risks at the facility,” the document said. This will include one “notification exercise” per year, one “tabletop exercise” every three years and at least one “field exercise” every decade. These requirements must be followed by March 14, 2018.

In regard to preventing catastrophic accidents, the final rule requires additional reporting in investigations after any incident that “resulted in or could reasonably have resulted in a catastrophic release,” the document said. In particular, a facility must identify the fundamental reason (root cause) for the incident and prepare a report within 12 months of the incident that includes “consequences of the accident and any emergency response action taken.”

The complete final RMP rule can be accessed in the Federal Register here: <http://bit.ly/2iJ6tQg>

■ MG

“While the EPA made several improvements in the final rule, industry still has concerns over some of the provisions.”

— Lowell Randel, GCCA

DEADLINES FOR THE EPA'S NEW RMP

The baseline for the following deadlines in the EPA's new Risk Management Program (RMP) is the effective date of the rule, March 14, 2017.

ONE YEAR

Comply with emergency response coordination activities.

FOUR YEARS

Comply with third-party compliance audits, root-cause analysis as part of incident investigations, Safer Technology & Alternative Analysis (STAA), emergency-response exercises, information-availability provisions, and public meetings.

FIVE YEARS

Correct or resubmit risk management plans to reflect new and revised data elements.

IN ADDITION

Develop an emergency response program in accordance to section 68.95 within three years of determining that a facility is subject to creating that program per that section.

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CANADA

Takes On HFCs

The country aims to phase down HFC imports and cap the GWP of refrigerants allowed in specific equipment, opening the door to natural refrigerants

— By Michael Garry and Charlotte McLaughlin

Following the Kigali amendment to the Montreal Protocol in October that established a global phase down of HFC emissions, Canada's Department of the Environment (Environment and Climate Change Canada, or ECCC) followed suit with a plan of its own.

The proposed HFC plan, called "Regulations Amending the Ozone-Depleting Substances and Halocarbon Alternatives Regulations", will combine an HFC consumption phase-down with controls on specific products that contain HFCs, including refrigeration and air conditioning equipment, foams and aerosols.

According to a regulatory impact analysis published online, it is expected that the proposed HFC reduction plan would result in the elimination of 8 million metric tons of CO₂-equivalent emissions

Canada's HFC Reduction Plan

YEAR	PERCENTAGE OF BASELINE*	MAXIMUM ALLOWABLE HFC CONSUMPTION (METRIC TONS OF CO ₂ -E)
2019	90%	16,184,830
2024	65%	11,689,044
2030	30%	5,394,943
2036	15%	2,697,472

*Baseline = 17,983,144 metric tons of CO₂-e, based on average HFC consumption + 75% of HCFC consumption, 2011-2013.

Source: *Environment and Climate Change Canada*

in 2030, an estimated 3% contribution to Canada's greenhouse-gas emissions reduction target (30% below 2005 levels by 2030) under the Paris agreement. (Next year Canada plans to also include nationwide carbon pricing.)

Alongside the reduction of HFCs, the new plan assumes the adoption of low-GWP alternative refrigerants similar to those used in the U.S., including natural refrigerants in a number of applications, according to the regulatory impact analysis.

For example, Canada is assuming the adoption of propane in stand-alone refrigeration, CO₂ in large centralized refrigeration, and isobutane in domestic refrigeration. It is expected that 4,900 supermarkets would install new CO₂ systems, at an estimated incremental capital cost of approximately \$42,000 per system, between 2018 and 2040.

Canada's proposal is similar to regulatory controls implemented in the European Union and Japan, and being proposed in Australia, which include both a phase-down of HFCs and product-specific controls.

But Canada's plan contrasts somewhat with HFC-reduction efforts undertaken by the U.S. Environmental Protection Agency, which prohibits the use of specific HFCs in certain equipment but has not yet introduced an HFC phase-down program. On the other hand, California, the most populous U.S. state, is planning an HFC phase-down ([see page 46](#)), and the regulatory impact analysis expects the U.S. to implement a national phase-down as a follow-up to the Kigali accord.

Canada's proposed plan was published on November 26, 2016, in Part I of the Canada Gazette. The ECCC then amended that plan to ensure that Canada would meet its obligations under the Kigali amendment to cut HFC emissions by 85% in 2036. (See chart, this page.)

ECCC has called for a 75-day public comment period that ends on February 8, 2017. Interested parties can contact Nathalie Morin, director, Chemical Production Division, at ec.gestionhalocarbures-halocarbonsmanagement.ec@canada.ca.

Final regulations will be published in Part II of the Canada Gazette, and go into effect six months later.

"HFCs are among the most potent greenhouse gases emitted around the world," said Catherine McKenna, Minister of Environment and Climate Change Canada. "[If these measures are adopted they] will reduce emissions by the same amount as taking almost two million passenger vehicles off the road per year for 23 years."

FOCUS ON IMPORTS

Canada's efforts to reduce HFC emissions began in December 2014, when the ECCC published a Notice of Intent to regulate HFCs at the national level and align with U.S. regulatory measures as much as possible.

In June 2016, Canada announced its initial regulatory scheme, "Ozone-Depleting Substances and Halocarbon Alternatives Regulations," which went into effect December 29, 2016; it repealed and replaced "Ozone-Depleting Substances Regulations, 1998", introducing a permitting and reporting system to monitor quantities of HFCs imported, manufactured, and exported, with reporting to begin in 2018 for activities that took place in 2017.

Under its new proposal announced November 26, Canada is presenting concrete regulatory steps to limit its domestic HFC consumption. Much of the proposed regulation focuses on imports.

Because HFCs are typically not made in Canada, they are mostly imported into the country in bulk for use in the manufacture, servicing and maintenance of refrigeration and air-conditioning equipment, and in the manufacture of foam-blowing products. The reduction in HFC imports is designed to encourage manufacturers of products containing HFCs to transition away from them toward low-GWP alternatives such as natural refrigerants.

In particular, importers of bulk HFCs would receive individual consumption allowances, based on each importer's share of Canada's total HFC consumption in 2014 and 2015. They would need to cut their imports by 10% in 2019, 35% in 2024, 70% in 2030, and 85% in 2036. HFCs contained in pre-charged refrigeration and air conditioning

Canada's Proposed GWP Limits, by Product

PRODUCT	USE	DATE	MAXIMUM GWP OF REFRIGERANT
Stand-alone medium-temperature refrigeration system with internal temperature at or above 0°C.	Commercial or industrial	Jan.1 2020	700
	Residential	Jan.1 2025	150
Stand-alone low-temperature refrigeration or industrial system with internal temperature of less than 0°C but not less than -50°C.	Commercial or industrial	Jan.1 2020	1,500
	Residential	Jan.1 2025	150
Centralized refrigeration system with a capacity greater than 20 kW, maintaining an internal temperature greater than or equal to -50°C.	Commercial or industrial	Jan.1 2020	1,500
Condensing unit with a capacity less than or equal to 20 kW, maintaining an internal temperature greater than or equal to -50°C.	Commercial or industrial	Jan.1 2020	2,200
Chiller that has a compressor, an evaporator and a secondary coolant (not an absorption chiller).	Commercial or industrial	Jan.1 2025	700
Mobile refrigeration system	Commercial or industrial	Jan.1 2025	2,200

equipment would not fall under the phase-down, but would be subject to sector-specific prohibitions in particular years based on GWP levels.

For example, centralized and stand-alone low-temperature commercial or industrial refrigeration could not contain HFCs with a GWP above 1,500 starting in 2020. (See chart, this page.)

The HFCs originally targeted by the Kigali Amendment and ECCC proposal include the following: R134, R134a, R143, R245fa, R365mfc, R227ea, R236cb, R236ea, R236fa, R245ca, R43-10mee, R32, R125, R143a, R41, R152, R152a, R161 and R23. Some of these HFCs are also components of commonly used HFC blends like R404A and R410a, which are also covered under the Amendment. (The revised Canadian proposal removed R161 from the list.)

Canada's proposed regulations are expected to result in cumulative HFC emission reductions of about 176 million metric tons of CO₂-equivalent between 2018 and 2040, a 32% decrease compared to a business-as-usual scenario, according to the regulatory impact

analysis. Compliance costs borne by industry are estimated to be \$685 million (Canadian dollars), which would be largely offset by cost savings of \$573 million. The net benefit to the Canadian economy is projected to be \$6.1 billion.

"Supermarkets operated by large businesses are expected to invest in refrigeration systems that would lead to long-term savings due to lower refrigerant costs and energy-efficiency gains," the regulatory impact analysis said.

The proposed regulations would complement existing provincial and territorial measures designed to reduce HFC emissions from existing equipment. They are also in line with the U.S.-Canada Joint Statement on Climate, Energy and Arctic Leadership, an agreement made in March 2016 that aims to reduce HFC emissions. ■ MG & CM



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Growing with CO₂

DeCicco & Sons rolls out transcritical CO₂ systems from Hillphoenix to additional supermarkets

— By Mark Hamstra

Grocery-store operator DeCicco & Sons has seen such strong performance from its first installation of a transcritical CO₂ refrigeration system that it has rolled the technology out to two of its other supermarket locations, with plans for a fourth and fifth CO₂ installation on the drawing board.

"The Larchmont store has been phenomenal over the past year in terms of its performance," said John DeCicco, Jr., president of DeCicco & Sons, referring to the chain's first installation at a store in Larchmont, N.Y., just over a year ago. (See ["DeCicco's Bold Move," Accelerate America, October 2015](#)). "The temperature control is amazing, and the efficiency of the system has been very, very good."

Although he had previously forecasted that the CO₂ system, along with other energy-saving measures at the store, would reduce the annual energy bill at the location by about \$25,000 per year compared to a similar-size store (See ["So Far, So Good," Accelerate America, May 2016](#)), he now forecasts that the savings will be about \$100,000 per year. That amounts to about half the energy costs of a comparable store.

Since the initial installation of the all-CO₂ Advansor system from Hillphoenix at the company's Larchmont location, DeCicco's has begun retrofitting an existing store in Pelham, N.Y., with a new transcritical CO₂ system, also from Hillphoenix, and has installed a system identical to the one at Larchmont in a new store in Millwood, N.Y., which opened in late December.

DeCicco's plans also call for installing a CO₂ transcritical refrigeration system in a store slated for remodeling in Harrison, N.Y., later this year, and another in a new store in Somers, N.Y., scheduled to begin construction late this year or early in 2018. DeCicco & Sons works with Hillphoenix and its contractor, AAA Refrigeration Service, on all of its transcritical installations.

"The temperature control is amazing, and the efficiency of the system has been very, very good."

— John DeCicco, Jr., DeCicco & Sons

TWO-PHASE RETROFIT

At the Pelham location, where the company is installing the transcritical CO₂ system in two phases, it is still running some of its equipment using R22 as a refrigerant on an interim basis. DeCicco said he anticipates completion of the second phase of the installation next year, when he plans to install a second refrigeration rack and have the entire store running on CO₂.

"We just wanted to split it over two years for cost reasons," DeCicco explained, noting that the R22 system is now only handling about 25% of the load it had previously.

The CO₂ system at the Pelham location is slightly smaller than the Larchmont installation — about 700,000 BTU at Pelham vs. about 1 million BTU at Larchmont; the CO₂ charge at Pelham is about 700 lbs.

At the new Millwood location, which at 20,000 square feet is about the same size as the Larchmont store, DeCicco said he sought to duplicate exactly the system that had been installed in Larchmont. That encompasses a single Advansor rack from Hillphoenix, including four medium-temperature Bitzer compressors (three 25 HP units and one 30 HP unit), two low-temperature Bitzer compressors (4 HP and 2 HP), and CPC XM case controllers. It has a CO₂ charge of about 1,200 pounds.



Transcritical CO₂ rack at DeCicco's new store in Millwood, N.Y.

The Millwood store is reclaiming heat from the CO₂ system to handle 100% of the store's hot water and for other uses. The Pelham store does not yet have heat recovery, but DeCicco said he hopes to incorporate it before the second phase of the installation.

All three installations are using Trillium adiabatic coolers from Baltimore Aircoil instead of condensers, DeCicco said.

"I am really happy with the system overall," he said.

DeCicco noted that the costs for the two newest locations were less than for the original Larchmont store, which he estimated was about 10% to 15% higher than a conventional refrigeration installation. The reduced costs at Pelham and Millwood were a result of the company being able to use the preferred copper piping that was specified for the system, rather than welded steel, and also because of increased familiarity with the system.

As DeCicco & Sons observes the system in operation, the company has taken steps to make it even more efficient, and transferred those efficiencies to its other CO₂ stores, DeCicco said. For example, the company has expanded the range of the variable-speed compressor at the original location.

"It originally started at 50% on the low end, but we are now down to 12% on the lead compressor," he said, noting that the range has similarly been adjusted for the lead compressors for medium temperatures at Pelham and Millwood.

"Whenever we learn something new, we bring it quickly to the other stores," said DeCicco. "If there are any setting changes, or pressure changes on the rack — anything we can do to save, we do it." ■ MH



John DeCicco, Jr.

New Seasons Market Goes With Transcritical CO₂ for 3 Stores

Small chain is running a Hussmann system in its GreenChill-certified store, with two more installations slated for 2018

— By Mark Hamstra

In the latest example of a small U.S. grocer adopting natural refrigerant technology, New Seasons Market, a 20-store supermarket operator based in Portland, Ore., has installed a transcritical CO₂ refrigeration system from Hussmann Corp. in a recently opened store — and is planning two more CO₂ deployments in 2018.

"I believe in the product," said Beau Butler, director of construction and facilities, New Seasons Market. "I believe natural refrigeration is the right way to go."

The 37,000-square-foot store, revamped from a former Albertsons supermarket in Mercer Island, Wash., was awarded EPA Platinum Certification, recognizing a reduction of at least 95% in refrigeration emissions.

The transcritical system comprises a Hussmann Purity transcritical CO₂ refrigeration rack, a CO₂ charge of 1,100 lbs., three Copeland scroll low-temperature compressors, four Bitzer reciprocating medium-temp compressors, CPC XM case controller and an air cooler with a variable frequency drive.

Although New Seasons Market was new to CO₂ refrigeration, Butler was not. He was involved in three CO₂ projects during his time at Whole Foods Market, including two transcritical CO₂ installations.

His familiarity with the technology, along with the efficiencies he witnessed at Whole Foods, contributed to his decision to deploy the Hussmann Purity CO₂ system at the New Seasons store.

PRICES DROPPING

Butler said he had noticed that costs for CO₂ systems seemed to be coming down, and more and more contractors were becoming familiar with the systems.

"The pricing was getting more competitive," Butler said. "It was the right thing to do financially for the company, both in the short and long term."

Hussmann was the lowest qualified bidder for the project, he said, and Butler was confident in the abilities of Hussmann's engineers. The cost for the system were comparable to that of traditional refrigeration systems, Butler said.

New Seasons is partnering with local contractor Refrigeration Unlimited to service the system.

The old Albertsons store that provided the shell for the New Seasons Market had been using an R404 refrigeration system, which New Seasons removed.

"We definitely weren't going back to R404," Butler said.

Although some supermarket operators have been able to use heat reclaimed from their CO₂ refrigeration systems to contribute a significant portion of their overall heating needs, Butler said the Mercer Island installation will only provide about 10% of the store's heat, as the store already has a highly efficient rooftop heating system.

The chain has two new stores slated to deploy transcritical CO₂ systems in 2018, one in Seattle and the other in San Francisco. New Seasons is working with Zero Zone, a manufacturer Butler had worked with at Whole Foods, on both of those projects.

New Seasons is in the process of calculating its energy savings from the newly installed system, Butler said.

"We're just looking for efficiencies," he said. "I know natural refrigeration is the right direction to go." ■ **MH**





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Energy Saving Continues at Piggly Wiggly

NH₃/CO₂ cascade system helps store cut energy consumption by 33% and save \$74,640 over a 13-month period

— By Michael Garry

A Piggly Wiggly store in Columbus, Ga., using an ammonia/CO₂ cascade system has cut its energy consumption by 33% on average – for a total of \$74,640 in savings – over a 13-month period compared to a similar store using HFC refrigeration.

The savings derives, to a significant extent, from the ammonia/CO₂ cascade system, according to Keith Milligan, CIO of JTM Corp., which owns the store. The system – only the fourth ever installed in a U.S. supermarket – has been used in the store since it opened in September 2015.

Milligan was a participant in a webinar hosted by the U.S. Environmental Protection Agency's GreenChill Partnership last month that provided an overview and update on the store's NH₃/CO₂ cascade system. A profile of the system appeared in the [September 2016 issue of Accelerate America](#).



Keith Milligan, JTM Corp. (Piggly Wiggly)

The period over which the store's energy performance was measured covered October 2015 to October 2016. In an earlier analysis of the store's overall energy consumption, conducted from October 2015 to April 2016, the Piggly Wiggly store consumed 23% to 33% less energy than the conventional HFC outlet, for an average energy savings of 28% (\$33,170 in savings).

Milligan acknowledged in the webinar that "not all of the savings was from refrigeration" – some came from LED lights, skylights and other measures.

However, the energy savings from the refrigeration was found to be significant. In an energy analysis of the store's NH₃ rack and an HFC rack installed in the store for comparison purposes, Heatcraft Worldwide Refrigeration, manufacturer of the system, found that the NH₃ rack consumed 22% less energy on average than the HFC rack, ranging between 18% and 25%, depending on ambient temperature; the analysis was done between February 2, 2016 and May 22, 2016.

VERIFYING ENERGY CALCULATIONS

Eric Nelson, engineer and project manager, CTA Architects Engineers, who also participated in the webinar, explained the role CTA played in independently verifying the equipment installation and energy calculations made at the Piggly Wiggly store. CTA began its analysis about six months after the store opened.

CTA was given remote access to the system's controller so that it could review measurements and set points. The combination of energy models and actual energy data from the store made this project "an engineer's paradise," Nelson said.

The store alternates using its NH₃ rack and HFC rack every one to two weeks to allow energy measurements and comparisons to be made. However, there could be ambient weather differences and case load variations from week to week, which would detract from the "apples-to-apples" nature of the comparison. To compensate for these potential variations, CTA "normalized" the evaporator loads and ambient temperatures, said Nelson.

If the ammonia rack were to operate full time (without periodically switching to the HFC rack), the efficiency of the store would increase by 5% to 7% or more, estimated Masood Ali, Heatcraft's global leader for alternative systems center for excellence, who also commented during the webinar.

Ali cited simulations showing that ammonia/CO₂ cascade systems can outperform the efficiency of HFC refrigeration systems from 20% to 30%, depending on the climate. ■ MG

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Store-Wide Hydrocarbons in Belgium

In an effort to go HFC-free, Colruyt is installing propane and propene chillers chainwide that serve all medium-temperature needs at its three formats, including unusual cold rooms

— By Andrew Williams and Michael Garry



Collin Bootsvelde, Colruyt

In North America, self-contained freezer and cooler cases that use hydrocarbons as the refrigerant have made tremendous inroads in the supermarket and foodservice sectors. For example, Target has installed propane cases in 580 of its more than 1,800 stores in the U.S.

In 2017, Target plans to operate some stores that use nothing but propane cases for refrigeration. For direction on how to do that, the Minneapolis-based discounter could look at some European merchants like U.K.-based Waitrose and Belgian retailer the Colruyt Group, which have rolled out all-hydrocarbon, HFC-free refrigerated stores, though Colruyt is pursuing a design that is unusual not only for the U.S. but Europe as well.

Based in Halle near Brussels, Colruyt operates about 516 stores in Belgium, France and Luxembourg, including about 376 that use refrigeration — Colruyt supermarkets, OKay convenience stores and Bio-Planet organic food stores. Beginning in 2017, the chain will use only hydrocarbon refrigeration in new stores and retrofits, with 50 to 60 new systems in the pipeline. At the current pace, Colruyt will be HFC-free by 2027, according to Collin Bootsvelde, the retailer's project engineer.

"Replacing all our refrigeration installations with [hydrocarbon] systems will result in the reduction of the Colruyt Group's CO₂ emissions in Belgium by 10%," said Mathieu Magrone, manager of the Morlanwelz, Belgium, Colruyt store.

Colruyt installed its first propane system, with 14 kg (31 lbs.) of the hydrocarbon, in 2013 outside of an OKay store in Roeselare, Belgium. In 2014, Colruyt switched to an engine-room chiller that employs up to 2.5 kg (5.5 lbs.) of propane and delivers chilled propylene glycol as the secondary coolant to medium-temperature applications in the store.

With a refrigeration capacity of 23 kW to 52 kW, one chiller can cool the smaller OKay and Bio-Planet stores. The larger Colruyt



supermarkets run two compact chillers. In addition, a redundant chiller is added at all stores, ready to step in should there be a failure. The chillers are supplied by German manufacturer Futron Eco Cooling Systems. They incorporate a heat exchanger from Multichannel AB that makes possible the low refrigerant charge.

The chiller system was first installed at a Bio-Planet store in Mons, Belgium, in November 2015. It has since been deployed in three other Bio-Planet store locations and two OKay outlets in Belgium. Last September, Colruyt deployed a smaller, higher-capacity third-generation propane system at a Bio-Planet store in Huy, Belgium.

Colruyt's most recent installations have taken place at its two renovated Colruyt supermarkets, where propene (also called propylene) is used rather than propane. The chain opened the first store, in Kortrijk, Belgium, on December 7 and cut the ribbon on the second, in Morlanwelz, Belgium, on December 14.

UNUSUAL COLD ROOMS

In all three formats, the propane/propene system serves display cases as well as separate cold rooms – highly unusual for a supermarket – in which customers choose fruit, vegetables, meat and other products from shelves. (The rooms are also used for storage, making them easier to stock.) Bootsvelde's team calculates that the cold rooms are three to nine times more efficient than stand-alone display cabinets (when comparing equal capacities). "Cabinets lose a lot of cold when customers open the doors," he said.

Bootsvelde is collecting data to compare the efficiency of the hydrocarbon chillers (including secondary glycol) to standard HFC refrigeration systems. He expects the efficiency to be comparable.

Air handling units above the cold room remove the air inside, cool it down with glycol, and put it back through perforated walls, creating temperatures of -2°C to

under 7°C (28.4°F to under 45°F) on shelves or crates (the upper temperature varies by room) and about 8°C (46°F) in the room. Constantly circulating cold air negates the heat given off by customers and the surrounding shop. The chillers themselves generate temperatures ranging between -5°C (23°F) and 1°C (34°F) in Colruyt stores and between -3°C (26.6°F) and 1°C in OKay and Bio-Planet stores.

Aren't shoppers chilly in the cold rooms? Bootsvelde acknowledged that shoppers may need to bring a sweater to the store. "However," he added, "customers stay in the cold room only for a short period of time and the quality of the fruit and vegetables is much better than at our competitors who sell those in non-refrigerated displays." In addition, the cool temperature inside the rooms enables much higher efficiency – and therefore lower prices. "Customers understand that," he said.

To complete the hydrocarbon refrigeration picture, all three formats run energy-



Cold room at Bio-Planet, Braine l'Alleud, Belgium



Propane chillers at Bio-Planet, Mons, Belgium

► efficient stand-alone chest freezers that have been using the natural refrigerant R600a (isobutane) for over 10 years. They employ only 100 g of R600a, generating temperatures between -18°C (-0.4°F) and -22°C (-7.6°F). "We did place standing freezer cabinets in our new OKay stores for less than a year, but this will be discontinued and we will use again stand-alone isobutane freezers," said Bootsveld.

PROPENE VS. PROPANE

Bootsveld gave two reasons why Colruyt chose propene and not propane for its Colruyt stores. The first reason is the need for slightly lower temperatures in Colruyt chillers – -5°C instead of -3°C – for the storage of meat "Propene is more effective at lower evaporation temperatures than propane, although the effect is small in this temperature range," he said.

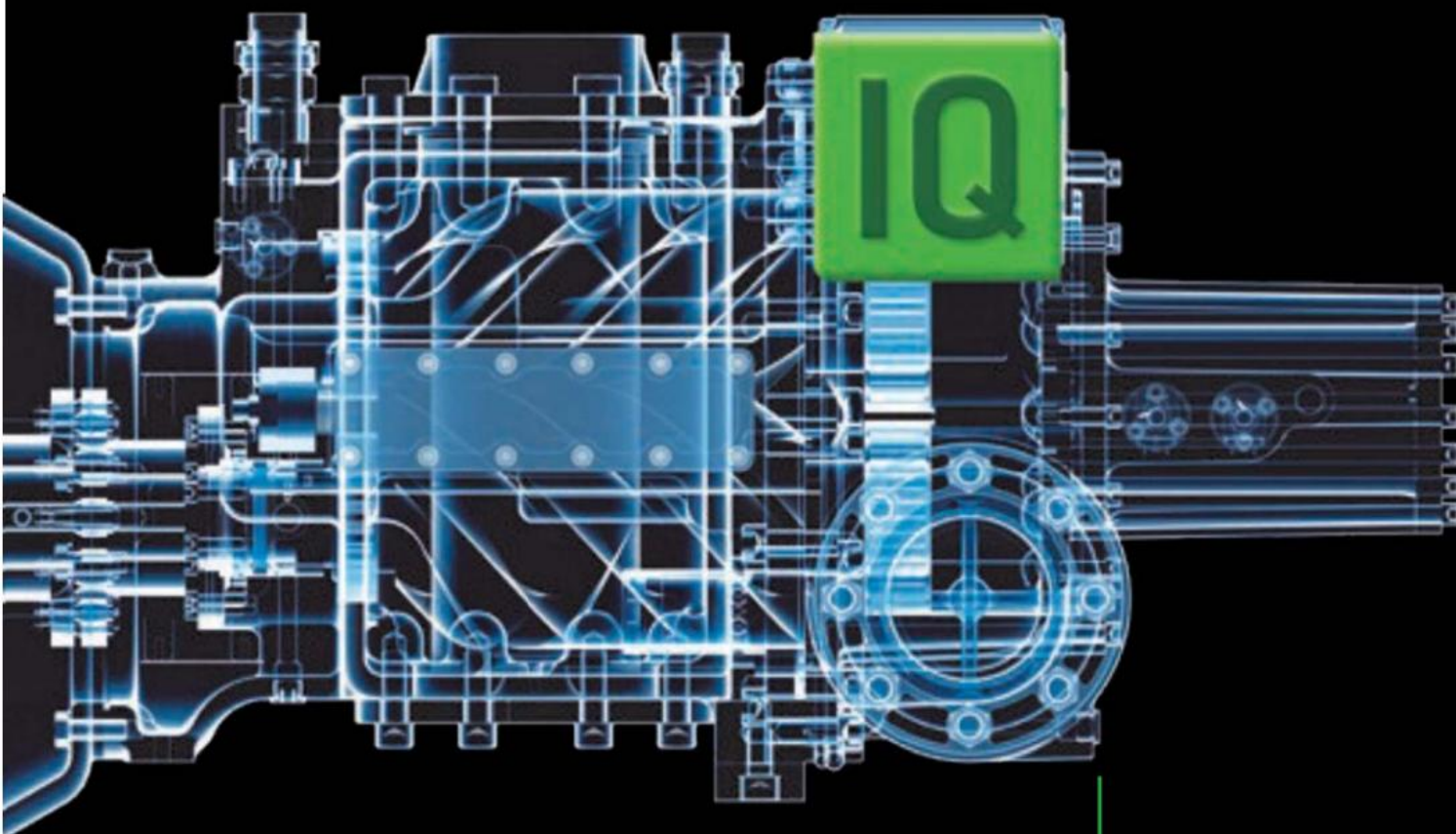
The second and more important reason is that Colruyt wants 100 kW of total cooling power in the supermarkets as a minimum, and did not want to install an extra chiller. Propene has a higher volumetric cooling capacity within the same chiller than propane, 52 kW vs. 42 kW.

Colruyt does not yet use propene for OKay and Bio-Planet because this would increase the cooling power too much in the winter due to the lower condensation temperatures. "This would require us to use smaller compressors and the potential investment savings were not worth the hassle yet," said Bootsveld. "We do not want to use too many different versions of chillers." It is too early to say if Colruyt will change to propene in the future for these brands.

The hydrocarbon charges used in the chillers is influenced by the standards used in the European Union. Europe's hydrocarbon charge limits are higher and more flexible than those of the U.S. Under the European Union standard EN378, 150 g – the charge limit in the U.S. for hydrocarbon refrigerant – applies to home refrigerators where there are no requirements on room size or safety measures.

In the shopping area of a store (assuming it's large enough), 1.5 kg is the maximum allowed, while in the engine room, 2.5 kg is a frequently used limit for chillers placed in a dry location above ground; however, higher charges are allowed depending on the location and the safety measures that are implemented. For Colruyt stores, the chain reports a maximum charge of 7.5 kg in the engine room.

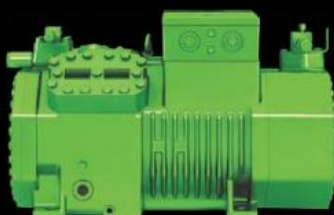
Colruyt takes ample safety measures regarding hydrocarbons, including propane and propylene detectors, and a fan that will extract any flammable substances. In the event of a leak, the new systems shut themselves down automatically. "The amount of propane is also so low that it is very difficult for anything bad to happen," Bootsveld said. ■ **AW & MG**



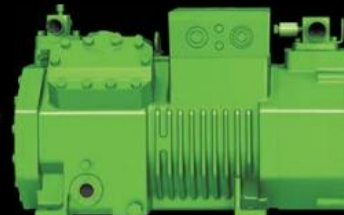
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California: A Bridge to the Future

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

– By Michael Garry



California Governor Jerry Brown, a longtime environmental advocate who acquired the moniker “Governor Moonbeam” in the 1970s, came out swinging at a meeting of the American Geophysical Union in San Francisco last month.

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

“We have the scientists, we have the lawyers and we are ready to fight!” declared Brown to thunderous applause. And he reminded them of California’s traditional and expected future role in leading

the way for environmental progress in the U.S. “Our emission standards, our energy rules, drove U.S. policy. We will set the stage, we’ll set the example, and whatever Washington thinks it is doing, California is the future.”

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

On a global level, California has spearheaded the Under2MOU, an unprecedented alliance of 165 subnational jurisdictions (states and regions) representing more than 1 billion people and more





Paul Delaney, Southern California Edison

▶ than one-third of the global economy, which is focused on limiting global warming below 2°C. The state has also signed a number of agreements to work with other countries, including China and Mexico, on actions to fight climate change.

The state agency responsible for formulating and executing AB32's emission-reduction rules is the Sacramento-based California Air Resources Board (CARB). "California is determined to continue to play a leadership role in fighting climate change and ensuring that all Californians breathe clean air," said Glenn Gallagher, air pollution specialist at the CARB. "We know there are other like-minded states that will continue to join with us in these efforts." ([See "Leading by Example," Accelerate America, December 2015 – January 2016.](#))

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

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

In regard to HFCs (the fastest-growing source of greenhouse gas emissions), California's Senate Bill (SB) 1383, enacted August 31, 2016, sets a target for a statewide reduction of 40% below 2013

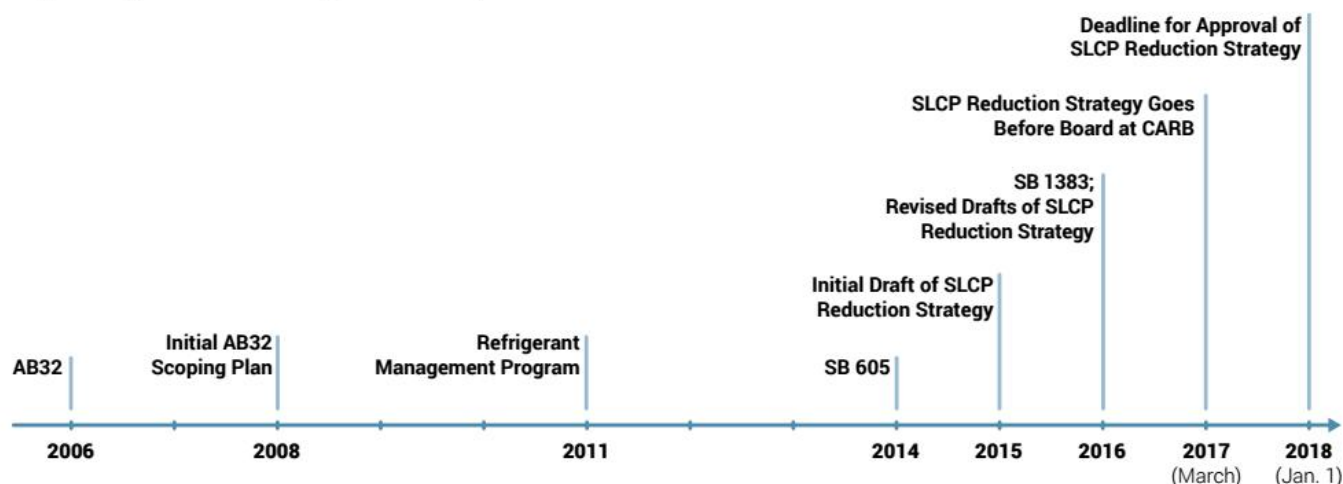
levels by 2030. By phasing down HFC emissions from refrigeration, air conditioning and other sources, the state is surpassing the efforts of the federal EPA and helping to shape the course of the HVAC&R industry in California and beyond, opening the door for environmentally friendly alternatives like natural refrigerant technology.

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

But the state will go much further in reducing emissions of HFCs and other SLCPs, as outlined in its Proposed Short-Lived Climate Pollutant Reduction Strategy; the document was initially released in September 2015 and revised twice in 2016, most recently in November. CARB will hold a public meeting of its governing board on March 23 and 24, 2017, when it will consider approving a final draft of the SLCP Strategy, which will be released prior to that meeting. The board is made up of 12 members appointed by the governor, including scientific experts and representatives of regional pollution control agencies.

The SLCP Strategy calls for SLCP emissions reduction to take place through a combination of voluntary and regulatory measures. Among the proposed measures are: a ban on refrigerants with GWPs of 150 or more in new stationary non-residential refriger-

Timeline for California Laws/Programs Impacting Natural Refrigerant Adoption



ation equipment and new residential refrigerator-freezers; a ban on refrigerants with a GWP of 750 or greater in air conditioning (non-residential and residential); and a prohibition on sales of high-GWP refrigerants (2,500 or more).

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

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

SB 1383 requires CARB to complete and approve the plan by January 1, 2018, after which it will commence the rulemaking process, leading up to new regulations in 2018 or 2019. "As always, we will work closely with all stakeholders in developing common sense and cost-effective regulations to reduce high-GWP HFC emissions," said Gallagher.

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

additional HFC emissions reductions measures will be needed in order to satisfy those requirements.

"CARB is still assessing the HFC emissions reductions measures we need to take, in addition to the global HFC phasedown," said Gallagher. The agency is also still determining the best start dates for additional HFC reductions measures and "may receive additional guidance from the board at the March meeting," he added. "Those efforts may need to begin quickly in order to meet the target."

A MULTITUDE OF NATREF INSTALLATIONS

With specific HFC regulations looming in the next few years, California's food retailers, foodservice providers and industrial operators have been motivated to start implementing HFC alternatives, including many examples of natural refrigerant technologies. ([See map, page 6.](#))

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

The U.S. retailer with the most diverse array of natural refrigerant installations in California is Whole Foods Market. In addition to three HFC/CO₂ cascade stores in Northern California, the organic/natural foods giant operates four stores with transcritical CO₂ (including a 365 by Whole Foods Market), one with ammonia/CO₂ cascade and one with propane/CO₂ cascade. ([See "Whole Foods Pushes the Propane Envelope," Accelerate America, October 2016.](#))



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



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

WILL INCENTIVE PROGRAM RETURN?

In January 2016, California Governor Jerry Brown included in his proposed 2016-2017 budget \$20 million for incentives to reduce HFC emissions from refrigeration systems.

The funds for what was called the refrigerant incentive program would come from the state's greenhouse gas reduction fund (GGRF) program, tied to its cap-and-trade initiative. The program is part of the California Air Resources Board's (CARB's) Proposed Short-Lived Climate Pollutant Reduction Strategy.

However, the money never materialized as the program was not included in the state's final budget or in cap-and-trade allocations for the current (2016-2017) fiscal year. The reason cited was reduced cap-and-trade proceeds.

"Whether cap-and-trade money is allocated for this purpose in the next fiscal year will depend on the final outcome of the budget and legislative process," noted Glenn Gallagher, air pollution specialist at CARB. An incentive program for low-GWP refrigeration "has been identified as a highly cost-effective greenhouse gas mitigation measure and

is included in CARB's three-year plan for GGRF funds," he added. "CARB's analysis found it to be an important component of efforts to meet the SLCP targets under SB 1383."

Incentive funding would go primarily to small retail businesses, particularly in disadvantaged communities, though any business or non-profit could apply. The program is technology neutral, but is geared toward new systems using refrigerants with a GWP under 150, as well as retrofits of existing equipment that reduce greenhouse gas emissions, and stand-alone refrigeration units that use hydrocarbons.

Cap-and-trade funds are not the only option for incentivizing low-GWP refrigeration. CARB is currently working with the energy sector throughout the state to identify existing funding opportunities such as the Emerging Technology Program (ETP), comprised of the six largest utilities and two statewide energy agencies. The ETP has a budget of approximately \$20 million per year available to pilot and test emerging technologies.

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

Coffin estimates that 80%-90% of Whole Foods’ natural refrigerant stores are in California. This is partly because he decided to become an advocate for natural refrigerants for Whole Foods and the food retail industry, but it is also because “California is a champion for progressive environmental legislation, which is further incentive for us to move toward naturals quicker,” he said.

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

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

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

The NXTCOLD system, developed by Chief Technology Officer John Scherer, is installed at cold storage facilities operated by Los Angeles Cold Storage (one unit); Lineage Logistics, Oxnard (one); Neptune Seafood, San Pedro (two); and Baker Cold Storage/Lineage Logistics, Long Beach (46). In 2017, NXTCOLD units will be installed at General Cold Storage, South Gate (eight); US Growers Cold Storage, Vernon (seven); and Farmer Woody, Ventura (12). The capacity of the units ranges from 15 TR to 75 TR.

Another industrial system, Mayekawa’s NewTon NH₃/CO₂ unit, was installed in Irvine, Calif., at the Imuraya USA plant, which manufactures desserts for Japanese restaurants. Southern California Edison (SCE) and Mayekawa have been tracking the energy efficiency of the system, and plan to release results in 2017. They expect the system to provide a 20% to 50% percent energy savings compared to an existing refrigeration system at the plant.



Tristam Coffin, Whole Foods Market

Though it remains neutral concerning low-GWP refrigerants, CARB recognizes that natural refrigerants “are quickly proving themselves viable alternatives to high-GWP HFCs,” said Gallagher. He cited several natural refrigerant technologies as being among those that “compete in a growing market for low-GWP refrigeration,” including transcritical CO₂, low-charge ammonia, self-contained propane cases, ammonia-CO₂ cascade systems, and propane-CO₂ cascade systems.

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

Among low-GWP options, CARB includes HFO chillers and air-conditioning, and low-GWP HFO-HFC blends for refrigeration and air-conditioning, deferring to the EPA SNAP program’s designation of HFOs/HFO blends as acceptable in certain applications. But CARB



Glenn Gallagher, CARB



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

► is aware of HFO's conversion to trifluoroacetic acid (TFA) in the atmosphere, with resulting TFA accumulations in surface waters.

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

California's national leadership in regard to natural refrigerants is reflected in its \$500,000 contribution last year to industry research on safety standards for A3 refrigerants (such as hydrocarbons) and A2Ls. Other entities in the project include Air-Conditioning, Heating, and Refrigeration Institute (AHRI), the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), Johnson Controls and the U.S. Department of Energy.

CARB has also contracted with San Francisco State University to research the technical feasibility and energy efficiency of low-GWP refrigerants. Dr. Ed Cheng of SFSU is the principal investigator, and he has been working with Doug Scott of VaCom Technologies on the research. A draft report is expected in the next two months, with the final report no later than September 1, 2017.

SCE'S INCENTIVES

Another factor supporting the adoption of natural refrigerant systems in California is the availability of energy incentives from utilities to defray the initial cost of the technology. One of the more active utilities in this regard is SCE, led by Senior Engineer Paul Delaney. ([See "Southern California Edison Takes on Natural Refrigerants," *Accelerate America*, June 2015.](#))

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



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

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

The installation of 46 NXCOLD units at a new Baker Cold Storage facility (overseen by Lineage Logistics) in Long Beach, Calif., will be receiving incentives through SCE's "Savings by Design" program, which uses a "whole building" approach. The incentives will be based on 8.5 cents/kW of energy savings and \$150/kW of demand reduction. "The incentive will be paid after measurement and verification is completed," Delaney said.

SCE is currently working with its Savings by Design engineers on estimating the energy savings and incentive for a new NXCOLD project in the Los Angeles area that will replace an R22 system. "As part of this process, we have to document SCE's influence in the decision by the end user to install the new technology," he said. The Emerging Technologies program will monitor the system's performance and publish a report quantifying savings, incentives and other benefits. The facility is scheduled for startup at the end of March, and results should be available in the fourth quarter of 2017.

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

Delaney is keenly interested in the potential of low-charge ammonia/glycol systems to replace R22 and R410 in large air-conditioning systems. "We are not there yet, although we have begun an effort with EPRI [Electric Power Research Institute] to do laboratory evaluation of these systems," he said. "Ultimately, we all agree the biggest market is in commercial building applications and space conditioning."

SCE is also in the process of developing deemed incentives for propane self-contained cases. The process involves validating performance, followed by custom-incented projects "where we collect enough data to make the CPUC [California Public Utilities Commission] happy," he said. Then SCE's engineers complete information requirements and submit them to the CPUC's deemed incentive process. "This last part can take up to a year unless the CPUC is motivated to act."

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

Delaney does not expect the change in administrations in Washington to deter what SCE and other utilities are trying to accomplish with energy-efficient natural refrigerant systems. "There is every indication that we are not slowing down our efforts to evaluate and influence market transformation," he said. "I would be very surprised considering the very large amount of money in EPIC [Electric Program Investment Charge] research funding and the CARB funding projects that reduce greenhouse gases." ■ MG

AHR Expo to Tackle NatRefs

Among the more than 75 educational sessions, many are related to natural refrigerant technologies; component makers showcase natref wares

— By Michael Garry

Attendees of 2017 AHR (Air-Conditioning, Heating, Refrigerating) Expo, to be held January 30 to February 1 at the Las Vegas Convention Center, will have access to more than 75 seminars, technical sessions and certifications, including many related to natural refrigerant technologies.

The AHR Expo also hosts close to 2,000 exhibitors, many with natural refrigerant products and services, and attracts 60,000 HVAC&R industry professionals. The event is co-sponsored by ASHRAE and AHRI, and is held concurrently with ASHRAE's Winter Conference.

"We pride ourselves on offering these ancillary education, training and certification opportunities as a way to fully maximize the

benefit attendees gain from being a part of AHR Expo," said Clay Stevens, president of International Exposition Company, which manages the show.

For example, more than 100 free, 20-minute presentations will be held in the Expo's New Product & Technology Theaters, featuring products being introduced by AHR Expo exhibitors in 2017. Attendees will also have the opportunity to participate in 56 free seminars on a range of topics presented by associations and other HVAC&R industry groups. In addition, numerous courses, continuing educational sessions and opportunities for testing will be offered for a nominal fee, both prior to and during the AHR Expo.

HVAC&R SUPPLIERS BULLISH ON 2017

In a recent AHR Expo and ASHRAE Journal survey sent to more than 1,400 HVAC&R manufacturers worldwide, 86% of respondents expect their sales to grow in the coming year.

Of these, 27% believed their business would increase by more than 10%, a 6 percentage-point jump from 2016.

"Combining these positive predictions with the fact that the 2017 AHR Expo will be the largest held in the show's 88-year history, we are anticipating a stellar year for business activity among exhibitors and attendees," said Clay Stevens, president of International Exposition Company, which manages the AHR Expo.

When asked to rate prospects for business in 2017, 98% of survey participants indicated a positive outlook. Within these responses, 24% answered "excellent," a nearly a 10 percentage-point increase from 2016. Additionally, 54% responded "good" and 20% responded "fair," with only 2%

rating prospects as "poor" for the coming year. Thirty-eight percent of survey participants said that maintenance and replacement applications would provide the best prospects for business in 2017. Retrofit and renovation applications were cited by 32% of respondents as providing the best business prospects, while new construction was chosen by 30%.

Overall, the light commercial market was identified as offering the most promising outlook for 2017, with 74% of respondents rating it as "excellent" or "good."

Energy efficiency was deemed "very" and "somewhat" important by 92% of respondents, while sustainability got those designations from 88% of respondents. Higher importance ratings were garnered by reliability (77% saying it was "very important"), maintenance (98% combined "very" and "somewhat" important) and first costs (96% combined).



Las Vegas

COMPONENT MANUFACTURERS WITH NATURAL REFRIGERANT PRODUCTS AT AHR EXPO

	BOOTH
Bitzer USA	N7935
Blissfield Manufacturing	C3628
Carel USA	C4140
Carlyle Compressor	C2706
Carrier	C1510
Dorin	C3628
Ebm-papst	C4528
Elco/Kulthorn	C6500
Embraco	C4534
Emerson	C1310
Evapco	N10313
Frascold USA	C5934
Galileo	C4144
Guntner US	C6006
Johnson Controls	C2929
Mayekawa USA	N9526
Sanden International USA	C6124
Stellar	N11923
Tecumseh	C3538
Temprite	C1525
Westermeyer Industries	C3438
Wieland Copper Products	C6715
shecco America	N11644

Those attending the AHR Expo can additionally sit for exams from several HVACR industry organizations, including the North American Technician Excellence (NATE).

Here is a list of educational sessions related to natural refrigerant technologies:

- ▶ **Hydrocarbon Refrigerant Safety.** Speaker: Arthur Miller, director, Region 2, Refrigeration Service Engineers Society (RSES); Monday, Jan. 30, 9 am-noon, N232.
- ▶ **E2VF: The High Performance Electronic Expansion Valve Leading to Reduced CO₂ Emissions.** Speaker: Giovanni Righetto, product manager, Carel Industries; Monday, Jan. 30, 1:15-1:35 pm, Theatre B.
- ▶ **Reducing Total Cost of Ownership with Advancements in Closed-Circuit Cooling Tower Technology.** Speaker: Benjamin Cohen, product marketing manager, North America, Baltimore Aircoil Company; Monday, Jan. 30, 2:15-2:35 pm, Theatre B.
- ▶ **Introduction of Mayekawa's New Air-Cooled NH₃/CO₂ Chiller Package.** Speaker: Troy Davis, energy manager, Mayekawa USA; Monday, Jan. 30, 3:45-4:05 pm, Theatre C.
- ▶ **Screw Compressors with Integrated VFDs for Max IPLV.** Speaker: Joe Sanchez, engineering manager, Bitzer US; Tuesday, Jan. 31, 10:15-10:35 am, Theatre B.
- ▶ **Tecumseh's VTC/VAE Series Variable Speed Compressors Deliver Significant Energy Efficiency Gains,** Tuesday, Jan. 31, 10:45-11:05 am, Theatre C.
- ▶ **The Impact of Flammable Refrigerants on Your Facility.** Speaker: Intertek representative; Tuesday, Jan. 31, 2:45-3:05 pm, Theatre C.
- ▶ **Adiabatic Cooling Systems: Wet When You Need It and Dry When You Don't.** Speaker: Mike Silverstein, senior sales engineer, Guntner US; Tuesday, Jan. 31, 4:15-4:35 pm, Theatre B.
- ▶ **Sustainable Technologies for Stationary Air Conditioning Workshop.** Speakers: Representatives of AHRI, Alliance for Responsible Atmospheric Policy, Climate and Clean Air Coalition, US EPA, Environment and Climate Change Canada, and the German Environment Agency; Wednesday, Feb. 1, 8:00 am-4:45 pm, N235/237. Advanced registration required at www.sustainableacworkshop.com.
- ▶ **R290a Inverter-Type Refrigeration Unit.** Speaker: Dean Rafiee, director of business development, Elco; Wednesday, Feb. 1; 10:15-10:35 am, Theatre B.

A complete list of 2017 AHR Expo educational opportunities can be found at <http://ahrexpo.com/education-overview/>. ■ **MG**

Emerson: All In for CO₂

The component manufacturer has a multi-pronged approach to promoting its CO₂ equipment, including an online product information tool, educational programs, energy research and training

— By Michael Garry

Building on informational programs launched in the past few years, Emerson Commercial and Residential Solutions plans to engage in a series of new initiatives in 2017 designed to promote its CO₂ refrigeration technology.

For example, a web-based CO₂ information tool ([emersonclimate.com/CO₂tool](http://emersonclimate.com/CO2tool)), which was launched last June to provide details on Emerson-made CO₂ components available in North America, will expand by the end of January to include equipment available in Europe. Emerson makes a wide range of CO₂ system components, such as compressors, oil separators, electronic controls and electronic expansion valves.

"We developed this with contractors and OEMs in mind," said André Patenaude, director - CO₂ business development for Emerson Commercial and Residential Solutions (which now incorporates Emerson Climate Technologies). "It's a one-stop area for technology details on CO₂ products."

Emerson has a network of about 1,000 component wholesalers across North America. While those wholesalers carry Emerson's CO₂ compressors and case controllers, they do not yet carry more specialized parts like high-pressure controls. End users or contractors in need of those components as replacement parts would need to go through an OEM, noted Patenaude. "Eventually, all specialized parts will be stocked by wholesalers."

A number of components available in Europe are not UL-approved and therefore

remain unavailable in North America, thus necessitating a separate list for North America and Europe. However, Emerson is working on getting "as many European components UL-approved as possible," said Patenaude.

On its main corporate website, emerson.com, the company last month added a section, [emerson.com/CO₂](http://emerson.com/CO2), that provides an overview of CO₂ refrigeration systems as well as a life-cycle performance energy tool.

ONLINE INFORMATION, ENERGY OPTIMIZATION

In 2017, Emerson plans to launch two online informational programs – a series of editorials on natural refrigerants, and 37 weekly "Did You Know" segments about CO₂ refrigeration, including 26 used in 2015 and 2016, and 11 new ones. Previous segment topics, which have appeared on social media outlets like Twitter, LinkedIn and Facebook, include triple point, critical point, charging a CO₂ system, dry-ice temperature and not your standard pressure.

The informational programs are designed to "increase the popularity of CO₂ and the perception of Emerson's presence in the space," said Patenaude.

The natural refrigerant editorials will be released every other month through early 2018 in blogs, social media and trade periodicals. Topics will include propane along with natural refrigerant options for convenience stores, small food retail, large food retail, commercial warehouses

OTHER NATURAL REFRIGERANTS

In addition to CO₂ components, Emerson makes components for the natural refrigerants ammonia and hydrocarbons.

For example, Emerson's Vilter division manufactures single-screw compressors for ammonia refrigeration, and is in the process of downsizing those compressors so that they can be used in low-charge-ammonia rooftop units. For hydrocarbon refrigeration, Emerson builds scroll and small reciprocating compressors, as well as condensing units and electronic valves.

The Vilter division is in the process of developing a single-screw industrial compressor for transcritical CO₂ systems rated up to 2,000 psig and suitable for almost 188 TR of medium-temperature capacity. "It uses the base ammonia heat pump/natural gas compressor design currently rated to 1600 psig and modified to reach an operating pressure of 2,000 pounds," said Patenaude.

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and large industrial. The first editorial, an introduction to natural refrigerants, appears on [page 16](#).

Starting in February, Emerson will also pursue an energy optimization project at its Helix Innovation Center in Dayton, Ohio, testing the efficiency of transcritical CO₂ systems under different ambient temperatures and different efficiency enhancements. A baseline transcritical system will operate at six temperatures ranging from -30°F to 115°F and at three humidity levels “so that we understand the real weather-normalized energy footprint in each climate zone,” said Patenaude.

Having established the baseline, Emerson will measure the energy footprint of the same transcritical systems equipped with a series of individual energy-efficiency enhancements – an adiabatic condenser, parallel compressor, mechanical subcooler, combination parallel compressor and gas ejector, combination parallel compressor and air conditioner, and heat reclaim. This will enable an energy comparison between the baseline systems and each enhanced system.

“It’s a unique opportunity to quite literally test apples to apples because the loads and the equipment will be the same.”

— André Patenaude, Emerson

The initial results of the project will be presented at the ATMosphere America conference in San Diego, June 5-7, hosted by shecco, publisher of *Accelerate America*. “We’re going to learn a tremendous amount,” said Patenaude. “It’s a unique opportunity to quite literally test apples to apples because the loads and the equipment will be the same.” Ordinarily such tests are challenging because the loads of the systems being compared are not the same.

CO₂ ROAD SHOW

Patenaude is overseeing an ambitious CO₂ training program in Canada. In 2016, he led two two-day hands-on training seminars at Emerson’s Brantford, Ontario office, and

will conduct another in March. Starting in April, Patenaude and Alain Mongrain will partner with The Master Group, an Emerson wholesaler based in Boucherville, Quebec, to put on a traveling CO₂ training program in Eastern Canada, with stops in Ottawa, Montreal, Quebec City, Moncton and Halifax.

The “CO₂ road show,” which will feature a working model of a transcritical CO₂ booster unit shipped to each location, will cover such topics as charging, evacuating, changing filter driers and oil management. ■ MG

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Additional Topics:

- ▶ Ice Rinks
- ▶ Data Centers
- ▶ Contractors
- ▶ Training
- ▶ Residential/Commercial Buildings
- ▶ Pharmaceutical/Scientific
- ▶ Chemical/Manufacturing
- ▶ Mobile Air Conditioning
- ▶ Research

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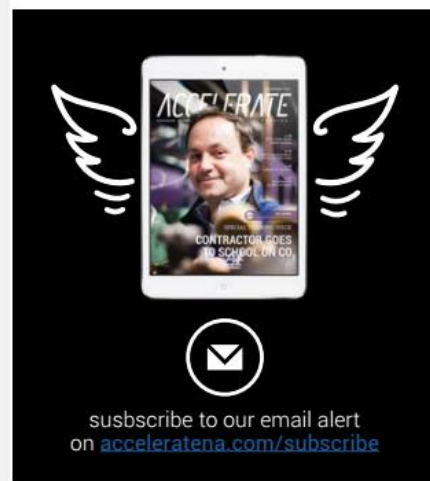
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