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Source Refrigeration's pivotal role in the transition to natural refrigerants

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How Will EPA
React to HFCs Ruling?

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Woolworths'
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A Flawed Ruling on HFCs

By Michael Garry



In a year of many upheavals at the U.S. Environmental Protection Agency, one area the agency has left alone is refrigerants, which the EPA has regulated since 1990 under the Title VI amendment to the Clean Air Act.

But now an outside player, in the form of a three-judge panel in the U.S. District Court of Appeals for the District of Columbia Circuit, has stepped in to throw the relatively uncontroversial world of refrigerants into disarray. In a decision announced on August 8 in *Mexichem Fluor, Inc. v. Environmental Protection Agency*, the court ruled that the EPA cannot require companies to replace HFCs designated for HVAC&R equipment or other applications with low-GWP substances under the SNAP (Significant New Alternatives Policy) program.

For a breakdown of this ruling and the industry's reaction to it, see the article on [page 24](#).

In essence, the final word on this matter has yet to be uttered. The EPA could appeal to the full Court of Appeals for the District of Columbia Circuit, which has more liberal leanings than the three-judge panel that ruled here (with one judge dissenting in part). The decision to appeal is up to EPA administrator Scott Pruitt, who in his previous role as Attorney General of Oklahoma took legal action 14 times to prevent the EPA from regulating environmental pollutants (albeit not HFCs). Or the agency could, following the court's suggestion, adopt a different course in regulating HFCs.

And Congress could make the lawsuit moot by simply amending Title VI to include HFCs. That would be a logical follow-up if the Senate confirms the Kigali Amendment to the Montreal Protocol, which calls for a global phase-down of HFCs.

My sense is that ultimately, the EPA will continue to regulate HFCs, not just because they are potent greenhouse gases but because U.S. chemical companies Chemours and Honeywell have spent millions on HFO/HFO blend replacements for HFCs, and major U.S. manufacturers like Hillphoenix and Heatcraft have aggressively invested in natural refrigerant systems as alternatives to HFC-based systems. These companies have considerable political clout, plus Honeywell and Chemours (as well as the National Resources Defense Council) were intervenors in this case and may be able to appeal the ruling.

Also, I believe the reasoning of the court in this case was deeply flawed. Writing for the majority, Judge Brett Kavanaugh insisted that the EPA could only replace ozone-depleting refrigerants one time, regardless of whether the replacement, HFCs, turned out upon further examination to be harmful to the environment. The dissenting judge, Robert Wilkins, lays waste to this argument, pointing out that it is fundamentally at odds with both the intent of Title VI and common sense. I think his view would prevail on appeal.

The global push toward natural refrigerants, like the global embrace of climate-friendly energy sources represented by the Paris accord, is not going to be derailed by ill-considered moves by the current U.S. president, or by a three-judge panel. The environmental and business case for these upgrades is too compelling to change course now.

Anyone who thinks that there may be some advantage in holding onto HFCs because of this court case is taking a myopic, short-term and short-sighted view that will ultimately prove costly ■ **MG**

ACCELERATE

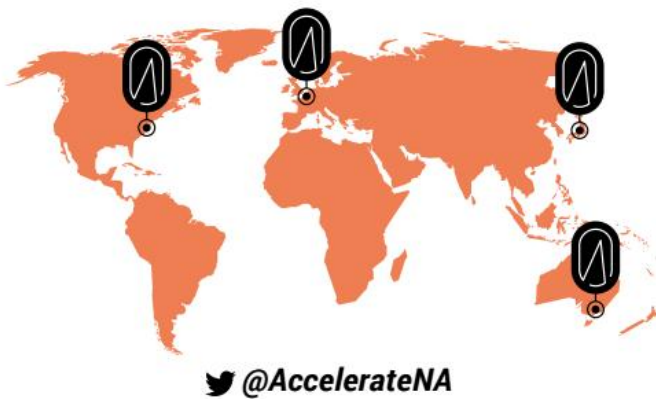
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About Accelerate America

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

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Letters to the Editor



Need for Incentives in California

The ATMOsphere America conference (June 5-7) in San Diego was an incredibly valuable experience both in terms of the content of the sessions and the networking opportunity. The conference is the ideal event for end users who do not have experience with natural refrigerant technologies and are interested to learn more. There is no other event that brings together the entire community of OEMs, product manufacturers and experts on natural refrigerants in the industry.

In particular, I found the California Air Resources Board's open discussion on HFC emissions reductions strategies extremely insightful. (See ["CARB Asks for Help," Accelerate America, June-July 2017](#).) The proposed ban on refrigerants with a GWP of greater than 150 in new equipment would have a tremendous impact on emissions reduction. However, it will also negatively affect retailers, especially independent and small-chain grocers, in California if it is not accompanied by an appropriate incentive mechanism to help offset the incremental cost of natural refrigerant systems.

In 2016, the state had proposed a budget line item (\$20 million/year) for a low-GWP program to be funded by cap-and-trade auction proceeds. Unfortunately, this budget item did not survive the political process while other emissions-reducing programs were approved, such as dairy digesters (\$35 million/year) and waste diversion (\$100 million/year).

How can we ensure this type of funding is not cut in the future? I would advocate for the supermarket industry and natural refrigeration community to work together with California's state agencies and utilities to build a solution that will help meet California's greenhouse gas reduction goals while not placing the burden of those goals solely on the shoulders of supermarket retailers.

Danielle Wright
Executive Director
North American Sustainable Refrigeration Council
Mill Valley, Calif.

"I would advocate for the supermarket industry and natural refrigeration community to work together with California's state agencies and utilities."

SMUD's Incentive Program

Thank you very much for your recent coverage of the Sacramento Municipal Utility District's new Pilot Natural Refrigerant Incentive program (See ["Game Changer," Accelerate America, May 2017](#).) and for providing so much valuable information on other developments in the industry. That issue was jam-packed with inspiring innovation and we were proud to be a part of it.

As you are probably aware, refrigerant management was identified as the No. 1 impact strategy in Project Drawdown, a compilation of proven solutions to reverse global warming. (See ["Refrigerant Management Tops List of Climate-Change Solutions, Accelerate America, April 2017](#).) Your publication serves a critical need to help expand knowledge and implementation of natural refrigerant technologies that will fulfill that promise.

After we launched our program we heard from organizations from all over California who were interested in installing a new system and hoping to utilize our incentive. While we can only offer it to projects within SMUD's service territory, we are happy to provide information to other utilities' staff so that they can consider offering a similar program to their customers.

Kathleen Ave
Climate Program Manager
Sacramento Municipal Utility District
Sacramento, Calif.

LETTERS ARE WELCOMED!

Accelerate America invites readers to submit letters to the editor at michael.garry@shecco.com. They can be about a recent article; anything related to the ATMOsphere America 2017 conference; an industry issue that readers would like us to cover in greater detail; or the value of Accelerate America and ATMOsphere America in educating the industry about natural refrigerants, including what we can do better. Letters may be edited for clarity or length.

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Christopher Pragassa, quality manager at ebm-papst

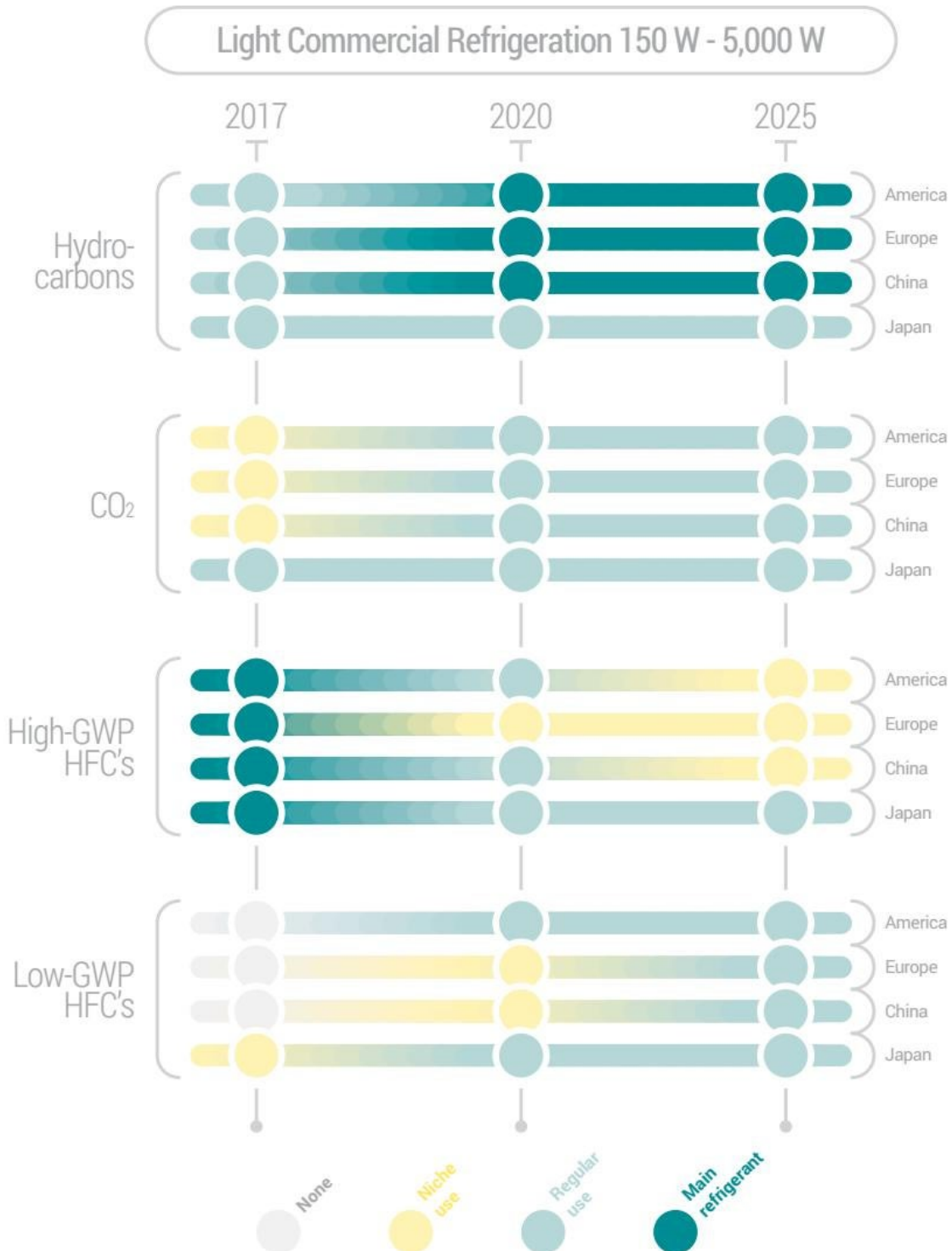


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Source: Embraco Position Paper :
Light Commercial Refrigeration, Refrigerants Outlook, 2017.

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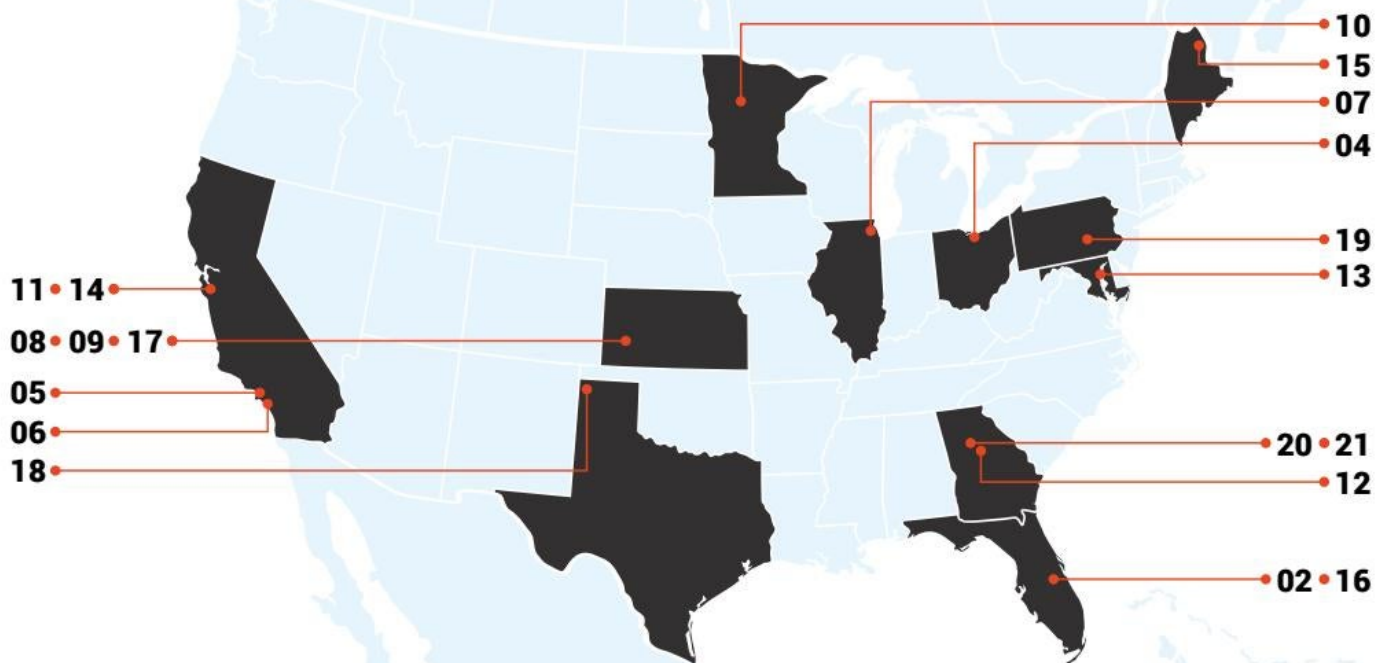
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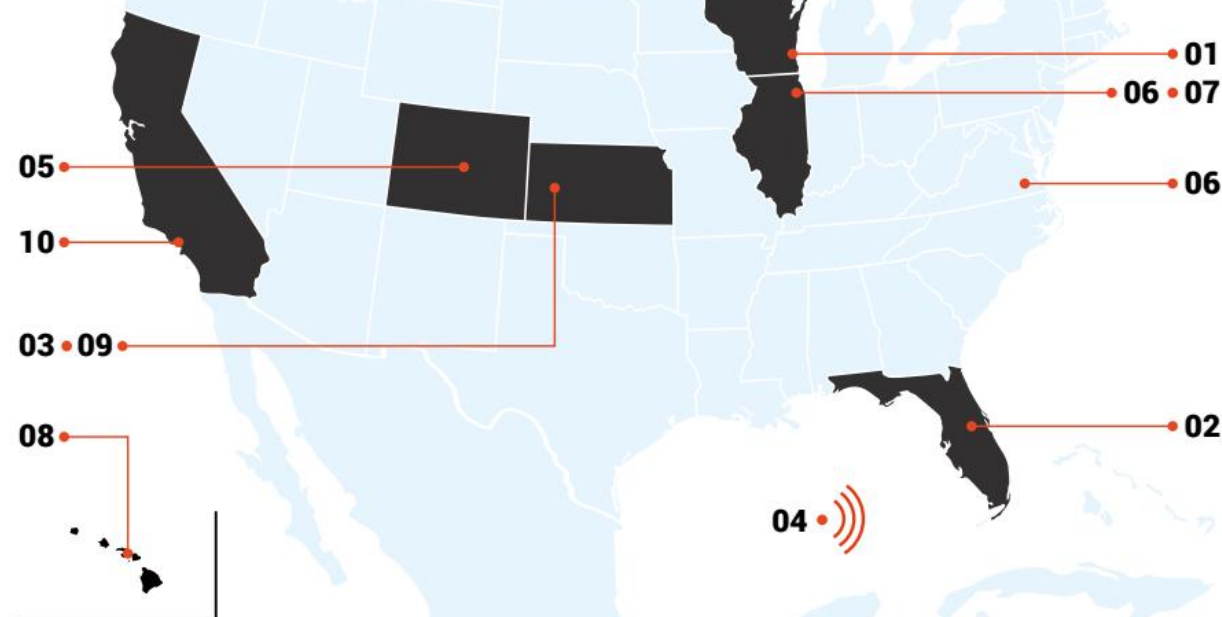


01 • 03 •)))

- **01** September 5, 2 pm Eastern, Online
GreenChill Webinar: Using Refrigeration Batteries to Manage Energy Use
www: <http://bit.ly/2ursQJP>
- **02** September 10-12, Orlando, Fla.
Florida Restaurant & Lodging Show
www: <http://www.flrestaurantandlodgingshow.com/125/florida-home.htm>
- **03** September 12, 2 pm Eastern, Online
GreenChill Webinar: Comparing the Performance of Different Advanced System Types
www: <http://bit.ly/2ursQJP>
- **04** September 12-14, Cleveland, Ohio
ComfortTech 2017
www: [@Contractor_LIVE #CLL2017](http://www.comforttechshow.com)
- **05** September 12-15, Castroville, Calif.
21st Annual Ammonia Safety and Training Institute (ASTI) 32-Hour Ammonia Responder Course
www: <http://bit.ly/2vHLCVb>
- **06** September 13-15, Irvine, Calif.
9th International Conference on Energy Efficiency in Domestic Appliances and Lighting – EEDAL'17
www: <http://iet.jrc.ec.europa.eu/energyefficiency/eedal17>
- **07** September 17-20, Chicago, Ill.
Food Marketing Institute Annual Business Conference
www: <http://bit.ly/2tcLAUm>
- **08** September 18-21, Garden City, Kans.
Garden City Ammonia Program (GCAP) CO₂ Technician Training
www: <http://bit.ly/2tMODzH>
- **09** September 18-21, Garden City, Kans.
Garden City Ammonia Program (GCAP) NH₃/CO₂ Cascade Training
www: <http://bit.ly/2tMODzH>
- **10** September 18-22, Park Rapids, Minn.
Ammonia Safety and Training Institute (ASTI) 8-Hour Refresher & 24-Hour Technician Training
www: <https://ammonia-safety.com/events/>
- **11** September 19, Santa Clara, Calif.
American Council for an Energy-Efficient Economy (ACEEE) Workshops at VERGE 17
www: [@ACEEEdc](http://aceee.org/conferences/2017/verge)
- **12** September 20-21, Conyers, Ga.
Supermarket Sense 2017
www: <http://www.supermarketsense.com/events/supermarket-sense-17/>
- **13** September 20-22, Annapolis, Md.
National Air Filtration Association (NAFA) Conference
www: <http://bit.ly/2t9CvL6>
- **14** September 20-21, Santa Clara, Calif.
Northern California Facilities Expo, Including Managing Green Buildings
www: <http://www.fenc.facilitiesexpo.com/>
- **15** September 23, Presque Isle, Maine
Presque Isle Ammonia Safety Day
www: <http://bit.ly/2t9kqNf>
- **16** September 24-27, Orlando, Fla.
Food Marketing Institute (FMI) Energy & Store Development Conference
www: <http://bit.ly/2sd8hmi>
@FMI_ORG #FMIEnergySD
- **17** September 25-28, Garden City, Kans.
Garden City Ammonia Program (GCAP) Implementation of Process Safety Management for Industrial Ammonia Systems
www: <http://bit.ly/2tMODzH>
- **18** September 26-27, Dalhart, Tex.
Ammonia Safety and Training Institute (ASTI) 8-Hour Refresher & 24-Hour Technician Training
www: <https://ammonia-safety.com/events/>
- **19** September 26-29, Hershey, Pa.
The Refrigerating Engineers and Technicians Association (RETA) Annual Conference (Heavy Equipment Show)
www: <http://www.reta-events.com/conference>
- **20** September 27-29, Atlanta, Ga.
ASHRAE 2017 Building Performance Analysis Conference
www: <http://bit.ly/2wKpkyS>
- **21** September 27-29, Atlanta, Ga.
World Energy Engineering Congress
www: [#weec](http://www.energycongress.com)

EVENTS GUIDE

October 2017



- **01** October 3-6, Milwaukee, Wis.
Plumbing-Heating-Cooling Contractors Association's Connect 2017
www: <http://bit.ly/2vHyGyr>
- **02** October 7-10, Orlando, Fla.
The National Frozen & Refrigerated Foods (NFRA) Convention
www: <https://nfraconvention.org/>
- **03** October 9-12, Garden City, Kans.
Garden City Ammonia Program (GCAP) Ammonia Operator Four-Day Course in Spanish
www: <http://bit.ly/2tMODzH>
- **04** October 10, 2 pm Eastern, Online
GreenChill Webinar: California Air Resource Board's Refrigerant Management Program & Short-Lived Climate Pollutant Strategy
www: <http://bit.ly/2ursOJP>
- **05** October 11, Aurora, Colo.
Ammonia Safety and Training Institute (ASTI) Aurora Safety Day
www: <https://ammonia-safety.com/events/>
- **06** October 17-20, Chicago, Ill.
NACS Show 2017
<http://www.nacsonline.com/NACSShow/>
www: @NACSONline @NACSONline
- **07** October 18, Chicago, Ill.
Ammonia Safety and Training Institute (ASTI) Chicago Safety Day
www: <https://ammonia-safety.com/events/>
- **08** October 22-25, Maui, Hawaii
Sheet Metal & Air Conditioning Contractors' National Association (SMACNA) 2017 Convention
www: <https://www.smacna.org/annualconvention>
@SMACNA
- **09** October 23-26, Garden City, Kans.
Garden City Ammonia Program (GCAP) Ammonia Operator Four-Day Course
www: <http://bit.ly/2tMODzH>
- **10** October 24-26, Compton, Calif.
Ammonia Safety and Training Institute (ASTI) 24-Hour Technician & 8-Hour Refresher Training
www: <https://ammonia-safety.com/events/>

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IN BRIEF

CO₂

HILLPHOENIX INSTALLS 4TH CO₂ ICE RINK IN ALASKA

ANCHORAGE, Alaska – Hillphoenix has delivered its fourth transcritical direct CO₂ ice rink system to the Municipality of Anchorage, Alaska – this time to the Dempsey-Anderson Arena, where it will become operational in September. The latest deployment follows three previous transcritical CO₂ installations at municipal ice rinks in Anchorage over the past three years – the Harry J. McDonald Center (2014), Sullivan Arena (2016) and Ben Boeke arena (2016). In all four facilities, which previously used aging R22 systems, CO₂ circulates under the floor to keep the ice frozen. These are the first ice rinks in the U.S. to use CO₂ as a refrigerant.

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

HYDROCARBONS

GREENPEACE: 57 g LIMIT ON HCs NEEDS TO RISE

AMSTERDAM, The Netherlands – The Underwriters Laboratories (UL), a U.S. safety body, this year adopted a new safety standard that boosted the hydrocarbon charge allowed in U.S. domestic refrigerators from 57 g to 150 g. However, the U.S. Environmental Protection Agency has to follow suit for the higher charge to be allowed in the U.S. Janos Maté, senior consultant with Greenpeace, contends that “the 57 g limit [in the U.S.] unnecessarily impedes the marketing of larger refrigerators, which may require somewhat larger charges. The key point is that refrigerators with larger hydrocarbon charges are safe and are sold in Europe and elsewhere in the world.”

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

AMMONIA

U.S. ATTYS GEN SEEK STOP TO RMP DELAY

NEW YORK CITY – New York Attorney General Eric T. Schneiderman, leading a coalition of 11 state Attorneys General, filed a lawsuit against the U.S. Environmental Protection Agency (EPA) for delaying the effective date of amendments to the EPA's Risk Management Program (RMP) for 20 months, or until February 19, 2019. Seeking to lift the delay, the lawsuit is signed by the Attorneys General of New York, Illinois, Iowa, Maine, Maryland, Massachusetts, New Mexico, Oregon, Rhode Island, Vermont and Washington.

More information at:
<http://bit.ly/2v0G4oo>

CO₂

CARNOT CITES 14 CO₂ LOCATIONS WITH EJECTORS

TROIS-RIVIÈRES, Quebec – Canadian manufacturer Carnot Refrigeration has installed 14 transcritical CO₂ booster systems with its own ejector and parallel compression in Ontario and Quebec at Sobeys and Costco stores as well as an industrial plant, according to Carnot President Marc-André Lesmerises. The ejectors were part of the original system in 12 of the 14 installations, which began four years ago, he noted. Carnot's transcritical systems work with both an ejector and parallel compression, but “we have a unique way to use [the ejector] that will eliminate the need for parallel compressors,” said Lesmerises. “In the near future, we will not need them anymore.”

More information at:
<http://bit.ly/2wNVgX0>

HYDROCARBONS

BLUPURA SEEKS UL OK FOR R290 WATER COOLERS

RECANATI, Italy – Italian OEM Blupura is bringing its propane water coolers in the U.S., now that the EPA's SNAP program has approved propane as a refrigerant for water coolers (with a 60g maximum charge). However, the company still needs approval from Underwriters Laboratories (UL), a process it recently began, said Debora Screpanti, marketing manager for Blupura. Blupura's propane units, which consume 15% less energy than HFC water coolers, are targeted at hotels, restaurants and offices, she noted.

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

AMMONIA

GCAP TO OFFER NH₃/CO₂ TRAINING

GARDEN CITY, Kan. – The Garden City Ammonia Program (GCAP), one of the leading industrial ammonia technical schools in North America, is set to offer ammonia/CO₂ cascade training from September 18-21. “We find each year more plants are being built and large expansions [are being installed] using cascade designs,” said Jeremy Williams, directing manager at GCAP. Though CO₂ refrigeration is not usually what GCAP teaches, it has offered CO₂ training since 2012, and has a website on CO₂ training for industrial systems. The class is aimed at those with a minimum of two years' experience in refrigeration.

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

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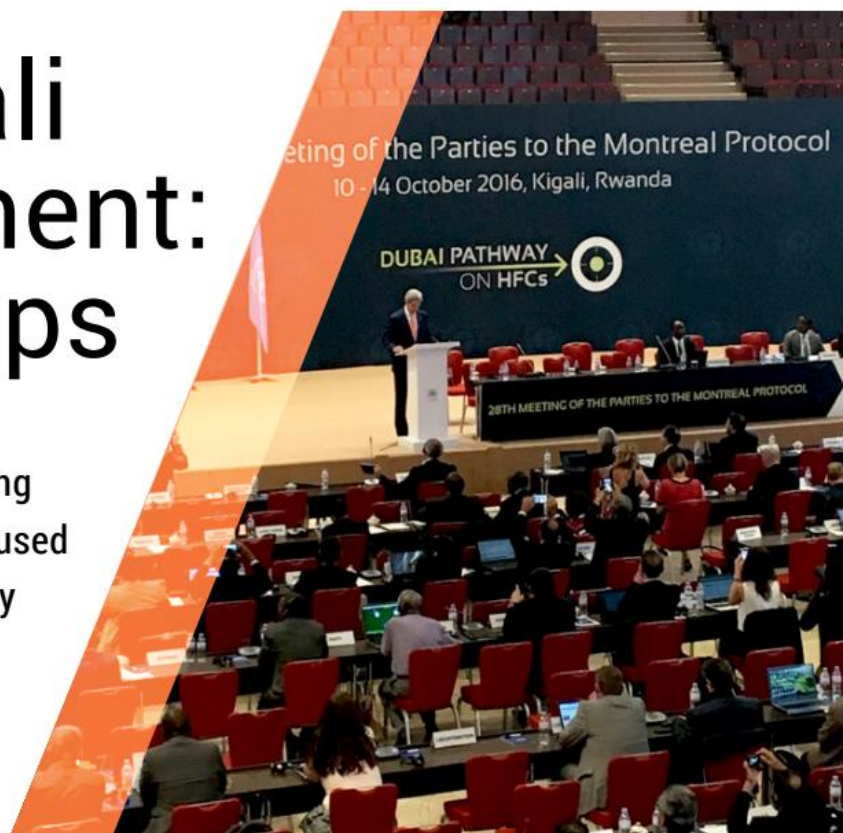


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The Kigali Amendment: Next Steps

A Montreal Protocol meeting last month in Bangkok focused on safety standards, energy efficiency and financial support for developing countries

By Avipsa Mahapatra



Last October, in Kigali, Rwanda, 197 countries agreed to extend the scope of the Montreal Protocol treaty from the original phase-out of ozone-depleting gases to a new phase-down of HFC super greenhouse gases in what has become known as the Kigali Amendment.

Seven years in the making, this was a signature moment in the global struggle to reduce global warming. If successfully implemented, the Kigali Amendment could avoid emissions of over 70 billion metric tons of carbon dioxide equivalent (CO₂e) by 2050. Also, the amendment represents a major boost to the prospects for climate-friendly natural refrigerants.

But the work has just begun. Last month (July 11-14), in the first follow-up meeting to the Rwanda gathering, the Parties (countries) to the Montreal Protocol met in Bangkok, Thailand, to

start addressing the critical elements needed to implement the Amendment. Officially, this was the 39th Session of the Open-Ended Working Group (OWEG) of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer.

Three key issues stood out among the topics under discussion:

Updating safety standards

Obsolete safety standards have been a barrier to market uptake of climate-friendly alternatives to HFCs in the cooling sector. To address this issue, a full-day workshop on "Safety Standards Relevant to the Safe Use of Low-GWP Alternatives to Hydrofluorocarbons" was convened the day before the OWEG meeting.

“ *Obsolete safety standards have been a barrier to market uptake of climate-friendly alternatives to HFCs in the cooling sector.”*

The workshop was divided into four sessions: an overview of the international safety standards of greatest importance to the Montreal Protocol and its Kigali Amendment, and the process for developing and revising the standards; identifying limitations to the uptake of lower-GWP alternatives that could be addressed with changes to existing international safety standards; the relationship between international and national safety standards; and how stakeholders can work together to maximize the opportunities for the safe use of lower-GWP alternatives.

Discussions revolved around unpacking the challenges associated with modernizing and harmonizing the standards that apply to this sector across geographies, while getting broader stakeholder participation and ensuring human safety is not compromised.

Broader participation by experts in developing (A5) countries could lead to more timely progress on key technical issues affecting refrigerant choices in priority sectors, and to increased focus on the most cost-effective and efficient technologies. For instance, A2L (so-called mildly flammable) refrigerants have received increased attention and focus in recent years as it is in the interest of multiple U.S., European and Japanese companies to open up the market to R32, HFOs and a number of new HFC blends that are A2Ls. But greater participation,

including from developing countries, may help address the full range of alternatives, including A3 refrigerants.

Expanded participation in working groups focused on standards will also contribute to greater regional knowledge of the technical aspects of proposed changes, allowing for more rapid adoption of changes to international standards at the national level. Continued political attention is thus critical for progress in this arena.

Integrating energy efficiency

Energy efficiency was a key discussion point at the Bangkok meeting. Two separate Conference Room Papers (CRPs) were presented – one from India and other Group 2 (high-ambient developing) countries, as well as one from the African Group; the latter asked for additional work on how refrigerant transition would be accompanied by concurrent energy-efficiency gains. These proposals received near-universal support from all developing countries.

Donor countries showed openness to discussing the scope of energy efficiency, and there was consensus around having a focused workshop to further flesh out an appropriate strategy. However, the challenge of incorporating energy efficiency compounds the complexities around how to best direct finite funds. There is a concern that transitional alternatives like HFC-32 or HFC/HFO blends, which are yet to be used in a widespread manner, are being pitched as “energy efficient alternatives” but there seems no reason to spend public money toward such chemicals that will necessitate another transition in the near future anyway. ►

► Replenishment

Another key negotiating issue was how much money will be available for the Multilateral Fund and what exactly it will be used for in helping developing countries to carry out an HCFC phase-out (the precursor to the HFC phase-down). The Technology and Economic Assessment Panel (TEAP) estimated that for the years 2018-2020 around \$600 million to \$750 million will be required, most of it going to phasing down HCFCs and about 5%-10% going towards “enabling activities” for developing countries to start the HFC phase-down.

After protracted discussions in a contact group formed for this specific issue, Parties agreed on a list of items to be covered by TEAP in its supplementary report on funding needs for the 2018-2020 replenishment of the Multilateral Fund at the next Meeting of the Parties (MOP) to the Montreal Protocol.

A robust replenishment will be critical to assuring developing countries that they’ll have adequate resources to plan for and implement the Kigali Amendment. This is particularly significant as Parties endeavor to ratify the amendment back home. Additionally, strong replenishment now will enable countries to look for greater opportunities to take the right preparatory steps for the HFC phase-down, or leapfrog HFCs altogether, thus being

more cost-effective in the long run.

Other conversations, which included reporting data and HFC destruction, will be continued at the next meeting in November in Montreal, Canada.

In addition, the OEWG meeting was preceded by the meeting of the Executive Committee of the Multilateral Fund, where important guidance work was completed regarding cost guidelines, enabling activities, and a study on the most cost-effective ways to destroy R23, a super-potent by-product of R22 production, with a very high GWP (14,800).

With the adoption of the Kigali Amendment, the Parties to the Montreal Protocol joined the urgent global effort to prevent dangerous anthropogenic climate change. It is now time for them to translate intent to actions in order to swiftly implement the Kigali Amendment and fulfill its potential.

When Parties to the Protocol meet again in November, the Protocol will be celebrating its 30th Anniversary. If we have learned anything in the last 30 years from the success of the Montreal Protocol, it is that a global agreement, regardless of how well intended, cannot meet its full potential unless it is accompanied by robust implementation. Well begun is half done! ■ AM

“It is now time for [the Parties to the Montreal Protocol] to translate intent to actions in order to swiftly implement the Kigali Amendment and fulfill its potential.”



Avipsa Mahapatra is the climate campaign lead at the Environmental Investigation Agency (EIA), based in Washington, D.C.

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Trending in North America: CO₂

Representatives from five transcritical equipment manufacturers see market growth as energy efficiency increases in warm climates and training improves

By Devin Yoshimoto and Michael Garry

When five executives from major OEM and component manufacturers came together at an ATMosphere America panel in June to discuss market trends and opportunities for natural refrigerants, they reached a consensus about transcritical CO₂ refrigeration systems.

While the systems still lag far behind market penetration in Europe, transcritical CO₂ booster technology has made major progress in the North American market, both in the number of installations and in their efficiency across geographical areas and climates, they said.

The number of installations in North America has roughly doubled since 2015 to approximately 410, with close to 300 of them produced by Hillphoenix, Conyers, Ga., said Scott Martin, the company's director of business development and industry relations; he was one of the five panelists discussing market trends at ATMosphere America, held in San Diego June 5-7.

Hillphoenix has also marketed numerous cascade and secondary CO₂ systems in North America under its Second Nature brand — more than 50 of the former and more than 200 of the latter, said Martin.

Hillphoenix's Danish subsidiary, Advansor, which it acquired in 2011, is a leading transcritical OEM in Europe, bringing Hillphoenix's worldwide



transcritical installations to over 3,300. Martin sees further growth coming in North America. "We are very excited about that growth," he said.

Peter Dee, sales & service director for component maker Danfoss North America, Baltimore, Md., agreed with his co-panelist Martin.

"The OEM's are seeing an increase in CO₂ in the industry in North America," he said. "We are seeing the same pattern. And it is the same pattern we saw in Europe as well, when CO₂ took off." This growth in CO₂ installations is leading to a drop in costs, added Dee.

Panelist Jerry Lozano, sales and application engineer for German component manufacturer Güntner, was encouraged to see several other companies joining the market. "The technology benefits from more competition," he said, adding that Güntner "is not the only manufacturer that is creating an adiabatic solution for CO₂ refrigerants."

In regard to the quality of transcritical systems, Kysor/Warren has been "working with suppliers to drive component quality to higher levels," which is "mitigating

problems in the field," said Michael Lehtinen, director of marketing for Kysor/Warren, Columbus, Ga.

Another application of CO₂ is in heat pumps. Italian compressor maker Dorin plans to market its CO₂ compressors for heat pumps in China, said Giacomo Pisano, the company's technical sales manager. This can happen in the U.S. as well, he said. "We are here to provide support."

(The ATMosphere America conference took place prior to the recent court ruling on the Environmental Protection Agency's ability to regulate HFCs. The decision could influence the U.S. natural refrigerants industry, though industry observers say it's too early to know. [See story, page 24.](#))

EFFICIENCY ENHANCERS

A major factor that will impact the growth of transcritical CO₂ systems in the U.S., particularly in warmer climates, is the development of energy-enhancing technologies like adiabatic condensers and ejectors.

Adiabatic condensers, in particular, have experienced considerable growth

of late in North America, said Lozano.

"So far, this year we've added 50 new sites going adiabatic," said Lozano. "It's a very big trend," driven by the efficiency savings offered by the technology.

Lozano showed an ROI calculation for the additional cost of an adiabatic condenser over a dry gas cooler. "There is a premium for going adiabatic," he said. "But because the system itself is so efficient, your simple payback is less than a year,"

Ejectors represent a new technology in North America that can also reduce energy consumption in transcritical CO₂ systems. "This year, we're excited to say that we deployed the first ejector system in [the U.S.]," said Martin of Hillphoenix, referring to a transcritical installation at a new Sprouts store in Georgia.

That ejector is Danfoss's CTM multi-ejector. Danfoss has deployed it around the world and is now working with Hillphoenix to use it in the U.S. "We have over 40 sites globally that are currently testing our ejector technology," said Dee. "We are willing to share data" on the impact the ejector has on efficiency.

Martin told conference attendees that when he began attending ATMOsphere conferences six years he predicted that over time technology enhancements like ejectors and parallel compression would address transcritical systems' energy challenges in warm climates.

He noted the historical progression of the technology in Hillphoenix systems, with subcoolers introduced in 2013, adiabatic condensers in 2014, parallel compression in 2016 and ejectors this year.

"We will beat HFC systems' energy efficiency and we're at that threshold now," he said.

In an effort to measure the energy savings delivered by different transcritical systems, Emerson Commercial and Residential Solutions has started running a series of tests at its Helix Innovation Center, in Dayton, Ohio. Panelist André Patenaude, the company's director of CO₂ business development,

said the data would help drive transcritical sales by boosting confidence in the efficiency of the system.

"What Emerson is trying to do this year is to take a CO₂ transcritical booster system and try to understand it better from an energy perspective," said Patenaude.

Emerson is starting with a basic booster system and "energy optimizing it as best as we can, running it at a gamut of temperatures and humidities," said Patenaude. In phase one of the project, launched in June and running through September, Emerson is comparing the basic system to a system with: parallel compression; an adiabatic condenser; a combination of parallel compression and an adiabatic condenser; mechanical subcooling; and heat reclaim.

In phase two, running from October through December, Emerson will compare the basic system to one with: air conditioning and parallel compression, vapor ejectors and parallel compression; vapor ejectors, parallel compression and an adiabatic condenser, and other potential systems.

COST CONSIDERATIONS

Though the efficiency of natural refrigerant systems continues to improve, the market is still faced with the challenge of overcoming the barrier of high initial costs.

To overcome this barrier, several panelists advocated looking at initial costs through the prism of such financial measures as total cost of ownership (TCO), ROI and total cost of installation.

"We spend a lot of time talking about how to overcome that first cost and you do that with the total install price, a total cost of ownership model," said Martin of Hillphoenix. "We have a very robust process for calculating the install price and ROI of CO₂ systems."

Martin pointed out measurable installation savings areas in transcritical systems, such as the start-up refrigerant charge, piping and electrical installation, and other savings from case



Scott Martin, Hillphoenix



Michael Lehtinen,
Kysor/Warren

performance with electronic expansion valves and lower refrigerant costs. Intangible benefits include future HFC retrofit cost avoidance, relief from leak and recordkeeping requirements, and a reputation for social responsibility.

Lehtinen of Kysor/Warren explained how the rising cost of HFCs is also an important factor when figuring total cost calculations.

"We're seeing HFC costs go up, which factors into the ROI and the TCO analysis," said Lehtinen. "We also know that refrigerant phase outs are coming and that this is going to create a financial burden for retailers as well." He also pointed out the reduced product loss as a result of transcritical's superior cooling effect.

"The total cost of ownership calculation is now a much more dynamic model than we've had in the past," said Lehtinen.

Hillphoenix's New Partner

While Hillphoenix has a reputation for driving the market for CO₂ refrigeration in North America, the company is involved in other natural refrigerants such as ammonia (in ammonia/CO₂ commercial systems) and hydrocarbons (in self-contained cases).

Recently, the company burnished its ammonia credentials by partnering with NXCOLD, Los Angeles, a developer of ultra-low-charge ammonia packaged systems for industrial applications.

"One of the most exciting things that we're working on today is the partnership with NXCOLD," said Scott Martin, director of business development and industry relations for Hillphoenix.

Hillphoenix is now the exclusive provider of NXCOLD systems in Canada, Mexico, Central America, South America, and the Caribbean islands, "and we're working hard towards an agreement that will include the United States," Martin said.

The partnership signals the potential for growth of low-charge ammonia systems in North America.

"We believe that this is a game-changing, revolutionary technology," said Martin. "We're excited to come back and talk next year about the evolution of this product."



Peter Dee, Danfoss



André Patenaude, Emerson



Jerry Lozano, Güntner



Giacomo Pisano, Dorin

► PROGRESS WITH TRAINING

While the advancement of technology is driving lower costs and wider adoption, the importance of training was not forgotten.

Dee of Danfoss, whose Mobile CO₂ Training Unit was present at ATMOSphere America (see page 48), was encouraged by the emphasis placed on improving skill sets in the industry.

"It's nice to hear that we're all doing our part in the industry, from the OEM's to the manufacturers and end users who are requesting that their contractors are trained and certified to help with these new technologies," he said.

Hillphoenix highlighted the results seen from its comprehensive training program. "We're very proud of it," said Martin. "It's in its eleventh year

of existence and we've trained over 26,000 people, including contractors, end users, engineers and consultants."

By partnering with contractors, OEMs can take the perceived "hassles" out of natural refrigerant systems, noted Lehtinen.

As a parting note, Lehtinen encouraged attendees at the conference to share information about natural refrigerants with their peers.

"We're believers here at ATMOSphere but a lot of others are not on board," he said. "So, as we leave here with all this information, go out there and communicate with our customers and retail partners and help grow this event and grow this thought process as we move towards natural refrigerants." ■ **DY+MG**

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Industry Waits for EPA's Next Move Following Court Ruling on HFCs



It's too soon to know the ultimate effect of the decision on the EPA's ability to regulate HFCs, but some say the momentum for natural refrigerants remains undiminished

By Michael Garry and Charlotte McLaughlin

Industry reaction to a federal court ruling on the U.S. Environmental Protection Agency's authority to regulate HFCs has so far been reserved as the EPA and intervening defendants contemplate their next step.

The U.S. Court of Appeals for the District of Columbia Circuit ruled August 8 in *Mexichem Fluor, Inc. v. EPA* that the EPA cannot require companies to replace HFCs designated for HVAC&R equipment or other applications with low-GWP substances under the SNAP (Significant New Alternatives Policy) program.

The decision specifically vacated an EPA rule released in 2015 "to the extent that [the rule] requires manufacturers to replace HFCs with a substitute substance." Some observers took this to be a challenge to the EPA's use of the Clean Air Act to address climate change.

While the ruling would appear to be a setback for low-GWP HFC replacements like natural refrigerants, several industry players said it was too soon to know its ultimate effect given the different directions the EPA can still take, including an appeal. In any event, a number of observers doubt the case can slow the momentum toward natural refrigerant technology.

"This decision is a temporary speed bump on the path to phasing down HFCs," said Avipsa Mahapatra, climate campaign lead at the Environmental Investigation Agency (EIA). "It is not going to stop the increasing global demand for future-proof solutions."

The two plaintiffs in the case were non-U.S. manufacturers of HFCs: Mexican company Mexichem Fluor and French company Arkema SA. In February, the Trump administration, along with intervenors (the National Resources Defense Council, Chemours and Honeywell), defended the EPA in oral arguments. Chemours, Honeywell and the NRDC are also exploring an appeal.

The EPA's SNAP program, which operates under Section 612 of the Title VI amendment to the Clean Air Act, was found by the court to have exceeded its authority.

The Obama administration's EPA in 2015 extended the original SNAP program — which had only dealt with the phase-out of ozone-depleting substances (ODS) — to the delisting of certain HFCs, which are non-ODS but have a high global warming impact. ▶

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► But Judge Brett Kavanaugh, writing for a 2-1 majority, ruled that the law does not extend to non-ODS and does not allow the EPA to require companies to replace HFCs with low-GWP refrigerants. However, the court rejected the plaintiffs' argument that the EPA's decision to remove HFCs from the list of safe substances was "arbitrary and capricious." The ruling also allows the agency to require manufacturers still using ODS to leapfrog over HFCs to low-GWP refrigerants.

The ruling requires the EPA to take action consistent with the court's decision. The agency was given other options by which it can regulate HFCs, such as the Toxic Substances Control Act.

Wait and see

Industry reaction to the decision has been cautious. "It's too early yet – we need to wait to see what happens," said Scott Martin, director of business development and industry relations for Hillphoenix, a major U.S. manufacturers of CO₂ refrigeration systems.

A representative of a U.S. grocer with natural refrigerant installations said the ruling would have "no impact" on his company.

"There are multiple parts to the court's decision and, in order to determine the long-term consequences, we first need to hear from the EPA on their next steps," said Danielle Wright executive director, North American Sustainable Refrigeration Council, Mill Valley, Calif., which supports the use of natural refrigerants in supermarkets.

In any event, "it would be an unsound decision to invest in HFCs for new equipment or retrofits when there are so many low GWP or zero GWP options available," she added. "We continue to believe that now, as always, the strongest case for natural refrigerants is the business case."

Noted Mahapatra, "There is no excuse for companies to continue producing and using these chemicals when climate-friendlier alternatives are readily available and in use around the world."

The Kigali Amendment to the Montreal Protocol, calling for a global phase-down of HFCs, is another

factor. The U.S. was a party to the amendment, but to go into effect in this country the Senate would need to ratify it, most observers agree. If the Senate does that, "HFCs will certainly need to be regulated in some way or the other for the U.S. to meet its commitments," said Mahapatra.

In the court's decision, Kavanaugh took particular issue with the EPA's interpretation of the word "replace" in the SNAP section of the Clean Air Act. "Under EPA's current interpretation of the word 'replace', manufacturers would continue to 'replace' an ozone-depleting substance with a substitute even 100 years or more from now," Kavanaugh wrote.

Judge Robert Wilkins, an Obama appointee who dissented in part, wrote that he believes that the word "replace" under the SNAP program does not just relate to ODS. Wilkins argued that the court should have deferred to the EPA in this case, because the position of Congress on the SNAP program is unclear and the EPA has made "reasonable" rules in this matter.

EIA's Mahapatra noted that while the divided decision was "essentially based on differing legal interpretations of the word 'replace,' what is unquestionable is that those HFCs are absolutely not 'acceptable' substitutes for CFCs [and HCFCs], given their impact on climate, and thereby human health and safety."

Now what?

The ruling has now gone back to the EPA, which is required to take action consistent with the court's decision, such as using other statutory authority to regulate HFCs, or accepting the court's restrictions on HFC regulation.

Alternatively, the EPA could explore implementing a "retroactive disapproval" of HFCs under the Clean Air Act, which may be permissible if the EPA could explain why it is pursuing this route.

Another avenue the EPA could take is to appeal the ruling to the full Court of Appeals for the District of Columbia Circuit, regarded as having a more progressive bent than the three-judge panel.

Finally, the U.S. Congress could adjust the Clean Air Act so that it applies to HFCs as well as ODS, particularly if the Senate ratifies the Kigali Amendment ■ **MG+CM**

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On August 1, 2017, Nidec successfully acquired the German compressor manufacturer Secop.

CAN UTILITIES ADDRESS THE 'ELEPHANT IN THE ROOM'?

End users still face a high initial equipment cost for natural refrigerant systems, but that can be eased with energy incentives – if utilities can be educated about the systems' energy-saving potential

By Charlotte McLaughlin and Michael Garry

Natural refrigerant systems in North America, while gaining market traction, continue to face the “elephant in the room”: initial cost.

Though costs are coming down, the premium an end user pays for a natural refrigerant system (before installation) vs. a standard synthetic system can range, on average, between 50%-60%, noted Leigha Joyal, technical product support – energy analyst for OEM Hillphoenix, Conyers, Ga. (Installation costs of a natural refrigerant system can be 10% to 15% less than that of a synthetic system, lowering the installed system pricing, she added.)

A growing way for end users to lessen the initial cost of a natural refrigerant system is to obtain incentives from energy utilities, based on the energy efficiency of the system.

“The incentives being granted are very significant in bringing that ROI down and actually making the customer take a second or third look and say, ‘This might be worth it for us to go to

a natural system,’” said Joyal, who joined representatives of Whole Foods Market and five western utilities (see next page) at a panel discussion at ATMosphere America in June.

Utilities across the U.S and Canada have various programs to encourage energy reductions, including some aimed at basic refrigeration equipment like LED case lighting, anti-sweat controls, etc. The total budget for these programs – including both energy efficiency and demand response programs – is considerable, reaching just over \$9.2 billion in 2016, according to the Consortium for Energy Efficiency.

But many utilities are still missing out on how can they achieve extra energy savings, according to Aaron Daly, global director for energy management at Whole Foods Market, Austin, Texas. When it comes to savings from natural refrigerant systems, they have a knowledge hurdle to clear.

With some exceptions, “utilities don’t care about natural refrigerants because

utilities don’t know about natural refrigerants,” said Daly, who challenged the audience by adding, “How can we engage with utilities? How can we get them interested in what we’re doing?”

“We need to spark the discussion with utilities to make them understand that natural refrigerants are the way to go,” added Joyal. While California utilities, such as the ones on the panel, have started to incentivize natural refrigerant systems, “it’s very different elsewhere,” she said.

A clear presentation of the energy savings inherent in natural refrigerant technologies is one way to gain their attention. In fact, retailers saving energy by switching to natural refrigerants are in a perfect position to start a dialogue with utilities, Daly said. “We need to think about it from the perspective of the utility – what they are ultimately trying to achieve.”

EXAMPLE OF ENERGY SAVINGS

In her capacity as an energy analyst at Hillphoenix, Joyal has been successful in securing millions of dollars in utility incentives for customers of the company’s CO₂ refrigeration systems.

One way for to engage with utilities is to point out the cost challenges that end users face. “Once we get [utilities] on their own, we can explain what the costs are for a natural system, and what the premium is for going to a CO₂ system,” she said.



Aaron Daly, Whole Foods Market

Joyal is also equipped with data on energy savings made possible by natural refrigerants. Refrigeration accounts for 50%-60% of a store's total electric consumption, and putting a natural refrigerant system in can mean a 10%-20% reduction in energy, "depending on the type of system you put in and where you put it," she said.

In one example Joyal provided, a supermarket in Ohio using a transcritical CO₂ booster system saved 10.6% in annual energy consumption by compressors, fans and pumps, compared with an R407A system.

While cooler climates allow more efficiency, transcritical systems in warmer climates can leverage energy-enhancing technologies to reduce energy costs, Joyal noted. An adiabatic gas cooler, for example, offers annual savings of 8%-12%; parallel compression delivers 6%-8% savings, and in combination with gas ejectors, 8%-10%.

This energy savings creates a synergy between end users and utilities, noted Daly. "It's difficult for us as end users to invest in natural refrigerant systems unless they have an energy return on investment; the same is true for utilities."

Utility Incentives

San Diego Gas & Electric

San Diego Gas & Electric has an Emerging Technologies Program for vetting new technologies. "Every year we use that money to do field demonstrations," said Chris Roman, project manager, at ATMOSphere America 2017. The research findings are publicly available at www.etcc-ca.com, along with that of other California utilities.

The utility also offers Energy Efficiency Business Rebates (EEBR) and Energy Efficiency Business Incentives (EEBI). For the former, "if you have a widget and it does the same thing every time, we'll dictate a rebate value," said Roman. A work paper must be submitted "to get to a deemed value."

The EEBI applies to custom projects. "If you have a natural refrigerant system that is better than X, and can prove kilowatt savings over a long period of time, you can get big money from our program," said Roman. "But there are a lot of rules."

Pacific Gas and Electric

Like San Diego Gas & Electric, Pacific Gas & Electric offers prescriptive rebate and incentive programs. To get a rebate, "just purchase an approved, [commercially available] energy-efficient product for your company, fill out a rebate application, and we'll send you a check," said Patrick Moore, the utility's agricultural and industrial lead product manager. Qualifying products include anti-sweat heater controls, efficient evaporator fan motors and high-efficiency refrigeration display cases.

To earn an incentive of at least \$2,000 for custom projects, "submit a project application that demonstrates energy savings and allow [us] to inspect and approve your project before you remove old equipment or systems and before you order, or install new equipment or systems," he said. The incentive rate for "basic non-lighting" equipment is \$0.08/kWh.

The utility also offers interest-free loans from \$5,000 to \$100,000 for replacing old equipment with more energy-efficient models, with up to five years for repayment. ►

► Bonneville Power Administration

The Bonneville Power Administration (BPA), Portland, Ore., is a non-profit federal utility wholesaler that sells carbon-free power to 142 retail utilities in the Pacific Northwest. It develops programs that can be used by its customers. (See, [“Sizing Up NatRefs in the Pacific Northwest,” *Accelerate America*, September 2016.](#))

BPA is involved in research projects, including one where it is using a ClimaCheck device to collect baseline data – including temperature, pressure, EER, power and cooling loads – on medium- and low-temperature refrigeration systems as well as a transcritical CO₂ system. In June, BPA released a report called “Demystifying Alternative Refrigerants” (<http://bit.ly/2v3Wflp>).

For the commercial sector, in addition to a standard deemed rebate program, BPA has a custom program that is open to natural refrigerant systems. “If you want to do a natural refrigerant project, and it saves money and we agree to estimate the energy savings, you can do it immediately,” said Anthony. “Give me a call. We would love to see a natural refrigerant project.” He recommends contacting him early for a custom project. BPA has \$5 million to \$8 million for the next four years earmarked for custom projects.

BPA also offers incentives through an Energy Smart Industrial Program, handled by a third party.

Southern California Edison

Southern California Edison (SCE) has been exploring incentives for low-charge ammonia packaged systems for industrial applications over the past few years. Its first site, a Lineage Logistics plant in Oxnard, Calif., using a NXTCOLD system, earned incentives of \$0.08/kWh for energy savings, and \$150/kW for demand reduction. “It’s about managing demand and [efficiency],” said Paul Delaney, senior engineer for SCE.

SCE is now involved in a study of energy efficiency and demand response at two Southern California facilities – a Baker Cold Storage warehouse using 46 rooftop NXTCOLD units, and a General Cold Storage warehouse employing eight NXTCOLD units.

Delaney also cited an SCE-funded project to study Mayekawa’s NewTon 3000 low-charge ammonia/CO₂ system at an Imuraya USA candy plant– the first such installation in the U.S. The system was found to consume 32% less energy than a baseline R507A system.

SCE partners with the Electric Power Research Institute (EPRI), Creative Thermal Solutions and other utilities “to understand the performance of new systems and determine load profiles,” said Delaney.

“We’ve committed ourselves to tackling global warming and leaving the world a better place than when we started,” he said.

Sacramento Municipal Utility District

On March 30, 2017, the Sacramento Municipal Utility District (SMUD) announced a new incentive program aimed at natural refrigerants used mostly by supermarkets, convenience stores, cold-storage warehouses and food processors.

It’s the first utility program in the U.S. to offer incentives based on the direct greenhouse gas reduction made possible by natural refrigerant technology, along with traditional energy incentives. (See [“Game Changer,” *Accelerate America*, May 2017.](#)) SMUD will pay for energy performance metering and data collection.

“Natural refrigerants can reduce direct GHG emissions by over 99%,” said Tim Kidman, project director, sustainability and energy, for WSP USA, who worked with SMUD on the program. “No projects have been funded yet, but [we] are fielding calls from around [California] from interested stores. And there is clear demand for similar programs in other utilities.”

SMUD is offering \$25/MtCO₂e reduction over a system’s lifetime, with a limit of 30% of a project’s cost or \$150,000, whichever is less. It is also providing \$0.10/kWh of energy savings and \$200/kW of demand reduction, with the same dollar limits. The combined incentive is limited to 50% of project cost or \$250,000, whichever is less ■ CM+MG



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Paving the Way for Transcritical CO₂, Down Under

Woolworths wants its first transcritical CO₂ store to serve as a learning lab for Australia's contractors, suppliers and other retailers

By Devin Yoshimoto

Two weeks before the grand opening of Woolworths' new store in Colebee, New South Wales, Australia, in May, a single bottle of champagne sat in a bottle cooler in an empty walk-in cold room. The rest of the 34,445-sq-ft supermarket was virtually empty of stock.

"You'll notice that somebody's already put out a bottle of champagne," said Dario Ferlin, Woolworths' sustainable innovations engineer, with a smile, as he led a tour of the store for *Accelerate Australia & NZ* (a sister magazine to *Accelerate America*).

No doubt Ferlin and the rest of his team later enjoyed the champagne in celebration of Woolworths' first transcritical CO₂ store in Australia.

The store's pilot transcritical CO₂ system is designed to operate in remarkably high ambient temperatures – up to 113°F (45°C) – reliably and efficiently, incorporating the latest in commercial refrigeration technology.

"This journey has taken quite a number of years to get to where we are today," Ferlin said. "But along the way, there have been quite a few learnings, all with

the view to developing what we believe is the best the world can offer for the Australian environment."

It is not just the technical achievements that make Woolworths' transcritical system impressive. The retailer has a broader vision for the technology, incorporating the rest of the Australian retail refrigeration industry.

"This isn't about simply opening up a store successfully and then walking away," Ferlin explained. "This is about building up the skill sets in the industry. It's about sparking creativity and imagination – with other contractors and other retailers – so we can start the ball rolling."

MASSIVE CHAIN

Based in Bella Vista, New South Wales, Woolworths Limited (no connection to the U.S. company F.W. Woolworths, now known as Foot Locker) has wide-ranging outlets, including 873 Woolworths supermarkets in Australia and 160 Countdown stores in New Zealand. The company also operates Caltex Woolworths (gas stations), Dan Murphy's



Dario Ferlin, Woolworths

and BWS (liquor chains), Masters (home improvement), Big W (general merchandise) and ALH (hotel and gambling).

The Woolworths supermarket chain has over 150 CO₂ cascade installations – what has been its “business as usual” technology – in Australia but the company is now interested in implementing CO₂-only waterloop display cases and CO₂ transcritical systems. Its Countdown chain in New Zealand currently employs several transcritical units.

Transcritical refrigeration is a relatively recent phenomenon for Australian supermarkets. The other dominant food retailer in the country – Coles – opened its first transcritical CO₂ supermarket in August 2015. (The system combines both refrigeration and air conditioning; display cases also use propylene and propane.) All told, there are reportedly about 15 transcritical systems in Australia.

Woolworths’ sustainability initiatives began in 2006, when the retailer released its 2007-to-2015 sustainability strategy. This targeted a reduction of carbon emissions of 40% during that period – an ambitious goal that the company reached in 2015. In 2017, Woolworths announced its 2020 Corporate Responsibility Strategy, which aims to reduce carbon emissions by an additional 10% below 2015 levels by 2020.

Replacing high-GWP HFC refrigerants with CO₂ systems has been a key to meeting Woolworths’ greenhouse gas reduction goals, picking up steam in 2010 when the company became a signatory to the Consumer Goods Forum agreement to phase out high-GWP refrigerant gases. Woolworths now plans to install 10 natural systems employing technologies such as transcritical CO₂ or water-loop CO₂ condensing units by 2020, according to its corporate strategy statement.

As Woolworths continues to look for opportunities to reduce its carbon emissions, another large target is its air-conditioning systems, which, said Ferlin, “have hundreds of kilograms of synthetic refrigerant.” One option would include integrating the HVAC system into the transcritical refrigeration rack, completely eliminating synthetic refrigerants from both.

AN HFC-FREE FUTURE

The wider need to train the HVAC&R industry in Australia on CO₂ systems has become apparent in light of the country’s impending HFC phase-down beginning in January 2018.

There must be an “acknowledgement that sustaining refrigeration innovation requires the upskilling of the local commercial refrigeration industry,” Ferlin told the ATMOsphere Australia 2017 conference in Sydney in May. “That acknowledgement goes beyond Woolworths and is industry-wide.”

From the outset, Ferlin and his team recognized the opportunity to use the development of the Colebee store to help move Australia’s wider HVAC&R industry to an HFC-free future.



“We used, almost exclusively, local technology providers,” said Ferlin, “which meant the R&D, the development and the support were all done locally. It also means the day we opened to trade, that skill set is still around. It’s available for the next store – or our competitor’s next store.”

A collaborative attitude among all participants in the project, explained Ferlin, set the tone and helped establish local transcritical CO₂ know-how.

“On this job, everyone was coming along for the same trip,” said Shaun Merry, national installation manager at Retail FM, a Woolworths-owned subsidiary that served as the installation contractor for the transcritical system at the Colebee store. “The case manufacturers, the rack manufacturers, the electricians, the people who do the architecture for the controls, have all worked together to get here.”

Woolworths hosted meetings at its offices in an effort to foster active participation and discussion among all stakeholders.

“Together with all of our subcontractors and all of our suppliers, we had several roundtable meetings at our head office,” said Ferlin.

“We went through the whole design and concept of a transcritical system,” added Merry, “so they understood what it was we were trying to achieve from the outset.”

“It was a collaborative approach – everyone’s voice was heard,” noted Jim Dowling, Woolworths’ senior refrigeration field engineer.

“This exchange – this ongoing dialogue between stakeholders – meant that the knowledge base, collectively, was increasing,” said Ferlin. ►



► FLESHING OUT THE DESIGN

The transcritical CO₂ rack supplier for this project, Bitzer Australia, played a key role in educating stakeholders early in the design process. The system consists of two independent racks, each one serving 50% of the freezer load and 50% of the medium temperature load.

"Throughout the design process," said Ferlin, "we had forums where the Retail FM design and installation team would come in, Bitzer Australia would come in, and the engineering department of Woolworths would come in, and we would actually flesh out the design that Bitzer was proposing, and it offered everyone an opportunity to challenge each other."

Among the questions asked, said Ferlin: Why are you doing this? Isn't there a better way of doing it? "So, having that local content being delivered by a local technology partner is part of that training – part of that skill set investment that we are trying to achieve."

Another key choice in the design of the transcritical CO₂ system was the controls. "What is particularly different about transcritical CO₂ systems, as opposed to conventional

systems, are the controls," Ferlin said, adding that this difference offers another learning opportunity.

The team decided to use Emerson programmable controllers for the front of the racks rather than conventional parametric controls. "Programmable means everyone needs to have a fundamental understanding of what the transcritical cycle is and how it's supposed to operate," said Ferlin. "You are obliged to do that when you're forced to program the controller to manage the cycle."

Though choosing a parametric control system might have been the simpler choice, "that would have come at the cost of not learning, understanding and developing that local transcritical CO₂ knowledge base."

Woolworths' pilot transcritical CO₂ system is designed to operate efficiently in ambient temperatures of up to 113°F (45°C), with a view to replicating it almost anywhere in Australia across various temperature conditions. "This is a template, one that is robust, energy-efficient, and simple to service in the years to come," Ferlin said.

The key to maintaining the system's efficiency and reliability is managing the flash gas – a side-effect resulting from the operation of the system in transcritical mode in Australia's blistering summer temperatures. The solution chosen was parallel compression – a well-known flash-gas management method tested in numerous transcritical CO₂ systems around the world.

However, that method comes with its own challenges, Ferlin noted. "You are balancing the use of parallel compressors with the flash-gas bypass valve, adding a bit more commissioning complexity." But the decision was made with a long-term view, looking ahead to the transcritical CO₂ installations to follow around Australia.

Once the design process was complete, Bitzer Australia facilitated hands-on transcritical CO₂ training for technicians.

"The design and install contractor, Retail FM, actually had an opportunity to charge up a test rig at Bitzer's facility and assist in actually starting up the test rig," said Ferlin. "And this is following a theoretical seminar, leading up to that hands-on experience."

"The training that the rack manufacturer has done has been really good," noted Merry. "It helped make sure that the technicians were comfortable [working with transcritical CO₂]."

Both Ferlin and Merry highlighted the importance of training contractors to help sustain this transcritical CO₂ system, and the others to follow. ►

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► CULTURE OF COOPERATION

One of the most interesting aspects of Woolworths' transcritical project was its participants' willingness to cooperate with the competition. Ferlin challenged every stakeholder to be open to cooperating with competitors in order to lift up the entire industry.

"Before Retail FM engaged the potential local rack manufacturers," said Ferlin, "I challenged both of them with a concept which was unfamiliar to them."

"I said to one, 'In the event that you are successful, are you willing to allow your competitor, the alternative rack supplier, to become familiar with your successful installation?' I asked the same question to the other one. To my surprise and gratification, they were both on board with this concept."

Merry added in agreement: "I think other installation contractors, who do work for Woolworths – we'd certainly be open to letting those guys through [to become familiar with the project]."

As stated in Woolworths 2020 Corporate Responsibility Strategy, Colebee is just a pilot store, with the company poised to roll out ten CO₂-only stores in Australia by 2020.

"The conversation with internal stakeholders is still ongoing," said Ferlin. "But there is enthusiasm within the engineering department to not just make this a one-off, but the start of a new journey."



From left, Shaun Merry, Retail FM; Dario Ferlin, Woolworths

Ferlin's conviction is firm, and no doubt necessary, in order to continue driving Woolworths – and the rest of the industry – forward towards an HFC-free reality.

"It is not necessarily the easiest path," Ferlin acknowledged. "Not necessarily the path most travel by. But I believe in the long-term interests of the viability of CO₂ transcritical."

"We are facing a reality now where HFCs are going to be phased out. So, we, as an industry, have to start taking measures towards that HFC-free environment. We need to start investing in upskilling the industry now."

"I believe this is what we're doing here." ■ DY



Transcritical rack, Colebee store

SYSTEM SPECS

Woolworths' transcritical CO₂ system at its store in Colebee, New South Wales, Australia, has the following characteristics:

- » Number of display cases: 60
- » Medium-temperature load: 85.3 TR (300 kW)
- » Low-temperature load: 11.4 TR (40 kW)
- » Two booster transcritical systems with parallel compression
- » Showcases: Hussmann
- » Compressor racks: Bitzer Australia
- » High-pressure expansion valves: Danfoss
- » Flash-gas bypass valves: Danfoss
- » Gas cooler: Alfa Laval
- » Cold room evaporators: Buffalo Trident
- » Stepper electronic expansion valves: CAREL
- » Controllers: Emerson
- » Installation contractor: Retail FM



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'We have met the enemy, and he is liquid'

Two cold storage operators explain how they are reducing the amount of liquid ammonia in their plants, while a third shows how to keep any primary refrigerant out of the storage area

By Charlotte McLaughlin and Michael Garry

When Pete Lepschat, corporate manager of engineering services at Henningsen Cold Storage, Hillsboro, Ore., approached his boss in 2009 about using less ammonia charge in its cold-storage plants, his response was, "Why would you want to do that?"

Ammonia, after all, was inexpensive and operators tended to use a great deal of it in traditional overfeed refrigeration systems. However, there are plenty of reasons to reduce the amount of ammonia used – a safer environment, less regulatory scrutiny and lower insurance costs, to name a few.

So Lepschat set about cutting the ammonia charge in a new facility, and has developed a number of strategies for doing so in standard, centralized systems since then. (See ["For Henningsen, Less Is More," Accelerate America, November-December 2016.](#))

He shared those ideas at a session at ATMOsphere America in June along with some industry peers who have their own approach to negotiating ammonia charge in central systems. (For a look at low-charge packaged systems, [see page 50.](#))

Lepschat provided data showing the progress he has made. In 1993, Henningsen used as much as 52 lbs/TR of ammonia, which was reduced to 16 lbs/TR at a new plant in Salem, Ore., in 2017 (and to 12 lbs/TR at another Salem plant in 2014). In terms of cu ft of storage space per lb of ammonia, the company went from 223 to 1,823 during that time period.



To achieve these changes, Lepschat looks at every component of an ammonia system, including the piping, vessels, evaporators, thermosyphon oil cooling and heat exchangers, and asks: "Do we need this component? Does it need to be that big? Do we really need to use NH₃ for this part of our process?"

"Every pound is good to get rid of," he said, adding, "We have met the enemy, and he is liquid."

In particular, Lepschat replaced a high-pressure receiver at a plant in Gresham, Ore., with a vessel that maintains a smaller level of liquid ammonia and holds it for less time. At the same facility, he



installed evaporator coils from Frick that enabled a 2-1 overfeed ratio rather than 3-1. The combined effect of these moves was to use about 5,000 lbs of ammonia instead of more than 10,000 lbs.

At its first plant in Salem, Ore., Lepschat installed an Evapco evaporator with an overfeed ratio of 1.2-1, and employs glycol rather than ammonia in the thermosyphon oil cooling process.

A lot of small improvements can have a big effect, said Lepschat. "Our systems are big, so you do this in 20 or 30 places, and soon that's adding up to a lot of ammonia."

Henningsen also prides itself on the efficiency of its plants. The company's latest facility design operates with an energy consumption of 0.3 kW/cu ft, less than one-third the industry average. He stressed that efficiency and low charge are not at odds with each other. "An efficient facility will function fine with a smaller charge."

27% LESS AMMONIA

United States Cold Storage (USCS), Voorhees, N.J., has taken a different approach to reducing its ammonia charge – installing ammonia/CO₂ cascade systems.

One of the first industrial users of ammonia/CO₂ cascade industrial systems in the U.S., USCS began with an installation in 2006 at a plant in

Bethlehem, Pa., and has added 12 more. Using these systems, the company has experienced a 27% reduction in ammonia charge along with energy savings (5.8% on average compared to a traditional ammonia system), improved safety and other benefits. ([See "Pioneering Ammonia/CO₂ Cascade," Accelerate America, June-July 2017.](#))

At the ATMOSphere America session, Michael Lynch, vice-president of engineering for USCS, shared some of the lessons the company has learned about ammonia/CO₂ refrigeration over the past decade.

The main caveats associated with ammonia/CO₂ cascade systems are keeping it moisture-free and mitigating the risk of ammonium carbamate, a system-clogging salt that forms when ammonia and CO₂ interact in the cascade condenser.

If moisture mixes with CO₂, dry ice can form, "so it's very important when you're commissioning the system that you properly evacuate it," said Lynch. Ammonia should also be the proper grade, very low in moisture. In addition, filter dryers require replacement on a routine schedule, "based on the amount of moisture we see in the system."

In regard to ammonium carbamate, Lynch recommended using two independent detection systems; one is an ammonium carbamate detector, now commercially available and used by three USCS systems; it is tied to the refrigeration control system and can shut the system down and set off an alarm. The other is a pressure sensor that monitors a suction-side strainer. USCS has not experienced ammonium carbamate formation to date.

For technicians, the cascade condenser, where the ammonia cools the CO₂, is the main point of departure from a traditional ammonia system, noted Lynch. While CO₂ operates at higher pressures, "there is always that temperature/pressure correlation that many of the refrigeration technicians can understand in a basic refrigeration cycle," he said. "The equipment is the same for the most part." With additional ammonia/CO₂ systems being installed in the industry, more engineer/operator training is available. ▶

PERMACOLD'S SECRET SAUCE



Steve Jackson, president and senior managing partner of PermaCold Engineering, Portland, Ore., participated in the industrial end users panel discussion at ATMOsphere America in June to provide a contractor's perspective.

However, PermaCold is not your average contractor. Under Jackson's leadership, the 24-year-old company, a full-service industrial refrigeration contractor, takes a decidedly environmental approach to industrial refrigeration, using as its slogan "Our Planet – Our Responsibility."

"Environmentally sound engineering is the future of industrial refrigeration," he said at the ATMOsphere America session in San Diego. "I've been saying that for 25 years and for 25 years I've been right." (See "Our Planet – Our Responsibility," *Accelerate America*, November-December 2016.)

In a business where cost and the bottom line take priority, Jackson has been able to use his environmental approach by tying it to ROI and dollar savings, what he calls "our secret sauce." He shows end users how to reduce, not just

energy consumption, but ammonia charge, refrigeration load, water and sewer usage, piping and materials, and maintenance. "Everyone uses ROI but we really dig deep," he said. "And we have never had one of our ROI's turned back for being inaccurate."

In one example, a customer was reluctant to pay the \$2 million price for five ammonia condensers, given only \$100,000 in annual water savings, and preferred a less expensive system using old technology. "I said 'I don't want to sell you something that's wrong for you or the planet,'" Jackson said. So, he reexamined the potential cost savings and discovered that the annual savings were actually \$410,000 based on additional water, sewer, chemical and energy reductions; the sale was then consummated.

Moreover, with additional LED lighting installations, more efficiencies were gained by the customer. "The first year in operation, we moved \$1.1 million from operating costs to the bottom line," he said. "That changed the face of PermaCold, and we now look at every project that way."

► ATYPICAL SECONDARY SYSTEM

Gerard von Dohlen, president of Newark Refrigerated Warehouse, Newark, N.J., operates in a state, New Jersey, that heavily regulates ammonia, making it impractical for operators to use. Like many others, Dohlen has employed R22 instead, but has been seeking a replacement for it. He started back with ammonia, but with concessions from the state, which later fell through. He then considered propane, but local fire marshals nixed that idea, and he is now looking at R507A; a cascade CO₂ system is also a possibility.

Whichever refrigerant von Dohlen uses, he has devised an unusual industrial system that limits the primary refrigerant charge by using a secondary cooling agent that consists of a brine solution and air – what he calls an "air conditioning style refrigeration system."

"I don't want to put any refrigerant in the occupied space," he said.

In essence, the primary refrigerant cools a 30% calcium chloride brine solution in an Alfa Laval plate-and-frame heat exchanger. The brine (at -14°F), in turn, is pumped into a Kathabar conditioner, where it cools air (about 0°F) coming from the freezer room. The cold air (-10°F) is then blown back into the freezer room. The brine serves another purpose – absorbing moisture from the air, as well as dust and bacteria; this removes the need for a defrost system.

"It's that simple," said von Dohlen. "There's virtually no maintenance and it doesn't break down. There's no refrigerant involved; you don't need any refrigeration experts." ■ CM+MG



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1 x R-3000

Imuraya

Irvine, CA

A confectionery/dessert manufacturing facility where an extensive energy study was done on NewTon in comparison to a baseline system. The study has shown the NewTon system saves up to 32% of energy, when compared to an R507a system running the same facility.



2 x R-6000

Wholesome Harvest Baking

Toronto, ON

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The Facilitator

Through installations, training and industry initiatives, contractor Source Refrigeration – led by its chief engineer Bryan Beitler – is helping food retailers and others transition to natural refrigerants

By Michael Garry

On July 25, 2012, Supervalu unveiled the first all-natural-refrigerant system in the U.S. at a remodeled store in Carpinteria, Calif.

The cascade refrigeration system employs ammonia on the rooftop and CO₂ in the store. This was the first time that only ammonia and CO₂ were used in a U.S. supermarket's refrigeration system (the first all-CO₂ transcritical system would come a year later); today there are three more U.S. stores with this cascade system.

Now owned by Albertsons, the Carpinteria store represented a turning point for natural refrigerants in the U.S. Many parties played important roles in this installation, including Supervalu and the manufacturers Hillphoenix (provider of the CO₂ rack) and Mayekawa (supplier of the ammonia rack).

Another key player was the main contractor for the project, Source Refrigeration & HVAC, which participated in the design, installation and maintenance of the technology. (Source no longer services the store.) It was a task no U.S. contractor had ever tackled before at a supermarket.

"We selected Source because of their commitment to training a workforce for next-generation refrigeration and because of their executive-level commitment to being involved with, and accountable for, the success of this history-making project," said Richard Heath, at the time Supervalu's director of energy innovations and projects.

At that time, Source, based in Anaheim, Calif., had just begun to install CO₂ refrigeration (mostly pumped systems using HFCs on the high side). Since then, Source has gone on to deploy many more CO₂ systems, including cascade and transcritical, for a total exceeding 50 – likely the most of any U.S. contractor. As Heath noted, the company has committed itself to teaching its technicians about the art and science of natural refrigerants, staking out an industry-leading position in the training arena.

The individual who has orchestrated Source's natural refrigerant activities is Bryan Beitler, its ►

Photography: Megan Miller





Bryan Beitler, Source Refrigeration, facing the control panel on a subcritical CO₂ compressor rack system being installed in Source's training center.



Source headquarters, Anaheim, Calif.

► vice president and chief engineer; he has more than 35 years of experience in refrigeration and HVAC design, sales, energy optimization and operations support, mostly focused on food retail, cold storage and process refrigeration. His myriad roles at Source range from design to training. "As a senior manager, I wear lots of hats," he said. His 40 contractor's licenses allow Source to operate in its far-flung footprint.

Beitler serves in several extracurricular roles as well, including CEO of the North American Sustainable Refrigeration Council (NASRC), which is helping drive adoption of natural refrigerants in supermarkets.

Source and Beitler exemplify the pivotal, multi-faceted role that a contractor can play in facilitating the transition to natural refrigerant systems.

Growth through acquisition

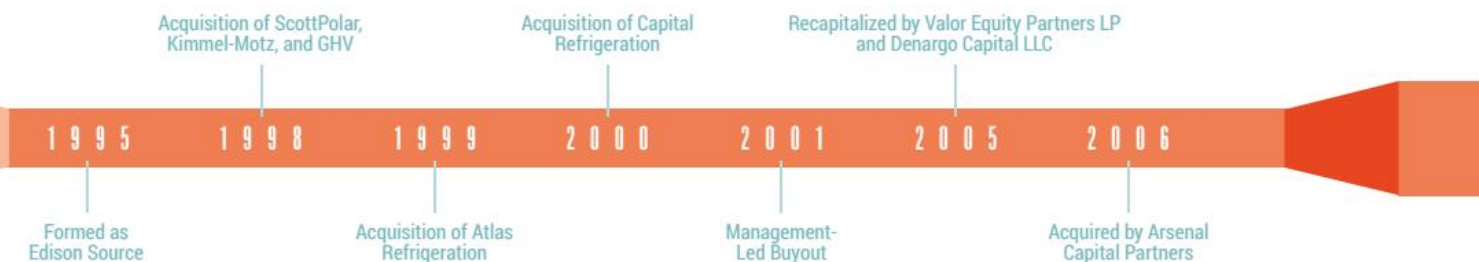
Source's roots extend back to the 1995, when it was started as Edison Source by power company Edison International (see timeline, this page). In 1998, Edison International purchased three western refrigeration and HVAC service and construction companies, Scott Polar, Kimmel Motz and GHV – and in so doing acquired the services of Beitler, Scott Polar's vice president of engineering (he had also worked for sister company Kimmel Motz).

In 2001, two former Edison executives led a management buyout of Edison Source and formed Source Refrigeration & HVAC, which went on to acquire other contracting companies, becoming one of the largest HVAC&R contractors in the U.S.

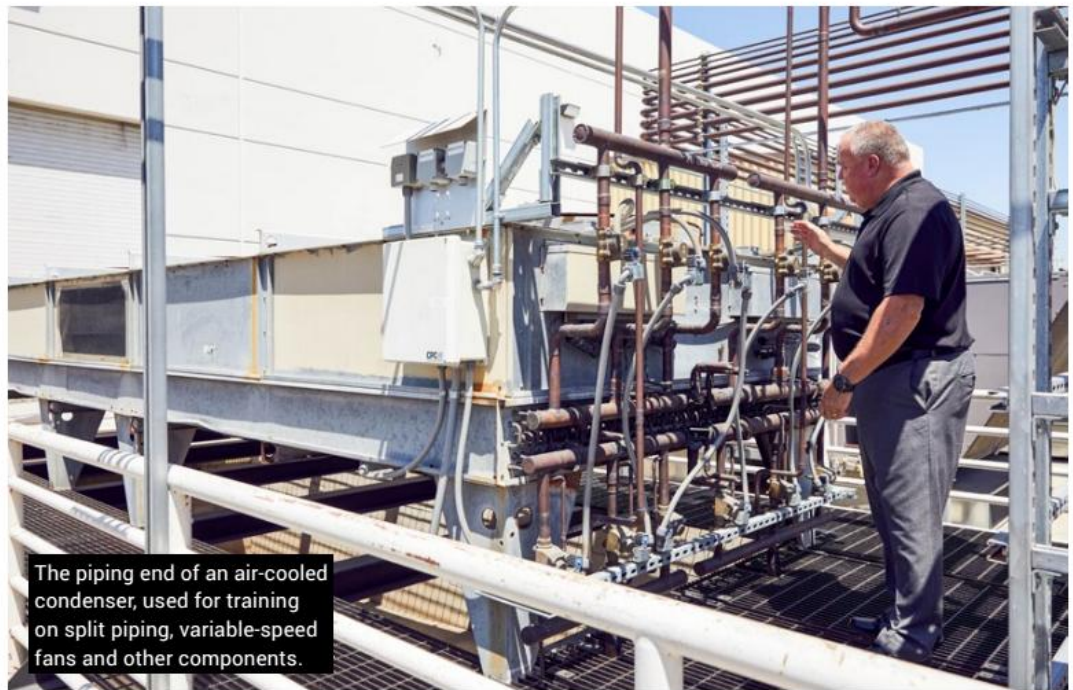
Now owned by Audax Private Equity, Source operates 46 branch locations with about 1,250 technicians across a large swath of the U.S., including all Western and Mountain states as well as in Texas, Florida, Alabama, Georgia and South Carolina. In the rest of the U.S. it has a "certified partner network" of contractors that can work for Source's clients. (See map, page 47.)

According to its website, Source's retail customers include some of the biggest names in the grocery business, such as Whole Foods Market, Albertsons, Kroger, Walmart, 7-Eleven, Target and H.E. Butt Grocery. The contractor also serves convenience stores, restaurant chains, dollar stores, cold-storage warehouses, telecom, schools, and pharmaceutical companies. Source recently quoted a transcritical CO₂ system to replace an R22 unit for a California pharmaceutical company.

In natural refrigerant projects, Source gets involved, as it did at the Carpinteria store, in all aspects, beginning at the engineering/design stage, and moving onto installation, service and optimization. "We design what the customer wants," said Beitler, and then an OEM produces



Source: Source Refrigeration



The piping end of an air-cooled condenser, used for training on split piping, variable-speed fans and other components.

the rack. (Source has a manufacturing division, Advanced Refrigeration Systems, which is in the process of designing CO₂ systems, but in the early stages of product development.)

Source's CO₂ installations are "scattered around our footprint," said Beitler, including an early transcritical system in a Tulsa, Okla., store, which uses an adiabatic gas cooler to operate efficiently in the warm southern climate.

Beitler is seeing early adopters install natural refrigerants in one or two stores, and then "evaluate it for a period," he said. "Some move forward with a program." Other retailers are "hanging back and letting others do the R&D."

Still, Beitler regards natural refrigerants as a growing trend in North America. "It's gotten the attention of the industry," he said. And the momentum is such that he does not see a retreat following the Trump Administration's decision to exit the Paris accord on climate change.

Beitler believes that Source technicians have done enough natural refrigerant installations to feel more comfortable about the process. The introduction of iron-copper piping that can be used instead of steel also "makes life easier," he said. Because of the variability of projects, it's hard for him to comment on installation cost trends, though he acknowledged that material and labor costs continue to rise. But the repetition of tasks leads to costs getting "under control," he said.

In a blog that he wrote for NASRC last year, Beitler identified the "consultative role" that contractors can play, "lending support, knowledge and advice to their retail store customers, many of whom are on the fence about natural refrigerants." Retailers who lack an in-house engineering capacity, he told *Accelerate America*, "might rely on us to steer them in the right direction or provide options."

While some retailers may not be ready for natural refrigerant technology, "we have to bring it to their attention," he said. In California, where the Air Resources Board is moving toward putting a ▶

Expansion into Texas

2008

Acquisition of Fournier (FL, SC) and TP Electrical

2011

Expansion into Florida & Georgia; Acquisition of DHR Mechanical

2013

Acquisition of Service Refrigeration (TX)

2014

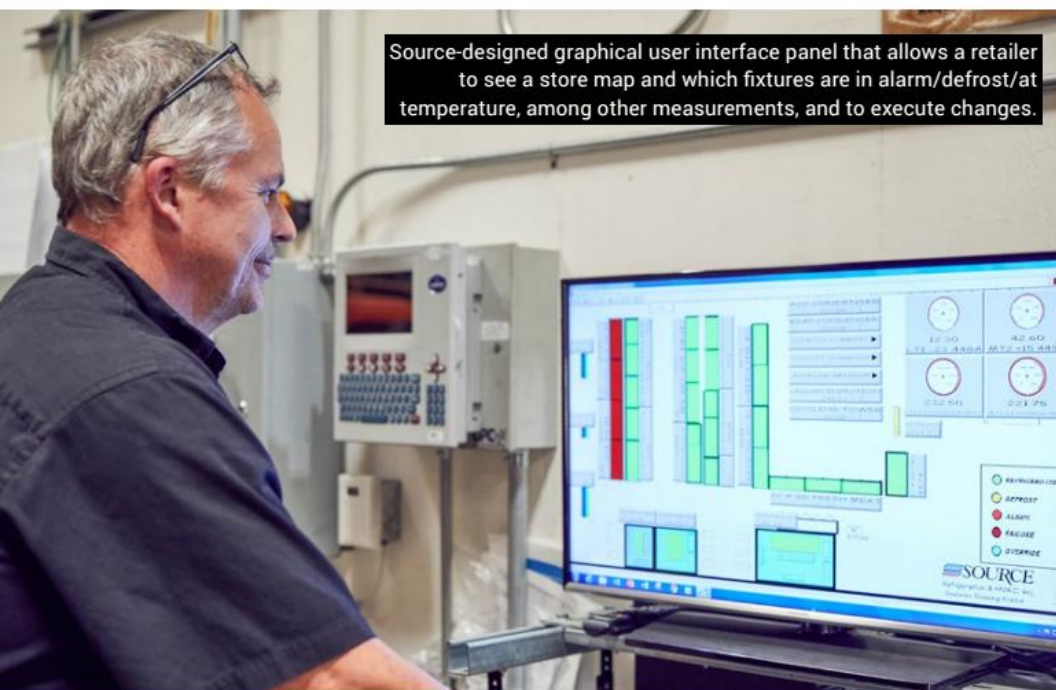
Acquired by Audax Private Equity

2015

Acquisition of Refrigeration Solutions, Inc. (NCAL) and Advanced Refrigeration Systems (Sys Mfg)

2016

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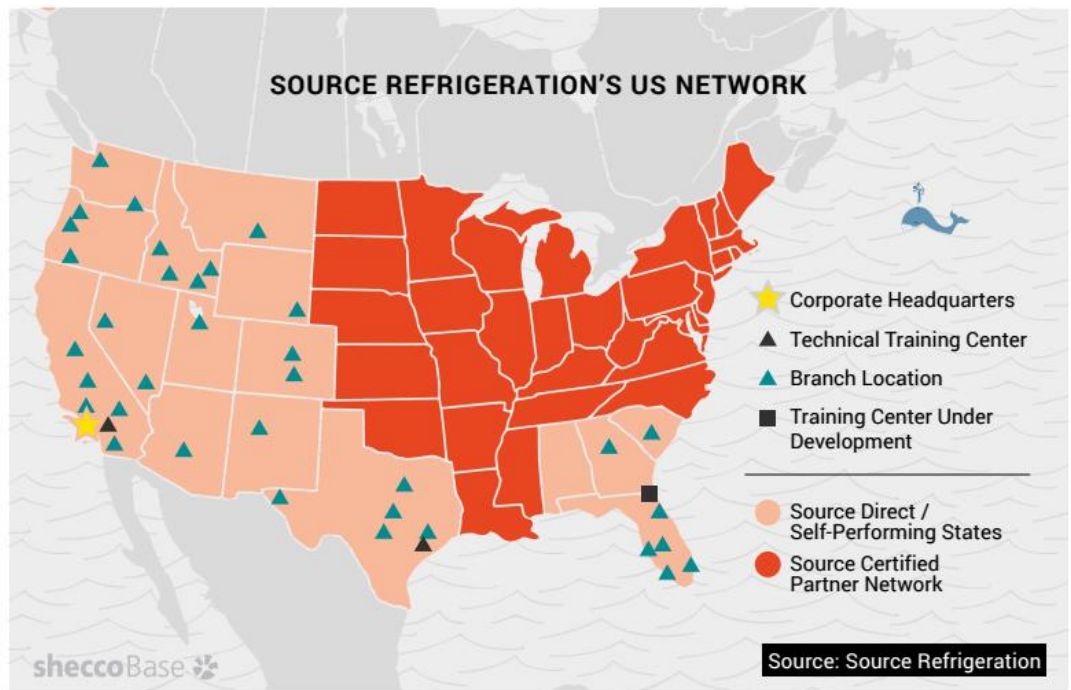
Source-designed graphical user interface panel that allows a retailer to see a store map and which fixtures are in alarm/de frost/at temperature, among other measurements, and to execute changes.



The piping side of a subcritical CO₂ rack system that Source is installing in its training center.



Controls training wall, including variable-speed drives and microprocessors from various manufacturers.



► GWP limit of 150 on new refrigeration systems, retailers may have no choice but to use natural refrigerants. "So, our message is, it's coming, let's make sure you're prepared for it. Do a test store, shake out the bugs, and get comfortable with it."

Contractors like Source can't operate alone – they need to strategically collaborate with manufacturers and others "both inside and outside the refrigeration industry" to accelerate the adoption of natural refrigerant technology, he wrote in the blog.

From a personal perspective, Beitler believes in the importance of "environmental awareness" in the work he is doing. "I want my grandkids and their kids to have the same opportunities that I have had," he said.

Increasing efficiency

Beitler's job at Source also encompasses running its energy optimization service, which does commissioning and fine-tuning for end users, as well as larger "makeover" projects that focus on energy and water reduction, among other improvements. This service reflects Source's stated goal in its press announcements, "to measurably increase efficiency while reducing environmental impact and total cost of ownership."

In one such makeover at a Whole Foods outlet in Sacramento, Calif., Source installed a CO₂ cascade system that contributed significantly to the energy savings at the store. Whole Foods earned an

energy incentive from the Sacramento Municipal Utility District totaling about 10% of the cost of the remodel. (See ["Getting an Energy Rebate, the Whole Foods Way," Accelerate America, June 2015.](#))

Beitler said in the NASRC blog that he would like to see more incentive programs for natural refrigerants, such as one proposed in California last year (but not adopted).

The Sacramento project was one of the early – and still fairly rare – examples of a CO₂ installation at an existing store rather than a new store. It included a new rack, piping infrastructure, walk-in coils and doors for medium-temperature cases. "We kept the store open and did the conversion in four days and nights," said Beitler.

Though it was the installing contractor for the Supervalu (now Albertsons) store in Carpinteria, Calif., that employs an ammonia/CO₂ cascade system, Source is not an ammonia contractor, and partnered with one for that project while being trained by ammonia system supplier Mayekawa. Beitler acknowledged that "if the food retail industry heads [toward ammonia cascade systems], we would have to diversify a bit more."

At the Carpinteria store, Source also installed an R407A system to keep the store operating during its remodel while the ammonia/CO₂ system was being built. This provided an opportunity to compare the energy consumption of each system ►

Peripatetic CO₂ Training



Danfoss Mobile CO₂ Training Unit

From June 5-7, Danfoss's Mobile CO₂ Training Unit made a stop at the ATMOsphere America conference in San Diego, Calif., as part of a worldwide tour aimed at giving end users, contractors and technicians hands-on instruction on transcritical CO₂ systems.

The training unit, launched in September 2016, then proceeded up the turnpike to Anaheim, Calif., where it resided at Source Refrigeration's training center from June 14-29. From there it spent July 10-20 at DC Engineering in Meridian, Idaho. It is scheduled to land in Australia in September.

The training unit features three training scenarios: a high-temperature (32°F-45°F) transcritical rack with two compressors; the initial rack with two additional parallel compressors; and the initial rack with two additional parallel compressors and a multi-ejector. Also included are commissioning and diagnosis screens as well as rack and case controllers.

The unit was developed to help "put to bed the notion that there is not enough CO₂ training," Jim Knudsen, segment manager, food retail, for Danfoss, said at ATMOsphere America.

In Anaheim, the training unit attracted "quite a few customers, technicians and engineers," said Bryan Beitler, vice president and chief engineer, Source Refrigeration. He noted that the multi-ejector "helps broaden the areas where transcritical becomes viable."

► under the same conditions, and the ammonia/CO₂ system was found to save "a significant amount of energy over the R407A system," said Beitler.

Making training count

Technician training "is a seven-figure expense every year" for Source, so "we want to make it count," said Beitler. Of course, it goes well beyond natural refrigerants, since 90% of what Source services still uses synthetic refrigerants. But, as a relatively new technology, natural refrigerants represent a significant part of the program, given the need for hands-on training in this technology.

At its Anaheim headquarters, Source opened its biggest training facility in 2013, a 12,000-sq-ft. Technical Training Center that was relocated from Chino, Calif. The company has another training center in Houston, and is completing build-out of a third in Jacksonville, Fla., to support the development of regionalized training programs.

Source has written its own technical training curriculum, with seven levels of certification for service technicians and another four for installation technicians. In Anaheim, Source typically trains mid- through upper-level technicians, while lower levels are done on a regional basis. Junior technicians may start out at a convenience store and work their way up to a supermarket. "I'm not sure they're into natural refrigerants at the lower levels, but it's probably going to have to find its way there," said Beitler.

Source's training season runs from late September/early October through April or May, considered the "off season" when the demand for technicians is likely to be lower than during the hot summer months.

The upcoming training season's calendar includes more than 40 week-long courses in Anaheim alone. Typically each course requires a full week of training. "That's a big commitment but we believe it's important to ensure our technicians receive development by participating in what we consider to be one of the best training programs of its kind in the country," said Beitler.

The Anaheim facility comprises a full grocery store set-up, featuring low-temperature and medium-temperature remote cases, walk-in coolers, self-contained cases, controls and an equipment room with operating racks.

Source recently installed, and is soon to start operating, a subcritical CO₂ refrigeration system

– used equipment from an abandoned store – for the grocery training area. It employs CO₂ in low-temperature DX and pumped medium-temperature applications, in concert with a synthetic high-side refrigerant to condense the CO₂. Technicians will be trained on how to install, start up and operate the system, which includes a liquid pump that not too many technicians are familiar with; the system may also be used as a guide to transcritical operations. “There are a variety of opportunities we hope to put in front of them,” said Beitler.

Propane education, Beitler noted, is an area that requires further attention at Source. “We have an educational push to dig into propane systems and get our technicians additional training. This fall it will be a bigger part of the curriculum. It’s showing up everywhere, so we have to be ready for it.”

To that end, Source is securing self-contained propane equipment for its training center in Anaheim. The contractor is also partnering with True Manufacturing, a self-contained propane case supplier that offers online classes.

Another major manufacturer with which Source collaborates on training is Hillphoenix, which recently sent its head CO₂ trainer Rusty Walker to Source’s Anaheim training facility. In general, when Source installs a natural refrigerant system anywhere in the U.S., it tries to set up a training session with the system’s manufacturer “so those on that job have the information they need” for installation, charging the system, start-up and maintenance, said Beitler.

Progress groups

In his role as CEO of NASRC, Beitler leads a progress group for contractors and service technicians that aims to “help increase the number of service contractors and technicians that are well-versed in natural refrigerant technology, equipment installation and maintenance through trainings and outreach,” according to the NASRC website. Other NASRC groups cover policy, best practices, utilities and energy efficiency, codes and standards, and ROI. “These are the areas where we’ve plugged ourselves into to further the opportunity to use natural refrigerants,” he said.

The contractors group is working with Refrigerating Engineers & Technicians Association (RETA) – an organization known for ammonia refrigeration – to develop a RETA-sponsored CO₂ certification program for technicians. NASRC’s contractor members are contributing “a fair amount of content” on topics like compressors and valves to a certification

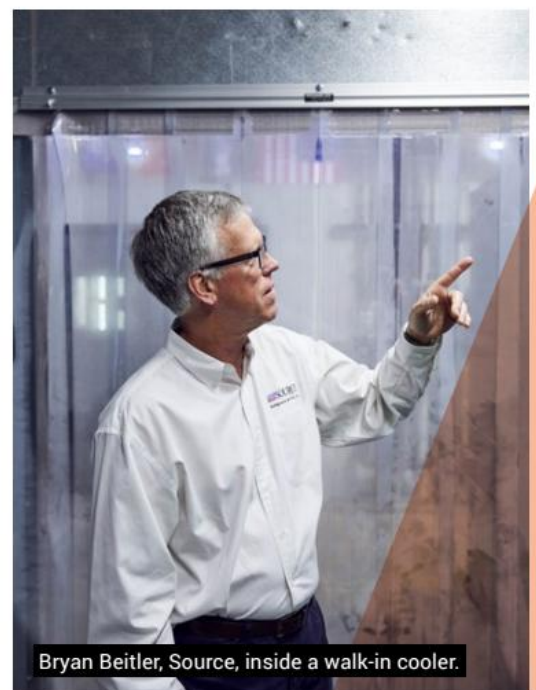
guidebook, Beitler said. He expects a draft copy to be ready in September and a final copy by the end of the year. “We’re excited about being able to have technician certification for CO₂ for both the industrial and commercial sectors,” he said.

Beitler also contributed to the creation of CO₂ refrigeration installation specifications for NASRC – a “best practices” document, he said. “If you’re just getting started, it’s a great resource,” he said.

Beitler is also involved with community colleges that have HVAC&R programs, sitting on the advisory board of one. In his NASRC blog, he urged that legislation banning HFC refrigerants should also include funding for community colleges and technical schools with HVAC&R program “to immediately fast-track a sustainable refrigeration curriculum.”

Source once hosted a group of such schools at Source’s Anaheim training center. “We gave them a tour and talked about the training needs of our industry,” distinguishing between the HVAC and refrigeration/low-temperature sides, he said. “We wanted them to understand what we’ll be looking for in technicians, and how their programs line up with the needs of our world.”

Source has also brought graduating technicians to Source’s headquarters to explain what the company does, how it trains technicians and “what’s awaiting them in the real world” ■ MG



Bryan Beitler, Source, inside a walk-in cooler.

Low-Charge Scenarios Boost North American Plants

Packages and ammonia/CO₂ systems reduce ammonia charge, improve safety and increase efficiency, according to system manufacturers

By Michael Garry

Low-charge-ammonia packaged units and ammonia/CO₂ cascade systems installed at industrial plants in North America are drastically cutting ammonia charge, improving safety and increasing efficiency, according to case studies presented by manufacturers at ATMOsphere America 2017 in June.

For example, Evapco's Evapcold packaged units are reducing ammonia charge significantly at a Turner Dairy plant, enabling the facility to remain well under the 10,000-lb regulatory threshold, said Kurt Liebendorfer, vice president, Evapco.

Turner Dairy, a member of Prairie Farms for 10 years, operates a milk and juice processing plant in Memphis, Tenn., that has an outdated ammonia refrigeration system and is undergoing significant expansion in production and its refrigerated warehouse. The plant wants to reduce ammonia charge and improve safety with Evapco's packaged units while avoiding disruption to production – which it can do because the packaged units are manufactured off-site.

The plant is installing four Evapcold



low-charge ammonia packaged units – two 35°F penthouse coolers (200 TR total) and two process cooling chillers (260 TR total); Prairie Farms is the first end user to employ the chiller, which was unveiled at the IAR's Natural Refrigeration Conference in late February (see ["IAR's Natural Refrigerant Show," Accelerate America, March 2017](#)).

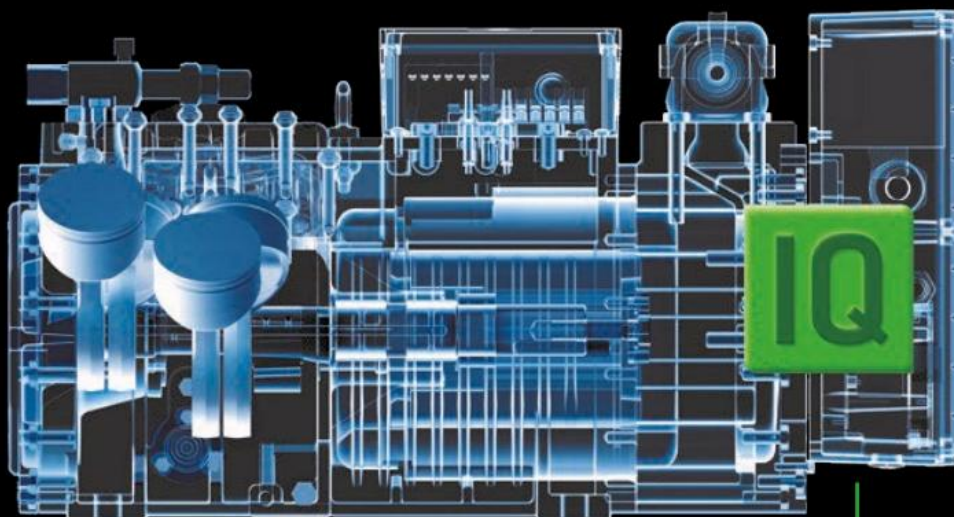
The total charge of the four units is 960 lbs. (2.1 lbs./TR), which is 1/10th the charge of what the system would have had in a conventional expansion.

The chillers use secondary glycol (at 26°F) to do process cooling at 35°F (for ingredient tanks and pasteurizers), eliminating ammonia from the process area. The penthouse units likewise confine ammonia to the roof, cooling the new warehouse and existing plant via ducted air. ▶





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LEADERSHIP IN NATURAL REFRIGERANTS
AMMONIA AND CO₂ COMPRESSORS

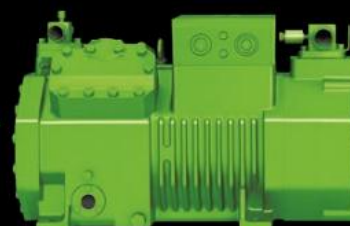
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► "By significantly reducing the quantity of ammonia, including in the expansion, we allowed safer operation, a real reduction of the regulatory burden, and a lower cost of ownership," said Liebendorfer. Other benefits include reduced energy consumption, no central machine room, one-day installation and faster start-up.

"Refrigeration field work is significantly reduced inside the existing plant and the plant jobsite, and less disruptive to plant production," he added.

In an industrial end users session at ATMOSphere America ([see page 38](#)), Liebendorfer filled in for David Bornemeier, president of Western Gateway Storage, Ogden, Utah, to talk about the company's two Evapcold low-charge ammonia packaged units, which were installed on the rooftop of a new 30,000-sq-ft facility in June 2016. ([See "The Road to Low-Charge Ammonia," Accelerate America, June 2016.](#)) "It's been running for a year very successfully," said Liebendorfer.

The total ammonia charge for the two Evapcold units is 580 lbs, with a total capacity of 140 TR. That keeps the ammonia charge for this facility and Western Gateway's original building well below the 10,000-lb threshold for greater oversight by U.S. regulatory authorities.

The Evapcold units serve a freezer with a target temperature of -10°F. Following the installation, Western Gateway acquired a tenant that is storing cheese at 35°F, which the Evapcold system was also able to accommodate.

Western Gateway was able to obtain a \$60,000 energy efficiency incentive for the two units from Rocky Mountain Power, based on their efficiency. The annual energy use of the low-charge system was calculated to be 20% less than that of the baseline system, a savings of 280,000 kWh annually. Of that energy savings, variable frequency drives on the evaporator and fluid cooler contributed 120,000 kWh. The baseline system was a single-stage economized recirculated liquid ammonia system.

According to Liebendorfer, the utility

did a follow-up inspection earlier in the year and found that the facility "met the energy [requirements] stipulated in the rebate program." The units were determined to have an efficiency of 1.1 kW/TR at peak condition, he added. The Evapcold units also offer heat reclaim, used here for under-floor warming in the freezer and snow melt in the parking lot.

Evapco studied the Western Gateway units over the past year and found the oil return in need of adjustment. "It was running all the time so we added some controls to make it only as needed, and that really improved oil return," said Liebendorfer.

Low-charge air conditioning

Low-charge ammonia chiller packages from Azane are being used to safely provide air-conditioning for a bakery in a populated area of Portland, Ore.

The bakery plant uses three low-charge-ammonia chillers, each at 300 TR and 450 lbs of ammonia (1.5 lbs/TR), which received jurisdictional acceptance for overall environmental impact. The air-cooled units have four levels of ammonia release prevention, three levels of leak detection, and fresh air dilution. Each chiller has a TEWI (total equivalent warming impact) that is 32% less than that of a water-cooled R507 unit.

"Azane's packaged outdoor ammonia chillers are inherently safe, energy efficient and use no water," said Caleb Nelson, refrigeration engineer, Azane. "They have lower operating costs than traditional industrial systems."

General Cold Storage is installing eight low-charge NXTCOLD packaged units at a facility in South Gate, Calif., according to John Scherer, chief technical officer, NXTCOLD.

The units will be used in five -10°F freezer areas and one 34°F dock. The energy efficiency is being vetted by the California Energy Commission, EPRI and Southern California Edison (SCE). ►

"By significantly reducing the quantity of ammonia, including in the expansion, we allowed safer operation, a real reduction of the regulatory burden, and a lower cost of ownership."

- Kurt Liebendorfer, Evapco



Caleb Nelson, Azane

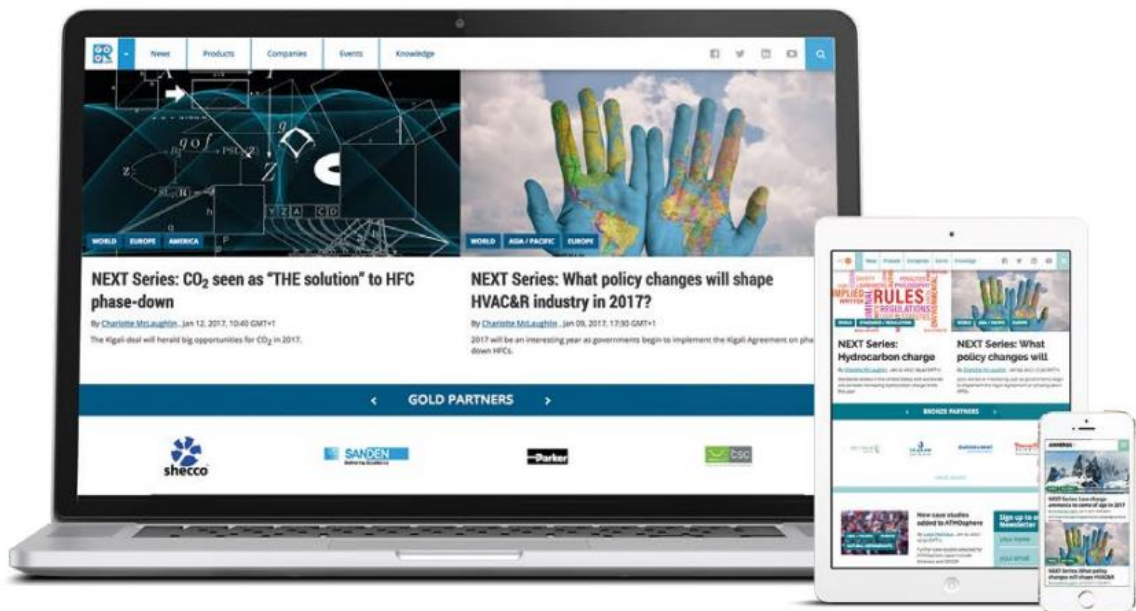


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“Azane’s packaged outdoor ammonia chillers are inherently safe, energy efficient and use no water.”

- Caleb Nelson, Azane

WATER AS A REFRIGERANT

efficient energy, a German firm, has developed an eChiller centrifugal chiller that uses water as a refrigerant. In a process cooling case study involving the condensing of a solvent, the eChiller provides a constant flow of chilled water at 64°F without temperature deviation, said Juergen Suess, managing director, efficient energy.

The process, which operates in a near-vacuum (.16 to 2.3 psi), includes 68% free cooling and 32% compressor cooling, depending on ambient temperature. It provides up to 20 kW of capacity.

The company has installed 20 eChillers, expected to grow to 30-40 by the end of the year.



► SCE has calculated an energy incentive of about \$85,000; the facility is expected to save \$1.4 million in energy costs over five years compared to a traditional system, and will pay for itself in 6-7 years, said Scherer.

Ammonia/CO₂ installations

Leading Mexican cold-storage operator Frialisa expanded a facility in Culiacán, Mexico, with a cold-storage room (350 TR), frozen storage room (130 TR) and blast freezing (71 TR).

Frialisa uses an ammonia/CO₂ cascade system at other plants. ([See Ammonia/CO₂ South of the Border, Accelerate America, April 2017.](#))

But here the company installed an ammonia/glycol chiller on the roof that supplies glycol inside the building to condense a low-temperature CO₂ DX system and a medium-temperature pumped CO₂ system. The total ammonia charge is about 1 lb/TR.

Because this system is using secondary glycol, “there is no chance of an ammonia-CO₂ interaction,” said Ely Espinosa, with Bohn De Mexico, who presented with Javier Atencia, chief technical officer, Tewis. When CO₂ and ammonia combine in a cascade condenser, the result is ammonium carbamate, a salt that can clog the system.

For a new Flanagan Foodservice cold-storage plant in Ontario, Canada, CIMCO Refrigeration proposed three refrigeration alternatives: all-ammonia, ammonia/CO₂ cascade (with recirculated CO₂, not DX), and transcritical CO₂. “We were trying to find the solution that matched the customer’s requirements,” said Benoit Rodier, director of business development, CIMCO.

In another facility in Ontario, Flanagan had installed the very first low-charge-ammonia and recirculated brine CO₂ NewTon system for its freezer operation. “It has been running for a few years now with excellent results and performance,” said Rodier.



John Scherer, NXCOLD



NXCOLD unit at LA Cold Storage

Ammonia/CO₂ also was chosen for the new plant because of its lower total cost of ownership (TCO). Energy costs were the biggest contributor to the TCO. “Some customers are capable of understanding TCO while most of the others have limited knowledge and are the hostage of some consultants and contractors still promoting lower-initial-cost Freon systems,” said Rodier ■ MG

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Issue #22

February 2017

Focus: Packaged ammonia/CO₂ systems (The NewTon)

Issue #23

March 2017

Focus: Hydrocarbon refrigeration in foodservice applications

Issue #24

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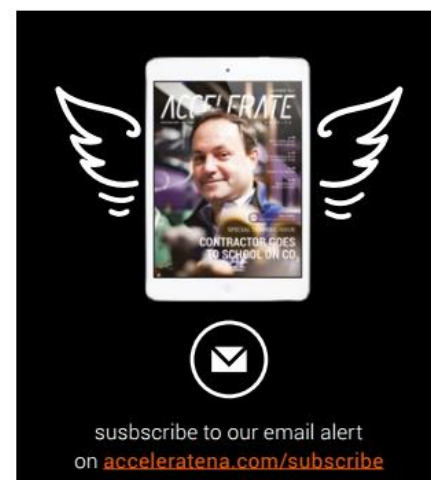
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