

JUNE 2016

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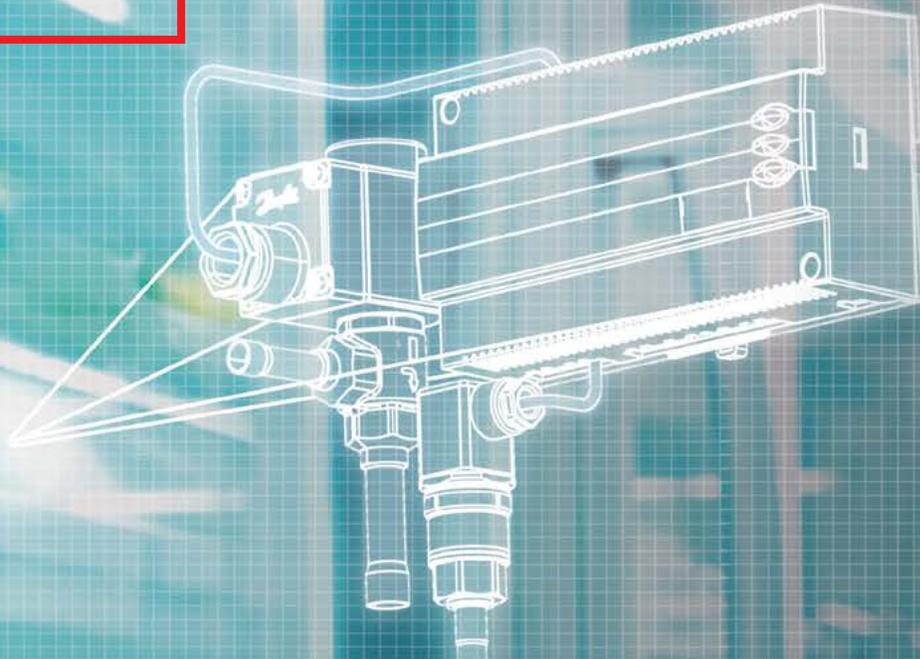
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At NRA Show
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Editor's note

OPEN UP THE INCENTIVES SPIGOT

By Michael Garry

To understand the impact that government subsidies can have on the market uptake of natural refrigerant systems, you only need to look at what's happened in Japan.

As described in this issue's articles on two Japanese industrial end users, Nissui Logistics and NittoBest ([page 32](#)), and a Japanese manufacturer, Mayekawa ([page 62](#)), the Japanese government has been extremely supportive of the implementation of natural refrigerant technology, such as Mayekawa's NewTon NH₃/CO₂ packaged unit. The country's Ministry of Environment (MOE), in particular, provided 6.3 billion yen (\$56.7 million) in subsidies last year, and has slated 7.3 billion yen (\$65.7 million) for 2016, covering up to one-half the cost of new systems.

In the U.S., of course, it's a different story. The Environmental Protection Agency has been active in regulating refrigerant leaks and delisting high-GWP refrigerants in many applications, but it has not offered any subsidies in support of natural refrigerants. At the state level, that may be changing as California is expected to soon announce funding for a refrigerant incentive program, which would be applied to natural refrigerant systems. ([Page 12.](#))

The one opportunity for outside funding for natural refrigerant projects has come from electric power utilities, which designate incentives for technology found to save energy. But, as delineated in an article on [page 36](#), securing an energy incentive for commercial and industrial refrigeration systems can be difficult because these systems often don't lend themselves to a straightforward prescriptive energy analysis like an LED light bulb. In order to qualify on a custom basis, they require a lot of data to back up their energy claims.

Still, there have been breakthroughs at several utilities, such as Rocky Mountain Power, which saw fit to provide an energy incentive for a low-charge ammonia system installed at Western Gateway Storage, the subject of our cover story ([page 16](#)). Other utilities on the cutting edge of natural refrigerant incentive funding include Southern California Edison, Pacific Gas & Electric, Sacramento Municipal Utility District, ComEd, Duke Energy, and NYSERDA (New York State Energy Research and Development Authority, which works with utilities).

Moreover, a good deal of research into the energy efficiency of natural refrigerant systems is demonstrating their great potential to reduce energy consumption. The Electric Power Research Institute (EPRI), for example, conducted studies last year showing the efficiency of self-contained propane units as well as the ability of CO₂ transcritical systems with mechanical subcooling to function efficiently in high-temperature climates.

EPRI is also working with Southern California Edison on collecting energy data on the NewTon at an Imuraya USA plant that makes frozen desserts. The utility and EPRI are planning to collaborate with several other utilities on advancing adoption of natural refrigerant technology.

Eventually, utilities may start following the state of California's lead in looking, not only at natural refrigerants' efficiency, but at their low-GWP profile.

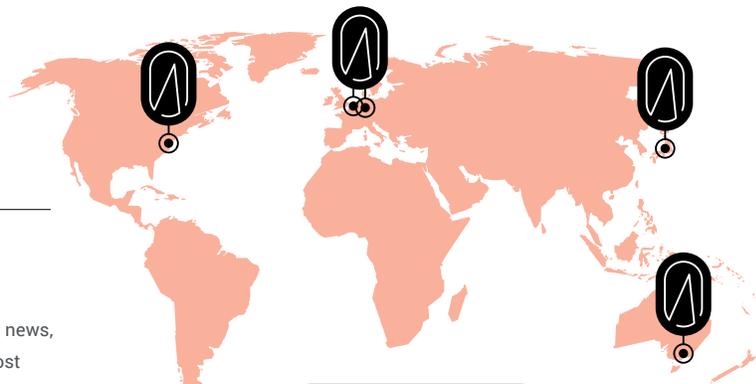
These efforts and more should eventually open up the incentives spigot, turning a trickle into a steady stream. **MG**

VOLUME 2, ISSUE #16, JUNE 2016

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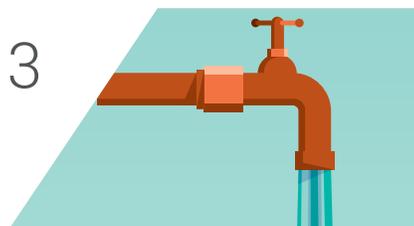


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About Accelerate America

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

<http://acceleraten.com>



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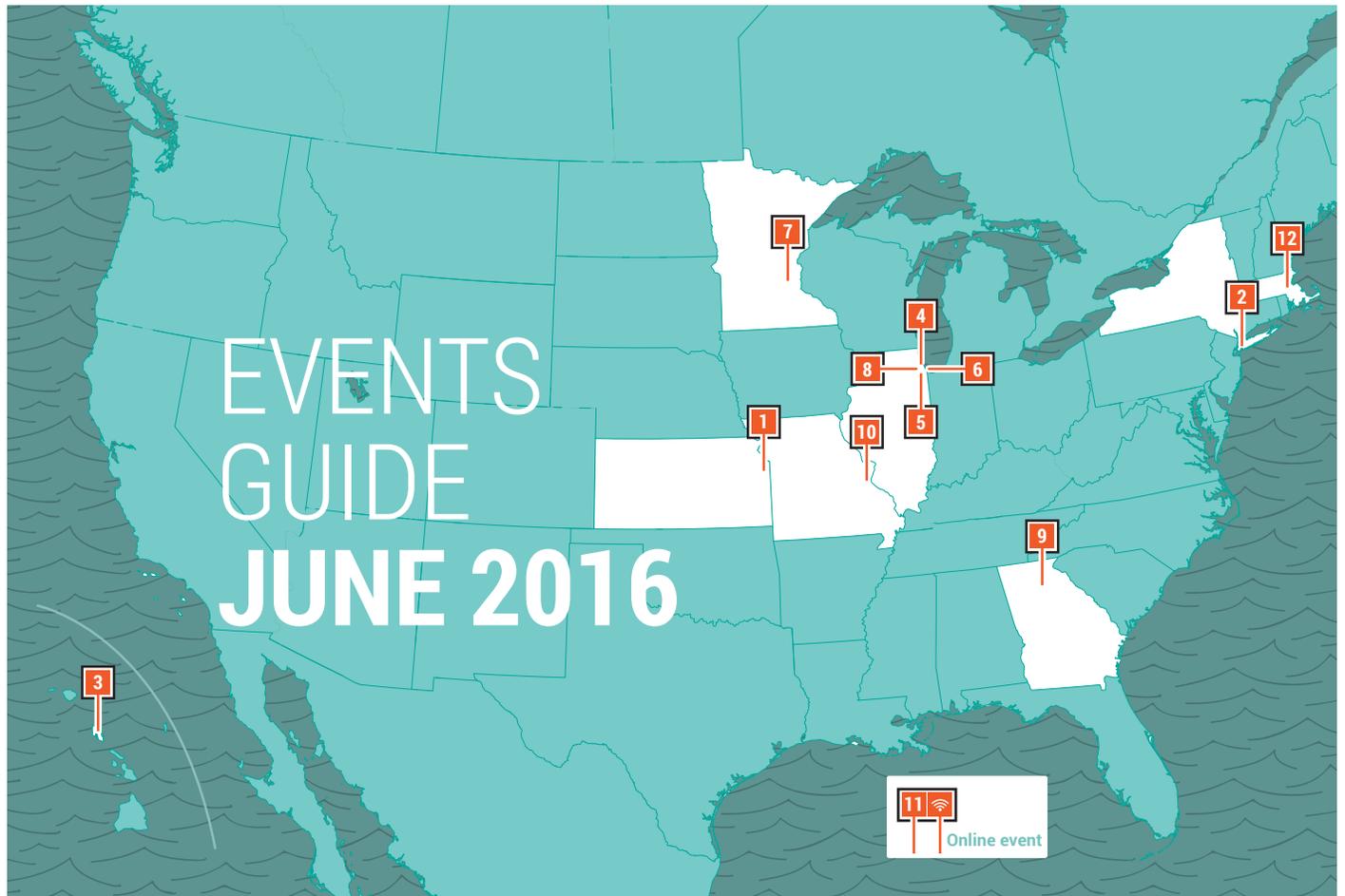
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1 June 2, Kansas City, KS
8th Annual Ammonia Safety Day
<http://reta.com/events/EventDetails.aspx?id=778648>

2 June 13-14, New York, NY
The NAPHN 2016 Conference & Expo: Decarbonize Our Future Today
<http://naphnetwork.org/2016-naphn-conference-is-announced/>
twitter: #naphn16 @NAPHN_info

3 June 15, Kapolei, HI
Hawaii Ammonia Safety Day
<https://www.eventbrite.com/e/hawaii-ammonia-safety-day-tickets-24661327695>

4 June 16-17, Chicago, IL
ATMOsphere America 2016
<http://www.atmo.org/events.details.php?eventid=44>
twitter: #ATMOAmerica @ATMOEvents

5 June 20-22, Chicago, IL
Global Cold Chain Expo 2016
<http://www.globalcoldchainexpo.org/>
twitter: #GCCE2016 @coldchainexpo

6 June 20-22, Chicago, IL
United Fresh 2016
<http://www.unitedfreshshow.org/>
twitter: #unitedfresh2016 #authenticveg @UnitedFresh

7 June 20-23, St Paul, MN
IDEA 2016 "Embracing Change," 107th Annual Conference and Tradeshow
<http://www.idea2016.org/>

8 June 20-23, Chicago, IL
FMI Connect
<http://www.fmiconnect.net/>
twitter: #FMIConnect @FMI_Connect

9 June 24, Oakwood, GA
ASTI Ammonia Safety Day at Lanier Tech
<http://www.eventbrite.com/e/asti-ammonia-safety-day-at-lanier-tech-tickets-24257139758>

10 June 25-29, St. Louis, MO
ASHRAE Annual Conference
<https://www.ashrae.org/membership-conferences/conferences/2016-ashrae-annual-conference>

11 June 28, 2pm EDT
GreenChill Webinar: CO₂ Systems 101 - Product Knowledge
<https://epawebconferencing.acms.com/co2productknowledge/>
twitter: #NEBFM16 @NEBFM

12 June 29-30, Boston, MA
11th Annual Northeast Buildings & Facilities Management Show & Conference
<http://www.proexpos.com/NEBFM/index.php>
twitter: #NEBFM16 @NEBFM



- | | | | |
|-----------------|--|-----------------|---|
| <p>1</p> | <p>July 11-14, West Lafayette, IN
 2016 Purdue Conferences: Compressor Engineering, Refrigeration and Air Conditioning, High Performance Buildings
 https://engineering.purdue.edu/Herrick/Events/Conferences</p> | <p>5</p> | <p>July 21-23, Omaha, NE
 77th American Convention of Meat Processors & Suppliers' Exhibition
 http://www.aamp.com/event-calendar/aamp-convention/
 twitter: @AAMPNews</p> |
| <p>2</p> | <p>July 11-14, San Francisco, CA
 Intersolar North America
 https://www.intersolar.us/en/home.html
 twitter: #Intersolar @Intersolar</p> | <p>6</p> | <p>July 26-28, Long Beach, CA
 2016 Energy Efficiency & Demand Response Symposium
 http://www.cvent.com/events/2016-energy-efficiency-demand-response-symposium/event-summary-e0ce07695aa849118d15703e4fab4d21.aspx</p> |
| <p>3</p> | <p>July 13-14, Houston, TX
 Build Expo 2016
 http://buildepousa.com/index.html
 twitter: @BuildExpoUSA</p> | <p>7</p> | <p>July 29-31, Monterey, CA
 PMA Foodservice Conference and Expo
 http://www.pma.com/events/foodservice</p> |
| <p>4</p> | <p>July 16-19, Chicago, IL
 IFT16 - Institute of Food Technologists
 http://am-fe.ift.org/cms/
 twitter: #IFT @IFT</p> | <p>8</p> | <p>July 31-August 3, St. Louis, MO
 2016 IAFP Annual Meeting
 http://www.foodprotection.org/annualmeeting/
 twitter: @IAFPFood</p> |



1 August 1-3, Washington, DC
2016 GCCA Assembly of Committees
<http://www.gcca.org/2016-gcca-assembly-committees/>

2 August 9-11, Providence, RI
Energy Exchange 2016
<http://www.2016energyexchange.com/>

3 August 10-12, New Orleans, LA
Global Sustainability Summit
<http://www.fmi.org/sustainability2016/overview>
twitter: #FMIGMASummit @FMI_ORG

4 August 10-12, Salt Lake City, UT
ASHRAE and IBPSA-USA SimBuild 2016: Building Performance Modeling Conference
<http://ashraem.confex.com/ashraem/ibpsa16/cfp.cgi>

5 August 17-18, Secaucus, NJ
Build Expo New Jersey 2016
<http://buildexpousa.com/>
twitter: @BuildExpoUSA

6 August 21-26, Pacific Grove, CA
2016 ACEEE Summer Study on Energy Efficiency in Buildings
<http://aceee.org/conferences/2016/ssb>

7 August 24-26, Calgary, AB
HRAI's 48th Annual General Meeting & Conference
<http://www.hrai.ca/agm/>

8 August 28-30, Los Angeles, CA
The 2016 Western Foodservice & Hospitality Expo
<http://www.westernfoodexpo.com/72/western-home.htm>

9 August 31-September 1, Oklahoma City, OK
2016 Oklahoma Restaurant Convention & Expo
<http://mms.okrestaurants.com/Calendar/moreinfo.php?eventid=36139>
twitter: #ORAShow2016

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SHORT TAKES

— By Michael Garry

AHR EXPO CALLS FOR 2017 AWARDS ENTRIES

The International Air-Conditioning, Heating, Refrigerating Exposition (AHR Expo) has announced its call for entries for the 2017 Innovation Awards Competition.

The winners in each of the ten product categories will receive special recognition at the AHR Expo, to be held in Las Vegas Jan. 30-Feb. 1, 2017 at the Las Vegas Convention Center. The winner of the Product of the Year Award will be announced at a ceremony on Tuesday, January 31 at the Expo.

As in past years, the annual competition aims to honor the most inventive, useful and original products, systems and technologies showcased on the AHR Expo's exhibit floor in the following categories: building automation; cooling; green building; heating; indoor air quality; plumbing; refrigeration; software; tools & instruments; and ventilation.

All 2017 AHR Expo exhibitors are eligible to submit a product for the Innovation Awards. Exhibitors may submit one product in each category, as long as that product has not previously won an award. To be considered, products must be exhibited at the Expo and available for sale by the end of January 2017. Completed entry forms and a \$100 entry fee must be submitted online at ahrexpo.com by Wednesday, Aug. 3, 2016. **MG**



EPA APPROVES CO₂ FOR ICE RINKS, CHILLERS

The U.S. Environmental Protection Agency has published in the Federal Register a notice finding carbon dioxide acceptable as a refrigerant in new equipment for ice skating rinks, centrifugal chillers, positive displacement chillers and industrial process air conditioning.

The published ruling, which took effect on May 23, falls within the EPA's SNAP (Significant New Alternatives Policy) program designating alternatives to ozone-depleting refrigerants.

The EPA noted that many substitutes listed as acceptable for ice skating rinks have higher GWPs than that of CO₂ (one); these include R134a, R404A, THR-03 and other HFC blends, which have GWPs ranging from 920 to 3,990.

Similarly, many substitutes listed as acceptable for centrifugal and positive displacement chiller as well as industrial process air conditioning have GWPs higher than that of CO₂; these include R513A, R450A, R134a, R404A and other HFC blends, which have GWPs ranging from approximately 600 to 3,990.

The EPA SNAP program has previously approved CO₂ for a host of applications, including retail food refrigeration, transport, cold storage and vending machines. **MG**

U.S. AGENCIES ISSUE FINAL RULE ON HFCS



The Department of Defense, General Services Administration and the National Aeronautics and Space Administration have issued a final rule amending the Federal Acquisition Regulation (FAR) to implement the Climate Action Plan's requirement to procure, when feasible, alternatives to high global warming potential HFCs.

This final rule, effective June 15, 2016, will allow agencies to better meet the greenhouse gas emission reduction goals and reporting requirements of the Obama Administration's Executive Order on Planning for Sustainability in the Next Decade, according to a notice published in the Federal Register last month.

In response to public comments, the final rule clarified the definition of high global warming potential hydrofluorocarbons to make it specific to a particular end use; and included the use of reclaimed HFCs as products that minimize or eliminate the use, release, or emission of high-GWP HFCs.

Some public comments to the proposed rule said it "could have considerable impact on reducing the government's greenhouse gas emissions." **MG**



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SOMETHING'S COMING, SOMETHING GOOD

If California's Refrigerant Incentive Program gets the proper funding support from the California legislature, it will transform the marketplace for natural refrigerant systems, not just in California but nationally

– By Keilly Witman



We are on the cusp of a game-changing development in the natural refrigerants arena.

In the near future, the California legislature is expected to announce its 2016-2017 budget, including funding for a low-GWP refrigerant incentive program, which would provide essential funding support for natural refrigerant refrigeration systems.

California's Governor Brown included \$20 million for this financial incentive program in his proposed budget. The California legislature's budget subcommittee #3, chaired by Assemblyman Richard Bloom, a strong advocate for environmental protection, has been primarily responsible for reviewing the portions of the budget relating to the program.

Glenn Gallagher, air pollution specialist at the California Air Resources Board (CARB), has made it clear that the funding would apply to systems that use natural refrigerants, such as transcritical CO₂, ammonia-CO₂ and hydrocarbon self-contained systems and stand-alone equipment, whose GWP is zero or close to it.

To paraphrase Vice President Joe Biden on another topic, the Refrigerant Incentive Program, if it comes anywhere close to getting the \$20 million the governor has allocated to it, will be a really big deal. For supermarkets, cold-storage operators and many other large end users of refrigeration equipment, the refrigerant incentive program would offer an opportunity to escape from endless refrigerant regulations and phase outs.

What's particularly significant about the refrigerant incentive program is that for the first time in the U.S. an incentive program would target the direct greenhouse gas emissions (GWP) associated with refrigerants. Heretofore, incentives in commercial refrigeration have been the realm of utility companies, and as a result, the incentives have been based on energy-efficiency improvements. While natural refrigerants are demonstrating energy-saving capacity, their super-low GWPs are what leads to the largest gains for our climate system.

CAP-AND-TRADE MONEY

The funding for the refrigerant incentive program comes from an apropos source – California's greenhouse gas cap-and-trade program, which collects a large amount of money annually from the state's greenhouse gas emitters. The state must, by law, invest the money in programs that combat climate change. The current investment cycle started in 2013, and ends this month as the legislature decides which entities will receive funding for the next three-year period (July 2016-June 2019).

Groups like the North American Sustainable Refrigeration Council (NASRC) and shecco have taken steps to support California's refrigerant incentive program; NASRC has been encouraging supermarket companies to tell the California legislature that they are in favor of this program.

continued on p.14 →



DAS HERZ DER FRISCHE

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→ Supermarket operators have for a long time been aware that they can't solve refrigerant-related environmental problems by just addressing leak repair and record-keeping.

But supermarkets, famously operating under razor-thin margins, for the most part can't afford, or are otherwise disinclined, to simply overhaul their leaky, high-GWP systems with natural-refrigerant alternatives that cost \$1 million to \$1.5 million, far above the cost of a conventional system – at least not without some help.

Why are costs of environmentally friendly refrigeration systems so high? According to systems manufacturers, it comes down to economies of scale. These systems are still relatively new to the U.S. market, so manufacturers have not yet achieved the sales volumes that lead to economies of scale and lower prices. Some system components are being imported from Europe and Japan because the U.S. market is still too small to warrant domestic manufacturing facilities.

Contractors also have limited experience with these new systems, resulting in higher installation and maintenance costs in the U.S.

The beauty of California's proposal is it would help generate enough sales for OEMs and component makers to achieve economies of scale, and lower equipment prices. Contractors would have more opportunities to gain experience installing and maintaining these systems. Organizations like NASRC and shecco could track system performance and share data throughout the industry.

“ The beauty of California's proposal is it would help generate enough sales for OEMs and component makers to achieve economies of scale.”

“ The funding for the Refrigerant Incentive Program comes from an apropos source -- California's greenhouse gas cap-and-trade program.”

Eventually, more supermarket companies and other commercial and industrial end users would invest in these systems, ultimately creating a continuous virtuous cycle. Most importantly, the impact of this cycle would be felt not just in California, but also nationally.

The commercial refrigeration industry eagerly awaits the verdict on the refrigerant incentive program from the California legislature. It remains to be seen how the legislature divvies up the cap-and-trade monies, but to quote from an old song, something's coming, something good. @KW

Keilly Witman is the owner of KW Refrigerant Management Strategy, a consulting firm that helps the supermarket industry manage strategic challenges in the refrigeration world. In 2015, she helped found the North American Sustainable Refrigeration Council, a nonprofit that promotes the use of natural refrigerants in the grocery sector. Prior to starting her own firm, she ran the EPA's GreenChill Partnership, which grew to encompass more than 8,500 supermarkets during her tenure.

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Existing Western Gateway Storage building, opened in 1950.



Photography by Jameson Clifton

THE ROAD TO LOW-CHARGE AMMONIA

The Bornemeiers – the husband-and-wife team that runs Western Gateway Storage – are the first to install Evapco’s low-charge packaged ammonia system. Here’s the story behind their decision.

– By Michael Garry

David Bornemeier always had a nose for a good investment. When he was a finance student at the University of Utah, Bornemeier discovered a mint-condition 1967 Mustang in a barn. He bought it for \$500, stripped it down, rebuilt it and sold it – for a price that “paid for a good chunk of my college education,” he said.

Years later, in 2011, Bornemeier came upon another investment opportunity – a 100-year-old cold storage facility in Ogden, Utah, called Western Gateway Storage Co., which he described to his wife, Becky, as a “giant refrigerator.” In addition to doing copious amounts of due diligence into the building, the company and the 3PL industry, he also had a gut feeling about this property, the same feeling he had about the Mustang. It was, he said, “gorgeous ... just a little dust on it is all.”

They bought the company, David becoming CFO and president; Becky, CEO.

continued on p.20 →



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→ This year, the Bornemeiers are embarking on the next phase of their journey as investors and entrepreneurs, opening up a brand new cold storage facility this July adjacent to the existing Western Gateway building. Among its enhancements, the new building will feature the Evapcold low-charge-ammonia packaged refrigeration system from Evapco – the first Evapcold system to be installed in the U.S. (See [“Research + Sustainability = Low-Charge Ammonia,” Accelerate America, December 2015-January 2016.](#))

It’s also among the first wave of low-charge, rooftop-mounted refrigeration systems that are starting to be used as a safer, simpler, faster-to-install, far-less-regulated, and, in many cases, more efficient alternative to traditional stick-built, large-charge industrial ammonia systems that require an engine room and network of piping. Other low-charge system suppliers include Azane, NXTCOLD, Stellar, Mayekawa and Cimco.

Low-charge ammonia systems are also regarded as an environmentally friendly alternative to industrial refrigeration units that employ R22 or HFC refrigerants, which are on their way out of the marketplace due to their ozone-depleting and/or potent global warming effect.

The story of the Bornemeiers’ decision to follow their investment in Western Gateway with another in a low-charge industrial refrigeration system demonstrates the kind of planning, curiosity, and resolve needed to move forward with next-generation technology.

DUE-DILIGENCE SKILLS

Before becoming investors and business owners, the Bornemeiers spent a decade honing their skills in private-sector jobs, David in commercial banking as a financial analyst and Becky in residential real estate. “By 2006, we decided we had the necessary skills and capital to shift our strategy of working for companies to actually owning them,” said Bornemeier.

Asked about how they manage a business relationship along with their marriage, Bornemeier replied that “it comes down to communication.” He has often heard that even building a home can “put your marriage to the test,” and yet they have been able to successfully build “multi-million-dollar commercial buildings and businesses.”

Bornemeier’s approach to new investments – whether a cold storage facility or a next-generation refrigeration system – is to apply the due-diligence

skills he developed as a financial analyst. “David got to see what formulas worked so he could look at a company and see how to make that company better and expand,” said Becky Bornemeier.

Bornemeier attributes part of his success to not being afraid to ask “dumb questions, even though they make you feel dumb when you ask them” as part of his due diligence. “That has made all the difference in making educated decisions and helping our company manage its risk exposure. We’re not embarrassed about asking the dumb questions - we get smarter and our businesses get better every time we ask one.”

An early company acquisition, in 2008, was born of personal experience. “One of the excuses I made to come see Becky while we were dating was to help her study for her real estate exam,” said Bornemeier. “We later purchased the company (Stringham Real Estate School) that provided the real estate exam prep I was helping her with.” They continue to own the company today, though their primary focus is on Western Gateway.

Within the new Western Gateway building, the Bornemeiers are also carving out a section that will house a new, separate company using a traditional stick-built

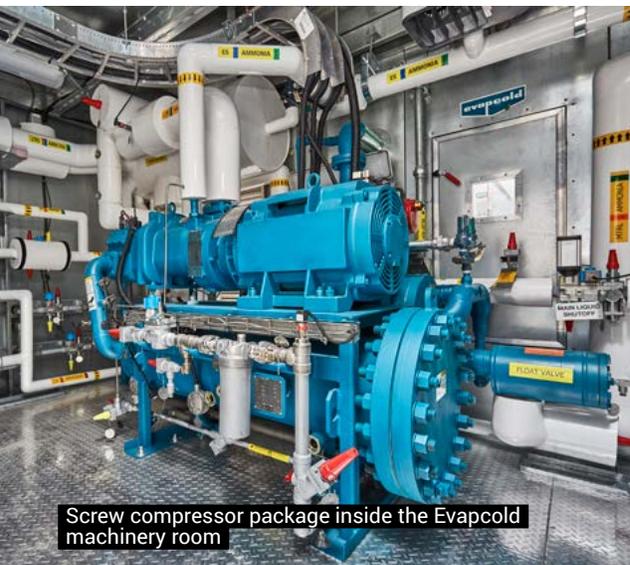




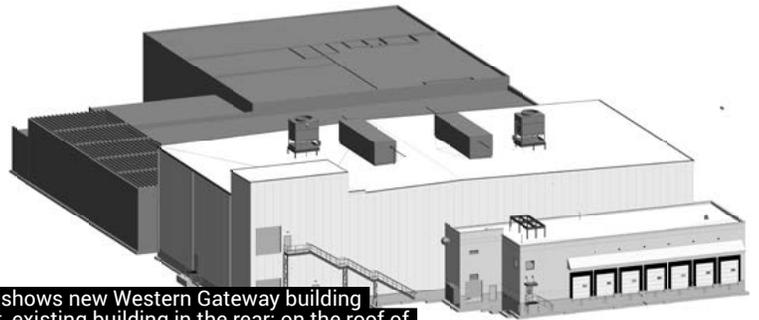
Cold storage room with supply air plenums at top for both Evapcold units



Rear of Evapcold unit; the blue pipe is the glycol/water connection from an adjacent fluid cooler.



Screw compressor package inside the Evapcold machinery room



Rendering shows new Western Gateway building in the front, existing building in the rear; on the roof of the new building are the two Evapcold units and adjacent fluid coolers.

ammonia system with an engine room.

When Bornemeier first approached Becky about Western Gateway, “she humored me,” he recalled. But Western Gateway met their key criteria: tangible assets, a great reputation, and being in business for many years. It has proven to be “a diamond in the rough,” he said.

Western Gateway’s roots go back to the turn of the 20th century when it partnered and later merged with a meatpacking company, which was sold in 1950. Western Gateway fittingly still makes use of the nearby transcontinental railroad, which helped open up the western U.S. “The theme of keeping our customer’s inventory ‘safe, clean and cold’ has a long legacy – one we are very prepared to continue,” said Bornemeier.

In addition to the Evapcold low-charge ammonia system – which Bornemeier calls the “crown jewels of our new building” – Western Gateway’s new cold storage facility has other elements designed to reduce material usage and energy consumption.

For example, the Evapcold pallet racking is constructed to distribute the weight of its product loads such that the amount of concrete used in the flooring could be reduced. In addition, “our warehousemen/women will really like our new forklifts and racking layout since it will allow them to safely move more product even faster,” he said. “We’ll be able to handle more truck loads in day and keep our reputation for moving trucks in and out on time.”

Western Gateway’s old two-story building – measuring 63,000 square feet and containing 1 million cubic feet – encompasses several storage rooms for

both medium temperatures (33°F and above) and low temperatures (5°F and below); it uses a traditional ammonia system with thousands of pounds of charge. The new building is one story with just 30,000 square feet, yet it holds the same volume as the other building because its ceilings are twice as high; its target temperature is -5°F or below.

In April, two Evapcold units arrived at Western Gateway’s new building, finding a home on the roof. Each Evapcold unit – which is 42-feet, 7-inches long, 10-feet, 10-inches wide and nine-feet, seven-inches high – contains 290 lbs. of ammonia, and can provide 70 TR of cooling (4.1 lbs./TR), for a total of 140 TR, though the facility’s cooling load is 100 TR. (The extra TR is spare capacity.) The units, which will blow cold air into the freezer room via ductwork, are sized to allow one to be down temporarily for maintenance.

To cool the low-charge units’ condensers, a fluid cooler is stationed next to each unit, feeding them a water/glycol mixture.

In addition, the separate stick-built ammonia system using two Evapco ceiling-hung evaporators will cool a 35°F dock with a 20 TR cooling load.

AN ALTERNATIVE TO FREON

Western Gateway did not originally plan to buy a low-charge ammonia system. The initial general contractor for the new Western Gateway building led the Bornemeiers toward a less expensive Freon-based refrigeration system. But, at the beginning of 2015, they found a new general contractor, Sirq Construction, and began rethinking their approach

continued on p.24 →

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The front of an Evapcold unit showing machinery room door with required signage.

ENERGY INCENTIVE FOR LOW-CHARGE SYSTEM

Western Gateway was able to obtain a \$60,000 energy-efficiency incentive for its two Evapcold low-charge ammonia packaged units from Rocky Mountain Power, helping to defray the cost of the equipment.

The company partnered with energy consultants Cascade Energy to secure the incentive.

The incentive was for the efficiency of the low-charge refrigeration system installed in Western Gateway's new 30,000-square-foot cold storage facility. 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 (\$30,000 annually). Of that, 220,000 kWh was attributable directly to the low-charge refrigeration (including 60,000 kWh from the evaporator's variable frequency drive) and 60,000 kWh to the variable frequency drive in the fluid cooler used to cool the condenser in the low-charge unit.

The baseline system was a single-stage, economized recirculated liquid ammonia system, with a fixed-speed screw compressor and evaporative condenser.

→ to refrigeration. Sirq "fostered an environment where we could educate ourselves, and then consulted [with us] on costs, pros and cons, etc.," said Bornemeier.

He started asking lots of questions about refrigeration, such as: What is the regulatory trend in different types of refrigeration? What are the pros and cons from a maintenance perspective? What do our customers want? Is there a way to keep piping to a minimum inside the freezer shell or can it be eliminated altogether? What are the install time differences between systems?"

Bornemeier takes pride in learning about a new area like refrigeration in order to make the best decision. He believes all end users should take that approach. "I'm known to be up until 2-3-4 o'clock in the morning just researching and searching for the latest and greatest," he said.

Asked if this thirst for knowledge is one of her husband's strengths, Becky Bornemeier laughed and said, "I would say so."

Bornemeier ultimately rejected the notion that he should invest in a less-expensive Freon system. "It seemed like with Freon we would be trying to cut corners," he said. "It just felt wrong not to make the refrigeration system the main focus." He also studied the regulatory environment and could see that HFC refrigerants were not a good solution for the long term. "We were looking at this building lasting a good long time, not only from a regulatory standpoint but for operations and maintenance as well," he said. "So hands-down, low-charge ammonia was a better decision."

In order to make that decision, Bornemeier solicited assistance from his local refrigeration contractor, Jack Gage, owner of Jack R. Gage Refrigeration, as well as his product rep, David Anderson of Clark Johnson Co., "Jack and David Anderson were patient enough to review I don't know how many different configurations – NH₃, CO₂, Freon, mixtures of both, you name it," he said. Bornemeier and Gage even concocted a novel solution of their own, but were advised that "the technology we were dreaming up hadn't been invented yet."

Bornemeier considered using an ammonia/CO₂ system but "we felt the design of our building lent itself to a low-charge ammonia package on the roof." He evaluated other low-charge ammonia vendors, but opted for Evapco because of its longevity as a supplier and OEM of refrigeration systems, including many penthouse units.

He made two trips to Evapco's headquarters in Taneytown, Md. The first was to vet the company and the second, last December, to see the Evapcold unit in action on a test stand. (See "[Western Gateway: First to Use Evapcold](#)," *Accelerate America*, December 2015-January 2016.)

On the second trip, the Bornemeiers brought their three children, ages 7, 9 and 11, who "turned the last bolt" on the system before it started up. "We wanted the kids involved as well," he said.

He acknowledged that being the first to implement a new technology is something of a risk. But he trusts Evapco's ability to package "tried, true and tested"



From left: Kurt Liebendorfer, Evapco; and David Bornemeier, Western Gateway.

components from major suppliers like Danfoss and Bitzer – whom he also vetted – into a new low-charge design. “I have full confidence that Evapco could provide this as a brand new, first-of-its-kind installation for them, in a brand new building for us,” he said. “We felt they had the same sound reputation we look for when we buy and invest in businesses.”

Bornemeier likened the Evapcold system to a cheese steak sandwich consisting of familiar ingredients – sliced prime rib, a soft French baguette, caramelized onions and provolone cheese – that he would happily consume individually. But he would still need to evaluate the chef putting those ingredients together. In Evapco, he found his “chef” – an OEM whose company culture and R&D capacity appealed to him.

SAFETY IS KEY

Selecting Evapcold units meant embracing a new refrigeration system with additional weight on the rooftop that would “affect the structural design of our building,” he said. But the advantages of the system made up for that issue.

Improved safety was one of the biggest reasons the Bornemeiers went with a low-charge system. “You want to build your system so there are no releases,” said Bornemeier. “But in the event there is a release, [with a low-charge, rooftop system] there’s no comparison with how

it affects the environment, the safety of our employees and the product we’re housing for our customers. Any ammonia leak can be handled from the outside, and there’s no chance the evaporator coils that contain ammonia will be hit by any operations in the warehouse.”

The Evapcold units’ fast installation compared to a conventional ammonia system was also a “huge selling point for us,” said Becky Bornemeier. Arriving in April, the low-charge units will be turned on in June and will slowly bring the temperature of the freezer down to target levels by the end of July.

By drastically cutting the amount of ammonia in the system, low-charge ammonia systems also reduce an end user’s regulatory burden, which spikes when ammonia charges exceed 10,000 lbs. “With an existing building next door, the new freezer operation and an additional stick-built system for a separate process, we were concerned with the potential to exceed the 10,000-lb. threshold,” said Bornemeier. “With the Evapcold units in place, we won’t come close to that threshold.”

The Evapcold unit also gives Western Gateway a single source to consult with in the event of operational problems, as opposed to a myriad of suppliers for a traditional ammonia system. “That was a big selling point for us and allows us to better manage our risk,” he said.

The ease of operation of the low-charge system also appeals to Bornemeier, with control features accessible on a computer or on the unit itself.

In terms of equipment and installation costs, the Evapcold units are “comparable to or less” than a conventional ammonia system, said Bornemeier. That includes the oversizing of the units and the additional structural costs to support the weight of the units on the roof, which were balanced by lower labor and equipment costs for installation, energy savings, and a \$60,000 utility incentive. ([See story, page 24.](#))

The Evapcold system lowers equipment and maintenance costs by drastically reducing the amount of ammonia piping, valves, insulation and controls needed to run the system.

The utility incentive earned by Western Gateway reflects the energy efficiency of the Evapcold unit, which was calculated to consume 20% less energy than a conventional ammonia system.

Bornemeier will be sharing the actual operational results of using the low-charge system with *Accelerate America* in the coming months. He will also be speaking about the system at the ATMOSphere America conference in Chicago on June 17, as will Kurt Liebendorfer, vice president of Evapco. Stay tuned. **MG**



SYSTEM SPECS

Western Gateway Storage’s new cold-storage warehouse and low-charge refrigeration system have the following characteristics:

- Size of building: 30,000 square feet, 1 million cubic feet
- Temperature of freezer room: -5°F or below.
- Number of low-charge ammonia units: 2
- Supplier of units: Evapco
- Size of unit: 42-feet, 7-inches long, 10-feet, 10-inches wide and nine-feet, seven-inches high
- Ammonia charge in each unit: 290 lbs.
- Capacity of each unit: 70TR
- Cooling load: 100TR
- Fluid cooler next to each unit supplying glycol/water mix



Michael Englebright, Woolworths

FOR WOOLWORTHS, CO₂ IS 'A NO-BRAINER'

Having gained experience with CO₂ cascade systems, the Australian retail giant plans to move forward with transcritical technology, enhanced to deal with the nation's warm regions, and a comprehensive training program

– By James Ranson



While other industrialized economies like the European Union and the U.S. are imposing regulations that support the adoption of natural refrigerant systems, Australia has yet to follow suit.

That leaves Australia's two largest food retailers, Woolworths and Coles – who share close to 80% of the market – with a sizeable role to play in setting the sustainable agenda.

"I'd be lying if I said that wasn't true," said Michael Englebright, Woolworths' national engineering manager during an interview amid the serene surrounds of Melbourne's National Gallery of Victoria. "It's really up to the big players in the industry here in Australia. We'd love to see the government regulating the industry and providing subsidies, but if we have to wait for that, then our store fleets will be nearing their end of life. We've got to be proactive and get on the front foot and steer the way with a rigorous strategy and program."

And getting on with it is exactly what Woolworths has done.

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

Its Woolworths supermarket chain has over 150 CO₂ cascade installations – its current "business as usual" technology – but Englebright is eager to implement CO₂-only waterloop display cases and

CO₂ transcritical systems. Currently, the company has five transcritical store systems (and three industrial systems) running in Australia and one in New Zealand that was installed in March, as well as one store with a waterloop CO₂ condensing unit.

The end game is to adopt transcritical technology, but that can be a difficult proposition in Australia given its warm climate. Still, the five installed systems "haven't missed a beat," said Englebright. "So as the technology continues to develop for us, it's a no-brainer for the future."

With the commercial sector's long history of using CO₂ subcritical systems in Australia – including expertise in technology, maintenance and training – a market-wide move to CO₂ transcritical would be a "logical transition," said Englebright. The declining costs of subcritical systems suggest a similar trajectory for transcritical systems as the latter's volume grows.

CO₂'S EVOLUTION DOWN UNDER

Englebright remembers vividly the unrest in the industry back in 2004 when he was starting out with Australian contractor Frigrite. "It was getting repetitive that every 5-6 years we'd have to go through another phase of transitioning out [refrigerants] and retrofitting stores."

While at Frigrite, Englebright worked on Australia's first full CO₂ liquid recirculation system, an experience he described as "a huge stepping stone in my career." For two years, Englebright monitored the store, including maintenance and energy performance.

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→ Around this time Frigrite, along with Austral Refrigeration, began to look at other alternatives to HFCs. This led to Woolworths' first CO₂ cascade system at a store in Sydney, Australia.

Personally, Englebright continued his natural refrigerants journey in Europe as Danfoss's global applications engineering manager before moving to Carel. He also worked closely with shecco (publisher of *Accelerate America*) to promote natural refrigerants, speaking at a number of U.N. forums before returning to Australia and joining Woolworths in 2014.

"I'm very passionate about natural refrigerants, but wherever you go in the world the biggest challenge is change," Englebright said. Yet he senses change happening in Australia. "Early on the development of natural refrigerants technology was slow, maybe once or twice a year. Now it's continuous; it happens every quarter. I'm getting calls all the time with the latest natural refrigerant solutions. Availability is increasing, and cost is coming down; now it's just picking the right solution for the application."

From the initial full CO₂ liquid recirculation systems, Woolworths transitioned to R134a/CO₂ cascade systems and continues to adopt these where feasible for all new and refurbished stores. A typical Woolworths store runs around 40,900 to 47,360 square feet and requires around 300kW of refrigeration capacity, provided predominantly by one or both of its two key rack suppliers, Heatcraft and Bitzer.

"Our [hybrid technology] really showed us the way, and we have now adopted a highly efficient hybrid system," Englebright said. And this is setting the stage for further development.

"With the evolution of the CO₂ technology and the adoption of so many different suppliers, it's becoming very competitive to really look at transcritical CO₂."

Waterloop technology supporting CO₂ condensing units for its display cases is of great interest to Woolworths. The retailer tested this solution with ARNEG Oceania (its Australian division) in December 2015. Woolworths is now waiting for a manufacturer to support a CO₂ "transcritical-type" version. Englebright sees potential now in Panasonic's acquisition of Hussmann, Woolworths' major display case supplier.

"That's great news for us, with Panasonic's experience with transcritical CO₂ compressor technology, which we hope can complement the waterloop system," he said. "If we can implement that then we would have two great solutions available for our fleet."

Sanden is another supplier to have introduced CO₂ waterloop technology for plug-ins, showcasing it at COP21 in Paris in late 2015.

Englebright acknowledged that the first transcritical stores would require an additional cost – the single biggest challenge to adopting transcritical CO₂. But over time he believes standardization will enable transcritical technology to reach cost parity with legacy systems.

Still, the capital-cost challenge remains especially thorny for the company's remote stores. "We cannot adopt CO₂ due to the rural challenges of some of our stores in the northern parts of Australia," he said. "It can be very challenging in terms of maintenance so we pay a price premium for these locations. But in these far reaches [HFCs are] not a long-term solution, and we'll look at natural refrigerants down the track."

And although Woolworths has gone through a turbulent year, we've "deployed new technologies last year and will continue to do so this year," he said.

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→ THE HIGH-AMBIENT CHALLENGE

Australia is blessed with sun, surf and endless space, but its climate hasn't necessarily aided the cause of CO₂ transcritical. Above CO₂'s critical point (88°F) – reached easily and often in many parts of regional and coastal Australia – transcritical systems face additional challenges to maintain efficiencies.

However, technology advances are helping to meet those challenges. “With our high ambients, CO₂ transcritical was not really suited to this environment, but now with the progression into parallel compression and adiabatic cooling, it makes it a very, very interesting proposition,” observed Englebright.

Woolworths is conducting a feasibility study of parallel compression, which it sees as “vital” for Australia’s high ambient temperatures. “With [parallel compression] you can incorporate AC,” he noted.

Englebright pointed out that some European and U.S. manufacturers are making a second version of their transcritical systems – a “Rolls Royce” system, including parallel compression – that is “very promising for us.” He cited Green & Cool, Enex and Advansor as suppliers that can “provide the solutions and allow us to work on making the commercial numbers stack up.”

In addition, Heatcraft and Bitzer Australia are developing their own versions of a CO₂ transcritical system. This growing competition among suppliers “allows us to [overcome] the hurdle of the capital outlay a lot quicker,” he said. But Woolworths is still waiting for a “full natural refrigerant solution that would really be the icing on the cake.”

WOOLWORTHS BY THE NUMBERS

- Gross revenue: \$60.7 billion
- Number of stores in Australia: 3,300
- Number of Woolworths supermarkets in Australia: 873
- Number of Countdown supermarkets in New Zealand: 160
- Other stores: Caltex Woolworths (gas stations), Dan Murphy's and BWS (liquor chains), Masters (home improvement), Big W (general merchandise) and ALH (hotel and gambling)
- Number of R134a/CO₂ cascade stores: 150+
- Number of waterloop CO₂ condensing stores: 1
- Number of transcritical CO₂ stores: 5
- Number new stores/year: 30 (plus 30-40 remodels)



Denis Casey, Woolworths' refrigeration field engineer

Another leg up for transcritical technology is its ability to offer considerable heat reclaim; this fits the need for reclaimed heat in Australia, especially in regions where humidity is high. Transcritical CO₂ also provides hot-gas defrost, another energy-saving benefit compared to electric defrost in glass-door display cases and freezer rooms.

COLLABORATIVE APPROACH

Despite competition between Woolworths and rival Coles being as fierce as ever, Englebright and his team are collaborating with their Coles counterparts to innovate and stay at the forefront of natural refrigerant technology.

“The relationship there [with Coles] is the closest ever,” he said. “We both see the benefits of working collaboratively to support the industry.”

Going forward, Englebright wants to accelerate collaborative training initiatives and policy discussion despite Woolworths owning its own service and installation division.

Last year Woolworths commenced a natural refrigerants training strategy with a Danfoss e-learning training portal, where its 200+ technicians are trained on CO₂ technology; that is followed by field days through TAFE (Technical and Further Education), Australia's vocational education program. Each technician's progress is then tracked. “When we evolve to new technology like CO₂ transcritical, they know all the fundamentals, they know the refrigerant, they know the technology; it's just the operating conditions that change.”

Englebright is looking for support from other companies to create an industry-recognized training scheme. “We would hope that Coles, ALDI and IGA get involved because at the end of the day it's the front-line people who are supporting us.”

He fondly recalls the collaboration between Sainsbury's and TESCO in the U.K. “to start the race to implement natural refrigerants; you saw the whole industry come together.” He sees a similar opportunity in Australia with the recent ATMOSphere Australia conference in Melbourne and his collaboration with Stuart Saville, Coles' national refrigeration engineering manager. “Hopefully we can set up a steering group [for] training.” @JR

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Michinori Kogawa, Nissui Logistics



Soichiro Tsukada, NittoBest

EXPERIENCING THE NEWTON

Nissui Logistics and food manufacturer NittoBest show how the Japanese have leveraged the ammonia/CO₂ system to meet refrigeration needs while saving energy, with the help of government subsidies

– By James Ranson and Jan Dusek

Japanese refrigeration manufacturer Mayekawa introduced its trend-setting low-charge ammonia NH₃/CO₂ packaged refrigeration unit, the NewTon, in 2008. Since then the company has sold more than 850 units in Japan and is exporting the NewTon to markets around the world, including the U.S. ([See story, page 62.](#))

The NewTon, which uses ammonia to cool CO₂, and then circulates the CO₂ to application areas, has evolved to serve a host of applications, from cold and chilled storage to frozen storage and ice rinks. This July, Mayekawa is introducing two new cold storage units and two new frozen storage units, all of which will feature reduced refrigerant charge, system size and weight.

But the companies to first experience the NewTon are based in Japan. The following articles depict how two cold-storage companies have applied and benefited from this technology.



Nissui Logistics: First with NewTon

In 2008, Tokyo-based Nissui Logistics, which has offices in 40 locations around the globe and operates 16 distribution centers, became the first company to install the NewTon at a new facility in Kawasaki, Japan.

Since then, it has installed the system at two more facilities, in Osaku-Kou (port) and Osaka-Maishima, Japan; the former is jointly operated by Ajinomoto Frozen Foods, Housenreizou, and Nissui.

Initially three refrigeration systems were considered for the Kawasaki logistics center: ammonia/CO₂; an ammonia direct expansion system; and HFC R404A. Mayekawa's NewTon was selected due to its "technological innovativeness, energy-saving performance, and overall safety," said Michinori Kogawa, Nissui's general manager of the equipment management department.

According to Kogawa, the installation of three NewTons with 14,000 tons of total refrigeration capacity at the Kawasaki facility resulted in an energy reduction of 80,000kW a year.

Nissui's decision to be the first company to deploy the NewTon helped it to "fulfill [its] corporate responsibility," Kogawa said, adding, "The age of natural refrigerants [was] here."

Like many Japanese companies, Nissui received subsidies from Japan's Ministry of the Environment (MOE) to defray the additional cost of the ammonia/CO₂ system compared to a traditional HFC system. The subsidies originally covered up to one-third of the cost of a system; that has since risen to about 50%.

Nissui has proved to be a valuable partner for Mayekawa, providing crucial energy efficiency, power consumption and maintenance data so that the Japanese manufacturer

could continue to develop the NewTon. As a result, various modifications have been made to enhance the technology.

The installation attracted numerous parties from the industrial refrigeration industry as well as government officials from Japan and abroad.

Nissui followed the Kawasaki installation with NewTon deployments at the two other facilities; the joint Osaka venture and its Maishima facility, which started operations in April 2016. So far, compared to an R404A system, the NewTons have saved energy (excluding lighting and other equipment) at a rate of 23% in Kawasaki and 53% in Osaka.

Mayekawa's NewTon is now mainstream technology in Japan but few competitors with comparable technology exist. Competition would not only reduce the cost of ammonia/CO₂ systems but also create a new dynamic in the market. "We are telling our sales representatives and other domestic manufacturers [to go down this path]," Kogawa said.

Nissui intends to continue installing natural refrigerant technology.

The company's focus remains on safety, with flammable refrigerants not under consideration in order to completely avert safety issues and charge limitations. Kogawa noted that large systems using only CO₂ are included in the list of possible alternatives.

“The age of natural refrigerants [was] here.”

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→ NittoBest: Going Big with NewTon

At 715,000 square feet, NittoBest Corp.'s flagship facility in Yamagata, Japan, is its largest by far, and considerably larger than most food processing facilities in Japan.

Equipped with two hamburger production lines and three ham-cutlet production lines, the facility produces 13 tons of hamburgers and 15 tons of ham cutlets daily.

Also notable is that the facility is equipped with nine NewTon units that supply refrigeration and freezing for its hamburger and ham-cutlet production lines. Mayekawa also supplied its EcoCute CO₂ heat pumps to utilize the waste heat produced by the NewTons for potable hot water.

"For us, there are no other options but natural refrigerants," said Soichiro Tsukada, NittoBest's managing director and general manager of production.

NittoBest specializes in the production of frozen, canned, packed, chilled, and retort-pouched food products, with a total of 13 factories and affiliated companies throughout Japan. Yamagata Prefecture is the heartland of the company's operations with eight factories situated there.

The company started investigating natural refrigerants in 2010, but decided to take a cautious approach and continue researching the available solutions. In February 2014 the company made its move, installing an NH₃/CO₂ system from another local supplier at a facility in Fukuoka Prefecture.

Nine months later NittoBest installed the nine Mayekawa NewTon NH₃/CO₂ units at its Yamagata facility. Its employees have actively engaged in equipment and facility management, including training programs for NH₃ refrigeration and leakage handling.

The Yamagata facility's energy consumption is 15% lower than NittoBest's other plants that use conventional systems – results that have brought representatives of companies from Thailand, Indonesia and South Korea to tour the factory.

The NewTon operates without the oil injection system required by a conventional NH₃ system, therefore maintaining temperature for longer periods and leading to an energy savings of 8%-9%. Because the NewTon uses CO₂ as the secondary refrigerant, it reduces the ammonia charge from around 661-882 lbs. for NittoBest's all-NH₃ systems to approximately 55 lbs.

A decisive factor in the decision to invest in NewTon, Tsukada said, was funding from Japan's Ministry of Economy Trade and Industry (METI) and Ministry of the Environment (MOE), which together helped subsidize one third of the cost of the units, including installation. The total cost of the units would have been approximately 50% more than that of a conventional R404A unit.

Around 15% of food-processing facilities in Japan utilize alternatives to f-gases for refrigeration. Of the companies that have gone down the natural refrigerant route, typically around 60% of their systems are natural refrigerant-based.

"Funding programs are essential in further expanding the use of natural refrigerants," said Tsukada. Such programs enable manufacturers of natural refrigerant components and equipment to establish dedicated manufacturing capacity, which NittoBest believes will eventually drive down costs.

Syoji Miyajima, Mayekawa's food division director, has been an integral influence on NittoBest's first, and so far, only NewTon installation in Yamagata. The idea for recovering waste heat via a heat pump had not been explored by NittoBest at its other plants prior to Mayekawa's involvement in the Yamagata project. Mayekawa has also provided maintenance support since the installation was completed in 2014.

Such has been the success of NittoBest's largest factory in Yamagata that it plans to relocate production lines there from other facilities. Tsukada said. When that transition occurs, NittoBest intends to switch to additional natural refrigerant systems, replacing old freezers with new ones. "Natural refrigerants are the only alternative that we are considering shifting to, and this is irreversible," he said.

NittoBest also plans to launch a business in Vietnam in 2016 and is investigating the potential to introduce natural refrigerant technology there.

But for now NittoBest will continue to work closely with Mayekawa to improve its production capacity and to navigate various factors affecting the introduction of natural refrigerant technology, including initial and operational costs, the safety and security of products, and maintenance and support services.

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“For us, there are no other options but natural refrigerants.”



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UTILITY INCENTIVES: A WORK IN PROGRESS

Utilities are starting to support natural refrigerant systems with energy-efficiency incentives, but a lot of barriers still need to be overcome

– By Michael Garry

Utilities possess one of the keys that can unlock the pent-up interest in natural refrigerant technologies – incentive funding.

Due to the relatively small market in North America for systems like CO₂ transcritical, low-charge ammonia packages, self-contained propane cases and other units that use natural refrigerants, their costs remain at a premium above conventional systems. And that's where utilities can step in and offer incentive funding based on energy efficiency that can defray the extra cost of the new technologies and tip the scale in their favor.

But while some utilities have started supporting natural refrigerant systems ([see map, page 38](#)), incentive programs are still a work in progress. “Utilities are interested in how [natural refrigerant systems] work and how they save energy,” said Leigha Joyal, energy analyst for OEM Hillphoenix, which makes transcritical CO₂ racks. “But it's been rough getting utilities to buy into incentives.”

One of the ways to generate more incentives for natural refrigerant equipment – though they may be modest – is to categorize them as “prescriptive” or “deemed” technologies whose universally proven energy efficiency calls for a set incentive, as opposed a custom system that has to demonstrate its bona fides from site to site.

“A lot of utilities really want simple plug-and-go proven equipment for programs,” said John Bush, senior engineer for the Electric Power Research Institute (EPRI), Palo Alto, Calif., which serves as a research & development resource for utilities.

Self-contained propane systems offer the possibility for prescriptive incentives, as well as low-charge packaged ammonia systems, including Mayekawa's NewTon NH₃/CO₂ unit, said Bush.

On the other hand, utilities will offer custom incentives for natural refrigerant systems if they have “good data so they feel comfortable with what they're getting in efficiency,” said Bush.



John Bush, EPRI



Leigha Joyal, Hillphoenix

For example, ComEd, a utility in Northern Illinois, has granted incentives for transcritical CO₂ systems to Roundy's and others. "Even though they use a whole-building approach, they do look at CO₂," Joyal said. "They've been extremely receptive to CO₂, one of the better utilities in the U.S."

NYSERDA (New York State Energy Research and Development Authority), which works with utilities, has also orchestrated incentives for CO₂ transcritical systems for DeCicco's & Sons grocery chain and Aldi stores in New York.

Custom incentives usually end up being more substantial than prescriptive incentives. In one case, however, a food retailer in Ohio earned an incentive of only \$1,500 from Duke Energy for a Hillphoenix transcritical CO₂ rack, even though the rack saves around 30% on energy consumption compared to an existing HFC DX system. "It was surprising," Joyal said. "We've had other areas where the incentive potential was up to \$30,000."

CALIFORNIA DREAMIN'

Paul Delaney, senior engineer for Southern California Edison (SCE), believes that natural refrigerant systems such as low-charge ammonia, self-contained R290 cases and CO₂ systems, as well as hybrid condensing systems that conserve water in drought-stricken California, represent the future for many commercial and industrial end users in the Golden State.

Based on its own lab tests on self-contained supermarket freezers using propane as a refrigerant (vs. R404A), SCE has started providing custom incentives for those units, Delaney said.

"Every time we do something [with incentives], it starts in a custom fashion," he said. "We try to squeeze out as much incentive as we can." But SCE also tries to develop a deemed program that is "easier to incent, with lower administrative costs." On the other hand, the deemed approach may mean sacrificing energy saving estimates calculated on a custom basis. "We battle over what makes the most sense," he said.

Meanwhile, SCE will be metering the energy consumption of self-contained propane coffin freezer cases in 30 stores. "We'll see if we can come up with data to deem it or express it on a little bit of an accelerated basis," he said. "The opportunity is here. We should take advantage of it."

Last year, EPRI studied the efficiency of self-contained propane units and projected 10%-20% energy savings for R290 freezers compared with R404A equipment in the same product line. (The test found energy consumption was about the same for R134a and R290 refrigerators.) Several utilities have responded to the study by looking into bringing the R290 equipment into an incentive program. "Utilities have shown interest in that R290-vs. R404A difference in particular because the cost of the equipment from this particular manufacturer is the same," said Bush.

SCE has also done a lot of work in the ammonia arena. Starting in March and continuing throughout the rest of the year, the utility is working with EPRI to collect energy data on a NewTon ammonia/CO₂ packaged unit installed in a walk-in freezer at the Imuraya USA plant in Irvine, Calif., which makes frozen desserts. The system is being compared with an R507 compressor/condenser and preliminary results show a 30% energy reduction when the NewTon system is running, Bush said.

With regard to low-charge packaged ammonia equipment, SCE is looking at incentivizing units that would replace comparable R22 or HFC equipment in walk-in freezer applications.

The energy savings of a packaged low-charge system compared to an HFC or HCFC unit is 20% to 30%, depending on whether it is air- or water-cooled. Delaney is particularly excited about the potential for low-charge ammonia equipment to replace R22 and R410A in industrial and office building air conditioning. "In California, office buildings are the biggest market we have for refrigerants," he said. "If low-charge ammonia can replace R22, that would be a big deal and we could go faster into that." In addition, "R410A is an awful refrigerant, and its replacement would be a big deal."

continued on p.38 →

→ SCE has for more than a year been studying the energy efficiency of a NXCOLD low-charge ammonia system at a Lineage Logistics facility in Oxnard, Calif. The utility has determined the energy savings compared to the existing ammonia system to be between 10% and 13%, and plans to offer custom incentives for future installations of low-charge systems that validate their efficiency in the field. At the same time, SCE is working on determining whether low-charge systems clear California’s Title 24 energy-efficiency standard for new buildings.

Meanwhile, SCE is promoting low-charge ammonia systems, not just for their energy savings but their safety. “It’s absolutely the right thing,” said Delaney. “Why would anybody put in a flooded ammonia system?”

CO₂ has been getting a mixed reception in California. SCE, for example has rejected Hillphoenix’s incentive applications for CO₂ transcritical systems, though it has agreed to reconsider, noted Joyal.

The original decisions were based on California’s “Savings by Design” program, which awards incentives based on a “whole building” approach. “But now [SCE] has switched gears and is looking at each system individually,” Joyal said.

Hillphoenix has shown that its systems’ efficiency surpasses the Title 24 standard by 10% to 12% with air-cooled condensers, 23% with adiabatic condensers, she said.

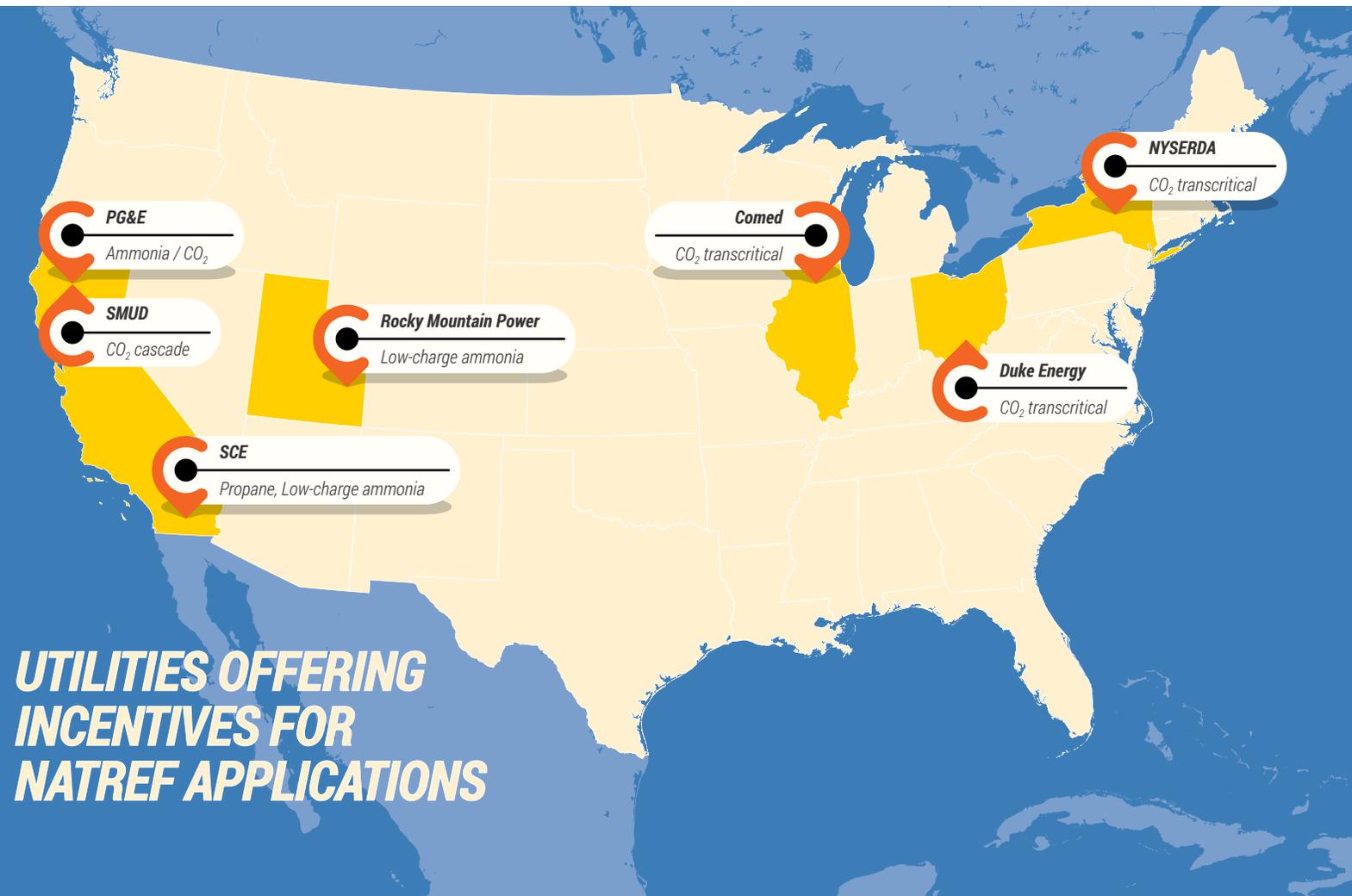
WHAT’S THE BASELINE?

One of the key variables that determine whether a utility approves an incentive, and how much it will be, is the baseline against which the natural refrigerant system is measured. Sometimes a CO₂ transcritical rack will be compared to a condensing unit instead of another rack system, or to a new system rather than to an end-user’s legacy or prototype system – comparisons that don’t fairly reflect the savings being offered by the transcritical system, said Joyal.

“Basing the incentive not on current usage but some hypothetical usage does not take into consideration the savings we’re giving,” she said.

Utilities in Connecticut, she noted, require comparisons to new systems, and are skeptical about the energy efficiency of transcritical systems in the northeast U.S. As a result, Hillphoenix has not worked on securing incentives for transcritical systems in Connecticut.

Hillphoenix has developed its own energy analysis tool called Pack-Calcs; it compares, for example, transcritical CO₂ racks to standard DX R404A parallel racks, taking into account loads and ambient conditions, and comes up with a hypothetical energy savings. When necessary, Hillphoenix will meter actual transcritical racks to back up its analysis.





Paul Delaney, Southern California Edison

Collaboration among utilities may lead to more incentives for natural refrigerant systems. SCE and EPRI are creating a supplemental project to evaluate refrigerants' energy efficiency that will bring in other utilities. "We're working on how we can collaborate to push the technology along, understand it and figure out how to incentivize it," Delaney said.

EPRI's research activities are also continuing to generate interest. Last year, EPRI also did a test of a CO₂ transcritical booster system with mechanical subcooling at its lab in Knoxville, Tenn., where Bush is based. With the subcooling, the CO₂ system showed "significant improvement in capacity and efficiency" across a 45°F-115°F temperature range, Bush said, cautioning that a final report on the test has not yet been issued. "You'd expect that benefit to be really helpful in overcoming the high-temperature efficiency barrier for transcritical."

EPRI is seeking field data for CO₂ transcritical, and is working on arranging a supermarket test, said Bush.

Natural refrigerant systems would earn more incentives if utilities took into account the zero or near-zero GWPs of these gases, which make a negligible contribution to global warming compared to HFCs or HCFCs. However, the utilities limit their attention to energy efficiency only. "Everything is kilowatts shed, and that's it," said Joyal. "Utilities say they're in the business of energy reduction, not greenhouse gas reduction." But, given the regulations that utilities are facing under the federal Clean Power Plan, "they may ultimately go down that road."

A refrigerant's GWP is a factor that "we need to look at," Delaney said, adding, "It's not something we can take a position on now."

CALIFORNIA REBATES FOR FOODSERVICE

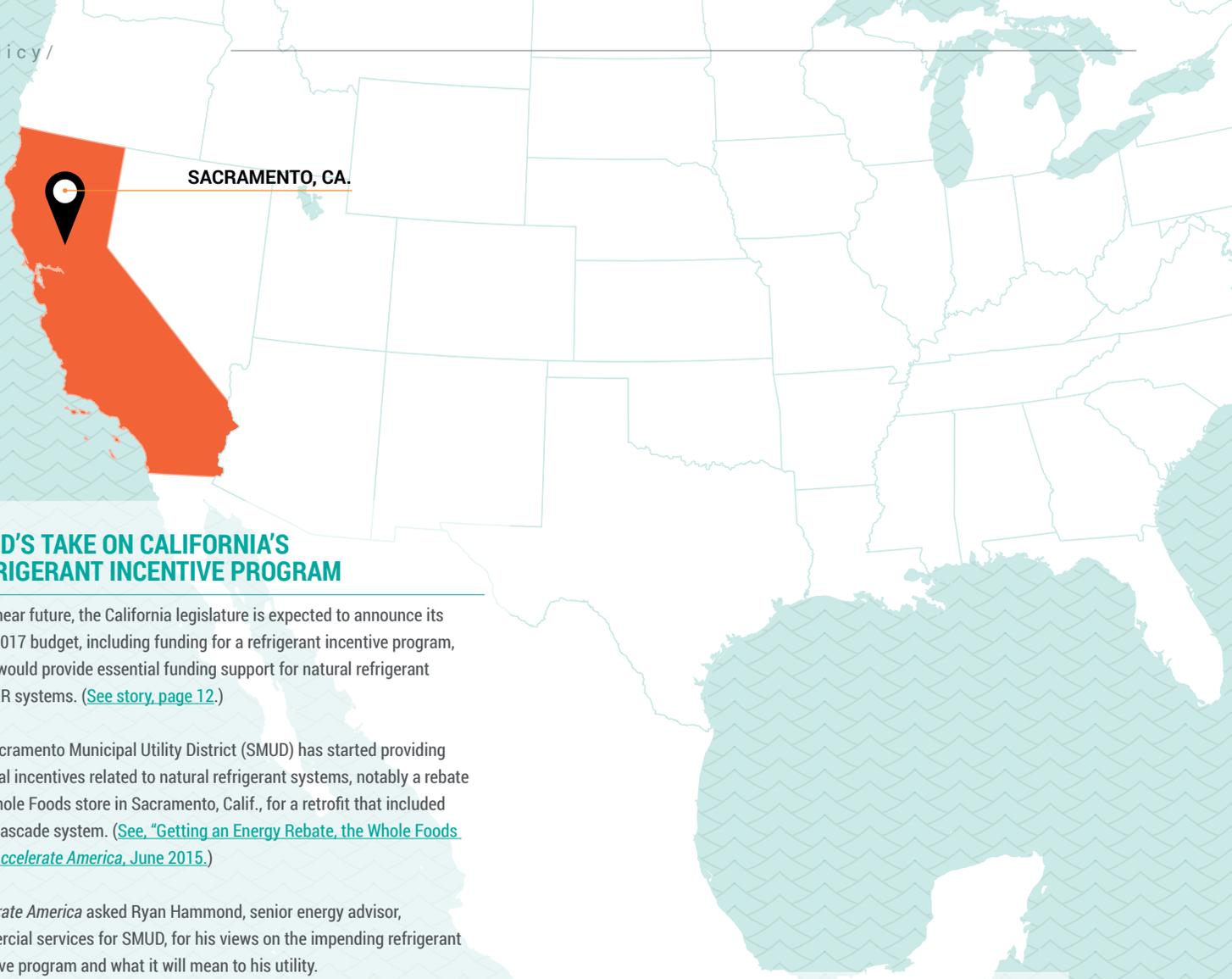
The Food Service Technology Center (FSTC), San Ramon, Calif., tests the energy efficiency and performance of commercial kitchen appliances on behalf of California utilities to determine whether they qualify for rebates.

Owned by Pacific Gas and Electric (PG&E), FSTC is operated by Fisher Nickel. In addition to PG&E, participating utilities include Southern California Edison, San Diego Gas & Electric, SoCalGas and Los Angeles Department of Water and Power.

Among natural refrigerant equipment that has qualified for rebates through FSTC are propane refrigeration units from True Manufacturing, including the T-23-HC and T-49-HC solid-door reach-in refrigerators, said Denis Livchak, lab manager for FSTC. Compared to the same units with R134a, the hydrocarbon refrigerators consumer less energy; for example, the T-23 with R134a uses 2.14 kWh/day while the T-23-HC consumes 1.27 kWh/day, a 41% savings

"We cannot solely attribute the energy savings to the refrigerant change; there have been other improvements done to the units to decrease energy consumption," said Livchak. "However, the savings look pretty impressive, percentage-wise."

continued on p.40 →



SACRAMENTO, CA.

→ SMUD'S TAKE ON CALIFORNIA'S REFRIGERANT INCENTIVE PROGRAM

In the near future, the California legislature is expected to announce its 2016-2017 budget, including funding for a refrigerant incentive program, which would provide essential funding support for natural refrigerant HVAC&R systems. ([See story, page 12.](#))

The Sacramento Municipal Utility District (SMUD) has started providing financial incentives related to natural refrigerant systems, notably a rebate to a Whole Foods store in Sacramento, Calif., for a retrofit that included a CO₂ cascade system. ([See, "Getting an Energy Rebate, the Whole Foods Way," *Accelerate America*, June 2015.](#))

Accelerate America asked Ryan Hammond, senior energy advisor, commercial services for SMUD, for his views on the impending refrigerant incentive program and what it will mean to his utility.

Accelerate America: What is SMUD's position on this potential program? Does the utility publicly support the appropriation of funds for this purpose?

Ryan Hammond: I am excited to be exploring this opportunity to develop a natural refrigeration incentive program. In addition, a program like this would help

meet one of SMUD's Board directives for the reduction of the region's total emissions of greenhouse gases through proactive programs. If the program is developed, SMUD would allot funds to support it.

Accelerate America: Would you envision this program directing some funds to public utilities in order to administer the incentives programs, considering that the utilities are already doing this?

Ryan Hammond: This is unknown at this time as we are still working on a program structure. If a natural refrigerant incentive program is developed, my hope is that other utilities (and possibly city and state agencies) would be able to adopt all or part of the program methodologies to assist with the implementation of natural refrigeration technologies.

Accelerate America: Do you think that your customers will be excited about the potential for receiving additional financial incentives for transitioning to natural refrigerant-based systems?

Ryan Hammond: Yes, my impression is that customers would be excited to have access to this incentive.

Accelerate America: What do you think would be the main challenges with implementation of such an incentives scheme?

Ryan Hammond: One challenge would be getting the word out to commercial businesses.

Accelerate America: Do you think that such a program would be sufficient for incentivizing a large number of your customers to purchase new equipment that utilizes natural refrigerants?

Ryan Hammond: The purpose of the incentive program is to help offset some of the incremental cost of one system over another, and is not intended to pay for the new system.

Accelerate America: Do you think this program should focus exclusively on natural refrigerants, or should it include other "low-GWP" refrigerants such as some HFOs?

Ryan Hammond: Again, the program is still under development. From my understanding at this point, the intent is to focus on natural refrigerants only. – *Matt Cullinen*

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CONVERTING TO PROPANE

Led by True Manufacturing, a slew of foodservice equipment manufacturers are transitioning their refrigerator/freezer lines from HFCs to R290 refrigerant; they showcased the change at the NRA Show

– By Michael Garry

It was only a matter of time before the foodservice industry began to take pending federal regulation of refrigeration equipment seriously.

For some time now, it has been widely known that the U.S. Department of Energy is ramping up its energy efficiency requirements by 30% to 50% for foodservice refrigeration equipment starting March 27, 2017, while the Environmental Protection Agency will begin delisting major HFC refrigerants used in that equipment in 2019.

With those deadlines on the horizon, several major equipment manufacturers, led by True Manufacturing, have sprung into action. And last month, at the NRA (National Restaurant Association) Show in Chicago, Ill., they reported transitioning most if not all of their lines from HFCs to propane (R290) refrigerant, in many cases dropping HFCs altogether; this approach deals with both the EPA's delisting plans and the DOE's efficiency requirements at the same time, rather than developing efficient HFC models for 2017 and then developing new R290 models for 2019.

True, which began marketing propane systems in the U.S. in 2013 and made its commitment to this technology clear at the NAFEM (North American Association of Food Equipment Manufacturers) Show last year, once again emphasized its propane equipment at the NRA Show, which ran from May 21-24 at Chicago's massive McCormick Place. Charles Hon, True's engineering manager, acknowledged that propane systems represent the fastest-growing part of True's business, adding, "We're discontinuing [HFC] models left and right, replacing them with [propane units]."

True's efforts are not going unnoticed. On May 21 at True's large NRA Show booth, Kirsten Hesla, product manager for the EPA, presented Steve Trulaske, owner of True, with the EPA's 2016 Energy Star Emerging Technology Award in the residential/commercial refrigeration category for 42 of the company's propane units. (See story, page 44.) The EPA gave the same award to Bosch for two residential refrigerators that use isobutane (R600a).

But True was far from alone at the NRA Show in highlighting hydrocarbon refrigeration. For example, during 2016, Beverage-Air, a division of Ali Group North America, is "converting its full [commercial refrigeration] product line to R290, if possible," said Bill Siskar, vice president of manufacturing & engineering, for the Ali Group's Refrigeration Division. Only large freezer units that need more than the 150g limit for propane will continue using HFCs.

Beverage-Air's propane units are 20% to 25% more efficient than previous HFC models, said Siskar, though he attributed that in part to "improved motor efficiency in the compressors."

The Delfield Company, a division of Manitowoc, will be transitioning its upright reach-in and under-counter commercial

refrigeration units to R290 by the end of 2016, and phasing out R404A, said Tim Wilczak, senior product manager for Delfield, at the Manitowoc booth. The R290 units are 15% more efficient than their HFC predecessors, he noted, adding, "It seems like hydrocarbons will be the refrigerant of choice for self-contained, mobile equipment."

The reliability of the R290 units is also better, observed Rick Caron, senior vice president, innovation, for Manitowoc Foodservice. "The number of service calls per unit per year is less because they are less complex than traditional systems."

Since February of 2016, about 80% of Traulsen's line of one- and two-section reach-ins and compact under-counter refrigeration units (308 models) have been available with R290 refrigerant, said Laura Gutkowski, sales development manager. Along with the addition of propane, "every element of the hydrocarbon units has been tweaked" to improve their efficiency, including fans, controls and the compressor, she added.

Traulsen's move to hydrocarbons was prompted by its large foodservice clients, who are concerned about their environmental footprint. "We got letters from our global and national accounts saying that effective immediately, they wanted to transfer to natural refrigerants, and we were up and running and able to convert," said Helith Sofer, director of marketing. But the company is also continuing to sell equipment with R134a and R404A "until further notice," she added.

Liebherr USA, whose parent company has sold R290 foodservice units in Europe for many years, is bringing them to the U.S. market for the first time this year, said Josef Steigmiller, divisional director, refrigerators and freezers division.

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R290 refrigeration units displayed at the NRA Show by (left to right): Traulsen, Delfield and Beverage-Air

→ PROPANE'S ENERGY ADVANTAGE

True's 42 award-winning models all met the EPA requirements of being at least 5% more efficient than predecessor units and using a refrigerant with a GWP of 15 or below (both helping to lower greenhouse gas emissions). In fact, the propane units are on average 25%-30% more efficient than the HFC models they replaced, while comparable in cost, noted Todd Washburn of True, which offers more than 150 R290 units in total (all fractional horsepower). The 42 units are in production today, but, per EPA award requirements, still with less than 5% market share.

For example, True's TUC-27-HC propane under-counter refrigerator (33°F-38°F using 1/6HP) consumes 1.44 kWh/day, a 20% reduction compared to the previous HFC model.

Though some observers downplay the energy-saving ability of propane, its strong heat capacitance (90% greater than R134a's and 140% better than R404A's) allows it to absorb more heat faster, True points out on its website; this results in quicker temperature recovery and lower energy consumption.

In its award requirements, the EPA specified that the energy comparison between a low-GWP refrigerant system (in this case propane) and a standard unit must look at only the refrigerant, compressor and any components needed to support the refrigeration cycle. All other components, such as the cabinet, insulation and lighting, must remain the same. "This allows for the isolation of efficiency gains due only to the low-GWP refrigerant system," said the EPA.

At the same time, True is also enhancing the efficiency of its units with LED lighting and other methods. "With DOE 2017, you can't not turn over all the rocks and look at the complete package," said Washburn.

In an effort to help promote adoption of True's efficient propane units, the EPA requires the company to "submit a commercialization plan for the U.S. market that includes a list of commercialization partners and date of product availability."

But True does not place propane units "unless there's a trusted technician within an hour's drive," noted Hon. To that end, True, based in O'Fallon, Mo., has "made an enormous investment in making sure our service network is hydrocarbon-prepared in North America and throughout the world," Trulaske said.

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TRUE'S TRIUMPH

It was a moment of triumph for Steve Trulaske, owner of True Manufacturing.

On May 21, at True's large NRA Show booth, he had just received the Environmental Protection Agency's 2016 Energy Star Emerging Technology Award in the residential/commercial refrigeration category for 42 of his company's propane (R290) units – by far the largest number ever recognized by the EPA. The metal-plated wooden award cited True's "environmental leadership through the design and manufacturing of innovative technology."

He held the award aloft, taking in the applause of colleagues and onlookers.

True's award-winning refrigerators and freezers all met the EPA requirements of being at least 5% more efficient than previous units (which have been phased out) and using a refrigerant with a GWP of 15 or below.

Kirsten Hesla, product manager for the U.S. Environmental Protection Agency, presented Trulaske with the award. @MG



Steve Trulaske, True Manufacturing, and Kirsten Hesla, EPA, holding True's 2016 Energy Star Emerging Technology Award.

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→ DIVERSE CUSTOMER BASE

True's propane refrigerators/freezers encompass glass-door merchandisers, under-counter units (glass and solid doors), commercial kitchen equipment and units built to spec. They all contain a maximum of 150g of propane, as per federal charge rules for flammable refrigerants, and use air-cooled condensers. Most are for spot placement in stores, though some are banked together.

The companies purchasing True's propane equipment encompass large grocery chains, convenience stores, discounters, dollar stores, restaurant chains and beverage brands. "The large supermarkets and restaurant chains are moving quickly," Trulaske said. "And as the big players move in this direction, it's making good sense for the smaller guys, too," added Hon.

True has built refrigeration units that use CO₂ as the refrigerant, but opted to commit to hydrocarbon as its standard. "We have a clear understanding of the difference between CO₂'s capabilities and hydrocarbon's, and we distinctly believe in hydrocarbons for our applications," Trulaske said.

True considered using isobutane, another hydrocarbon, as a refrigerant but decided against it because its lower capacity would not be suitable for freezer units. "We found we could do a whole model mix – refrigerators and freezers – with propane," said Washburn.

True has discontinued some HFC units "depending on market demand and component inventory," said Hon. "Some customers still want the same old thing, but we're educating them [about propane technology]."

Concerns about the flammability of propane, while prevalent a few years ago, have abated, said Washburn. "Once we educate them on the UL certification and the low charge sizes, it becomes a non-issue." @MG

PAIRING PROPANE WITH GLYCOL

One of the winners of the NRA (National Restaurant Association) Show's "Kitchen Innovation Awards" – which were highlighted in a special exhibit-floor pavilion – was Turbo Coil Refrigeration Systems, for its new propane/glycol refrigerated "chef base."

The foodservice unit stores seafood, steaks and other foods in four drawers at 33°F to 38°F, with cooking equipment used on the top. It employs an R290 condensing unit to chill glycol, which circulates through coils in the draws. The compressor toggles on and off to save energy, said Hector Delgadillo, Baldwin Park, Calif.-based Turbo Coils' CEO, who designed the system.

The chef base saves 30% to 50% in energy costs compared to similar units, according to tests conducted by the PG&E Food Service Technology Center.

Delgadillo was prompted to develop the R290 model by trends in Europe as well as EPA and DOE regulations. "This is the way it's going and we are getting ahead of the game," he said.

Delgadillo also designed a propane/glycol "sauté station" (which won a 2015 Kitchen Innovation Award) for another foodservice equipment company, Montague, based in Hayward, Calif. It's similar to the chef base except that it also includes four cooking burners, with refrigerated cabinets below and condiment trays above, maintained at about 38°F.

The combination of propane refrigeration and cooking burners "is very new to foodservice," noted Joe Deckelman, vice president of sales and marketing for Montague. The unit has been designed to protect against the flammability of the propane, he added.

The sauté station is Montague's first propane system, but the company is launching other propane units, including refrigeration equipment and a prep table. "We're trying to stay current with the regulations," said Deckelman. "The EPA is banning HFCs, so we have to move to something for the future." Using glycol as a secondary refrigerant helps to compensate for the small (150g) charge of propane allowed, he noted.

The University of Tampa is using the R290 sauté station with other cooking equipment in its student cafeteria, he said. @MG

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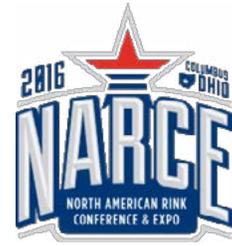
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DOUBLE DUTY

North America's first ammonia/CO₂ ice rink system provides both heat and cold

– By Mark Hamstra



Art Sutherland, Accent Refrigeration Systems

“It’s a huge payback.”

Feating the Wells Fargo Sports Complex at the University of Alaska in Anchorage is certainly not the primary task of its ice rink’s new ammonia/CO₂ refrigeration system, but it is an important one, said Art Sutherland, president of Accent Refrigeration Systems, Victoria, B.C., provider of the system.

Sutherland described the dual functionality of what is North America’s first ammonia/CO₂ system installed in an ice rink during a presentation at the North American Rink Conference & Expo (NARCE) last month in Columbus, Ohio.

The ammonia/CO₂ combination, which is now widely deployed in ice rinks in Europe, replaced a previous direct system that used R22 as a refrigerant. The rink was a good candidate for an ammonia/CO₂ system because it already had ½-inch steel pipes welded for high pressure — needed for CO₂ delivery — in place in a relatively new floor, Sutherland explained.

The previous system had used two, 125-horsepower Holmsten compressors, one of which ran continuously. For the Wells Fargo project, which began in 2015, Accent used a limited-charge ammonia system with shell-and-plate heat exchangers. Accent designed the system, which was built by Ultimate Fabrication, Edmonton, Alberta. The

system runs on one 100-hp Mycom compressor with a variable frequency drive, operating primarily on four of its six cylinders. A second Mycom compressor serves as a backup.

Using ammonia as a primary coolant required locating the charge outside of the facility because the machine room does not have ventilation to the outside, as required for safety in case of a leak.

The new system — which uses an ammonia charge of less than 400 lbs., vs. 8,000 lbs. of R22 in the previous system — includes an adiabatic fluid cooler on the roof, which reduces water use by 95% compared with an evaporative condenser, Sutherland noted.

The system also uses a gas desuperheater for heat reclaim. In this device, the ammonia is sent through a self-contained plate condenser cooled by glycol, which then redistributes the captured heat throughout the building. It provides all of the heat for the facility’s swimming pool and also heats fresh air for the facility, which includes a dance studio, gymnasiums, offices and other areas.

The heat from the system is equivalent to 278 kilowatts of energy, Sutherland said. “It’s a huge payback.”

EFFECTIVENESS OF CO₂

Using CO₂ as a secondary refrigerant also introduces efficiencies because it allows a lower “approach,” or the temperature difference between the primary and secondary refrigerant. Traditional indirect systems might have an 8-degree approach between the primary refrigerant and the brine — 10°F for the primary and 18°F for the secondary refrigerant — but the ammonia/CO₂ system allows for a 2-degree approach because of the effectiveness of CO₂ as a coolant.

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University of Alaska, Anchorage

HERE COMES AQUA AMMONIA

Using aqua ammonia as a secondary coolant could be the next big thing in natural refrigeration for ice rinks, according to Art Sutherland, president of Accent Refrigeration Systems, Victoria, British Columbia.

"It could be a game-changer," he said during a presentation at the North American Rink Conference & Expo (NARCE) in Columbus, Ohio, in May.

Aqua ammonia, or ammonium hydroxide, which consists of a solution that is 17% ammonia and 83% water, was first used as a secondary coolant in an ice rink in France and was rolled out to an additional 20 rinks in Sweden last year. "We're going to start doing a few of them," he said.

He told *Accelerate America* after the presentation that some North American rink operators have expressed interest in aqua ammonia, but it will require some discussions with local safety authorities to move forward.

While the use of ammonia in refrigeration systems is tightly regulated because of its toxicity, aqua ammonia actually poses very little risk, Sutherland explained. "We could have a bucket of it sitting open right here in this room, and it wouldn't bother anyone. It poses no risk as a gas."

Handling of aqua ammonia does require traditional protective wear for eyes and skin, however.

Aqua ammonia is already used as a coolant in industrial applications in Europe, Sutherland said.

Among its advantages is the very low pressure required to pump it through the floor system of a rink — 5HP, vs. 9.5HP for calcium chloride, a more common secondary refrigerant.

Sutherland said he is looking to pair the use of aqua ammonia with his company's Reduced-Charge Ice Rink Chiller, which uses a small charge of ammonia.

He's confident he'll get the first such systems started within the next 12 months. "We'll make it happen," he said.



→ He calculated that operators incur an "energy penalty" of about 2% per degree of approach, so a traditional system using brine would have a 16% energy penalty.

CO₂ comes back to the chiller as a frothy liquid, after circulating throughout the floor at the pressure at which it was delivered. "We can provide a higher temperature and still provide good ice throughout the floor," said Sutherland.

Of course, the environmental benefits of using an ammonia/CO₂ system are numerous, Sutherland explained.

Unlike many synthetic refrigerants, ammonia does not impact the ozone layer and does not impact global warming, he explained. Ammonia is also superior to R22 in terms of its energy efficiency, he said. "R22 is good, ammonia is better — much better than anything down the list today."

Still, Sutherland said the ammonia/CO₂ system is "not for everyone," especially if it requires the installation of new pipes under the floor.

In addition to the Wells Fargo Sports Complex, Anchorage is also home to the U.S.'s first direct CO₂ ice rink systems, installed by Hillphoenix for the Anchorage Parks and Recreation Department. ([See, "Skating on CO₂-Made Ice," *Accelerate America*, May 216.](#)) By next year, the CO₂ transcritical system will be employed at four municipal rinks.

continued on p.52 →

Shaping Refrigeration Systems for Tomorrow



NewTon

Premium NH₃ / CO₂ Cooling System

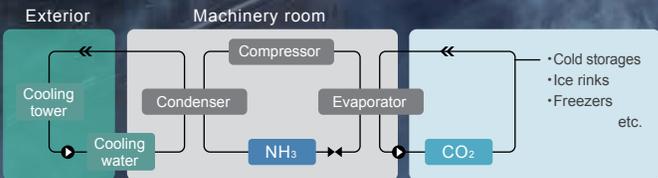
Energy-Saving

- ▶ Semi-hermetic screw compressor equipped with a high performance IPM motor
- ▶ Use of screw rotors with a new type of more efficient profile, "J-profile".



Safety

- ▶ Ammonia / CO₂ indirect cooling method, Minimizing the risk of ammonia leak



- ▶ Support via remote monitoring system

→ Rink Operators Wary of CO₂ Conversion Costs

The U.S. ice rink industry is taking a closer look at natural refrigeration technologies, but perceptions about the costs of conversion from Freon-based systems and a fear of the unknown could be holding some operators back.

That was the feedback from attendees and exhibitors at the North American Rink Conference & Expo (NARCE) last month in Columbus, Ohio.

“The industry right now is in a ‘proceed with caution’ phase” when it comes to using CO₂ as a refrigerant, said Ian B. Storey, president of I.B. Storey Inc., which specializes in refrigeration and arena design.

I.B. Storey, which has offices in both Canada and the U.S., has worked on some rinks using CO₂ in Canada, he said, and is exploring the feasibility of using CO₂ in two arena projects in the U.S., one in New York and the other in Maryland. In both instances, the operators are considering the possibility of converting their R22 direct systems to either CO₂ direct systems or indirect systems using ammonia as the primary refrigerant and CO₂ as the secondary refrigerant.

R22 is being phased out as a refrigerant by the Montreal Protocol because of its ozone depletion potential, and will not be available after 2020 except in recycled form.

PIPING AND EFFICIENCY

Major costs for some operators seeking to convert to CO₂ could be replacing the piping in the floor as well as the rink downtime that comes with such construction. CO₂ requires steel piping built to withstand high pressures.

In warmer climates, CO₂ can be a tough sell for rink operators, Storey said, because of its reduced efficiency. (However, new technology like ejectors and parallel compressors are enabling CO₂ transcritical systems to operate efficiently in warm climates.)

“Most ice rinks are operating with slim profits, so it’s tough to convince them to take an energy penalty,” said Storey. “Ammonia, where allowed, will be much more popular.”

“CO₂ gives you better heat transfer at every point in the system.”

“The industry right now is in a ‘proceed with caution’ phase”

Ammonia has become widely used as a primary refrigerant in ice rinks in Canada, and is gaining acceptance in the U.S., although people are “still a little paranoid” about it because of its toxicity, said Thomas R. Moore, a partner at HTG Architects, Minneapolis.

“You have to get the building officials and the municipal officials to accept it as well,” he said. “Once you convince people it’s been around and working, they come around.”

Mike McDevitt, chief executive officer of Apple Valley, Minn.-based Minnesota Ice LLC, an ice rink construction company, agreed that the cost of conversion is steering some operators away from CO₂. “Plus, there’s not a lot of track record out there,” he said.

Many operators seem to be interested in ammonia systems, McDevitt said, and synthetic refrigerants “are still in demand” because they often present the lowest up-front costs.

Tim Henderson, industrial program manager at Conyers, Ga.-based Hillphoenix, which installed the nation’s first CO₂ direct ice rink systems in Anchorage, Alaska, with three more on the way there, said he’s seeing more interest in CO₂ from operators.

“We have a lot of quotes out there, and it’s increasing every quarter,” he said.

Henderson said he hopes that once he installs some CO₂ direct ice rink systems in the continental U.S., operators will more easily see first-hand how the systems work.

He agreed that some operators are wary of the cost of conversion, although he said a CO₂ system can be installed “for a lower cost than an industrial ammonia system.”

Hillphoenix is remaining focused on direct CO₂ for ice rinks, rather than hybrid systems using ammonia or Freon as the primary refrigerant.

“CO₂ gives you better heat transfer at every point in the system, because we don’t have the additional steps of heat exchange” with the primary refrigerant, he said. **MH**



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Carnot Refrigeration display at Data Center World

COOLING SYSTEMS TRY TO KEEP UP WITH DATA CENTERS

Evolving IT technology is enabling server farms to operate at higher temperatures and make extensive use of ‘free cooling’ – but natural refrigerants are beginning to play a role

– By Michael Garry

One of the biggest markets in the world for cooling systems is the data center industry, whose mission-critical servers need to be prevented from over heating to function properly.

But data centers and the cooling equipment used to maintain them are both evolving to keep pace with the ever-growing demands of a digital world

For one thing, many large information processing companies – Facebook, Intel, Google, Apple and Microsoft among them – have been collaborating on an “open compute” project aimed at maximizing the efficiency of servers, storage and data centers. As part of this design, computers are now capable of operating at higher temperatures, and many Internet giants have raised the temperature of their server rooms.



“People are not that familiar with CO₂.”

Most server rooms still operate between 62°F and 70°F, but ASHRAE’s 2011 thermal guidelines for data centers – which recommended temperatures from 64.4°F to as high as 80.6°F – have “changed the world,” said Steve Kinkel, CEO of UMP, a Tempe-Ariz.-based manufacturer of data center cooling equipment. “Now they’re talking about 85°F because servers are made to withstand the heat. You don’t worry about the computer chips in your car; this is the same thing.”

But Steve Carlini, senior director of data center solutions marketing for equipment manufacturer Schneider Electric, cautioned that “unless you have a good understanding of raising the temperature, it may cause the data center to be less efficient.”

Moreover, the reality for colocation data centers is that even if 80°F is acceptable for the computer equipment, it may not be “for the customers writing the checks,” said Alex Carroll, managing member, Lifeline Data Centers, an Indiana-based colocation facility.

Still, the upward movement of temperatures acceptable in server rooms is having a pronounced impact on the application of cooling equipment. In fact, half of all data-center cooling systems will be upgraded before the end of 2016, according to research by Emerson Network Power.

MOVING TO FREE COOLING

The data center industry, particularly the large cloud-based companies, are pursuing cooling systems that essentially rely entirely on free cooling, which employs outside air for cooling in an economizer mode (using a fan without compression), when outside temperatures drop below that needed by the server room. Free cooling dramatically reduces the consumption of energy.

A study by market research firm BSRIA predicts that, over the next five to 10 years, the use of traditional CRAC (computer room

air conditioning) units will drop as end users opt for technologies like free cooling, liquid cooling and chilled-water cooling. And according to the Emerson survey, 40% of respondents are adding economizers to their systems that provide free cooling when outside temperatures allow.

This trend has led many Internet players to use free-cooling systems based on large custom air handlers in their cloud-computing facilities, said Carlini. “They’re putting big heat sinks [heat exchangers] on them and running air across it. There’s no [compressor-based] refrigeration.”

Some of these cloud-computing facilities are being built in colder climates like Finland and Iceland, Carlini noted. If necessary, the workloads in a given facility can be moved to a cooler location. “They can ‘follow the moon’ by only running workloads at night when it’s cooler.”

These changes in the data center market are “making the cooling market not as attractive for a company like us,” said Carlini.

It’s a little different for colocation centers that handle the computing needs of many companies, large and small. In particular, colocation centers serving “edge computing” – tablets, smartphones and the like – will build replicas of cloud stacks on-premise to operate as standard and/or back-up facilities. “If you run everything off the cloud, you’re susceptible to outages,” noted Carlini. For example, Google is building 60 data centers in the U.S. that it’s calling edge data centers; these will reside in colocation facilities.

Schneider is also looking at another type of free cooling system – immersing smaller servers in a pool of circulating water to keep them cool. “Water’s more efficient than air, said Carlini.” The company is testing prototypes this year.

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“We like ammonia a lot but we don't know enough about it.”

→ ROLE FOR NATURAL REFRIGERANTS

Where does all of this leave natural refrigerants? Even though free cooling is being used for a larger percentage of data center cooling, in most cases it still can't be expected to do 100% of the job. For the rest, the normal refrigeration compression cycle is needed. But the refrigerants that data centers use in those instances largely remain synthetics. To date, not many data centers have employed natural refrigerants like CO₂, ammonia or hydrocarbons as part of their cooling arsenal.

At the Data Center World conference in Las Vegas in March, Carnot Refrigeration, the Quebec-based pioneer of CO₂ transcritical refrigeration systems in North America, was one of the few vendors, if not the only one, promoting the use of CO₂ technology in computer server rooms. (See, “CO₂ for Server Rooms, *Accelerate America*, May 2016.)

So far, Carnot has sold eight of its Aquilon CO₂ transcritical CRAC units, with as many as 20 more on the way, said Marc-Andre Lesmerises, CEO of Carnot. At least two of the units are running at Bell Canada locations, and at least two are deployed at Rogers Communications facilities.

The UL-approved Aquilon system ranges from 52kW (15TR) to 158kW (45TR). It features Carnot's patented “Rain Cycle” free cooling technology. The Aquilon system leverages free cooling 80%-85% of the time in northern cities like Montreal.

At Data Center World, “people are not that familiar with CO₂” as a refrigerant, said Lesmerises. “Here we are starting at the beginning. It's like in supermarkets [in the U.S.] where we were the first one [with CO₂ transcritical].”

Emerson Network Power's Liebert brand markets a DSE CRAC system that incorporates free cooling but uses R134a (which is being replaced by R410A) as the refrigerant. “We're looking at alternative refrigerants like CO₂,” said John Peter (JP) Valiulis, vice president, thermal management marketing, data center solutions, for Emerson Network Power. “We're doing research and talking to Copeland [a brand of Emerson Climate Technologies] and others about CO₂.”

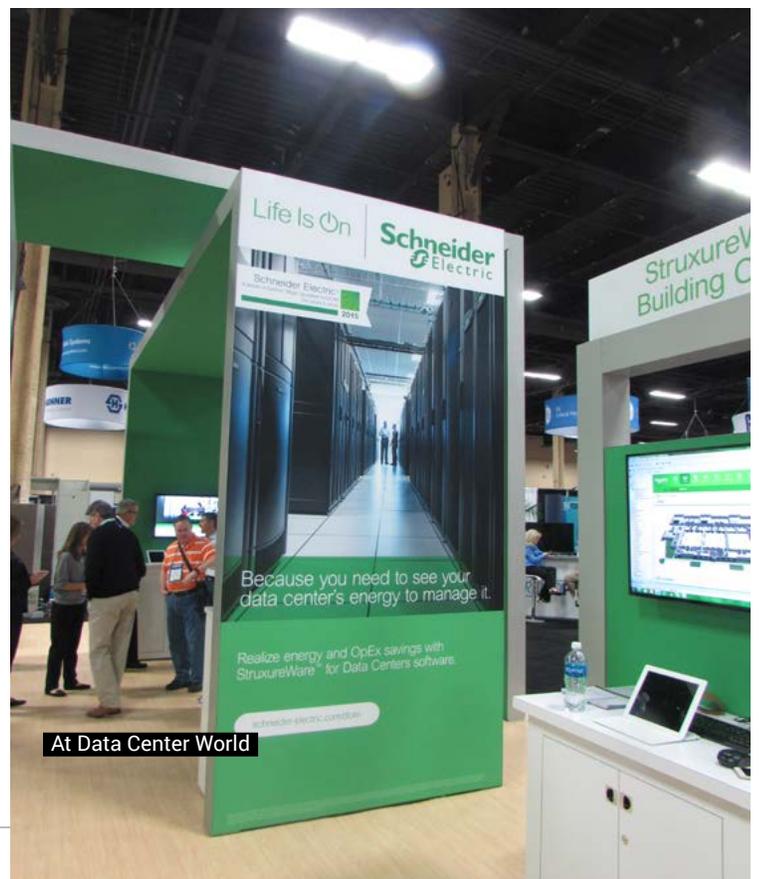
But so far Valiulis regards CO₂ as “not ready for prime time just yet in data centers in terms of cost. It's not proven yet in data centers. But we want to move to greener solutions.”

The Liebert DSE system is able to leverage free cooling 88% of the time in northern climates like San Francisco, said Valiulis. Under free cooling it uses a pump rather than a compressor to circulate refrigerant.

CRAC systems that employ free cooling can be used as an efficient, water-saving alternative to chilled-water systems in data centers. Emerson announced in January that its DSE system saved over 1.4 billion gallons of water in the previous 36 months in North America when compared to the deployment of chilled-water cooling systems in the same facilities.

ClimateWorx, a Brampton, Ontario-based maker of CRAC systems, uses R407C in a traditional refrigeration system that incorporates glycol-based free cooling. “We would possibly look at CO₂ and see where the industry starts to go,” said Gerry Ball, sales manager for ClimateWorx. “We have safety concerns about the pressure of a CO₂ system.”

Lifeline Data Centers, which uses R407C, also has questions about the pressures associated with CO₂ refrigeration in a “fail-proof world,” said Carroll. However, the colocation company is looking at ammonia refrigeration. “We like ammonia a lot but we don't know enough about it.” **MG**



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At ATMOsphere Europe in Barcelona, Spain

EUROPEANS EYE TRAINING PROGRAMS

At ATMOsphere Europe, representatives of European nations describe efforts to develop training for natural refrigerant systems that are taking root in a favorable regulatory climate

– By Klára Skačánová

“Last year we provided 18 million euros [\$20 million] to finance 252 refrigeration systems running on natural refrigerants.”

While European countries have promoted the adoption of natural refrigerant systems through regulation, there is still room for further development of training programs to support and maintain the installed base, according to policy experts who spoke at ATMOsphere Europe in Barcelona in April. ATMOsphere Europe was organized by shecco, publisher of *Accelerate America*.

For example, Ricardo Almeida from the Portuguese Environmental Agency pointed out the lack of trained technicians on natural refrigerants in southern European countries. “Adequate training and knowledge among contractors operating in different countries, particularly in the south of Europe, should be guaranteed,” he said.

Guillermo Martínez López from the Spanish Office for Climate Change, Ministry of Agriculture, Food and Environment, said that his agency is waiting for approval from the government to move forward with new requirements for training on alternative refrigerants and a certification system for technicians.

Spain followed the example of northern European countries by introducing a tax on fluorinated refrigerants in 2014. Although the tax level (\$14.4/tCO₂eq) is much lower than in Norway

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→ (\$44.4/tCO₂eq), Martínez López pointed out that significant emission reductions are expected for 2015 as a result of adopting HFC alternative technologies in new refrigeration installations and retrofitting with lower GWP substances in existing facilities.

Katja Becken from the German Federal Environment Agency revealed that while Germany is considering making practical training on natural refrigerants mandatory, “we need to enable training facilities.”

As part of Germany’s Climate Action Program 2020, several ideas are currently on the table. These include financial support for training facilities and on-the-job practical training on natural refrigerants to help familiarize trainees and professionals with the technology.

In order to accelerate the uptake of alternative technologies, Germany has been providing millions of euros since 2008 as a financial incentive to companies working in the commercial refrigeration sector. “Last year we provided 18 million euros [\$20 million] to finance 252 refrigeration systems running on natural refrigerants,” said Becken. “In total we spent 114 million euros [\$127 million] on 1,300 projects from 2008 to 2014.”

Meanwhile, the European Commission is currently working on a report on training for HFC alternatives, which will be published by 2017. While the EU has strict rules regarding training and mandatory certification for f-gases, it doesn’t have that for alternative refrigerants. “We don’t think that EU-wide regulation for training on alternatives is necessary,” said Arno Kaschl, a policy expert from the European Commission, adding that individual national legislators are best placed to decide the most appropriate way forward.

In terms of policy and industry actions taken to reduce the use of HFCs, northern Europe is more advanced in its move away from high-GWP substances than southern Europe, and natural refrigerant technology has become more the standard rather than the exception. For example, Norway’s tax and refund scheme on fluorinated refrigerants has been in place since 2003. At its current level, the tax has provided a supportive regulatory framework for natural refrigerant technologies, especially in larger systems, Torgrim Asphjell from the Norwegian Environment Agency said.

While policy representatives from Spain and Portugal were hesitant on whether natural refrigerant solutions could work in their countries, Asphjell clearly stated Norway’s favorable position towards natural refrigerants. “In the long term we want to phase down fluorinated gases and get back to natural refrigerants because we think that this is a sustainable and long-term solution.”

Ⓜ KS

GREEN & COOL’S NEW CO₂ CONDENSING UNIT

Swedish manufacturer Green & Cool, a major supplier of CO₂ refrigeration systems in Europe, launched a small, stand-alone CO₂ condensing unit at the ATMOSphere Europe conference in Barcelona, targeting small-scale applications like convenience stores and gas stations.

“The unit is basic and inexpensive, but still bears a state-of-the-art eco-performance,” said Johan Hellman sales engineer for Green & Cool at the company’s ATMOSphere Europe booth. “It’s a small condensing unit for applications like small shops or petrol stations, or for bigger shops that need to add extra display cases. It is already CE-marked, so it’s ready for the European market.”

The unit – which is manufactured in the south of France – uses a rotary hermetic compressor and a BLDC motor to achieve a capacity of up to 5.8kW. And as a plug-and-play system, it is simple to use. “All you need to do is set which operating pressure you want,” said Hellman.

The control system, manufactured by Italian firm CAREL, features a small microprocessor linking the unit to the cloud, allowing operations to be monitored remotely from a mobile phone and opening the door to its use as part of a wider super-market system.

Hellman believes the condensing unit will work in ambient temperatures of up to 113°F, making it suitable for use in warmer climates like southern Europe.

“With this condensing unit, smaller businesses can also afford to keep cool without harming the environment”, said Micael Antonsson, Green & Cool’s technical & business director. – Andrew Williams

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Tadashi Maekawa, Mayekawa

BRINGING THE 'NATURAL FIVE' TO THE WORLD

Having established itself as a premier provider of systems that use NH₃, CO₂, HCs, H₂O and air in Japan, Mayekawa is focused on growing its business and spreading its environmental message globally

– By James Ranson and Marc Chasserot

While the global climate conference in Paris (COP21) last December signaled progress in addressing the effects of climate change, Japanese manufacturer Mayekawa has put environmental preservation at the heart of its commercial activities for decades.

Kisaku Maekawa founded the Tokyo-based company in 1924, producing industrial reciprocating refrigeration compressors for ice making and cold storage. Since then Mayekawa has developed systems based on what it calls the “Natural Five” refrigerants – ammonia, carbon dioxide, hydrocarbons, water and air. The company employs these refrigerants in a wide range of applications – air conditioning, cooling, chilling and freezing, as well as heating, drying and hot-water making – across temperatures ranging from -148°F to 392°F. Its products include Mycom compressors, cooling systems, freezers, heat pumps and more.

Current President Tadashi Maekawa, grandson of the founder, has continued the legacy of his grandfather and father in manufacturing products that support environmental goals like

“Solving environmental issues is a global mission that has to be [solved] this century.”

reversing global warming. “Our endeavor on natural refrigerant technologies started from the conception that solving environmental issues is a global mission that has to be [solved] this century,” Maekawa said.

In 2024, Mayekawa will celebrate its 100th anniversary, but rather than view the milestone as an opportunity to reflect, the company is instead using it as a catalyst for further growth. For example, by 2024 Mayekawa aims to double its 2014 sales to 200 billion yen (\$1.8 billion) by expanding its global business and extending its product portfolio from industrial applications to the commercial sector.

FIVE-YEAR GLOBAL STRATEGY

Mayekawa now has subsidiaries in 40 countries, with new global markets each year, including the Middle East, Africa and Eastern Europe. In 2014, the company had more international than domestic sales, with a 60-40% split.

“We believe our business will expand more overseas than in Japan in the coming years - the international market is huge compared to that of Japan,” Maekawa said. “And without increasing our overseas sales, we cannot make a significant contribution to the global environment.” The company has its eye on a number of key accounts – “world-leading end users” – outside Japan, he added.

This doesn’t mean that the Japanese market is no longer important to Mayekawa, he stressed, but at least it already has environmental actions underway. “We believe if such actions are conducted on a global scale, the global environment will be far better, even in China or India. That is what we hope to do in the next five years.”

To accomplish that, Mayekawa will share the lessons it has learned in Japan. For example, the company will maintain open dialogues with local industries and governments, as it has done for decades in Japan.

The company has a strong tradition of working with the Japanese government, utilizing the many subsidies and incentive programs it offers to expand Mayekawa’s business. Japan’s Ministry of Environment has helped numerous companies install energy-efficient natural refrigerant technology, with 6.3 billion yen (\$56.7million) in subsidies provided in 2015 and 7.3 billion yen (\$65.7 million) slated for 2016. The subsidies encourage end users to purchase natural refrigerant technology by covering up to one-half of the total cost of the systems and installation.

But Maekawa acknowledged that it doesn’t always work that way overseas. “We enjoy significant support from the Japanese government when we build relationships with our customers in terms of the Natural Five, but we are not yet in such a position in other countries. So we hope to build relationships with all relevant governments, regulatory agencies, and international organizations.”

To build new accounts and increase its visibility globally in the absence of government support, Mayekawa is inviting potential international customers to Japan to show them its successful installations and enduring partnerships with leading clients. “I have great confidence in the environmental business that we conduct here in Japan,” said Maekawa.

CONSTANT INNOVATION

When asked how Mayekawa continues to innovate and how innovation is ingrained in the company’s corporate culture, Maekawa mused for a moment before replying, “There is no special tip, but without innovations, we cannot secure our existence. Therefore, in order to survive, we need to be innovative. And I sense this is a shared feeling among everyone at Mayekawa. Never being complacent, we need to try new things one after another.”

This philosophy is certainly reflected in of Mayekawa’s flagship low-charge NH₃/CO₂ system, the NewTon. These systems are predominantly manufactured in Japan, where Mayekawa has sold over 850 units, but they will be crucial for growth in new markets, where natural refrigerant cascade systems are starting to make their mark in the industrial sector.

“The NewTon series is really an important business for us, but although it has gained ground in the Japanese market, we also need to continue [marketing it] overseas, so that this system will be a standard throughout the world,” he said. One of those markets is the U.S. (See “Coming to America,” [Accelerate America, February 2016](#).)

Mayekawa will continue to develop a more advanced NewTon that achieves higher efficiency using a smaller ammonia charge. The company will also improve its service networks and collaborate with local companies with the aim of launching a smaller NewTon for the commercial market that uses an NH₃ scroll compressor. In addition, new production lines for NewTon motors will be constructed at the company’s Higashi-Hiroshima plant in Japan. “We need to address compressors as well, but we will first enhance the efficiency of the motors,” said Maekawa.

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→ While Mayekawa traditionally services a wide spectrum of industrial refrigeration sectors, a move into the commercial arena (supermarkets and convenience stores) as well as industrial air conditioning applications could have hugely positive implications for the company's business. "Our next mission is to develop components that do not use f-gases and have less impact on the environment, and bring them into markets we haven't addressed before," Maekawa said. Mayekawa even plans to construct a building that has NH₃/CO₂ air conditioning systems.

Looking forward, Maekawa insisted little would change in the company's philosophy. "We will continue to be pioneers but

at the same time we hope other companies will [work] with us promoting the Natural Five, so as to make a better global environment for younger generations.

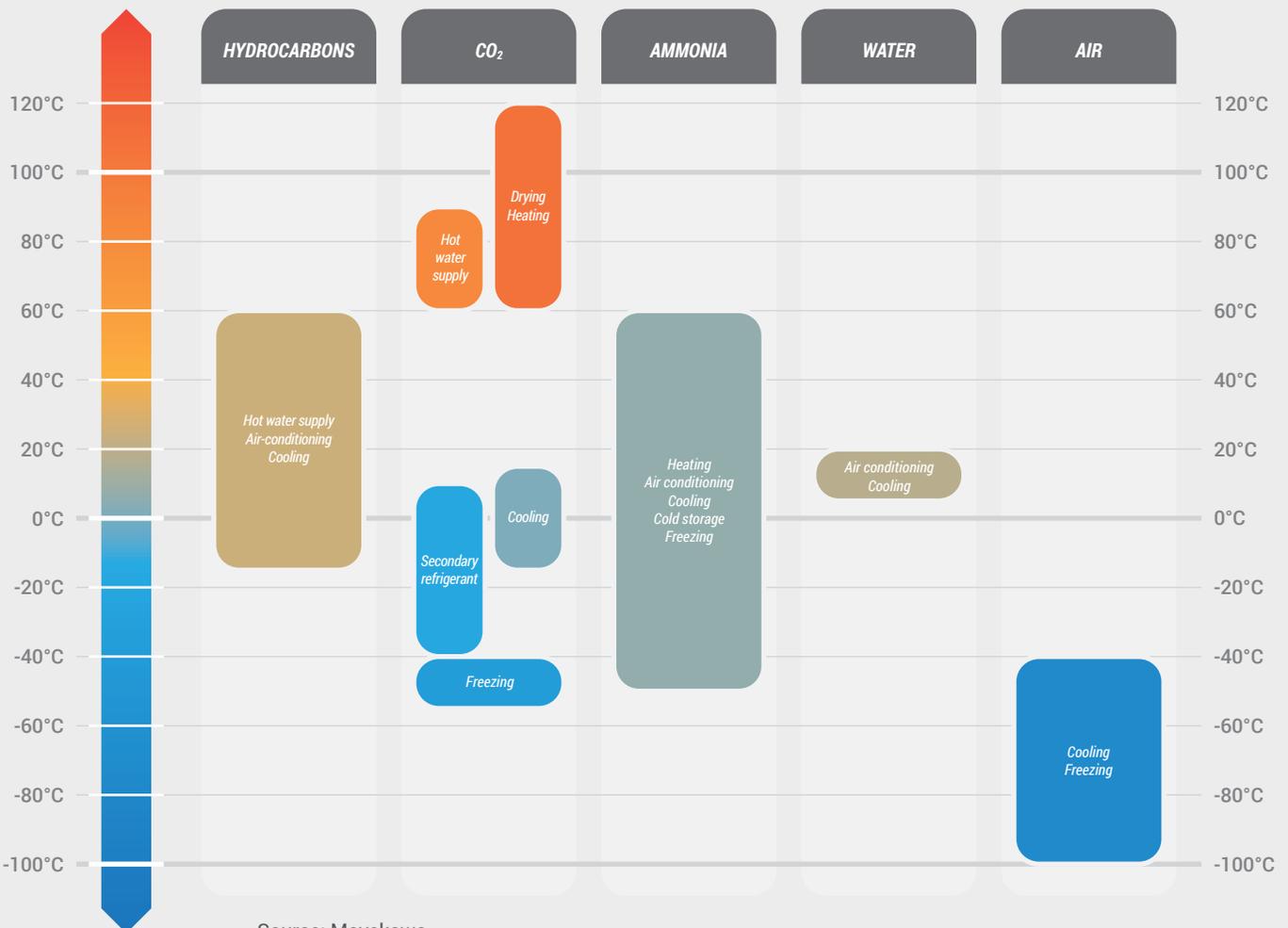
"I want people to perceive Mayekawa as an ecological company making a big effort to support the global environment. That is an important aspect of our company. In 20 years time, I hope we will be constantly developing products that are friendly to the environment and introducing green components to the market. If we fail in these things, we also fail in committing to our mission."

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APPLYING THE NATURAL FIVE

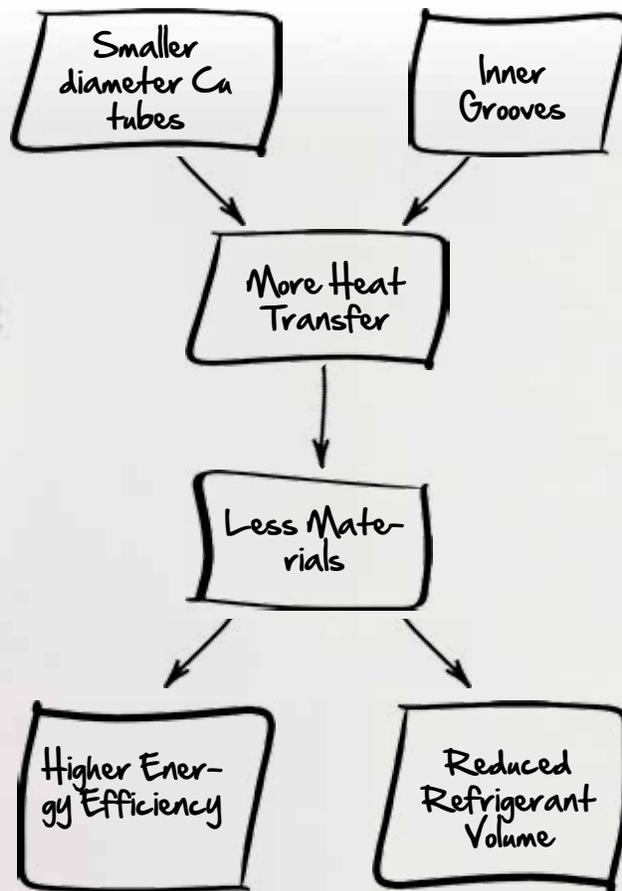
Mayekawa's product portfolio includes the following:

- The NewTon NH₃/CO₂ cooling system
- CO₂ heat pumps
- Hydrocarbon heat pumps
- Adsorption chillers using water as a refrigerant
- Extremely low-temperature freezers (-58°F to -148°F) using air as a refrigerant



Source: Mayekawa

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Peter Dee, Danfoss

FOLLOW THE LEADER

Danfoss' Peter Dee sees a familiar pattern from his time in Europe as the U.S. begins opening up to natural refrigerants

– By Mark Hamstra and Michael Garry

Regulation of HFCs in Europe helped propel the adoption of CO₂ and other natural refrigerants there, and a similar pattern could unfold in the U.S., said Peter Dee, sales and service director, Danfoss North America, based in Baltimore.

“There is this mindset in America that this is kind of an unknown quantity, but that is definitely shifting,” he told *Accelerate America*.

Danfoss specializes in research, development and manufacturing of controls, valves and other equipment for refrigeration systems used in commercial and industrial applications. Dee is responsible for the food retailing customer segment. He previously owned a company in Ireland that provided sales and support services for Danfoss.

Although Danfoss' products are sold directly to original equipment manufacturers (OEMs), Dee said he works closely with food retailers to determine how best to optimize their refrigeration

technologies, whether they are seeking to minimize their impact on the environment or reduce their energy costs – which often includes transitioning to natural refrigerants.

One of his primary messages about transitioning to CO₂, ammonia and other natural or low-GWP refrigerants is that although such systems may be novel to some end users, they have actually been around for a long time.

“It is a proven technology, but does require that the entire delivery channel is properly educated and trained,” he said.

Following are excerpts from *Accelerate America's* conversation with Dee about his views on the transition to natural refrigeration technologies in the U.S.

Accelerate America: What kinds of customers do you see adopting natural refrigeration technology?

whether to reduce their carbon footprint or their energy use, or both. A lot of organizations are looking into this [because of] their corporate sustainability commitment or the regulations that are coming into effect for HFCs.

Many of our customers want certainty with their technologies and don't want to go through multiple transitions. They want to get to the end state. Many see CO₂ or hydrocarbons as technology that will be around for a long time.

Others will wait to see how these early adopters fare. That also provides an opportunity for the manufacturers to build up their skill sets and knowledge.

Accelerate America: There are a handful of food retailers who are looking at transitioning to natural refrigerants, but it seems like there are a lot of people who are not that interested, even though the regulatory handwriting is on the wall. Do you still think there is a significant percentage that needs to be convinced or educated around this?

Washington, D.C. It was a discussion about where HFCs were going, and what people were doing in other regions. Then in the second year, we saw some clear leaders moving forward.

By last year at ATMOSphere, you had certain end users that have made the decision that, "This is the way we are going to go. It is going to take us a while to get there, but this is the decision we made, and we are going to move forward with it."

Peter Dee: As in any market, there are always leaders and early adopters who are willing to look at new technologies,

Peter Dee: It is being driven by regulations, and the industry will be able to respond, but many will wait until they are required to change.

It has been an interesting journey for me. I joined Danfoss four years ago, and the first ATMOSphere [shecco's natural refrigeration conference] was in

“ Many see CO₂ or hydrocarbons as technology that will be around for a long time.”

As a component manufacturer we have the product portfolio and the expertise. Danfoss has been involved in over 7,000 CO₂ installations worldwide and have over a decade of experience, but it does require training the people who are going to touch this day in and day out. Preparing the entire channel is critical to safe deployment of the technology.

Accelerate America: Besides CO₂, the food retailing industry is also looking at hydrocarbons, and a few places are testing ammonia/CO₂. Are you working with those kinds of applications?

lines that have been used in the industrial sector have been used in the food retail/commercial sector as well. We have already done one or two ammonia systems [in food retail] in America.

Accelerate America: What portion of your business involves natural refrigerants?

enabler for them to transition into CO₂.

Case controllers will build up the skill sets of the technicians and the contractors, so that is one hurdle out of the way. Then if you move to CO₂, you are just looking at what's required for the CO₂ application at the rack level.

We have customers today that are using case controllers and electronic expansion valves. So now they are already getting more efficiency, and once they have done this for one or two years, it's not such a big hurdle to move to CO₂.

Peter Dee: We have our own controllers specifically to control hydrocarbons. As far as ammonia, we are heavily involved with industrial refrigeration, and that crosses over — a lot of the component

Peter Dee: It's a relatively small percent, but we are increasingly seeing end users moving to case controller technology, and that's an

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→ **Accelerate America: Is that what happened in Europe?**

to case controllers, and that was the first stage. I have seen the transition in Europe from case controls to natural refrigerants, and it is like a carbon copy here.

Accelerate America: Do you think the Europeans are more open to natural refrigeration technologies than Americans?

implementing these technologies, and here the end users are pushing for it.

In Europe it was driven mostly by the HFC phase outs. There is also the higher cost of energy in Europe, and that's another driver.

With national and global agreements moving forward we are now at the stage where some people are saying, "Maybe we should be looking at natural refrigerants, so we don't have to go through multiple phase outs."

One potential barrier for end users is that it might be seen as a more expensive solution — and it is, if you just look at first cost. But you also have to look at the total cost of ownership and life cycle climate performance. We are very conscious of the first cost, and we have been very active in trying to reduce the cost of a CO₂ application.

Peter Dee: It is very, very similar to what happened in Europe. A lot of people went

Peter Dee: I really do think the U.S. market is open to it, but I think the industry is slightly different here. In Europe it is mainly the contractors

“ Case controllers will build up the skill sets of the technicians and the contractors.”

Accelerate America: Do you see costs coming down for natural refrigerant equipment for the end user, as uptake increases?

controls. That's why you have to look at the whole picture. With case controls alone, [users] are getting 11%-15% improved energy efficiency out of it, so there is definitely an ROI. But costs will decline when we achieve scale.

Accelerate America: At ATMOSphere America, we are having a speaker from supermarket chain DeCicco & Sons, John DeCicco, who is retrofitting an existing R22 store with a transcritical CO₂ system. Are you hearing more people talking about doing CO₂ retrofits?

Peter Dee: We are definitely seeing costs reduced, but you are still going to have that first-cost impression because you have to use case

Peter Dee: Yes, we are having more discussions with end user reaching out to us for support for retrofits on the CO₂ side. There are a few who have been the early adopters. They are saying, "I am doing a remodel of this store, so I can retrofit and put transcritical with CO₂ in."

It can be done, and it is not new technology. I think the obstacle is the expertise available in North America in order to manage that. The OEMs have embraced it, and have built up their expertise, because they see things moving in the same direction that we see. It makes business sense to make sure we are training people.

continued on p.70 →

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Nature Inside



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→ **Accelerate America:** In the U.S. there were about 50 transcritical refrigeration systems last year. Do you think that number will double this year?

Just look at the momentum after four years: There are more people involved, the expertise is growing, the industry is investing, and there's a comfort factor that's building.

The reason I say that is we saw the same pattern in Europe. First there were all these early adopters, and then there was a huge increase in people starting to use these transcritical systems. Danfoss was able to help customers transition and meet the regulations in Europe, so we have the expertise to enable end users here make the transition.

Accelerate America: In Japan there's a big market for CO₂ condensing units as opposed to big racks, and now Panasonic is seeking to expand such technology in the U.S. and elsewhere with its acquisition of Hussmann Corp. Are you seeing more interest from convenience stores and smaller stores? Do you see more of these condensing units coming in?

across the whole U.S., you have huge swings in temperatures, so you have to consider [different options].

Peter Dee: I think it is certainly moving that way, and I think it will continue to increase. I think there will be a spike in about two years' time.

Peter Dee: The trend we're seeing is the smaller supermarket chains are looking at that, but I think they are not just looking at CO₂ transcritical. They are looking at whether they can use hydrocarbons, or whether they can use water-loop systems. I think they are looking at what will be the best fit for their chains. If you have a chain

“ It is very, very similar to what happened in Europe.”

We can expect it will be similar to CO₂. You will have the early adopters, and it will come down to what are the safety requirements, and what is the legislation around it. I think there is a little bit of cost concern, but as we get more people adopting, the costs will definitely come down.

Accelerate America: In the U.S., would you say more companies are going toward naturals, or are more going toward HFO blends, as a replacement for HFCs?

industrial refrigeration ammonia is a proven solution while we see hydrocarbons gaining momentum for self-contained refrigeration equipment. © MG & MH

Peter Dee: It completely depends on the application. There is no one single solution. For supermarkets CO₂ really seems to be the best alternative solution. For



Peter Dee, Danfoss, at ATMOsphere America 2014



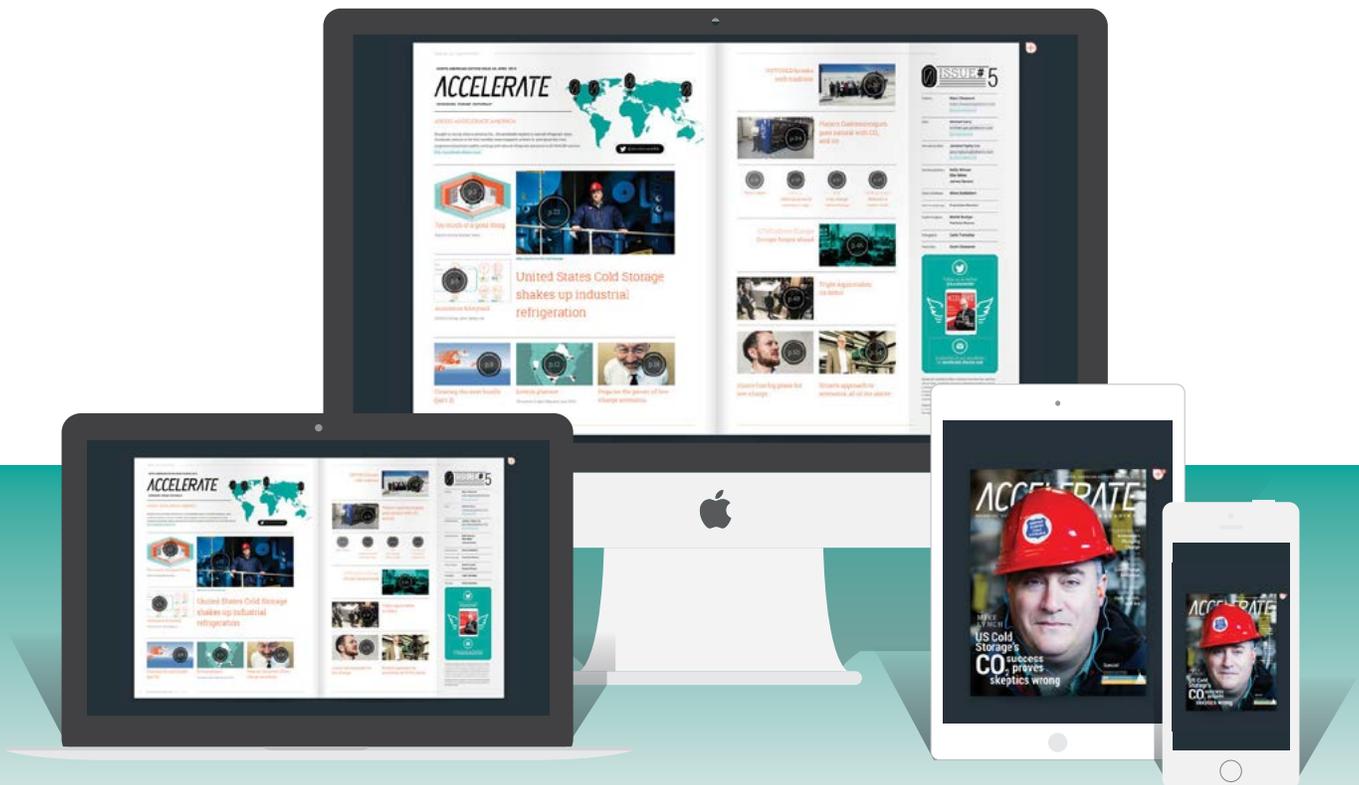
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- » Data Centers
- » New Technology
- » Mobile Air Conditioning
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- » Buildings (hospitals, universities, offices, government, hotels, sports, shopping centers, airports)
- » Research