

# ACCELERATE

ADVANCING HV

MAGAZINE

p.28

**Energy Rebates, the  
Whole Foods Way**

p.36

Angelo Caputo's  
Fresh Markets  
**In Love with CO<sub>2</sub>**

p.40

Newark  
Refrigerated  
Warehouse  
**Ammonia  
Returns to the  
Garden State**

p.20

Paul  
Delaney  
Southern  
California  
Edison

California  
Dreamin'

Utility sees  
**big potential  
for natural  
refrigerants**



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Editor's note by Michael Garry



# A NATURAL PARTNERSHIP

**While natural refrigerant systems – both in refrigeration and HVAC – continue to gain traction in North America, their capital cost typically remains above that of conventional technology.**

That cost, of course, would come down with greater demand and production. But what can spark that demand? Many factors, including increasing regulation of HFCs and more pilots demonstrating advantages like energy efficiency and maintenance savings. Another factor, sometimes underestimated, that can drive adoption is the availability of monetary incentives for energy efficiency from power utilities.

This issue of *Accelerate America* is dedicated to showing how end users, utilities and third parties can work together to justify these rebates for natural-refrigerant equipment. Indeed, though they are still largely unacquainted with natural

refrigerants, utilities can become natural partners (pun intended) with end users in that they both have a common interest in cutting energy consumption.

But in order to offer incentives, utilities need ironclad proof that natural-refrigerant systems are more energy efficient than conventional models. A number of parties are beginning to step up to provide this proof, including retailers, cold-storage facilities, third parties like OEMs and energy consulting firms, and the utilities themselves.

California utilities are leading the way. For example, our cover story on Southern California Edison, which starts on page 20, shows how this utility is helping to bring natural-refrigerant systems to industrial and commercial customers. Pacific Gas & Electric has also been proactively testing systems like an ammonia-CO<sub>2</sub> configuration, while Sacramento Municipal Utility District has provided a major rebate for a store using a CO<sub>2</sub> cascade system. On the East Coast, NYSERDA (New York State Energy Research and Development Authority) is involved in a number of rebate programs involving natural refrigerants,

And the Electric Power Research Institute (EPRI), a nonprofit group funded by utilities, has also been probing the energy value of natural refrigerant systems like ammonia-CO<sub>2</sub>, transcritical CO<sub>2</sub> and CO<sub>2</sub> heat pumps.

Meanwhile, end users with natural refrigerant installations have been taking the initiative on rebates, including Whole Foods, U.S. Cold Storage, Aldi, Roundy's, and Lineage Logistics, among others.

Apart from the leaders, most utilities still need to be educated about natural refrigerant technology. Hillphoenix, a major provider of transcritical refrigeration, has taken on the role of showing utilities the finer side of this technology.

But it's quite likely that over time utilities will increasingly regard energy-efficient natural-refrigerant systems as worthy of support. End users should make sure they don't miss the opportunity to partner with utilities and reduce the up-front cost of these systems @MG

NORTH AMERICAN EDITION ISSUE #6, JUNE 2015

# ACCELERATE

ADVANCING HVAC&R NATURALLY



## 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://accelerate.shecco.com>



### A natural partnership

Editor's note by Michael Garry



Paul Delaney from Southern California Edison



### A look back – and forward

Editor's note by Jana Topley Lira

## Southern California Edison takes on natural refrigerants



### Tips for obtaining utility incentives



### Events planner

The events in June, July and August 2015



### The natural refrigerants industry set to converge at ATMOSphere America



EPRI investigates natural refrigerants



Getting an energy rebate, the Whole Foods way



In love with CO<sub>2</sub>



Ammonia returns to the Garden State



Educating utilities



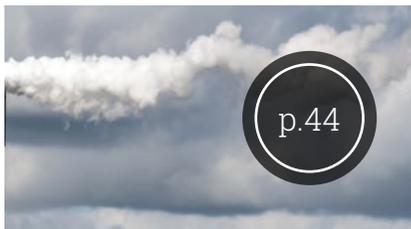
Events affecting utility support of natural-refrigerant systems



Short takes



HFCs discussion hits snag at Montreal Protocol



CARB workshop sets stage for HFCs reduction



IARW schools cold-storage industry on ammonia and CO<sub>2</sub> trends



China embraces natural refrigerants



Gearing up for CO<sub>2</sub>

# ISSUE # 6

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Accelerate's network of offices stretches from New York and Brussels to Tokyo. Accelerate America is published monthly except for a mid-year and year-end double issue. The views expressed by the contributors are not necessarily those of the Publisher. Every care is taken to ensure the content of the magazine is accurate but we assume no responsibility for any effect from errors or omissions.

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Editor's note by Janaina Topley Lira

# A LOOK BACK – AND FORWARD

As we put together the final touches to our 6<sup>th</sup> edition of *Accelerate America*, it's a good time to take a look back at the first half of the year (and the last few months of 2014), which saw a number of revolutionary natural refrigerant product launches, more CO<sub>2</sub>, ammonia and hydrocarbon technologies exhibited at trade shows than ever before, and more and more end users investing in green HVAC&R solutions

As North American policy inches gradually towards more support for natural refrigerants and away from HFCs, many leading end users, working hand-in-hand with system and component suppliers, are helping to drive a much faster market uptake of CO<sub>2</sub>, ammonia, and hydrocarbons.

The first issue of *Accelerate America*, published last November, fittingly featured the man behind the first U.S. transcritical CO<sub>2</sub> store, Harrison Horning, who represented a brave new world for commercial refrigeration. The store's promising first year results point to CO<sub>2</sub> as being one of the best low-GWP (global warming potential) refrigerants for centralized supermarket refrigeration.

Whole Foods, whose Kathy Loftus was on the cover of the second issue, confirmed this trend. According to Loftus, between 10% and 20% of Whole Foods' new stores could have a natural refrigerant system in the future. Even though currently more expensive than equipment

using HFC refrigerants, CO<sub>2</sub> technology allows retailers to future-proof their businesses against phase downs and bans affecting fluorinated refrigerants.

Gracing the cover of issue #3 was Target's Paul Anderson, whose public commitment to introducing a CO<sub>2</sub> system to all new stores and remodels dramatically changed the commercial refrigeration landscape. Like several other U.S. food retailers, Target has started its natural refrigerant journey with a hybrid CO<sub>2</sub> cascade solution that achieves greater efficiencies than a standard DX unit.

Pushed by beverage giant Coca-Cola, light commercial refrigeration equipment is moving in a similar direction. Coke's enthusiasm for natural refrigerants (CO<sub>2</sub> in particular) has seen the company place more than 1.4 million HFC-free units worldwide, including more than 12,000 in North America. Coke's Tomas Ambrosetti explains how in issue #4.

Finally, the industrial refrigeration sector, which was the focus of the 5<sup>th</sup> edition of *Accelerate America*, looks to be embracing low charge ammonia refrigeration and CO<sub>2</sub>/NH<sub>3</sub> cascade equipment. This helps cement natural refrigerants as the preferred solution for cold storage, warehouses, food processing plants, ice rinks and more.

Taken together, all of these stories paint a promising future for natural refrigerants.

Why not come and meet the people behind these and some of the other projects featured in *Accelerate America* at ATMOSphere America 2015? The conference, which takes place from June 25-26 in Atlanta, will bring together all of the key industry players leading this natural refrigerant revolution. If you are looking for the "next big thing" in HVAC&R, ATMOSphere America is your chance to learn more about CO<sub>2</sub>, ammonia, and hydrocarbons and join the shift to a more sustainable future

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CHANGE ON.

# TIPS FOR OBTAINING UTILITY INCENTIVES

Here's some advice for supermarkets on how to go about seeking incentive funding from utilities for natural-refrigerant projects, from consultant and former GreenChill manager Keilly Witman.

— By Michael Garry



Keilly Witman

In the March and April issues of *Accelerate America*, Keilly Witman, the Boise, Idaho-based owner of consulting firm KW Refrigerant Management Strategy, examined the possibilities for prescriptive and custom incentives from power utilities for self-contained and central refrigeration systems in supermarkets that use natural refrigerants.

In this article, Witman, the former head of the EPA's GreenChill program who specializes in refrigerant management strategy for supermarket owners, service contractors and equipment manufacturers, sums up the state of the supermarket industry when it comes to natural-refrigerant-system incentives. She also provides tips on how grocers and utilities can more effectively work together to increase the flow of incentives.

**Accelerate America:** Do you expect that utilities around the U.S. will provide incentives for various supermarket systems that employ natural refrigerants?

**Keilly Witman:** Yes, we'll see this happen over the next five years. Different regions will jump on the energy savings opportunity at different times. Once the early movers develop methodologies for these types of incentives, other utilities will then roll out their own programs. You'll start to see incentives on the West Coast, then they'll spread to the Northeast, and (hopefully) eventually spread to the Southeast. The savings opportunities for utilities are too great for them to ignore.

Having said that, I think you'll see prescriptive incentive programs for self-contained cases that use natural refrigerants before you'll see widespread custom incentives for refrigeration systems.

**AA:** What are the biggest hurdles supermarkets have to overcome to get these incentives?

**KW:** The biggest hurdle for supermarkets is the amount of time and effort it takes to work with utilities on custom incentive projects.

**AA:** Do supermarkets need third-party companies or equipment vendors to get the incentives?

**KW:** That depends on what you mean by third-party companies. If you are talking about companies that specialize in being the middleman in these types of projects, usually in exchange for a percentage of the incentive, then I don't think supermarkets need them. Supermarkets can certainly manage these projects on their own. It's just a question of having the people and the time.

Though they don't need them, it probably does make sense from a business perspective for many supermarkets to use these middlemen. It's a cost/benefit question. These companies cost money, but they save you time, effort, and frustration. Whether you use a third party or not depends on where your priorities lie.

If you are talking about commercial refrigeration engineering firms as third-party companies, I think it's wise to include their help on incentive projects in their scope of work. They know the ins and outs of the systems, so they can help with a lot of the back-and-forth questions that come from the utility about the various features of the systems. That can save a lot of time for the technical people at the supermarkets who would otherwise have to answer those questions.

I don't think a supermarket needs an equipment manufacturer to help get incentives, but if I were an equipment manufacturer, I'd offer this service to my customers. These incentives help with supermarkets' ROI calculations, which help sell systems.

**AA: How much lead time should supermarkets give themselves in securing incentives?**

**KW:** That really depends on the type of incentive, which utility you are dealing with, and the amount and type of resources you have available. The only thing that is certain in terms of utilities and lead time is that you always wind up thinking that you should have started the project sooner.

**AA: Will utilities eventually take into account the fact that leaks from natural refrigerant systems have minimal or no effect on global warming?**

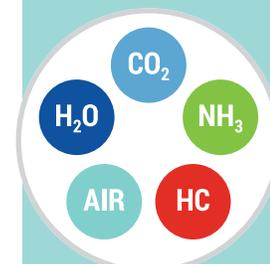
**KW:** I think that some utilities will take this into account, especially in California where they regulate greenhouse gases. Municipal-owned utilities in California should look closely at the greenhouse gas savings that can be accomplished with the win-win of zero GWP refrigerants and improved energy efficiency. In areas of the country where there is no requirement to reduce greenhouse gases, most utilities aren't interested in the slightest in the direct greenhouse gas emissions from refrigerant leaks.

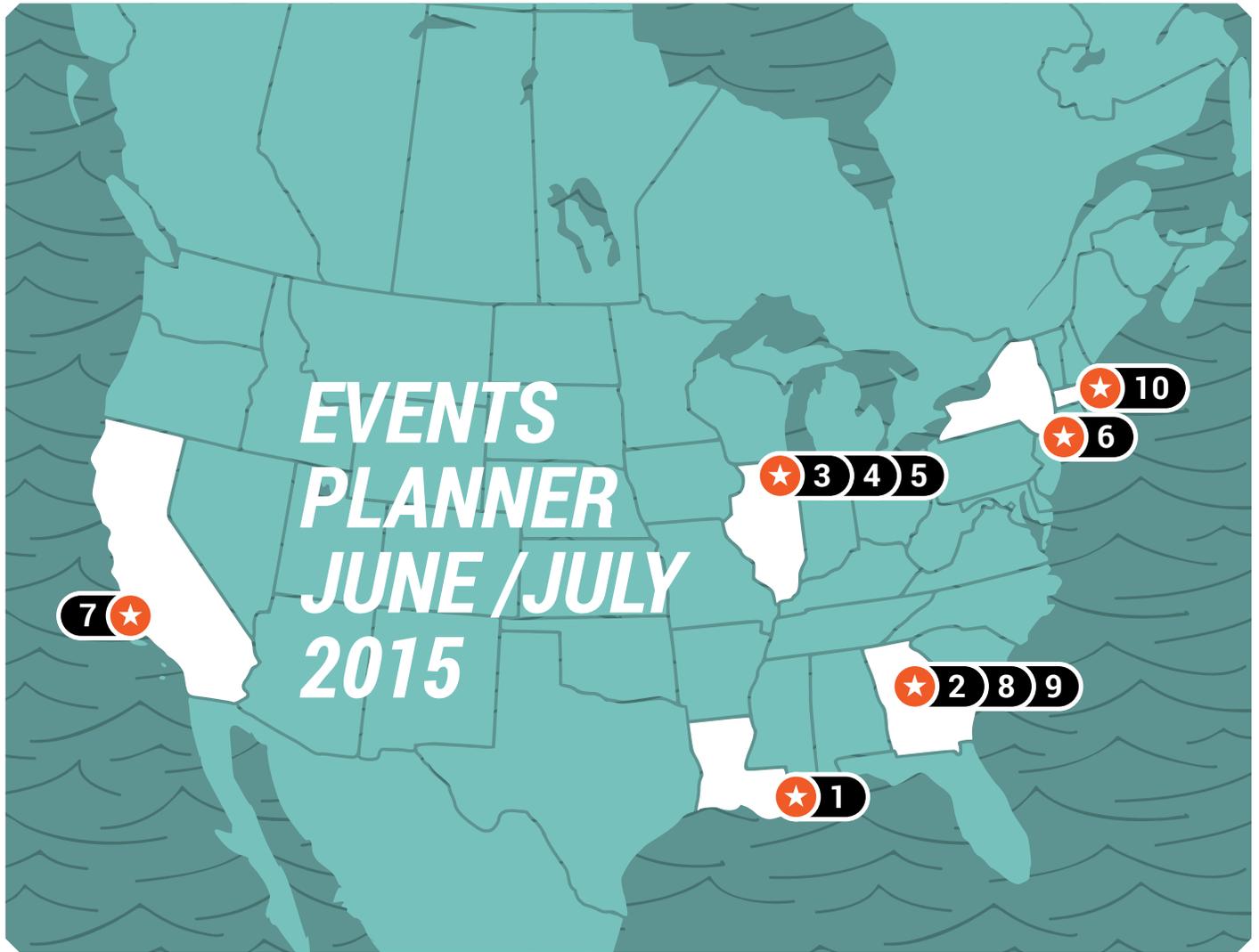
**AA: What's the biggest change you'd like to see in the way utilities award incentives for environmentally friendly refrigeration systems?**

**KW:** There are a lot of things that I'd like to see change in the way that utilities award incentives. The biggest change I'd like to see is for utilities to get out of their own way on some of these projects. The overall impression that I get from utilities is that they tend to overcomplicate things to the point where projects take so much time and effort that supermarkets just can't participate in the programs.

I'd also like to see utilities shift their focus from pre-construction modeling of energy savings as the basis for incentives to incentives being based on the validation of real energy savings post-construction. I get the impression that utilities have never met a model they don't like. But I've never met a model that I trust more than real data. A system where utilities take more chances on projects up front and speed up the pre-construction incentive process, with the vast majority of the incentive coming over a period of time upon validation of the energy savings, seems like a better way to do things

This type of change would embed more accountability into the entire industry. Supermarkets would make sure that they can measure the actual energy savings, and they'd evaluate those savings vs. the energy savings claims that equipment manufacturers make in their sales pitches. You'd have more case study write-ups on the projects that worked and which ones didn't, which would motivate supermarkets and utilities to pursue the technologies that have been proven successful **MG**





- 1** June 2-5 New Orleans , LA  
**2015 Industrial Energy Technology Conference 37th Annual Conference**  
<http://aceee.org/events/industrial-energy-technology-conference-i-0>  
**twitter : @ACEEEdc**
- 6** June 24-26, New York, NY  
**59th Global Summit, The Consumer Goods Forum**  
<http://www.tcgsummit.com>  
**twitter : #CGFSummit / @CGF\_The\_Forum**
- 2** June 7-9, Atlanta, GA  
**Dairy-Deli-Bake Seminar and Expo**  
<https://www.iddba.org/conference.aspx>  
**twitter : #IDDBA**
- 7** June 24-26, Monterey, CA  
**PMA Foodservice Conference & Expo, Produce Marketing Association**  
<http://www.pma.com/events/foodservice>  
**twitter : #PMAFSC / @PMAFSC**
- 3** June 8-10, Chicago, IL  
**United Fresh, United Fresh Produce Association**  
<http://www.unitedfreshshow.org>  
**twitter : #UnitedFresh2015 / @UnitedFresh**
- 8** June 25-26, Atlanta, GA  
**ATMOsphere America 2015**  
<http://www.atmo.org/events.details.php?eventid=30>  
**twitter : #ATMOAmerica / @ATMOEvents**
- 4** June 8-11, Chicago, IL  
**FMI Connect**  
<http://www.fmiconnect.net>  
**twitter : #FMIConnect / @FMI\_ORG**
- 9** June 27- July 1, Atlanta, GA  
**2015 ASHRAE Annual Conference**  
<https://www.ashrae.org/membership-conferences/conferences/2015-ashrae-annual-conference>  
**twitter : #ASHRAE / @ashraenews**
- 5** June 11-12, Chicago, IL  
**FMI Foundation Retail Food Safety Forum**  
<http://www.fmi.org/forms/meeting/Microsite/RFSF2015>  
**twitter : #foodsafety / @FMI\_FoodSafety**
- 10** June 28- July 1 July, Boston, MA  
**IDEA2015**  
<http://www.idea2015.org/>  
**twitter : #IDEA2015 / @districtenergys**



1

August 4-6, Buffalo, NY  
**ACEEE Summer Study on Energy Efficiency in Industry**  
<http://aceee.org/conferences/2015/ssi>  
 twitter : @ACEEEdc

2

August 19-21, Denver, CO  
**Global Sustainability Summit**  
<http://fmi.org/forms/meeting/Microsite/2015TPASustainabilitySummit>  
 twitter : #FMIGMASummit / @FMI\_ORG / @GroceryMakers

3

August 22-25 – Denver, CO  
**NACDS Total Store Expo**  
<http://tse.nacds.org>  
 twitter : @nacds

4

August 26-28, Windsor, Ontario  
**2015 HRAI Annual Meeting and Conference**  
<http://www.hrai.ca/agm/sponsors.html>  
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# THE NATURAL REFRIGERANTS INDUSTRY SET TO CONVERGE AT ATMOSPHERE AMERICA

– By Janaina Topley Lira

The fourth annual U.S. conference will feature a wide array of end users, suppliers, regulators and other experts discussing the latest natural-refrigerant developments in North America.

Simply put, natural refrigerants are here to stay.

More and more U.S.-based companies are seeing the competitive advantage of being among the first to replace synthetic refrigerants with naturals. As a result, the next two-to-three years are likely to be an exciting time for those working with CO<sub>2</sub>, ammonia, hydrocarbons and water in HVAC&R.

To help end users, contractors, suppliers, regulators and others make the transition to natural refrigerants, shecco, publisher of *Accelerate America*, will host the fourth edition of the ATMOSphere America conference, covering every aspect of market trends, regulatory issues and technology innovations.

The conference will take place on June 25 and 26, 2015, at The Grand Hyatt Atlanta in Buckhead in Atlanta, Georgia. The specialized mix of 300 attendees will include a who's who of natural refrigerant experts.

Attendees will hear from regulators such as Underwriters Laboratories (UL), the EPA and the California Air Resource Board (CARB); end users including McDonald's, The Coca-Cola Company, Red Bull, Lowe's Markets, Delhaize America, Ahold USA, Starbucks and Whole Foods Market; as well as leading system and component manufacturers Hillphoenix, Hussmann, Carnot, Heatcraft, Mayekawa, Bitzer and Emerson among others, who will share their latest success stories, lessons learned, challenges and next steps for natural refrigerant based technologies.

"ATMOSphere plays a key role in bringing together all stakeholders required to advance natural refrigerants in the marketplace," said Eric MacGregor, owner, Versatile Refrigeration.

"Far and away the richest concentration of natural-refrigerant knowledge anywhere in North America," said Carl Roberts, engineering lab manager, Zero Zone.

One day before the conference, on June 24, Hillphoenix, Bitzer and Hussmann will lead plant tours of their facilities to showcase the very latest CO<sub>2</sub> and ammonia industry advancements.

The conference program kicks off with a market opportunities session where end users will discuss their technology needs and the opportunities for natural refrigerant technologies across various applications in North America.

The program features panels dedicated to food retail, foodservice, low-charge ammonia, training and contractors; specialized sessions on regulations and standards, and the state of the industry; as well as more than 20 technology case studies on commercial refrigeration, light commercial refrigeration and industrial refrigeration.

Case studies will cover an array of topics including the effective use of CO<sub>2</sub> in booster systems in the Southeastern U.S., for server room cooling, in heat pumps and in ammonia/CO<sub>2</sub> cascade refrigeration technology. The efficiency of hydrocarbons in plug-in cabinets and ultra-low-temperature freezers will be highlighted, as well as the advantages of using low-charge ammonia technology for industrial applications.

"Very excited to see the additional focus on industrial refrigeration and ammonia," said Trevor Hegg, director—industrial refrigeration product development, EVAPCO. "I believe ammonia, which is widely used in the industrial side, can greatly benefit the commercial market. I think there will be more blending of industrial philosophies in the commercial markets."

Topping all this off will be a series of lunch-break Technomercials by Hillphoenix, Mayekawa, Emerson, Embraco, Carel, Stellar, Blupura and Wieland to showcase their latest and most innovative natural refrigerant-based technologies and projects.

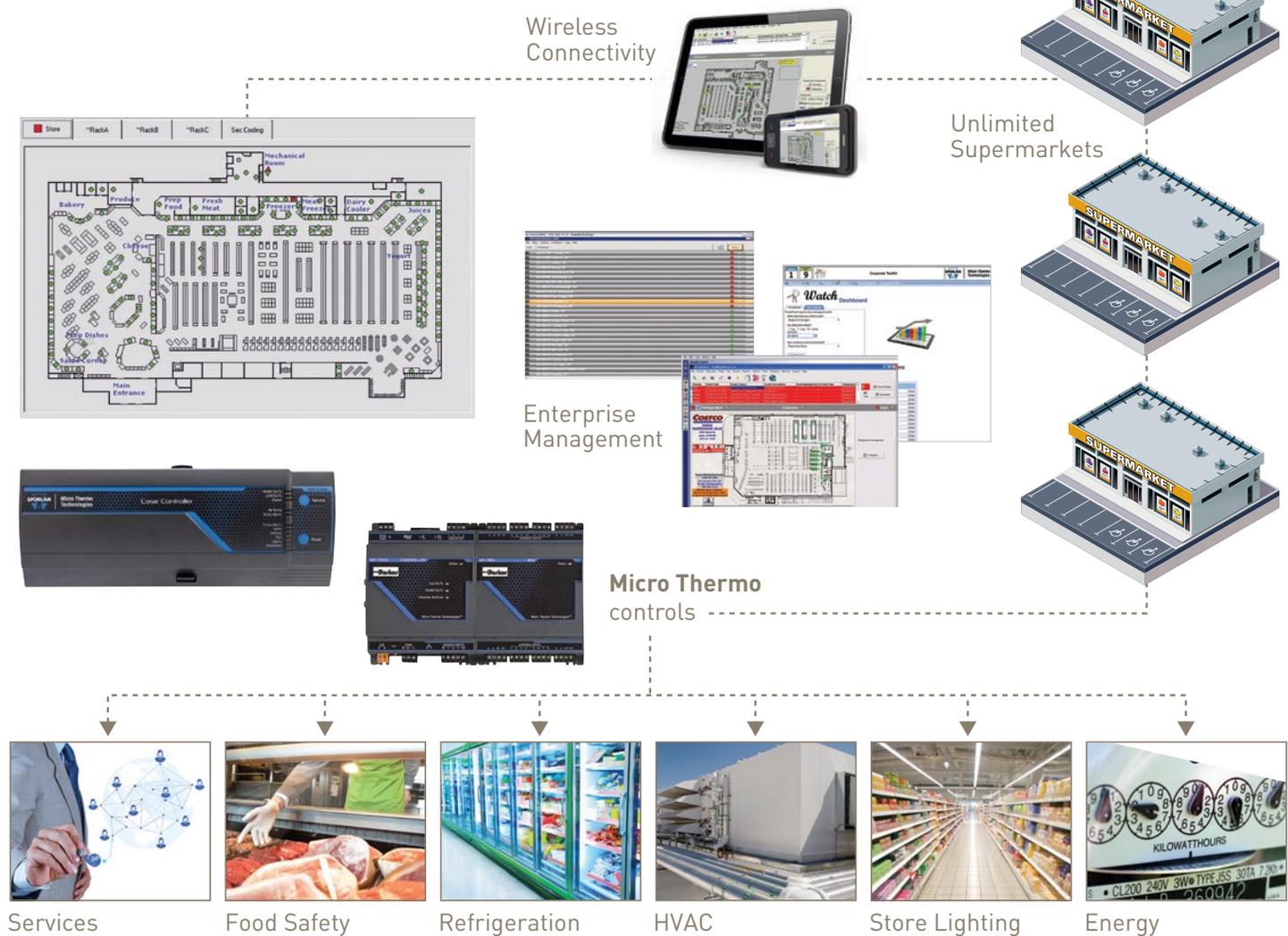
After the first conference day, participants will have the opportunity to relax and network at an exclusive dinner reception at the Georgia Aquarium, sponsored by Hillphoenix.

Compared to last year, when CO<sub>2</sub> in commercial refrigeration stole the show, the 2015 conference will have a broader focus. It will draw attention to the low-charge-ammonia revolution sweeping across the industrial refrigeration sector and the growing interest in hydrocarbons in the foodservice sector. Meanwhile, the discussion is no longer about when CO<sub>2</sub> will take off in commercial refrigeration; this is happening now.

In sum, the pace of market penetration of natural refrigerant-based technologies is accelerating. Playing its part in driving the change, ATMOSphere America provides a unique platform to explore this market transformation @JTL

For more information, go to: <http://www.atmo.org/events.details.php?eventid=30>

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# EPRI INVESTIGATES NATURAL REFRIGERANTS

The research group, which supports the use of CO<sub>2</sub> heat pumps, is helping utilities evaluate CO<sub>2</sub> refrigeration systems, explains Ammi Amarnath, EPRI's senior program manager

— By Michael Garry

**F**ounded in 1972, the Electric Power Research Institute (EPRI), based in Palo Alto, Calif., is a private nonprofit organization dedicated to collaborative, objective research aimed at “advancing safe, reliable, affordable and environmentally responsible electricity for society.” Funded by member utilities, the group encompasses more than 450 participants in more than 30 countries; its member utilities generate about 90% of the electricity in the U.S.

Part of EPRI's research strives to ensure that residential, commercial and industrial consumers use electricity as efficiently as possible. To that end, it has explored the efficiency of natural-refrigerant refrigeration and HVAC systems for a number of years. In this exclusive interview with *Accelerate America*, Ammi Amarnath, EPRI's senior program manager, gives an overview of the organization and the status of its work with natural refrigerants.



Ammi Amarnath, EPRI

**Accelerate America:** Please describe how EPRI works with utilities on energy incentives for commercial and industrial end users.

**Ammi Amarnath:** We support the utilities in their public mission to make their customers more efficient. Our role is to research emerging technology – what's coming out in the market – so that utilities can put it in their incentive programs. We scout around the world looking at what is emerging and then we test and evaluate the technology. We can't test every new light bulb so we narrow it down to certain technology that we evaluate in our labs or outside labs. We evaluate technology both in the lab and in the field to see how the technology performs in actual operating conditions. We give these results to member utilities who figure out if it is appropriate to use them in their programs. We support utility efficiency programs in market transformation with new products.

**AA:** When did EPRI start looking at natural refrigerant refrigeration and HVAC systems?

**Amarnath:** We've been looking at all refrigerants, including natural refrigerants like ammonia and CO<sub>2</sub>, for a number of years. Our activities regarding natural refrigerants accelerated in the 2007 timeframe when we saw CO<sub>2</sub> being used as a refrigerant, especially for heat pump water heaters (HPWHs), such as the “EcoCute” HPWHs in Japan. We looked at it, not just from a GWP or ozone-depletion perspective, but more from an efficiency perspective.

We found the CO<sub>2</sub> EcoCutes to be very efficient with COPs of 3.5-4. But such units are not currently available in the U.S. New heat pump technology in the U.S. uses R134a and similar refrigerants; these are more efficient than electric resistant heater type of

continued on p.18



# Purity

## THE NATURAL ALTERNATIVE

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→ water heaters. HPWHs have been introduced in the U.S. market and there are utility rebates for such units. Compared to these HPWHs in the U.S., Eco-Cute is not cost effective; the payback period is rather long. Also, the CO<sub>2</sub> heat pump water heater still needs a UL label. We are working with several manufacturers to provide technical input, so that they can bring down the cost of the CO<sub>2</sub> heat pump. And these manufacturers are trying to get them approved by UL.

**AA: Does EPRI consider the total global warming impact of natural refrigeration systems, including the direct contributions of refrigerant leaks?**

**Amarnath:** We do look at climate impacts, but much more in the power-generation side of the business. My group is more focused on energy efficiency but we look at both GWP and efficiency, especially if the refrigerant is escaping into the atmosphere. There are natural refrigerants that are both efficient and low GWP. We look at the whole picture. We want to improve efficiency of end-use technologies, support the reduction of global warming and provide technical input for the coming regulations of such technologies.

**AA: Can you describe EPRI's Emerging Refrigeration Technologies Project, funded by Southern California Edison**

**Amarnath:** Southern California Edison and Pacific Gas & Electric are some of the leading proponents of emerging refrigeration technology. We are working with Southern California Edison on a field demonstration to understand the efficiency of emerging low-GWP refrigeration systems; we are also putting together plans to work with PG&E and utilities in other parts of the U.S. We write white papers and technology papers on what is coming up in the market, and these are funded by 50 or more utilities. Last year we released a technical report on the state-of-the-art in commercial refrigeration technology. We identified the research gaps; we are doing more work this year to address the gaps.

In a demonstration project, we are testing natural refrigerant equipment in our lab to look at the energy efficiency in different weather conditions. In one case, we are testing a CO<sub>2</sub> transcritical refrigeration system in a supermarket. CO<sub>2</sub> traditionally struggles under hot climate conditions; this system uses a mechanical subcooler designed to allow the transcritical system to be deployed in all climates. If successful, we hope to do field evaluations soon.

In another case, we are planning a field test of an ammonia/CO<sub>2</sub> unit in a food processing/storage facility, comparing its efficiency with that of an R507A system. We'll monitor performance of the system with sensors and controls for six months to a year. This is our first test of emerging refrigeration equipment with all natural refrigerants in the field.

We are closely monitoring EPA's SNAP regulations, and the potential delisting of certain HFC refrigerants. Therefore, we plan to test the efficiency of several pieces of natural-refrigerant equipment around the U.S. We're talking to several utilities about that @ MG

SPECIAL EDITION AUGUST 2015

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Paul Delaney,  
Southern California Edison



# ***SOUTHERN CALIFORNIA EDISON TAKES ON NATURAL REFRIGERANTS***

The utility is evaluating the energy savings delivered by natural-refrigerant technologies, with an eye on driving their marketplace adoption

By Michael Garry



continued on p.22 

→ **In** 2006, the state of California passed Assembly Bill (AB) 32, called the California Global Warming Solutions Act, which created the first program in the U.S. to take a comprehensive, long-term approach to addressing climate change.

AB32, in essence, requires California – which has the eighth largest economy in the world and the largest of any U.S. state – to reduce its greenhouse gas emissions (including HFCs) to 1990 levels by 2020. This would cut emissions generated under a business-as-usual scenario by 15%. (In later years the reductions would increase. See “CARB Workshop Sets Stage For HFC Reduction,” [page 44.](#))



Bruce Coburn, technical specialist, Southern California Edison's Technology Test Centers (left) with Paul Delaney

One of the ways California is achieving this reduction is by implementing a Refrigerant Management Plan that requires commercial and industrial refrigeration operators that use high-GWP refrigerants to better control their refrigerant leaks. The Plan, launched in 2011, is managed by the California Air Resources Board (CARB), and currently applies to facilities with refrigerant charges greater than 200 pounds. Next March, the threshold will drop to 50 pounds.

The focus on cutting greenhouse gas emissions, in part by controlling refrigeration leaks of high-GWP refrigerants, has sparked interest in the Golden State in refrigeration systems that use low-GWP gases like natural refrigerants and at the same time run more efficiently than traditional systems. This, in turn, has attracted the attention of the state's power utilities, which are always interested in reducing the amount of energy consumed so that they can affordably provide a sufficient amount of power to everyone.

“The California Refrigerant Management Plan and AB32 have caused businesses to look at alternative refrigeration systems,” said Paul Delaney, senior engineer for Southern California Edison (SCE), Rosemead, Calif., the primary electricity supplier for much of Southern California, serving 50,000 square miles and nearly 14 million people. “We’re looking to help them understand and assess the efficiency of those systems.”

Because California is also in the midst of a major drought, SCE is also interested in systems that both improve efficiency and conserve water. EVAPCO, for example, markets an air-cooled low-charge ammonia system that consumes no water.

Delaney works in SCE's New Product Development & Launch (NPD&L) group, whose purpose is to provide alternatives to energy customers that reduce energy consumption and cut demand during peak periods.

Delaney's NPD&L group manages two buckets of funding – one for emerging energy-efficient technology and one for emerging technology that helps end users limit peak demand, when rates are highest. “My specialty is process loads, which includes refrigeration,” he said.

The carrot here, of course, is that natural-refrigerant systems passing muster in terms of energy efficiency qualify for monetary rewards (incentives) from the utilities. The money helps end users afford these systems, especially early in the adoption lifecycle when their production is low and their price high relative to traditional technology. This can set off a virtuous cycle whereby incentive-driven investments in natural-refrigerant systems lead to more production, lower prices and more sales of the technology.

Though utilities are often criticized for drawing out the incentive process, “our goal is to provide incentives as soon as we can,” said Delaney. “If we can do this faster,

while maintaining the level of rigor that we need, that would be best by far.”

What can delay the distribution of an incentive is the requirement that SCE get its energy incentive programs approved by the California Public Utilities Commission (PUC). For example, if a program involves a new technology that can earn a prescriptive incentive, “the process may take longer,” said Tara Becnel, SCE’s senior project manager.

The PUC and California utilities have developed a Database for Energy Efficient Resources (DEER), which provides well-documented estimates of costs as well as energy and peak-demand savings associated with particular types of technology. The information is public; other states use it. “If [a technology] is in the database, that makes it easier [to give incentives],” said Delaney. “If it’s not in there, and if there is no load profile for each facility and climate zone, that’s when things get harder to do.”

Importantly, SCE does not take manufacturer’s efficiency claims for their refrigeration or HVAC systems at face value, always seeking third-party

validation, either internally at its own Technology Test Centers in Irwindale, Calif., or from outside agencies like the Electric Power Research Institute (EPRI), Oak Ridge National Laboratory or the labs operated by Pacific Gas & Electric (PG&E). “We validate the claims and make sure they do what they are supposed to do,” said Delaney.

SCE doesn’t endorse particular technology vendors. “All of our tests are impartial and unbiased,” said Ramin Faramarzi, manager of the Technology Test Centers. SCE will not include the names of manufacturers in its assessment reports.

But SCE does do research on behalf of manufacturers and promotes the adoption of equipment that meets energy-efficiency parameters. “If we can help technology companies find more customers and build more equipment to really transform the market, that would be the panacea for emerging technology,” said Delaney.

continued on p.24 →



Ramin Faramarzi, manager, Southern California Edison's Technology Test Centers

## SCE’s Test Lab

Southern California Edison (SCE) opened its Technology Test Centers in 1996 to help its supermarket customers meet their energy challenges, particularly around refrigeration, which accounts for half of their energy load.

“Commercial refrigeration is a very complex end use,” said Ramin Faramarzi, manager of the Technology Test Centers, located in Irwindale, Calif. “So utility incentive programs at that time were not sophisticated enough for these systems.” In addition, supermarkets lacked a baseline or standard for analyzing their energy usage.

SCE’s lab was set up to address those issues, and it proceeded to test the energy usage of refrigeration components, posting the results in the public domain.

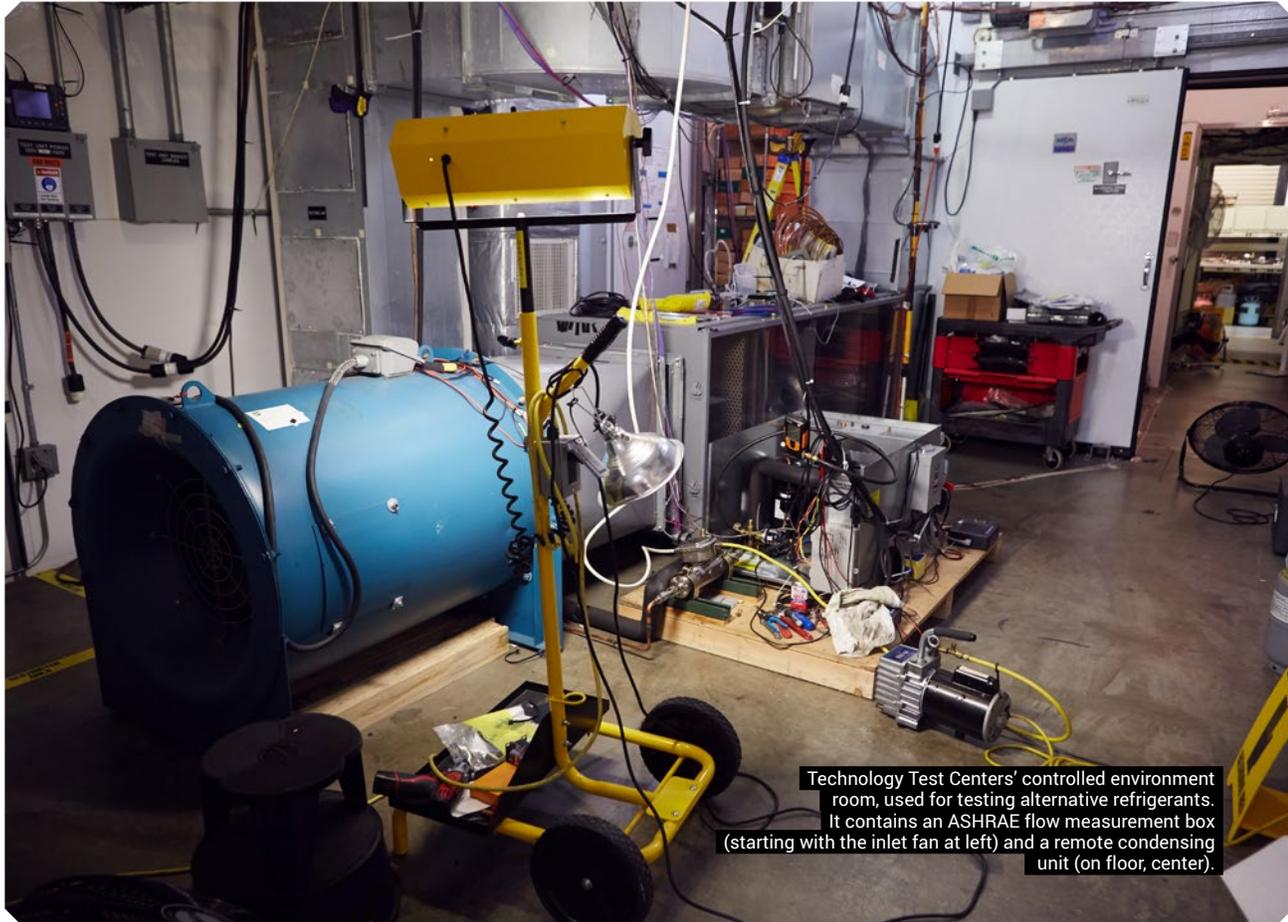
In 2001, the Test Centers expanded to test air conditioning in commercial and some residential applications. Finally in 2004, the lab extended its work to include lighting applications in commercial, industrial and residential settings.

The test chambers at the lab are designed not only to accurately test a particular system, but to do so in the context of customers’ realistic operational conditions so that they can make an informed purchasing decision. “When we’re done with a test, the customer can relate to our findings,” said Faramarzi.

In its lab, SCE has a mechanical room with two types of refrigeration racks – one for a small to mid-size supermarket and one multiplex system for larger stores. Both systems reject their heat to a separate glycol refrigeration rack to replicate different climatic conditions. The racks are connected to display cases sitting in a supermarket test chamber that replicate a store environment and contain dummy or simulated products. The lab also includes test chambers for walk-in coolers and freezers as well as for indoor and outdoor HVAC systems.

“By the time we’re done with our test projects, we can stand 100% behind the data,” said Faramarzi.

The lab has not yet evaluated natural refrigerants in those racks. Its first natural refrigerant test – what Faramarzi called a high-level scanning project – took place last year when it compared the energy efficiency of a beverage vending machine using CO<sub>2</sub> as a refrigerant to one using R134a. (Preliminary results found them comparable.) This year, the lab will examine, on behalf of a major supermarket customer, the energy efficiency of self-contained cases using propane, and possibly cases using butane, isobutane or CO<sub>2</sub>.



Technology Test Centers' controlled environment room, used for testing alternative refrigerants. It contains an ASHRAE flow measurement box (starting with the inlet fan at left) and a remote condensing unit (on floor, center).

## → LAB TO FIELD

The first step in NPD&L's analysis of new technology is usually to test it at SCE's Technology Test Centers in Irwindale, Calif., or other labs. The Test Centers can simulate environmental conditions for eight climate zones as well as the conditions in a supermarket, cold storage warehouse or walk-in cooler.

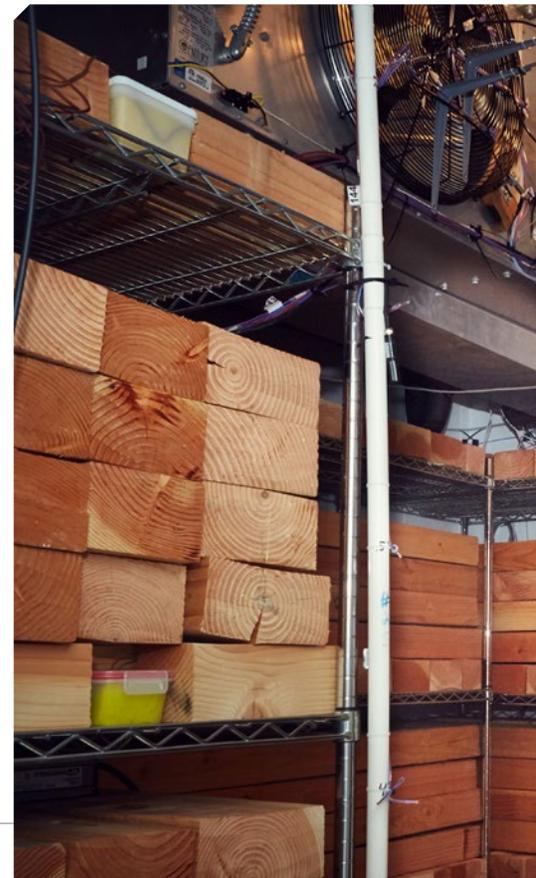
For example, the lab plans to test a self-contained freezer case using the natural refrigerant propane (and potentially butane, isobutane and CO<sub>2</sub>) for a major supermarket chain, which asked SCE for help in evaluating the technology and estimating its energy efficiency vis-a-vis a case using an HFC.

Once done validating a technology, the lab hands off its results – “as much information as we can,” said Faramarzi – to NPD&L, which seeks a field evaluation of the technology in a live facility or store.

In one field test, NPD&L has embarked on an evaluation of an ultra-low-charge ammonia system from NXCOLD, which

is installed as a retrofit at an existing cold storage facility operated by Lineage Logistics in Oxnard, Calif.; the legacy system is a flooded ammonia system. The low-charge system's evaporator maximizes heat transfer using an electronic refrigerant injection control (ERIC) mechanism. (For more on NXCOLD, see “Breaking With Tradition,” *Accelerate America*, April 2015.) “There are more opportunities in retrofits so we look there first,” Delaney said

NPD&L is also assessing a NXCOLD system with under 500 pounds of ammonia at a new Lineage facility in Long Beach, Calif., that would have otherwise used a flooded system with 22,000 pounds of ammonia. SCE is also validating how well low-charge ammonia systems can reduce consumption on demand, especially during hot summer afternoons, at Oxnard and Long Beach. (Delaney stressed that SCE's intent is to validate the energy efficiency of the technology, not endorse any particular vendor.)



In the case of low-charge ammonia systems, SCE was not able to do a lab test because the units, at 10 TR, were too large. "We have asked the manufacturers for units in the five tons range that we can test in the lab," Delaney said. "But we didn't want to hold up the field analysis waiting for a smaller unit."

Nonetheless, SCE was able to create a model, using a traditional flooded ammonia system as a baseline, which estimated that the energy savings for the Lineage's Oxnard low-charge ammonia unit is 15%-17%. "Once we understand the operational characteristics of the low-charge system, we'll adjust the estimate," he said.

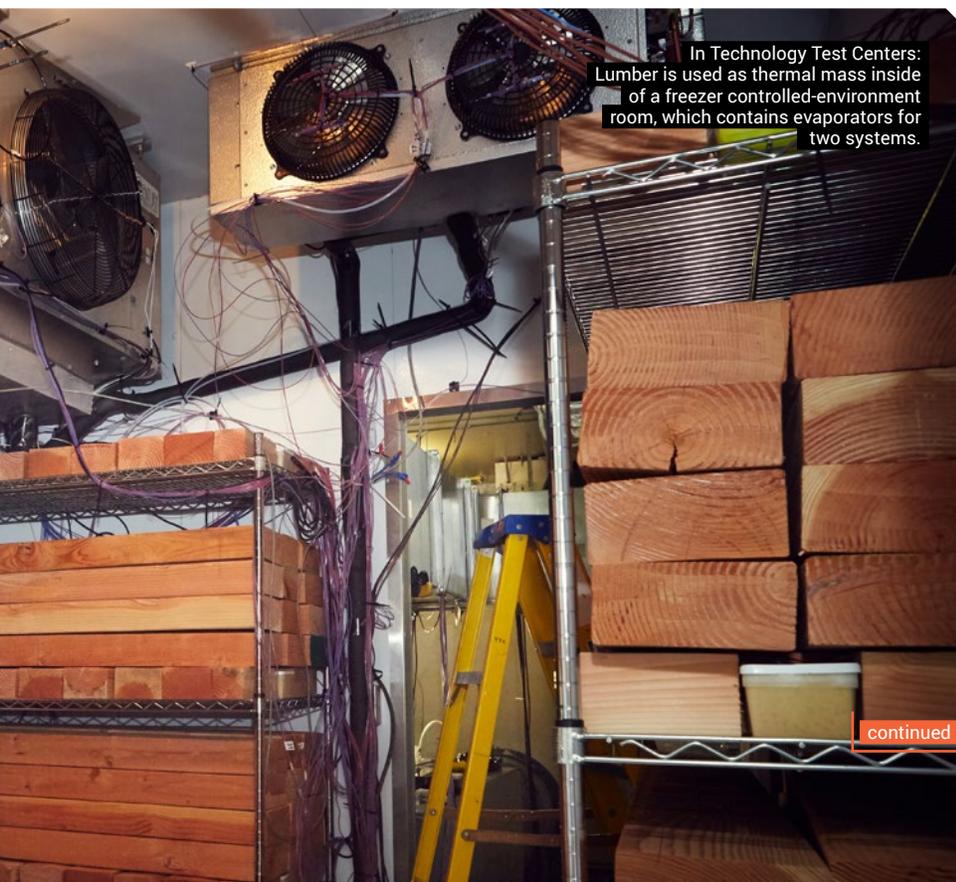
In general, SCE calculates that low-charge ammonia would enjoy a 5%-10% efficiency gain over a flooded ammonia system and a 15% -25% gain over an HFC system. At Oxnard, the efficiency advantage is greater because the existing ammonia system is "old and has been modified many times to keep it operational," Delaney said.

The NPD&L group provides its energy analysis and that of the Test Centers to a larger group called Customer Programs and Services, which then determines the incentives to be awarded. It has already determined a cents-per-kWh and per-kWh

incentive for low-charge ammonia, which will be applied to the Oxnard and Long Beach projects once the low-charge system's energy efficiency is validated.

Because low-charge ammonia technology varies from site to site, it falls into the category of a custom system, with varying energy efficiencies and incentives. Prescriptive (also called deemed) incentives, by contrast, are tied to specific pieces of equipment and remain the same from project to project. "Custom incentives are more difficult to get but the customer realizes more benefit because we have specific data for a specific installation, which allows us to be more accurate," Delaney said. It is up to Customer Programs and Services to decide whether a technology should have a prescriptive or custom incentive.

Like other utilities, SCE does not offer incentives for lessening the global-warming impact of refrigerant leaks by replacing high GWP F-gases with low-GWP natural refrigerants. Energy efficiency comes first, though "as we account for [GWP emissions] more and more, we will look for help from the Public Utilities Commission to account for this," Delaney said. "It's under consideration and often drives our customers to look for refrigeration alternatives."



continued on p.26 →

## The PG&E study that proved NH<sub>3</sub>/CO<sub>2</sub>'s efficiency

In 2005, United States Cold Storage became one of the first public refrigerated warehouse companies to install an ammonia (NH<sub>3</sub>)/CO<sub>2</sub> cascade refrigeration system at a new facility in Bethlehem, Pa. (See, "Shaking Up Industrial Refrigeration," *Accelerate America*, April 2015.)

The company continued putting NH<sub>3</sub>/CO<sub>2</sub> systems in new warehouses and today has them in 11 facilities. In 2009 Pacific Gas and Electric (PG&E), as part of its Emerging Technologies Program, evaluated the performance of the system over a five-month period at a US Cold Storage warehouse in Fresno, Calif. PG&E provides gas and electricity to most of the Northern two-thirds of California.

The Fresno facility operates blast freezing (-58°F), freezer storage (-20°F) and cooler and docks (20°F). It was compared with a conventional two-stage ammonia system running the same applications at the same temperatures.

In a report issued in 2009, PG&E concluded that the cascade NH<sub>3</sub>/CO<sub>2</sub> system is more efficient in providing low-temperature cooling than a conventional ammonia system, particularly at ultra-low blast freezing temperature levels.

"Considering the entire refrigeration system energy usage for the facility examined in this study, a cascade [NH<sub>3</sub>/CO<sub>2</sub>] system is approximately 5.8% more efficient than an optimally designed and controlled conventional two-stage ammonia system operating at the same conditions."

As a result of its findings, PG&E provided US Cold Storage with an energy incentive, said Charles Toogood, vice president of business development for M&M Refrigeration, and vice president of engineering for US Cold Storage at the time of the study.

# IN TECHNOLOGY TEST CENTERS



Evaporator coil (left), and humidifier (right), which is used to control conditions inside a controlled-environment room



CO<sub>2</sub> soda vending machine with team member photos



Screen showing interface for video recording that is used to monitor defrosting on top of hygrometers



Instrumented evaporators inside of the freezer controlled-environment room.

## → ASSESSING MARKET POTENTIAL

After the low-charge ammonia systems at Lineage's Oxnard and Long Beach facilities are fully evaluated, SCE will be able to use those results plus information on traditional ammonia systems to provide estimates of energy efficiency for low-charge applications to other cold-storage facilities. The estimates are adjusted based on a facility's location, climate, size and the temperature of its storage areas. "If the customer doesn't understand what the incentive might be, they often do not consider a new or emerging technology," noted Delaney.

Moreover, with these estimates in hand, SCE can analyze the market potential of the more efficient technology. "We will come up with some estimated savings so we can develop a campaign and figure out who we want to target," said Becnel. In the case of low-charge ammonia, "we have a list of refrigerated warehouse customers that are ideal. Our account managers can talk to them about energy-saving technologies."

The market's interest is growing. "Every week, I'm getting more and more calls from people who want to know what we're doing with low-charge ammonia and when we're going to have data on it ready to go," said Delaney.

SCE's evaluation of low-charge ammonia is starting in cold-storage warehouses, but Delaney expects the technology, sometimes using a secondary fluid like CO<sub>2</sub>, will eventually be applied to supermarkets, ice rinks, and other facilities. "We're looking at technologies like Mayekawa's NewTon ammonia-CO<sub>2</sub> unit for simple walk-in retrofits at supermarkets," he said.

In 2012 SCE provided an incentive to a new Supervalu (now Albertsons) store in Carpinteria, Calif., that uses an ammonia-cascade refrigeration system, but the incentive was for the new construction and all of its energy components, not just for the refrigeration system. The "savings-by-design" incentive was based on modeling what the store would likely experience after it was built.

Some companies are interested in how low-charge ammonia can be used to cool office space. "That's ahead of the curve in my opinion, but to me it seems like a big opportunity," he said.

Meanwhile, other utilities around the U.S. have become aware of what SCE is doing with regard to energy-efficient refrigeration and HVAC technology. "They're waiting for the results so they can determine if there are opportunities for their customers," said Delaney @ MG

## Lineage's energy-saving mission

Southern California Edison is evaluating the energy efficiency of low-charge ammonia systems at two Lineage Logistics facilities – in Oxnard and Long Beach, Calif.

But that's just part of a comprehensive three-year energy efficiency program that Lineage, the second largest refrigerated warehouse provider in the U.S., launched this past February in concert with Cascade Energy. It will cover all of Lineage's 111 facilities.

Lineage is targeting a 10% energy reduction over the next three years, and pledged to the Department of Energy that it would reduce power by 25% by the end of 10 years.

The program expands on successful pilot projects that Lineage and Cascade conducted in the past year. "We did 15 pilots tuning up our buildings and achieved 10%-12% energy savings," said Bill Hendricksen, CEO of Lineage, during a session at the IARW-WFLO Convention & Expo in April.

The energy savings resulted from a range of adjustments, including improved control system algorithms and set points. "It's a huge amount of Sherlock Holmes and a lot of Larry King – asking lots of questions, measuring, poking around," said Marcus Wilcox, CEO of Cascade Energy, at the IARW session.

Cascade also provides energy efficiency software incorporating energy use, and weather data.

# GETTING AN ENERGY REBATE, THE WHOLE FOODS WAY

The natural/organic food retailer worked closely with Sacramento Municipal Utility District last year to earn a substantial incentive for a remodeled store that includes a CO<sub>2</sub> cascade system

– By Michael Garry

Whole Foods Market has been among the most active food retailers in the U.S. when it comes to testing and evaluating natural refrigerant systems.

Starting in 2009 with secondary and cascade refrigeration systems, the iconic natural and organic foods retailer, based in Austin, Texas, installed its first all-CO<sub>2</sub> transcritical system in a store in Brooklyn, N.Y., in 2013. (See “Whole Foods’ Journey to Natural Refrigerants,” *Accelerate America*, Dec. 2014-Jan 2015.) It followed up with two more transcritical stores in Berkeley and San Jose, Calif., and then, this past May, with a store in Dublin, Calif., that uses an ammonia/ cascade system, just the second installed in a U.S. supermarket. On top of that, Whole Foods is testing 30 propane-based self-contained refrigerated units in about 20 locations.

Whole Foods is trying to determine if natural refrigerants “make sense to us” from an energy, operational and maintenance perspective, said Aaron Daly, Whole Foods’ San Francisco-based global energy coordinator, responsible for energy efficiency improvements and incentive programs throughout the chain’s 12 operating regions. “We don’t have enough data to say yet. That’s why we are testing different designs to find the sweet spot.”

To help defray the costs of these natural refrigerant systems, Whole Foods applies to utilities for energy-efficiency rebate incentives. However, the retailer’s



strategy has not been to apply for incentives for the refrigeration systems themselves (though they are typically more efficient than conventional systems) but for the store as a whole.

The Brooklyn store, for example, received support from NYSERDA (New York State Energy Research and Development Authority). The other transcritical stores’ requests are pending. “We apply for rebates for every store we build where we can get them,” said Daly. “We build very efficient stores, whether with natural refrigerants or not.”

Whole Foods’ first store with a CO<sub>2</sub> transcritical system in Brooklyn, N.Y.

## Retrofitting an existing store

An example of a Whole Foods store with a natural refrigerant system (a cascade system) that received a substantial rebate for its overall energy efficiency is one located in Sacramento, Calif., the state's capitol. Unlike most stores with refrigeration, which are typically new buildings, this was an existing store that was retrofit with the cascade system and other energy-saving components last year.

The project was put together by Whole Foods in consultation with PECL (acquired last fall by CLEAResult), an energy consulting firm; Source Refrigeration, a contractor; and Sacramento Municipal Utility District (SMUD). "This is a compelling example of how utilities and supermarkets can work together toward a common goal driven by energy efficiency but also achieving multiple goals," Daly said.

SMUD, Daly added, was "an active partner with us" both in the scrutiny it gave the project as well as in the incentive it granted. "That provided a level of certainty to operations and executives [at Whole Foods] who are not necessarily down in the weeds with this," he said. "Having a third party putting their money behind it goes a long way to building confidence in the project."

A food retailer doesn't necessarily need an intermediary like PECL to work with a utility, but its expertise can be helpful. "We lacked the engineering staff to turn out the models the utility was asking for,"

he said. "PECL understood what SMUD needed."

While Whole Foods is still analyzing the store's power consumption, it has seen an energy savings of greater than 30% for the remodeled building as a whole compared to the original format. For that it received a rebate equal to about 10% of the cost of the remodel. SMUD is engaged in a post-retrofit walk-through to validate that the store is operating as efficiently as the model upon which the incentive was based.

The rebate was significant not only because of the amount – which Daly described as "huge" – but also because of SMUD's flexible approach to the project. Most utilities need to document that the energy savings fits within a state's regulatory framework, and prefer to see prescriptive projects like LED lighting that call for a designated rebate. By contrast, SMUD was willing to try something more innovative, looking at the energy savings produced by the entire retrofit, with contributions from various sources, including the cascade system. "SMUD is definitely at the forefront of utilities pursuing a holistic approach," said Daly. This approach, he added, enabled the utility to award a rebate large enough to justify Whole Foods' investment in the project.

Even utilities that are open to custom incentives, he said, "usually lack the horsepower to understand what we are talking about when we bring an upgrade such as this."

## Multiple Energy Savers

The cascade system by itself contributed an important piece (about 20%) of the energy savings in the Sacramento store. In addition, new cases optimized for the system enhance efficiency by using evaporator coils with a smaller temperature differential (TD). The cascade system also allows Whole Foods to use a less expensive refrigerant (CO<sub>2</sub>) and reduces the potential regulatory exposure associated with HFCs.

But the project also had other energy-saving elements that added up to what Daly called a "holistic program." These included LED lighting, solar film on front windows and a new rooftop unit that replaced an air-conditioning rack. In addition, by removing heat reclaim, the store saved electricity by not having to run its compressors as aggressively. This more than compensated for the energy required by the natural gas system that replaced heat reclaim. (California now requires stores to use heat reclaim. Had the Sacramento store's heat-reclaim design not been so outdated, it may have been retained.)

Putting doors on the display cases was a major energy-saving measure, lessening the refrigeration load for medium-temperature compressors. This in turn allows the medium temperature compressors to pick up capacity from the low-temperature compressors. Whole Foods was thereby able to reduce the horsepower on the new low-temperature compressors by 85% compared to the previous model.

Though carbon reduction was not a requirement for receiving the energy rebate, SMUD did not want the project to negatively impact the store's footprint. "Most utilities are just about energy, but that's beginning to change, particularly in California and the Northeast where utilities are within a regulatory structure focusing on carbon reduction," Daly said. "They are keenly aware of it and don't want to be caught off guard."

continued on p.30

→ In addition to reducing energy consumption, Whole Foods cut the Sacramento store's carbon footprint by reducing its use of R404A, which has a high global warming potential (3,900). The original store had a "fairly old DX system with a high R404A charge," noted Daly. "By replacing the low-temperature rack with a cascade system, we reduced the charge dramatically," which lowers the amount that leaks into the atmosphere and contributes to global warming,

Utility rebate programs involving custom-built equipment usually take a considerable period of time to approve, in contrast with plug-and-play prescriptive programs where the rebates are based on specific equipment. Whole Foods approached SMUD three months before construction began on the remodel.

Getting approval "was a fairly lengthy process," with the proposal going through several iterations, said Daly. "We had the utility review every aspect to make sure they were a believer in the choices we were making. And we incorporated some of their feedback and ideas." Whole Foods presented a "base case" (the existing building) and a "retrofit case" and showed what the savings would be with the latter.

For retailers seeking custom utility incentives for a retrofit project involving a natural refrigerant system, Daly recommended doing "robust modeling and working with an OEM to demonstrate that the energy savings are real." (For an example of how an OEM can help secure an energy rebate, see ["Educating Utilities," p.32](#))

This requires advance planning to come up with the data utilities need "to feel comfortable," he said. But the investment of time makes it more likely that the utility will be excited about a project rather than "shoehorning you into an existing idea."

Daly is now working with a major utility on developing prescriptive rebates for stores with self-contained freezer or cooler cases using propane (R290) as the refrigerant. Such rebates don't currently exist, he said, adding that once this utility approves the rebate, others will follow suit. Incentives would help speed up Whole Foods' investment in these energy-efficient systems.

Prescriptive rebates, he observed, don't require the advance planning that custom incentives do. "You send in a rebate application after you buy it and they cut you a check" **MG**



Aaron Daly,  
Whole Foods Market



## Whole Foods' Energy Partner

Whole Foods Market collaborated with PECL (acquired late last year by CLEAResult) on obtaining an energy rebate for its remodeled store (including a CO<sub>2</sub> cascade refrigeration system) in Sacramento, Calif. *Accelerate America* asked Kelsy Houston, associate product manager for CLEAResult, to talk about the project from the perspective of an energy management consultant.

### **Accelerate America:** How did CLEAResult help Whole Foods secure energy rebates for the Sacramento store?

**Kelsy Houston:** The rebates offered for this project were through a whole building energy-reduction program requiring a reduction of at least 30%. CLEAResult provided consultative and managerial support on the analysis of the project as a whole, for all project measures including the retrofit of the existing hydrofluorocarbon (HFC)-based direct-expansion (DX) system, to a low-temperature cascade refrigeration system (with two refrigeration systems connected in series). CLEAResult worked with the contractor to ensure the new refrigeration system produced energy savings within the requirements of the energy reduction program, and CLEAResult facilitated the rebate payment from the utility to Whole Foods.

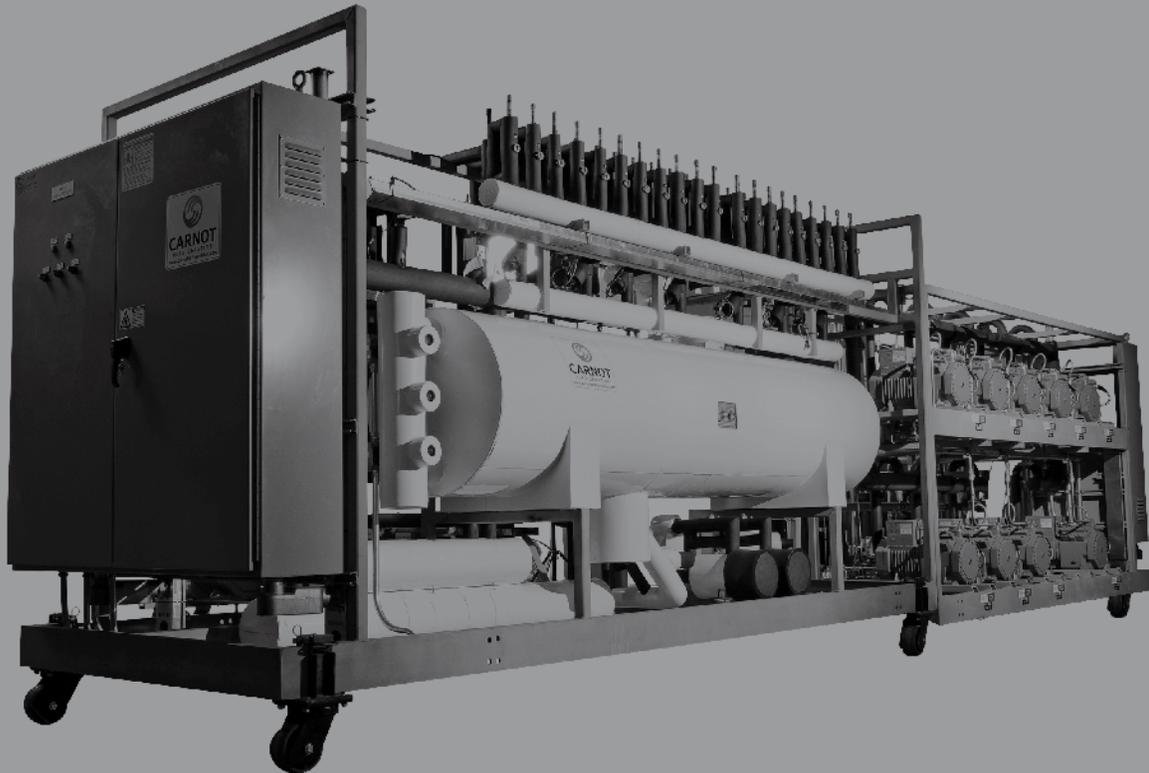
### **AA:** What were the elements that went into the store's energy-efficiency program?

**KH:** CLEAResult provides a holistic approach to evaluating and consulting on refrigeration-based energy efficiency projects. For this project, the store's HVAC and lighting system's loads were reduced through various upgrades across the store like LED store lighting, solar film on front windows, adding doors to open refrigerated cases, and store ventilation and HVAC system improvements. These translated into lower loads seen by the refrigeration system. When coupling these lower loads with refrigeration system controls, hybrid condensers, and efficient CO<sub>2</sub>-compatible scroll compressors, the CO<sub>2</sub> refrigeration system design was optimized, and multiple systems were evaluated together, allowing for the best design at the building level.

### **AA:** What role does CLEAResult typically play with supermarkets and other users of commercial/industrial refrigeration?

**KH:** CLEAResult creates and manages numerous utility energy-efficiency programs across the U.S. in the commercial sector focusing on, or including, refrigeration. As program administrators, CLEAResult's goal is to help the utility implement the most cost effective energy-efficiency program for its customers, in this case supermarkets or large commercial buildings. As energy advisors, CLEAResult supports the evaluation of new technologies and calculates energy savings for retrofits and new construction applications. We also work to incentivize and engage contractors and end users along the way.

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REFRIGERATION

# EDUCATING UTILITIES

Hillphoenix is hard at work teaching utilities about the energy-saving benefits of CO<sub>2</sub> transcritical systems – and earning rebates for retail customers like Aldi

– By Michael Garry

This past January several refrigeration vendors sponsored an unusual industry workshop in Berkeley, Calif. The meeting brought together supermarket refrigeration executives, utility representatives, equipment manufacturers, and others to discuss natural-refrigerant systems like all-CO<sub>2</sub> transcritical models and how they can earn utility rebates for energy efficiency.

Leigha Joyal, energy analyst for Hillphoenix, was one of the attendees of the event. (Hillphoenix was one of its sponsors.) Some of her takeaways: U.S. food retailers are beginning to regard CO<sub>2</sub> refrigeration as a viable option and some have even made it their standard. At the same time, utilities are still learning about the technology and operational benefits, which is why they have been hesitant to incentivize the use of natural refrigerants. “This event was a first step to really help educate the utilities,” she said.

Utilities, she added, tend to think that CO<sub>2</sub> systems – still relatively new technology in the U.S. – use more energy than conventional DX systems and therefore will not qualify for incentives.

Joyal’s focus at Hillphoenix is to help retailers receive the best possible ROI by providing operational calculations and researching rebate opportunities. Part of the process is helping utilities gain an understanding of how natural refrigerant systems like the vendor’s all-CO<sub>2</sub> transcritical units are, in fact, better for the environment and expend less energy than their traditional DX counterparts, thereby qualifying for energy rebates. These rebates would make transcritical systems – often higher priced than DX at this stage of their development – more affordable and help end users like retailers overcome their hesitation about trying them. “We

know the incentive can make a difference on deciding which technology to invest in,” said Joyal.

When power utilities do offer incentives, they are accustomed to basing them on published data gleaned from equipment spec sheets. But CO<sub>2</sub> systems, like other centralized refrigeration equipment, are customized to a store’s needs, and the energy savings will vary depending on the site and conditions. “One of the biggest hurdles has been getting utilities to understand that,” said Joyal.

However, some utilities are opening up to the energy possibilities presented by natural refrigerant systems, particularly those in California and New York. Joyal, who is based in Rhode Island, has been working this year with NYSERDA (New York State Energy Research & Development Authority), which provides energy incentives on behalf of New York utilities, on a multi-store natural refrigerant project involving Aldi U.S., part of the global Aldi organization based in Germany. She is also collaborating with Aldi on a rebate for a California store using a natural refrigerant system

In New York, for example, Aldi is building a “completely green store,” part of which is an all-CO<sub>2</sub> air-cooled transcritical booster refrigeration system. The store, which is slated to open in 2015, will also have self-contained “wide island” cases using propane as a refrigerant.

## MAKING PROJECTIONS

Joyal is working with Aldi “hand-in-hand” on securing a rebate for the transcritical system, making sure NYSERDA receives the data it needs – projected energy consumption compared to a DX R404A system that factors in weather patterns.

She is also helping to educate NYSERDA about how the CO<sub>2</sub> system is built.

The rebate for the transcritical system will be part of the overall new-construction rebate that NYSERDA will give Aldi. Aldi is also getting incentives for other energy-saving elements like LED lighting, glass doors for medium-temperature cases and anti-sweat systems for low-temperature case doors.

NYSERDA has, in fact, decided it will give Aldi a rebate for the store’s overall energy savings, but has not yet determined the amount, which will be a percentage of the store’s construction costs. The rebate will go directly to Aldi and help to significantly lower the ROI on the CO<sub>2</sub> refrigeration system.

Utilities and retailers are often at odds about the length of time it takes to evaluate a rebate application. “For the retailer, the faster they can get a rebate and open a store, the faster they are recouping their investment,” explained Joyal. “Utilities, on the other hand, need to ensure that all savings projections can and will be realized. We’re in a difficult position being in the middle, trying to move the utility to get it done faster, while meeting the retailer’s construction schedule.”

To avoid this dilemma, Hillphoenix provides the utility with a timeline of fixed dates. In the Aldi project the retailer has proactively tracked the progress of the rebate evaluation with the utility. “You need someone to assist in the project management process, provide analysis and answer any questions that might arise,” she said.

Joyal doesn’t expect any problem with the Aldi rebate coming through in a reasonably timely fashion. NYSERDA is

expected to announce the rebate in the coming months; the application process started in January. "The utility wants the savings they get and they want to promote themselves for giving a significant incentive for a natural refrigerant system," she said. "It's innovative for them so they are receptive to moving forward quickly with it."

## OTHER TRANSCRITICAL STORES

To date, Hillphoenix has installed transcritical refrigeration systems at 66 stores in North America, including an Angelo Caputo's Fresh Markets store/warehouse in Carol Stream, Ill. (see story, page 36) and a Roundy's Pick 'n Save (see story, page 42). In those two cases, the stores consulted directly with local utilities to obtain new-construction rebates covering all

energy-saving elements. Aldi is the first U.S. retailer Hillphoenix has directly helped obtain utility rebates, focusing specifically on CO<sub>2</sub> refrigeration.

In Joyal's estimation, about half of retailers seek utility rebates on their own, while the other half prefer to employ a third party for that task. Larger retailers often have internal staff responsible for incentives, though sometimes they will outsource the incentive/rebate process for CO<sub>2</sub> systems to Hillphoenix, given the manufacturer's expertise with the technology.

Utilities are focused on energy savings, but Joyal tries to educate them on other benefits of the CO<sub>2</sub> technology, including a lower carbon footprint (from using CO<sub>2</sub> rather than high-GWP HFCs, as well as from the energy savings) and

maintenance savings (CO<sub>2</sub> is vastly less expensive than HFCs).

"Getting utilities to understand the full impact of natural- refrigerant systems is one of our biggest challenges," she said. "However, as the adoption rate increases, so do the awareness, knowledge and acceptance."

A greater understanding of natural refrigerants may be coming as utilities increasingly grapple with their own carbon footprint challenges brought about by federal regulation of their greenhouse gas emissions, she noted. "There will come a time when they have to take into account the carbon footprint of their customers" **MG**

## Start-up debuts refrigeration battery

Food retailers face two fundamental dilemmas: their margins are tiny (around 1.4%) and their energy costs are high because they use refrigeration.

"To me, these guys are suffering," said Amrit Robbins, president and co-founder of year-old Axiom Exergy, Richmond, Calif., a start-up that aims to alleviate their energy woes.

Robbins and Axiom's other co-founder, Anthony Diamond, have developed the "Refrigeration Battery," a patent-pending energy storage system that connects seamlessly to a standard centralized refrigeration system. The battery "stores cooling" overnight when electricity rates are low and delivers it from noon to 6 pm when rates soar. "We're storing refrigeration the way a battery stores electricity," Robbins said.

This can cut usage of a supermarket's peak demand by 40%, offering a payback of two to four years on the upfront cost of the system, said Robbins, who added that the company plans to offer a "savings-as-a-service" payment model next year. Stores can also use the battery as a back-up source of refrigeration in the event of a power outage.

Axiom plan to test the system at a national chain supermarket location in the San Francisco Bay Area later this year (Robbins declined to name

the chain.) The Refrigeration Battery system will qualify for state and utility incentives that substantially reduce its up-front cost.

The system is currently designed to work with an HFC refrigerant but Axiom plans to release a model designed for CO<sub>2</sub> in the near future, said Robbins

The Refrigeration Battery stores energy by freezing a 5,000 to 10,000 gallon tank holding a proprietary salt-water solution. The battery acts like any other freezer case at night, using the store's refrigerant to freeze the salt solution. Then, from noon to 6 pm, the Refrigeration Battery substitutes for the store's compressor/condenser system, taking in superheated refrigerant gas from the store and using the frozen tanks (in concert with a circulating glycol loop and a low-energy pump) to turn out pressurized liquid refrigerant. That liquid refrigerant then makes its appointed rounds through the display cases and walk-in coolers, refrigerating food as if it came from the store's compressor/condenser system.

So, instead of using the compressor/condenser during the afternoon, the store effectively uses a pump that consumes 97%-99% less energy. Including the energy consumed by the salt-water tank at night, use of the Refrigeration Battery slightly increases the net amount of energy the

store consumes (as any battery system would). But because it offsets the consumption of so much energy during peak demand hours, it still saves the store money. "This substantially moves the needle from an energy and dollar perspective," said Robbins.

"It's a pretty novel concept, and the science is valid," said Pete Cuneo, national facility systems manager for a major supermarket chain, who serves as an advisor to Axiom Exergy.

Axiom Exergy's device, noted Robbins, enables power plants to consume less fuel by shifting the store's energy load to night hours when power plants (and refrigeration systems) operate more efficiently, and power lines are less congested. It also allows power plants to use more renewables by providing a buffer against erratic solar or wind production.

Similar ice storage batteries exist for HVAC applications, but not for refrigeration, said Robbins.

# Events Affecting Utility Support of Natural-Refrigerant Systems



## GOVERNMENT

2006

California passes AB32

2011

CARB launches Refrigerant Management Plan

June 2014

EPA announces Clean Power Plan

2016

CARB to announce final strategy for SLCPs



## UTILITIES AND END USERS

— 1972 —  
EPRI founded

— 1996 —  
Southern California Edison (SCE) opens Technology Test Centers

— 2012 —  
SCE awards incentive to Supervalu for store in Carpinteria with ammonia-CO<sub>2</sub> cascade system

— 2009 —  
Pacific Gas & Electric awards efficiency incentive to U.S. Cold Storage for ammonia-CO<sub>2</sub> system

— 2007 —  
EPRI finds COPs of 3.5-4 for EcoCute CO<sub>2</sub> heat-pump water heaters

— 2013 —  
Whole Foods' Brooklyn store with transcritical system gets rebate from NYSERDA

— 2014 —  
Whole Foods receives energy rebate from SMUD for remodeled Sacramento store with CO<sub>2</sub> cascade system

— Dec 2014 —  
EPRI report on the state of the art of commercial refrigeration

— 2015 —  
EPRI tests an ammonia/CO<sub>2</sub> unit in a food processing/storage facility

— 2015 —  
Southern California Edison (SCE) tests low-charge ammonia system at cold-storage facilities

— 2015 —  
Whole Foods seeks energy rebates for self-contained refrigerated cases using propane.

— 2015 —  
Aldi seeks energy rebate from NYSERDA for N.Y. store with transcritical system and self-contained cases using propane

— 2015 / 2016 —  
EPRI tests transcritical CO<sub>2</sub> in a supermarket

# The clear path to a smaller carbon footprint.



## Emerson offers a future-proof solution through CO<sub>2</sub> technologies

Commercial refrigeration users throughout the world are moving towards phasing out harmful refrigerants and are looking for alternatives. Emerson CO<sub>2</sub> technology leads the trend to efficiency. This refrigerant's non-ozone depleting, non-flammable and near-zero global warming potential properties create an ideal solution towards reducing your environmental footprint.

The efficiency, reliability and liquid-handling advantage of Copeland Scrolls, coupled with Emerson Climate Technologies controls, components and transcritical compression architecture makes it ideal for exploiting the positive characteristics of CO<sub>2</sub> refrigeration systems.

Learn more about the future of refrigerants through the podcast audio below or read the white papers under CO<sub>2</sub> Solutions at [EmersonClimate.com](http://EmersonClimate.com)



Scan to listen to  
the podcast now

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# IN LOVE WITH CO<sub>2</sub>

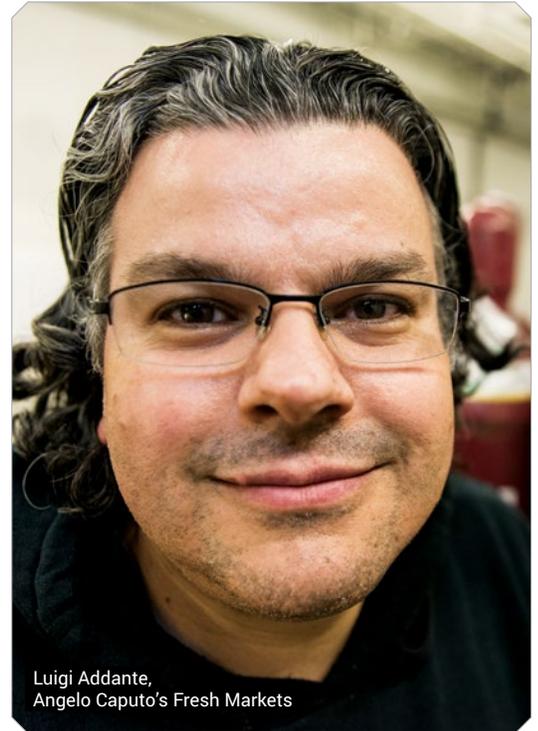
Angelo Caputo's Fresh Markets, an eight-store retailer, embraces transcritical CO<sub>2</sub>-only refrigeration at its unusual store/warehouse/commissary near Chicago – By Michael Garry

## It was love at first sight.

The first time Luigi Addante laid eyes on an all-carbon-dioxide transcritical refrigeration system at Hillphoenix's Conyers, Ga., headquarters, he knew it was the right technology for Angelo Caputo's Fresh Markets, an eight-store food retailer based in Carol Stream, Ill., just outside of Chicago.

"When you start hearing about different refrigerants and how harmful they can be, I said this has got to change," noted Addante, Caputo's chief information officer, with oversight over refrigeration and maintenance. "So when CO<sub>2</sub> [transcritical] came in, that's for us. I took the CEO [Robertino Presta] and said, 'Listen, you want to go green? This is the way to go.'"

Caputo's subsequently became one of the first U.S. grocers to use a transcritical system. However, unlike other pioneers like Hannaford Bros. and Whole Foods, Caputo's initially installed the technology in a new 200,000-square-foot warehouse/commissary opened in Carol Stream in July 2013. Then, last September, the retailer opened a 100,000 square-foot store (its largest) that adjoins the warehouse/commissary, and expanded the transcritical system. The combined 300,000-square-foot store/warehouse comprises four transcritical racks, three in the warehouse and one on a mezzanine overlooking the store – one of the



Luigi Addante,  
Angelo Caputo's Fresh Markets

most unusual transcritical installations in the world. Of the four racks, two and one-half are devoted to the warehouse/commissary and one and one-half to the store.

The Carol Stream warehouse, which replaced one located in Addison, Ill., supplies most of the grocery and perishable products sold at Caputo's eight stores. The rest is provided by Central Grocers, a retail cooperative. The commissary prepares soups, sauces, and hot dishes along with bakery items like cookies, cakes and pastries; shoppers can watch through windows as Caputo's employees put the finishing touches on bakery items. The commissary mainly supplies the Carol Stream store, but is expanding to accommodate the rest of the locations.

The Carol Stream store also features a sit-down eating area with 150 seats, where shoppers can have lunch or dinner before grocery shopping.

Overall, the Carol Stream facility is 99.99% HFC free, with the exception of the Coca-Cola vending machine. (Coke is in the process of transitioning to CO<sub>2</sub>-based refrigeration in its coolers and vending machines – see *Accelerate America*, March 2015.)

Using CO<sub>2</sub> (GWP of one) rather than an HFC (such as R404A, with a GWP of 3,800) enables the facility to drastically reduce the impact of leaked refrigerant on global warming. Assuming leakage of 18,750 pounds of refrigerant over 10 years, the difference would be 71.2 million pounds of CO<sub>2</sub> equivalent eliminated from the atmosphere. ([See chart, p.37](#))

## Loss inspires change

Caputo's, which opened its first store in 1958, prides itself on its close-knit family's Italian roots, with Old World photos of the founders – Italian immigrants Angelo, and his wife Romana – adorning the walls of the store, and a loop of Italian music playing continuously. References to Romana, the family matriarch, abound. For example, the store's prepared foods café, called La Bella Romana Cucina, offers all manner of ready-to-eat selections while La Bella Romana private label products fill the store. "Food is what we do. Family is who we are," reads a large poster.

Caputo's decision to look for environmentally friendly technologies was sparked by the death of Romana, in 2004, to cancer. "After that, they wanted to make a difference in the environment and were always looking for ways to go green," said Addante, who has worked for the company for 13 years.

Caputo's began its natural-refrigerants journey two years later when it acquired a store in Naperville, Ill., that came with a brine refrigeration system that had not

been installed properly. "We decided to keep that system," he said. "Once we got it up and running, we were on the path to green."

The next step came when the company decided to remodel its Elmwood Park location, and Hillphoenix introduced Addante to a secondary CO<sub>2</sub> system. It was then that he visited Hillphoenix's headquarters and saw the transcritical system, which wasn't quite ready for end users. So he selected the secondary system, which cut the HFC charge from more than 2,000 pounds to 300 pounds at the Elmwood Park store. "We were heading in the right direction."

When it came time to build the Carol Stream facility, Addante knew that Caputo's should now invest in the all-CO<sub>2</sub> transcritical system, and he persuaded owner Presta to do so. "I didn't want to do it half-and-half like Elmwood Park," he said. The transcritical option uses "a smaller footprint and inexpensive refrigerant. And as far as the environment goes, it's hands down the way to go."

But Addante still faced the challenge of convincing others at Caputo's that implementing a transcritical system was "the right thing to do," including his in-house techs. "One [technician] was skeptical as to whether it would work or not," he said. "If you ask him today, he'll say it's a really good system and runs really well. He loves the accuracy of how it takes temperatures and instantly drives the temperature down in the case."

The transcritical system, like the secondary and brine systems that preceded it, also encountered skepticism from contractors. "They were trying to convince the owners that it requires high pressures and isn't a good idea," said Addante. "But with any high pressure system, it's how it's designed and put together that's going to make it work."

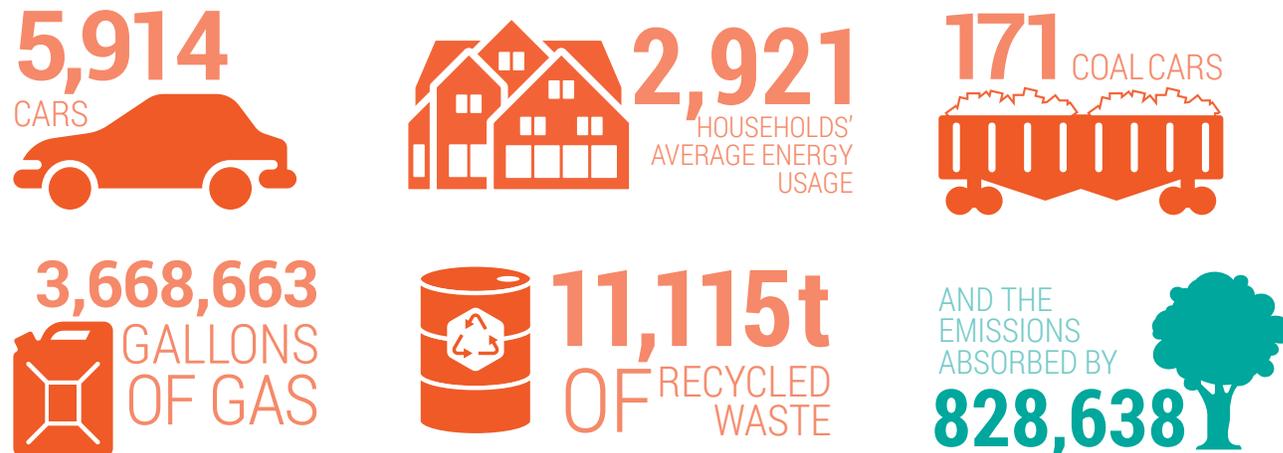
The lesson for Addante was that, with new refrigeration technology, a commitment to success is needed. "It'll only work if you believe in it enough."

continued on p.38 →

## Environmental Impact of Caputo's Transcritical System

Compared to using R404 over 10-year period (based on 18,750 pounds of leaks):  
71,249,991 pounds of CO<sub>2</sub>-equivalent emissions reduction.

That is equivalent to the 10-year emissions from:



Source: Hillphoenix

## → Hard to Compare

Caputo's operates outside of Chicago in Northern Illinois, which has long and cold winters along with hot summers. Its average annual temperature is 49°F, which puts it in a temperature zone that typically allows transcritical systems to operate more efficiently than DX systems.

But it is difficult to assess the efficiency of the Carol Stream facility's transcritical system because of the unusual structure of the store/warehouse/commissary and the lack of a comparable DX facility.

Notwithstanding that limitation, Addante anecdotally said he was "amazed" at the efficiency of the CO<sub>2</sub> system and its ability to minimize compressor activity. "I don't think there will be a lot of wear and tear on the equipment because there's not that much run time," he said. For example, in a tour of the warehouse racks in January, only one of the three was running. "That's all we need; everything is satisfied," said Addante. "If this was DX, it would all be going nuts."

In the warehouse coolers, which employees are constantly entering and leaving, temperatures have been maintained by the transcritical system. By contrast, "in my old warehouse, when we had the doors open, you'd see the temperature spike up," he noted. In addition, frozen food cases in the Carol Stream store are able to revert to -10°F after defrosting in one-third the time it takes the cases in DX stores. "I was blown away by that."

He also observed that during the summer the system has not entered into "supercritical mode," when temperature of the CO<sub>2</sub> would exceed 88°F and lower the efficiency of the system. "The pressures have built up but not to the point where it was supercritical," said Addante.

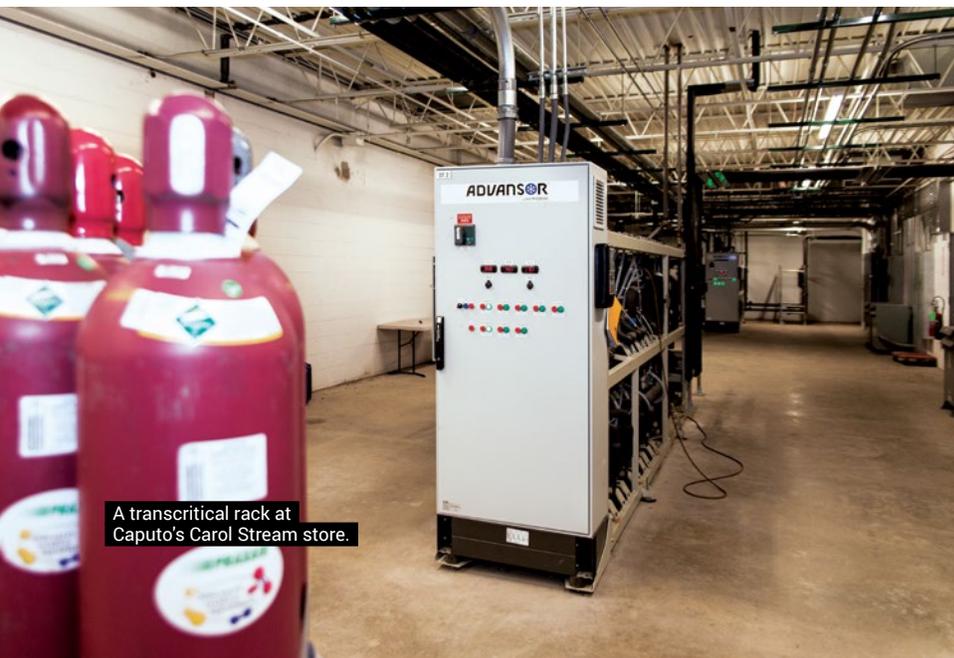
In terms of equipment costs, when Caputo's purchased the Hillphoenix Advansor transcritical system two years ago, it ran about 20% more than traditional DX equipment. But the retailer saved on installation costs by installing the system with its in-house technicians. Indeed, Caputo's prides itself on being a truly independent operator, with not only its own warehouse but also its own in-house technician staff, which has been trained on the CO<sub>2</sub> system.

As for maintenance, Addante said he has had no problem obtaining parts for the transcritical system or high-grade CO<sub>2</sub>, which has a minimum purity of 99.99%, with less than 50 PPM of nitrogen, less than 20 PPM of oxygen and less than 10 PPM of water.

Addante acknowledged that other small retailers, even ones as passionate as he is about the environment, would be reluctant to pay more for a refrigeration system. "But we want to be green, even if it takes a few dollars to do that."

Still, his passion for the CO<sub>2</sub> system is such that he hopes that it catches on throughout the food retail industry, especially among larger operators. "I want big business to say, 'We need this.'"

In the future, when Caputo's opens new stores, they will be equipped with a transcritical system, Addante said. In addition, if the retailer goes forward with a major remodeling of the Naperville store, he will replace the brine system with a transcritical system. "I'm OK with the brine, but it's too corrosive. I wanted to give it a shot but I fell in love with CO<sub>2</sub> and now I'm done" **MG**

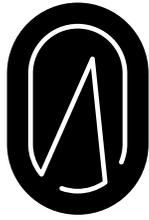


A transcritical rack at Caputo's Carol Stream store.

## System Specs

The transcritical CO<sub>2</sub> system used at Caputo's Carol Stream, Ill., hybrid store/warehouse/commissary has the following characteristics:

- » Four transcritical racks from Hillphoenix, each with three low-temperature compressors and five or six medium-temperature compressors
- » Dorin semi-hermetic reciprocating compressors
- » Total capacity of approximately 4,361.1 KBTUs
- » Approximate CO<sub>2</sub> charge: 7,500 pounds
- » Temperature range: -5°F freezers; 32°F meat cases; 36°F dairy cases; 38°F produce cases.
- » Heat reclaim is used to produce hot water and for under-floor heating of freezer floors.



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# AMMONIA RETURNS TO THE GARDEN STATE

Jerry von Dohlen of Newark Refrigerated Warehouse helped get the refrigeration rules changed in New Jersey so that he and others can convert from R22 to low-charge ammonia systems

– By Michael Garry

In the 1920s, the state of New Jersey passed a law requiring operators of refrigerated warehouses that use ammonia as a refrigerant to have engineers on premises 24 hours a day, seven days a week to ensure the safety of the facility.

Today, that requirement would add about \$900,000 in annual salaries to the payroll of operators opting for ammonia, effectively eliminating it as a viable refrigerant. As a result, the vast majority of cold-storage facilities in New Jersey employ R22, the ozone-depleting refrigerant that is being phased out across the U.S.

But that scenario has changed, thanks to the efforts of Gerard von Dohlen, president of Newark Refrigerated Warehouse, in Newark, N.J., which deals largely with imports and exports at Port Newark-Elizabeth. Two years ago, he and Bruce Badger, then president of the IIAR, met with the New Jersey Department of Environmental Protection and Department of Labor and negotiated an exemption to the old law that allows refrigerated warehouse operators to use ammonia without having engineers on premise 24/7. To gain the exemption, an operator needs to meet three criteria: use 5,200 pounds or less of ammonia; run a refrigeration system that is IIAR-2 compliant; and employ one full-time engineer who is certified by RETA (Refrigerating Engineers & Technicians Association). The exemption, in effect since June 2013, is in the process of being put in writing, said von Dohlen.

The exemption will enable most of the public refrigerated warehouses in New Jersey to convert to a low-charge ammonia system. Moreover, by requiring ammonia charges to be 5,200 pounds or less, it enables operators to avoid having to comply with the most stringent aspects of the federal Process Safety Management (PSM) and Risk Management Plan (RMP) rules.

However, a handful of major food processors with large ammonia refrigeration systems in New Jersey would not be able to easily convert to low-charge ammonia and would therefore not benefit from the rule change.



For those larger facilities a bill was proposed last October in the New Jersey Senate (S2511) that would exempt them from the 24/7 rule as well as from the state's Toxic Catastrophe Prevention Act. The bill is currently under consideration by the Senate Environment and Energy Committee. Von Dohlen does not believe it will be approved. "I have a better chance of playing center for the Knicks than the bill has of getting through the Jersey legislature."

Von Dohlen, who has a bachelor's degree in engineering and a doctorate in accounting, and has taught at Columbia University, purchased his Newark plant (and the company) in 1994 and used ammonia under the original requirements until 15 years ago, when he switched to R22. He plans to revert to ammonia under the exemption within two years, becoming one of the first cold-storage operators to do so.

Over the past few years, he has "spent a lot of money converting over to a system so that we could pull R22 out and put ammonia in," he told *Accelerate America* during an interview at the IIAR Conference & Exhibition in late March. This includes changing from copper to steel piping and to ammonia-compatible valves, gaskets and compressors. "The only thing left to do is replace some gaskets and change the oil."

Von Dohlen is installing an automated control system to monitor the ammonia. "If anything goes wrong, it will notify us and the contractors." In addition, if the sensors in the engine rooms sense ammonia, high-speed fans will be activated to evacuate the gas. The ammonia charge will

range from about 2,000 pounds in one system and 600 pounds in a second (the latter all confined to the engine room).

To support the change in the New Jersey law, Essex College in Newark, the IIAR and RETA have launched an associate program to train young people to become operating engineers in ammonia refrigeration plants. "Part of what the Department of Labor wanted are trained engineers," said von Dohlen. "There is no history of ammonia refrigeration in New Jersey going back to the 20's, so we needed an infrastructure to train people, and we got Essex to agree to have a program."

In addition to training, operators will need equipment suppliers to make ammonia parts available in New Jersey, noted von Dohlen.

Van Dohlen eagerly anticipates phasing out of R22. With R22's phaseout proceeding apace, the price of the refrigerant has skyrocketed. "Two years ago I paid \$24 a pound for R22; it'll be \$40-\$50 a pound by 2016, he said.

He regards ammonia as a much better alternative to R22 than an HFC, given that HFCs are likely on their way out over the next decade. "Europe is eliminating two-thirds of HFCs by 2030, and we expect the U.S. to do the same," he said. "So if you put HFC in, the most it's going to last is 15 years, and then you'll have to convert again."

## Innovative Designs

Von Dohlen's cold storage facility in Newark features two innovative refrigeration systems that set it apart from most others in industrial refrigeration.

The facility consists of two adjoining buildings – the original 210,000-square-foot structure he purchased in 1984, and a second, 25,000-square-foot warehouse added a decade ago that uses a manual crane system. In two years, he will add a third 14,000-square-foot building that will employ automated cranes.

The original, nine-story building has two refrigeration systems, both currently using R22 but converting to ammonia. For 12 freezer rooms (0°F) and four medium temperature rooms (32°F-40°F in two; 50°F-55°F in two), von Dohlen runs a DX refrigeration system that includes Colmac aluminum evaporators controlled by Danfoss motorized control valves. The system uses electric defrost. About 4,000 pounds of R22 are used currently in the system; half as much ammonia will take R22's place. Well water at 57°F is piped in to condense the refrigerant.

For the dock staging area and elevator shaft (34°F) in the original building, von Dohlen operates an entirely different refrigeration system that employs brine and air as secondary coolants.

In the decade-old adjoining building, von Dohlen, who did the basic refrigeration design for both buildings, installed a larger version of the same brine/air secondary system to cool one large freezer room, which holds almost as many pallets as the larger building. The new building coming in two years will have a version of the same system.

Here's how the larger secondary system in the adjoining building works: First, it uses a refrigerant (2,000 pounds of R22, but eventually 600 pounds of ammonia, both confined to the engine room) to cool a 30% calcium chloride brine solution. The brine is cooled in an Alfa Laval plate-and-frame heat exchanger where the liquid refrigerant vaporizes and absorbs heat from the brine.

The brine, in turn, is pumped into a Kathabar conditioner located above the dock, where it cools air coming from the freezer room. That cold air is then blown back into the freezer room to execute cooling.

The freezer room does not have a defrost system. Instead, the moist air in the room has the moisture removed back in the conditioner, where the brine solution, acting as a desiccant, absorbs moisture as well as heat.

"The brine (at -10°F) is sprayed over the fill in the cooling tower (conditioner) and the air (at about +2°F) passes through the fill," explained von Dohlen. "The brine absorbs the heat and the moisture from the air. It chills the air very effectively. It also removes 90%-95% of the dust and kills 95%-98% of the bacteria in the air. So the air coming out is cold (-8°F), dry and very clean."

When the level of brine, fortified with moisture, gets to a certain point, it is pumped to a Kathabar regenerator. "There, we heat the brine up to a much higher temperature with waste heat from reciprocating compressor engines (transferred via a glycol solution) and that forces the [excess liquid] to move out of the solution," he said. "Then we blow that moisture outside."

Occasionally in the summer, when there isn't enough waste heat, von Dohlen uses the boiler to drive off the excess moisture in the brine.

The advantage of this design is that because the system never goes into defrost mode, it "never stops cooling," said von Dohlen. "I don't add any heat back into the freezer room like a defrost does. The heat I'm adding is to the desiccant regenerator."

Von Dohlen believes he can remove moisture from the air more efficiently his way than via defrost, "particularly when I use waste heat to regenerate the brine, because I'm not paying for that."

He says his plant is the only one in the industry that uses brine as both a dehumidifier and cooling agent.

Maintenance for the system is simple, he said. "We don't have a bunch of valves opening and closing. There's no control system; it just runs at 100% all the time"

MG

### System Specs

(All systems currently use R22 but will use ammonia instead within two years.)

#### Original Building/Secondary Brine-Air System

- » For the dock staging area and elevator shaft (34°F)
- » Smaller version of the system in second building

#### Original Building/ DX System

- » 250 TR capacity (includes other secondary brine-air system)
- » Two Vilter reciprocating compressors
- » Colmac Aluminum Evaporators
- » Danfoss motorized control valves
- » 12 freezer rooms (0°F)
- » Four medium temperature rooms (32°F-40°F in two; 50°F-55°F in two)
- » Electric defrost
- » 4,000 pounds of R22; will have 2,000 pounds of ammonia
- » Well water (57°F) used to condense refrigerant

#### Second Building/Secondary Brine-Air System

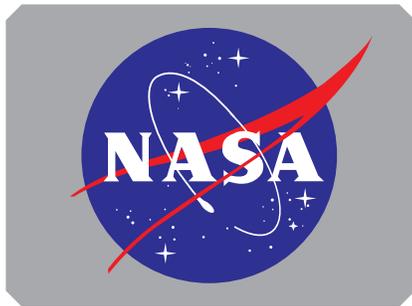
- » 300 TR capacity
- » Two Frick screw compressors
- » 2,000 pounds of R22 (to be replaced with 600 pounds of ammonia)
- » 30% calcium chloride brine solution
- » Alfa Laval plate-and-frame heat exchanger
- » Kathabar conditioner and regenerator
- » One freezer room (0°F)
- » No defrost system
- » Brine desiccant system
- » Glycol used to heat brine in regenerator



## SHORT TAKES

— by James Ranson & Michael Garry

### US Agencies Target HFCs



The Defense Department (DoD), General Services Administration (GSA) and NASA submitted a proposal promoting the adoption of low-GWP alternatives to HFC refrigerants, a move that would require an amendment to the Federal Acquisition Regulation (FAR).

As part of President Barack Obama's 2013 Climate Action Plan, federal agencies were urged to purchase cleaner alternatives to high-GWP HFCs, including natural refrigerants. The amendment to FAR would implement a set of measures to phase down the use of HFCs predominantly in refrigeration and air conditioning applications.

For example, contractors would be required to report to the government their use of HFCs in pounds for equipment and appliances that normally contain 50 or more pounds of HFCs or refrigerant blends containing HFCs **MG JR**

For further information on the proposal visit: <https://www.federalregister.gov>

### Roundy's to Open Two More Transcritical Stores

Milwaukee-based Roundy's Supermarkets, which operates 149 supermarkets under five banners, plans to open two new stores in early 2016 that will use a CO<sub>2</sub> transcritical system from Advansor (Hillphoenix), according to Kevin Christopherson, director of maintenance and purchasing, for Roundy's.



The stores are a Mariano's in Orland Park, Ill. and a Metro Market in Shorewood, Wis. Those will be Roundy's first two transcritical stores since the retailer opened its initial transcritical store, a Pick 'n Save in Menomonee Falls, Wis., in January 2014. (See Roundy's Money-Saving CO<sub>2</sub> System, *Accelerate America*, November 2014.)

The new stores will be larger than the Menomonee Falls outlet, which is 64,351 square feet. The Orland Park store will be 73,125 square feet while the two-story Shorewood supermarket will encompass 90,320 square feet. Each store will have two refrigeration racks.

For low temperatures (-22°F and -14°F), the capacity of the racks in Menomonee Falls is 201,000 BTUs/hour and 203,000

BTUs/hour, respectively. For similar temperatures, the capacity of the racks at the new stores range from 181,000 BTUs/hour (Orland Park) to 94,900 BTUS/hour (Shorewood)

For medium temperatures (+16°F and +18°F), the capacity of the racks in Menomonee Falls is 815,000 BTUs/hour and 697,000 BTUs/hour, respectively. For similar temperatures, the capacity of the racks at the new stores range from 839,200 BTUs/hour (Orland Park) to 750,400 BTUS/hour (Shorewood).

Halfway through its first year of operation in 2014, the Menomonee Falls' transcritical system was determined to be a less costly alternative to Roundy's prototype system (R507/glycol), in operating expenses as well as first cost and installation **MG**

### Minnesota Helps Ice Rink Drop R22



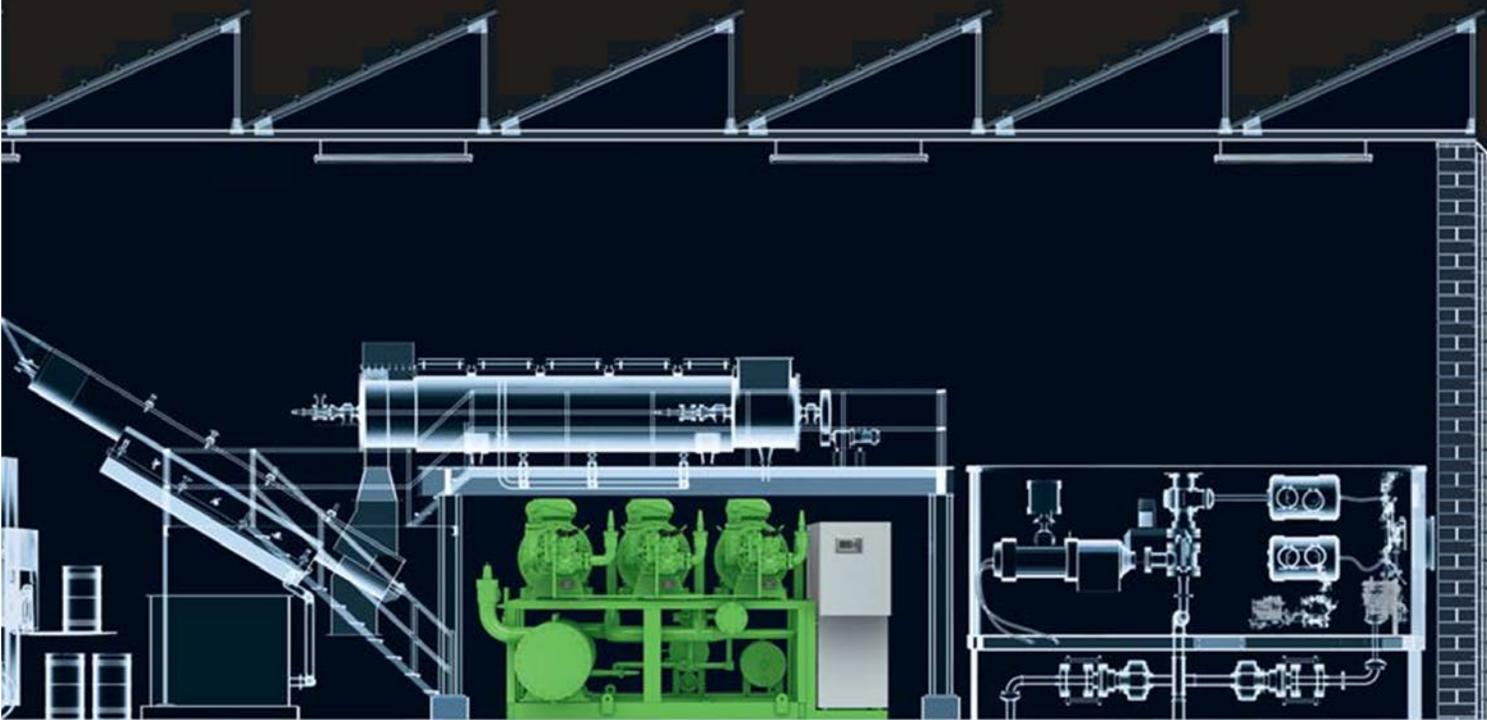
A city-owned ice arena in South St. Paul, Minnesota has undergone \$2.1 million worth of upgrades, including an ammonia refrigeration system that replaces R22 equipment.

The Wakota Arena was officially unveiled on May 7. Its renovations were made possible by a \$10.1 million bond sale approved by voters in a referendum in 2014. The facility follows a line of

upgraded ice arenas in Minnesota, as the state transitions away from ozone-depleting R22 systems, which are typically used in ice arenas.

Input from local communities and stakeholders helped state senators author the Mighty Ducks bill to provide grants through the Minnesota Amateur Sports Commission to the bevy of community-owned ice arenas using R22 that otherwise may not be able to foot the bill.

There are a number of arenas still in need of financial support to convert their systems, with Baudette, Wilmar, Red Wing, East Grand Forks and Cloquet among an estimated 120 ice arenas in Minnesota racing the clock before the 2020 deadline **MG JR**



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# CARB WORKSHOP SETS STAGE FOR HFCs REDUCTION

— by James Ranson

Stakeholders grapple with ways to drastically cut emissions of short-lived climate pollutants like HFCs

California has taken another step towards implementing its strategy to phase down HFCs by 80% in 2050 – which would set a benchmark well above national standards.

Following the publication of the California Air Resources Board's (CARB) concept paper in May, which described the state's phase down goals, the first in a series of public workshops was held in Sacramento on May 27. The meeting gathered a range of stakeholders and experts to explore possible paths to reduce emissions of short-lived climate pollutants (SLCPs), which are often hundreds, in some cases thousands, of times more potent than CO<sub>2</sub> in global warming effect.

The preeminent leader in the implementation of environmental legislation in North America, California has committed to reduce the emissions of fluorinated gases in new refrigeration and air conditioning equipment by 40% compared to 1990 levels in 2030 and 80% in 2050.

In early June, the California Senate passed a bill codifying executive orders to reduce all greenhouse-gas emissions by these amounts and dates.

The concept paper follows the updated Climate Change Scoping Plan published last year, and it is hoped the final strategy

on SLCP reduction will be released in spring 2016 to align with scientifically established levels required in the U.S. to limit global warming below 2°C.

The purpose of the initial workshop was to canvass existing plans and new ideas to significantly reduce emissions of SLCPs, including fluorinated gases (HFCs) as well as methane, tropospheric ozone and black carbon (soot).

Fluorinated gases remain the fastest growing source of greenhouse gas emissions both globally and in California, with refrigeration accounting for 82% of F-gas emissions in California in 2013.

California's landmark AB 32 greenhouse gas law was originally projected to reduce HFC emissions in California by 30% below "business as usual" levels (with 1990 as a baseline) by 2030. However, the figure has been viewed as not ambitious enough for the state, which is insistent on not putting a roof on HFC reductions.

Meanwhile, the proposed de-listing of high-GWP refrigerants in certain sectors under the EPA's Significant New Alternatives

Policy (SNAP) Program would have the effect of reducing HFC emissions by another 10% in California in 2030.

“Reducing the emissions of these short-lived climate gases is an important part of California’s – and the world’s – efforts to keep the planet from exceeding the most

dangerous levels of warming,” said CARB Chairman Mary D. Nichols.

“Taking steps to significantly reduce these greenhouse gases now will deliver climate and air quality benefits in the short-term while we move our energy systems and vehicle fleets to clean technologies.”

## Commercial refrigeration central to strategy

A major target of these reductions is the commercial refrigeration sector, where alternatives to HFCs - specifically CO<sub>2</sub> - are readily available and commercially viable. It is hoped that this sector-specific action will then provide a comprehensive template for application in other sectors.

Other measures already in place include imposing a mitigation fee on sales of high-GWP HFCs, and a cap-and trade offset protocol incentivizing the capture and destruction of ozone depleting substances.

CARB will evaluate all responses at the Sacramento workshop from an environmental and economic point of view in addition to assessing the public health impacts. Comments on the concept paper and strategy development are welcome until June 12, 2015 via CARB’s website: <http://www.arb.ca.gov/homepage.htm>

The draft strategy will be finalized by the fall of 2015 and the final Strategy completed by the spring of 2016.

Various avenues were investigated at the Sacramento workshop, including the potential scope and cost-effectiveness of:

- » Reducing the use of HFCs in new refrigeration and air conditioning equipment by at least 80% by 2050.
- » Removing high-GWP refrigerants from existing equipment and replacing (retrofitting) with low-GWP refrigerants in the same equipment.
- » Offsetting some or all of the higher cost that might be associated with replacing older high-GWP refrigeration equipment

with new, low-GWP refrigeration systems.

- » Installing low-GWP refrigeration systems at new facilities.
- » Linking with energy-efficiency programs in cases where low-GWP refrigerants can reduce energy use. For example, low-GWP refrigerants such as ammonia, carbon dioxide, and hydrocarbons have been shown to reduce energy consumption by between 5% and 35% compared to HFC refrigerants, with a corresponding decrease in electricity use and GHG emissions.
- » Encouraging greater use of recycled refrigerants for air conditioning and refrigeration.
- » Recovering and destroying F-gas refrigerants no longer produced.
- » Reducing leaks from existing equipment and at end-of-life.
- » Targeting early action in commercial refrigeration applications.

As part of California Governor Jerry Brown’s climate change goals set out in his January inaugural address, all the recommended actions in the Climate Change Scoping Plan Update must meet the requirements of Senate Bill 605, which calls for controlling SLCPs by 2016.

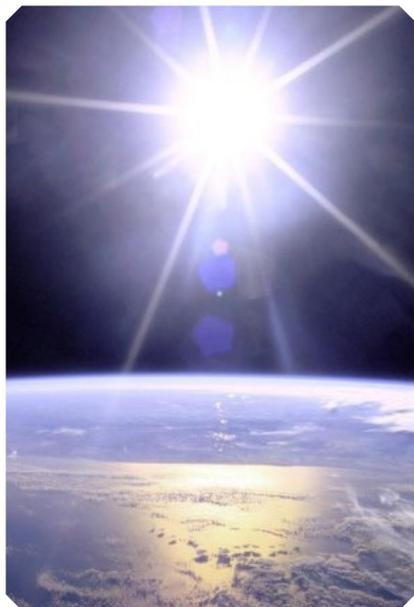
These actions include maintaining an inventory of sources and emissions, identifying existing and new control measures as well as research to address data gaps, coordinating with other state agencies and local air districts, and consulting with academic, industry, and community experts @JR



## California to encourage global action on HFCs

Besides strengthening state-level regulations on HFCs, California will build on its partnerships with other countries and regions to encourage further emissions reductions.

According to CARB’s concept paper, “Building on leadership around SLCPs can provide an important example for action in other countries and jurisdictions, and is one of the most significant opportunities to accelerate international progress to fight climate change. California is in a unique position to serve as a model for action for other countries and jurisdictions to accelerate their progress to reduce emissions of both SLCPs and CO<sub>2</sub>, based on our demonstrated leadership on air quality and climate change, commitments to set stringent, science-based targets to reduce emissions of both CO<sub>2</sub> and SLCPs, and integrated planning efforts like this one to develop comprehensive policy frameworks to achieve those goals.”



# HFCs DISCUSSION HITS SNAG AT MONTREAL PROTOCOL

An April meeting in Bangkok, expected to move toward a phase down of HFCs, ran into opposition from Middle Eastern countries, though African nations emerged as strong supporters of a phase down

– By Robert Davidson and Klara Skacanova

**The** Montreal Protocol, which came into force in 1989 to safeguard the earth's ozone layer, is lauded as the most successful international environmental agreement to date. Its ability to phase down ozone-depleting CFCs and HCFCs inspired hopes among many countries that the agreement could be extended to address the phase down of HFCs, which spare the ozone layer but contribute significantly to global warming.

Thus at last year's Meeting of the Parties (MOP) to the Montreal Protocol in Paris, the countries agreed to host a supplemental Open-Ended Working Group (OEWG) in April in Bangkok – in addition to its annual meeting in July – to discuss HFCs.

There were high expectations ahead of the five-day meeting, which marked the first OEWG of the Montreal Protocol's 30-year history dedicated to discussing HFCs. India, previously one of the strongest opponents of tackling HFCs under the Montreal Protocol, raised hopes with its HFC phase-down amendment proposal that this could be the meeting that moved discussions on HFCs to a formal setting.

Unfortunately, this did not happen. What is more, the suggestions made in the Indian proposal need to be treated with caution as they essentially provide for an increased use of HFCs in developing countries until 2031, when a consumption and production freeze would be set at average levels between 2028 and 2030.

Moreover, the proposal suggested that, following a 15-year grace period, full compensation would be given for any lost profits from the closure of HFC facilities and for conversion costs in developing countries.

In addition, strong opposition to any formal HFC discussions from countries such as Pakistan, Saudi Arabia, Kuwait and several other Gulf States showed there remain serious obstacles ahead. These countries maintain that low global warming potential (GWP) alternatives are not available for very high ambient temperature regions, particularly in the air conditioning sector.

As a result the meeting's only outcome was to continue inter-sessional discussions in an informal manner and to study the feasibility and ways of managing HFCs, with a view to the establishment of a contact group on these subjects at the 36th OEWG Meeting July 20-24, 2015, in Paris.

While the April OEWG meeting was a missed opportunity in terms of moving to formal discussions on an HFC phase down, there were still some positive developments, most notably a declaration calling for formal negotiations on an HFC phase down from 54 African countries, led by Senegal and Zimbabwe.

The United States, Canada and Mexico, as well as the EU and other backers of an HFC phase down, also did their

best to support the transition to formal discussions. Prior to the meeting, the North American countries jointly submitted an amendment – as has been tradition for the last six years – which attempted to alleviate the concerns of developing countries regarding having an HFC phase down concurrent to the on-going HCFC phase out. The North American proposal foresees a slowing down of the HFC reduction steps while also introducing a review clause that would make it possible to change the reduction targets if need be.

Alongside the April Montreal Protocol meeting, shecco hosted an ATMOSphere Network Bangkok event, which suggested that a global HFC phase down is forthcoming, and that natural refrigerant-based technologies are increasingly available in different regions. A Chinese government representative spoke of the country's notable progress in converting room air conditioning (RAC) production lines to R290, which was complemented by an exclusive preview into shecco's findings from the biggest-ever natural refrigerant survey in China.

A delegate from Mexico informed the audience that it too is making good progress, with the country experiencing a small boom in manufacturers of natural refrigerant-based equipment. Updates from UNIDO on projects in The Gambia and Vietnam also demonstrated progress in the introduction of natural refrigerant technology in the fisheries sector **RD+KS**



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**#ATMOEVENTS**

# IARW Schools Cold-Storage Industry on Ammonia and CO<sub>2</sub> Trends

– By Michael Garry

Suppliers of low-charge ammonia and ammonia-CO<sub>2</sub> systems put technology in front of CEOs from public refrigerated warehouses



Following on the heels of the IIAR Conference & Exhibition in San Diego in March, the IARW-WFLO Convention & Expo, held in late April in Orlando, Fla., highlighted many of the trends observed at IIAR, such as low-charge ammonia, ammonia-CO<sub>2</sub>, and refrigeration safety.

But the audience for the IARW Convention was more targeted to public refrigerated warehouses than IIAR, and the attendees were more often high-level executives as opposed to the technical folks who inhabit the IIAR show. “These are the high-level people with overall responsibility for safety and reliability and who make the

[equipment] buying decision,” said Derek Hamilton, business development manager for Azane, a division of Star Refrigeration. Azane was one of several low-charge ammonia suppliers at the IARW show, providing both freezers and chillers.

Low charge ammonia continues to be a hot topic. “People are becoming very aware of low charge,” Hamilton said. “It’s a new niche in the industry and people want to learn more.”

Azane’s low-charge freezer units would be typically used in small- to medium-sized (10,000- to-100,000-square foot) facilities. They would replace central ammonia or systems that use R22 or HFCs

At the IARW show, EVAPCO continued to discuss the low-charge ammonia system it launched at the IIAR show in March. “We’re ready to reply quickly to quoting activity,” said Kurt Liebendorfer, vice president, EVAPCO.

EVAPCO’s Evapcold Packaged Low-Charge Refrigeration System requires 2.5 to 3 pounds of ammonia per ton of refrigeration, “a fraction of the refrigerant charge associated with traditional field-built systems,” the company said in a statement.

Stellar, a designer and builder of refrigerated warehouses, has built its own low-charge ammonia system that includes a condenser, compressor and vessels in one package, said Michael Smith, vice president of operations, who added that

the rooftop system has not yet been installed.

Ryan A & E, a construction firm, hasn't incorporated low-charge ammonia systems in any refrigerated warehouses yet, but Tim Bauer, director of architecture – industrial, expects that to change this year.

"We're interested in the technology," he said. "It's definitely seen very favorably by our customers. It's just a matter of time."

At the IARW Convention, Brian Davis, senior director, global industrial refrigeration for Danfoss, discussed how the company's products are addressing the need for safety in ammonia-based industrial refrigeration, which is also tied to the interest in low-charge ammonia technology.

"We're seeing an overall higher focus on safety," he said, adding that catastrophic accidents in China have driven this trend.

Among the ways Danfoss improves safety:

offering products that are all-welded rather than including flange gaskets subject to leaks; combining up to six valves in a single high-pressure housing, which reduces the ammonia charge; providing automated controllers for small operations that monitor liquid levels and temperatures; and delivering corrosion-resistant and stainless steel products.

**"We're seeing an overall higher focus on safety"**

The consolidated valve stations, noted Davis, encompass only a few ounces of ammonia, making it easier to evacuate and prevent accidents, and use modular components that are easy to replace.

Danfoss's valves are small enough to fit low-charge ammonia systems as well as compressors that are being downsized, Davis added. "With each generation, compressors are getting smaller and smaller."

## CO<sub>2</sub> Gaining Traction

In addition to featuring a number of low-charge ammonia products, the IARW Convention included several exhibitors promoting CO<sub>2</sub>-only and ammonia-CO<sub>2</sub> refrigeration systems. While CO<sub>2</sub> is still relatively new to the refrigerated warehouse operators attending the show, it is slowly gaining traction as an alternative to traditional high-charge ammonia systems.

Hillphoenix's CO<sub>2</sub>-only Advansor transcritical systems, which are beginning to be used in U.S. supermarkets, can accommodate a cold storage warehouse requiring 200 TR, said John Gallaher, vice president of industrial refrigeration for the company. Transcritical CO<sub>2</sub> systems allow industrial end users to "get out of ammonia."

In contrast with transcritical installations at supermarkets, those used by cold storage warehouses are more likely to employ heat recovery, noted Gallaher.

An example of a current transcritical facility is Angelo Caputo's Fresh Foods' combined store/warehouse/commissary near Chicago, which uses multiple Hillphoenix racks. "Over three-quarters of the load is for cold storage," he said. ([See story, p.36](#))

Art Mathews, business development manager, industrial products, for Bitzer observed that at the IARW show there was "a lot of interest in CO<sub>2</sub>, both ammonia-CO<sub>2</sub> and CO<sub>2</sub> transcritical. Everybody wants to reduce ammonia charge or get out of HFCs."

As an example of an ammonia-CO<sub>2</sub> system using Bitzer compressors, he cited a US Cold Storage facility in Lumbarton, N.C., that just finished building an add-on blast freezer. "It has 12 30-horsepower Bitzer CO<sub>2</sub> compressors, each with a variable frequency drive so you can get more capacity and adjust the load."

continued on p.50 →

## Technology Reshaping Industrial Refrigeration

Though industrial refrigeration has traditionally been a conservative industry, that is changing, said Brian Davis, senior director, global industrial refrigeration for Danfoss.

"I'm seeing more technological innovation in the last five years than in the previous 20," he told *Accelerate America* during an interview at the IARW-WFLO Convention & Expo, held in late April in Orlando, Fla.

The factors driving technology innovation include environmental regulation, calls for better safety, industry consolidation and the proliferation of profitable new food trends like organics and Greek yogurts. "We need systems that enable temperature control and support high quality," said Davis.

In addition, the growth of two-income households has been demanding more convenience foods that need to be precooked and distributed through the cold chain. This is creating "tremendous opportunities in the industry," he noted. Moreover, cold-storage technology is helping to feed undernourished and underserved parts of the world. These trends tend to make food processing and distribution a "recession-proof" industry.

The advent of new technologies is helping to attract a new generation of employees to industrial refrigeration. "People used to say, '[industrial refrigeration] smells like ammonia, it's dirty and ugly,'" said Davis. "But now they're saying, 'Hey, refrigeration can be techy and interesting.' They can carry around their tablet or laptop and troubleshoot from afar."

→ Meanwhile, Cimco Refrigeration is marketing Mayekawa's NH<sub>3</sub>/CO<sub>2</sub> NewTon cooling system throughout North America. In one warehouse in California, an end user is comparing the energy efficiency of a NewTon freezer system to that of an HFC system, said Hanks McCrory, Cimco's business development manager, national accounts.

At the IARW Convention, Heatcraft highlighted its ammonia-CO<sub>2</sub> cascade refrigeration rack, which is being deployed at a Piggly Wiggly supermarket opening this fall in Columbus, Ga., about two hours south of Atlanta. It is also designed to serve refrigerated warehousing and food processing applications.

The system places the NH<sub>3</sub> rack on the roof of a building, and a CO<sub>2</sub> rack inside. The low-charge NH<sub>3</sub> (400-500 pounds) is restricted to the roof, and is cooled by glycol that rejects the heat in a separate evaporative cooler. Meanwhile CO<sub>2</sub> is cooled in the NH<sub>3</sub> rack, liquefied and distributed through the building as brine pumped to medium-temperature applications and separately through a DX line to cold-temperature areas.

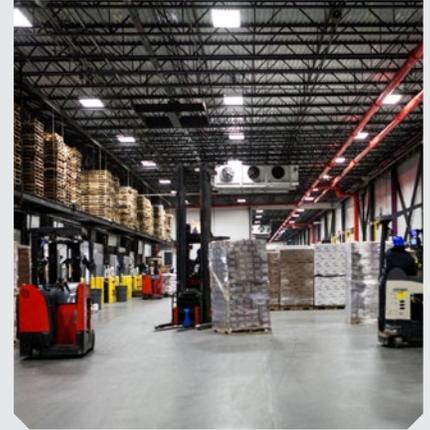
“Everybody wants to reduce ammonia charge or get out of HFCs.”

The Piggly Wiggly system has a capacity of 100 TR, but with an additional rack the system can be scaled to 250 TR, said Ajit Kailasam, cold storage manager, Heatcraft. The store is installing a parallel R407 rack (also using CO<sub>2</sub> as a coolant) so that an “apples to apples” comparison can be made with the NH<sub>3</sub>-CO<sub>2</sub> system, he added.

More than 40 companies worldwide use M&M Refrigerations' ammonia-CO<sub>2</sub> system, noted Charles Toogood, vice president of business development for M&M. Toogood was a pioneer in the implementation of ammonia-CO<sub>2</sub> systems when he worked as vice president of engineering at United States Cold Storage

◉ MG

## US Cold Storage's BIM Warehouse



The latest high-tech building innovation is known as BIM, or Building Information Modeling, used to exchange data and 3D representations among the parties involved in a facility's construction. It helped United States Cold Storage build its latest cold storage warehouse in Covington, Tenn., including the installation of an ammonia-CO<sub>2</sub> refrigeration system.

All of this was described in an educational session at the IARW-WFLO Convention & Expo, held in late April in Orlando, FL.

The 337,000-square-foot, LEED-certified warehouse, constructed last year, adjoins an existing ice cream manufacturing facility. Its NH<sub>3</sub>-CO<sub>2</sub> system – one of 11 that US Cold Storage has deployed across the U.S. -- chills ice cream down to -20°F. US Cold Storage worked with Primus Builders and Republic Refrigeration on planning and construction.

US Cold Storage employed the BIM system “to enhance the team's interaction and decision-making process,” said Matt Hirsch, president of Primus Builders. The team incorporated 10-12 key decision makers, including stakeholders and subcontractors. “It enables us to see problems before starting with construction, which reduces installation time,” he noted.

Republic Refrigeration used the BIM tool to prefabricate much of the piping used in the ammonia-CO<sub>2</sub> system, including condenser and compressor piping, pipe supports and control groups, as well as penthouses. “We were able to eliminate a lot of the clashes with other trades and control quality in the shop rather than the field environment,” said Walter Teeter, CEO for Republic. As a result the installation of the system took less than two months, a month or two faster than under a conventional approach.



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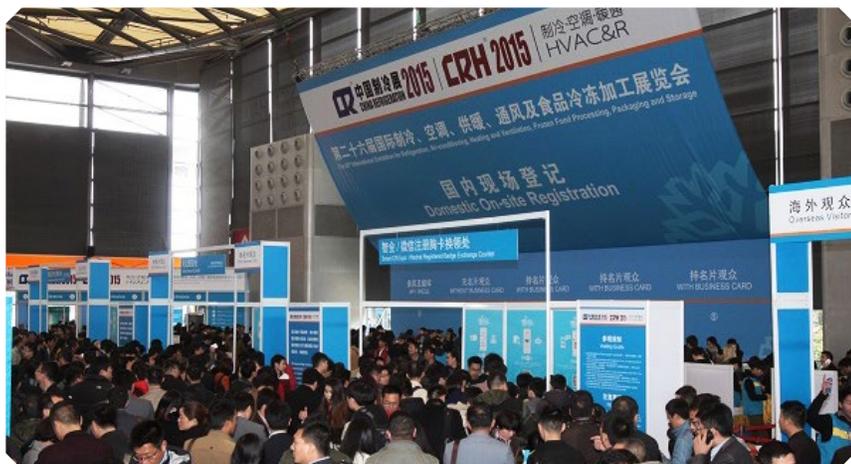


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# CHINA EMBRACES NATURAL REFRIGERANTS

At China Refrigeration 2015, a plethora of HVAC&R technologies using CO<sub>2</sub>, ammonia and hydrocarbons were showcased, with many exhibitors predicting rapid growth for nearly all applications

– By Caixia Mao and Janaina Topley Lira



**I**f China Refrigeration 2015 was any indication, China, which now has the world's largest economy, is on board with natural refrigerants.

The show, held April 8-10 in Shanghai, attracted more than 60,000 visitors and 1,000 exhibitors from across the world. More natural refrigerant solutions were on display than ever before, from both Chinese and international players, demonstrating a strong growth potential for what is still a niche market.

It seems that the country's rapid economic growth is resulting in rampant demand for HVAC&R equipment and that thanks to the country's HCFC Phase Out Management Plans (HPMP), there is a growing appetite for sustainable heating and cooling products.

When it came to industrial refrigeration, China Refrigeration 2015 gathered many international players such as Bitzer, Danfoss, GEA, Parker and Güntner, who

showcased CO<sub>2</sub>/NH<sub>3</sub> technology, alongside local companies such as Yantai Moon, Bingshan Group and Snowman.

Targeting commercial applications, Carrier, CAREL, Castel, Danfoss, Dorin and Panasonic featured CO<sub>2</sub> components and systems for both heat pumps and refrigeration. Chinese system manufacturer General Fushi displayed for the first time a new CO<sub>2</sub>/HFC solution for supermarkets, which is already installed by retailer Metro Group at a store in Shandong province. For residential use, SANDEN and Highly launched CO<sub>2</sub> heat pump water heaters.

A wide variety of hydrocarbon products were also at the show. For light commercial refrigeration, Embraco demonstrated its newly launched ice cream freezer using R600a, while Secop, Huayi and Tecumseh showed off their extensive compressor ranges.

## METRO GROUP'S CO<sub>2</sub> PLANS



China Refrigeration 2015's Ozone2Climate Roundtable offered a chance to learn about Metro Group's plans to shift toward CO<sub>2</sub> solutions in China.

Having opened a CO<sub>2</sub> cascade store in November 2014, the German retail giant plans to debut another CO<sub>2</sub> store and remodel five more using CO<sub>2</sub> hybrid technology in 2015. In 2016, it plans to launch five CO<sub>2</sub> stores and remodel another six with CO<sub>2</sub> systems. In the next two years Metro is also planning its first CO<sub>2</sub> transcritical store in China.

The investment in CO<sub>2</sub> is part of the retailer's move away from F-gases and its plans to reduce greenhouse gas emissions by 20% by 2020. Currently, the retailer has 36 CO<sub>2</sub> refrigerated Cash and Carry's in Europe, representing around 2% of its global store total. Based on assessment of its current HVAC&R installations, it is estimated that 40-70 stores per year will get a new commercial refrigeration system. This means that in addition to its CO<sub>2</sub> outlets in China, Metro will open new CO<sub>2</sub> stores in Russia, Turkey, Italy, Germany, Denmark, the Netherlands and Belgium in 2015. By 2025, 1,478 Metro Cash and Carry HVAC&R units will have been converted.

According to Olaf Schulze, Metro Group's director of facility, energy and resource management, this investment is higher than one billion dollars and is the biggest investment program outside of the company's store expansion program.

The now-standard hydrocarbon solutions for light-commercial refrigeration were matched by hydrocarbon technologies for room air conditioning and industrial refrigeration. Local manufacturer Haier had an R290 air conditioning unit at its booth labeled with the newly launched "Low-GWP Label." Another propane room air conditioning (RAC) unit could be found at the Chunlan booth, while Snowman had on display its R290 screw compressors for industrial uses with cooling capacity of 323.4 kW.

The domestic refrigeration market in China has been moving towards hydrocarbons since the 1990s, advancing to the stage where 100% of newly produced Chinese refrigerators and freezers now use hydrocarbons,

China is traditionally one of the leaders in the absorption chiller market, and in this sector too China Refrigeration 2015 did not disappoint. Shuangliang Eco-Energy showcased over 100 of its projects from around the world that rely on combined cooling, heating and power supply solutions using absorption technology. For example, in China, Shuangliang Eco-Energy's absorption systems have been installed at the Beijing Conference Centre for the Olympics, the China Expo Exhibition Complex –the world's largest exhibition center– and the Shanghai Disneyland Park. Absorption chiller and heat pump technology was also presented by Yantai Ebara, who manufacture steam double effect and hot water/low pressure absorption chillers.

### Government support for natural refrigerants

The Chinese government is widely credited with having played a key role in the country's shift towards natural refrigerants. It is thanks to government support that the use of R290 as an alternative refrigerant in room air conditioners has become a reality. Specifically, the Chinese government offers subsidies to incentivize the implementation of R290 air conditioning systems as part of the country's "Room Air Conditioning Industry HCFC Phase-out Management Action Plan."

China's stated goal is to replace 18 RAC production lines with R290 technology. In total, nine companies are eligible to receive the government subsidy including: Zhuhai Gree, Guangdong Midea, Qingdao Haier, Chongqing Haier, TCL Zhongshan, Guangdong Kelon, Sichuan Changhong, Jiangsu Chunlan, and Yair.

At China Refrigeration 2015's Ozone2Climate Industry Roundtable – organized by UNEP, the Ministry of Environmental Protection and the Chinese Refrigeration and Air-Conditioning Industry Association – an update on the RAC conversion process was given by the Foreign Economic Cooperation Office (FECO) of the Ministry of Environmental Protection.

Beyond the RAC sector, the Chinese government also supports the use of CO<sub>2</sub>/ammonia cascade systems in industrial applications, as well as CO<sub>2</sub> heat pumps – already a mainstream technology in neighboring Japan. In fact, at the Ozone2Climate Roundtable, FECO announced that in 2015 it would be promoting CO<sub>2</sub> as a climate-friendly refrigerant for heat pumps and commercial refrigeration applications.

FECO, in collaboration with GIZ, UNIDO and UNEP, also recently launched a label for environmentally friendly residential refrigeration and HVAC products, and in particular R290 RAC and CO<sub>2</sub> heat pumps. This will complement several other recently introduced labels designed to raise public awareness and encourage investment in more energy-efficient technology in China. These include the "Top Runner" Energy Label, introduced in December 2014 by the National Development and Reform Commission, and the Energy Efficiency Label for Lithium Bromide Absorption Chillers using water as refrigerant.

Other related government initiatives include: the development of new standards for the safe use, installation, maintenance, production and transportation of natural refrigerants; and a newly revised Environmental Protection Law, which will further incentivize enterprises to introduce environmentally friendly technology

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### NOW AVAILABLE: GUIDE TO NATURAL REFRIGERANTS IN CHINA

At ATMosphere Network Shanghai, shecco's Managing Director Marc Chasserot presented an exclusive preview of the first ever "GUIDE to Natural Refrigerants in China – State of the Industry 2015."

Based on a collaboration between shecco and the Chinese Association of Refrigeration (CAR), the newly launched industry report includes results from a countrywide survey that received 1,098 responses to questions on current and future natural refrigerant trends in the Chinese market.

Also featured is market data on CO<sub>2</sub> commercial heat pumps, and commercial and industrial refrigeration installations, as well as hydrocarbon and CO<sub>2</sub> light-commercial applications. Exclusive interviews with leading academics, government agencies, industry leaders and end users provide first-hand accounts on the very latest technology trends in China.

Generally speaking, in the last three years China has experienced a remarkable transformation in its natural refrigerant market. A favorable business and policy climate for both domestic and foreign companies working with natural working fluids has been created, driving greater uptake of CO<sub>2</sub>, ammonia, hydrocarbons and water in HVAC&R.

The "GUIDE to Natural Refrigerants in China – State of the Industry 2015" can be downloaded for free at: <http://publication.shecco.com>

By Janaina Topley Lira  
and Marc Chasserot

# GEARING UP FOR CO<sub>2</sub>

Bitzer U.S., which manufactures compressors for CO<sub>2</sub> transcritical refrigeration systems, expects growth in North America for CO<sub>2</sub> applications in supermarkets, food processing plants and ice rinks



Joe Sanchez,  
Bitzer U.S.



Some of Bitzer's reciprocating piston compressors, suitable for transcritical refrigeration (at right) or subcritical applications (middle and left).

As refrigeration systems that incorporate carbon dioxide continue to gain traction in the U.S., Bitzer U.S. will be ready to supply the compressors needed for those systems.

Bitzer U.S. is the third largest subsidiary of 80-year-old German compressor giant Bitzer, considered a global leader in the production of screw, scroll and semi-hermetic reciprocating compressors. In the U.S. the company has more than 300 employees and three production facilities, including one in Flowery Branch, Ga., which also serves as its U.S. headquarters. There, the company manufactures most of its reciprocating compressor line, from fractional up to 50 HP units, covering all refrigerants.

On the natural refrigerants front, Bitzer U.S. is dedicated to serving the burgeoning ammonia refrigeration market, including low-charge and larger systems, as well as the growing number of CO<sub>2</sub> applications, according to Joe Sanchez, application engineering manager at Bitzer U.S. In the April issue of *Accelerate America*, he described Bitzer's approach to ammonia and in this article delineates its CO<sub>2</sub> strategy.

The assembly of CO<sub>2</sub> compressors was introduced at the Flowery Branch

location in 2008. Expanded in 2013 to 95,000 square feet, the plant has produced well over 1,000 CO<sub>2</sub> transcritical compressors, enabling Bitzer U.S. to meet the growing North American demand for CO<sub>2</sub> components with ease. Since 2014, the Flowery Branch plant has also manufactured more than 50 CO<sub>2</sub> vessels for transcritical booster systems at its ASME-certified Pressure Vessel factory. What is more, the plant has a unique capability for pneumatic (dry) testing as opposed to hydro testing.

The Flowery Branch facility guarantees flexibility of stock, a key concern for Bitzer customers because of the different voltages used in the U.S. market. Whereas in Europe Bitzer can cover almost the entire market using one motor that operates at 230V and 400V, in the U.S. it needs motors that operate at 230V, 460V and 575V.

Since the compressor manufacturing process itself does not differ significantly for CO<sub>2</sub> or fluorinated refrigerants, Bitzer U.S. can take advantage of the overlap of parts. However, with many of the parts made in Germany, a major investment for Bitzer U.S. was having the parts on hand. Another was training. Bitzer's CO<sub>2</sub> Octagon compressor range is not easy to make; the compressors have an eccentric shaft with

one-piece connecting rods. Feeding the crankshaft through the connecting rods is a job that requires skill. To help provide training to its U.S. mechanics, factory engineers from Germany were recruited ahead of the CO<sub>2</sub> compressors' assembly-line startup.

### CO<sub>2</sub> growth in supermarkets

Currently, the vast majority of Bitzer CO<sub>2</sub> compressors in North America are for supermarket racks manufactured by OEM customers like Carnot, Hussmann and Hillphoenix. Although this represents less than 10% of Bitzer U.S.'s business, Sanchez firmly believes that CO<sub>2</sub>, used in low-temperature systems, will be the choice for supermarkets in the future.

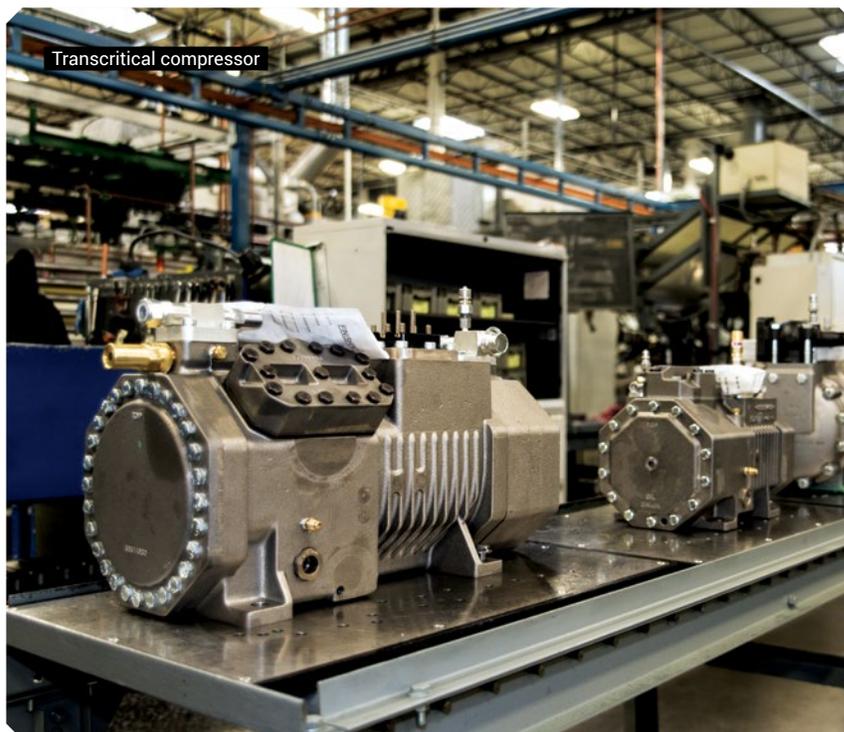
Outside of commercial refrigeration, CO<sub>2</sub> transcritical compressors are also used in ice rink refrigeration, and in the future will be used in U.S. food processing plants where there are heat loads and the potential for heat recovery, he said. Already in Europe, a CO<sub>2</sub> Advansor industrial refrigeration site claims to have achieved better efficiency than ammonia by using ice banks and heat reclaim.

According to Sanchez, the blending of commercial and industrial solutions is a new trend. Industrial engineers are now starting to ask themselves, "What in the commercial world can be adapted to an industrial installation?"

For example, users of CO<sub>2</sub> are finding that the high volumetric capacity of this refrigerant lends itself to smaller compressors and more flexibility.

In a project of this very nature Bitzer U.S. recently started up its first semi-hermetic industrial subcritical CO<sub>2</sub> installation at a cold-storage facility in North Carolina. The plant uses twelve 30-HP semi-hermetic compressors as opposed to two or three large industrial compressors. This installation will enable the facility to reap benefits the commercial world is already familiar with: no shaft seal leakage, high part-load efficiency, and no slide valve, among others.

Part load efficiency is always a challenge because CO<sub>2</sub> gains in capacity more rapidly than any other refrigerant as the



ambient temperature drops. This means that no ramping down of compressors or other unloading will be as efficient as simply shutting off the compressor. "The most efficient compressor is the one you shut off," said Sanchez.

Sanchez's "Industrommercial" CO<sub>2</sub> system presentation at ATMOSphere America 2015, on June 26 in Atlanta, will provide more details on the project.

What about the future? Sanchez lauded technologies such as adiabatic cooling, heat reclaim, ground cooling, and ejectors, which are helping to increase the efficiency of CO<sub>2</sub>, even in warm ambient climates. "I think the U.S.'s contribution to CO<sub>2</sub> transcritical is bringing it further south." Although the humidity of areas such as Atlanta remains a challenge, the opening of the first warm climate CO<sub>2</sub> transcritical store last year at Sprouts Farmers Market in Dunwoody, Ga., has proven the technology is viable even where the ambient temperature climbs above 85°F.

While Sanchez would like to see the market evolve more rapidly, he acknowledges that training takes time. To speed things along, Bitzer provides CO<sub>2</sub> training for classes of 20 people at Flowery Branch [@JTL+MC](#)

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