

# ACCELERATE

ADVANCE

MAGAZINE

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John DeCicco, Jr,  
DeCicco & Sons

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# Small grocer takes Big Step with CO<sub>2</sub>



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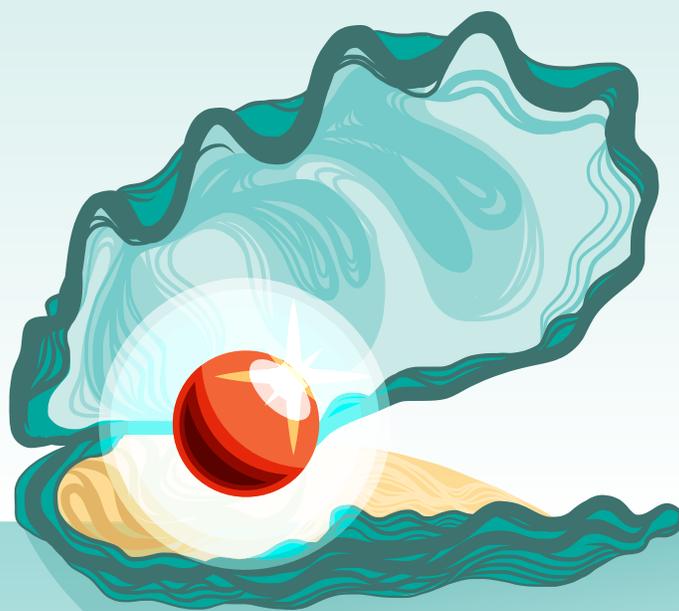
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ENGINEERING  
TOMORROW

*Danfoss*

# SMALL IS BEAUTIFUL

Editor's note by  
Michael Garry



**In** the traditional world of refrigerants, “bigger is better” has been the prevailing motif, but in the natural refrigerants arena, as in many environmental realms, the opposite is true. Small is not only better, it's beautiful, as the British economist E.F. Schumacher put it in his seminal 1973 book.

**This dichotomy is apparent across sectors, with examples throughout this issue. In industrial refrigeration, for example, large-scale ammonia systems (albeit using a natural refrigerant) have been steadily evolving into low-charge packages and modest-charge ammonia/CO<sub>2</sub> systems, as described on [page 36](#).**

In the supermarket industry, where central DX systems may encompass upwards of 5,000 pounds of synthetic refrigerant, we are seeing several changes in the direction of small. A growing number of food retailers have pledged to reduce their refrigerant charge and accompanying leaks by joining the Environmental Protection Agency's GreenChill program; the program recently recognized retailers with the best records for charge and leak reduction at its annual awards ceremony ([see page 16](#)).

GreenChill supermarkets employing all-natural refrigerant equipment – mostly CO<sub>2</sub> transcritical systems so far – have especially small charges and low leak rates. In fact, eight out of the 10 supermarkets that have received GreenChill's

highest level of certification (platinum) use only natural refrigerants.

Now we're seeing interest in an even smaller scale solution for the supermarket and convenience store industries – self-contained or microchannel display cases that each carry their own mini-refrigeration system. (See stories on [page 6](#) and [page 32](#).)

The natural refrigerants most associated with these systems are hydrocarbons (especially propane), which in the U.S. are limited to 150 grams of charge, equivalent to the amount in a BIC lighter. Efforts to raise the charge limit to the European level of up to 1,500 grams – still a safe amount – will not alter the fact that this is an exceptionally low refrigerant charge.

Still another example of smallness is the remarkably small-diameter (3-5 mm) copper tubing available for heat exchangers, which is facilitating the adoption of small-charge hydrocarbon systems. (See story on [page 50](#).)

To complete the small-is-beautiful concept, consider this month's cover story ([page 24](#)) on DeCicco & Sons, a six-store grocer based in suburban Westchester County, N.Y., just north of New York City. Despite its modest size, DeCicco's, led by its president John DeCicco, Jr., is installing a transcritical CO<sub>2</sub> system in its soon-to-open store in Larchmont, N.Y.

Most of the U.S. food retailers that have installed transcritical CO<sub>2</sub> refrigeration systems have been medium-to-large chains. DeCicco's is one of only a few independent grocery operators taking this step.

But being a small operator hasn't stopped DeCicco from pursuing his vision of a more environmentally friendly store. In some ways, it's helped him. And that's a beautiful thing @MG

NORTH AMERICAN EDITION ISSUE #9, OCTOBER 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>



### Small is beautiful

Editor's note by Michael Garry



John DeCicco, Jr.

## DECICCO'S BOLD MOVE



### Hydrocarbons: a developing option for supermarkets



### Events planner

The events in November 2015, December 2015 and January 2016



### Short takes



### The GreenChill effect

Naturals make waves at FMI E+SD conference



# ISSUE # 9

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Hydrocarbons: the refrigerant of the future for supermarkets?

Seizing the NH<sub>3</sub> /CO<sub>2</sub> opportunity



EPA on the move



Teaming up with the DOE



Heat exchanger software advances natural refrigerant applications

Private sector meets again with White House to discuss HFC reduction



Sanden set to expand CO<sub>2</sub> compressor market

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# HYDROCARBONS: A DEVELOPING OPTION FOR SUPERMARKETS

Given their efficiency and negligible environmental impact, hydrocarbons have significant potential as a refrigerant in self-contained and microdistributed grocery cases

By Jim Armer

The Food Marketing Institute's Energy and Store Development Conference, held last month in San Diego, continues to offer valuable networking and educational opportunities for supermarket professionals. Following this conference, I enjoy sharing thoughts on the themes the industry is discussing. Sharing the technical fundamentals, lessons learned, and data about refrigeration applications with the industry can trim years off development, advancement, and adoption of standards for the entire industry.

One of the FMI presentations I found most beneficial was one of the general sessions called "A Provocative Look at the Future of Refrigeration and Store Design." One of the presenters, Paul Anderson of Target, shared his experience with propane (R290) as a refrigerant and its performance in self-contained applications. (See story, [page 32](#).) This sharing of real data and forward thinking about the future of refrigeration is something many appreciate. It is intriguing to consider what continued development and scalability of hydrocarbons could look like in supermarkets.

Hydrocarbons, especially propane, are getting some much-needed attention and consideration. A number of articles and webinars have reported on the many favorable characteristics of hydrocarbons, such as their efficiency, near-zero global warming potential (GWP), growing use in Europe, and acceptance by the Environmental Protection Agency's SNAP program for several applications. Versatile display-case solutions continue to be developed, demonstrating creative design techniques to reject heat from these systems.

Propane solutions have been generally deployed as self-contained or as microdistributed systems. In the self-contained configuration, the heat rejection from the systems interacts directly with the sales floor environment – a potentially

unwanted scenario. Alternatively, a water-cooled microdistributed solution (also called self-contained cases) has been designed whereby the heat rejection is directed to a water loop and then rejected outdoors. The latter configuration was discussed in 2015 in the GreenChill webinar "Supermarket Experiences with Micro-Distributed System Architecture" (<http://bit.ly/1jRKJ2i>). A potential drawback of this solution is the need for a chiller to lower the water-loop temperature.

## Charge obstacle

A common obstacle for scaling these solutions and further advancing development is refrigerant charge compliance. Currently, the EPA allows 150 grams of propane to be utilized in a system. This inherently produces a barrier to the kinds of display cases and configurations of walk-in coolers and freezers that can be utilized. In order to adhere to the charge limits, many display cases are fitted with doors, but this directly impacts the availability of bulk-produce display cases with misting systems.

Let's assume that the propane charge limits will one day be increased. There would be new safety requirements for larger propane charges, but many of the barriers to adoption that currently exist would be diminished. The quantity of required compressors would decrease, display-case options could increase, and opportunities to accommodate walk-in box loads should improve. Additionally, opportunities to use the refrigerant in an upper-cascade system could open up. Given propane's acceptance, efficiency, and negligible environmental impact, there would be growing interest in finding ways to further integrate and develop this refrigerant, especially for use in warmer climates.

Propane is clearly not the only solution; there is room for other natural refrigerants in supermarket applications. For countries like the

United States, where there are several distinct climate zones and many different store formats, having a variety of solutions available is of great value.

What does this mean for the supermarket industry? It gives retailers and service providers more options to consider when thinking about selecting a refrigerant solution. The playing field of acceptable synthetic refrigerants continues to narrow, and the long-term viability of the HFOs and blends that are entering the marketplace is not something that can be easily predicted. This provides greater opportunities for utilizing natural solutions. But if anyone is expecting a silver bullet refrigerant solution soon, you may be in for a long wait! @ JA



*Jim Armer is an associate principal and director of energy services with CTA Architects Engineers. His team's focus is on the development, advancement and integration of technologies that capture energy efficiency and sustainable system design. He is recognized as a leader in refrigeration system design and has been involved with multiple industry-shaping technology innovation projects.*

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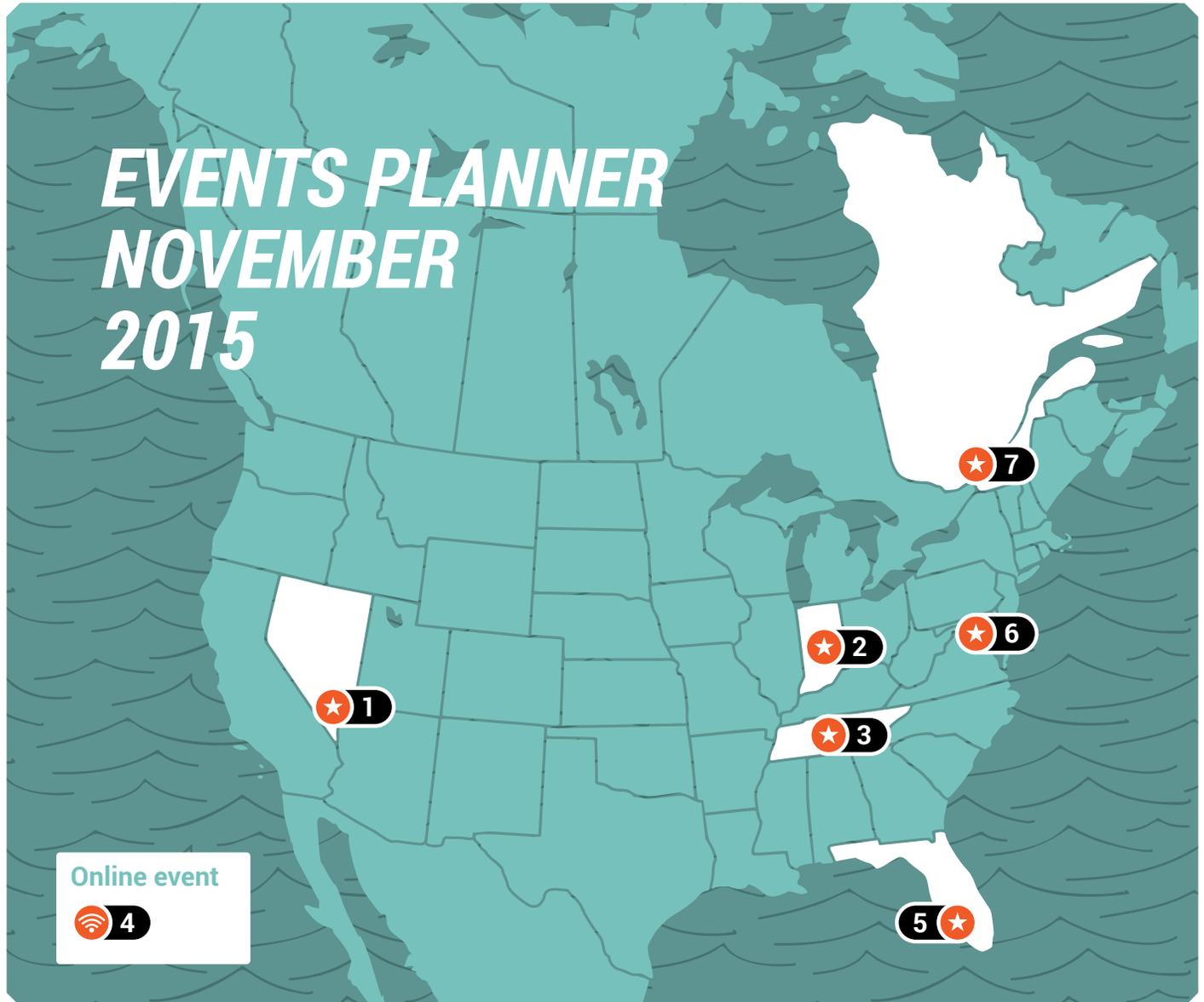
Besides of having **no impacts on the environment**, natural refrigerants such as R600a and R290 have an important role on the reduction of the equipment's **energy consumption**, which means that it solves both direct and indirect emissions at once.

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Know more about natural refrigerants at:  
[www.naturalrefrigerants.info](http://www.naturalrefrigerants.info)

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# EVENTS PLANNER NOVEMBER 2015



- 1** November 5-7, Las Vegas, NV  
**35th IACSC Conference & Expo**  
<http://www.gcca.org/35th-iacsc-conference-expo>  
**twitter** : #IACSC2015 / @iacsc
- 2** November 8-10, Indianapolis, IN  
**IES Annual Conference**  
<http://www.ies.org/ac/>  
**twitter** : @IllumEngSoc
- 3** November 9-10, Nashville, TN  
**RCI Building Envelope Technology Symposium**  
<http://www.rci-online.org/symposium.html>
- 4** November 10, online, 2pm EST  
**GreenChill Webinar: Case Study of Ammonia/CO<sub>2</sub> Cascade System at Texas Air Force Base Commissary**  
[https://epa.connectsolutions.com/commissary\\_cascade/](https://epa.connectsolutions.com/commissary_cascade/)  
**twitter** : @EPAGreenchill

- 5** November 15-17, Bonita Springs, FL  
**AHRI 2015 Annual Meeting**  
<http://www.ahrinet.org/site/915/News-Events/Meetings-and-Events/AHRI-2015-Annual-Meeting>  
**twitter** : #AHRIannual / @AHRI\_connect
- 6** November 18-20, Washington, DC  
**Greenbuild International Conference and Expo 2015**  
<http://www.greenbuildexpo.com/>  
**twitter** : #Greenbuild / @Greenbuild
- 7** November 21, Montreal, Canada  
**CCAC: Advancing Ozone & Climate Protection Technologies: Food Cold Chain Workshop**  
<http://www.unep.org/ccac/Events/AdvancingOzoneClimateProtectionTechnologies/tabid/1060438/Default.aspx>

# EVENTS PLANNER DECEMBER 2015

## Online event



1

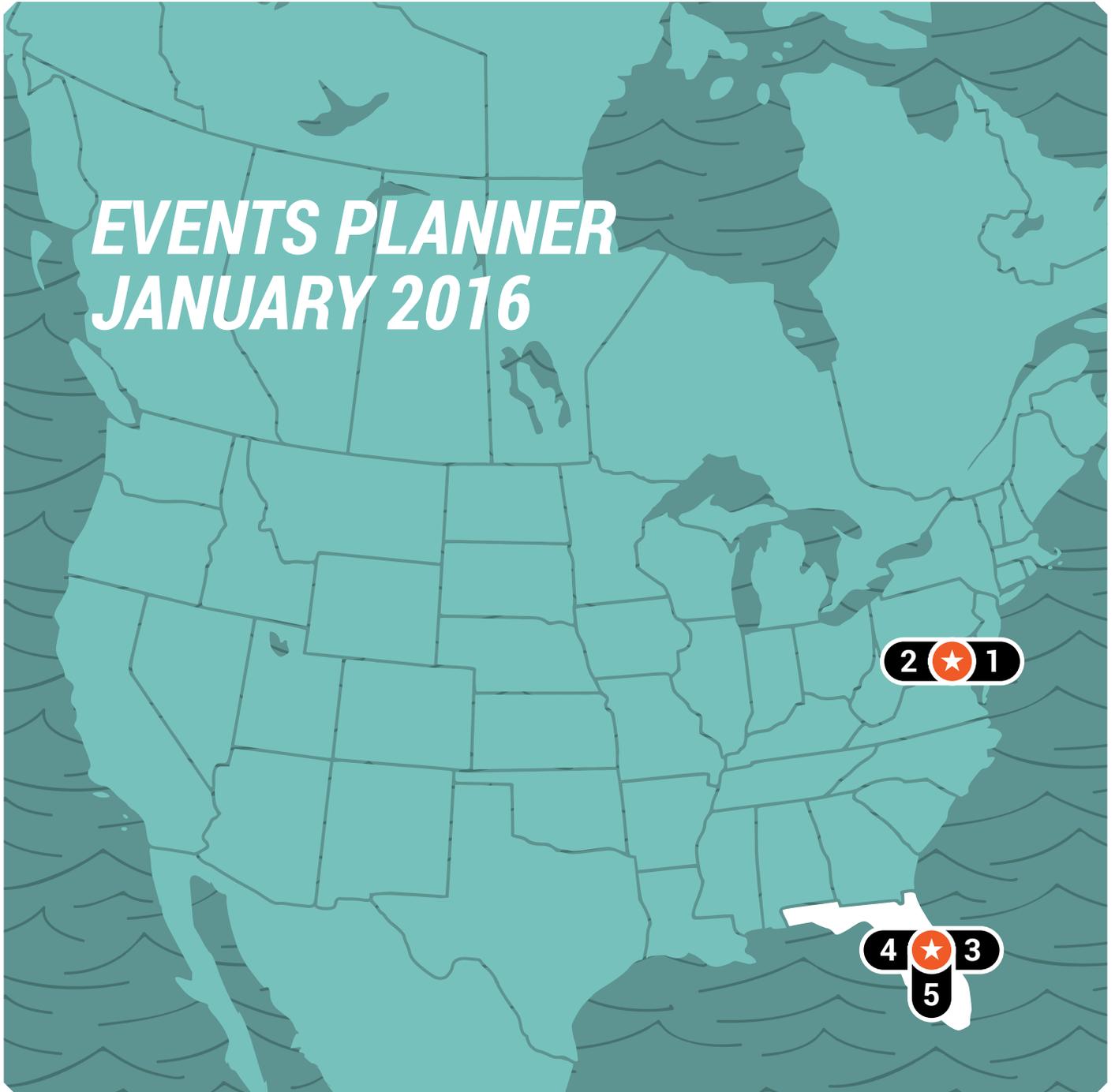
December 1, online, 2pm EST  
GreenChill Webinar: Achieving Cost Savings through Refrigerant and Asset Lifecycle Management: Case Study with Stater Bros.  
<https://epa.connectsolutions.com/lifecycletools/>  
twitter: @EPAGreenchill

2

December 1-3, Galveston, TX  
Clean Air Through Energy Efficiency Conference (CATEE)  
<http://catee.tamu.edu/home>

3

December 5-8, Orlando, FL  
HARDI Annual Conference  
<http://www.forward15.com>  
twitter: @HARDInews



1

January 11-15, Washington, DC  
**Building Innovation 2016**  
<http://www.nibs.org/?page=conference2016>

2

January 20-22, Washington, DC  
**SAE 2016 Government/ Industry Meeting**  
<http://www.sae.org/events/gim/>  
twitter: #SAEComVEC / @SAEIntl

3

January 23-27, Orlando, FL  
**2016 ASHRAE Winter Conference**  
<https://www.ashrae.org/membership-conferences/conferences/2016-ashrae-winter-conference>  
twitter: @ashraenews

4

January 24-27, Orlando, FL  
**IAQA 19th Annual Meeting**  
<http://www.iaqa.org/iaqa2016>  
twitter: @IAQAssociation

5

January 25-27, Orlando, FL  
**AHR Expo 2016**  
<http://www.ahrexpo.com/>  
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# Short Takes

— By Elke Milner

## CARB RELEASES SLCP DRAFT STRATEGY



Glenn Gallagher, CARB

The California Air Resources Board (CARB) published on September 30 a draft strategy to reduce emissions of short-lived climate pollutants (SLCP), including HFCs, in the state.

The draft strategy puts forward a set of measures that would cut fluorinated gas emissions from refrigeration and air conditioning systems in California by 40% before 2030.

The proposed measures include: banning the sale or distribution of high-GWP refrigerants in applications where alternatives are available; offering incentives for using low-GWP refrigerants in new and retrofit applications; phasing down HFC supplies; and developing maximum allowable GWP levels. Refrigerants that are reclaimed or recycled would be exempted.

The strategy may be affected by the November Montreal Protocol meeting where a global HFC phase-down will be debated.

CARB, which is reviewing comments from stakeholders, is required to come up with a comprehensive SLCP reduction strategy by Jan. 1, 2016. [EM](#)

## PIGGY WIGGLY NH<sub>3</sub>/CO<sub>2</sub> STORE GETS GREENCHILL PLATINUM

A new Piggly Wiggly supermarket in Columbus, Ga., which operates an NH<sub>3</sub>/CO<sub>2</sub> cascade refrigeration system, has received platinum certification from the Environmental Protection Agency's GreenChill program, just the 10<sup>th</sup> supermarket in the U.S. to achieve platinum status and the second in Georgia.

The 35,763-square-foot store, which opened Sept. 9, is one of 20 owned by JTM Corp, Phenix City, Ala. JTM acquired the cascade system from Kysor/Warren, a subsidiary of Heatcraft Worldwide Refrigeration.

The cascade system limits the ammonia charge to only 53 pounds (¾ of a pound per TR), all of which is confined to the roof of the supermarket. The small charge eliminates the need for an on-site engineer to monitor the system. In addition, the system provides Piggly Wiggly with energy savings compared to a traditional HFC system.

Platinum-level stores achieve extremely low charge and emission rates or use refrigerants with a GWP under 150. In meeting the latter criterion, the Piggly Wiggly store will have an annual global warming impact of only a fraction of 1% of that of a traditional HFC store.

[EM](#)



## CARRIER TRANSICOLD TO USE CO<sub>2</sub> IN ROAD TRANSPORT

In light of the U.S. Environmental Protection Agency's move in July placing restrictions on a number of HFCs for some commercial and non-transport applications, Carrier Transicold has set its sights on commercializing CO<sub>2</sub> refrigeration systems for transport applications.

Carrier Transicold has experience employing CO<sub>2</sub> in stationary commercial refrigeration and marine container refrigeration. The company successfully petitioned the EPA to approve CO<sub>2</sub> for transport refrigeration. Currently, R404A is widely used in North American truck and trailer refrigeration units,

In Europe, some refrigerated transport providers have begun providing R452A, a blend including a hydrofluoroolefin (HFO), which has a GWP (2,140) about 45% lower than that of R404A. In the U.S. however, R452A is not approved under the EPA's SNAP program.

"Carrier Transicold's greater goal for transport refrigeration significantly surpasses the benefits of R452A," said David Appel, president, Carrier Transicold & Refrigeration Systems. "The natural refrigerant CO<sub>2</sub> is cost-effective, readily available worldwide and has a GWP of only 1." [EM](#)

Shaping Refrigeration Systems for Tomorrow

# NewTon

## Client Testimonial - Yokohama Reito Co., Ltd. (Japan)

### 38% Power consumption reduced by installing NewTon



In the newly built Yumeshima Logistics Center, (2) NewTonR-3000 for the cold storage, (1) NewTon C for the dock area and (1) Brine application NewTon B for the platform on the main floor are installed.

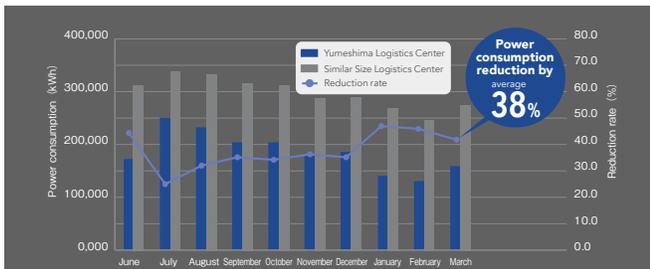
### Deciding Factor

Energy Savings and Safety, in comparison to the DIRECT Ammonia system

### Advantages

- **Power consumption reduction** ; 38% reduced compared with similar size facilities
- **CO<sub>2</sub> Emission Reduction**
- **Easy to install, Self-contained** reduces the installation time and cost
- **Improved Safety** ; Semi-hermetic screw compressor and Low ammonia charge reduces the risk of an ammonia leak. Also, the ammonia refrigerant charged is contained to the machine room reducing exposure to employee and product. Complete automation, as well as 24 hour remote monitoring, offers a very safe operation.

#### Energy consumption comparison between Yumeshima and the similar sized facilities (June 2014 to March 2015)



Power calculated from BEMS (Building Energy Management System)  
The Power consumption includes the office area, lighting, and the freight equipment in the entire facility.

### Power consumption reduction by 38%, compared with similar size facilities

Approximately 20% in power usage reduction has been proven is at Yumeshima logistics center over a year period, compared with the similar size facilities.

"The direct expansion R-22 system our company have been using does not require fan power for the evaporator and is a very efficient system. It is such a surprise to see NewTon exceed it in efficiency.

"Upon seeing these results from our first facility with NewTon, we have planned to install NewTon in other facilities as well. To start, Five NewTonR-3000 will be installed at a facility of our child company Thai Yokorei Co.,Ltd Bangkok Distribution Centre Phase II in Thailand."



Yokohama Reito Co.,Ltd.  
Deputy General Manager  
Cold Storage Headquarters  
Mr. YUKIO SASAKI

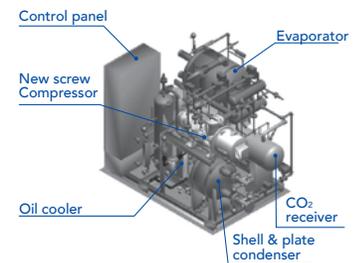
### Proven Energy Efficiency

#### New Profile



In order to improve the drive efficiency the system employs IPM motor, achieving higher efficiency by 5 to 10% than conventional induction type.

#### NewTon Structure



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# Short Takes

– By Michael Garry & Elke Milner

## CAREL WATERLOOP SYSTEM GOOD WITH NATURALS

Supporting growing interest in microchannel commercial refrigeration systems as an alternative to central systems, Carel is promoting its Heos System DC compressor waterloop system.

Factory-tested to improve ease of installation, flexibility and energy efficiency, the system is suited for use with natural refrigerants propane and carbon dioxide. In grocery and convenience store applications, it eliminates the need for a compressor rack, and accommodates a wider and flexible sales area.

Carel engineer Tommaso Ferrarese, explaining the system at the ATMOsphere America conference, held in Atlanta in June, described it as “a new frontier for natural refrigerants.” He outlined a test in which the system, using free cooling, operated more efficiently with propane than R410A in several U.S. cities.

The system consists of plug-in units with DC inverter compressors and an on-board water condenser connected with a water loop system for condenser heat management. The heat of condensation is carried outside the store via the water loop, which is in turn cooled by an outdoor dry cooler. The system offers 25% energy savings thanks to high-efficiency DC compressors. [@EM](#)



Tommaso Ferrarese, Carel

## NONPROFIT FORMED TO HELP GROCERS ADOPT NATURALS

A group of companies from different sectors of the supermarket refrigeration industry in late September announced the formation of the Santa Cruz-Calif.-based North American Sustainable Refrigeration Council (NASRC).

The nonprofit group’s mission is to help the supermarket industry transition to environmentally friendly natural refrigerants (such as carbon dioxide, hydrocarbons and ammonia) from traditional synthetic refrigerants that deplete the ozone layer and/or contribute significantly to global warming.

NASRC’s founding members include a food retailer (Whole Foods Market), service contractor (Source Refrigeration & HVAC), system manufacturers (Hillphoenix, Carter Retail Equipment and True Manufacturing), component manufacturers (Danfoss and Parker Hannifin) and a refrigerant consultant (KW Refrigerant Management Strategy). Its executive director is Liz Whiteley, formerly an environmental scientist with the Environmental Protection Agency.

“The purpose of the organization is to bring together stakeholders who believe that advancing natural refrigerants is a win-win for the environment and business,” said Whiteley, in a statement. “Today, we finally have proven technologies that use natural refrigerants, but we need to achieve economies of scale in order to have a dramatic impact on our climate footprint.”

NASRC’s first-year priorities will center on training service technicians to work with natural refrigerants; helping to establish local building codes; encouraging utilities to establish incentives for natural refrigerant use; and working with the EPA and equipment-certification organizations to speed up approval of alternative refrigerant technologies.

Some food retailers, such as Whole Foods Market, are piloting natural refrigerant solutions. “We have the technology. We know what needs to be done,” said Tristram Coffin,

sustainable facilities coordinator at Whole Foods Market. “It’s a question of overcoming hurdles so we can move ahead as fast as we’d like.” [@MG](#)



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## THE GREENCHILL EFFECT

The EPA GreenChill program's Achievement Award winners show the impact the partnership has had on reducing environmentally harmful refrigerant emissions

– By Elke Milner

From left:  
Mark Rotner, Sprouts Farmers Market;  
Tom Land, EPA

**A**s U.S. supermarkets make the transition from R22 and HFCs to environmentally friendly natural refrigerants, many are trying to at least stem the amount of refrigerant emissions leaking out of their large refrigeration systems and drifting up into the atmosphere.

The Environmental Protection Agency has become an unlikely ally in that endeavor through its GreenChill Advanced Refrigeration Partnership, launched in late 2007.

In fact, the program has been so helpful to food retailers that the term “GreenChill Effect” has emerged to describe its impact on the reduction of refrigerant emissions, which deplete the ozone layer and/or contribute significantly to global warming.

Examples of the GreenChill Effect: Of the 23 food retailers that have been in the partnership for more than one year, 19 have reduced their emissions rate since joining, 13 have reduced their emissions rate by more than 10%, two have reduced their emissions rate by more than 40%, and four have lowered their emissions rate in three or more consecutive years.

GreenChill's retail partners account for 29% of all

food retail stores in the U.S., so their cumulative emission reductions have been substantial. The newest members include Kroger, Aldi, City Market, Onion River Co-op and Port Townsend Food Co-op. “We hope to get up to one-third if not 50% of all stores this year,” said Tom Land, GreenChill's manager, at the Food Marketing Institute's Energy & Store Development (E+SD) Conference in late September.

The average U.S. supermarket has an annual refrigerant emissions rate of 25%, whereas the average emissions rate of a GreenChill partner is 12.5%, or half the national average. If every supermarket in the U.S. achieved GreenChill partners' emission rate, “we'd be reducing annual refrigerant emissions by 29 million metric tons of CO<sub>2</sub> equivalent and 196 ODP tons, and it would save, across the country, \$169 million in annual refrigerant replacement costs,” said Land.

While voluntary, the GreenChill program works by having retailer members (known as partners) commit to achieving leak reduction goals and document their progress. Those who meet or exceed their targets are given annual awards publicly recognizing their achievements. The program also recognizes individual stores that attain extremely low emission rates and refrigerant charge with silver, gold and platinum

certification awards. The number of certified stores has grown from 25 in 2009 to more than 130 this year.

### ACHIEVEMENT AWARD WINNERS

The annual FMI E+SD Conference is the venue where the EPA presents its GreenChill Achievement Awards at an early-morning breakfast. On September 29, Land presented this year's awards in the following categories: Superior Goal Achievement, Exceptional Goal Achievement, Most Improved Emissions Rate, Best Emissions Rate, Best of the Best, Store Certification Excellence, Store Re-Certification Excellence, and Distinguished Partner.

- » The Superior Goal Achievement award is given to GreenChill retail partners that achieve a corporate-wide goal to reduce refrigerant emissions below the rate achieved the previous year. Hannaford Supermarkets, Harris Teeter, Hy-Vee and King Kullen received this award.
- » GreenChill partners have the option to set a “stretch” goal to reduce their emissions even further. Hy-Vee and King Kullen received the Exceptional Goal Achievement award for meeting these enhanced goals.

» Two Most Improved Emissions Rate awards are presented. One goes to the retailer with the greatest improvement over the previous year, which was Harris Teeter. The other is given to the company with the best improvement over the baseline rate it had upon entering the program, which was Brookshire Grocery Company.

» Two retailers are also recognized for Best Emissions Rate among all GreenChill retail members – a small/independent partner, and a retail chain. (The rate covers emissions from all sources of refrigeration, including central systems, stand-alone cases and HVAC.) Port Townsend (Washington) Food Co-op received the former award and Stater Bros. Markets the latter.

» GreenChill presents a Best of the Best award to the GreenChill-certified store that stands out from other certified stores by demonstrating an innovative aspect of an advanced refrigeration technology. This year the award went to Sprouts Farmers Market for its Dunwoody, Ga., store, the southern-most CO<sub>2</sub> transcritical store in the United States.

**“ We hope to get up to one-third if not 50% of all stores [in GreenChill] this year.”**

Sprouts was recognized for “putting a CO<sub>2</sub> transcritical system in a warmer climate and proving that it actually can operate there,” said Land.

» GreenChill awarded two Store Certification Excellence honors: to the supermarket company with the most GreenChill store certifications and to the systems manufacturer with the most store certifications, each in the past year. Sprouts received the former award

for having 42 store certifications, compared to 27 the previous year, while Hillphoenix got the latter recognition for having its refrigeration systems in 101 certified stores, compared to 67 the previous year.

“We are committed not only to the research and development of sustainable technologies – but also to making our customers aware of the competitive and environmental advantages of investing in sustainable systems,” said Scott Martin, director of sustainable technologies for Hillphoenix, in a statement. “Alongside organizations like GreenChill, we will continue to provide the much needed education and training necessary to help our industry move toward more widespread use of natural refrigeration systems.”

» GreenChill’s Store Re-Certification Excellence award goes to stores that have achieved GreenChill certification for five consecutive years. (Emission rates and charge levels required for certification have to be established on an annual basis.) Six stores received this award: Sprouts in Thousand Oaks, Calif.; Wegmans in Lanham, Md.; Whole Foods in Santa Rosa, Calif.; and Stater Bros. in Carlsbad, Cathedral City and Morena Valley, Calif.

» GreenChill presented its Distinguished Partner award to Food Lion and Nick Cordasci, refrigerant compliance specialist with Food Lion, for “extraordinary leadership and initiative to further the GreenChill mission in the past year.” Commented Land: “Food Lion is a founding partner that has reduced emissions for four consecutive years. Nick has been very instrumental in keeping Food Lion involved in GreenChill. He has actively participated in roundtable discussions and webinars, provided good information in refrigerant management plans and promoted GreenChill across the industry.” @EM



From left:  
Scott Martin, Hillphoenix;  
Tom Land, EPA

## NATURAL STORES ARE THE BEST OF THE BEST

The EPA’s GreenChill program helps food retailers reduce their refrigerant leak rates and refrigerant charge in part by certifying stores (silver, gold or platinum) that achieve very low levels in each category. Moreover, the program awards an annual Best of the Best award to the most outstanding certified store, which invariably demonstrates an innovative aspect of an advanced refrigeration technology.

So it’s probably no surprise that the Best of the Best awards for the past four years have gone to stores using only natural refrigerants.

This year’s award went to the Sprouts Farmers Market store in Dunwoody, Ga., which is the southern-most CO<sub>2</sub> transcritical store in the United States. The store is demonstrating that transcritical systems can operate effectively in warm climates.

In 2014, the award was given to the Whole Foods Market store in Brooklyn, N.Y., which uses a transcritical refrigeration system and has eliminated HFCs in every other cooling system in the store. (See “Whole Foods’ Journey to Natural Refrigerants,” *Accelerate America*, December 2014-January 2015.)

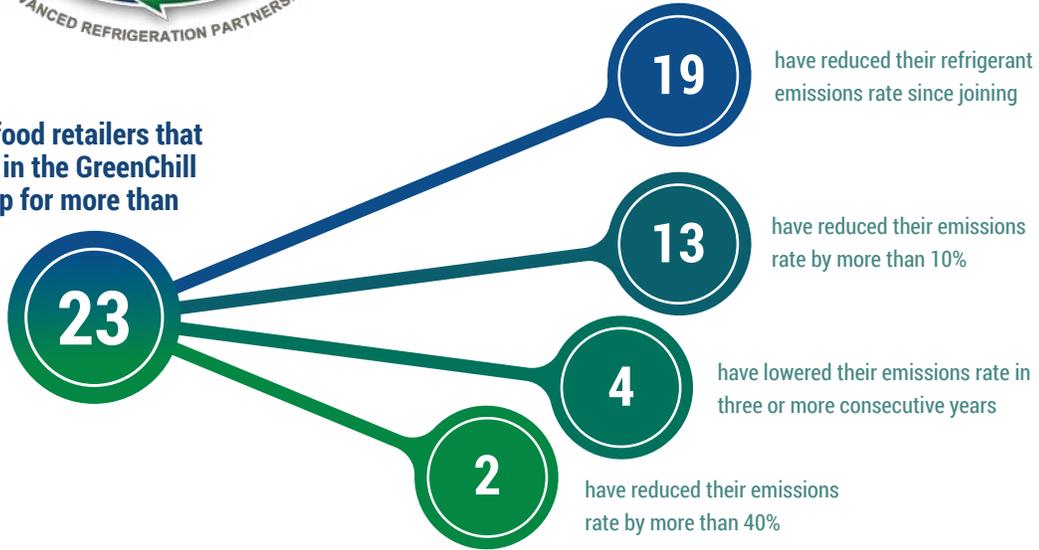
Hannaford Supermarkets’ Turner, Maine, store, which in July 2013 became the first U.S. supermarket to install a CO<sub>2</sub> transcritical system, received the award in 2013. (See “Food Retail Panel Discussion: Learning from Experience,” *Accelerate America*, July/August 2015.)

In 2012, the award went to Supervalu for its Albertsons store in Carpinteria, Calif., that in 2012 became the first supermarket to install an ammonia/CO<sub>2</sub> refrigeration system; this was also the first all-natural-refrigerant system in a grocery store. (The store is now owned by Albertsons LLC.)



# THE GREENCHILL EFFECT

Of the 23 food retailers that have been in the GreenChill partnership for more than one year:



The average U.S. supermarket has an annual refrigerant emissions rate of 25%, whereas the average emissions rate of a GreenChill partner is 12.5%, or half the national average.



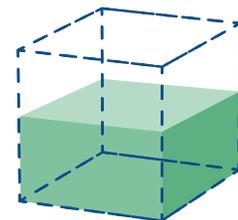
If every supermarket in the U.S. achieved GreenChill partners' emission rate of 12.5%, there would be:



savings of \$169 million in annual refrigerant replacement costs



an annual reduction of 196 ODP tons.



an annual reduction of 29 million metric tons of CO<sub>2</sub> equivalent.



# Purity

## THE NATURAL ALTERNATIVE

Hussmann is proud to partner with LMP to bring industry leading transcritical CO<sub>2</sub> systems to the North American market.

### Industry Leading CO<sub>2</sub> Refrigeration Technology for Food Store Applications

The Purity offering is a multiple compressor system that uses R744 (CO<sub>2</sub>) exclusively. Purity operates efficiently in low, medium and high temperature applications and can be used in combination with all three. The Purity system is optimized for an operating range of 15 to 225 tons, and it is highly adaptable for use in most climatic conditions.

#### Benefits for Food Retailers

- A completely natural refrigerant solution
- Minimal green house gas emissions
- Superior energy efficiency
- Precise compressor suction superheat control for long term reliability
- Minimal operating costs
- Innovative compressor lubrication management system for reliability and performance
- Remote management of system parameters
- Adaptable for efficient operation in southern climates
- Customized, plus variety of options to meet the needs of each customer

#### Hussmann Offers You the Right Refrigeration System for Your Business

There is not one refrigeration system solution that will meet the needs of all food retailers. That is why Hussmann offers multiple refrigeration solutions with a variety of options and products from 100% HFC free to hybrid systems that provide you with the perfect green alternative.

**Contact your Hussmann rep today to discuss the right solution for your business.**

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Danfoss valve for transcritical systems



Mueller tubes and fittings for transcritical systems



## NATURALS MAKE WAVES AT FMI E+SD CONFERENCE

Vendors discuss SNAP hydrocarbon proposal, and new CO<sub>2</sub> and ammonia systems for supermarkets – By Michael Garry

At the Food Marketing Institute's 2015 Energy & Store Development (E+SD) Conference, held Sept. 27-30 in San Diego, a large room at the Sheraton Hotel was on two occasions filled up with equipment suppliers and retailers at what was dubbed the Manufacturer-Retailer Exchange. The room buzzed with activity, thanks to a record conference attendance of more than 600.

When shecco America, publisher of *Accelerate America*, was not chatting with passers-by at its own table, we had an opportunity to visit other tables to find out what suppliers were saying about the adoption of their natural-refrigerant solutions at supermarkets in North America. Here's a sampling of what they said.

### CARTER'S UPCOMING SNAP PROPOSAL

While the majority of frozen and refrigerated cases in North American supermarkets are tethered to refrigeration racks situated in a machine room, there is growing interest in self-contained cases that employ their own hydrocarbon-based refrigeration unit.

Birmingham, U.K.-based Carter Retail Equipment, which was represented at the FMI E+SD Conference, hopes to bring its popular self-contained hydrocarbon cases to North America. Carter's hydrocarbon cases, which use propene (R1270), are widely employed by the Waitrose supermarket chain in the U.K.; Tesco is testing the system at one store in Thailand while Cole's has a test in Australia. R1270 offers a 16% better capacity than R404A, said Geoff Amos, Carter's head of sales and marketing.

Waitrose's cases contain between 300 and 1,000 grams of propene, well above the 150-gram limit in the U.S. (Waitrose uses an R290-chilled water loop to remove 80% of the heat from the cases.) However, Carter plans to submit a draft proposal for an increase in the hydrocarbon charge limit to the EPA SNAP (Significant New Alternatives Policy) program later this year, Amos said. The EN (European norm) 378 standard allows up to 1,000 grams of hydrocarbons in equipment below ground and up to 1,500 above ground.

Carter's SNAP application will "follow the rationale" of the international standard and reflect "all the safety and compliance we've done working with A3 refrigerants," said Amos. Carter will simultaneously petition for UL approval.

Amos pointed to a three-year study done at the Tesco store in Thailand showing the advantages of the hydrocarbon self-contained cases over an HFC DX system. The self-contained cases experienced a 60% reduction in maintenance costs, a 90% reduction in refrigeration charge and an 8% reduction in energy consumption.

Some U.S. food retailers are already testing self-contained cases using 150 grams or less of hydrocarbon refrigerant, including H.E. Butt Grocery Co., Lowe's Markets, ShopRite (Wakefern Corp.) and Whole Foods Market. Whole Foods and ShopRite are piloting cases from AHT Cooling Systems USA, which had a table at the FMI E+SD Conference. AHT's parent company is based in Austria.

A representative of AHT said that the company is gaining traction in the U.S. with highly efficient modular islands and spot cases using the hydrocarbon propane (R290). Because of their

small propane charge, the modular islands are virtually maintenance free, while offering flexibility in store layout. Next year, AHT will introduce multi-deck and vertical merchandisers with propane refrigeration to the U.S. market.

U.S. retailers are "pushing us toward propane," said the AHT rep. Small format stores in urban markets are especially open to the installation of these self-contained cases.

### HUSSMANN/LMP INSTALL FIRST CO<sub>2</sub> TRANSCRITICAL SYSTEM

Hussmann, in its alliance with Systemes LMP, has installed a Purity transcritical CO<sub>2</sub> system at an Aldi store in West Seneca, N.Y., near Buffalo, Chris Culhane, technical sales specialist – systems specialist for Hussmann told *Accelerate America* at the FMI E+SD Conference.

This is the first Hussmann/LMP transcritical system that Hussmann/LMP has installed in the U.S. The store opened Oct. 1. The Purity system accommodates loads ranging from 15 to 225 tons, according to Hussmann.

"Aldi is one of our biggest customers for our Protocol distributed systems, which reduces the amount of refrigerant and better matches loads," said Culhane.

Because of its northern climate, the West Seneca store's transcritical system does not incorporate LMP's patented mechanical subcooling system, which enables transcritical units to operate efficiently in warmer climates, noted Xavier Marle, director of operations for Systemes LMP.

continued on p.22 →

# 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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→ Aldi is also installing a transcritical system from Hillphoenix in another store in New York. The store will also have self-contained cases using propane as a refrigerant.

It is unusual for a retailer to retrofit an existing store with a transcritical system. But two months ago Systemes LMP finished retrofitting a Sobeys IGA store in St. Therese, Quebec, near Montreal, with a transcritical system using mechanical subcooling. Systemes LMP also retrofit another IGA Sobeys store in Sherbrooke, Quebec with a transcritical system but without subcooling. In both cases there was “no loss of sales” during the retrofit process, said Marle.

In the St. Therese store, the retailer replaced the evaporators in the cases and “we repiped the cases to the new rack,” said Marle. “Every night we worked on more and more cases until it was done.” The three existing R22 racks were decommissioned, taken apart and removed.

### NEW CO<sub>2</sub> COMPONENTS SHOWCASED

Also at the FMI E+SD Conference, the Sporlan Division of Parker Hannifin showcased its new range of Parker Sporlan valves and controllers rated 140 bar for transcritical CO<sub>2</sub> high-pressure systems.

The line features five gas cooler valves (GC-10, -20, -30, -40, and -50) for system capacities from 7 to 200 Tons (25 to 700 kW). These valves offer the flexibility to be applied in flash gas bypass applications as well.

The gas cooler/flash gas bypass valves allow for fine pressure tuning in transcritical operation. They can also be applied in heat reclaim applications to modulate the flow to reclaim coils.

Danfoss has a new control valve for transcritical CO<sub>2</sub> systems that can be used as a high-pressure or gas bypass valve. The valve, which comes equipped with a pressure transmitter, is designed specifically for commercial transcritical applications in food retail, said Hans Matthiesen, Danfoss’s global segment director – food retail. Previous valves were suited for both industrial and commercial systems.

The new valve has connections for Wieland’s K65 high-pressure copper/iron tubing as well as stainless steel tubing. “Many are switching to the K65,” said Matthiesen. The valve also has an integrated filter that permits easy servicing. In addition, the “moving parts” of the valve can be removed and replaced within 30 seconds, he said.

The new Danfoss valve will be UL-approved and installed in field trials in the U.S. and Europe.

By the 2016 AHR Expo in January, Mueller Industries expects to have UL approval for its Streamline XHP copper-iron alloy tubes and fittings designed for CO<sub>2</sub> transcritical systems, said Christopher Mueller, vice president and general manager – joining systems, Mueller Streamline Co., a division of Mueller Industries. The XHP products are rated to 120 BAR/1,740 PSI. “It will be easier for contractors if the products are UL-approved.”

Carel spoke about its Heos waterloop system, which removes condensing heat from plug-in units in self-contained refrigeration systems, including those that use CO<sub>2</sub> and propane. These self-contained systems can be easily moved around the store and are very leak-tight, noted Mike Tokarsky, Carel USA’s Midwest regional sales manager.

CO<sub>2</sub> versions of Howe Corp.’s icemaker machine, which produces ice flakes in supermarkets, are installed at a Boston Roche Bros. store and a Brooklyn, N.Y., Whole Foods outlet. The latter is linked to a transcritical system while the former is driven by a secondary liquid-overfeed refrigeration system, noted Andrew Ortman, vice president, sales & marketing, for Howe.

Howe’s machines, which produce between one thousand and four thousand pounds of ice per 24 hours, employs subcooling to maintain temperatures at 22°F. This enables the ice to last longer, said Ortman.

### GOOD START FOR NH<sub>3</sub>/CO<sub>2</sub> SYSTEM AT PIGGLY WIGGLY

A new Piggly Wiggly store in Columbus, Ga., which opened Sept. 9, has been experiencing a “smooth operation” with its ammonia/CO<sub>2</sub> cascade refrigeration system, one of the first installed in the U.S., according to Dustan Atkinson, formerly sales manager, supermarket systems with Heatcraft Worldwide Refrigeration, parent company of Kysor/Warren, the maker of the system.

“We’re getting positive reports that the retailer’s happy with it,” Atkinson said at the Kysor/Warren table during the FMI E+SD Conference. (He has since joined Hillphoenix.) “There have been some intricacies on the control side that we’ve worked through; nothing particularly concerning. I’ve been very impressed with it.”

The Columbus Piggly Wiggly, which is located near Heatcraft’s corporate facility in the same city, has already received platinum-certification from the EPA’s GreenChill program ([See page 12.](#))

Kysor/Warren reduced the amount of ammonia refrigerant to three-quarters of a pound per ton of refrigeration, or 53 pounds, all of which is confined to an enclosure on the roof of the supermarket. A glycol loop on the roof removes heat to a cooling tower, while CO<sub>2</sub> is sent down to the store for cooling purposes.

Minimizing the ammonia charge eliminates the need for on-site engineers and other requirements typically associated with ammonia applications. “Our plume studies show no fallout from a catastrophic leak,” said Atkinson. “With that small of a charge, you avoid regulatory and safety concerns.”

The NH<sub>3</sub>/CO<sub>2</sub> system can provide significant energy savings vs. both traditional HFC systems and CO<sub>2</sub> transcritical systems in many climates, according to Kysor/Warren. In addition, the system recovers heat for the hot water system. The store features several other energy-saving features, including skylights and LED lighting throughout the store as well as doors on all beverage, preserved meat and dairy refrigerated cases.

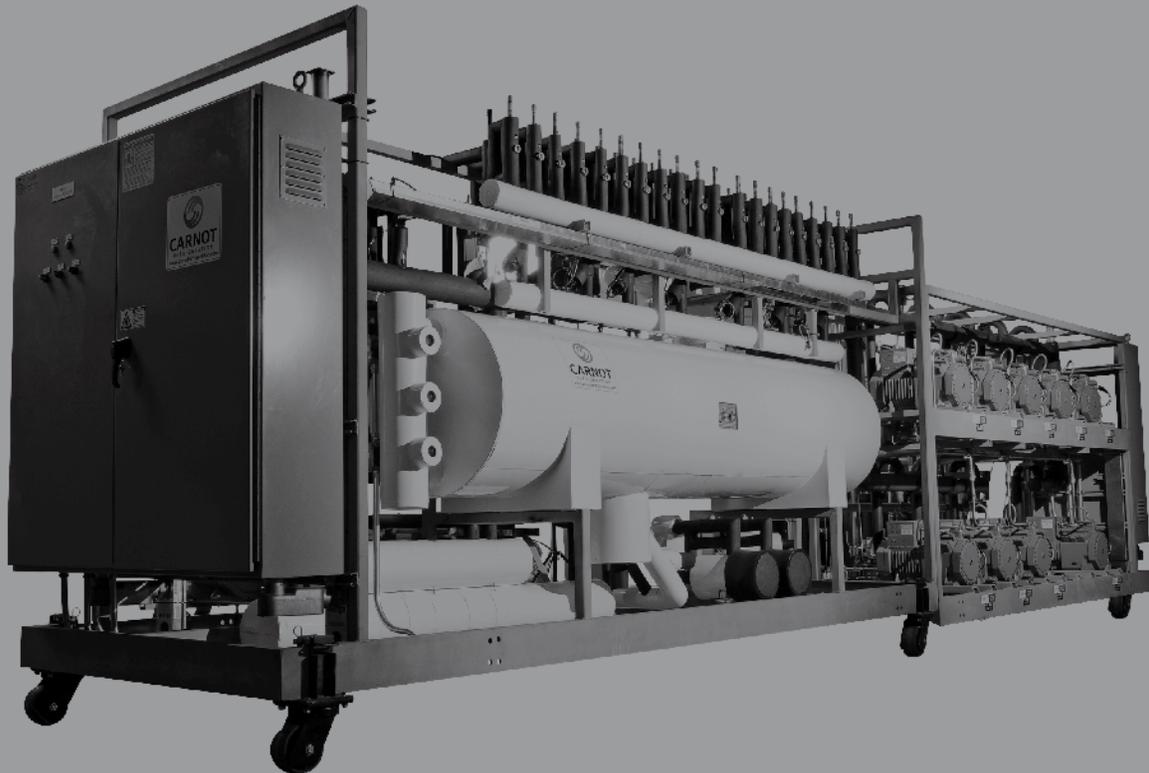
Kysor/Warren is also developing transcritical CO<sub>2</sub> systems at two labs for supermarket applications. “We believe a portfolio of solutions is the right approach,” said Atkinson. “We’ll end up seeing a spread between the designs.”

However, in high ambient regions such as Georgia, “ammonia/CO<sub>2</sub> will be the best solution for a lot of people,” he said. “We can design a transcritical solution and give you compelling performance. But it’s hard to reach the efficiency levels you see with ammonia even with the most innovative transcritical.”

Whichever systems are used, an understanding of their design and operation will remain a key necessity, said Atkinson. “We have to make sure as manufacturers that we have educational programs to overcome concerns about the systems. That’s what’s going to make or break natural refrigerants in my opinion.”

At the Columbus store, Kysor/Warren had “hands-on training” with the third-party technicians responsible for the NH<sub>3</sub>/CO<sub>2</sub> system, he noted. “The reality is, the systems are not as different or as scary as people think.” **MG**

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John DeCicco, Jr.

# DECICCO'S BOLD MOVE

The six-store grocery operator becomes one of the few independents to implement a CO<sub>2</sub> transcritical refrigeration at its new environmentally friendly store

— By Michael Garry —

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## → Out of the mouths of babes

John DeCicco, Jr., president of DeCicco & Sons, a six-store grocery store operation based in Pelham, N.Y., has been hearing about the need to protect the environment from his two young children, a girl, age 5, and a boy, age 3.

"They learn about it in school and bring it to my attention," he told *Accelerate America* during a recent interview at his still-under-construction store in Larchmont, N.Y., an upscale village in Westchester County, just north of New York City. "They're very concerned about it. So we're talking about it at home now and reading books about the earth and being green."

Wanting to preserve the environment for his children helped drive DeCicco's decision to make the 18,000-square-foot Larchmont supermarket (25,000 square feet including basement), a showcase for environmental technology. In addition to such features as solar panels, LED lighting and a high-tech kitchen ventilation system, the store, opening later this year, will use a transcritical CO<sub>2</sub> refrigeration system. DeCicco is applying for not just LEED certification for the store but also EPA GreenChill platinum-level certification.

The choice of an all-CO<sub>2</sub> transcritical refrigeration system – an Advansor booster system from Hillphoenix – makes DeCicco & Sons one of only a handful of small independent grocers in North America willing to invest in this technology. By far, the majority of stores with transcritical equipment are operated by chains, including Sobey's, Hannaford Bros., Whole Foods Market, Roundy's, Ahold USA, Delhaize America, Kroger and other industry leaders. But a few independents, such as Angelo Caputo's Fresh Markets near Chicago (See "In Love with CO<sub>2</sub>," *Accelerate America*, June 2015), Mustard Seed, Solon, Ohio, and now DeCicco's, have taken the plunge with transcritical refrigeration.

"I feel like it's a big undertaking, what we're doing," DeCicco acknowledged. "It's not normal for a small operator to be doing this."



John DeCicco, Jr., with his father

But, added DeCicco, 37, who has an MBA from Fordham University, he has been preparing for this challenge his entire life. "I've been working in the supermarket business since I was three years old. I've learned every aspect – financial, merchandising and marketing. And I have a passion for the engineering aspect as well. Now is the right time for me to put all my talents to use in doing this and making an example of this store."

Caring about the next generation makes perfect sense for DeCicco's, a tight-knit, family-owned and operated business started by DeCicco's Italian-born father, John Sr., and his father's two brothers, Joe and Frank, in 1974. Their stores have the feel of a traditional Italian market with a cornucopia of prepared foods, cheeses and craft beers. (See story [page 30](#).)

Two years ago Frank DeCicco amicably branched out to operate his own five-store grocery business, DeCicco Family Markets. DeCicco, with his brother Chris (vice president of marketing) and cousin Joe, Jr. (vice president of merchandising and accounting) runs DeCicco & Son's six stores (including Larchmont), with help also from his dad and uncle Joe. DeCicco's wife, a Ph.D. in electrical engineering, chips in technical advice.

Among his duties, DeCicco handles refrigeration and construction, and personally made the choice of the transcritical system for the Larchmont store. "I can't tell you how many

case studies I've read about CO<sub>2</sub>," he said. He was assisted by his refrigeration contractor, AAA Refrigeration Service, Bronx, N.Y., and system supplier, Hillphoenix, Conyers, Ga. "I was consulting with Dan [Steffen, vice president, AAA Refrigeration Service] from the beginning, when I first started considering [transcritical] back in December of last year."

In choosing Larchmont as the location for the transcritical store, DeCicco selected a community known for its receptivity to environmental initiatives. "People here really appreciate it and understand it," he said. "This is one of the few towns in Westchester County [N.Y.] with a plastic bag ban and they are big solar users." He plans to promote the energy efficiency of the store, citing the CO<sub>2</sub> refrigeration system as one example. (See story [page 29](#).)

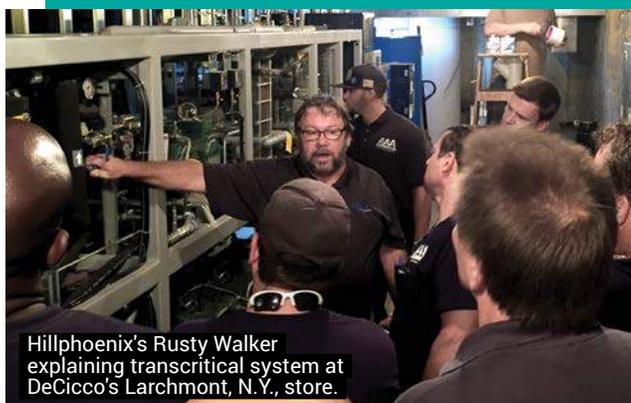
DeCicco actually considered selecting a transcritical system for a store in Armonk, N.Y., that opened in 2012, which would have made DeCicco's the first supermarket in the U.S. to install transcritical technology (a distinction gained by Hannaford Supermarkets in 2013). But he wasn't ready back then, nor did he think the technology was sufficiently tested.

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Cheese section at DeCicco's Armonk, N.Y., store

## CRASH COURSE ON CO<sub>2</sub>



Hillphoenix's Rusty Walker explaining transcritical system at DeCicco's Larchmont, N.Y., store.

including a trip to the store to study its transcritical system. The Larchmont store is slated to open later this year, with eight AAA technicians having contact with it.

"This is our first transcritical system," said Dan Steffen, vice president of AAA, which is based in the Bronx, N.Y. The contractor had previously been trained on -- and is working with -- cascade and secondary CO<sub>2</sub> equipment.

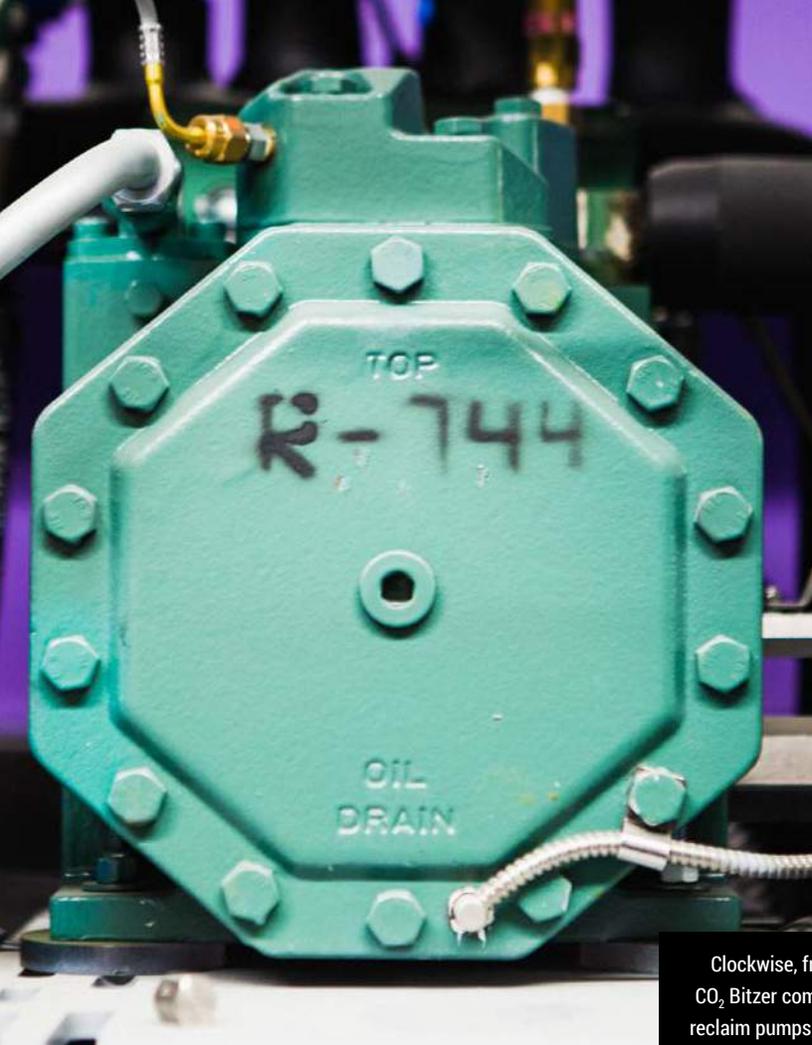
John DeCicco, Jr., president of DeCicco & Sons, expressed pride at having prompted the training of 25 technicians on transcritical technology, including many who will not service his store. "They are all learning about it, and will be capable of servicing it," he said. "It's bringing a whole new light to this area."

AAA prides itself on being "proactive on education," said Steffen. It is one of the few contractors to host an annual all-day symposium (in April) on refrigeration advances, including CO<sub>2</sub> systems. Vendors like Hillphoenix, Emerson Climate Technologies, and Carrier make presentations at the symposium, which is attended by 80-90 of AAA's customers as well as other end users. "Our best customer is an educated consumer," said Steffen, paraphrasing the old Sym's clothing store slogan. "By educating our customers, we enable them to make better decisions."

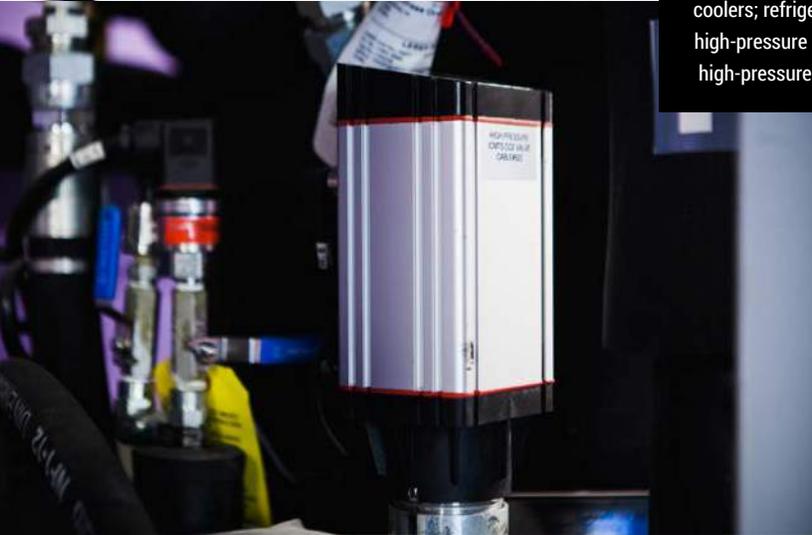
One of the major bugaboos surrounding CO<sub>2</sub> transcritical refrigeration is the shortage of technicians adequately trained to handle installation and servicing of the technology.

To ensure that 25 of its technicians assigned to the lower Westchester County, N.Y. area were well versed in CO<sub>2</sub> technology -- and able to handle transcritical systems like the one at DeCicco & Sons' new store in Larchmont, N.Y. -- contractor AAA Refrigeration Service organized a one-day training session in Westchester last August,

AAA collaborated with Hillphoenix's corporate trainer Rusty Walker on the crash-course transcritical training session, which included a four-hour class at a partnering company's Westchester facility on what's required for startup and operation of a transcritical system, followed by a two-hour visit to the Larchmont store to study the transcritical rack and related equipment. A Hillphoenix representative will be present when AAA starts up the system later this year.



Clockwise, from top left:  
CO<sub>2</sub> Bitzer compressor; heat  
reclaim pumps; adiabatic gas  
coolers; refrigeration scales;  
high-pressure safety switch;  
high-pressure control valve



## GREEN GALORE

→ He also considered going with partial-CO<sub>2</sub> systems like secondary or cascade, but ultimately decided he wanted to use just CO<sub>2</sub> and not any other refrigerant. “There’s more energy consumption with the others,” he said.

DeCicco’s other supermarkets use R404A, except for its oldest store in Pelham, N.Y., which is still on R22. Rather than retrofit it with an HFC, DeCicco is contemplating a conversion to transcritical, though that is something Hillphoenix has yet to do.

To determine whether a conversion would be a viable option, DeCicco will be testing a conventional case in the basement of the Larchmont store, linking it to the transcritical rack and installing CO<sub>2</sub> case controllers and electronic valves in the case. “In theory it should work,” he said. “I’m pretty sure the [evaporator] coils will hold the pressure.” If it does, he could simply retrofit his R22 racks at the Pelham store and replace the current rack with a transcritical version.

Since the stores with R404A use relatively new racks, it may not be feasible to convert them to transcritical in the near future, though he could replace the R404A with a lower-GWP refrigerant.

## Evaluating efficiency

DeCicco will be submetering the energy consumption of the transcritical system at the Larchmont store and comparing it to that of his HFC DX system in Armonk, N.Y., which is about the same size. He is studying how Hannaford Supermarkets went about evaluating the efficiency of its pioneering transcritical system in a Turner, Maine, store, which is detailed in a Department of Energy study. (See <http://1.usa.gov/1jQxsad>.)

“Our transcritical system will require a lot of fine-tuning so the [energy monitoring] will go on for quite a while,” he said. But he expects the system to ultimately prove to be more energy efficient than a DX system..

Unlike some other retailers that are installing transcritical systems, such as Dehaize America and Ahold USA, DeCicco decided to invest in two Trillium adiabatic gas coolers (from Baltimore Aircoil) instead of a conventional condensers. The units will help keep the system from going into less efficient supercritical mode when ambient temperatures exceed 88°F, CO<sub>2</sub>’s critical point. “That should get us an additional 20% to 30% energy savings over a traditional CO<sub>2</sub> system,” he said.

He selected adiabatic gas coolers even though Larchmont is a relatively northern climate where transcritical systems are expected to function efficiently without them. “I think we are one of the first in the Northeast to use CO<sub>2</sub> with Trillium condensers,” he said.

DeCicco has other ideas about how to derive more energy savings from the transcritical system that he is discussing with Hillphoenix, such as using well



Carrier HVAC system

In addition to its CO<sub>2</sub> transcritical refrigeration and heat reclaim systems, the new DeCicco & Sons store in Larchmont, N.Y., will have numerous other environmentally friendly features. Many are being incorporated into DeCicco’s other five stores.

- » Rooftop solar paneling. A 100 kW solar system on the roof will generate 28% to 35% of the power needed by the store. Other power will come through the grid from renewable sources.
- » LED lighting with motion sensors will be used throughout the store, consuming 18-20 kW of power vs. 75-80 kW at other DeCicco stores.
- » Light sensors near windows will turn off lights when there is enough ambient light.
- » Glass doors will be used on half of dairy cases as well as beer and some produce cases.
- » A highly efficient Carrier HVAC system is located on the roof.
- » A CaptiveAire kitchen ventilation system will balance airflow using computer-controlled sensors and variable speed exhaust fans.
- » Glass door heaters will be controlled by humidity monitors.
- » Recycled materials. The store’s bricks were reclaimed from construction sites in Manhattan while the wood came from old barns in upstate New York.
- » Reduced water usage will be seen in faucets and toilets, water pumps, and dishwashers.

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## CRAFT BEER HEAVEN



In addition to having many environmentally friendly features, DeCicco's new store in Larchmont, N.Y., will have a uniquely customer-friendly aspect: an encyclopedic variety of beer.

The six-store retailer has earned a reputation in Westchester and Putnam Counties, just north of New York City, for having one of the most extensive selections of local and imported craft beers in the area. Its store in Brewster, N.Y., for example, has about 2,000 varieties. In addition to selling beer at retail, the stores are equipped with a bar that sells beer on tap. At the upscale Armonk, N.Y., store, *Accelerate America* enjoyed a mug of Sierra Nevada Oktoberfest Marzen Lager at the upstairs bar and dining area.

"Anything that can be purchased or imported in New York State we probably have," said John DeCicco, Jr., president of DeCicco & Sons. "There are a lot of local, seasonal and limited editions."

DeCicco got the idea to expand his company's beer selection during a trip to London in the late 1990s. He worked on it for a few years and turned the responsibility over to his brother Chris, who travels the world in search of exotic brews and has "brought it to a whole other level," he said.



water in the adiabatic gas coolers. He also puts stock in the electronic expansion valves' ability to control the flow of CO<sub>2</sub> refrigerant in the cases, which improves efficiency. And over time he expects Hillphoenix to make new technology available – such as ejector and parallel compression systems – that will boost the efficiency of the transcritical system.

Heat reclaimed from the transcritical system will be used for about 50% to 60% of the store's heating and hot water needs; the store's HVAC system will make up the rest.

DeCicco acknowledges that the first cost of the transcritical system is 10% to 15% more than that of a conventional system; this does not count the adiabatic gas cooler, which is about three times the cost of a traditional condenser.

However, he has determined the installation cost to be slightly less than that of a conventional system, owing in part to the lower copper cost of the smaller-diameter pipes (½-inch vs. 3-4 inches) conveying liquid CO<sub>2</sub> to the cases, and the accompanying drop-off in soldering costs. Using case controllers also cuts down on electrical wiring costs.

One issue that came up during installation was the inability to get preferred high-pressure piping because it could not be approved for the system. The alternative was welded steel piping ordered by Hillphoenix.

DeCicco does not expect high pressures to be a problem. "It's fine. I'm not scared," he said, laughing. High discharge pressures (generally up to 1,400 psig in supercritical mode) would be vented outside the store on the roof. And each case circuit has a check valve, so that in the event a case is turned off and pressures build, they're released back to the rack and then outside.

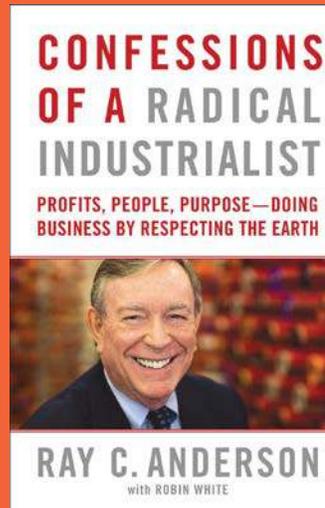
DeCicco's contractor, AAA Refrigeration Service, handled the installation and will be responsible for maintenance. To ensure that its technicians, including those assigned to the Larchmont store, are up to speed with CO<sub>2</sub> technology, AAA organized a training session in Westchester last August, including a trip to the store to study the rack. (See story, [page 27](#).)

## Holistic view of ROI

Summing up the cost of the transcritical system and other energy-saving elements, DeCicco estimates that he spent about 20% more on the Larchmont store than he would otherwise have spent. He may defray some of those costs by applying for utility rebates through NYSERDA (NY State Energy Research & Development Authority) for energy-efficient refrigeration, lighting, HVAC, night curtains, fans and variable speed motors.

Though the return for individual environmental measures may extend beyond 10 to 15 years, for the store as a whole DeCicco expects a reasonable pay-back period. He takes a holistic view of ROI that includes the intangible value of investing in environmental measures. He has drawn inspiration from the book, “Confessions of a Radical Industrialist – Profits, People, Purpose: Doing Business by Respecting the Earth; in it author and carpet mogul Ray Anderson describes how making his company environmentally friendly allowed him to “save a tremendous amount of real money, as well as create one of the most sustainable companies in the world well ahead of everyone else, which gave him a great competitive advantage,” said DeCicco.

In the case of his Larchmont store, he added, “I feel that combined, using all of the measures I used to promote sustainability, energy conservation and reduced greenhouse gas emissions, I’ve created a better value proposal to my customers, and in turn will generate a much faster ROI on the entire project than any individual measure.” **MG**



Book that influenced John DeCicco, Jr.



### SYSTEM SPECS

DeCicco & Sons' transcritical system has the following characteristics:

- » One Hillphoenix Advansor rack
- » CO<sub>2</sub> charge: 700 pounds
- » Four medium-temperature and two low-temperature Bitzer compressors
- » Medium-temperature capacity: 919 kBTUH; low-temperature capacity: 104 kBTUH
- » CPC XM case controllers; CPC rack controller
- » Hillphoenix cases
- » Two Baltimore Aircoil Trillium adiabatic gas coolers
- » Electric defrost
- » Heat reclaim for 50%-60% of heating needs

# HYDROCARBONS: THE REFRIGERANT OF THE FUTURE FOR SUPERMARKETS?



Paul Anderson,  
Target

As urban stores multiply and become smaller, and EPA regulations continue to target central HFC DX systems, self-contained cases using hydrocarbon refrigerants look like a compelling refrigeration option, according to Target and GreenChill's former director

—By Robert Davidson and Michael Garry



Keilly Witman,  
KW Refrigerant Management Strategy

Target's Paul Anderson and refrigeration consultant Keilly Witman have taken a careful look at the present and near future, and arrived at the same conclusion: for many supermarkets, particularly those with smaller footprints, self-contained cases using a plug-and-play hydrocarbon refrigeration unit are the best solution.

For a "store of the future" with low-cost refrigeration equipment that enables flexible merchandising, operates very efficiently and meets regulations, "self-contained refrigeration systems are the logical choice," said Anderson, senior group manager of engineering for Minneapolis-based Target, during a packed general session last month at the Food Marketing Institute's 2015 Energy & Store Development (E+SD) Conference in San Diego.

"And to ensure that [self-contained systems] meet energy efficiency and regulatory standards, they'll also use, in our opinion, a hydrocarbon-based refrigerant," added Witman, Anderson's co-speaker, who is owner of Boise, Idaho-based KW Refrigerant Management Strategy and previously the founding manager of the Environmental Protection Agency's GreenChill program.

Following the FMI E+SD Conference, at a White House-hosted meeting on Oct. 15, Target announced that all of the new stand-alone coolers in its stores with a compressor capacity below 2,200 BTU/hr will be HFC-free starting in January 2016.

Target is not a conventional food retailer. About 1,300 of its 1,800 general merchandise stores are dubbed PFresh for having an expanded food section, including a selection of fresh, refrigerated and frozen foods; the chain also operates about 250 SuperTargets that include a full grocery store.

Most of Target's stores are currently of the larger variety (about 130,000 square feet) that Anderson believes are more suited for centralized refrigeration systems. But the chain has begun opening smaller format stores such as City Target at about 80,000 square feet and Target Express at between 14,000 and 21,000 square feet. (Both were recently rebranded as Target stores.) Target is testing hydrocarbon units in its smaller locations, though Witman pointed out the units are being used by other retailers in larger stores as well.

## PERFECT STORM

The emergence of self-contained refrigeration systems using hydrocarbons such as propane is the result of what Witman described almost biblically as a "perfect storm of events, trends and innovations" that is changing the landscape of refrigeration in North America and is requiring companies to develop "arks" to weather the storm.

Among the elements of the storm: the growth of smaller stores that cater to the 71.2% of the U.S. population that lives in 486 urban areas; competitive pressures on supermarkets calling for more creative in-store merchandising; and the paucity of trained technicians. And, of course,

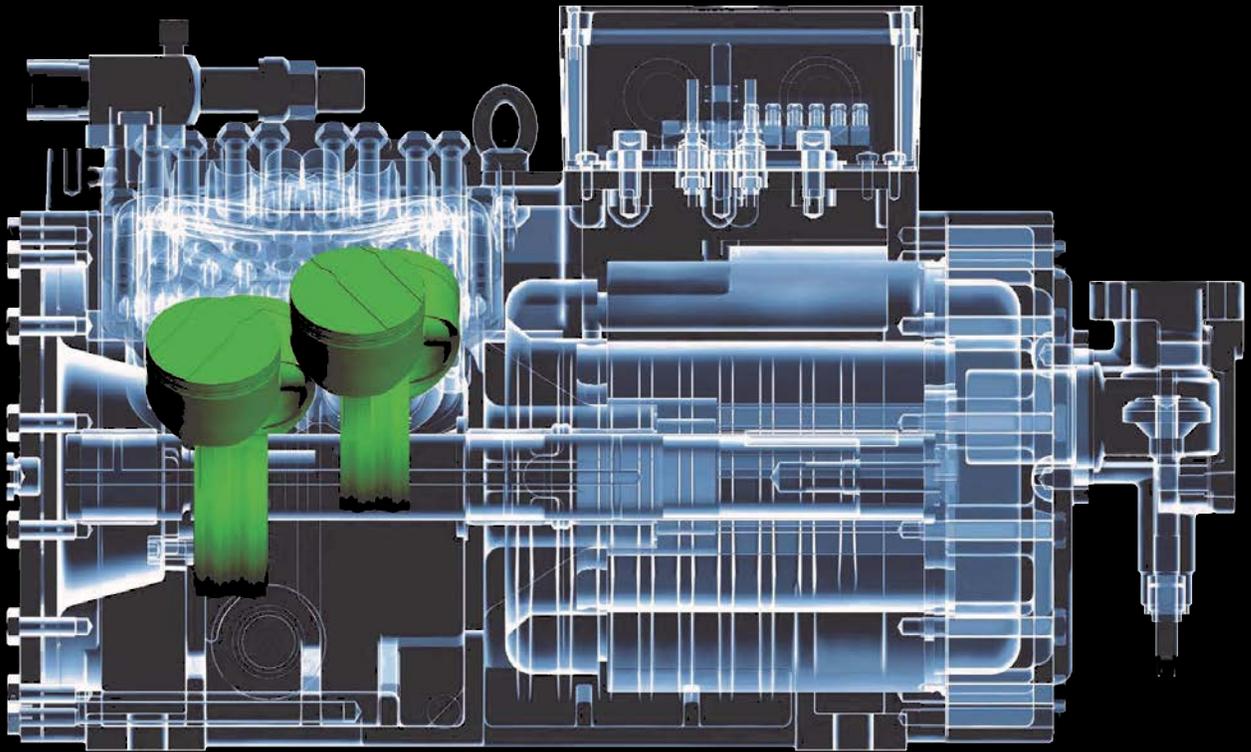
there are the ongoing regulatory headwinds: increasing pressure from the EPA, which has proposed several changes to Section 608 of the Clean Air Act, including the regulation of HFCs; and the Department of Energy's stricter energy requirements coming in 2017. "Keeping up with and finding solutions that overcome existing and proposed regulations are creating enormous amounts of confusion and uncertainty for me and my team," said Anderson.

But self-contained systems offer some answers. For example, because of their mobility within the store, these cases meet retailers' need for greater merchandising flexibility – such as setting up a special meat display for July 4th holiday sales, noted Witman. And unlike central systems, self-contained cases can also be easily moved to other store locations that offer a more favorable lease.

Moreover, self-contained systems are so easy to install and maintain that they considerably lessen the need for experienced technicians – a real benefit considering the diminishing ranks of experienced technicians.

"The store of the future will be all self-contained units that will be wheeled into position and plugged in, no installation required, and can be moved around for special promotions at any time," said Witman. In the event of an equipment problem, a store employee could easily remove a modular "refrigerant cartridge" and replace it on

continued on p.34 →

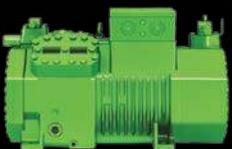


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Bitzer

the spot with a spare, sending the problem unit off to the factory with no down time. “Imagine a refrigeration system that doesn’t require in-store servicing,” she noted.

Modern self-contained cases use scroll compressors and other technology that minimizes their noise level, added Witman. The heat generated by the units can be removed via a water loop, used to keep aisles warm, or reclaimed to lower heating bills.

Due to their flammability, hydrocarbon charges are limited to 150 grams per self-contained unit – about what’s in a BIC lighter sold at the checkout. Witman acknowledged that the federal limits on hydrocarbon charge would need to be elevated so that self-contained units could accommodate entire stores. She confirmed that SNAP applications to the EPA to raise hydrocarbon limits are in the works. (Carter Retail Equipment plans to submit an application; see story on [page 20](#).)

Global experience with self-contained units using 150 grams or less of hydrocarbons have found them to be safe to operate. Even larger charges of hydrocarbons have been safely used in Europe for several years. Leaks from self-contained units are virtually non-existent, Anderson and Witman noted, in contrast with leak-prone rack systems.

Assuming the hydrocarbon limit in the U.S. is raised to 1,000 grams, the total amount of refrigerant per system would still be less than 50 pounds – and thus exempt from Section 608 regulations.

## PROPANE FOUND MOST EFFICIENT

According to Witman, hydrocarbon-based, self-contained units can be more energy efficient (on a total store basis) than traditional rack systems, which is contrary to popular perception. In addition, the hydrocarbon cases perform more efficiently than comparable cases using an HFC like R134a.

Anderson provided data backing up the latter statement. In one side-by-side test of self-contained units (small and large coolers), Target compared the efficiency of propane and CO<sub>2</sub>, using R134a as the baseline. Propane was found to use 53% less energy than R134a, while CO<sub>2</sub>

used 25% less. Annual savings for a chain of 100 stores with 10 cases per store came to \$42,920 for propane, \$20,150 for CO<sub>2</sub>.

“If we had used R290 in all of those coolers, we would have saved more than \$700,000 annually in energy,”

Over the past two years, Target and its beverage suppliers have replaced about 17,000 coolers across its roughly 1,800 stores. “If we had used R290 in all of those coolers, we would have saved more than \$700,000 annually in energy,” said Anderson.

Target will be testing a display case using an HFO blend as the refrigerant, though “it doesn’t appear that HFO blends will be able to achieve the energy levels of R290,” he said.

## CASCADE PROTOTYPE

While Target considers the possibilities for self-contained propane units in smaller stores, the chain is still reliant on conventional DX systems for most of its existing stores. In 2014, at the ATMOSphere America conference in San Francisco, Anderson announced that Target’s prototype refrigeration system for new stores would switch to a hybrid cascade model that uses DX CO<sub>2</sub> for low-temperature cases and DX R134a for medium-temperature cases. (See “Why Target Opted for CO<sub>2</sub> as its Prototype,” *Accelerate America*, February 2015.) Target has four stores so far with the prototype cascade system, including two that opened this year in Texas and Illinois.

The prototype cascade system accounts for \$2,300 less annually in energy costs than a conventional DX system, but that is how much more its maintenance runs per year, said Anderson. Capital equipment and installation costs are 25%-30% and 5% more than conventional equipment, respectively, though Target is working on lowering them.

The prototype system has an aggregate GWP (global warming potential) of 1,001, compared to 3,922 for a standard DX system using R404A. Anderson said that by substituting HFO blends

for the R134a, the aggregate GWP would drop to 420; in a system that used pumped CO<sub>2</sub> for medium-temperature cases, it would drop to 210. However, “unless you go to all-natural refrigerants, you won’t hit the 150 GWP mark many are talking about today,” he said.

And while HFO blends offer lower GWPs than traditional HFCs, “we don’t know if [HFOs] will be on the [regulatory] chopping block next,” said Witman.

Anderson acknowledged that the most efficient and low-GWP scenario for a cascade system would be an all-natural ammonia/CO<sub>2</sub> combination, but Target is not yet ready to test this option. In addition, because of its PFresh stores’ relatively low number of cases relative to a conventional supermarket, Target would not derive enough heat reclaim to make an all-CO<sub>2</sub> transcritical sufficiently energy efficient, Anderson said. However, he is working with OEMs to develop a transcritical model that would work in Target’s format.

Retrofits remain a challenge for retailers seeking to replace R22 and high-GWP HFCs with a future-proof alternative, noted Witman. Hydrocarbons are not currently a retrofit solution in central systems while CO<sub>2</sub> has not yet been widely used in the U.S. in retrofits (though it has been used in retrofits in Canada).

Target has tested HFOs as a retrofit solution in HFC DX systems and found them to consume 6% to 8% less energy in medium-temperature cases, but 2% to 4% more energy in low-temperature cases. Then after making a superheat adjustment the low-temperature cases showed an energy savings. “Target will take our time studying this system,” noted Anderson.

Anderson concluded that there is no “silver bullet” approach to refrigeration, and urged FMI E+SD Conference attendees to “understand your business drivers when investing in new systems.”

RD + MG



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## SEIZING THE NH<sub>3</sub>/CO<sub>2</sub> OPPORTUNITY

Rendering of new Lineage Logistics facility in Charleston, S.C.

For its new Charleston, S.C., plant, Lineage is installing a cascade NH<sub>3</sub>/CO<sub>2</sub> system that is gaining popularity for cutting ammonia charge while operating very efficiently

— By James Ranson

There are big changes afoot in the North American industrial refrigeration business, as systems that use far less ammonia than conventional setups are gaining considerable traction. Add Lineage Logistics, one of the nation's largest cold-storage providers, to the list of companies going in this direction.

Next March Lineage, which operates 110 warehouses in the U.S. encompassing over 600 million cubic feet, plans to unveil a refrigerated warehouse in Charleston, S.C., that will be its first to employ a cascade ammonia/carbon dioxide refrigeration system in lieu of a traditional two-stage ammonia system to blast freeze product from 30-40°F down to 0°F.

The reasons for this are many, but chief among them: NH<sub>3</sub>/CO<sub>2</sub> systems dramatically cut ammonia charge, improving safety while exempting operators from most ammonia regulations. Moreover, economies of scale are bringing down the cost of NH<sub>3</sub>/CO<sub>2</sub> systems, and

for facilities like Lineage's relying on blast freezing, these systems have proven to be very efficient.

Another large cold-storage operator, US Cold Storage, can be credited with bringing the NH<sub>3</sub>/CO<sub>2</sub> system to the fore in 2005, when that technology was virtually unheard of. Since then the company has established many industry standards when it comes to NH<sub>3</sub>/CO<sub>2</sub> installations, with 11 of its 35 public refrigerated warehouses operating this system. (See "Shaking Up Industrial Refrigeration," *Accelerate America*, April 2015.)

Overall, there are now 53 NH<sub>3</sub>/CO<sub>2</sub> cascade systems installed in industrial facilities in the U.S., eight in Canada and eight in Mexico, according to the 2015 GUIDE to Natural Refrigerants in North America.

Ten of US Cold Storage's systems are cascade models, using low-temperature CO<sub>2</sub> compressors, while one, in Quakertown, Pa., uses a critical brine solution with CO<sub>2</sub> circulated as a secondary refrigerant. Its

Bethlehem, Pa., facility has 6,400 pounds of ammonia and 48,000 pounds of CO<sub>2</sub> in the cascade setup.

Lineage's 180,262-square-foot Charleston facility will contain 7,969 pounds of ammonia and 60,111 pounds of CO<sub>2</sub>. (The ammonia side serves only as a condenser and to reject heat from the CO<sub>2</sub> system.) This will accommodate 2,191 tons of refrigeration capacity across 646,160 cubic feet of storage. By contrast, a traditional two-stage pump-recirculated ammonia system typically contains between 40,000 and 50,000 pounds of ammonia.

### SIGNIFICANT UPTAKE FOR NH<sub>3</sub>/CO<sub>2</sub>

Matt Hirsch, president of Primus Builders, Woodstock, Ga., which, together with Republic Refrigeration, is installing Lineage's NH<sub>3</sub>/CO<sub>2</sub> system, has the benefit of hindsight on its side. Primus has completed seven of US Cold Storage's NH<sub>3</sub>/CO<sub>2</sub> installations, including the most recent one in Covington, Tenn. "It's true, we've seen a significant uptake for NH<sub>3</sub>/

CO<sub>2</sub> systems,” Hirsch said. “Four years ago only US Cold Storage was using the systems as well as the ice cream manufacturers like Nestle.”

Primus now has 5-6 clients – including Lineage, US Cold Storage, Americold and Valley Cold Storage – who are “seeing more and more advantages for NH<sub>3</sub>/CO<sub>2</sub> systems as they move forward,” said Hirsch. The systems are proving particularly popular for food distribution facilities eager to eliminate the use of ammonia in their facilities to improve safety and protect products. Like US Cold Storage’s Bethlehem warehouse, the Charleston facility contains a central engine room where all of the ammonia refrigeration will be confined, while CO<sub>2</sub> will be used as the sole cooling refrigerant in the facility.

And using under 10,000 pounds of ammonia also allows the cascade system to largely avoid federal safety and maintenance regulations such as OSHA’s PSM (Process Safety Management) program and the Environmental Protection Agency’s RMP (Risk Management Plan).

Confinement to the engine room is what keeps the charge low. “This is done without sacrificing efficiency, and we expect to actually gain efficiency all the while using a natural refrigerant that doesn’t run the risk of phase out in the future,” noted Jim Romine, Lineage’s senior director of engineering. “While ammonia systems are inherently safe to operate, it is an advantage to be able to lower the charge on site.”

Hirsch also points to the significant energy efficiency advantages of NH<sub>3</sub>/CO<sub>2</sub> systems compared to two-stage NH<sub>3</sub> systems when blast freezing products in temperatures below -20°F. “The beauty of using the cascade systems is that the colder it goes, the more efficient it is,” said Hirsch. “Whereas with ammonia, the colder you go, the less efficient it becomes.”

For that reason, Primus, as it did with Lineage, recommended to Valley Cold Storage that it opt for NH<sub>3</sub>/CO<sub>2</sub> in one of its facilities. Valley Cold Storage can’t use ammonia alone because the company stores and process pecans, which would be ruined by even a small leak. “Traditionally, these storage facilities have been forced to use Freon and have had higher operating costs as a result,” noted Hirsch.



The engine room at US Cold Storage's Covington, Tenn., facility, which uses an NH<sub>3</sub>/CO<sub>2</sub> system.

Lower costs are also facilitating the transition to NH<sub>3</sub>/CO<sub>2</sub> systems from traditional ammonia systems. “We did evaluate this project with standard two-stage ammonia systems as well as NH<sub>3</sub>/CO<sub>2</sub> systems,” said Hirsch. “There has been a cost premium attached to NH<sub>3</sub>/CO<sub>2</sub> systems in the industry, but it was more significant than it is now. I would attribute that to the fact that there are many more equipment manufacturers available with CO<sub>2</sub> systems than there were 10 years ago.”

This change is being leveraged by Republic Refrigeration, Monroe, N.C., the designer and installation contractor for the

continued on p.38 →

## SYSTEM SPECS

Lineage Logistics’ NH<sub>3</sub>/CO<sub>2</sub> cascade refrigeration system at its new plant in Charleston, S.C., will contain the following characteristics:

- » Phase 1 will have 1,698 TR capacity, with the full build-out at 2,191 TR
- » One freezer space, two convertible rooms, two docks and one quick-freeze room, encompassing 647,160 cubic feet
- » Two CO<sub>2</sub> recirculators, one at 20°F and one at -30°F
- » Full build-out ammonia charge: 7,969 pounds
- » CO<sub>2</sub> charge: 60,111 pounds
- » The freezer and convertible rooms are served by mini-penthouse evaporators
- » The docks are served by ceiling-hung evaporators
- » The quick-freeze room is served by standard penthouse evaporators
- » For CO<sub>2</sub>: 7 Sabroe high-pressure reciprocating compressors
- » For NH<sub>3</sub>: M&M high-temperature screw compressors
- » For NH<sub>3</sub>: 3 rooftop hybrid condensers

complete industrial refrigeration system in Charleston. The company sources equipment from multiple manufacturers, while supplying components of its own.

By contrast, designer/manufacturer M&M Refrigeration almost exclusively designed and supplied equipment for several of US Cold Storage's early NH<sub>3</sub>/CO<sub>2</sub> projects. But Hirsch said that practice is rare today. "M&M really used to be the only manufacturer in the U.S. designing CO<sub>2</sub>/NH<sub>3</sub> systems," he said. "We now have a number of industrial refrigeration companies that are doing the design/builds, like Republic Refrigeration, which are able to interchange three or four equipment manufacturers. And now that we have competition in the market, the costs have come down."

### CASCADE STANDARD UNDERWAY

One limitation on the growth of NH<sub>3</sub>/CO<sub>2</sub> cascade systems has been the reluctance of the IAR (International Institute of Ammonia Refrigeration) to draft a standard for cascade systems, a move that would undoubtedly impinge on the broader adoption of all-ammonia systems.

As the International Institute of Ammonia Refrigeration, "they didn't necessarily want to promote the elimination of ammonia as a refrigerant," Hirsch said. "However, they recognize that it's a cascade system and it's still using ammonia as a refrigerant."

So in 2015 the IAR created a sub-committee that is committed to producing

a standard for NH<sub>3</sub>/CO<sub>2</sub> cascade systems. "In order for them to publish a formal standard it's going to be a multi-year effort but it's great that they have developed a sub-committee and a team," said Hirsch. "A few years down the road we will see a standard similar to the IAR's best practice standard for ammonia refrigeration."

Hirsch also believes that there needs to be more technicians trained on the cascade systems. "That's where we've witnessed the most resistance actually, though the cascade systems are not that different from a two-stage ammonia system."

US Cold Storage has been very active in running chapter RETA (Refrigeration Engineers and Technicians Association) meetings at its facilities to allow participants to see the differences between two-stage ammonia and cascade systems. In addition, both Republic and Innovative Refrigeration do training at their facilities, with the latter providing in-house training on a fully running NH<sub>3</sub>/CO<sub>2</sub> cascade system installed at one of its largest facilities.

"I think having those resources for their clients and providing the assurance that if I go down this road that I have a place to go and train my staff has allowed [end users] to really take advantage and venture out to these types of systems," Hirsch said. **@JR**



US Cold Storage facility in Texas with NH<sub>3</sub>/CO<sub>2</sub> system, designed and installed by Republic Refrigeration.

### THE POTENTIAL OF LOW-CHARGE AMMONIA

In addition to testing the waters with its first NH<sub>3</sub>/CO<sub>2</sub> cascade system, Lineage Logistics has implemented its first low-charge ammonia-only packaged systems in California. (See "Southern California Edison Takes On Natural Refrigerants," *Accelerate America*, June 2015.)

Matt Hirsch, president of Primus Builders, Woodstock, Ga., thinks that there's definitely potential for low-charge packaged systems in industrial applications, but from pricing to economies of scale, they have a lot of hurdles to overcome. "They are not the standard right now in large-volume manufacturing; they need some capital cost reductions to really become competitive in the market."

He also believes that for a facility the size of Lineage's in Charleston S.C., low-charge ammonia would never be a feasible solution. These systems, he said, are typically engineered for between 30 TR and 60 TR per unit, containing anywhere between 2-5 pounds of ammonia refrigerant per ton of refrigeration.

"[Primus has] used low-charge ammonia systems on other projects, but when you get into very large-capacity systems it becomes less cost competitive than NH<sub>3</sub>/CO<sub>2</sub> systems," he said. The Charleston warehouse, for instance, has a large blast freezing room, comprising roughly half of the facility's 2,191 TR capacity. The room would require about 36 low-charge ammonia units, which "wouldn't make sense in that application."

The low-charge ammonia system does have inherent advantages. "The major difference between an NH<sub>3</sub>/CO<sub>2</sub> systems and a low-charge system is that the entire low-charge package is remote," said Hirsch. "There is no central refrigeration equipment -- they're stand-alone systems. Because there are no large vessels and piping running from a central room out to the individual packages, the charge can be reduced tremendously. The only charge necessary is what's required within the evaporator circuit."

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## EPA ON THE MOVE

The agency discusses plans to expand guidelines on acceptable and unacceptable refrigerants, as well as propose a new Section 608 rule, at the FMI Energy & Store Development Conference

– By Justina Tamasiunaite and Michael Garry

The relationship between the Environmental Protection Agency and the supermarket industry has been a checkered one over the past few decades. Under Section 608 of the Clean Air Act, the EPA has been obliged to enforce refrigerant emissions limitations of HCFCs, and the agency has also undertaken to delist HFC refrigerants that have been widely used by food retailers.

On the other hand, the EPA has also allowed many new, low-GWP refrigerants in the last few years, including natural refrigerants, that have enabled food retailers to improve their operations and carbon footprint. The agency has also collaborated with almost one-third of U.S. supermarkets via its GreenChill program, which helps stores reduce their refrigerant leaks and charge. (See story, [page 16](#).)

All of that history was in evidence at the Food Marketing Institute's Energy & Store Development (E&SD) conference last month in San Diego, where EPA biologist Rebecca von dem Hagen, from its Stratospheric Protection Division, gave an overview of recent agency refrigerant initiatives, and previewed those on the horizon.

The upshot of her presentation: Building on its recent actions under the SNAP (Significant New Alternatives Policy) program, the EPA plans to expand its list of acceptable and unacceptable refrigerants. The agency also will finalize in 2016 a new rule regarding Section 608, continue the HCFC phaseout under the Montreal Protocol, expand federal procurement of HFC alternatives and continue to pursue a phasedown of HFCs under the Montreal Protocol.



Rebecca von dem Hagen, EPA



Von dem Hagen reacquainted conference attendees with the EPA's long-awaited controversial rule, published in July, delisting certain high-GWP HFCs by certain dates, which were later than what the agency originally proposed. (See "EPA Announces Final Rule for Delisting of HFCs," *Accelerate America*, July/August 2015.)

For instance, in retail food refrigeration applications, the use of HFCs R404A, R507A and others in new supermarket systems will be delisted as of January 1, 2017, rather than the initial proposal of January 2016.

### VON DEM HAGEN OUTLINED SOME KEY PRINCIPLES BEHIND THE EPA'S APPROACH TO REFRIGERANTS:

- » SNAP rules will continue to consider individual end-uses.
- » There will be no across-the-board GWP (global warming potential) cutoffs.
- » There will be no prohibition on HFCs as a whole, or in any one sector.
- » New HFCs or HFC blends may be listed if their risk is not greater than any other available substitutes.

## NEW PROPOSED RULE

On September 1, the EPA held a stakeholder meeting to discuss its next proposed SNAP rule on refrigerants, which is in the early stages of development but will be proposed in 2016. The rule could include a listing of acceptable alternatives with use conditions as well as a listing of unacceptable alternatives “where risks cannot be mitigated sufficiently” because of flammability, toxicity, air quality impacts and climate effects,” said von dem Hagen; the latter group could include hydrocarbons and hydrocarbon blends in stationary and motor vehicle air conditioning.

The proposed rule could also address later transition dates for refrigerants delisted in July than what was indicated in the final delisting rule. The rule could also apply the delisted refrigerants to additional end uses, such as chillers, refrigerated food processing and dispensing, household refrigerators and freezers, and cold storage warehouses.

EPA’s next steps will also include expansion of SNAP’s acceptable alternatives and end uses, including a new SNAP notice for acceptable listings.

In a GreenChill webinar held on October 6, Tom Land, manager of the EPA’s GreenChill program, noted that utility providers are starting to offer incentives for the use of low-GWP alternatives around the U.S. “They are working with the supermarket industry and trying to evaluate advanced refrigerants and provide incentives for these refrigerants,” he said, suggesting that industry attendees contact utility providers about possible incentive schemes.

Following the FMI E+SD Conference, at a White House-hosted meeting on Oct. 15, EPA Administrator Gina McCarthy announced a proposed rule updating several aspects of Section 608 of the Clean Air Act. The EPA plans to finalize this rule in 2016.

### AMONG THE PROPOSED CHANGES TO SECTION 608:

- » Simplify, clarify and improve existing requirements.
- » Expand the regulations to include HFCs.
- » Reduce the leak trigger rate from 35% to 20%.
- » Add leak repair verification procedures, including quarterly inspections for commercial refrigeration containing 500 or more pounds of refrigerant.

As for the HCFC phaseout, last year the EPA announced that the final 2015-2019 R22 allocation would be about 75% below the total allowed under the Montreal Protocol. In 2016, noted von dem Hagen, R22 allocation would be approximately 20% below the 2015 allocation. As of January 1, 2020, no production or import of R22 will be allowed.

HFCs have been a target of the Obama administration’s Climate Action Plan. The EPA now plans to issue a proposed rule amending the Federal Acquisition Regulation and directing the government to purchase cleaner alternatives to high-GWP HFCs where feasible, use alternatives in the SNAP program and report on the use of HFCs. A final rule is expected in 2015, said von dem Hagen. @ JT + MG

## NGOs PETITION EPA FOR MORE DELISTINGS

Although the Environmental Protection Agency in July released a final rule under the SNAP program delisting a host of high-GWP HFC refrigerants, three NGOs petitioned the agency in October to delist these and other HFCs in a number of end uses not covered in the final rule.

The Natural Resources Defense Council (NRDC) and the Institute for Governance and Sustainable Development (IGSD) filed one petition, while the Environmental Investigation Agency (EIA) filed another.

The NRDC/ISGD petition asks the EPA to replace HFCs “with safer alternatives,” including natural refrigerants, in medium- and heavy-duty vehicles, commercial water chillers, refrigerators, portable air conditioners, home air conditioners, commercial rooftop units, cold-storage warehouses and other applications.

Among the HFCs being targeted by NRDC/ISGD: R134a, R410a, R404A and R507A. The phaseout dates range from 2017 to 2025. The petition singles out ending the use of R410A in residential and commercial air conditioning applications.

The EIA’s petition covered a much larger range of end uses and high-GWP refrigerants than the NRDC/ISGD petition. Notably, EIA emphasized using natural refrigerants such as carbon dioxide, ammonia and hydrocarbons as HFC alternatives far more than NRDC/IGSD did.

# TEAMING UP WITH THE DOE

Whole Foods' participation in the Better Building Alliance and Challenge is helping the retailer adopt energy-saving technologies, including natural refrigerant systems

—By James Ranson and Michael Garry

Food retailers and other companies often regard the Environmental Protection Agency with a degree of trepidation stemming from the agency's role as an enforcer of environmental restrictions on the private sector. However, since 2007, the EPA has been able to forge a productive partnership with supermarkets through the agency's GreenChill program, which helps stores reduce their refrigerant charge and emissions.

The Department of Energy also plays a regulatory role in regard to the energy efficiency of equipment and appliances, but the DOE, too, has been able to develop positive relationships with a wide variety of business sectors through its Better Buildings Initiative, launched in 2011 by President Obama. The initiative calls for buildings to become 20% more energy efficient over the next decade. Out of that initiative, the DOE has created a number of free, voluntary sub-programs, including the Better Buildings Alliance (BBA) and the Better Buildings Challenge.

At the Food Marketing Institute's Energy & Store Development (E&SD) Conference in San Diego in late September, Holly Jamesen Carr, the DOE's energy technology program specialist, explained the Better Buildings Challenge and the BBA to food retail executives during a well-attended general session, and encouraged them to participate in the programs. She was joined by Aaron Daly, global energy coordinator for Whole Foods Market, which participates in the programs; he described the benefits that retailers and other companies can derive from getting involved with the DOE.



Aaron Daly, Whole Foods

The BBA has more than 200 members from the private sector that are divided into four sector groups: retail, food service and grocery; healthcare; higher education; and commercial real estate and hospitality. Sector members collaborate by phone, webinars and in person. Among the grocery members: Walmart, Safeway, Publix, Supervalu, Food Lion, Costco and Whole Foods.

In addition, the BBA runs cross-sector technology and market solutions teams. The technology teams include refrigeration, lighting, energy information systems and space conditioning. "We see great value in this approach in that that allows different sectors to come together and discuss what's working in food service, hospitality or healthcare, which could be valuable for other sectors," Carr said.

Daly has participated on the energy information systems team for two years. "I find it useful," he said. "It gives me the opportunity to look at all competing technologies out there and find out what people in different markets are using, and bounce ideas off them."

In addition to peer networking, the BBA makes energy-efficiency resources available to members, including a guide to retrofitting medium-temperature display cases with doors, and a webinar on energy management information systems. The Alliance also gives members the chance to test lab-proven technologies in the field. Whole Foods has tested "super-efficient" roof top units in several markets,



Holly Carr, Department of Energy

said Daly. "They are more expensive than typical units but we do see energy benefits."

BBA members are required to set an organization-wide energy reduction goal, which does not need to be made public; DOE suggests at least 2% per year. Members are also asked to assign a point of contact for the DOE, participate in at least one workgroup annually, monitor progress toward goals, and share progress and successes.

## RISING TO THE CHALLENGE

The DOE also allows companies and other organizations to take a more proactive stand than what is required in the BBA in the Better Business Challenge. This program calls for setting a public goal of 20% or greater energy savings over a 10-year period, reporting on progress annually and sharing best practices. More than 200 organizations are participating, including city and state governments.

Whole Foods is among the retail, food service and grocery partners currently engaged in the Challenge; others include Walmart, Walgreens, Arby's Restaurant Group and CKE Restaurant Holdings. Whole Foods has set a 20% goal using 2010 levels as a baseline, and has an internal 25% goal with an earlier baseline.

continued on p.44



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→ Per the Challenge program's requirement, Whole Foods has made public that it has, as of 2014, reduced its energy consumption by 9% compared to baseline. Having concrete results like this, reported to the federal government, "is a very effective strategy for garnering support from [corporate] people who might otherwise not be interested in energy-efficiency improvements," said Daly.

Also as part of the challenge, companies are asked to present a "showcase project" – an individual building achieving 20% or greater savings. Whole Foods has cited its Brooklyn store, which in 2015 is expected to have energy savings of 60% compared to an ASHRAE benchmark for new stores. The store uses a transcritical CO<sub>2</sub> system, among many other energy-saving technologies. (See "Whole Foods' Journey to Natural Refrigerants," *Accelerate America*, January 2015.)

In addition, the challenge requires organizations to have an "implementation model," which Carr described as "what the organization is doing differently – their secret sauce allowing them to approach 20% savings." In Whole Foods' case, the model is the chain's effort to obtain utility incentives based on energy consumption reductions at stores.

Whole Foods has partnered with several utilities on rebates, most successfully with NSTAR, a utility in the northeast U.S. (now owned by Eversource), from which it has received over \$1 million in utility incentives, enabling it to save over \$1.2 million per year in energy and maintenance costs from incentivized upgrades "We achieved vastly more energy efficiency and recouped vastly more energy efficiency money [from NSTAR] than we do with most utilities."

Whole Foods was also able to obtain utility funding from Sacramento Municipal Utility District (SMUD) for the remodeling of a store in Sacramento, Calif., which was retrofitted with a cascade CO<sub>2</sub> system (CO<sub>2</sub> refrigeration is rarely used in retrofits.) Whole Foods collaborated on the project with PECL (later acquired by CLEAResult), an energy consulting firm.

In another utility project, Whole Foods worked with the National Renewable Energy Laboratory (NREL) and the Bonneville Power Administration,

a northwest U.S. energy provider, on a demand-response and refrigeration control study. Applying demand response to refrigeration is challenging because refrigeration typically uses a separate measurement and control system with limited web-enabled communication and visualization capabilities. There is also ongoing concern that demand response strategies could jeopardize product safety and integrity.

Nevertheless, Daly and Carr argued that building information and control technologies had advanced to the point that they are now adequate to enable demand response in commercial refrigeration systems, allowing utilities to provide extra capacity and balance system loads.

While the BBA and the Challenge are voluntary programs, they require high-level leadership buy-in from a CEO, VP of facilities or the like. This "elevates energy efficiency to company leadership," Carr said. Other benefits of the program: validation of internal energy reporting by the DOE; White House recognition events; and in-store media events with the DOE.

"Partners like Whole Foods are sharing a lot with us – annual data, which is no small task, as well as best practices and case studies," Carr said. "What we have to offer back is recognition and media awareness, and those types of things that your communications teams are looking for. This enables companies to say, 'not only are we doing this, but the DOE is saying that we're doing this.'"

That sort of validation from the DOE helps to eliminate charges that a company is overhyping its environmental activities, noted Daly.

"Our involvement in the Alliance, but more so in the Challenge, is a way for us to get out our messaging about our environmental commitment but we also see it as a brand image opportunity," he said. "Having that data shared through that platform substantiates what we're doing, that we're not just 'green washing'; our customers can see the real work we're up to."

The DOE has established a website called the Better Buildings Solution Center (<http://betterbuildingsolutioncenter.energy.gov>), which includes more than 125 showcase projects, implementation models, guidance documents and other material related to energy efficiency.

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## Getting the Message Out

As a leading purveyor of natural and organic foods, Whole Foods has been an active advocate of sustainability in the food chain as well as in its own operations. The chain has taken a number of steps to become more energy efficient, such as using CHP (combined heat and power) systems in six stores, solar arrays in 25 and electric vehicle charging stations at 76. It purchased over 4.3 billion megawatt-hours of wind-based renewable energy credits from 2005 to 2012.

In refrigeration, Whole Foods has more stores testing natural refrigerant systems than any other U.S. food retailer, including transcritical systems in Brooklyn, N.Y., and two California locations, and an ammonia/CO<sub>2</sub> cascade system in California. The Brooklyn store is the only U.S. store that is 100% HFC-free. Whole Foods also has 20 stores with GreenChill certification, 33 with Green Globes certification and 12 with Leadership in Energy & Environmental Design (LEED) certification.

With all of this activity supporting the environment, Whole Foods has a lot to talk about. Aaron Daly, global energy coordinator for Whole Foods Market, said the key to effective environmental messaging is driving awareness of the company's initiatives and achievements to all key stakeholders. The retailer achieves this through a number of channels:

- » Employees: "Green Mission" Program, newsletters, training days.
- » Customers: In-store displays.
- » Partnerships/Initiatives: EPA, DOE, Energy Star, GreenChill, LEED, Green Power Partnership.
- » Media relations: To enable sustainable "storytelling."

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# PRIVATE SECTOR MEETS AGAIN WITH WHITE HOUSE TO DISCUSS HFC REDUCTION

End users, OEMs and component manufacturers announce many new natural refrigerant initiatives and progress reports

— By Michael Garry

**On** October 15, a wide range of companies involved in the HVAC&R industry convened for the second White House-hosted Industry Leader Roundtable — a follow-up to the initial roundtable in September 2014 — to address ways to reduce emissions of HFCs.

At the meeting, held at the Eisenhower Executive Office Building, the White House announced new private-sector commitments and executive actions that will reduce the use and emissions of HFCs. In addition, the White House recognized the progress that has been made toward the private-sector commitments and executive actions that were announced in September 2014 to address HFCs.

In 2013, President Obama incorporated HFC reduction into his Climate Action Plan, pledging to reduce emissions of HFCs through both domestic and international leadership. The Environmental Protection Agency has taken the lead in the domestic effort through its Significant New Alternatives Policy (SNAP) program. (See story, [page 40](#).) Globally, the U.S. has been working to negotiate an amendment to the Montreal Protocol to phase down the production and consumption of HFCs.

As a complement to those governmental measures, the White House called the private sector's commitments and progress evidence that "U.S. companies are at the cutting edge when it comes to developing the next generation of safe and cost-effective alternatives to HFCs and also incorporating these alternatives into American cars, air conditioners, refrigerators, foams, and other products."

The following is a summary of the private-sector initiatives announced at the event, including new commitments and progress updates, related to natural refrigerant adoption. The information was adapted from a White House fact sheet that can be accessed at <http://1.usa.gov/1k7Nrky>.

**Danfoss** announced its multi-million dollar investment in a state-of-the-art application development and testing center in North America that will help to facilitate the transition to low-GWP refrigerants through providing air conditioning and refrigeration manufacturers with additional capacity to test new equipment using low-GWP refrigerants for performance and safety. The center is anticipated to come online in 2016 and it will accommodate equipment sizes up to 150 tons of refrigeration.

Danfoss made a commitment in September 2014 to champion a stakeholder task force to accelerate the adoption of standards and building codes for low-GWP refrigerants. In the past year, Danfoss assembled a broad and diverse stakeholder group that has been working to support ASHRAE in the development of its refrigerant safety Standard 15. The stakeholder group has been actively working to raise awareness and educate model code groups to enlist their support in preparing codes once Standard 15 is ready.

**Hillphoenix** announced that it will launch in Q4 2015 a CO<sub>2</sub> booster system that is intended for stores with a smaller footprint. In addition, it announced that it has completed its second commercial installation of an ammonia/CO<sub>2</sub> cascade system for use in supermarket applications. Furthermore, based on its successful installation of the first two CO<sub>2</sub> ice rinks in Anchorage, Alaska, Hillphoenix is planning for the future introduction of this CO<sub>2</sub> booster system technology, contingent on EPA approval of CO<sub>2</sub> as a refrigerant in ice rink applications.

Hillphoenix made commitments in September 2014 to commercialize a CO<sub>2</sub> booster system, to introduce a hydrocarbon self-contained door case, and to introduce a re-engineered service that utilizes its door technology to retrofit existing open display cases. Hillphoenix has carried through on all three of those commitments in the past year. Related to the first commitment, approximately 50 stores have installed new Advansor CO<sub>2</sub> booster systems. Related to the second commitment, Hillphoenix has several HFC-free self-contained R290 display cases in supermarket applications. Related to the third commitment, Hillphoenix's Close-the-Case projects have enclosed over 12.3 miles of cases in 2015. This equates to \$6.3 million in annual energy savings.

**Roundy's Supermarkets** announced that it has joined EPA's GreenChill program. Roundy's also announced that it will use HFC-free transcritical CO<sub>2</sub> refrigeration technology in the six new stores that it is opening in in the following locations next year: Orland Park, Ill.; Westmont, Ill.; Naperville, Ill.; two stores in Chicago; and Shorewood, Wis. Starting in 2016, Roundy's will

“ U.S. companies are at the cutting edge when it comes to developing the next generation of safe and cost-effective alternatives to HFCs.”

use this technology in all new store builds. In addition, it announced that it will also use this technology in all future store remodels that involve the replacement of the entire refrigeration system.

**Target** announced that all of the new stand-alone coolers in its stores with a compressor capacity below 2,200 BTU/hr will be HFC-free starting in January 2016. This action has Target moving out of HFC refrigerants in these applications long before the SNAP requirement comes into place in 2019. Target also announced its commitment to expand the use of CO<sub>2</sub> refrigeration systems in new stores, and it currently has seven systems operating in Target stores and two additional stores under development that will use these refrigeration systems.

In the past year, Target has opened two stores that use a hybrid CO<sub>2</sub>/R134a refrigeration system that will eliminate more than 150 metric tons of CO<sub>2</sub> equivalent each. Target also installed prototype beverage display cases that use R290 and it is conducting performance tests against CO<sub>2</sub>.

**Thermo Fisher Scientific** announced that it will transition its entire platform to hydrocarbons by 2020. In particular, 20% of its entire medical and laboratory cold storage portfolio will be HFC-free by the end of 2016, 65% of its refrigeration systems will be HFC-free by the end of 2017, and it will be 80% HFC-free on blowing agents by the end of 2017. At the same time, it will reduce the energy consumption of its entire cold storage portfolio by more than 50% by 2020.

continued on p.48



EPA Administrator Gina McCarthy with John Galyen, president, Danfoss North America

## → Other Progress Updates

**Carrier** made a commitment in September 2014 to pursue HFC-free refrigerants across the cold chain by 2020. In the past year, Carrier provided technical analysis to support SNAP approval of CO<sub>2</sub> as a natural refrigerant for transport refrigeration. Also in the past year, it developed prototype natural refrigerant trailer units in the U.S. In addition to the more than 1,600 supermarkets in Europe using Carrier's HFC-free natural refrigeration technologies for food retail, the company installed its first food retail units in China this year using natural refrigerants to help lower emissions.

**Coca-Cola** announced in September 2014 that it had more than 1 million units of HFC-free equipment throughout its global system, in support of its goal for 100% of its newly purchased cold drink equipment to be HFC-free. Today that number is 1.5 million HFC-free units, with nearly 100,000 of those units placed in North America.

**Emerson Climate Technologies** made a commitment in September 2014 to expand its product offerings that use CO<sub>2</sub> as a refrigerant. In the past year, Emerson introduced new compression technologies and also control technologies that drive energy efficiency improvements in CO<sub>2</sub> refrigeration systems. In addition, Emerson released a line of higher-efficiency refrigeration scroll compressors. Finally, construction of the Emerson Innovation Center that was highlighted as part of the September 2014 commitment is on schedule and the opening is planned for December 2015.

**Kroger** announced in September 2014 that it would join EPA's GreenChill program. In doing so, it also made commitments to establish a refrigerant management inventory and set emissions reduction targets; use advanced refrigeration technologies in new and remodeled stores where possible; and collaborate across the industry to identify and share service and operational practices that reduce emissions. In the past year, Kroger set a 2015 refrigerant emissions reduction goal of 5% for all systems with more than 50 pounds of refrigerant (with a stretch goal of 8%); committed to installing a stationary electronic emission detection system in all new stores; and opened its first store using a transcritical CO<sub>2</sub> refrigeration system.

**PepsiCo** announced in September 2014 a goal that all of its future point-of-sale equipment – coolers, vending machines, and fountain dispensers – purchased in the U.S. would be HFC-free by 2020. It also announced that it would begin purchasing new HFC-free equipment starting in 2015 in order to meet that goal. Following up on that commitment, PepsiCo anticipates that it will have placed approximated



275 new HFC-free units in the U.S. by the end of this year. In the past year, PepsiCo established a team to facilitate additional placements of these units by addressing barriers related to technology, regulation, supply chain, and serviceability. Also in the past year, PepsiCo established several training programs for its technicians to ensure that the highest standards are met for the new equipment.

**Red Bull** announced in September 2014 that it would order an estimated 32,000 climate-friendly hydrocarbon coolers for 2015 and implement ongoing training of cooler service technicians from six partner companies for the repair and proper disposal of those coolers. Both of those were intended to support its commitment to the 100% procurement of ECO-Coolers for the cooling of its beverages where technically and legally feasible. Following up on its announcement in September 2014, Red Bull has ordered more than 42,000 hydrocarbon coolers so far in 2015 and it anticipates that it will order 54,000 hydrocarbon coolers in 2016. In addition, 65% of all the coolers that it purchased in 2014 were ECO-Coolers. Finally, Red Bull has in the past year mandated and provided specialized training on end of life and repair of these coolers for all technicians handling hydrocarbon refrigerants.

**True Manufacturing** made a commitment in September 2014 to use only low-GWP refrigerants and low-GWP blowing agents in all future general use and refrigeration product development. It also made a commitment to develop low-GWP replacements for its existing products over the next five years. In the past year, True Manufacturing improved its production-line readiness so that it currently has the capacity to produce 70% of overall annual production in hydrocarbons. Also in the past year, it made 19 hydrocarbon models commercially available in its food service product line. By December 2015, True Manufacturing anticipates that 24 models will be commercially available in this product line. In addition, True Manufacturing anticipates that 90% of its Standard Glass Door Refrigerator product line will be available in hydrocarbons by December 2015 **MG**

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# ACCELERATE

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# HEAT EXCHANGER SOFTWARE ADVANCES NATURAL REFRIGERANT APPLICATIONS

CoilDesigner's latest upgrades incorporate small-diameter MicroGroove tubing, which supports CO<sub>2</sub> and hydrocarbon systems

– By Michael Garry



**I**n any refrigeration, air conditioning or heat pump system, the heat exchanger is where the action is – cooling the air in the evaporator, or heating the air in the condenser or gas cooler. The better the heat exchanger, the more efficient the equipment.

Over the past 15 years, the University of Maryland's Center for Environmental Energy Engineering (CEEE) has been developing heat exchanger design software called CoilDesigner that enables HVAC&R system designers and heat exchanger engineers to design and simulate heat exchangers that best meet their requirements. The software predicts vital metrics like heat-transfer coefficients and pressure drops for refrigerants and air.

Since 2009, Optimized Thermal Systems, Inc. (OTS), Beltsville, Md., has held an exclusive license for the software, making custom versions and providing commercial licenses to the industry.

"CoilDesigner enables you to design a wide variety of heat exchangers," said Cara Martin, chief operating officer of OTS. "It's not limited by real-world manufacturing constraints or by refrigeration type. Some designs can't be manufactured today, but in three to five years you could manufacture them. It's a tool to push the boundaries and come up with next-generation products."

CoilDesigner has been used to accurately design and simulate heat exchangers using natural refrigerants like CO<sub>2</sub> and propane. "We were able to design and build those heat exchangers, test them and find good agreement with the results predicted by the software," said Dennis Nasuta, engineering manager of simulation for OTS.

For example, OTS and others have used CoilDesigner to design heat exchangers using hydrocarbons (such as isobutane) or CO<sub>2</sub> for vending machines and cold beverage cases.

Worldwide, CoilDesigner is used by more than 60 companies, including HVAC&R system and heat exchanger manufacturers; some of those companies also sponsor R&D for the software at the University of Maryland.

### ACCOMMODATING MICROGROOVE TUBES

In March of this year, CoilDesigner took several steps forward as OTS, in concert with the International Copper Association (ICA), updated the software to include design data (known as correlations, which reflect the results of lab tests) for refrigerant-conveying copper tubing known as MicroGroove with diameters ranging between 3 mm and 5 mm. The data shows how refrigerants, including natural refrigerants, behave in these tubes in terms of heat transfer and pressure drop. (In addition to MicroGroove tubes, the software also designs microchannel and tube-in-tube configurations.)

MicroGroove tubes feature tiny grooves (also called microfins) of various designs in the interior surface of the tube, which can increase heat transfer by more than 20%, according to recent collaborative studies by OTS, ICA and Burr Oak Tool, Inc.

The tiny diameter and inner grooves of MicroGroove tubing offer several benefits to heat exchangers, including less weight, less refrigerant and lower material costs, as well as better heat transfer because of greater surface-to-volume ratio.

“Microfins can increase heat transfer by more than 20%”

The MicroGroove tubes work well with natural refrigerant applications. For example, the tubing is able to accommodate higher pressures without greater wall thickness, making it well suited for carbon dioxide. In particular, MicroGroove small-diameter tubes have been used in the manufacture of high-pressure gas coolers for CO<sub>2</sub> transcritical applications. In regard to propane, MicroGroove tubing enables heat exchangers to minimize the refrigerant charge, per federal requirements.

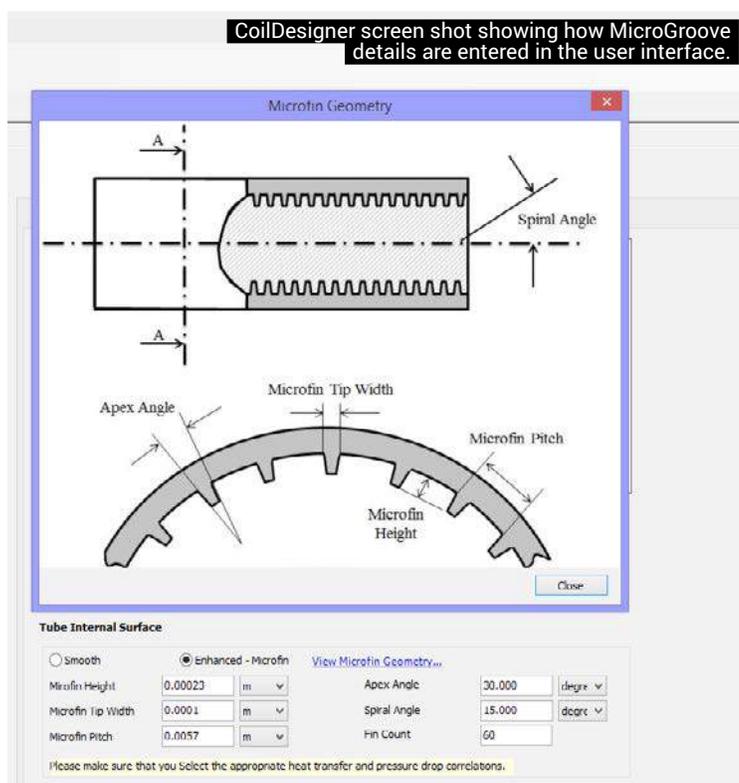
“One of the big challenges with flammable natural refrigerants, like propane, is the charge,” said Martin. By incorporating MicroGroove tubing, [CoilDesigner] “is able to make the system more compact and more efficient in terms of heat transfer performance, and consequently reduce the refrigerant charge to meet EPA requirements for various applications. Natural refrigerants then become a lot more feasible.”

Work over the summer has extended the initial effort in March to include more comprehensive design data for small-diameter Microgroove heat exchangers. Early next year, OTS will update CoilDesigner to enable prediction of both the refrigerant and air-side performance of a heat exchanger with small-diameter Microgroove tubes. “At that point, engineers will have all the capability they need to fully design and vet small-diameter MicroGroove tubes in heat exchangers,” Martin said.

While CoilDesigner can be and has been used to design heat exchangers that use propane, the software still lacks experimental data on the performance of propane specifically for small-diameter Microgroove tubes, noted Nasuta. “We need in the future to validate that experimentally.” Anyone who has this experimental data and is willing to share it can contact Nasuta or Martin at OTS.

Apart from its work with CoilDesigner, OTS is designing and building a CO<sub>2</sub>/geothermal air conditioner that will be part of a net-zero-energy demonstration house developed by the National Institute of Standards & Technology (NIST). The air conditioner will use ground-sourced water in concert with CO<sub>2</sub> as a refrigerant, along with 5 mm copper tubing in the evaporator’s heat exchanger. “We’re using CoilDesigner to design the heat exchanger and we’re working with vendors to finalize the design,” said Martin.

OTS also conducts heat exchanger and system-level testing for new HVAC&R applications and provides custom design and optimization to address energy and environmental challenges, including evaluating the potential for alternative refrigerants **MG**



# SANDEN SET TO EXPAND CO<sub>2</sub> COMPRESSOR MARKET

The Japanese compressor maker behind Coca-Cola's global conversion to CO<sub>2</sub> vending machines and coolers, Sanden is gearing up production in China to support other end users of the natural refrigerant

— By James Ranson

Beverage companies and foodservice operators committed to using natural refrigerants in their display coolers and vending machines inevitably come to a fork in the road; one path leads to using carbon dioxide as a refrigerant, the other to using a hydrocarbon like propane or isobutane. A choice needs to be made.

Most companies, including major players like Red Bull, PepsiCo and McDonald's, have opted for hydrocarbons, while Coca-Cola has bucked that trend to become the primary follower of the CO<sub>2</sub> path, using Gunma, Japan-based Sanden as the maker of its compressors. (See "Coke's Quest to Reinvent Refrigeration," *Accelerate America*, March 2015.)

Sanden, through its Sanden Shanghai Thermal Environmental System subsidiary, is gearing up its production of CO<sub>2</sub> compressors to not only serve Coke but also expand the market to other companies opting for CO<sub>2</sub> to refrigerate their vending machines and coolers.

In so doing, Sanden will stretch its production capacity to more than one million reciprocating CO<sub>2</sub> compressors annually, positioning itself as the leading maker of this type of compressor for vending/display applications in the world, the company says.

At present, Sanden has a handful of other domestic and global clients aside from Coke. "Our business is mostly with Coca-Cola for now, but yes, we are strategically marketing our products to attract more customers," said Mamoru Yajima, general manager of Sanden Shanghai, adding that sales strategies are developed and implemented by "our team in Japan."

Sanden has already fielded inquiries from a number of end users and has the ability to increase the capacity of its facility to meet new demand, Yajima said.



After starting production in 2010, Sanden Shanghai started selling compressors the next year at a rate of two thousand units annually. Now the company projects that figure to reach 1.2 million by 2017.

Currently, the company's 43,056 ft<sup>2</sup> facility in Jiading, Shanghai churns out 2,500 CO<sub>2</sub> compressors a day (roughly 60,000 a month) and has the capacity to increase production to accommodate any additional demand. Sanden distributes its compressors globally to a number of regions including India, U.S., China and Europe.

Sanden Shanghai's products cover three main refrigeration applications – open showcases, vending machines and visi-coolers – with its CO<sub>2</sub> compressors covering a performance range of 0.2 kW to 1.8 kW. "We have five basic models of different sizes and capacities," Yajima says. "These models are further adjusted so that they can be used in different countries with different voltages."



## FOCUS ON EFFICIENCY

Walking the vast grounds of the company's Shanghai facility, a short journey northeast of Pudong International Airport, it's easy to be swept up by the enormity of the operation. The facility includes two production lines, the second of which was installed in 2013. This important step in the company's history increased production capacity by nearly 300%, from 220,000 units a year to 800,000 in 2015.

Despite its ambitions, Sanden has no short-term plans to expand the facility with a third production line, Yajima said. "Our efforts are focused on increasing the efficiency and productivity of the existing two lines to achieve our production target. We may, however, need to make some adjustments eventually to upgrade those lines."

Given the sheer volume of compressors produced by Sanden's two lines, Yajima expects the cost of manufacturing each unit to fall by around half compared to the first ones rolled out in 2010.

Sanden Shanghai was founded in August 2010 as a joint venture between Sanden Japan and a Chinese partner. Initially the

business structure represented a 51-49 percent split (Sanden Japan-Chinese partner) but following Sanden's increase in capital in 2013 and the addition of the second production line, the ownership ratio changed to the current structure of more than 80-20. Sanden Japan is responsible for sales, customer service, and technology, while the Chinese partner provides production resources, purchasing capacity, and human resources.

Sanden and its Chinese partner, which is also its joint venture partner for automobile compressors, "have built trust with each other based on our long-standing relationship," said Yajima.

Yajima described the Jiading base as "one of the most important in the Sanden Group." Its focus is on producing 100% of Sanden's reciprocating compressors, while scroll compressors and core systems are manufactured in the company's Japanese factories.

Sanden Shanghai employs around 260 people, including employees from both Sanden and its Chinese partner.

Yajima said the company was immensely proud of its status as a leading CO<sub>2</sub> compressor manufacturer. "If we weren't proud of ourselves, we, together with all our employees, would not have become what we are today," Yajima said. "We take great pride in our work and do our jobs to the best of our abilities."



Part of Sanden Shanghai's CO<sub>2</sub> compressor production line.

continued on p.54

## SANDEN'S CO<sub>2</sub> COMPRESSOR PRODUCTION



### 2011



2200 UNITS

X100

### 2013



220,000 UNITS

X3.6

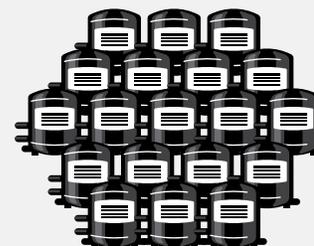
### 2015



800,000 UNITS

X1.5

### 2017



1.2 MILLION UNITS

From Shanghai production site, per annum

## → HISTORY WITH COKE

Sanden remains steadfast in its view that CO<sub>2</sub> is the optimal refrigerant for most marketing and point-of-sales equipment. And no company has helped support Sanden's business model more than Coca-Cola, which aims to be HFC-free by the end of 2015.



At the ATMOsphere America 2015 conference, held in Atlanta in June, Coke's global program director Antoine Azar said the company had reached an "inflection point" in the company's HFC-free system adoption, asserting that CO<sub>2</sub> is the refrigerant that best fits Coke's portfolio of equipment.

As of the first fiscal quarter 2015 Coca-Cola had installed 1.48 million HFC-free units, a large portion of which would not have been possible without Sanden.

To make this happen, Sanden had to overcome some early supply chain and productivity obstacles.

"When we started out, we had a supply agreement with Coca-Cola, but we had a delay for a number of reasons," Yajima said. "One is that we had some component supply issues, and also the productivity did not increase as we had expected."

The two problems were related, he explained. "It was our first production here in Shanghai and we needed to find effective solutions for our operation but were basically starting from scratch. Without proper component supplies, it goes without saying that we cannot keep our production lines running."



Those teething issues are now just a distant memory to Yajima, who has been in his role, with Lin Zhiping as his deputy general manager, for the past two years. Zhiping has overseen the project from the very beginning.

Now the facility can deliver a CO<sub>2</sub> compressor for a customer's showcase and vending machine in one-and-a-half months due to the updates to the supply chain. "Our customers have different time frames for their businesses, and we strive to cater to their specific demands," Yajima said. "When we talk about quality, it includes not only the quality of the products itself, but also our ability to deliver the products to our customers when they need them by shortening the lead time."

Sanden's new automatic quality control system takes a lot of the heartache out of the company's quality control processes. "We have automatic sensors in place that detect, for example, when components are picked up," Yajima noted. "These sensors also prevent any possible human errors from going into the production process."

Yajima understands the critical role the company is playing in commercializing CO<sub>2</sub> technology on the largest scale possible and the example it is setting for others to follow. "We are continuously striving to lead the industry with our CO<sub>2</sub> technology," he said. **JR**

CO<sub>2</sub> compressors made by Sanden Shanghai





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