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NORTH AMERICAN EDITION #1, NOVEMBER 2014

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DISRUPT & ACCELERATE

"Natural Refrigerant"-based technologies are disrupting the HVAC&R industry in North America.

Behind this wave of innovation are people with brilliant and creative ideas who are designing and using functioning technologies in brand new ways to meet exciting new business opportunities. These are the people, ideas and technologies that we want to cover in *Accelerate America*.

We firmly believe that this new era of market competition between natural refrigerants and synthetic refrigerants will drive down costs, improve efficiencies, reduce energy consumption and have a reduced impact on the environment. This is what all customers want.

Accelerate America will showcase the best of these natural refrigerant-based technologies across all segments of the growing HVAC&R industry. We will look at all aspects of the industry. Everywhere refrigerants are used, we will go. Whether for heating or cooling, large or small. We will explore CO₂, ammonia, hydrocarbon, water and air-based solutions. We will start with the all-important end-user experiences with new applications and the ever-changing regulatory environment, right through to training and servicing. We will

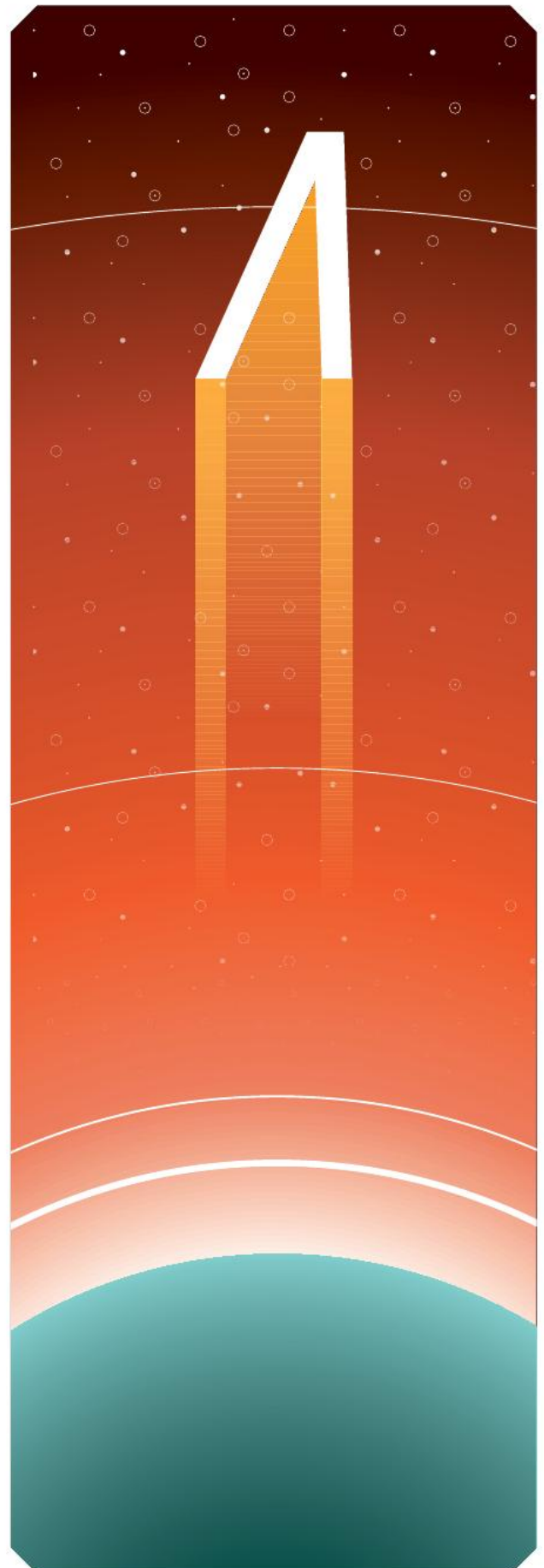
share best practices, opinions and expertise from industry leaders of today but also keep a keen eye on the next generation of business leaders, engineers, technicians and students, who will come into a far more complex industry full of opportunity.

Importantly, we will ask all questions and not shy away from discussing the challenges of natural refrigerant-based technologies.

Next month we will publish our editorial calendar highlighting topics and events that we will cover during the coming year.

Until then enjoy our first issue and feel free to send me your comments at marc.chasserot@shecco.com

● MC



ACCELERATE

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ABOUT ACCELERATE AMERICA

Brought to you by shecco, the worldwide experts in natural refrigerant news, *Accelerate America* is the first 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>



 @AccelerateNA



Editors' notes

Moving the needle by Michael Garry
Heading to the future by Janaina Topley Lira



Events planner

From November 2014 to January 2015



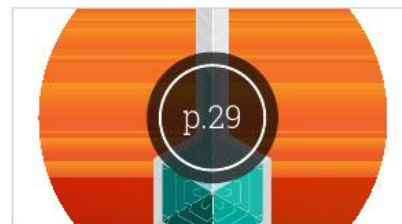
Opportunity in a SNAP



"No more retrofits,"
says Food Lion



Roundy's money-saving
CO₂ System



2014 FMI Energy & Store
Development Conference



Canada to align with the US on limiting
the use of HFCs



New alliance addresses growing US
demand for CO₂ commercial refrigeration



Featured interview with **Harrison Horning** from **Hannaford Supermarkets**

Does transcritical CO₂ refrigeration deliver?

Hannaford reports encouraging results so far with the first CO₂-only refrigeration system in the U.S.

The modest-sized Hannaford supermarket in Turner, a bucolic town of about 6,000 in southern Maine, greets shoppers entering the parking lot in the customary way. There's the red Hannaford logo, festooned with a colorful image of fresh produce, above the entrance. To the left, an American flag hangs from the top of a tall pole. Inside, the frozen food aisle looks like any other, cabinets on either side stocked with product... [continued p.16](#)



US government teams up with private sector to accelerate commercialization of HFC-free equipment



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ISSUE #1

Publisher **Marc Chasserot**
marc.chasserot@shecco.com
[@marcchasserot](https://twitter.com/marcchasserot)

North American Editor **Michael Garry**
michael.garry@shecco.com
[@mgarrywriter](https://twitter.com/mgarrywriter)

International Editor **Janaina Topley Lira**
jana.topleylira@shecco.com
[@JanaTopleyLira](https://twitter.com/JanaTopleyLira)

Contributing Writer **Keilly Witman**

Contributing Writer **Nina Masson**

Contributing Writer **Klára Skačánová**

Contributing Writer **Elke Milner**

Advertising Manager **Franziska Menten**

Designer **Mehdi Bouhjar**



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Welcome to the first issue of Accelerate America!
by **Michael Garry**



MOVING THE NEEDLE



Our mission is straightforward: to inform readers about how natural refrigerants – such as carbon dioxide, ammonia, propane and water – are being used in HVAC&R applications across industries in the U.S., Canada and Mexico. In so doing, we hope to advance – indeed, accelerate – adoption of natural refrigerants in North America.

Accelerate America is making its debut at a pivotal time, both for users of HVAC&R systems and for humanity as a whole, as the issue of climate change grows in significance with each passing day. In September, more than 400,000 people from around the world walked through the streets of Manhattan in the People's Climate March to call attention to the growing threat to the climate from greenhouse gas emissions and demand that something be done about it.

Among the fastest-growing and most potent greenhouse gases in the world are HFC (hydrofluorocarbon) refrigerants. One remedy for climate change – which is closer to realization than many other remediation measures – is shifting away from HFCs and other synthetic gases to natural refrigerants, whose effect on the atmosphere is benign.

Using natural refrigerants in lieu of HFCs is not only an environmental win; it is also potentially a business win for end users like retailers, warehouses, truckers and corporations, from the perspective of efficiency and maintenance as well as total cost of ownership. Companies around the world are coming to this realization.

Though lagging behind Europe and Japan, North America is beginning to undergo a sea change in the adoption of climate-friendly refrigeration technology. Sobeys, Canada's second-largest grocery chain, has led the way with the installation of transcritical CO₂-only systems throughout Quebec and in other parts of the country. And here in the U.S., we're seeing a growing number of single-store tests of transcritical equipment, as well as pilots of propane- and ammonia-based refrigeration solutions.

In *Accelerate America*, through a combination of news and feature stories that place a heavy emphasis on end users of HVAC&R equipment, we will show how the transition to natural refrigerants can be accomplished. In this first issue, we look at transcritical CO₂-only refrigeration tests at two East Coast Delhaize chains, Hannaford Supermarkets and Food Lion, and at Roundy's, a Midwest retailer. Future issues will continue to cover activity at food retailers but will also encompass many other end-users of HVAC&R equipment, from transportation to industrial to corporate to residential.

Together, let's move the needle on adoption of natural refrigerants in North America **MG**

by Janaina Topley Lira



HEADING TO THE FUTURE



When *Back to the Future II*'s time-traveling DeLorean blasted Marty McFly and Doc Brown to the future, they arrived on October 21, 2015. While the sci-fi comedy predicted some things about the future correctly (playing video games without hands, for example), I wonder if they would have correctly predicted that we would be using a century-old technology to preserve and refrigerate food and other substances, as well as provide comfort heating and cooling.

The use of natural refrigerants such as CO₂ and ammonia dates back to the 1890s, but these fell out of favor with the advent of synthetic fluorocarbon refrigerants in the 1930s. Much of the refrigeration and air conditioning equipment used in North America today relies on these refrigerants.

However, their high global warming potential (GWP), and the potential of these chemicals to cause damage to the ozone layer, have brought a return to natural refrigerants, with CO₂, ammonia, and hydrocarbons such as propane and isobutane, finding their way back into a number of different applications.

We have come full circle, or "back to the future."

With an editorial focus on leadership and cutting-edge solutions, *Accelerate America* will track the upswing in natural refrigerant investment in

North America. While this will depend heavily on government policies, investment incentives and company behavior, the continued future growth of natural refrigerant technology looks set to become a reality.

For example, in addition to the 130+ CO₂ refrigerated supermarkets in the US and Canada, The Coca-Cola Company and Unilever have installed several thousand fluorinated-free refrigeration units of various sizes across their North American operations.

These viable refrigerant alternatives will not be familiar to all, but *Accelerate America* can help to draw attention to their benefits, as well as look into the challenges faced by the market to make the technologies more widespread.

Providing insights to the market potential for natural working fluids, our magazine will allow

for a better understanding of the business opportunities for CO₂, ammonia, hydrocarbons and water as refrigerants in the US, Canada and Mexico.

I would like to see North America take the lead in addressing the growing demand for HVAC&R using climate friendly refrigerants, and inspire global action for the benefit of coming generations **JTL**

ACCELERATE

ADVANCING HVAC&R NATURALLY M A G A Z I N E

Never miss an issue



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EVENTS PLANNER

November 2014 to January 2015



1 November 4-7 – Atlanta, GA, U.S.
RETA 2014 National Conference
www.reta.com/pages/conference-details

2 November 2-5 – Chicago, IL, U.S.
PACK EXPO
www.packexpointernational.com

3 November 16-18 – Carlsbad, CA, U.S.
2014 AHRI Annual Meeting
www.ari.org/site/415/News-Events/Meetings-and-Events/AHRI-2014-Annual-Meeting

4 January 21-23 – Washington, DC, U.S.
SAE Government/Industry Meeting
www.sae.org/events/gim

5 January 24-28 – Chicago, IL, U.S.
ASHRAE 2015 Winter Conference
<http://ashraem.confex.com/ashraem/w15/cfp.cgi>

6 January 25-28 – Orlando, FL, U.S.
StorePoint 2015
www.storepointevent.com

7 January 26-28 – Chicago, IL, U.S.
AHR Expo
www.ahrexpo.com

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OPPORTUNITY IN A **SNAP**

by Keilly Witman

Those who pay attention to the goings-on at the Environmental Protection Agency (EPA) have probably noticed the recent proposal by the Significant New Alternatives Policy (SNAP) program to make it illegal to use certain HFC (hydrofluorocarbon) refrigerants that are potent global warming gases in new commercial refrigeration equipment and retrofits as of January 2016.

Manufacturers of equipment that uses natural refrigerants may be wondering if this EPA proposal represents an opportunity for them. The answer to that question is a definite “maybe,” depending on the type of commercial equipment they manufacture and where they are in the development process.

Manufacturers of commercial refrigeration systems or the components used in these systems are unlikely to feel a direct effect from the proposal. There are still plenty of HFC refrigerants available for commercial systems, such as R-407A and R-407F, so systems manufacturers are not (yet) being forced into natural refrigerants. Manufacturers may see an indirect effect, however, because even though the proposed rule doesn’t directly dictate that end-users must use natural refrigerants, end-users may view it as the EPA’s first step in that direction and interpret this proposal as a not-so-gentle electric shot to their derrières.

Many supermarket end-users have already been investigating natural refrigerant commercial equipment, perhaps even trying them out in a store or two. When asked by their colleagues why they install these systems even though they are currently more expensive than traditional systems, they usually respond that they think it is important to get out in front of the EPA, so that they are ready when the agency starts to phase down or eliminate HFCs. They want to start evaluating natural refrigerant systems at their own pace and influence the designs where necessary to make the technologies work for them. They realize that the first natural refrigerant system they install may not be the cheapest one available, but they are banking on the fact that they’ll work out the kinks and get to the point where these systems make financial sense. They think that starting with natural refrigerant systems now will give them a competitive advantage later when everyone else is forced to make the switch on the government’s timetable.

The equipment manufacturers now working with these end-users will be ahead of the game when natural refrigerants become mainstream. They will have benefited from the expert input from end-users at all stages of the design phase, as well as from valuable feedback from end-users and service technicians on improvements in the ease and cost of installation. They will have gathered proof that natural refrigerant systems reduce costs through energy efficiency gains, decreased line sizes for piping, etc.

Most of the major systems manufacturers saw the writing on the wall that the EPA was going to start to move the market in the direction of lower-GWP (global warming potential) refrigerants. The EPA has not made a secret of its desire to combat global warming, and it hasn’t minced words about refrigerants being one of the opportunities to quickly make major greenhouse gas cuts.

continued on p.14

SNAP END USES (Red indicates proposed rule change)					
		Systems	Condensing	Self-Contained	Vending
R E F R I G E R A T I O N S	R-744 (CO ₂)	Yes	Yes	Yes	Yes
	R-717 (ammonia)	Yes	Yes	Yes	not yet submitted for SNAP review
	R-290 (propane)	No/Maybe	No/Maybe	Yes	proposed
	R-441A	not yet submitted for SNAP review		proposed	proposed
	R-600a (Isobutane)	not yet submitted for SNAP review		proposed	proposed
	HFC-134a	Yes	Yes	NO*	NO*
	R-404A	NO	NO	NO	NO
	R-407A	Yes	Yes	NO	NO
	R-407C	Yes	Yes	NO	NO
	R-407F	Yes	Yes	NO	NO
T S	R-422A&D	NO	NO	NO	NO
	R-507A	NO	NO	NO	NO
	HFOs/HFO Blends	not yet submitted for SNAP review			

*allowed in retrofits; not allowed in new units

source: EPA

→ The agency has attempted for the past several years to get the Montreal Protocol to act against HFC refrigerants. They have started an international organization called the Climate and Clean Air Coalition with more than 80 partners around the globe to address HFCs and other potent global warming gases. The EPA's GreenChill Partnership has been consistently preaching that supermarkets should be using the lowest GWP refrigerant that meets their performance needs. EPA plenary presentations at the Food Marketing Institute's annual Energy and Store Development Conference have focused on the list of lower GWP refrigerants that are available for commercial refrigeration and presented the history of refrigerant use as a series of moves over decades that will eventually lead to the use of very low GWP refrigerants (see diagram). The EPA has held numerous webinars on lower GWP refrigerants that are available for commercial refrigeration and focused on CO₂ systems, ammonia systems, and hydrocarbons, which are already in use in U.S. supermarkets. The manufacturers that did not see this coming have not been paying attention.

MORE TIME NEEDED

Take the manufacturers of self-contained commercial refrigeration units as an example. Many of them testified at an EPA hearing in August on the proposed delisting rule that they need more time to convert their equipment to use lower GWP refrigerants. There is no doubt

that their R&D process will take several years, as will line conversion at manufacturing facilities and the process to get new equipment tested for safety and certified by a Nationally Recognized Testing Laboratory.

That's not to say that there aren't plenty of self-contained equipment companies that saw that the EPA was going to move in this direction. There are several that are ready to supply the market demand for self-contained refrigeration units that use hydrocarbon and CO₂. They are ready for January 2016, and they definitely have a competitive advantage over companies that lag behind them.

But isn't that as it should be in our system that thrives on innovation, smart decisions, and visionary leadership? Should the EPA give more time to companies that failed to see or ignored what was coming? Or is this natural selection at work in our capitalist marketplace? Yes, the free market is cruel. Survival of the fittest makes easy prey of those who don't change with the times.

Whether the EPA gives more time to self-contained equipment manufacturers that lag behind will depend in part on whether companies that already have this equipment will be able to supply 100% of the demand for that equipment as of January 1st, 2016. If they can't meet the demand, or if there are too few manufacturers to provide healthy competition, the EPA will likely give others a few years to develop their capabilities.

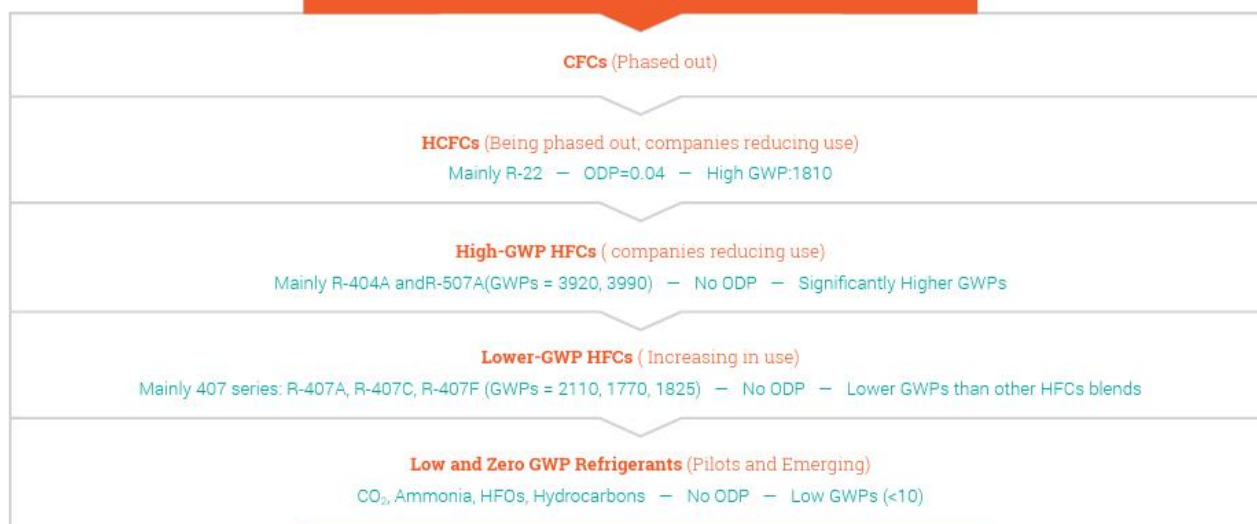
Even if self-contained commercial equipment manufacturers are given more time to bring low GWP refrigerant equipment to market, companies that are ready now will still have an advantage. End-users don't want to wait until regulations go into effect to start trying out new equipment. They want to figure out whether units that use hydrocarbons or CO₂ save energy, whether size requirements will change, even whether it is possible to use self-contained units to refrigerate all the food in small footprint stores. They want equipment now.

Companies that stop everything to try to fit a lot of R&D and manufacturing changes into a few years will also suffer from the disruption to their business caused by having to focus all their human resources, time, and financial resources to make this switch as soon as possible. During this time, they won't have any people, energy, or money to focus on much else. In the meantime, companies that are ready now can focus on next-generation technology over the next five years to remain ahead of everyone else. And that may be as it should be **OKW**

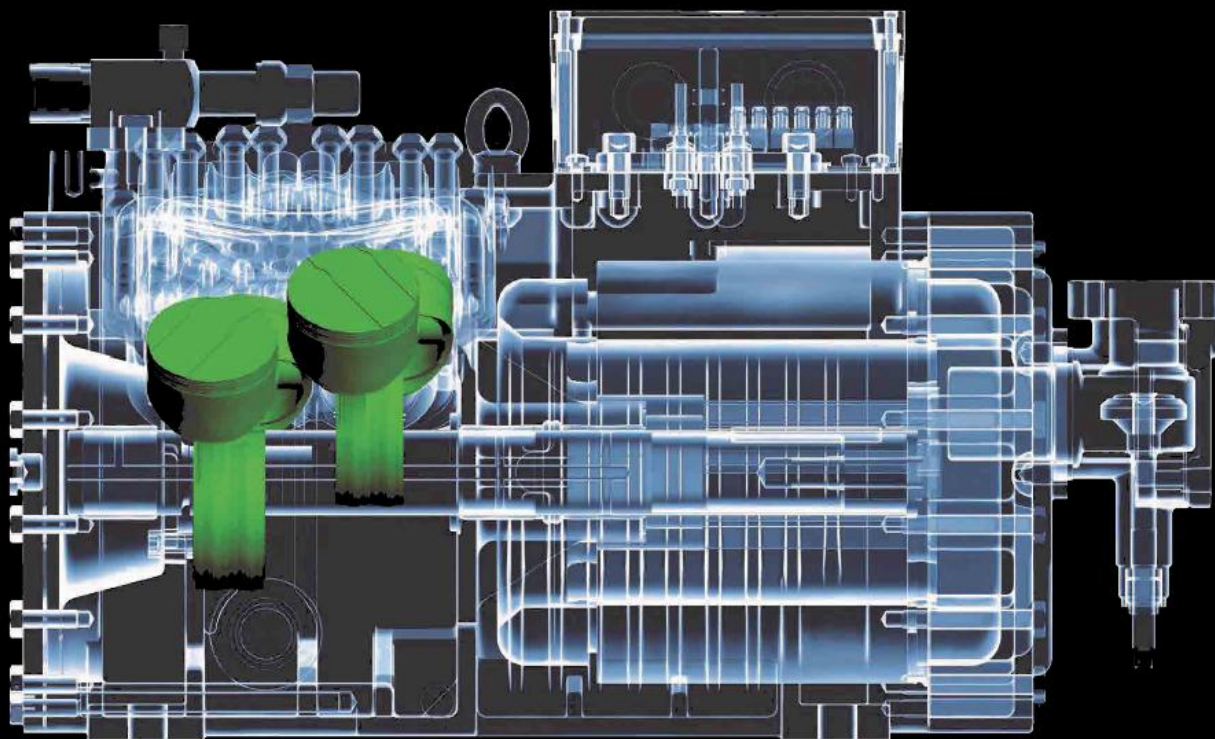
About the Author

Keilly Witman is owner of KW Refrigerant Management Strategy, former manager of the Environmental Protection Agency's GreenChill Partnership and a contributing writer for *Accelerate America*.

Trends in Refrigeration GWP



Source: FMI Energy & Store Development Conference 2012



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Bitzer

A man with short, light brown hair is smiling and looking slightly to the right. He is wearing a blue and white vertically striped button-down shirt. The background consists of a light-colored wall and green foliage. The lighting is bright, suggesting it's daytime.

DOES TRANSCRITICAL CO₂ REFRIGERATION DELIVER?

Hannaford reports encouraging results so far with the first CO₂-only refrigeration system in the U.S.



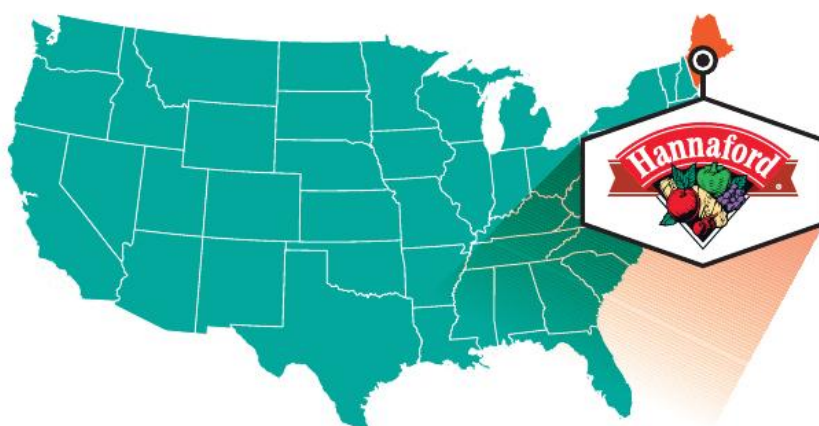
Exclusive interview with

HARRISON HORNING

from Hannaford Supermarkets

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Turner Maine



by Michael Garry

→ Yet for all its familiarity, there's something radically different going on here that even the most discerning shoppers can't see. For this 36,000-square-foot store is the first in the U.S. to expand the boundaries of refrigeration technology with the installation of a transcritical booster system that only uses a natural refrigerant – carbon dioxide – to keep food chilled or frozen. It employs none of the HCFCs (hydrochlorofluorocarbons) that deplete the ozone layer when they leak into the atmosphere or

the HFCs (hydrofluorocarbons) whose emissions contribute significantly to global warming.

The Turner store, which opened in July of 2013, now has more than a year of experience with transcritical technology under its belt. Hannaford Supermakets, based in Scarborough, Maine, not far from Turner, has begun assessing whether the all-CO₂ refrigeration system has met its needs and expectations and, most significantly, whether it can serve as the chain's standard model in

the future in place of the current prototype, a customized direct expansion (DX) system that relies on an HFC refrigerant (R-407A).

In short, the burning question for Hannaford – and for food retailers throughout North America – is this: Does transcritical refrigeration deliver? That is, does it offer an efficient, economical and reliable alternative to systems that use environmentally destructive synthetic refrigerants?

THE MOST FASCINATING CHALLENGE



Harrison Horning, director of energy and facilities for Hannaford, has been making the rounds this year of industry conferences, including shecco's ATMOsphere America conference in June and the Food Marketing Institute's Energy & Store Development Conference in September, where he has been providing updates on the transcritical system's performance. At the FMI Energy & Store Development Conference in St. Louis, he sat down with *Accelerate America* to elaborate on what he has been telling conference attendees.

Hannaford never intended to be the first U.S. supermarket with a transcritical system, Horning said. "We went through a process to select a supplier [Carnot Refrigeration, Trois-Rivieres, Quebec] to partner with and to help us figure out a design and hold our hands all the way through. Once we got moving, it moved right along and we ended up being the first one in the country."

Tall and trim with some resemblance to the actor Harrison Ford, Horning earned a bachelor's degree in nuclear engineering at Rensselaer Polytechnic Institute and a master's in energy engineering at the University of Arizona. During his 30-plus-year career (including the last 14 at Hannaford), he has engaged in some compelling engineering projects, such as the Trident submarine and Biosphere 2. Yet he calls the transcritical pilot

"the most fascinating technical challenge I think I've ever worked on."

It's the challenge – and how he can work with others to address it – that most drives him. "That kind of keeps me going," he said. But there's a moral component as well. "We as retailers all have a responsibility to address this challenge," he advised the audience at the FMI Energy & Store Development Conference.

"I like to feel like I'm doing good for the environment," he told *Accelerate America*. His two sons, ages 19 and 22, "appreciate the value [of the project] to the environment," he added.

But Horning, who oversees more than 70 employees in the engineering department at Hannaford, knows full well that the adoption of a natural refrigerant-based system ultimately depends on whether it makes economic sense. "Dollar signs will never go out of style," he said at the FMI Energy & Store Development Conference, acknowledging the difficulty in making capital investments in the low-margin supermarket business.

To that end, he is taking a close look at the key cost factors underlying the investment in transcritical: reliability, energy efficiency,

maintenance, up-front price and installation. His overall impression: "I'd say it's delivered pretty close to my expectations."

Reliability was Horning's biggest concern about using a transcritical refrigeration system, but so far it's been good. "There's been relatively little downtime – nothing noticeably different from a standard system, nothing that has affected the product," he said. "So in that area, it's delivered very well."

One of the chief concerns associated with the reliability of a transcritical system is the high pressure that it can sometimes experience. To date, however, this has never been an issue at the Turner store, said Horning. The system is designed with stainless steel piping in high-pressure areas, special evaporators to accommodate higher pressures, and relief valves that are set for pressures ranging from 580 to 1,740 psig. "The relief valves are piped to locations where they pose no danger if they lift," he said.

OK, but what about efficiency? Horning evaluates this by measuring the total energy (electric and gas) used in the store – "the energy bills we pay each month," he said. On this basis, the Turner supermarket consumes 187 KBTUs/square foot/year. That is a little higher than at Hannaford's

two most efficient stores of a similar size in a comparable climate (167 and 179) but lower than a similar store in an older format (202).

"I honestly did not expect it to beat our [best] existing system and it hasn't, but it's in the ballpark," said Horning. "And I'm fully confident that with a little bit of focus on it and a few iterations, we can get it equal to or better than our existing systems."

Horning looks at the stores' overall energy consumption – not just that of their refrigeration systems – because of the interaction of the systems' heat generation with the stores' HVAC equipment. At the Turner store, for example, the transcritical system supplies considerable heat via a series heat reclaim component. "In a cold climate [like Maine's], heat reclaim is really important in the total economics and total cost of ownership of the system," he said at the FMI Energy & Store Development Conference.

On a daily basis, the transcritical CO₂ store's total energy consumption generally fell between a comparable new DX store, which was more efficient, and an older DX store. The transcritical store's consumption dipped below even the new DX store in the spring and fall, but spiked above it during the winter "when it was pushing to get heat," and in the summer "when it's pushed into the transcritical range [above the critical point] for some hours," said Horning.

He also separately tracked the daily gas and electric energy usage of the three stores and found a similar pattern, with greater variability in the electric energy consumption at the transcritical store compared to the others. He also recently finished analyzing the kilowatt-hours consumed by the individual compressor racks and found that "the transcritical CO₂ system can be very efficient when condensing temps are not too high."

One factor left out of the analysis is heating-degree days, which is a reflection of the coldness of the winter and the heat thereby required. Turner, for example, has a higher level (about 7,600) than a comparable store in Portland, Maine (7,100).

Hannaford's location in Maine's relatively colder climate makes its stores particularly suitable for the transcritical system, noted Horning. "Because of our climate, I'm convinced we can make transcritical work." In a colder climate, the system is less likely to enter the less efficient transcritical mode (although manufacturers are beginning to design transcritical systems that can work well in warmer climates).

Maintenance costs for the transcritical system have also been comparable to those of Hannaford's conventional DX systems, with two exceptions. First, CO₂, at roughly \$1 per pound, is much less expensive to replace than HFCs. On the other hand, Hannaford is paying an extra monthly fee for a remote monitoring service provided by Carnot. "That's because this is a pilot," Horning said. "Once we get up the learning curve we won't need to do that anymore."

In the meantime, Horning identified coordinating

with Hannaford's IT department to maintain the remote monitoring service as the biggest challenge he has faced in implementing the transcritical system. He had to "jump through extra hoops" to make sure the service met IT security standards; in addition, if Hannaford loses the remote link, "sometimes it takes longer than it should to get it back," he said.

The local service technicians who oversee the transcritical system are Hannaford's in-house employees, making it "easier for us to manage training and ongoing service," said Horning. The in-house techs have worked on the system since its inception, gaining a sense of "ownership" in it. "It wasn't just foisted on them. That's important to anybody getting into it."

Horning acknowledged that the up-front cost of the transcritical system was higher – "not a huge number" – than that of a conventional DX system. Moreover, Hannaford spent more on cases, which have special evaporators to accommodate higher pressures. Because of the higher costs, the payback on a transcritical system is currently more than the four years that Hannaford generally requires.

But Horning fully expects these costs to decrease over time, enabling a four-year ROI by 2017. "As more competitors enter the market and they produce more volume, the [cost] trend is downward." In his presentation at the FMI Energy & Store Development Conference he cited shecco data showing a drop in the premium paid for CO₂ booster systems.

Though the up-front cost of a transcritical system may be higher than that of a conventional system, the installation cost is less, said Horning. That's because it uses smaller-diameter copper piping, cutting material costs and the labor needed to braze pipes together.



MORE ON THE WAY

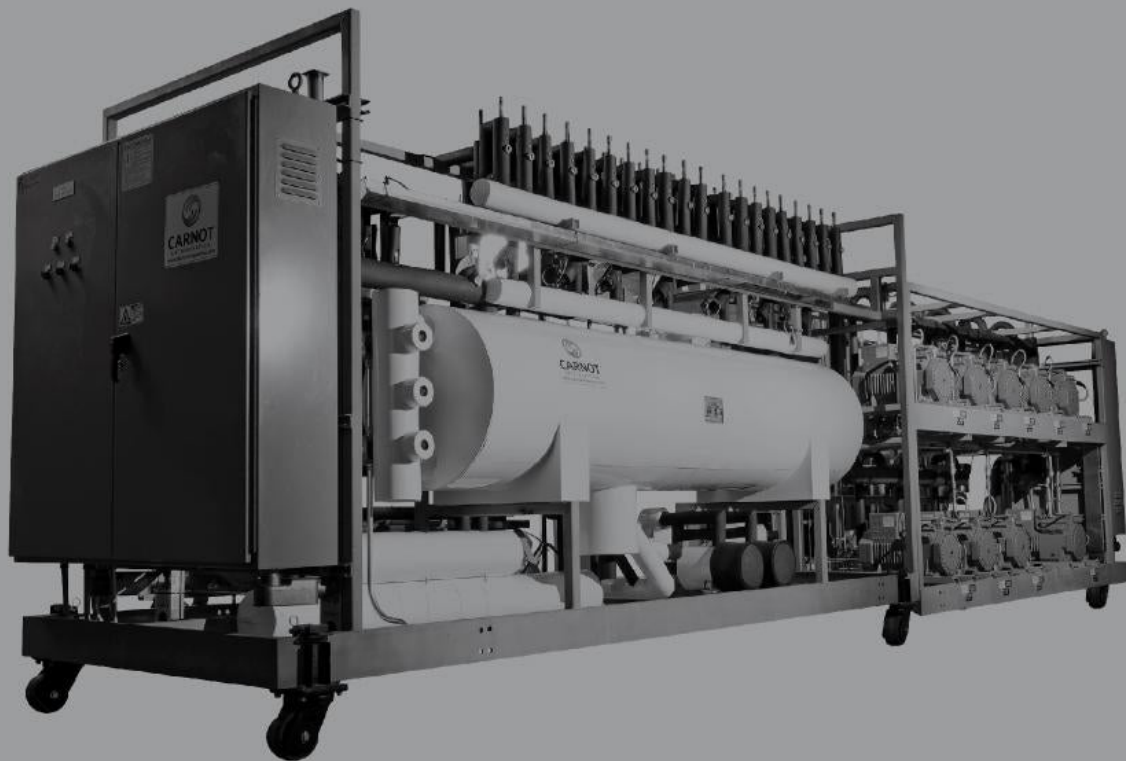
Hannaford, which operates more than 165 stores in five Northeastern states, will continue running transcritical pilots to gain more experience, probably one per year in new stores over the next few years. "We don't intend to make a long term

decision based on one project," Horning said at the FMI Energy & Store Development Conference. "We're going to do more and look at thousands of other projects out there in Europe and worldwide." Hannaford's sister company in the U.S., Food

Lion – both are divisions of Belgium-based Delhaize Group – also plans to test transcritical technology. (See story, page 24.)

continued on p.21

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→ Hannaford will consider other suppliers for future transcritical projects, Horning said. “The next store could be a different design; it could be a smaller or bigger store.” Carnot was selected for the first pilot in part because it had a track record of success with Sobeys stores in a similar climate.

In addition to testing transcritical at new stores, Hannaford has an eye on eventually transitioning existing supermarkets with aging equipment to the CO₂-only technology, particularly in stores being remodeled. “A large part of it is asset management in terms of the remaining useful life of [refrigeration] assets,” said Horning.

In such a remodel, in order to keep the doors open, the store would run the original refrigeration system while the transcritical unit was being installed.

Hannaford is buttressing its transcritical test in a number of ways. For one thing, the retailer is an original member of the U.S. Environmental Protection Agency’s GreenChill Partnership, a seven-year-old voluntary program in which food retailers voluntarily try to achieve leak-reduction goals while testing advanced refrigeration technology.

Last year, the Turner store received the highest GreenChill certification award – platinum – for its

elimination of HFCs, as well as GreenChill’s “best of the best” for having the most environmentally friendly refrigeration system of any certified store.

GreenChill has also helped Hannaford deal with the conundrum surrounding the EPA-mandated phasedown of ozone-depleting R-22, which has been removed from 75% of its stores. “We had this need to phase out [R-22], knowing full well that the HFCs we were using [in R-22’s place] were going to have issues,” said Horning. “The GreenChill Partnership gave us a forum where we could get together with other supermarket operators and government people and suppliers and really start getting out arms around it.”

continued on p.22 →



System Specs

Hannaford’s transcritical booster system, from Carnot Refrigeration, Trois-Rivieres, Quebec, has the following features:

- Low-temperature capacity of 259,800 BTUs/hour, generated by 3 Bitzer 2DSL-5K compressors.
- Medium-temperature capacity of 898,200 BTUs/hour, generated by 6 x Bitzer 4 FTC-20K compressors.
- UL-approved compressors and controller.
- Glycol heat reclaim.
- Warm gas defrost system.
- Micro Thermo control systems from Parker Sporlan.
- As a back-up, one of the compressors and the gas cooler are linked to an emergency generator. “If we lose power we have enough to keep it running at least four hours, which is enough time to get product taken care of,” said Harrison Horning, director of energy and facilities for Hannaford Supermarkets.



→ Hannaford's refrigeration efforts have also been guided by its parent company, Delhaize Group, which aims at reducing its carbon footprint 20% globally by 2020, compared to a 2008 baseline. Delhaize is "halfway there, and on track" to reach its goal, said Horning.

As a member of the Consumer Goods Forum, a Paris-based consortium of food retailers and packaged goods manufacturers, Delhaize Group has joined the Forum's resolution to begin phasing out of HFC refrigerants by 2015. The Turner pilot, as well as another transcritical pilot store in Belgium, are evidence of that commitment, said Horning. "The Consumer Goods Forum's resolution really put some urgency to [the transcritical pilots] in terms of timing," Horning said.

Another motivation for testing a CO₂-only system is the growing vulnerability of HFCs, given the movement by the EPA to delist those with high global warming potential (GWP), as well as the possibility of the Montreal Protocol incorporating HFCs into a phasedown process. "I don't think anybody's ignoring those signals," said Horning. "People are paying attention" **MG**

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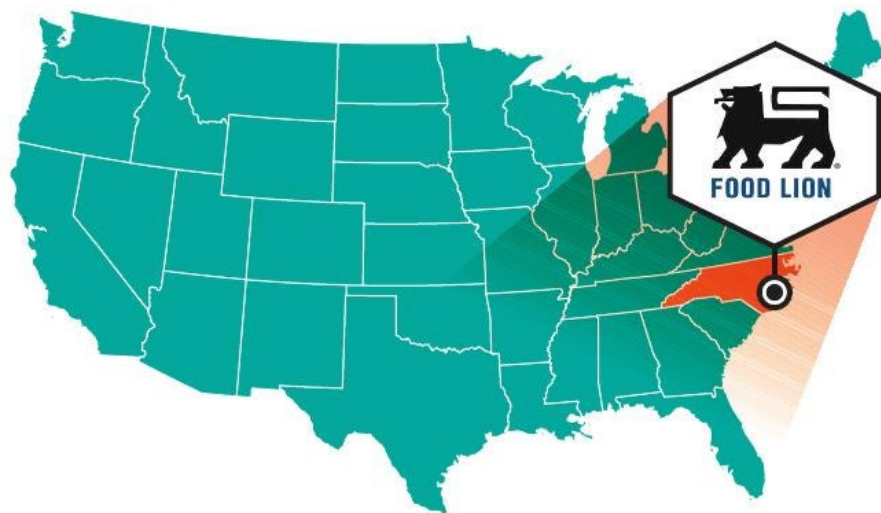
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“NO MORE RETROFITS”

Says Food Lion

The Southeast U.S. chain is testing CO₂ systems
that it hopes will stand the test of time

Food Lion has been climbing the alternative refrigeration ladder over the past eight years and is preparing to reach the top rung— a CO₂-only transcritical system — in 2015. When it gets there, the retailer, which is based in Salisbury, N.C. and is a division of the Belgium-based Delhaize Group, hopes to finally have a future-proofed system that won't require any more changes in refrigerants. In other words, after transitioning from ozone-depleting CFCs and HCFCs, and now facing the prospect of needing to phase out HFCs, Food Lion would like to stay put with CO₂, if the transcritical system meets its other requirements.



Southport North Carolina

by Michael Garry

"No more retrofits," said Susan Sollenberger, director of energy, maintenance & equipment purchasing, in a conversation with *Accelerate America* in September at the Food Marketing Institute's 2014 Energy & Store Development Conference in St. Louis.

Food Lion plans to test its first all-CO₂ transcritical refrigeration system late next year, at a new store in Southport, N.C. Food Lion's sister Delhaize company, Hannaford Supermarkets, became the first U.S. retailer to use a transcritical booster CO₂-only system in July 2013 at a supermarket in Turner, Maine. (See story, page 16.)



Wayne Rosa
energy and maintenance manager
for Food Lion

Food Lion, which operates more than 1,100 stores, "is still working through the design and pricing" of the system and has not yet selected a supplier, said Sollenberger.

Like Hannaford Bros., Food Lion has been following the lead of the Delhaize Group in pursuing climate-friendly refrigeration systems that reduce or eliminate HFCs. As a member of the Paris-based Consumer Goods Forum, Delhaize has committed to start phasing out of HFC refrigerants by 2015. "We are trying to participate in that and learn what we can, moving forward," said Sollenberger.

Probably the biggest question surrounding Food Lion's transcritical test will be whether the system will perform efficiently in the relatively warm climate in North Carolina. Transcritical installations are typically located in cooler, northern climates, such as Hannaford's store in Maine and Sobeys stores in Quebec, where they are less likely to be forced by high ambient temperatures into "transcritical mode."

But the hot summers in North Carolina are another story. "This is the time period when the energy model could show a dramatic increase in energy use, nullifying any potential ROI," said Wayne Rosa, energy and maintenance manager for Food Lion, who joined Sollenberger at the FMI Energy Store & Development Conference.

However, Hillphoenix broke new ground in July when it installed an Advansor transcritical CO₂ booster system in a Sprouts Famer's Market store in Dunwoody, Ga., a warm-weather location. "Hillphoenix says we can take it south of the Mason-Dixon line," said Sollenberger. "We'll be testing that."

Other concerns in regard to the transcritical system, said Rosa, include covering the higher initial costs of the technology, having design documents for proper installation, delivering adequate training for the installing contractor and in-house service technicians, and securing the tools needed to adequately service the equipment.

EARLIER PILOTS

Food Lion began its CO₂ journey in 2006 at a new store in Montpelier, Va., with a low-temperature secondary loop system using CO₂ as the secondary coolant. Earlier that year, the chain opened a store in Dinwiddie, Va., with a medium-temperature secondary loop system employing glycol as the secondary coolant.

In 2008, Food Lion opened a store in Portsmouth, Va., that combined low-temp and medium-temp secondary systems in one location. The following year, the chain opened a supermarket in Columbia, S.C., that, among many green features, employed a CO₂-based cascade refrigeration system.

After that, Food Lion began scaling back store openings and consequently any further advanced

refrigeration installations. But the chain has now reversed course with numerous remodels and some new store construction. It is also almost halfway through converting R-22 refrigerant to R-407A.

Rosa said the cascade and secondary refrigeration systems were comparable in both energy usage and maintenance to Food Lion's conventional direct exchange (DX) system using R-407A. From a leak perspective, the alternative systems were superior to the DX units, he added. He called training technicians the biggest challenge in implementing the systems.



Susan Sollenberger
director of energy, maintenance
& equipment purchasing

The initial costs of the cascade and secondary systems were significantly higher than that of a conventional system, and appear to still be higher, said Sollenberger.

But with the transcritical store on the horizon, Food Lion doesn't plan any more cascade or secondary systems. "They were designed as pilots, to understand the technology," said Rosa.

Food Lion regards testing new technology as a necessary bulwark against an uncertain future. "So if there's a game changer, like a refrigerant tax, we'll be able to make choices on what we want to do," said Rosa. **MG**



ROUNDY'S MONEY-SAVING CO₂ SYSTEM

Halfway through a year-long test, the Wisconsin chain's transcritical refrigeration system expends less energy than a comparable prototype system – and costs less to buy and install.

— by Michael Garry



Menomonee Falls Wisconsin

At the beginning of our conversation, Kevin Christopherson got right to the point:

“I don’t want us to have any HFCs in the future for refrigerants.”

Christopherson is energy program manager for Milwaukee-based Roundy's Supermarkets, a chain of 149 supermarkets in Wisconsin and Illinois that operate under five banners (Pick 'n Save, Copps, Metro Market, Rainbow and Mariano's). To achieve his vision of an HFC-free future for Roundy's, he became the driving force behind his company's test of a transcritical refrigeration system that does indeed eliminate HFCs in favor of natural refrigerant carbon dioxide.

As a refrigerant, CO₂ emissions from a leaky refrigeration system contribute very little to global warming compared to R-507, the HFC gas that Roundy's uses in its other stores. In fact, the ratio of their global warming potentials (GWPs) is 1 (CO₂) to 3,300 (R-507).

In December 2013, Roundy's kicked off its transcritical test, installing an Advansor CO₂-only booster system, from Hillphoenix, at a Pick 'n Save location in Menomonee Falls, Wis., near Milwaukee. The store, which officially opened on Jan. 14, 2014, became one of just a handful in the U.S. to test a transcritical unit, including a Hannaford Bros. outlet in Turner, Maine (see story, page 16) and a Whole Foods Market in Brooklyn, N.Y.

The Pick 'n Save transcritical system is expected to bring about a carbon footprint reduction of nearly 15 million pounds over 10 years – the equivalent of removing more than 1,230 cars from the road annually. And so far, it's proving to be less costly alternative to Roundy's prototype refrigeration, not only in operating expenses but in its initial cost and installation as well.

Christopherson, an engineer with 27 years of experience, spent two years evaluating whether Roundy's should test a CO₂-only technology, looking at what retailers have done in Europe and Canada, as well as talking to suppliers like Carnot Refrigeration and Hillphoenix. He developed a vision that encompassed getting rid of HFCs as well as lowering installation, operating and utility costs. Transcritical technology appeared to address those goals while fitting the northern climate in which Roundy's operates.

But the project would never have taken place without buy-in from Roundy's chairman and chief executive officer, Robert Mariano.

“Bob Mariano is focused on being sustainable and taking an environmentally friendly, green approach,” Christopherson told me. “Bob wants to know, is this going to save us money? Is it the

right thing to do in general? Is this going to make it better for customers and employees?"

To answer those questions, Christopherson has undertaken a detailed analysis of the transcritical system's performance, energy usage, maintenance requirements and overall costs. Roundy's requires a full year of data before coming to a firm conclusion, but through the halfway point, "everything looks positive," he said.

CHANGE IN PLANS

The Menomonee Falls store was originally slated to run Roundy's prototype refrigeration system, which since 2009 has employed glycol as a secondary refrigerant for medium-temperature cases, in concert with R-507 in the rest of the system. But that plan was scrapped and the transcritical system, supplied by Hillphoenix, was installed instead.

Christopherson put together a project plan for the refrigeration portion of the store and worked with the general contractor on implementing it. Considering that this was brand new technology never before installed by the contractor, the installation went smoothly, he said. "Did I baby sit the project? Darn right I did. I was involved in every aspect of the installation. But I was so, so pleased."

Prior to the installation, Hillphoenix and Parker Sporlan, provider of the Micro Thermo case controller and transcritical rack controller used at the store, held training sessions with the service and installation contractor, Zone Mechanical. "The training helped a lot," said Christopherson, who singled out Parker Sporlan for the outstanding support it gave during the installation process.

Before the transcritical system went live in December 2013, Roundy's had it commissioned, converting one case from medium to low temperature.

Service technicians, initially concerned about working with a high-pressure system, began to realize "that there are a lot of similarities to a regular DX [direct expansion] system," said Christopherson. "They started feeling a lot more comfortable." The Micro Thermo case controllers helped by providing very detailed information. "It's incredible what control they give you over the cases, with the ability to fine-tune the system," he said.

After the transcritical system started operating in December 2013, Roundy's had to bring it down before New Year's, when a sensor found that one of the racks was using too much oil. That turned out to have been caused by metal shavings left in an oil canister. "Since then, we've never had a problem with the system," said Christopherson.

From an energy perspective, the transcritical system has performed "surprisingly well," said Christopherson. Hillphoenix predicted before it went live that it would save Roundy's \$12,800 in annual utility costs compared with the retailer's prototype DX/glycol system installed at a similar store in Sheboygan, Wis. But the transcritical unit is on pace to save more than \$20,000 in its first year of operation, he said.

Adjusting for differences in the refrigeration loads of each store's medium- and low-temperature cases, Christopherson calculated that the transcritical system expended 20% less electricity than the prototype system.

The Micro Thermo case and rack controllers help lower energy usage and reduce temperature changes in display cases. Another energy saver comes from CO₂'s high heat of rejection. The heat generated by the transcritical system produces hot water for the store and may be used in other applications, such as area or floor heating.

One factor supporting a higher level of efficiency by the transcritical system was a cooler-than-average summer in southeastern Wisconsin. "If we had a normal summer, the energy savings would have been closer to [Hillphoenix's estimate]," said Christopherson.

Even so, the system went into transcritical mode, its least efficient stage, 30 times, he noted. This takes place when the outside (ambient) temperature reaches 88 degrees Fahrenheit – CO₂'s critical point, or the highest temperature (and pressure) where the refrigerant can still condense.

Christopherson said he learned that the ambient temperature doesn't need to reach 88 degrees for the transcritical state to be reached. It can happen when the condenser, located on the rooftop, hits that temperature. The Menomonee Falls store has a stone roof, which heats up "like AstroTurf," and can be hotter than the reported temperature.



Snapshots

Dry Ice Snafu

One Saturday almost a year ago, as products were being stocked in a new Pick 'n Save store in Menomonee Falls, Wis., Kevin Christopherson received a frantic call regarding the transcritical CO₂-only refrigeration system just installed at the store.

"We got an evacuation alarm on CO₂," said Christopherson, energy program manager for Milwaukee-based Roundy's Supermarkets, owner of the Pick 'n Save banner. "I thought, oh no, is it leaking?"

It turned out to be a false alarm, as far as the refrigeration system was concerned. What triggered the alarm was CO₂ vapor that had evaporated from the dry ice used to keep product cold during shipment. A CO₂ leak detection sensor in the store's walk-in freezer reacted to the vapor.

Problem solved. Or was it? The incident made Christopherson concerned about the safety risk posed by dry ice being housed in an enclosed storage area. Roundy's uses a CO₂ detection sensor only in the transcritical store's walk-in freezer – not in any of its other supermarkets.

"If you have dry ice in a confined space, it can push out the oxygen, which makes it dangerous," he said. "It opened my eyes to packing food in dry ice."

Christopherson has talked to Roundy's maintenance department about installing CO₂ sensors in all walk-in freezers as a precaution. He wonders whether dry ice should be necessary in delivery trucks with refrigerated storage. "This is a real concern."

Other Green Features

In addition to its transcritical CO₂ refrigeration system, Roundy's Pick 'n Save store in Menomonee Falls, Wis., has a host of other environmentally friendly features:

- All energy and water performance is controlled in real time with a building automation system.
- High-efficiency LED lighting technology, controlled by motion sensors or the building automation system, is installed throughout the interior and exterior of the store, including case fixtures, the walk-in cooler and freezer, and the refrigeration prep room.
- Daylight harvesting uses natural light to reduce electricity demand.
- The store uses highly efficient HVAC equipment coupled with constant air balancing, and supplemented by CO₂ monitoring and dehumidification.
- The building's foundation and wall sections were manufactured with recycled materials.
- The concrete floors eliminate the need for additional floor coverings or hazardous cleaning chemicals.
- Restrooms include low-flow motion-activated urinals and hand sinks.
- Paints and adhesives have little if any volatile organic compounds.
- Packing material, food scraps and cooking oils are recycled or repurposed.
- Environmentally friendly and non-harmful cleaning chemicals are used to maintain the store.

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→ Having gone through the summer, Christopherson still wants to assess the third quarter's energy numbers before coming to a definitive conclusion about the transcritical system's energy efficiency. (He expects the fourth quarter's results to be the same as the first quarter's.) If the third quarter pans out, he thinks a second transcritical store could be planned for the Chicago market in late 2015.

From a maintenance point of view, the transcritical system has been "on par or better" than the prototype system, he said. However, Christopherson is reserving judgment on maintenance until the system is older. "Everything looks great now but the system's new," he said. "How's it going to perform in two or three years?"

The higher pressures associated with transcritical technology have not been a problem for the Pick 'n' Save store. According to Hillphoenix, the transcritical system's pressure-reducing valves, which are set for 580 to 1,740 psig, should ensure that "everything inside of the store operates under lower pressure, as it would with an HFC system." As a further precaution, carbon steel is used to reinforce the compressor racks, and the piping to and from the gas cooler is made of either carbon steel or stainless steel.

"The only people concerned about the high pressures are the service people who support the system," said Christopherson. "And they have been with it eight-plus months and have seen no issues."

"I know the system is designed for [high pressures]," he added. "It doesn't make me nervous. But is it always a concern in the back of my mind? Yes. If they designed a CO₂ system that didn't go into transcritical mode, I'd probably lean toward that."

COST ANALYSIS

Christopherson provided a breakdown comparing the capital costs incurred by the transcritical system to what the prototype DX/glycol system that was originally slated to go into the Menomonee Falls store would have cost.

The transcritical system, under warranty for one year, cost 21.4% more than the prototype (actual dollar figures were unavailable for publication). In addition, the transcritical technology required CO₂-ready fixtures that cost 11.6% more, and electrical circuitry that was 31.7% higher; it also called for low-voltage wiring and touchscreens that were not used in the prototype system.

On the other hand, the installation cost of the transcritical system was 25.6% less than that of the prototype, partly because it required less piping and used low-voltage wiring. Roundy's was also able to obtain steel support credit and energy incentives for the transcritical system. Moreover, CO₂, which was included in the installation cost, runs only .99 cents per pound, compared to \$8 per pound for the R-507 used by the prototype system, creating a considerable cost difference in the initial refrigerant charge.

All told, the transcritical system's equipment and installation costs were estimated by the *Milwaukee Journal Sentinel* to run \$1.8 million. The actual costs came in under that amount, said Christopherson – and ended up being about 1% less than those of the prototype system. (He did not factor in the maintenance or energy savings observed at the Menomonee Falls store into this cost calculation.) "There's potential to save more money [in a future installation]," said Christopherson. "That's what makes it exciting."

While he is still holding back on a full-fledged commitment to transcritical technology until more data comes in, Christopherson is hoping CO₂ refrigeration takes off. "I am very for CO₂," he said. **MG**

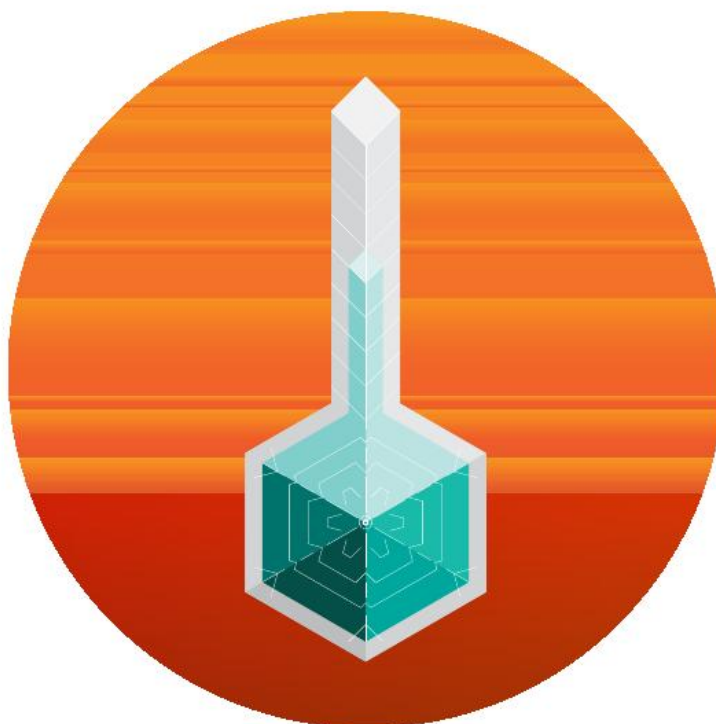


System Specs

Pick 'n' Save's transcritical booster system, from Hillphoenix, Conyers, Ga., has the following features:

- Two racks (A and B), each with seven compressors.
- Low-temperature capacity: 201,000 BTUs/hour (Rack A) and 203,000 BTUs/hour (Rack B)
- Medium-temperature capacity: 815,000 BTUs/hour (Rack A) and 697,000 BTUs/hour (Rack B)
- UL-approved compressors and controllers.
- Electric defrost system.
- Micro Thermo case controller and rack controller from Parker Sporlan.
- Hillphoenix cases incorporating Clearvoyant LED lights.

2014 FMI ENERGY & STORE DEVELOPMENT CONFERENCE



US RETAILERS ARE TESTING THE TEMPERATURE WHEN IT COMES TO CO₂ TRANSCRITICAL REFRIGERATION

Attended by over 600 people, the 2014 FMI Energy & Store Development Conference, held from September 8-10 in St Louis, provided the latest update on experiences with CO₂ refrigeration systems from the North American food retail industry.

→ continued on p.30



St Louis Missouri

by Janaina Topley Lira

Facing pressure to reduce their impact on the environment and to adopt climate friendly refrigeration systems, North American retailers are investing more and more in natural refrigerant commercial refrigeration systems. There are different forces that are incentivizing this change. On the one hand members of the Consumer Goods Forum (CGF) have voluntarily pledged to phase-out HFCs (hydrofluorocarbons), a pledge that was reaffirmed in July 2014. On the other hand, the EPA is proposing to ban some high-GWP (global warming potential) HFC refrigerants in new and retrofit applications and to allow some new natural refrigerant-based applications that were previously prohibited.



Thus far, the preference of many US retailers has been to install CO₂-HFC hybrid systems, which is also the case in Eastern Europe, South America and China. In Northern Europe, Japan and Canada CO₂ transcritical solutions are preferred.

However, this situation is changing. In July 2013, Delhaize America opened a new Hannaford store in Turner, Maine, where the refrigeration is provided by a transcritical CO₂ rack with series heat reclaim. The 36,000-square-foot store has shown good energy performance, reliability and maintenance, with very little downtime.

In one measurement of electric energy consumption, the CO₂ booster rack was lower than the refrigeration systems in two similar-sized Hannaford stores, one with three DX (direct expansion) R407A racks installed in Bradford, Vermont in 2013, and one with three DX R-507 racks installed in Portland, Maine in 2005.

Harrison Horning, director of energy and facilities for Hannaford Supermarkets, who presented this data at the FMI Energy & Store Development Conference, emphasized that Delhaize plans to complete more pilot stores and learn what it can from the 3000+ CO₂ transcritical stores installed globally.

"I am fully confident that the next pilot we do will be much better than 187 KBTUs[per square foot per year]," said Horning.

Delhaize is also considering remodels and retrofits for locations where existing equipment is reaching its end-of-life and where there is sufficient space for new equipment. (For more on

Hannaford's transcritical installation, see cover story, page 16.)

Walgreens, one of the largest US retail pharmacy companies, also opened its first "CO₂-only" store in 2013. The "net zero" Illinois store features a CO₂ transcritical system coupled with geothermal energy, which enables the efficient use of CO₂ transcritical refrigeration in more southern climates thanks to the steady condensing temperature provided by the geothermal loop.

"I am fully confident that the next pilot we do will be much better than 187 KBTUs"

said Harrison Horning,
Hannaford Supermarkets

Jamie J. Meyers, manager of sustainability, Walgreens, and Rob Olden, director of engineering, North America, GI Energy, shared the lessons they learned from the Walgreens "net zero" project. For example, they experienced hurdles when it came to UL Certification related to the 5 times pressure rating at 90 bar and found that US suppliers lack sufficient stock of 80-bar-rated components. On a more positive note, by incorporating HVAC into the refrigeration, a historic barrier to innovation was overcome.

Benny Smith, vice president of facilities at Price Chopper Supermarkets, was the third retailer to talk about CO₂, specifically his company's investment in the first US CO₂

supermarket, a cascade R-404a/CO₂ system. The 2008 installation, a combined SNLTX2/SNMT system installed in Saratoga New York, has a CO₂ charge of 700 lbs and has helped to reduce the store's carbon footprint by 5,132 tons of CO₂ equivalent.

Thanks to their early involvement in the project, technicians working on the system provided feedback that was very positive. Furthermore, the installation cost for the CO₂ cascade system at \$9.63 per square foot was comparable to a DX system at \$9.61 per square foot.

The FMI Energy & Store Development Conference also featured the Environmental Protection Agency's GreenChill Partnership Achievement Awards, created to recognize actions taken by supermarkets to reduce their ozone layer and climate change impact. Drussila Hufford, director of the Stratospheric Protection Division at the EPA, opened the awards ceremony by underlining the partnership's aim: to spur really fast evolution of an entire sector.

Hufford said that the US commercial refrigeration sector's initial reliance on refrigerant gases with high GWP and/or high ozone depletion potential (ODP), such as CFCs, HCFCs and HFCs, has been replaced by growing reliance on climate friendly natural refrigerant solutions.

In 2007 for example, 68.8% of commercial refrigeration systems used an ozone-depleting substance, with 63.8% using R-22. The average ozone layer impact per store was 110.6, while the average climate impact per store was 448. Of all racks sold, 52.3% were centralized DX systems and 47.7% were total advanced systems.

Just six years later, these numbers have changed dramatically with only 38.8% of commercial refrigeration systems using an ozone-depleting substance. The average ozone layer impact per store dropped to 47.1, while the average climate impact per store was 379. Of all racks sold, 42.8% were centralized DX systems and 57.2% were total advanced systems.

The GreenChill Partnership has played a central role in supporting the transition to environmentally benign refrigeration systems. Over the course of five years, GreenChill has expanded to over 8,000

partner stores in all fifty states. Today, 22% of all US stores are GreenChill partners.

However, it is estimated that if every US supermarket met GreenChill benchmarks, the supermarket industry would reduce emissions by 22 million tons of CO₂ equivalent and 238 ODP tons. In addition, the industry would save \$100 million in reduced refrigerant replacement costs.

GreenChill's popular Store Certification Program, which awards platinum, gold, or silver level certifications to stores, has done much to publicize company commitments to environmental protection. In the US, system manufacturer Hillphoenix has supplied equipment for the highest number of store certifications, 67 in total, 41 of which were awarded in the last year. In recognition of these impressive figures, Tom Land, head of the EPA's Greenhill program, presented Scott Martin, Hillphoenix's director

Maintenance and Refrigeration Coordinator for Whole Foods, was at the ceremony to receive the "Best of the Best" award.

Perhaps a bit surprising is that since 2014 when Carnot Refrigeration joined GreenChill, the highest number of platinum certified CO₂ stores (31 in total) is actually in Canada, despite GreenChill being a US initiative **JTL**.

Other GreenChill awards announced at the ceremony were as follows:



of sustainable technologies, with the award for "Store Certification Excellence" (non-supermarket partner category).

The prestigious Green Chill "Best of the Best" Award was given to US retailer Whole Foods for its transcritical CO₂ refrigerated store in Brooklyn N.Y., which features a Hillphoenix CO₂ transcritical system. Built using reclaimed and repurposed materials, the store features a number of other green technologies such as car charging stations powered by wind and solar energy, self-generated light-emitting diode (LED) parking lot lighting and solar canopies (with a total capacity of 324 kiloWatt) that cover roughly 29% of the store's electricity demand, in addition producing electricity for the cars. Mike Ellinger, Global

Store Certification Excellence

(supermarkets):

- Publix and Sprouts Farmers Market

Store Re-Certification Excellence:

- Food Lion, Columbia, SC
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US GOVERNMENT TEAMS UP WITH PRIVATE SECTOR TO ACCELERATE COMMERCIALIZATION OF HFC-FREE EQUIPMENT



The Obama Administration has partnered with several private companies in a voluntary agreement aimed at reducing HFC emissions.

— by Klára Skačánová

On September 16, leading end-users and manufacturers, including The Coca-Cola Company, Red Bull, Target, Hillphoenix, Carrier, Emerson Climate Technologies, Danfoss, Johnson Controls, and True Manufacturing, made voluntary commitments to reduce the use of HFCs (hydrofluorocarbons) while advancing development and uptake of HFC-free technology. To complement these commitments, the Obama Administration initiated several actions to promote the use of HFC alternatives.

The new agreement is aimed at reducing the cumulative global consumption of these gases by 700 million tons of CO₂ by 2025. "Unless we act now, US HFC emissions are expected to nearly double by 2020 and triple by 2030," according to a White House statement.

As one of the pioneers of transcritical CO₂ technology in the US, Hillphoenix has announced commercialization of a CO₂ booster system that is viable for all climate regions. In addition, Hillphoenix plans to introduce a self-contained hydrocarbon refrigerated case with doors and a recently re-engineered service called "Close the Case" that utilizes the company's door technology to retrofit existing open display cases.

Carrier, an expert in CO₂ commercial refrigeration systems, has committed to commercialization of HFC-free transport refrigeration by 2020, following successful trials of its CO₂-based container refrigeration. Emerson Climate Technologies said that in July 2015, it will also expand its CO₂ offerings in its complete line of compressors, flow controls, discrete and system electronic controls.

In the retail food sector, Target, which has five stores that use CO₂ refrigeration systems, plans to expand this technology to two additional sites in 2015 as part of its commitment to a hybrid CO₂ prototype for new stores. The company has also started working with a manufacturer of beverage coolers to test HFC-free solutions, in addition to opening two new cold storage facilities designed with ammonia.

In a similar vein, Kroger, has committed to using advanced refrigeration technologies in new and remodelled stores where feasible, and announced a partnership with the US Environmental Protection Agency's GreenChill Partnership.

As part of the new initiative, and in line with its long-term sustainability policy, The Coca-Cola Company said that all its newly purchased cold drink equipment will be HFC-free. In 2014 the company has already bought around 20,000 HFC-free units for the US. Globally, Coca-Cola has more than one million pieces of HFC-free equipment already in use.

Rival PepsiCo has committed to use only HFC-free coolers, vending machines and fountain dispensers in the US by 2020, starting implementation in 2015. Beyond the US, PepsiCo has already put in place over 290,000 HFC-free units since 2009.

Red Bull, in line with its commitment to procure hydrocarbon-based ECO-Coolers where technically and legally feasible, has announced that in 2015 it will order 32,000 HFC-free ECO-Coolers using hydrocarbons for the US. In addition, Red Bull plans to focus on technician training, especially with respect to repair and proper equipment disposal, in partnership with six companies.

True Manufacturing, an industry leader in self-contained commercial refrigeration for over 65 years that has already developed a series of plug-in refrigerating equipment operating with natural refrigerant R-290 (propane), announced that it will use only climate-friendly and low-GWP (global warming potential) refrigerants in all future product development. The manufacturer committed to develop low-GWP replacements for its existing products over the next five years. These improvements are expected to reduce the emissions of HFCs by over 200,000 tons of CO₂ equivalent.

In the industrial refrigeration, heating and cooling sector, Johnson Controls has committed to using the lowest GWP option

for each application that best fits the needs of its customers from the standpoint of safety, efficiency, reliability, availability, and economy. In the past three years the company has already spent more than \$26 million in the development of low-GWP technologies.

Complementing actions driven by the private sector, the US government will seek to promote the use of low-GWP refrigerants and encourage development of such technologies through a number of initiatives, including enhancing public procurement of equipment using safe alternatives to HFCs. The Obama Administration will review federal acquisition regulations to promote the use of safer alternatives to HFCs by service and vendor contractors.

In addition, technology manufacturers and industry stakeholders, including those that offer alternatives to HFCs, are invited to submit information on innovative and transformational building technologies that can be used in federal buildings. Technologies will be evaluated within the Green Proving Ground program and results will be used to guide both the public and private sector, and enable them to make an informed decision and accelerate commercialization of the technology.

The Administration also plans to expand the list of alternatives under the Significant New Alternative Policy (SNAP) program. The EPA is currently working on a proposal to list additional hydrocarbon refrigerants in six refrigeration and air conditioning applications.

Lastly, the Department of Energy (DoE) has announced new funding that will encourage development of energy efficient technologies that use alternative refrigerants to HFCs in heating, refrigeration, air conditioning and heat pump applications. **KS**



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CANADA TO ALIGN WITH THE US ON LIMITING THE USE OF HFCS

Like the US, Canada is proposing rules to cut down on the use of HFC refrigerants with high global warming potentials.

— by Klára Skačánová



Leona Aglukkaq
Canadian Minister for the Environment,

Canada was among the governments and private organizations making pledges to tackle HFCS (hydrofluorocarbons) at the UN Climate Summit held in New York on September 23, setting the stage for a potential global climate agreement next year in Paris.

Canadian Minister for the Environment, Leona Aglukkaq, outlined in her UN Climate Summit speech that the government plans to reduce emissions of HFCS and to publish a Notice of Intent to regulate these climate-changing gases, in-line with similar proposals published by the US Environment Protection Agency (EPA) under the Significant New Alternative Policy (SNAP) program.

In alignment with its largest trading partner, one of the proposed Canadian rules could prohibit the use of some high-GWP (global warming potential) HFCS in certain applications where low-GWP refrigerants are available and already in use. The affected applications would include commercial and stand-alone refrigeration systems as well as mobile vehicle air conditioning (MVAC). The second of the proposed rules, issued in July 2014, foresees the listing of four hydrocarbons as acceptable in six different refrigeration and AC sectors.

In addition to this, more than 20 countries and 10 international organizations at the UN Climate Summit supported a joint statement on a global phase-down of HFCS under the Montreal Protocol, highlighting the need to begin formal negotiations in 2014. Supporters of the joint statement also committed to promote public procurement of climate-friendly, low-GWP alternatives, and welcome complementary private-sector-

led efforts, including the formation of the Global Cold Food Chain Council. The Council will convene refrigeration system manufacturers, food suppliers, ocean and road transportation providers and food retailers to accelerate the transition to energy-efficient refrigeration systems using low-GWP refrigerants.

United Technologies and Carrier are among those supporting the formation of the Global Cold Food Chain Council. "CO2 as a natural refrigerant holds great promise across the cold chain as a preferred environmental choice for refrigeration," said David Appel, president at Carrier Transicold & Refrigeration Systems.

Complementing these announcements, 73 national governments, 11 regional governments and more than 1,000 businesses and investors indicated support for pricing carbon, which would reflect the true costs of emissions. Together, these leaders represent 52% of global GDP, 54% of global greenhouse gas emissions and almost half of the world's population.

Lastly, several countries pledged to make financial contributions to mitigate climate change. For example, France will provide \$1 billion (€0.78 billion) to the Green Climate Fund, while other smaller contributions brought the total to \$2.3 (€1.79) billion **KS**

*New alliance addresses
growing US demand for*
***CO₂ commercial
refrigeration***



HUSSmann®





In a move destined to impact the North American CO₂ refrigeration market, Canadian transcritical refrigeration maker Systemes LMP has announced an alliance with refrigeration manufacturer Hussmann Corporation.

— by Janaina Topley Lira

The alliance enables Hussmann, Bridgeton, Mo., to expand its product portfolio, and support its mission “Enabling Excellence in Food Retailing” by providing a climate friendly solution for retailers.

One of the features that differentiates the LMP transcritical refrigeration system is that the technology can be installed in southern climates and will operate as efficiently as traditional HFC systems, according to Systemes LMP.

Laval, Québec-based Systemes LMP, which has over 15 years of experience in the field of refrigeration, started working with CO₂ in its testing facilities in 2008. The company has since installed a number of CO₂ transcritical units in Canada for retailer Sobeys.

Jeff Gringas, Vice President of Sales at Systemes LMP, said that having the alliance will definitely expand usability of CO₂ technology in the United States. “The Hussmann team will be able to support our technology and reach out to new clientele to deliver the message on how they can benefit from using CO₂ as a refrigerant for supermarkets.”

Following the public announcement, the Hussmann and LMP teams have been busy fielding inquiries from across the Western Hemisphere. The market is clearly receptive to the alliance and customer interest, remains strong. “We have been surprised by the breadth of retailer interest which is not just coming from traditional supermarkets but also from non-traditional

formats,” says Gringas. “Hussmann and LMP look forward to engaging more retailers in dialogue about their refrigeration needs. Having many CO₂ solutions to offer will make those conversations more valuable for both parties.”

Hussmann already supplies refrigerated and non-refrigerated display merchandisers, specialty display cases, and refrigeration systems, including a low-temperature subcritical direct expansion refrigeration solution using CO₂. The alliance enables Hussmann to add one more product to its refrigeration system portfolio, and offer its customers the right solution to meet their needs. Hussmann will be working with food retailers throughout the United States, Canada, Australia and New Zealand to deploy these systems.

Michael Higgins, senior VP, marketing, strategic planning and business development at Hussmann said of the alliance, “It is very important that we understand what drives decisions made by our customers when it comes to their refrigeration footprint in the front and back of their retail stores. This alliance with LMP provides us with the opportunity to add one more solution to our refrigeration system portfolio so that we can offer all of our customers the right product based on the goals and objectives established for their business. We look forward to working together to deliver innovative R-744 solutions when appropriate for our customers.”

Gaetan Lesage, President, LMP, also expressed enthusiasm about the alliance, saying, “As major

grocery food retailers look for ways to achieve their environmental goals, there has been increasing interest in CO₂ transcritical systems as one of the methods that can help them achieve those goals. Our modules solely use R-744. We look forward to bringing this technology as well as our future innovations to Hussmann, which has its own legacy of innovation for over 105 years.” **JTL**

A PLACE TO DREAM

Emerson is building an Innovation Center to blaze new paths in HVAC&R efficiency, sustainability and connectivity



Dayton Ohio

In an effort to reinvent the way it innovates, Emerson Climate Technologies has started building a 38,000-square-foot HVAC&R Innovation Center on the campus of the University of Dayton in Dayton, Ohio, about 40 miles from its headquarters in Sidney, Ohio.

by Michael Garry & Marc Chasserot

The Innovation Center – named “the Helix” – is designed to be Emerson’s global hub for research and education in the heating, ventilation, air conditioning and refrigeration industry, tying together the company’s product development and testing facilities in the U.S., Canada, Asia and Europe.

Groundbreaking on the Center took place on Oct. 17. Construction began immediately thereafter and is expected to conclude by the end of 2015.

The Center will bring together Emerson experts, business partners and customers, as well as university faculty and students, to brainstorm on the development of new products and best practices addressing such industry challenges as energy efficiency, sustainability and system connectivity.

“We need to reinvent how we innovate. We want to innovate better, differently,” said Rajan Rajendran, vice president, Systems Innovation Center and Sustainability, Emerson Climate Technologies, who is leading the development of the Innovation Center.

The Center will seek to foster an atmosphere of openness and collaboration among disparate specialists, said Rajendran. “We want to be able to bring all of our people from our diverse divisions – all of our thinkers, all of our

dreamers, all of our innovators – so they can start talking about how to share each other’s ideas.”

Emerson is investing close to \$20 million in the construction of what will be a LEED-certified building,

Emerson employees have attended. The university is one of several academic institutions with which Emerson has established a working relationship. “We want to be able to tie to academia, to people who know things and look at things differently

are always on the outside looking in as a component manufacturer,” said Rajendran. “For us to be able to deliver good components, we need to be able to also have a deep understanding at the system level. That is going to help us provide more value to our customers all along this value chain, not just the end customer but our OEMs and our suppliers.”

Rajendran defines a system as not just a refrigeration or air conditioning system but the entire building in which they reside, as well as the surrounding area. “If I take a grocery store, I would draw a control volume around it, including the ambient around the store, perhaps the ground as well.”

Second, the systemic approach will also help Emerson deal with the tremendous influx of data coming through its component monitoring systems. “All this data at the component level makes a lot of sense to us,” said Rajendran. “But it is not very good unless you take it to the system level.”

Finally, Emerson recognizes the considerable drop-off in the efficiency of a component (like a compressor) from the time it is designed to one year into its operation – something that can be addressed at the Center. “There’s a huge amount of efficiency that gets left on the table,” Rajendran said.



Rajan Rajendran
vice president, Systems Innovation Center and Sustainability,
Emerson Climate Technologies

“We need to reinvent how we innovate. We want to innovate better, differently.”

which will incur a substantial operating cost as well.

The facility is also supported by a partnership between Emerson and the University of Dayton, which more than a hundred of

than we do,” said Rajendran.

As a component manufacturer, Emerson has three primary reasons for building the Center. First, to take a more holistic “systems” approach to component development. “We

END-MARKET MODULES

The Center will have separate modules, or labs, dedicated to five HVAC&R end-markets, an unprecedented combination under one roof: residential, light commercial, food retail, food service, and network/data centers.

The 2,000-square-foot residential module, which will be built to code and based on what the U.S. Department of Energy considers a

typical home, will be a test lab for insulation, ventilation, cooling and heating. The module will be located inside of an environmental chamber allowing researchers to simulate cold and hot weather, from minus-20 to 120 degrees Fahrenheit ambient, and from 20% to 90% humidity. Users will also be able to simulate solar loading and adjust the size of rooms and the location of heating and cooling sources.

The lab for light commercial HVAC applications will encompass the entire Center.

The 1,000-square-foot data center module will reflect Emerson’s status as one the largest providers of data center cooling for companies like Google, Yahoo and Amazon under the Liebert brand. Because many data centers are moving to northern climates, this module will also

be enclosed in an environmental chamber where cold weather conditions can be simulated.

The fourth module will be a fully functional, high-density commercial kitchen, 1,500 square feet, including heat-generating equipment as well as refrigeration and cooling equipment. Researchers will be able

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→ to assess equipment performance under actual working conditions, with attention paid to how chefs use equipment, compared to how it is designed. "Ultimately it's the user that has to win here," said Rajendran.

Finally, the Center will house a 2,500-square-foot supermarket module that will mimic a grocery store. It will have a full-blown grocery store refrigeration system — a CO₂ transcritical booster system using Emerson-made

components, including subcritical and transcritical compressors as well as controls and valves. The transcritical system's gas cooler will sit inside an environmental chamber where ambient can range from minus-20 to 120 degrees Fahrenheit. "We want to figure out how to make [transcritical systems] like high ambient temperatures!" said Rajendran.

The refrigeration system will also support air conditioning and hot water heating for the entire Center.

"We're going to try and maximize all aspects of what a transcritical CO₂ system can provide," said Rajendran.

Flexibility will be one of the hallmarks of the Center, allowing all manner of adjustments to be easily made to the lab systems, said Rajendran. The supermarket, for example will sit on an 18-inch-high false floor so that changes in plumbing, wiring or refrigerants can be handled under the floor.

In addition to the five modules, the facility will house an 8,000-square-foot training center on the second floor that can accommodate up to 120 people at a time, with classes averaging between 30 and 50.

Emerson also envisions hosting industry conferences at the Center and in nearby campus auditoriums. "We want to be a steward and in that stewardship role we want to be able to do all of these things," said Rajendran.

IDEATION ROOM

While the modules will offer an opportunity to do hands-on research in end-user environments, the Center will separately provide space just for creative thinking.

For example, a group of four or five people spending a week or 10 days at the Center would start off in the "ideation room," which is devoid all technology other than white boards. "There, the technology is your brain," said Rajendran. "There are no chairs because you're not expected to get too comfortable. You're supposed to think on your feet, brainstorm."

From there, the group would migrate into the "team studio," which is replete with technology, including teleconferencing equipment to link up with anyone around the world. Individuals could then branch out to different areas, such as an open collaboration area or, for more privacy, focus rooms for one or two people.

There will also be an open café area "because we get a lot of good ideas when we're sitting at the kitchen table," said Rajendran. "It's an easy casual atmosphere."

The Innovation Center will also offer outdoor meeting areas amid five acres of land. "There are places to sit outside. We're even putting an ideation room outside. It's not a

"You may be doing something here that is completely outside the scope of the labs."



room, but a row of trees so you can sit there if it's a beautiful day."

At this point, visitors may decide to explore the five end-market modules. "But you may come here and work for a week or two and never set foot into the labs because your work does not require that,"

said Rajendran. "You may be doing something here that is completely outside the scope of the labs."

The common work area is extremely important to Emerson, said Rajendran. "If you're working on a supermarket and you have an 'aha' moment and start shouting

"Eureka" like Archimedes, we would love for the people in the residential modules sitting next to you to say, 'What is that?' And then you share that idea with them. Maybe that triggers a thought in their mind about a problem they are trying to solve. That way a residential idea may one day find itself in a supermarket, and a supermarket idea can find itself in a data center" ● MG+MC

EUROPE: THE UNDISPUTED LEADER



Study shows natural refrigerants work for Europe.
Could North America be next?

— by Nina Masson & Elke Milner

According to a new report by Carrier Commercial Refrigeration, based on a study by market development expert shecco, a whopping 65% of large supermarkets from northern and western European countries now use natural refrigerants. With the refrigerant revolution fully under way in Europe, the question is, will North America also embrace the natural refrigerant movement?



The study, which was conducted predominantly among large food retailers in Germany, France, Denmark, Norway and the United Kingdom, found that nearly two-thirds of all respondents have already implemented natural refrigerant technology in their stores. The shift towards very low GWP refrigerants in Europe is propelled by a combination of market and policy influences and technology advancements, including, of course, the build up to, and implementation of, the newly revised F-Gas Regulation.

"This research reflects the shift we've observed across the industry over the past two years," said Thierry Jomard, president, Carrier Commercial Refrigeration, Europe. "What we're seeing today is an intersection point between legislation and increased acceptance of how natural refrigerant technologies can contribute to the overarching goals of carbon footprint reduction and increased energy efficiency."

Furthermore, the study revealed that many retailers' decisions to switch to natural refrigerants come from

a growing awareness that carbon footprint reduction is good business practice. To that end, the study found, the switch stemmed largely from company-wide sustainability policies and a desire to stand out as an environmental leader.

According to survey responses, F-Gas and hydrofluorocarbon (HFC) phasedown is no longer seen as a threat to food retailers' business. That's because the use of carbon dioxide as a refrigerant in centralized commercial refrigeration systems has actually become standard. Of the respondents to

the survey that already use natural refrigerants, an impressive 83% employ CO₂ centralized systems.

Regulation or no regulation, the business case for natural refrigerants sells itself. They offer an ideal solution for food retailers under increasing pressure to reduce operating costs and environmental impact. In fact, when it comes to reducing environmental impact, more than half of all study participants indicated they would be willing to shorten their normal investment cycles to promote the uptake of more environmentally sustainable refrigeration technology.

Europe is now the world leader in natural commercial refrigeration, with an estimated 2,885 CO₂ transcritical stores at the end of 2013 (a number expected to more than double annually by 2018) and

continued on p.42

nearly 1,700 stores operating CO₂ cascade systems. In addition, there are more than 480,000 hydrocarbon plug-in units operating in Europe and more than one million light commercial units cooled with hydrocarbons or CO₂.

Of course, the natural refrigerant market didn't boom overnight. Before 2006, centralized commercial CO₂ systems in supermarkets were about as common as unicorns, and there was substantial trepidation regarding the move toward natural refrigerant solutions due to concerns surrounding safety, performance and high investment costs. Some manufacturers will even say in complete seriousness, "Everyone thought we were crazy."

However, the last two years have seen marked changes in the market for natural refrigerants. F-Gas Regulations in the European Union (EU) have been revised, and significant investments have been made into research and development, most recently into improving CO₂ system efficiency in warmer ambient temperatures.

The outlay is beginning to pay off, with the majority of food retailers involved in the Carrier-shecco study believing that natural refrigerants have achieved parity with HFCs in terms of return on investment and life cycle costs. In other areas such as reliability, safety, efficiency and performance, respondents also ranked natural refrigerant solutions on par with – and in some cases even outperforming – their fluorinated counterparts.

Although initial capital costs and investments currently remain higher for natural refrigerant systems than for traditional HFC solutions, the study suggests this gap is relatively small and will be bridged in the near future as development continues to gain pace.

When it comes to the industry's maintenance infrastructure, there

is room for improvement, but this, too, will change with continued development and uptake of natural refrigerant solutions.

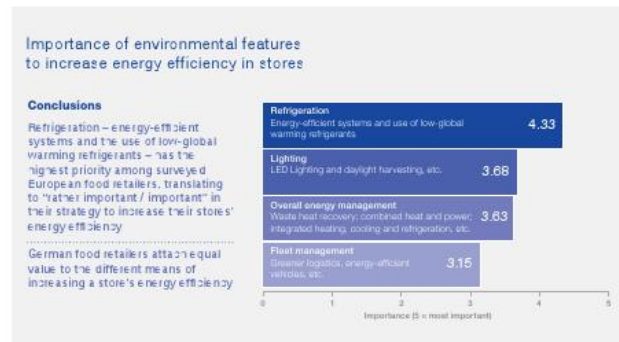
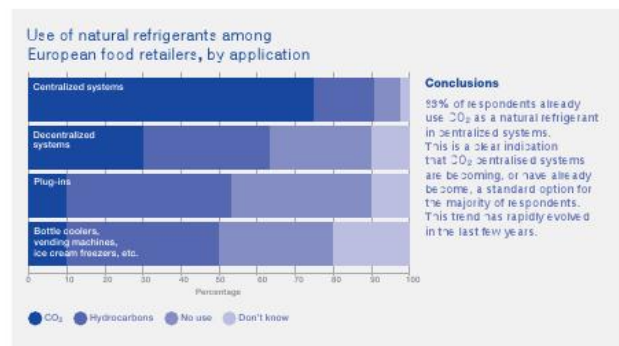
Investment in CO₂ systems has to make financial sense, and the price of CO₂ installation is becoming more accessible. There is still work to be done, but there is strong evidence that the difference in initial investment cost between CO₂ transcritical and traditional systems is coming down.

The study also suggests the move to natural refrigeration systems is stimulating more holistic thinking to combine heating and cooling in integrated system solutions, optimizing overall energy management. This trend is particularly pronounced in Scandinavia where many food retailers attach equal importance to overall energy management and refrigeration.

A key challenge for the future is to make natural refrigerant technology readily accessible to smaller format stores, as well as in warmer ambient climates. With that said though, innovations in technology are already pushing the "efficiency equator" of CO₂ solutions south. In the last few years stores using improved CO₂ refrigeration systems have started to open in warm climates, such as the Carrefour hypermarket in Alzira, Spain.

So you may find yourself asking, "If natural refrigerants have become a standard and are even outperforming their global warming fluorinated counterparts in Europe, where does North America stand?"

While natural refrigerants do have a solid start in North America, particularly in industrial refrigeration and in the Canadian commercial refrigeration industry, Europe has a clear head start.



When it comes to CO₂ and hydrocarbon commercial refrigeration installations, the US is playing catch up.

Unsurprisingly, North Americans have the same concerns about moving from chemical refrigerants to naturals as the Europeans had in the mid 2000s. The difference between the concerns of North Americans and those of the Europeans nearly ten years ago is just that – nearly ten years of trials, tribulations, failures and, finally, great success.

“More food retailers are proactively seeking new substances and technologies to align with their companies' sustainability agendas. This is irrespective of legislation, challenging the perception that legislation is a key driver.”

In North America, just like in Europe, hydrocarbons and carbon dioxide have massive dynamic growth potential. Sobeys, a Canadian food retailer, has 58 CO₂ transcritical stores in Quebec alone. Brooklyn is home to a *Whole Foods* store that has been dubbed the greenest supermarket in the United States, and features a transcritical CO₂ refrigeration system.

In Dunwoody, Georgia, the southern-most transcritical CO₂ supermarket in the northern hemisphere – a Sprouts Outlet – opened its doors, pushing the “efficiency equator” further south than ever before. The Coca Cola Company has committed to using CO₂ in all new light commercial refrigeration equipment. Unilever, parent company of ice cream favorite Ben and Jerry's, has launched a number of projects in North America using hydrocarbons in ice cream freezers, while all new Unilever freezers in Europe are equipped with hydrocarbons.

It's a good start, but there is a lot more work to be done.

Granted, the North American policy environment incentivizing the switch to natural refrigerants isn't exactly as supportive as it is in Europe, particularly in the United States. However, it is evolving. For example the Significant New Alternatives Policy (SNAP) under the United States Environmental Protection Agency (EPA) has recently opened several doors for natural refrigerants.

And, as indicated by the study conducted in Europe, it is the refrigeration system manufacturers and company-wide sustainability efforts of end users that had the most significant hand in driving the European market for naturals.

More food retailers are proactively seeking new substances and technologies to align with their companies' sustainability agendas. This is irrespective of legislation, challenging the perception that legislation is a key driver.

Let us not forget, it was not so long ago that cell phones were regarded as a novelty. The first cell phones were bulky, fairly inefficient and expensive, not unlike some of the first generation CO₂ centralized refrigeration systems. Just as with cell phones, natural refrigerant-based technology has come a long way, with hydrocarbons now a standard in European domestic refrigerators, and bottle coolers using CO₂ or hydrocarbons being able to outperform those equipped with HFCs. In addition, ever greater energy savings are being achieved thanks to improved and compact CO₂ commercial refrigeration systems. So natural refrigerant solutions have now reached parity with HFC systems in terms of life cycle costs and returns on investment.

North American retailers can consider themselves lucky that they don't have to take the risks their European counterparts did when it comes to choosing environmentally friendly refrigeration systems.

The business case for natural refrigerants has been made, both in theory and in practice; most of the hard work is done. The only thing left to do is rake in the savings.

Your move, North America **NM+EM**



Report on Natural Refrigerant Market Growth for **North America**



The GUIDE 2015: Natural Refrigerants – North America's Market Potential gathers data from industry experts to address market trends and the potential of sustainable refrigeration, cooling and heating.

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