

ACCELERATE

ADVANCING HVAC&R

MAGAZINE

TAKING THE
NEXT STEP:

Food Lion's transcritical CO₂ test

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Lawson:
World's No. 1
natural
refrigerants
retailer

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The environmental argument for using natural refrigerants is both simple and compelling: gases like carbon dioxide, ammonia and hydrocarbons have a zero or negligible global warming potential (GWP) compared with the vastly higher GWPs of conventional synthetic refrigerants like HFCs and HCFCs.

The business argument for natural refrigerants (the critical part that relates to ongoing costs and ROI) is also simple and compelling: naturals are more efficient than synthetics, consuming less energy, and costing less money. (This, of course, is also part of their environmental appeal.) But the numbers behind the efficiency argument are not standardized like the GWP numbers – they have to be measured in each field application, comparing a natural refrigerant system with a synthetic refrigerant system.

In the articles published in *Accelerate America* from its inception last year to the current

issue, we have reported on many end users who have found natural refrigerant-based systems to be more efficient than their synthetic counterparts. But these end users have gone about their measurement and analysis in different ways. This raises the question: is there a “best practice” for comparing the efficiency of a natural refrigerant system to a synthetic one – one that accounts for factors like local ambient temperatures and load conditions.

Sobeys, the leading user of natural refrigerants in North America, thinks so. While the Canadian chain long ago concluded that transcritical CO₂ refrigeration is

more efficient than traditional DX with synthetic refrigerants, it is now employing a measurement tool called System Efficiency Index (SEI) to compare the efficiencies of two transcritical systems made by different manufacturers, each with distinct technical features. SEI has the advantage of being “a normalized unit of absolute efficiency,” said Ian Crookston, Sobeys manager, energy management. (See [p.32](#))

Food Lion, the subject of our cover story, is planning to use both submetering and a mass flow meter to compare the energy efficiency of its new transcritical system with that of a DX/synthetic system. The

mass flow meter is key, because it normalizes the operational differences in data from different stores. (See [p.24](#))

As the natural refrigerants industry evolves, it will become increasingly important to ensure that statements about energy efficiency can be validated. For that, the industry will need to consider the various measurement options and decide which one or ones should be standardized as best practices.

I would like to congratulate [Jan Dusek](#) and shecco's other colleagues in Japan on the launch last month of *Accelerate Japan*, an every-other-month Japanese language version of *Accelerate* – that will focus on natural refrigerant developments in East Asia. A condensed, translated version of *Accelerate Japan's* first cover story on the convenience store giant Lawson starts on [p.36](#)

● MG

NORTH AMERICAN EDITION ISSUE #8, SEPTEMBER 2015

ACCELERATE

ADVANCING HVAC&R NATURALLY



ABOUT ACCELERATE AMERICA

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

<http://accelerate.shecco.com>



Wanted: A measurement standard

Editor's note by Michael Garry



Susan Sollenberger and Wayne Rosa from Food Lion



The Natural Voice relaunches global call to action on naturals

Taking the next step



Are CO₂ transcritical systems a good investment?



Events planner

The events in September, October and November 2015



FMI Energy Conference to feature natural refrigerant standouts

A natural way to comply
with the clean power plan



Doing it all with CO₂

— by Klaas Visser

Sobeys' new
efficiency-measuring
tool



Lawson:
Becoming the
world's best

ATMOsphere America
Poll results, training panel,
contractor's panel, new
applications & industrial
refrigeration



Fall frenzy of
industry events



Hillphoenix's
components quest



Policy:
DOE and AHRI
settle over
efficiency rules for
walk-ins



Short takes

ISSUE #8

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THE NATURAL VOICE RELAUNCHES GLOBAL CALL TO ACTION ON NATURALS

With an industry-supported statement aimed at governments and climate negotiators, The Natural Voice urges action to phase down HFCs and replace them with natural refrigerants

— By Klara Skacanova

In an effort to increase awareness of natural refrigerant solutions among policy makers and climate negotiators, and harness the technology's full potential globally, Brussels-based shecco has relaunched The Natural Voice (TNV) campaign with new initiatives and an open statement currently supported by 74 signatories.

TNV was originally unveiled in 2010 as a global call to action aimed at climate negotiators. Since then it has served as a platform for HVAC&R companies, end users, industry associations, NGOs and other parties to show their support for the environmental, economic and social potential of natural refrigerants – in particular, carbon dioxide, ammonia, hydrocarbons, water or air.

Despite progress over the past five years in adopting natural refrigerants in a number of applications, barriers to wider adoption still exist at different levels. This is partly due to insufficient support from national governments – which is what TNV wants to change.

The revival of TNV comes at a time of growing momentum to phase down HFCs on a global scale under the Montreal Protocol and find environmentally friendly replacements. The team behind TNV at shecco recognized the need to revamp the campaign to better reflect the changing market and policy landscape.

At its July meeting in Paris, The Montreal Protocol, which has led the global phase-down of CFCs and HCFCs, made slow

progress towards establishing formal negotiations on a global HFC phase-down; that process is expected to continue during the Dubai Meeting of the Parties to the Montreal Protocol in November. It has thus become critical that policy makers and climate negotiators acknowledge the potential for natural refrigerants to become the mainstream HFC-free solution for both developed and developing countries.

"Relaunching The Natural Voice at this point in time is crucial," said Nina Masson, shecco's deputy managing director, at the official relaunch of TNV at the ATMosphere Network Paris event held during the July Montreal Protocol meeting.

"While we are seeing a growing interest from both end users and suppliers worldwide in future-proof heating, refrigeration and AC solutions without climate-damaging synthetic gases, there still exist basic misconceptions about natural refrigerants among national governments, commercial end users and individual consumers. Therefore, what is needed now is one global call for action, not only to address remaining barriers, but more importantly to provide evidence of a global business case for users and producers of natural refrigerant-based technologies."

The new TNV will take a proactive approach to showing the benefits of natural refrigerants through publications, video maps, and other projects. While aimed at national policy makers and climate negotiators, the program will



enable industry and non-industry partners, including end users and consumers, to be actively involved in initiatives to fast-track natural refrigerants globally.

For example, to show the growing global momentum for natural refrigerants, TNV will collect “VOICES” from public forums, conferences, articles and other sources talking about the value of using these efficient, environmentally friendly refrigerants. Anyone wishing to add his or her voice can do so by contacting speakup@thenaturalvoice.org

REVISED STATEMENT

As part of the relaunch of TNV, its underlying statement (which can be read at www.thenaturalvoice.org), has been revised to address the key barriers to a wider uptake of natural refrigerants.

In a preamble to the statement, TNV posits that each nation and industry bears a responsibility to fight climate change, and that the refrigeration, heating and cooling industry recognizes the role it can play to reduce direct and indirect greenhouse gas emissions.

The statement then calls upon national governments to acknowledge the potential of well known, energy-efficient and low-cost natural refrigerants to address emissions globally. It also asks governments to remove impediments like trade barriers and to revise standards, codes and legislation that restrict the use of naturals, which can be used safely under appropriate standards and best industry practices.

The statement also calls upon governments to provide financial and other support for research and promotion of natural refrigerant technologies, and to facilitate a technology transfer from developed to developing countries.

Calling action to phase down fluorinated gases “low-hanging fruit” in the battle against climate change, the statement encourages national governments to pursue this course under the Montreal Protocol without further delay.

“The Natural Voice will continue calling on all parties to adopt natural refrigerants as a major response to replacing HCFCs and HFCs as a long term solution, and to stopping the chemical treadmill,” said Sidi Menad Si Ahmed, shecco’s international chief adviser, who moderated ATMOSphere Network Paris. **KS**

BECOME A SIGNATORY - ADD YOUR VOICE

So far TNV’s statement has been endorsed by 74 organizations representing HVAC&R system and component suppliers, industry associations, end users, development agencies, NGOs and research institutes.

Organizations from all over the world are invited to join TNV campaign for free and support the statement by becoming a signatory at www.thenaturalvoice.org.

For more information on TNV, contact Nina Masson at nina.masson@shecco.com

ARE CO₂ TRANSCRITICAL SYSTEMS A GOOD INVESTMENT?

Considering energy efficiency, the growing costs of HFC systems, and the impact of regulations, yes they are

— By Jim Knudsen

The fun and excitement associated with using naturally occurring substances such as CO₂ and hydrocarbons as refrigerants are over. There are literally thousands of natural-refrigerant systems generating cold every day.

As usage of these systems expands due to concerns over the environment, and regulatory action, it is time to look at their financial justification or return on investment (ROI) — perhaps not as much fun. In this article I will talk about the issues that arise in evaluating the ROI for natural-refrigerant systems in food retail applications. I will use CO₂ transcritical systems as a reference, but the issues highlighted here can be applied to other natural-refrigerant equipment as well.

ROI definition

The analysis of ROI can vary from organization to organization based on policy, available capital, and overall strategy. In this article I will not address detailed technical issues such as lifecycle, payback period, tax treatment, and amortization (my apologies to the financial types). Instead I will consider the simplest basis for determining ROI, which is comparing the total cost to implement with the returns generated.

The returns in this analysis are revenues and profits generated by retail sales. It is easy to assume that the retail sales over the evaluation period would not be overly impacted by the choice of the refrigeration system. Not so fast; considering that many retailers highlight their environmental stewardship in promotional and branding messages, clearly there is an expectation that environmental awareness may drive shopping decisions for a segment of consumers.

Quantifying this factor for refrigeration systems compared to the plethora of other environmental programs may be difficult, but it should not be ignored. There is a clear risk that actions contrary to stated environmental goals may result in a backlash. Retail organizations have already been accused of “green-washing” in the press. I believe that if an organization that serves the public claims environmental responsibility, they should factor in the value of a refrigeration strategy consistent with this message.

On the investment side, the discussion comes down to total cost of ownership, with consideration for future trends, ongoing costs, and potential risks associated with regulatory and enforcement changes.

Higher first costs

The very big elephant in the room is that CO₂ commercial refrigeration systems are much more expensive than traditional HFC systems, especially in the United States. In a recent presentation at ATMOsphere America 2015, the equipment cost of a CO₂ transcritical system was shown to be nearly twice that of comparable HFC systems. This is not an unusual situation, but as the number of systems increases, the premium is expected to fall. In fact, similar numbers published in Europe show a much smaller difference, more like 30% to 50%. The reasons for this are:

- » The greater penetration of these systems in Europe has resulted in a maturing of the market and the moderation of pricing. The maturing of the market has helped to reduce installation/service and component costs, and provided many qualified suppliers with significant volumes.
- » In general, energy-saving technologies such as electronic expansion valves, case controllers, and variable speed drives are widely used in conventional systems in Europe, while often they are considered part of the premium for CO₂ systems in North America.
- » The European market has been driven by an aggressive approach to environmental regulation. It has pushed refrigerant pricing for HFCs higher while fees and regulatory costs work against HFC systems.

Energy: an overwhelming cost

The most critical factor in the entire analysis is energy cost. The cost of energy in the operation of commercial refrigeration systems represents 75% to 85% of the total cost of ownership, depending on the price of electricity and the life of the equipment. In addition, energy in conventional HFC systems accounts for approximately half of the environmental impact. As such, the cost of energy represents as much as 10 times the first cost of the system. Said another way, a 10% reduction in energy can offset a 100% increase in first cost of the system.

Recently, *Accelerate America* reported that a retail CO₂ transcritical system operating at a Sprouts store near Atlanta, where the warmer climate makes these systems less efficient, was more than 6% more efficient than comparable HFC systems.

continued on p. 10

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→ With energy such an overwhelming factor, any technology that saves energy should be strongly considered.

Currently, maintenance and repair costs can represent a premium cost for CO₂ systems. This is largely due to the lack of familiarity with these systems by U.S. service organizations. In Europe these costs are similar to those of HFC systems, and it is reasonable to expect that this will be the case in the U.S. as the market matures.

Refrigerant is – and will continue to be – a high cost for HFC systems. As regulatory efforts continue to limit their production (closely paralleling HCFCs) the cost of these refrigerants can be expected to rise significantly.

Just a quick mention of the principle related to valuing initial cost vs. ongoing expenses. Typically, initial capital outlays are viewed differently from ongoing operating expenses due to the effect of inflation over time. In other words, a dollar today is worth more than

a dollar in the future by the factor of inflation. On the other hand, offsetting this are cost trends that also need to be considered.

Energy costs tend to go up. Economic growth continues to put pressure on the grid, but is offset by conservation; slow growth in electrical cost (roughly offsetting the inflation effect) is a reasonable assumption. The cost of HFC refrigerant, as environmental regulation continues to mount, will keep increasing. The cost of R22, for example, has increased by a factor of 10 as its production has been phased out.

By contrast, the ongoing cost of maintaining natural-refrigerant systems will continue to fall as more trained technicians gain experience and the newness and risks are factored out of the pricing. Putting this all together, it is reasonable to assume that the increase in HFC-related operating costs will more than offset the time-value of the initial investment in natural-refrigerant systems.

Operating cost trends

References		Units	Current	In 2025	% gain/year
Federal Reserve bank of Philadelphia: Short and Long Term Forecast	Inflation	% Change	1.97	2.14	2.0%
DOE/EIA Annual Energy Outlook 2015	Energy	cents/kWh	10.2	11.7	1.5%
Compilation of current R404A pricing and R22 pricing trend 2005-2015	R404A	\$/lb.	6.31	45.95	24.7%
Estimate	Maint. & Repair	\$/hr	100	120	2.0%

Regulatory costs and risk factors

No matter who wins next year's election, we can expect a continued trend toward regulation of chemical refrigerants. While the cost of this may be difficult to estimate, it is a real cost. Already some retailers have seen substantial fines related to refrigeration leaks and venting of controlled refrigerants. For natural-refrigerant systems, regulatory risk is expected to be a much smaller issue. This technology can "future-proof" (to quote Keilly Witman of KW Refrigerant Management Strategy) your refrigeration investment.

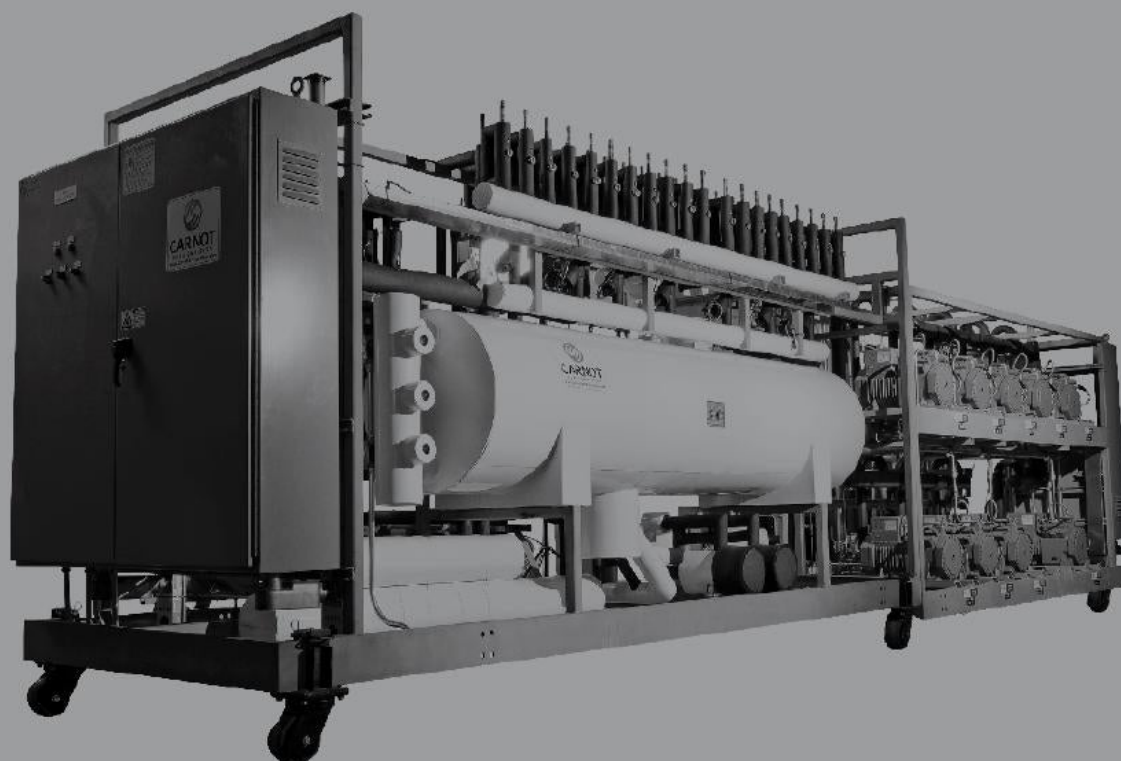
How to factor the "risk premium" into the ROI calculation is up to every organization to decide. It is difficult to measure; fees, fines, and negative publicity can be very costly, but it is unclear how likely they are to occur. The cost of one incident under the current regulations can be as high as \$4.5 million. Even a one-in-a-thousand chance of this happening would be significant in the ROI calculation, particularly if you consider that the likelihood of tighter regulations on HFCs is very high.

Considering all of the above factors, a natural refrigerant system – in particular, a CO₂ transcritical system – can compete very effectively for investment dollars in today's environment. The decision is clear. Now is the time to rethink our investment strategy. Want to save some green? Choose natural refrigerants **JK**



Jim Knudsen, who lives in Columbus, Ga., is an experienced refrigeration executive, specializing in global marketing, business development and product strategy. He is the holder of five U.S. patents. His Strategic Leadership Blog is located at: www.jamesknudsen.com

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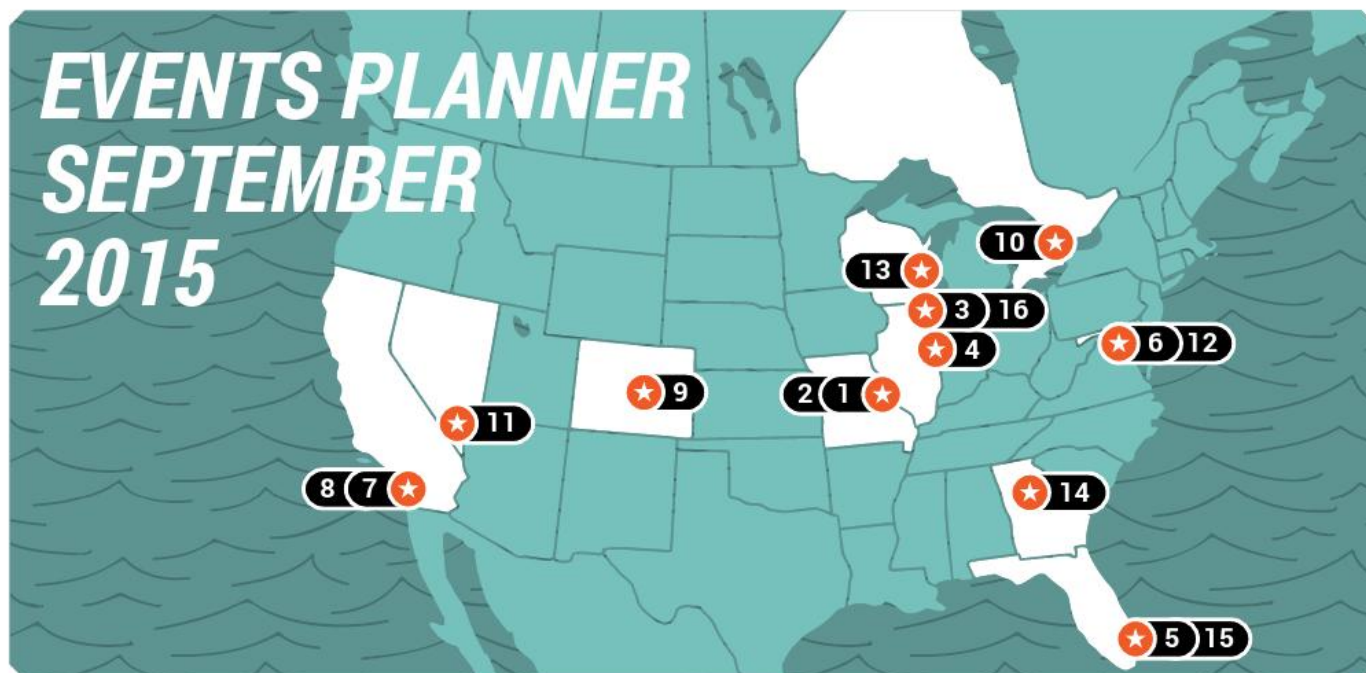
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twitter: #WomenInIndustry / @WomenInHVACR
- 2 September 15-17, St. Louis, MO
Comfortech 2015
<http://www.comfortechshow.com/ct15/public/enter.aspx>
twitter: #Comfortech2015 / @comfortechshow
- 3 September 15-18, Chicago, IL
International Dairy Show 2015
<http://dairyshow.com/>
twitter: #DairyShow / @dairyshow
- 4 September 22-25, Urbana, IL
CTS Training on Transcritical CO₂ Technology
<http://www.creativethermalsolutions.com/servicesandfacilities.html>
- 5 September 20-22, Fort Lauderdale, FL
IANA Intermodal Expo 2015
<http://www.intermodalexpo.com/index.php>
twitter: #IntermodalExpo / @IntermodalEXPO
- 6 September 20-23, National Harbor, MD
Data Center World
<http://www.datacenterworld.com/fall/>
twitter: #datacenter / @DataCenterWorld
- 7 September 27-30, San Diego, CA
2015 FMI Energy & Store Development Conference
<http://www.fmi.org/forms/meeting/Microsite/ESD2015.0>
twitter: #FoodRetail / @FMI_ORG
- 8 September 27-30, San Diego, CA
CSCMP's 2015 Annual Conference
<https://cscmp.org/annual-conference>
twitter: #CSCMP2015 / @cscmp
- 9 September 27-30, Colorado Springs, CO
SMACNA Annual Convention
<https://www.smacna.org/annualconvention>
twitter: #SMACNA / @SMACNA
- 10 September 28-29, Toronto, Canada
Grocery Innovations Canada 2015
<http://www.groceryinnovations.com/closed.html>
twitter: @CFIGFCEI
- 11 September 28-30, Las Vegas, NV
PACK EXPO
<http://www.packexpolasvegas.com>
twitter: #PACKEXPO / @packexposhow
- 12 September 29 - October 1, Washington, DC
2015 AFFI Government Action Summit
<http://www.affi.org/events/2015-affi-government-action-summit>
- 13 September 29 - October 2, Milwaukee, WI
RETA 2015 National Conference
http://reta.com/events/event_details.asp?id=644201&group=
- 14 September 30 - October 2, Atlanta, GA
ASHRAE: Energy Modeling Conference
<https://www.ashrae.org/membership-conferences/conferences/ashrae-conferences/2015-ashrae-energy-modeling-conference>
@ashraenews
- 15 September 30 - October 2, Hollywood, FL
PHCC CONNECT 2015
<http://www.phccweb.org/connect/>
twitter: @phccnatl
- 16 September 30 - October 3, Rosemont, IL
78th Annual RSES Conference and HVACR Technology Expo
<http://www.rses.org/conference.aspx>
twitter: #RSES / @RSESHQ

EVENTS PLANNER

OCTOBER 2015



1

October 5-9, Boston, MA
**13th Cold Chain GDP & Temperature Management
 Logistics Global Forum**
<http://www.coldchainglobalforum.com/#ColdChain>
 twitter: #Logistics / @CCGlobalForum

2

October 10-13, Dallas, TX
NFRA Convention
<http://nfraconvention.org/>

3

October 11-14, Las Vegas, NV
NACS Show 2015
<http://www.nacsonline.com/nacsshow/Pages/default.aspx>
 twitter: @NACSONline

4

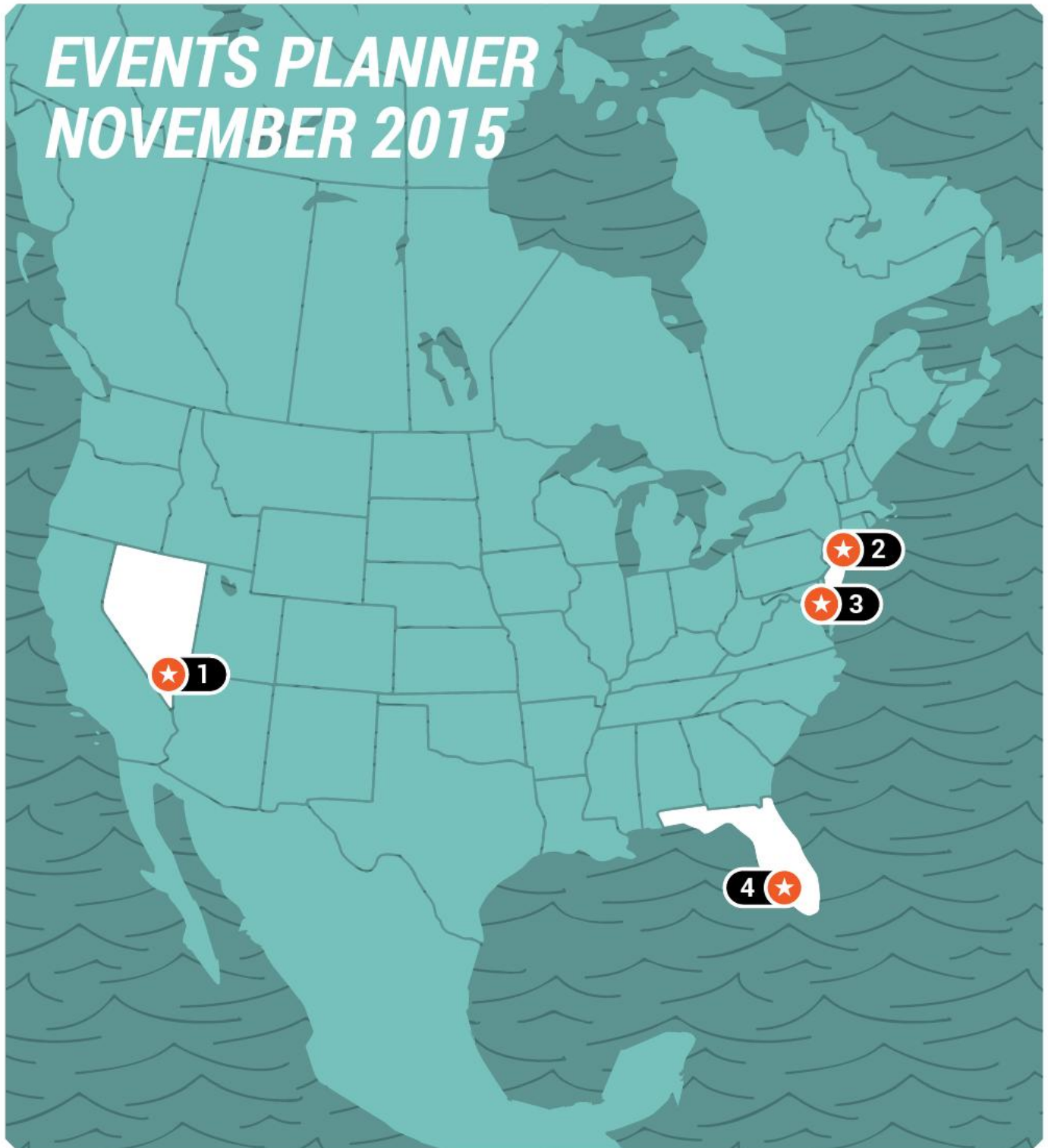
October 20-22, Guadalajara, Mexico
2015 AHR Expo-Mexico
<http://www.ahrexpomexico.com/sp/index.php>
 twitter: #AHRExpo / @ahrexpomexico

5

October 23-25 Atlanta, GA
PMA Fresh Summit
<http://www.pma.com/events/freshsummit>
 twitter: @FreshSummit

EVENTS PLANNER

NOVEMBER 2015



1

November 5-7, Las Vegas, NV
35th IACSC Conference & Expo
<http://www.gcca.org/35th-iacsc-conference-expo>
 twitter: #IACSC2015 / @iacsc

2

November 10-11, Secaucus, NJ
Kosherfest
<http://www.kosherfest.com>
 twitter: @Kosherfest

3

November 18-20, Washington, DC
Greenbuild International Conference and Expo 2015
<http://www.greenbuildexpo.com/>
 twitter: #Greenbuild / @Greenbuild

4

November 15-17, Bonita Springs, FL
AHRI 2015 Annual Meeting
<http://www.ahrinet.org/site/915/News-Events/Meetings-and-Events/AHRI-2015-Annual-Meeting>
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FMI ENERGY CONFERENCE TO FEATURE NATURAL REFRIGERANT STANDOUTS

Target, Whole Foods, Sobeys, Ahold USA will offer insights on refrigeration and energy savings

— By James Ranson

The supermarket industry's annual conference on refrigeration, energy and store development trends is headed to the state that has done more than any other to impact those trends – California.

The Food Marketing Institute's Energy & Store Development Conference, which will take place Sept. 27-30 at the Sheraton Hotel in San Diego, brings together a variety of stakeholders in the food retail industry from refrigeration engineers and service technicians to store designers to manufacturers.

The event will include presentations from a number of retail speakers that have been at the forefront of natural refrigerant adoption, including Paul Anderson of Target, Aaron Daly of Whole Foods Market, Ian Crookston of Sobeys and Ken Welter of Baltic Trail Engineering (Ahold USA's contractor).

Anderson, Target's senior group manager, engineering, will team up in a general session with Keilly Witman, the former manager of the EPA's GreenChill program who now runs KW Refrigerant Management Strategy. Their topic: "A Provocative Look at the Future of Refrigeration and Store Design," in which they will challenge "preconceived notions" about refrigeration technology, store maintenance, store design and merchandising, as well as environmental best practices.

In another general session, Aaron Daly, global energy coordinator for Whole Foods Market, will share best practices for communicating sustainability achievements to customers and other parties without "green-washing." He will explain how Whole Foods partners with the Department of Energy and various EPA programs to lend credibility to sustainability claims.

Breakout sessions on refrigeration will cover basic refrigeration principles, maintenance, what to expect from an EPA inspector, and a refrigeration roundtable for retailers and wholesalers.

The maintenance session, presented by Kenneth Welter, former Ahold USA refrigeration executive who is now manager of refrigeration and design, Mid-Atlantic for Baltic Trail Engineering, will address maximizing overall store efficiency while maintaining long-term profitability. Welter will outline the strategies inherent in a comprehensive supermarket refrigeration and HVAC maintenance program, and how to identify the right metrics and align the goals of the maintenance, engineering and energy divisions.

Energy reductions, EPA presentations

The energy and store development breakouts will include case studies on energy efficiency, recommendations to achieve 50% energy reduction in grocery stores, HVAC best practice and design trends, retro-commissioning, and LED retrofit solutions.

In a session on reducing utility consumption, Ian Crookston, Sobeys' manager, energy management, will review some common and easily replicated utility conservation initiatives used in one of Sobeys' 40,000-square-foot food retail stores. These include adiabatic cooling and variable flow compressors, which will be reviewed from the perspective of reduced utility consumption, government incentives and system efficiency index.

Mick Schwedler, steering committee chair of the Advanced Energy Design Guides (AEDG), will also talk about obtaining energy reductions in grocery stores. The AEDG are a series of publications showing how to achieve energy savings over the minimum code requirements of ANSI/ASHRAE/IESNA Standard 90.1. In March of 2015, a Grocery AEDG was published. Schwedler will provide specific examples of recommendations, case studies, technologies, systems, and controls to reduce grocery store energy use by 50% (compared to ASHRAE 90.1-2004).

Rebecca von dem Hagen, a biologist with the EPA's Stratospheric Protection Division, will provide an update of ongoing EPA regulatory actions relevant to the food retail industry. These include the Significant New Alternatives Policy (SNAP) program, the Obama administration's Climate Action Plan, anticipated regulatory updates to section 608 of the Clean Air Act, and the current status of the HCFC regulatory allocation program.

The EPA's GreenChill program, led by Tom Land, will present its annual achievement awards at a 7 am breakfast ceremony on Sept. 29. The awards include, among others, best emissions rate, most improved emissions rate, store certification excellence and distinguished partner.

The last day of the conference will feature a tour of San Diego's Energy Innovation Center and local supermarkets. A grocery store in the 1950s, the Energy Innovation Center is now home to a working demonstration kitchen and a number of energy-efficient technologies. The Center reuses or recycles about 85% of the building's materials; has a heat-reflecting roof to reduce HVAC&R energy consumption, solar panels, ultra low-flow water fixtures, intuitive sensors to switch off lighting and HVAC&R applications; and is one of only ten buildings in the world to achieve Double LEED



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www.fmi.org/forms/meeting/Microsite/ESD2015

FALL FRENZY OF INDUSTRY EVENTS

Retailers, contractors, truckers, data centers, and training associations all have conferences over the next three weeks.

Rarely are there as many conferences related to natural refrigerant adoption as there are over the early weeks of the fall. In addition to the FMI Energy & Store Development Conference (see the previous page), the next month will include Comfortech 2015, IANA Intermodal Expo 2015, Data Center World, the RSES Conference and the RETA Conference. Here's a brief overview of each one.

— By James Ranson

Comfortech 2015

Held at America's Center Convention Complex in St. Louis, Mo., from September 15-17, Comfortech is described as a supermarket of HVAC, hydronics, and plumbing. Geared specifically to mechanical contractors, the conference provides a platform for products, market trends and business solutions.

Sponsors include Danfoss and Emerson Climate Technologies; the latter's Vice President A/C sales Karl Zellmer, in a session on modulation technology, will look at how the rollout of new efficiency regulations and changing consumer preferences for comfort are affecting the way industry looks at HVAC systems in the U.S.

Another session will feature Richard Hiles, national residential geothermal sales manager for Carrier, providing updates on the geothermal heat pump industry.

The event includes the following co-location association events: Service Nation Alliance, Quality Service Contractors, National Comfort Institute, and Women in HVACR.

For more information visit:
www.comfortechshow.com/ct15/public/enter.aspx

IANA Intermodal Expo 2015

IANA (Intermodal Association of North America) will hold its Intermodal Expo on Sept. 20-22 at the Greater Ft. Lauderdale/Broward County Convention Center in Florida. The event will examine all aspects of the growing intermodal freight transport industry, including products, services and challenges facing the sector. Attendees will include 3PLs, ocean carriers, motor carriers, equipment manufacturers, leasing companies, and technology vendors.

The Expo will present the latest transport refrigeration and air conditioning systems used in trucking and shipping, among other products.

For more information visit:
www.intermodalexpo.com

Data Center World

The use of energy-efficient CO₂ transcritical refrigeration to cool data centers, which consume enormous amounts of energy, is one of the greatest growth opportunities for natural refrigerants.

For those interested in learning more about the data center industry, Data Center World, to be held at National Harbor, Md., from Sept. 20-23, addresses the key challenges facing this globally expanding market.

For more information visit:
<http://www.datacenterworld.com>

RETA National Conference

RETA (Refrigerating Engineers and Technicians Association), which focuses on industrial refrigeration, will hold its annual National Conference in Milwaukee, Wis., Sept. 29 to Oct. 2. The backbone of the conference is its education and technical training sessions designed to "refresh, renew and expand refrigeration knowledge and understanding."

The 2015 edition includes hands-on workshops, manufacturer-specific sessions, technical paper presentations and "hot point" presentations in the form of infomercials to alert professionals to upcoming issues, trends, new equipment and other industry tips.

The conference allows attendees to accrue RETA professional development hours towards their RETA certification by attending its four days of technical sessions as well as a two-day Refrigeration Review Course & CRES Review Course held prior to the conference.

Industry vendors Parker, Baltimore Aircoil, GEA, Mayekawa, Colmac Coil Manufacturing, Evapco, Hillphoenix, Danfoss and Bitzer will all present across a range of topics including low-charge ammonia technology, CO₂ temperature tolerances, evaporator selection, and Process Safety Management.

For more information visit:
www.reta.com/?page=conference

RSES Conference and HVACR Technology Expo

From Sept. 30 to Oct. 3, the 78th RSES (Refrigeration Service Engineers Society) Conference and HVACR Technology Expo will take place at the Embassy Suites in Rosemont, Ill., focusing primarily on training programs for HVAC manufacturers, service technicians and installers.

The conference includes training/education sessions tailored to professionals with basic, intermediate and advanced knowledge levels. The sessions cover safety and evacuation practices, the EPA's phase out of high-GWP refrigerants, installation practices, and troubleshooting, among other areas.

Among the sessions, Arthur Miller, Region 2 director for RSES, will deliver a one-day hydrocarbon training program on Sept. 29 covering best practices for working safely with flammable refrigerants. In addition, Danfoss will present on how humidity affects the built environment, while Embraco will discuss the regulations on the use of hydrocarbons, among other topics.

For more information visit:
www.rses.org/conference.aspx

A NATURAL WAY TO COMPLY WITH THE CLEAN POWER PLAN

By supporting the adoption of natural refrigerant systems, states can move closer to meeting their goals under the new EPA program

— by Elke Milner

On August 3, the Environmental Protection Agency and President Obama announced the final Clean Power Plan (CPP). The plan aims to reduce carbon pollution from power plants, but it also has the potential to open new opportunities for the adoption of natural refrigerant technologies.

Widely considered President Obama's most ambitious climate policy to date, the Clean Power Plan authorizes the EPA to cut carbon dioxide emissions from power plants by 32% from 2005 levels by 2030.

In a nutshell, the EPA is giving each state an individualized goal to reduce emissions from their electric power plants, and each state gets to determine how to meet its goal. Each state is required to submit a game plan by September 2016 (states can apply for an extension up to 2018) and begin cutting emissions by 2022 at the latest.

As expected, some states, particularly those heavily invested in fossil fuels like coal, are raising concerns about unemployment and increased electricity costs despite the flexible deadlines; led by West Virginia, more than a dozen states have filed a petition for an emergency stay of the CPP with the U.S. Court of Appeals.

On the other hand, California and a handful of other states, mostly in the west and northeast, are already way ahead of the game and are expected to surpass their 2030 targets. Having passed its Global Warming Solutions Act in 2006, which requires that greenhouse gas emissions be reduced to 1990 levels by 2020, California is on track to meet the EPA's new emissions target years ahead of schedule.

Key role for natural refrigerants

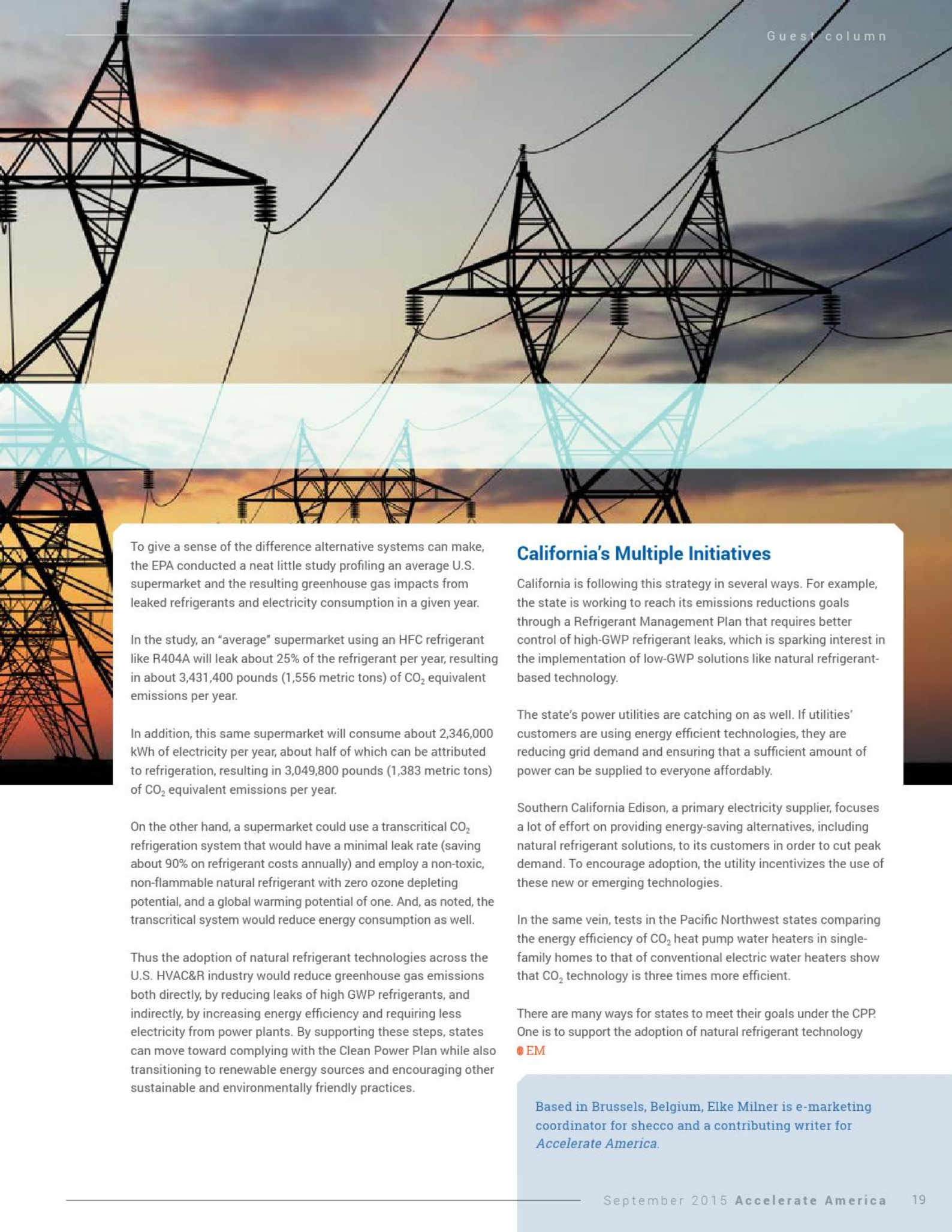
So where do natural refrigerants come in?

A major focus of the new Clean Power Plan is on moving toward renewable sources of energy, but it also maintains energy efficiency as a key compliance tool. States have broad flexibility to design their carbon reduction plans with an emphasis on energy efficiency and other emission reduction strategies.

There have been numerous examples of natural refrigerant systems operating more efficiently than conventional DX/HFC systems. For example, transcritical CO₂ systems have proven time and time again to be as efficient and at times even more efficient than traditional HFC technology, even in high ambient temperatures. In addition, integrated CO₂ systems recover waste heat to provide other necessary functions such as space and water heating, and can even drive an absorption chiller during summer months for additional cooling, further reducing energy consumption.

Another good example of an energy-saving natural refrigerant system is Red Bull's "ECO Cooler," which uses isobutane (R600a) to chill its energy drinks. Seven of these coolers use less energy than a single 100-watt light bulb.

Efficiency is related to indirect carbon emissions (originally generated by power plants). Natural refrigerant systems also offer the opportunity to substantially reduce the direct emissions contributed by refrigerant leaks (and end-of-life venting) by replacing leak-prone, high-GWP HFCs and R22 with very-low-GWP natural refrigerants that are also less prone to leak.



To give a sense of the difference alternative systems can make, the EPA conducted a neat little study profiling an average U.S. supermarket and the resulting greenhouse gas impacts from leaked refrigerants and electricity consumption in a given year.

In the study, an “average” supermarket using an HFC refrigerant like R404A will leak about 25% of the refrigerant per year, resulting in about 3,431,400 pounds (1,556 metric tons) of CO₂ equivalent emissions per year.

In addition, this same supermarket will consume about 2,346,000 kWh of electricity per year, about half of which can be attributed to refrigeration, resulting in 3,049,800 pounds (1,383 metric tons) of CO₂ equivalent emissions per year.

On the other hand, a supermarket could use a transcritical CO₂ refrigeration system that would have a minimal leak rate (saving about 90% on refrigerant costs annually) and employ a non-toxic, non-flammable natural refrigerant with zero ozone depleting potential, and a global warming potential of one. And, as noted, the transcritical system would reduce energy consumption as well.

Thus the adoption of natural refrigerant technologies across the U.S. HVAC&R industry would reduce greenhouse gas emissions both directly, by reducing leaks of high GWP refrigerants, and indirectly, by increasing energy efficiency and requiring less electricity from power plants. By supporting these steps, states can move toward complying with the Clean Power Plan while also transitioning to renewable energy sources and encouraging other sustainable and environmentally friendly practices.

California's Multiple Initiatives

California is following this strategy in several ways. For example, the state is working to reach its emissions reductions goals through a Refrigerant Management Plan that requires better control of high-GWP refrigerant leaks, which is sparking interest in the implementation of low-GWP solutions like natural refrigerant-based technology.

The state's power utilities are catching on as well. If utilities' customers are using energy efficient technologies, they are reducing grid demand and ensuring that a sufficient amount of power can be supplied to everyone affordably.

Southern California Edison, a primary electricity supplier, focuses a lot of effort on providing energy-saving alternatives, including natural refrigerant solutions, to its customers in order to cut peak demand. To encourage adoption, the utility incentivizes the use of these new or emerging technologies.

In the same vein, tests in the Pacific Northwest states comparing the energy efficiency of CO₂ heat pump water heaters in single-family homes to that of conventional electric water heaters show that CO₂ technology is three times more efficient.

There are many ways for states to meet their goals under the CPP. One is to support the adoption of natural refrigerant technology

■ EM

Based in Brussels, Belgium, Elke Milner is e-marketing coordinator for shecco and a contributing writer for *Accelerate America*.

DOING IT ALL WITH CO₂

By combining refrigeration, air conditioning and heating in one unit, transcritical CO₂ systems save energy and water while cutting indirect and direct greenhouse gas emissions

— By Klaas Visser

In the late 1950s, I operated a carbon dioxide refrigeration system on a ship carrying frozen meat eastbound from Buenos Aires, Argentina, to Yokohama, Japan. I knew it worked very well with low-temperature seawater, which cooled the CO₂ condenser, and very poorly with warmer seawater, particularly in tropical waters.

It was not until 1985 that my dear late friend Gustav Lorentzen (who, in the late 1980s, rediscovered how CO₂ could be used in refrigeration) explained to me why this is so. CO₂ is funny stuff. It is the only refrigerant I know that improves its energy efficiency when you increase the compressor discharge pressure when operating above the critical pressure of 1,071 psig at 88°F. If only I had known that in 1959! I would have throttled the cooling water supply to one compressor instead of starting the second compressor, and supplying maximum cooling water to the CO₂ condensers!

In 2009 I was very fortunate to get involved in the design of a multi-function, two-stage transcritical CO₂ refrigeration system with parallel CO₂ refrigeration (or MF2STTCCO₂RSPC for short) to replace 22 existing systems in an Australian food processing plant. The other systems comprised a number of R12 and other

CFC/HCFC systems, as well as six ineffective R134a air-to-water heat pumps and several HFC inverter units for office cooling and heating. In fact I was terrified when the Australian Federal Government awarded my client a \$472,000 grant to develop the system I had designed and budgeted. Some of my friends in Europe were kind enough to vet my design before I entered into a partnership with Bitzer Australia and Guntner Australia to supply the compressor racks and evaporators, respectively. Many thanks to all.

The system has now been operating for nearly five years after an extremely difficult six-month commissioning period. It is fair to say we were lucky that we were able to fix all problems as they arose. It was a closely run thing and failure stared us in the face a number of times. But all's well that ends well, and in the end we produced a MF2STTCCO₂RSPC that performs virtually all refrigeration and heating functions at the plant. As it turned out, it was the world's first system of its kind.

The trials and tribulations during the past six years have proved invaluable in gaining practical operating experience with a MF2STTCCO₂RSPC delivering seven refrigeration functions from blast freezing to office AC cooling, and nine heating functions from freezer-door fascia heating with warm glycol to hot water



Klaas Visser is owner, since 2002, of Australia-based KAV Consulting Pty Ltd, a refrigeration consulting and engineering firm responsible for the world's first fully integrated, two-stage transcritical CO₂ refrigeration system. He has extensive international experience in the design, building and troubleshooting of medium to large ammonia systems, with involvement in more than 800 NH₃ projects during the past 50 years.

for chocolate melting. As a result of this experience it dawned on me that properly designed and operated CO₂ refrigeration systems, by combining refrigeration, air conditioning and heating, are the most efficient systems available.

SIMULTANEOUS NEEDS

In many applications in the food processing industry, there is a simultaneous need for high-capacity refrigeration and hot water. Conventionally, the refrigeration plant takes care of the cooling with the heat rejected to an evaporative condenser,

which consumes large quantities of water, just as cooling towers do in AC systems. In another part of the process, steam is generated in a boiler to heat water to temperatures of about 130 °F for chicken de-feathering to 145 °F for pig scalding prior to de-hairing. The important thing to

note is that food hygienic processing rules prohibit recirculation of hot water, which needs to be continuously heated from mains water temperature to the process temperature.

continued on p.22



Each Nation and each Industry Sector bears an individual responsibility in the fight against climate change.

The refrigeration, heating and cooling industry recognises the role it can play to reduce direct and indirect emissions of greenhouse gases.

The Organisations who endorse this statement call upon the National Governments to responsibly shape today the climate opportunities of tomorrow, and acknowledge the potential of Natural Refrigerants.

Support the statement today on
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When using a CO₂ refrigerating plant at such facilities the plant may be elected to operate in transcritical mode to heat water quite readily to temperatures of 160°F and up to 185°F with a bit more effort. When doing so, there is no longer a need for steam to heat the process water. This results in a reduction in gas or oil consumption, thus cutting operating costs and attendant CO₂-equivalent emissions. The amount of heat rejected to

the refrigerant condenser or cooling tower is reduced, thus lowering cooling water consumption, with attendant reduction in the use of water-treatment chemicals. Also reduced is the electrical-energy consumption of the condenser or cooling tower fans – and of the spray or cooling-water circulating pumps, respectively – which further cuts operating costs and CO₂-equivalent emissions. Reduction of cooling water consumption is a

welcome feature in many parts of the U.S., particularly California.

A similar scenario is applicable to hospitals and hotels, which generally require cooling and heating and consume large quantities of hot water. So here again we have the same situation. We reduce electrical energy and fuel consumption, and attendant emissions and water consumption.

INCORPORATING AC

But there are several other benefits associated with CO₂ refrigeration systems, notably their support of air conditioning. In many food-processing operations some AC and heating functions are often required for offices and staff amenities. When used for AC cooling, CO₂ refrigeration, if equipped with a water-cooled evaporative condenser, is more efficient than conventional refrigeration. Moreover, by integrating the AC and refrigeration duties into one system, the AC function may be combined with parallel compression – similar to an economiser operation on an ammonia screw compressor – to remove “flash” CO₂ gas in high ambient temperatures.

In the case of water heating, the critical point of 88°F is a big advantage, but it is a disadvantage for the refrigeration application due to the high volume of flash gas generated. Such gas needs to be compressed without doing any useful work in chilling water or providing refrigeration for other functions like, for example, space cooling. However, by incorporating parallel compression for AC, the flash gas inefficiency is largely removed and indeed the rest of the system, while

providing normal refrigeration for chilling, cold storage and freezing, operates more efficiently than any other refrigerant, be it ammonia, hydrocarbons or HFCs.

CO₂ has a very high proportion of sensible heat in the compressor discharge, which may be removed by air-cooling rather than by evaporating water in a hybrid evaporative condenser. This saves 50% of the water that would be used in an evaporative condenser or cooling tower. Over a whole year of operations, running water savings are greater, estimated between 65% and 80%.

Other benefits of CO₂ are its low cost and low GWP (global warming potential) of 1, compared with the much higher values for HFCs, which would undergo an 80% phasedown by 2030, under a proposal before the Montreal Protocol and already ratified by the EU legislature. Pumping CO₂ through buildings also offers the potential of using CO₂ as a fire-extinguishing medium by depleting the oxygen volume to 15% or lower, at which point a fire is unsustainable. A 14% oxygen level is still safe for people, although it will cause extreme exhaustion from physical activity.

Thus CO₂ as a fire-extinguishing medium is safe, quick and proactive without any water damage such as that caused by sprinkler systems and conventional firefighting with water. Frequently, the water damage is much greater than the actual damage caused by the fire itself.

CO₂ systems are also suitable for retrofitting to existing buildings and hospitals. A recent desktop study of hospital energy consumption in Washington, D.C., shows that retrofitting CO₂ for cooling and heating would reduce the electrical energy consumption by 24% and fuel consumption by 100%. This would result in a combined reduction in energy consumption of 47%.

In addition, the study revealed a reduction in cooling-tower water consumption estimated at 64%, as well as a 100% drop in fugitive HFC gas emissions. In new hospitals the electrical energy consumption reduction was estimated at 57%, again with 100% reductions in fuel consumption and HFC emissions, and a 68% decline in cooling-water consumption.

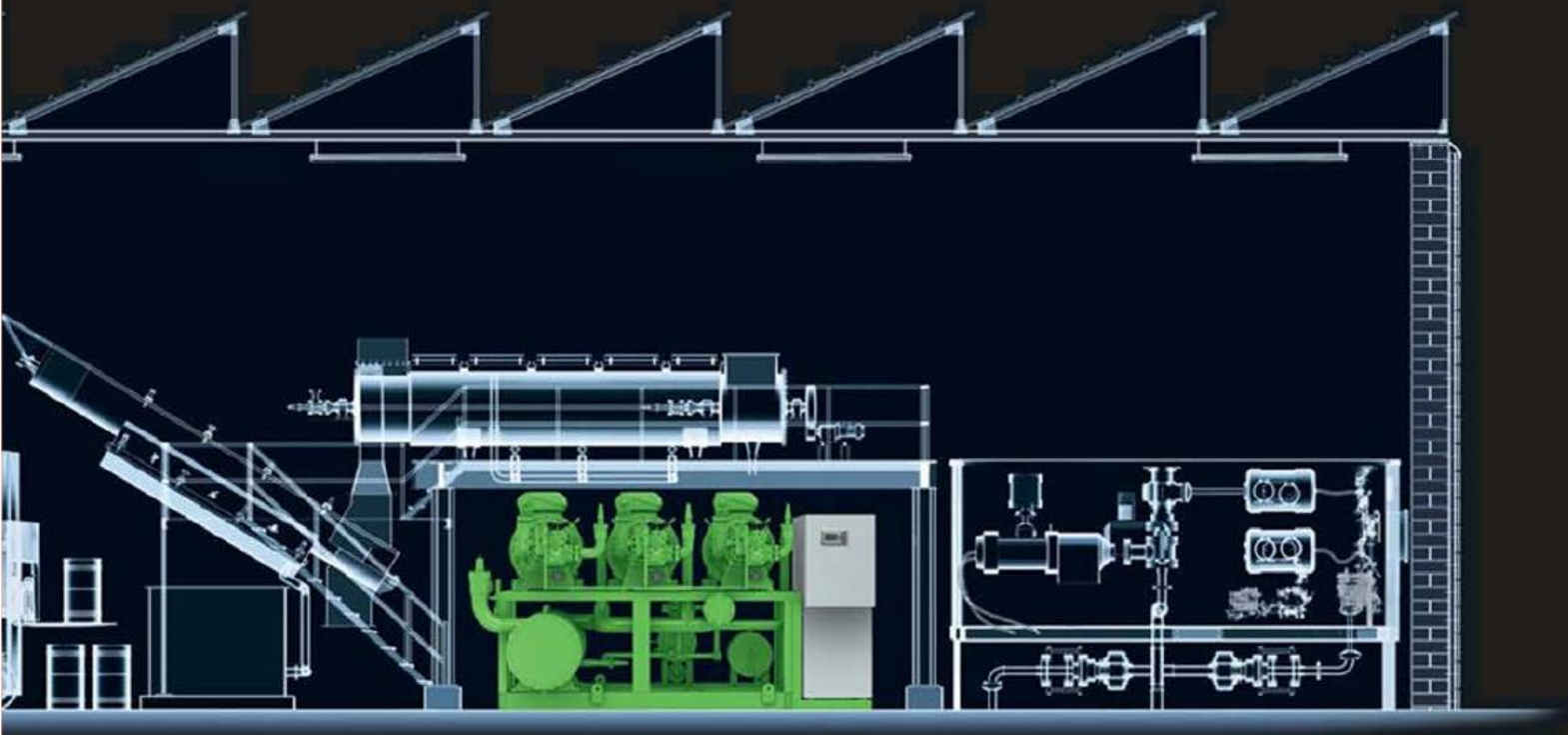
FUTURE-PROOFING

It is fair to say that CO₂ systems, applied to all manner of refrigeration applications in industrial processes as well as comfort cooling and heating in the built environment, reduce the energy consumption for both cooling and heating, with the attendant reduction in indirect greenhouse gas emissions. Furthermore, cooling-water consumption is reduced significantly as are direct emissions from the displaced HFC refrigerants. With

these advantages, CO₂ will future-proof any new installation against any further actions against HFCs or their very expensive HFO replacements.

The only thing holding back a rapid expansion of CO₂ refrigeration application to virtually all cooling, freezing and AC duties is the unavailability of larger compressors. But the economic and environmental benefits of CO₂ refrigeration

techniques are significant enough to be worthy of attention from manufacturers of suitable compressors – indeed, from all sectors of the industry. **KV**



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PROCESS RELIABILITY. **WE HAVE THE NEW
AMMONIA COMPRESSOR PACK FOR YOU!**

The new Ammonia Compressor Pack (ACP) from BITZER promises high efficiency at full and part load operation with high reliability, even in complex industrial refrigeration and process cooling applications. The modular design of the ACP combines two or three compressors, a common oil separator, and a frequency inverter to provide a broad range of operation in high, medium or low temp applications. Additional highlights include compressor and controls redundancy, and the units are designed to be service friendly.

— by Michael Garry



Susan Sollenberger

TAKING THE NEXT STEP

After a decade-long test of secondary and cascade CO₂ equipment, Food Lion is ready to run its first transcritical refrigeration system — in a warm climate, no less

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Wayne Rosa

Prototype Food Lion store, similar to the upcoming transcritical store in Southport, N.C.



→ Over the past decade, Food Lion has taken a careful, incremental approach to evaluating carbon dioxide-based refrigeration systems, as part of its focus on providing more sustainable refrigeration equipment to its stores.

It is now set to take its biggest step so far — a test of a transcritical all-CO₂ booster system. The system will refrigerate foods in a new store in Southport, N.C., a coastal community in the southeast corner of the state, near Myrtle Beach. The store is scheduled to open in the fourth quarter of 2015.

Wayne Rosa, energy and maintenance manager for Food Lion, believes the company is ready for the next step. “We’re experienced with CO₂ as a refrigerant in secondary and cascade systems,” he said. “We look forward to using this new refrigerant and evaluating the opportunities to bring it to more stores in the future.”

The Southport store is modeled on Food Lion’s standard, 35,000 ft² prototype, of which there are about 150 in the field. The chain will pick a nearby prototype store using conventional DX refrigeration with R407A to run operational comparisons with the Southport store.

Salisbury, N.C.-based Food Lion, which operates more than 1,100 stores in the southeastern U.S., will become the second division of Delhaize America to test a transcritical store. The first, Hannaford Supermarkets, based in Scarborough, Maine, opened the very first U.S. supermarket with a transcritical system in July 2013, and unveiled another last month in Berwick, Maine.

Food Lion and Hannaford are part of a growing cohort of U.S. food supermarket chains testing transcritical CO₂ systems that includes Kroger,

Ahold USA, Whole Food Markets, Roundy's, Aldi, Wegmans and Sprouts. Small independent operators, such as Angelo Caputo's Fresh Markets, are also getting into the transcritical game.

Among the larger players, Delhaize America, Kroger and Ahold USA have committed – or are part of organizations that have committed – to start reducing consumption of HFC refrigerants in 2015, which a transcritical system would allow them to do. These companies made their HFC pledge as members of the Consumer Goods Forum, a Paris-based group of global retailers and consumer-goods manufacturers.

Food Lion's first foray into carbon dioxide refrigeration took place in 2006, when it opened a store in Montpelier, Va., with a low-temperature secondary loop system using CO₂ as the secondary coolant. (See "No More Retrofits," *Accelerate America*, November 2014.) Earlier that year, the chain had introduced a medium-temperature secondary loop system employing glycol as the secondary refrigerant at a store in Dinwiddie, Va.

Two years later came the next step: combining the two secondary systems in a store in Portsmouth, Va. The retailer's first cascade CO₂ system emerged in 2009 at an environmentally friendly store in Columbia, S.C.

At that point, Food Lion ceased further installations of advanced refrigeration systems – as part of a hiatus on new store development – and compiled data on the existing secondary and cascade equipment. Overall, those systems, while substantially higher in first costs, have been comparable in both energy usage and maintenance to Food Lion's conventional DX systems using R407A.

In 2015, Food Lion resumed opening new stores on a small scale, with two this year and two in 2016, creating an opportunity for the transcritical test in Southport. (It no longer plans to install secondary or cascade systems.)

LEARNING FROM EXPERIENCE

The biggest lesson Food Lion learned from the earlier CO₂ stores was the need for proper training on the new technology. For the Southport store, Food Lion has already done one training event at the Conyers, Ga., headquarters of Hillphoenix, supplier of the transcritical system. On hand were the installation contractor, in-house service technicians who will be responsible for the system, and the backup service contractor. "We ensured there was training not only for installation but for maintenance," said Rosa.

Food Lion has also had the benefit of learning from the transcritical refrigeration experience of its sister company, Hannaford Supermarkets, and its director of energy and facility services, Harrison Horning. Fortunately for Food Lion and other food retailers getting started with transcritical systems, every component part is now rated for CO₂ in the U.S., which was not the case when Hannaford installed its first system two years ago.

At the same time, U.S. retailers do not have access to all of the less expensive transcritical components that are used throughout Europe because some of those components have not yet been UL-certified. "If we can open the market to those European manufacturers, that would put more pressure on costs and help to reduce the initial cost of the system," said Rosa.

The transcritical system currently carries a first-cost premium compared to a DX HFC system, said Susan Sollenberger, the chain's director of energy, maintenance and equipment purchasing, adding that some of the premium is a function of particular choices Food Lion made.

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Waiting out Merger Implications

In late June – as executives from Delhaize and Ahold were participating in a food retail panel discussion at ATMOsphere America 2015 – the two companies announced their intention to combine their businesses through a merger of equals.

The transaction is expected to be completed mid-2016, following regulatory clearances and shareholder approval. At completion, Ahold shareholders will own 61% of the combined company's equity and Delhaize shareholders will own 39%. The combination, Ahold Delhaize, will serve over 50 million customers per week in the United States and in Europe.

In the U.S., Delhaize owns Food Lion and Hannaford Supermarkets; Ahold owns Stop & Shop and Giant, among other banners. Both companies are pursuing tests of transcritical CO₂ refrigeration in the U.S.

How will this merger affect the companies' refrigeration programs and employees? "Ahold Delhaize's retail stores will continue to operate their existing brands," Food Lion said in a statement. "It is too early to comment on specific details regarding the merger before a full integration plan has been put together."



→ Food Lion looks for a defined ROI for investments of this type, yet the chain is not holding the first transcritical test to that standard. “We’re not doing this as an energy project,” said Sollenberger, “we’re doing it as a learning opportunity on where we can go with CO₂.”

Rosa agreed, pointing out that Food Lion’s previous pilots with CO₂ secondary and cascade systems all came with a cost premium that was absorbed in the interests of understanding alternative refrigeration systems. The transcritical test is “just one more step in 10 years of investigating alternative technology.”

For some retailers, such as Whole Foods Markets, the installation costs for natural-refrigerant systems have so far been artificially high due to the lack of experience among installing and service contractors, said Tristram Coffin, Whole Foods’ sustainable facilities coordinator at ATMOSphere America 2015 (See, “Food Retail Panel Discussion: Learning From Experience,” *Accelerate America*, July-August 2015.)

Rosa observed that Food Lion’s installation costs – owing to some material savings in smaller copper lines – have been a little lower than for conventional systems. He agreed that contractors are still apprehensive at the startup stage about what is still new technology for them, and tend to invest more time than usual to avoid missing anything. But he is optimistic that as contractors and technicians gain experience with natural refrigerant systems, installation costs will fall and “help us reduce our initial investment.”

One of the qualities of transcritical systems that appeal to Food Lion is its relative simplicity. Though transcritical systems’ use of CO₂ sets them apart in some regards (such as higher operating pressures, the use of gas bypass valves and the need to prevent dry ice buildups when pumping down the system), “it’s just refrigeration,” said Rosa. “You look at it like a DX system.” By contrast, cascade and secondary systems include components like CO₂ pumps that are outside the norm for commercial refrigeration.

The similarities with a DX system helps accelerate training for transcritical refrigeration and makes it easier to deploy than secondary or cascade equipment, added Rosa.

Higher pressures are sometimes cited as a drawback for transcritical systems. On the case side, the pressures are “not significantly higher” than those of a DX system, noted Rosa, though on the condenser side they rise to 800-900 psig under 88°F and up to 1,400 psig over that temperature, which puts CO₂ into supercritical mode (mix of gas and liquid). In any event, Rosa regards those pressures as manageable. “They are not something to be afraid of.”



Rendering of new transcritical store in Southport, N.C.

AN ENERGY PENALTY?

Perhaps the biggest challenge facing Food Lion in its first transcritical implementation is the location of the Southport store, which Rosa described as “a few hundred yards from the coast, close to our hottest area.” The Southport location represents a test of whether a transcritical system – which is typically used in cooler regions like Canada and the northern U.S. – can run just as efficiently in warmer climates. “If it works there, it will work anywhere in Food Lion’s area,” said Rosa.

Before committing to its transcritical system, Rosa modeled its energy performance at this location. “Our concern is not that a transcritical system won’t work but it will not be on energy parity with a traditional DX system,” said Rosa. “But as we look at the transcritical system on paper, it appears to be energy-equivalent [to a conventional DX system].”

After the system goes live later this year, Rosa will collect data for 12 to 18 months on its energy consumption compared to a DX system in a nearby prototype store. He expects peaks and valleys for the transcritical system in the summer and winter, respectively, “but if you look at a rolling one year’s worth of energy data, we anticipate it will be equal to the DX.” He added with a chuckle, “I hope we can say it’s a lot more efficient.”

While Food Lion is not expecting a payback from an energy perspective, Rosa and Sollenberger nonetheless hope that in 18 months they will be able to say that Food Lion is using natural refrigerants “for the right reasons and there’s energy savings providing some type of ROI outside of avoiding the higher costs of traditional refrigerants,” said Rosa.

At the transcritical and control stores, Rosa is using both submetering and a mass flow meter, which measures the amount of refrigerant used per unit of time, to improve the energy comparison and derive “more in-depth data.” Given the difficulty of comparing energy usage at different stores, with potentially differing weather and shopping patterns, the mass flow meter normalizes operational differences in the stores’ data.

Rosa acknowledged being encouraged by the energy performance results obtained by Sprouts Farmers Market for a year-old transcritical system installed at a 29,000-square-foot store in Dunwoody, Ga. At ATMosphere America 2015, Jeff Newel, director of research and development, Hillphoenix, revealed that the system was expected in an analysis to operate about 6% more efficiently than a comparably situated DX R407A system; measurements made at the operating store supported that analysis. (See, “Transcritical System Taking the Heat in Georgia,” *Accelerate America*, July-August 2015.)

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Hannaford’s Lessons Learned

Food Lion’s sister company within Delhaize America, Hannaford Supermarkets, has a more than two-year head start on testing transcritical CO₂ technology (from Carnot Refrigeration) at a store in Turner, Maine.

Last January, the Department of Energy (Buildings Technologies Office) released a report on the effectiveness of the Turner store’s transcritical system. The report, “Case Study: Transcritical Carbon Dioxide Supermarket Refrigeration Systems,” revealed that the transcritical system’s electricity consumption was comparable to that of a DX system using R407A in a similar Hannaford store in Bradford, Vt. Moreover, the Turner store’s use of CO₂ reduced its direct climate impact by 15% compared with the Bradford store.

The report also has a section called “Lessons Learned.” Here are the highlights of that section:

- » During commissioning, the transcritical system, which operates at relatively high pressures, should be tested to verify that pressure-relief lines and valves are sound.
- » To protect against accidental CO₂ asphyxiation in the event of a leak, alarms and monitoring need to be set up in confined spaces per ASHRAE standards.
- » Due to durability issues, plastic electronic expansion valves were replaced after a year by metal ones.
- » Store staff needs to be trained on how the transcritical system’s control unit differs from those used at other stores to avoid deviations from standard operating procedures (like lighting schedules).
- » An inventory of spare parts for the transcritical system should be set up on site.

(To read the complete DOE report, go to: http://energy.gov/sites/prod/files/2015/02/f19/Hannaford%20Study%20Report%201-22-2015_CLEAN.pdf)



System Specs

The transcritical system to be used by Food Lion at its Southport, N.C., store has the following characteristics:

- » Rack supplier: **Hillphoenix**
- » Case supplier: **Hillphoenix**
- » Compressor supplier: **Bitzer**
- » Controls supplier: **CPC**
- » Number of racks: **1**
- » Number of low-temp and medium-temp compressors: **5 medium-temp; 3 low-temp**
- » Low-temperature capacity (BTUs/hour): **188,700**
- » Medium-temperature capacity (BTUs/hour) : **771,900**
- » CO₂ charge: **600 pounds**
- » Temperature of freezers, meat cases, dairy cases, produce used: **-18°C, 22°C, 32°C, 28°C**
- » Heat reclaim used: **Air and water**
- » Type of defrost: **Electric**

→ Those results are attributable to the adiabatic gas cooler employed at the Dunwoody store to lower the temperature of the CO₂, thereby helping to compensate for higher ambient temperatures. By contrast, Food Lion has opted not to use an adiabatic gas cooler, preferring to stick with the typical gas cooler employed in a transcritical system. "You can pick up some energy savings with an adiabatic system, but you also have to cost-justify the up-charge," said Rosa. "The payback in energy savings with adiabatic doesn't meet our standard criteria."

Ahold USA, parent company of Stop & Shop and Giant Food and other banners, made the same decision as Food Lion not to use an adiabatic condenser at a Giant store in Springfield, Va., where the company recently started piloting its first transcritical CO₂ system. Ken Welter, manager of refrigeration & design, Mid-Atlantic, for Baltic Trail Engineering, Ahold USA's refrigeration service provider, explained the decision along similar cost justification lines at ATMOsphere America 2015. (See, "Food Retail Panel Discussion: Learning From Experience," *Accelerate America*, July-August 2015.)

Ahold USA's evaluation of adiabatic's role in transcritical refrigeration helped validate Food Lion's, said Rosa. "When you make these decisions and others say the same thing at a conference, you have more confidence in your decision."

(In late June, Delhaize and Ahold announced an intention to merge; see story, [page 27](#).)

THE RETROFIT OPTION

As it moves forward, Food Lion is implementing many more remodels, and is exploring whether any would lend themselves to a transcritical CO₂ retrofit. Last month, Food Lion convened a meeting in Maine with system suppliers to discuss retrofit options. "For now, it's not a viable option," said Sollenberger, with Rosa adding that vendors are targeting only new stores for natural refrigerant systems; there are very limited options for natural refrigerants in current stores. Compounding the problem, he said, is the uniqueness of each retrofit, which prevents standard solutions from being developed.

Sollenberger explained that when remodeling stores Food Lion typically leaves existing cases in place; that's not possible for transcritical systems, making them a poor fit for remodels. Replacing cases would mean "spending \$2 million on a remodel rather than \$1 million," she said. At the same time, she hopes that, over time, there will be a natural-refrigerant solution for retrofits.

Meanwhile, there remains a "huge gap" in the natural refrigerant world between new-store installations and retrofits, noted Rosa. One of the few U.S. food retailers to undertake a retrofit installation of a cascade CO₂ system is Whole Foods, which did so at a store in Sacramento. (See "Getting an Energy Rebate, the Whole Foods Way," *Accelerate America*, June 2015.)

But more natural refrigerant retrofits may be coming as a result of the EPA's R22 phaseout. When retailers remove R22 from their systems, the replacement gas is typically an HFC of some kind. Rosa believes companies need to move away from this approach as he anticipates more EPA regulations aimed at curbing HFC use, which would lead to still more retrofits.

By contrast, using natural refrigerants obviates the need for any further retrofits. "Everybody is trying to get to the natural refrigerant test phase because it's got to be cheaper over the life of the store than taking small measures to meet current EPA guidelines," said Rosa ● MG



Wayne Rosa

Susan Sollenberger

SOBEYS' NEW EFFICIENCY-MEASURING TOOL

In a comparison of two transcritical CO₂ booster systems, the Canadian retailer is using System Efficiency Index (SEI) rather than COP or EER.

— By Michael Garry



Ian Crookston, Sobeys

Over the past several years, Sobeys Inc., Canada's second largest grocery chain with nearly 1,500 stores (some franchised), has become the North American leader in the number of installed transcritical CO₂ booster refrigeration systems.

There are currently 78 Sobeys stores in eight provinces (63 in Quebec that operate under the IGA banner) using CO₂ transcritical booster systems with heat reclaim, the company's standard

refrigeration technology; forty-four of these received EPA GreenChill Platinum certification. Each year, another 15 to 20 stores (both new and renovated) are being equipped with transcritical systems. Sobeys also has nine stores with cascade CO₂ systems.

Based on its experience, Sobeys believes the first cost of a transcritical system, including all components (racks, cases, controls, etc.) is comparable to that of traditional DX systems using synthetic

refrigerants and the same level of controls. It also believes transcritical is more efficient than traditional DX with synthetics.

This year, Sobeys began a two-year study comparing two transcritical systems, each from a different manufacturer, one running in a store in Milton, Ontario (opened in December 2014) and the other in a store in Stratford, Ontario (opened in March 2015). The study aims at determining which system has the highest efficiency and the lowest total cost of ownership (TCO).

Each store has two similarly sized racks and each rack contains both low- and medium-temperature cooling, along with reverse-cycle defrost. The difference is that the Stratford store's system employs mechanical sub-cooling and has three separate low-temp suction groups per rack; the Milton store's system does not use mechanical sub-cooling and has one low-temp suction group per rack.

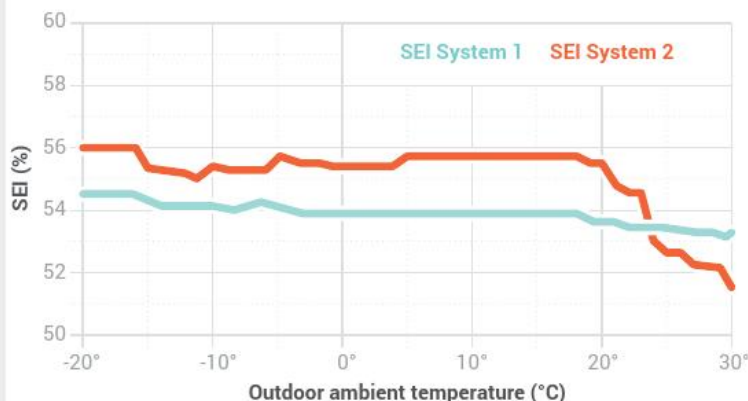
One of the interesting aspects of this study is that energy efficiency is being measured with a recently developed benchmarking tool – System Efficiency Index (SEI) – rather than Coefficient of Performance (COP) or Energy Efficiency Ratio (EER). Sobeys is utilizing a ClimaCheck Performance Analyzing System that applies SEI along with consulting services from Renteknik Group for this project.

SEI BENCHMARKING

SEI is independent of outdoor temperature and:

Figure 1.

- » should be consistent across wide range of temperatures
- » changes vs temperature represent issues with sub-system performance
- » difference between systems represents overall efficiency difference.



continued on p.34

The clear path to a smaller carbon footprint.



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→ ACCELERATE AMERICA ASKED IAN CROOKSTON, MANAGER, ENERGY MANAGEMENT, FOR SOBEYS TO EXPLAIN WHY THE RETAILER CHOSE THIS APPROACH.

Accelerate America: Why do you consider System Efficiency Index (SEI) a better measure of a system's energy consumption than other measures like COP or EER? When did SEI come to your attention?

Ian Crookston: System Efficiency Index (SEI) has the advantage of being a normalized unit of absolute efficiency. 100% SEI occurs when a system is operating at the ideal theoretical efficiency (i.e. the Carnot Cycle). It was introduced by VDMA (Verband Deutscher Maschinen- und Anlagenbau, or the German Engineering Association) and IOR (The Institute of Refrigeration) in the U.K.

Coefficient of Performance (COP), Energy Efficiency Ratio (EER), etc. are based on design/standard conditions (i.e. saturated suction temperature, condensing temperature, etc.). As an example, ANSI/AHRI Standard 1201 (Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets) uses "standard conditions" of 75°F (24°C) and 55% RH. It is great for relative comparison of refrigerated display cases

at steady state, but does not account for the geographical location (i.e. local weather) of the refrigeration system and the wide range of load and control behavior a real system is exposed to. It will generate the same "values" for a store located in Phoenix, AZ as Nome, AK. Your actual system, in your actual location, will have a very different performance. A bin temperature analysis is needed to predict actual energy consumption.

A decrease in COP/EER is not necessarily a change in performance, as it would require an expert's analyses of both ambient and load conditions. SEI will, without any adjustments for ambient or load conditions, show the actual magnitude of any performance change (See Figure 1).

SEI can also be used on sub-systems (i.e. compressor, evaporator, condenser, etc.) to measure their performance. If there is an issue, this will expose the right part of the system for corrective measures.

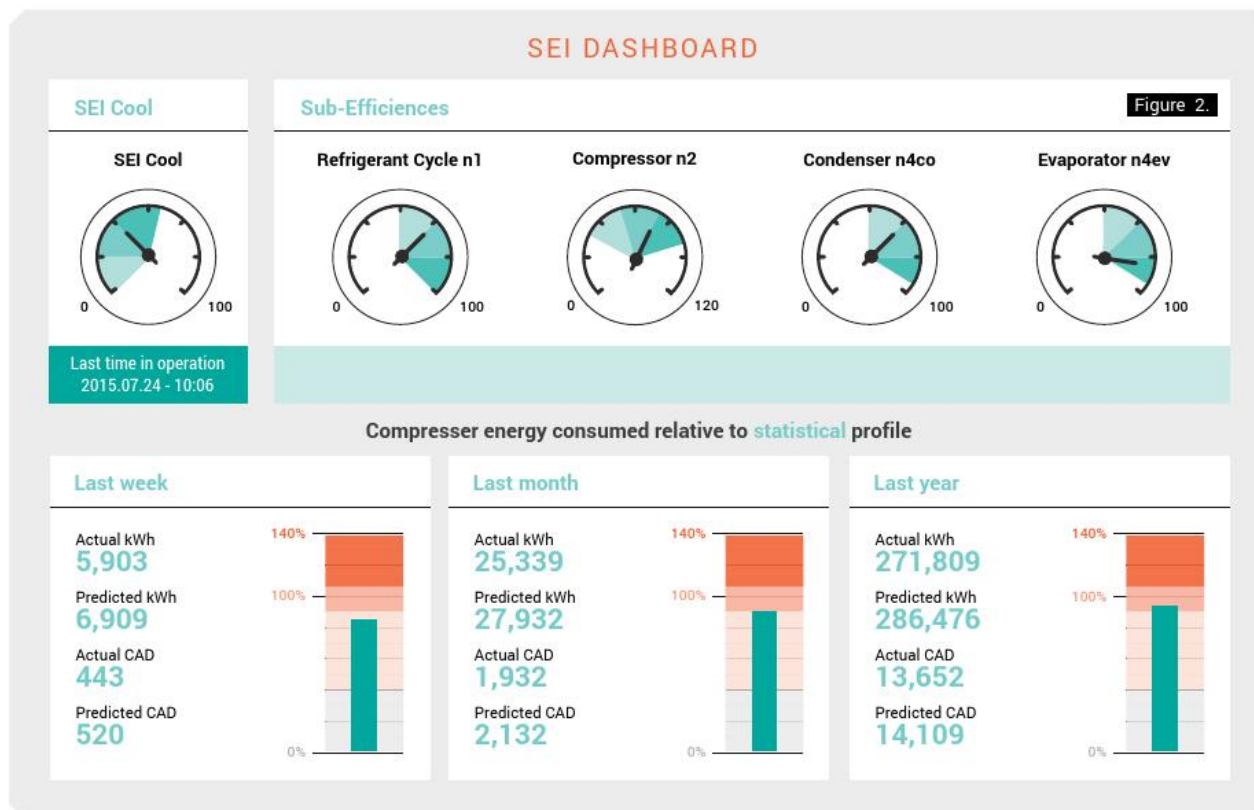
We learned about SEI through a paper published by the SP Technical Research Institute of Sweden.

AA: How have you employed SEI?

IC: We are currently using SEI to benchmark two CO₂ transcritical booster systems installed in Ontario (Milton and Stratford). SEI also enables us to get an early warning of when the performance of any part of the system is deviating from its optimized state. SEI, together with comparing the predicted energy use to actual energy use, allows us to understand, in detail, how each system operates (see Figure 2).

AA: Is SEI incorporated into TCO?

IC: Optimizing SEI reduces the amount of energy a system consumes, which impacts total cost of ownership (TCO). In food retail, efficiency is important, but having an effective refrigeration system is paramount. The refrigeration system must always provide the appropriate level of "cold." **MG**





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BECOMING THE WORLD'S BEST

Japanese convenience store operator Lawson is leading a revolution in the commercial refrigeration sector, with plans to operate more than 1,300 stores with CO₂ transcritical refrigeration stores and become the world's number one retail user of natural refrigerants



— By Jan Dusek and Janaina Topley Lira —

Shinichirou Uto, Lawson

→ CO₂ stores in 2015 alone. "I look back and think that this would not have been possible if I had not gone to Europe twice and made the decision to be the world's number one," said Uto.

Standard Lawson convenience stores employ two CO₂ systems, a 10 HP and a 2 HP CO₂ transcritical condensing unit made by Panasonic. The CO₂ units contribute to average energy savings of 21% compared to conventional HFC units in subtropical climates. It is the energy savings that are

most important to the franchise operators. The savings help keep Lawson c-stores profitable despite difficult sales and soaring electricity costs.

"If there had been more efficient technology to reduce energy consumption than CO₂ refrigerant, we may have opted for it," noted Uto. "After implementing various energy-saving equipment, we needed to choose a new means to save energy, and CO₂ technology turned out to be the only option with high cost efficiency."

Lawson's most advanced CO₂ store can be found in Toyohashi City, in the Aichi Prefecture. Opened in November 2014, the store also has glass doors on its display cabinets along with ground-source heat pumps, and has a high level of insulation thanks to its double-skin façade. As a result, the store has achieved a 60% reduction in energy use compared to 2010 levels. Lawson plans to open a flagship store such as this one every year.

Government support turns the tide

Of course, pioneering a new technology with the aim of becoming the world leader is not all smooth sailing. Uto initially had to address concerns about how to construct and manage CO₂ systems. Once again he looked to Europe to find out what, if any, special standards applied to CO₂ technology. While finding that CO₂ was not subject to any specific regulations, he learned that, unlike Japan, in Europe piping is designed and installed based on a sound understanding of the properties and pressures of the gas to be carried. Following Europe's lead, Lawson designs and constructs pipes to suit the high-pressure properties of CO₂. "It is absolutely critical to have construction practices established," Uto said. "Without this, we would be unable to introduce CO₂ technology."

Another challenge was the fact that although CO₂ refrigeration systems are very energy efficient, the up-front costs are almost double those of traditional refrigeration systems. Looking for support to lower these costs, Lawson turned to the Ministry of Economy, Trade and Industry (METI), which in 2010 granted Lawson a subsidy. It was this subsidy that allowed Lawson to install CO₂ systems in the first 50 stores. Based on the results of these pilot stores, Lawson received funding for further CO₂ installations.

A further round of subsidies, this time from the Ministry of the Environment (MOE) eventually enabled Lawson to make CO₂

refrigeration systems its standard technology across all stores in September 2014.

The 2015 budget for MOE subsidies, which are specifically aimed at encouraging operators to use natural refrigerants, increased from 5 billion yen (\$40 million) to 6.2 billion yen (\$50 million). In fiscal year 2014, Lawson was among 18 companies selected to receive the subsidy to install CO₂ refrigeration technology, while another 31 companies have received a subsidy to deploy natural refrigerant technology in 33 cold storage projects.

For Uto, government subsidies have played a key role in the success of CO₂. The subsidies enabled Lawson to solve teething problems related to system operation and to reinvest in the technology and eventually standardize the systems. Without the subsidies Uto believes CO₂ refrigeration may never have been introduced.

The subsidies also helped the c-store operator overcome a second hurdle that could have hampered the rollout of CO₂ commercial refrigeration systems: lack of technician training. Working closely with system manufacturer Panasonic, Lawson has so far provided training in the installation and maintenance of CO₂ refrigeration technology to more than 900 refrigeration technicians.

Thanks to funding from METI, in the fiscal year 2013, Lawson conducted a pilot project to build the first CO₂ convenience



stores in Jakarta, Indonesia. Another 12 CO₂ stores have since been opened in Indonesia as a result of a grant from the MOE's Joint Crediting Mechanism (JCM), a scheme designed to help facilitate the diffusion of leading low carbon technologies and contribute to the sustainable development of developing countries.

The first of these stores are projected to achieve annual energy savings for refrigeration of 41,558 kWh (in comparison with an R22 system). Although these energy savings are attractive, once again because of the relatively high cost of the CO₂ technology, it will likely take a while before CO₂ systems are widely adopted in Indonesia. For now the win is proving the technology's efficiency in a warm ambient climate. "Although people say that CO₂ systems are not suited to reduce

energy consumption in tropical regions, we have actually been able to save energy by implementing Japanese technology," said Uto.

"The results in Indonesia and the region exceeded our expectations," he added. "We introduced CO₂ showcases with three times more capacity than the ones they originally had, and the electricity consumption increased by about 10% only."

What does the future hold?

Talking about the outlook for natural refrigerants at Lawson, Uto said he has no plans to introduce hydrocarbon technology anytime soon. Unlike in Europe, where plug-in hydrocarbon refrigerated display cabinets are a popular commercial refrigeration technology, Japan has only a handful of stores that use these solutions. For Uto the lack of Japanese hydrocarbon manufacturers that offer these solutions alongside a comprehensive maintenance agreement is a key barrier.

As he explained, "Users have concerns for safety, but the real question is – are there established systems where manufacturers assure the safety,

provide thorough maintenance, and take responsibility in case of accidents? This may sound very Japanese, but it is essential. Because we Japanese users take for granted the availability of such practices, we may feel the gap if we work with overseas manufacturers."

With regard to CO₂, Lawson's story now has come full circle. Having initially learned about the technical aspects of CO₂ transcritical refrigeration from its European counterparts, Lawson is well on the way to surpassing Denmark's more than 700 CO₂ transcritical stores. What is more, in conjunction with Japanese system manufacturers Lawson has

developed its own special CO₂ know-how. The Japanese standardized packaged system is very different from the European CO₂ rack-type system. Japanese companies are hoping to introduce their approach to Europe, where the c-store market is rapidly developing.

Lawson will also soon tackle one remaining challenge: raising awareness about natural refrigerants among its customers. This year Lawson and the MOE will embark on a project to explain the benefits of CO₂ refrigeration to consumers. With broad public support, who knows what heights the CO₂ commercial refrigeration market could reach? **JD + JTL**



DOE AND AHRI SETTLE OVER EFFICIENCY RULES FOR WALK-INS

The agency will support a rulemaking process aimed at creating new standards for walk-in cooler and freezer equipment by January, with enforcement delayed till 2020

— By Robert Davidson

While the EPA's decision to delist several high-GWP refrigerants is likely to improve the prospects for natural refrigerant adoption, another federal agency, the Department of Energy, is also impacting natural refrigerants with its latest energy efficiency rules.

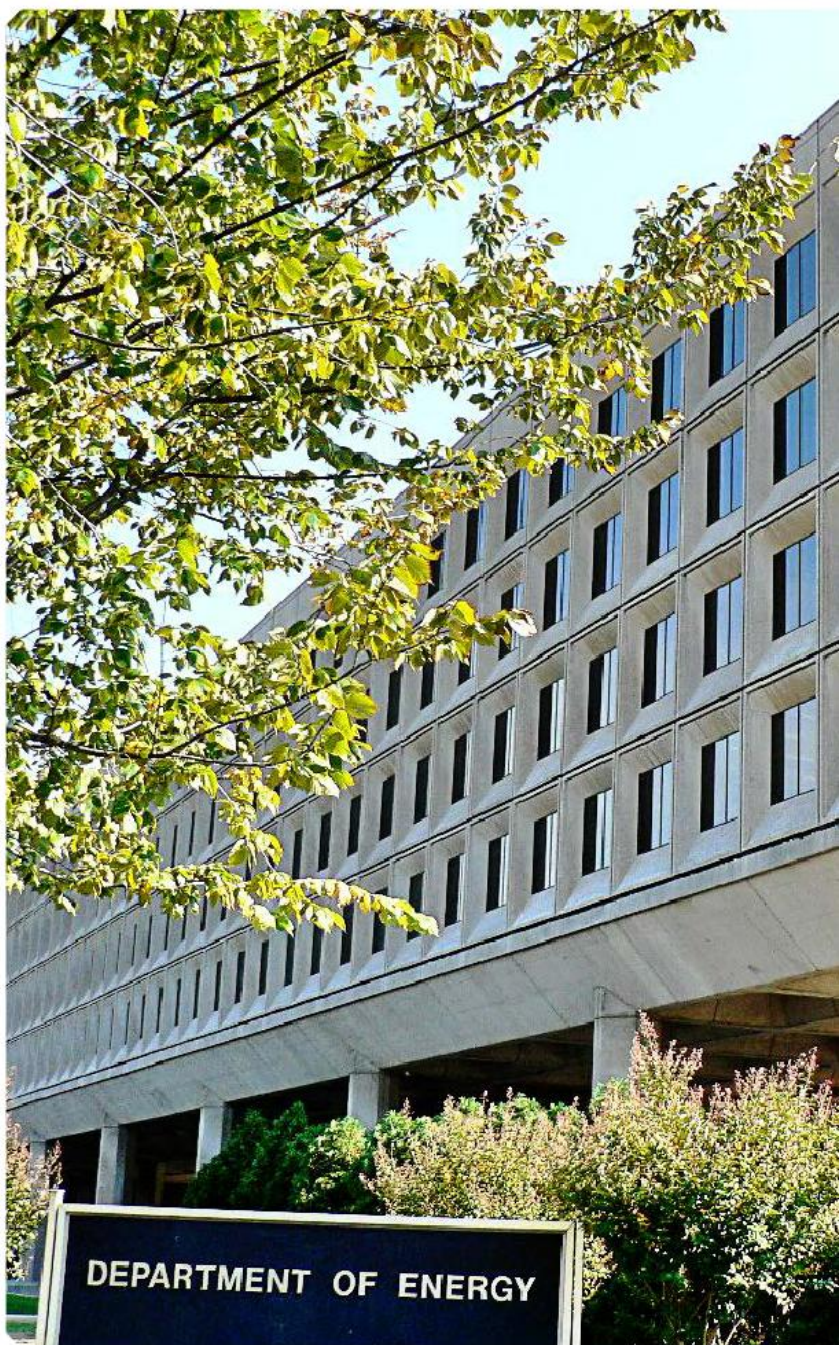
Under those rules, several pieces of commercial refrigeration equipment must operate more efficiently within a few years. Self contained, closed-door cases and display cases (including remote units) need to become 30% to 50% more efficient by March 2017, while ice makers are expected to be 5% to 15% more efficient (amended from 12% to 25%) by the same date. In addition, walk-in coolers and freezers (WICF) were put on a June 2017 deadline to gain 20% to 40% in efficiency.

Since natural refrigerants typically improve the efficiency of refrigeration equipment, they stand to benefit from the DOE rules, which were finalized in 2014.

However, the HVAC&R industry challenged those rules, and in one instance – WICF – they are in the process of changing. On July 30, following yearlong litigation, the DOE and the Air Conditioning, Heating, and Refrigeration Institute (AHRI) announced a settlement that vacates six standards for WICF equipment, including multiplex condensing systems at medium and low temperatures, and dedicated condensing systems at low temperatures. (The WICF standards for doors and panels are not affected.) The settlement needs to be approved by the U.S. Court of Appeals for the Fifth Circuit.

The DOE will support the use of a negotiated rulemaking process to replace the vacated standards, with a targeted completion date of January 22, 2016. As part of the negotiated rulemaking process, the agency agreed to consider and substantively address any potential impacts of the standards on installers and smaller manufacturers.

Moreover, the DOE agreed that, if the negotiated rulemaking process delivers proposed standards by January 22, it will not enforce the standards until January 1, 2020 – two-and-a-half years later than the original date.



DOE FINALIZES RULE ON VENDING MACHINES

— By James Ranson



Last month the Department of Energy (DOE) removed the requirement to test beverage vending machines (BVMs) at 90°F ambient, responding to comments from beverage giant Coca-Cola.

In effect, the maximum temperature conditions required by the test procedure will be 75°F and 45% relative humidity. The DOE reasoned that these were representative of the average operating conditions of most beverage vending machines.

In particular, the DOE noted that the majority of beverage vending machines are installed indoors, removing the need for testing under high ambient temperatures.

The DOE sought comments from stakeholders Coca-Cola, Automated Merchandising Systems, and Sanden Vendo America, which all supported amendments to the referenced test method in ANSI/ASHRAE Standard 32.1-2010.

Coca-Cola, which outlined plans at ATMosphere America 2015 in June to convert the remaining 4% of its vending machine fleet to HFC-free models, called for a single set of conditions for testing and rating purposes.

Also last month the DOE published a notice of proposed rulemaking regarding updated energy conservation standards for beverage vending machines. The agency will host a public meeting on the proposal on Sept. 29 in Washington, D.C.

● JR

Beyond this particular case, the DOE said that within six months it will initiate a public process to determine how it will address error corrections in future rulemakings. The agency also committed to employ best efforts to finalize that process within one year of an agreement.

Not technically feasible

The original DOE requirements caused concern within the industry, with the AHRI stating that the rule calling for energy efficiency gains for WICF of between 20% and 40% by 2017 were not “technically feasible at an economically viable level.”

On July 30, 2014, the AHRI, along with Lennox Intl. Inc., petitioned the DOE to reconsider its final rule. However, the DOE replied that it was unable to review the rule short of a court order. So on August 4, 2014, the AHRI filed a petition asking the U.S. Court of Appeals for the 5th Circuit to review the U.S. DOE’s final rule.

The AHRI argued that not only were the efficiency requirements inappropriate, but that the DOE had erred in various ways in calculating and adopting the WICF rule. In particular, the AHRI said that the DOE had:

- » Set internally inconsistent standards that were unachievable using economically feasible technologies
- » Performed flawed cost-benefit work
- » Did not properly analyze the impact on small businesses.

“In issuing this final rule on WICF equipment, the DOE exceeded its statutory authority and failed to comply with agency rulemaking requirements,” said the AHRI.

The implementation of the DOE’s efficiency rules is taking place at a time of considerable pressure on HFCs like R404A. In its original efficiency ruling in June 2014 the DOE acknowledged that a widely used refrigerant commercial refrigeration is R404A; but that refrigerant and other HFCs will be delisted from new retail food refrigeration applications and new remote condensing systems as of January 1, 2017, per the EPA recent final ruling.

Moreover, the agency has noted that it “is aware that many low-GWP refrigerants are being introduced to the market, and wishes to ensure that this rule is consistent with the phasedown of HFCs proposed by the United States under the Montreal Protocol.”

This crackdown on high-GWP HFCs opens the door for more installations of low-GWP natural refrigerant systems, which will also help end users meet the current DOE efficiency rules and whatever new ones are fashioned for WICF ● RD



SURVEY SAYS...

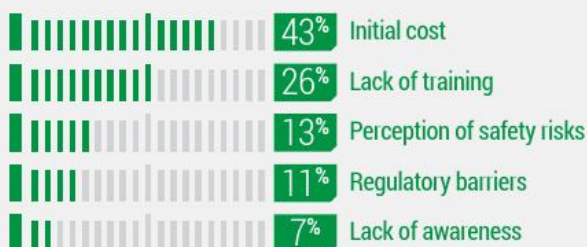
ATMOsphere America 2015 attendees weigh in on natural refrigerant trends

During a number of sessions at ATMOsphere America 2015, shecco moderators polled attendees for their opinions (expressed through text messages) on the evolution of natural refrigerants in the North American market. Here are the results of some key surveys.

— By Elke Milner

THE BIGGEST CHALLENGE

For the 82 ATMOsphere America attendees responding to the question, the biggest challenge facing the increased adoption of natural refrigerant technology in North America remains initial cost, with 43% of the vote. Lack of training is considered the second largest hurdle at 26%, followed by perception of safety risks, regulatory barriers, and lack of awareness.

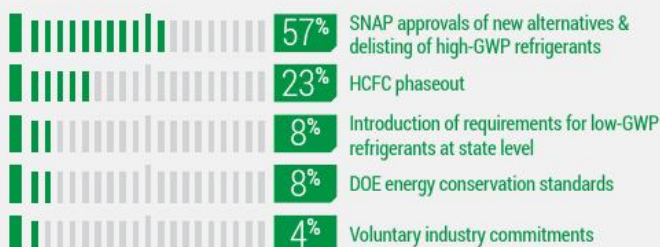


TRANSCRITICAL ADOPTION

Conference attendees held a fairly optimistic view of the CO₂ transcritical market in the United States. A third of the 46 poll respondents suggested the U.S. would have more than 1,000 CO₂ transcritical refrigeration systems by 2020, and 30% expected that number to reach 500.

POLICY DRIVERS

Policy encouraging the adoption of environmentally friendly refrigeration practices in the United States tends to lag behind that of other regions and nations. Still, 57% of the 53 respondents at the standards and regulations session indicated that SNAP approvals of new alternatives and delisting of high-GWP refrigerants will be the most powerful regulatory measure driving the adoption of natural refrigerant technologies.



COMMERCIAL AVAILABILITY, FOOD RETAIL

Of the 72 respondents to the question, one-third believe that natural refrigerant-based centralized commercial refrigeration equipment for supermarkets will be fully commercially available in North America by next year. But 32% don't expect full availability until 2020.

COMMERCIAL AVAILABILITY, FOOD SERVICE

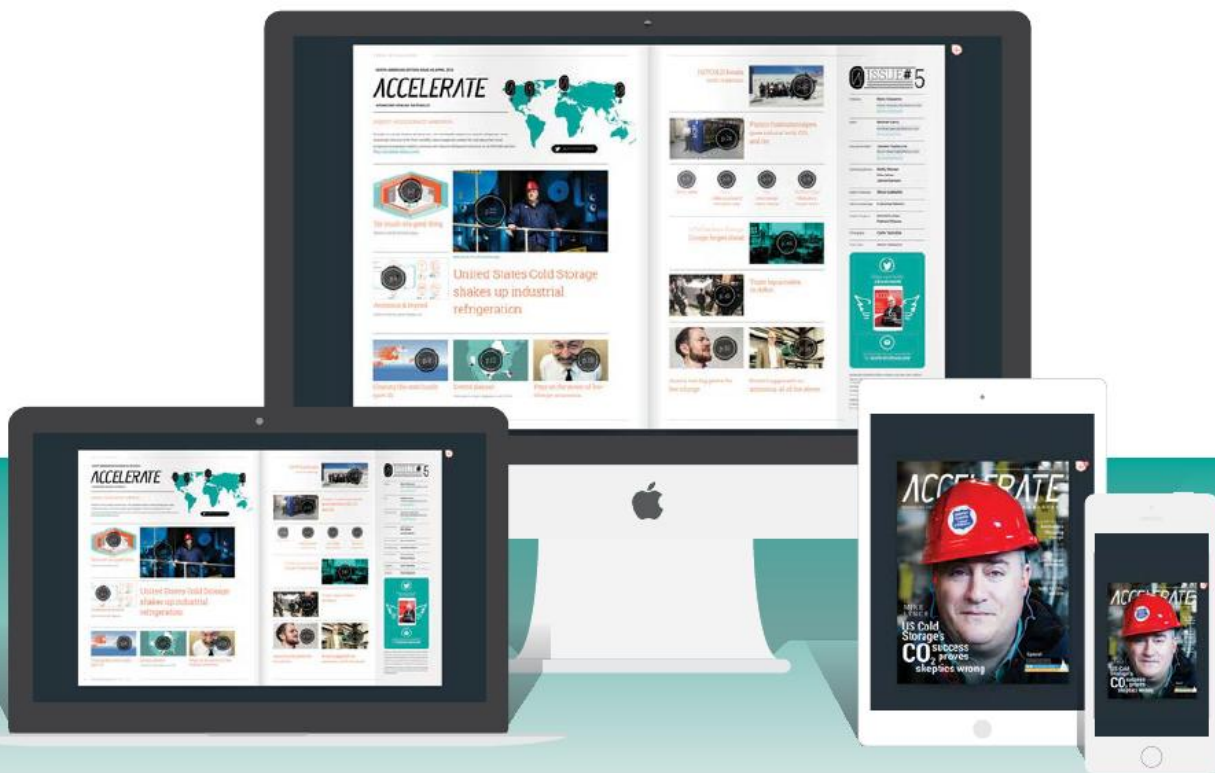
Among attendees of the light commercial refrigeration session, 52% of the 27 poll respondents believe natural refrigerant-based light commercial refrigeration equipment for food service will be fully commercially available by 2016, while 41% said by 2018.





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INDUSTRY TACKLES TRAINING CHALLENGE

Associations, manufacturers and academia expand training opportunities in light of regulatory shifts and uptake of natural refrigerants

— By James Ranson



The lack of adequate education and training for contractors and technicians is often cited as one of the key stumbling blocks to greater adoption of natural refrigerant technology in North America.

With the EPA SNAP program's expansion of allowable hydrocarbon applications, as well as the increasing uptake of CO₂ transcritical and subcritical systems in commercial and industrial refrigeration, the need for capable installation and maintenance crews has grown more acute.

Many organizations – from industry associations to colleges to OEMs – are stepping up to the training challenge with upgraded curricula and online training packages aimed at bridging the knowledge gap between traditional systems and systems incorporating CO₂, hydrocarbons and low-charge ammonia. Several of them provided updates on their efforts in a training panel discussion at ATMosphere America 2015.

Demand for training

The Refrigeration Service Engineers Society (RSES) is seeing huge increases in demand for its hydrocarbon training services – both online and face-to-face – as a result of the EPA's decisions to delist certain high-GWP refrigerants and expand the use of hydrocarbon refrigerants last March, said Arthur Miller, Region 2 director for RSES and owner of KAM Associates, a training firm.

RSES, said Miller, is the only independent organization that has a hydrocarbons training program, which it introduced in 2012. Between

2012 and June 2015, RSES has trained approximately 1,500 people on the technology. "Demand and inquiries for RSES's training services have tripled since the [SNAP] regulations were introduced in March," said Miller. "Awareness is obviously growing, but we still have a long way to go."

RSES's hydrocarbons training program is designed to equip manufacturers, service technicians and installers in proper working practices with flammable hydrocarbon refrigerants such as propane and isobutane. RSES partners with several manufacturers that use the program as their approved training protocol. "RSES is interested in partnering with additional manufacturers, so we welcome your inquiry," he said. RSES also works with end users like Red Bull and Ben & Jerry's/Unilever.

Miller sees a real need for this type of training. "The technicians in the United States specifically really do not know what is hitting them," he said. "I was with an HVAC&R contractor, a friend of mine, at a picnic recently and I asked him, 'Are you aware of what's going on with the hydrocarbons and R22?' And he said, 'Huh?' So there's a lot of people way behind right now."

Jim Price, past president of the Refrigerating Engineers and Technicians Association (RETA), and currently South Central regional sales manager, Hansen Technologies, agreed that regulatory burdens will inevitably shape the need for more training curricula.

"As the refrigeration industry in the U.S. evolves towards more regulatory compliance requirements as well as increased use of natural refrigerants other than ammonia, there would be a need to update not only the content of [technician] training but also the delivery methods," he said.

RETA, which focuses on industrial refrigeration, offers online training courses on the U.S. government's Process Safety Management and Risk Management programs. The courses cover a range of topics, from basic industrial refrigeration and electricity to safety issues like emergency response and hazard communication. RETA also offers ANSI-accredited certification testing for refrigeration operators and skills assessment to become a certified refrigeration energy specialist.

Manufacturer training tips

Manufacturers also discussed their training initiatives at ATMosphere America 2015. Bitzer, for example, provides training for the variety of natural refrigerant compressors it manufactures (CO₂, ammonia and hydrocarbons).

Bitzer offers training courses in Germany, Brazil, Australia and the U.S., as well as "roadshow" training in around 40 subsidiaries. The courses can accommodate a broad variety of personnel from designers, engineers and technicians to sales staff and end users.

In assessing the state of training, Joe Sanchez, application engineering manager, Bitzer U.S.,



From left to right :
 Pega Hrnjak, University of Illinois ;
 Jim Price, RETA ;
 Joe Sanchez, Bitzer ;
 Arthur Miller, RSES ;
 Jim Kalish, Stark State College ;
 Rusty Walker, Hillphoenix

observed that IIAR and RETA have established the "gold standard" for ammonia training. But he added that training for low-charge ammonia systems "will require some adaptation," especially if their commercial use increases.

With regard to CO₂ training, Sanchez noted that IIAR and RETA are adapting their programs for "industrial use," but OEMs are also required for systems training. The industry still needs application-based training for CO₂ technology and he speculated about the need for CO₂-dedicated certification.

The establishment of better training and certifications on flammable hydrocarbon refrigerants may pave the way for larger charges and applications in the U.S., Sanchez said. "Things that we wouldn't even think about in the U.S. they're already doing in Europe with large flammable systems. This requires the correct knowledge and of course training."

In one of the more entertaining presentations, Rusty Walker, Hillphoenix's senior corporate trainer, asked the audience, "Is training really necessary?" before citing a list of training challenges manufacturers commonly encounter with contractors.

Among those challenges: understanding the differences among subcritical, transcritical and supercritical; distinguishing myths from reality; putting the risks of CO₂ in perspective; and knowing how a gas cooler, condenser and adiabatic condenser differ.

"Is CO₂ dangerous?" asked Walker, who is based at Hillphoenix's Learning Center in Conyers. "The answer is, 'Yes, of course it's dangerous,' but we have to explain to contractors that it's no more dangerous than R22 and R134a – because these are both very dangerous, but it doesn't come across their minds."

Hillphoenix's online and instructor-led CO₂ courses have increased from 75 participants in 2006 to 23,454 in 2014. The audience runs the gamut from dealers and contractors (48%) to customers (35%), employees (14%) and architects/engineers/associations (3%). Contractors, in particular, are hands-on learners, Walker said. "We have to be able them to get their hands on the equipment."

What's missing from the classroom are younger people, he noted. "We're a greying, maturing industry and we're not getting young technicians in the field anymore."

Ohio learning hub

One place where young people are learning about refrigeration is Stark State College, Canton, Ohio, which offers two-year associates degrees. Among its more than 15,000 students, 520 are directly involved in energy savings, environmental studies and HVAC&R courses, said Jim Kalish, adjunct instructor, engineering technologies at Stark State.

Kalish described several opportunities students have:

- » To perform commercial refrigeration surveys that identify energy savings and environmentally sustainable opportunities at grocery and convenience stores, and food service facilities
- » To assist companies in applying for utility rebates for improvement projects
- » Study advanced refrigeration with an emphasis on CO₂ systems.

The college expects the installation of a transcritical rack and a full CO₂ lab to be completed in September.

Stark State's engineering staff also conducts surveys of "heartbreak stores" that are a particular burden to service contractors and in-house maintenance teams. "Investments in metering and surveying tools and an extensive equipment performance database make these surveys highly effective," said Kalish.

The faculty also offers training, on campus or at company locations, on CO₂ systems and controls to contractors, technicians and store managers. Consulting services on transcritical and subcritical systems are also offered.

Kalish described the college's CO₂ training program as "neutral" to any equipment or controls manufacturer. The program came about due to a "void in the market" where there were basically no trained technicians to install CO₂ transcritical systems, let alone maintain them. **● JR**



Rob Arthur, CTA Architects ; Jose Mergulhao, CIMCO Refrigeration ; Rusty Walker, Hillphoenix

CONTRACTORS SEE OPPORTUNITIES FOR NATURAL REFRIGERANT INSTALLATIONS

While many contractors are still lagging, these companies see great potential for CO₂ and ammonia refrigeration

— By Robert Davidson

Contractors, in their myriad roles as designer, builder, installer and maintainer of refrigeration systems, have become the linchpin in the growth of natural refrigerants in North America. Without a large host of well-trained contractors and technicians, the amount and speed of adoption of natural refrigerant systems will be highly compromised.

Yet, as it currently stands, the refrigeration contracting industry has not yet fully embraced the challenges represented by natural refrigerant systems — a concern for the entire industry.

Thus it was with great anticipation that several contractors with active track records in natural refrigerant-based technologies convened at ATMOsphere America 2015 to provide insights into the direction of natural refrigerant adoption in North America and how contractors will be integral to this process. Overall, these companies observe a palpable uptick in natural refrigerant activity in North America.

Mark Turner, national director of sales, Stellar, which provides a range of contractor services, set the tone by observing that “regulations are pushing the industry toward natural refrigerants” and away from synthetic refrigerants.

In the industrial sector, he pointed out, the Obama Administration’s 2013 order 13650, “Action to Improve Chemical Facility Safety,” has spawned more than 3,400 potential regulations targeting large-charge ammonia systems, and led OSHA and the EPA to step up existing regulatory enforcement.

This is leading industrial users to take a closer look at low-charge packaged ammonia systems

and CO₂/NH₃ cascade systems. In addition, low-charge ammonia chillers have become an increasingly viable option for air conditioning applications. “The real opportunity for natural refrigerants is HVAC,” he said.

This message of industry uptake was confirmed by Jose Mergulhao, U.S. vice president of CIMCO Refrigeration, a designer, builder, installer, service provider and manufacturer of refrigeration systems.

Ammonia is still the “go-to” refrigerant in the industrial sector, he said, though it is being buffeted by regulations and misperceptions about its dangers. At the same time, CIMCO is seeing greater adoption of CO₂ transcritical in U.S. industrial refrigeration, particularly smaller facilities, following the Europe model. “The European norm is the North American trend,” said Mergulhao.

But he noted that there is some resistance to being the “guinea pig” for new solutions, though once this threshold is passed, demand will accelerate. Mergulhao was quick to point out that the industry must be ready to handle the surge in demand once the guinea pigs become the leaders of the herd.

Wide-ranging projects

Rob Arthur, principal with CTA Architects Engineers refrigeration team, confirmed that demand for installation of natural refrigerant-based technology has increased. CTA’s own projects include Albertsons’ Greenchill platinum-certified supermarket in Carpinteria, Calif., which uses an ammonia/CO₂ cascade system and was the first 100% natural refrigerant grocery store in the U.S. Other projects include Walgreens’ and Whole

Foods’ transcritical systems and HFC/CO₂ cascade systems used by Target, Walmart and Supervalu.

Natural refrigerant systems offer a lower lifecycle cost and TEWI (total equivalent warming impact, which includes direct and indirect emissions) than DX central systems, said Arthur. For example, compared to an R407A central system, a transcritical CO₂ booster system has a 4% lower lifecycle cost and a 53% lower TEWI.

Arthur noted that CTA’s understanding of its clients’ motives for adopting these new systems relates primarily to refrigerant leakages and their repercussions, which include environmental damage, cost of replacement refrigerant, and penalties imposed by the EPA. Companies are also becoming tired of converting from one refrigerant to another and wish to have long-term stability. “We do need to state the endgame and figure out how to get there, instead of taking several little steps lowering GWP a bit,” he said.

Arthur expects that in the future the industry will adapt to growing demand by standardizing “off-the-shelf” units in lieu of individual, customized designs. This would lessen the burden for contractors and simplify the process for both end users and installers.

OEM Hillphoenix has been very active in training contractors and engineers to meet the demand for its CO₂ transcritical systems, noted Rusty Walker, Hillphoenix’s corporate trainer. This includes learning about case controllers and electronic expansion valve operations. Walker also noted that since contractors and engineers are visual people, there should be a focus on “hands-on” training so they can become comfortable with any form of maintenance required **RD**

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A NEW WORLD OF APPLICATIONS

Natural refrigerants are expanding their reach in data center cooling, ultra-low-temperature freezers, magnetic cooling, specialized copper tubing and braze-free fittings, as described at ATMOsphere America 2015

— By Elke Milner

Transcritical CO₂ cools data center

With its start in 2008 applying CO₂ transcritical technology to supermarket refrigeration systems, Carnot Refrigeration has expanded its application range to include industrial processes, ice rinks and now data centers.

Carnot began working with telecommunications giant Bell Canada in 2012 to create a cooling system specifically designed for data centers. In September 2014, Bell Canada's Ottawa facility became the first data center in the world to use an all-CO₂ cooling system to protect its business-critical information, noted Marc-André Lesmerises, CEO of Carnot in a session at ATMOsphere America 2015 on new applications of natural refrigerants.

The project involved replacing an R22 refrigeration system with the new natural refrigerant-based, low-maintenance, 105-kW system. With the old system, server cooling consumed about half the energy at the facility. Energy use has since been cut by about 70%, partly through a "CO₂ rain cycle free cooling" process, patented as Aquilon, which uses cool outdoor air to accommodate some of the load.

Hydrocarbons realize energy savings at ultra low temperatures

Hydrocarbon refrigerants are also meeting new challenges. John Prall, commercial technical support engineer for Embraco North America, and Richard Bair, systems engineering manager for Thermo Fisher Scientific's Laboratory Products Cold Storage Business Unit, jointly detailed the first hydrocarbon variable-speed ultra-low-temperature (ULT) freezer for the medical and chemical industries, the TSX freezer.

Using an Embraco Fullmotion variable-speed compressor and natural refrigerants R290 (propane) on the high/warm stage and R170 (ethane)/R290 blend on the low/cold stage, the freezer is able to achieve up to 50% energy savings compared to an R404A/R508B single-speed design, reducing energy consumption from 17 to 9 kWh/day.

Magnetic refrigeration proves promising

Vincent Delecourt, director of sales and marketing at Cooltech Applications, examined magnetic cooling and its integration into the commercial refrigeration market.

Cooltech has developed a cooling technology based on the magnetocaloric principle, where energy is harvested from temperature changes in a material. The technology does not use a refrigerant gas at all, but rather a water-based coolant liquid. The company's first series of machines ranges from 150-700 W.

In a coefficient of performance (COP) comparison between a 200 W magnetic refrigerator and a comparable standard butane refrigerator, the COP of the magnetic refrigerator, at 4.08, was more than double that of the butane refrigerator, with an energy savings of more than 50%.

Improved tubing and fittings

To support the application of alternative refrigerants, Yoram Shabtay, president of Heat Transfer Technologies; Jian Yu, director of product development for Super Radiator Coils; and Nigel Cotton, MicroGroove OEM team leader, the International Copper Association; explored new MicroGroove copper tubing technology used for CO₂ gas coolers and evaporators as well as for R290 DX coils.

For natural refrigerants CO₂ and R290, heat exchangers based on MicroGroove 5 mm inner-grooved copper tubing offer better heat transfer because of the tubes' greater surface-to-volume ratio, which allows them to do more work with less material. This results in lower refrigerant charge and overall cost savings. In addition, the tubes are able to work with higher pressures without increasing wall thickness.

In a CO₂ gas cooler example, 5 mm tubing offered a 35% reduction in tube weight, a 20% reduction in fin weight and an overall 45% reduction in total internal volume vs. 5/16-inch tubing.

Shabtay also discussed the advantages of copper fin technology, which can improve system efficiency through the metal's inherent antimicrobial properties; these inhibit mold buildup that often affects aluminum fin designs.

Another technological advancement in the realm of tubing is the braze-free connection solution from RLS Press Fittings. The solution allows for the joining of tubing for high-pressure refrigerant applications without the use of solder or flame, reducing install time and costs.

The RLS solution has been five years in the making, and has been used in continuous testing since August 2011, with over 25,000 fittings now installed without a single failure, noted Michael Duggan, president and general manager of RLS.

The fittings are applied with a crimping tool, eliminating the need for flame or soldering and significantly reducing the potential of human error, he said. **EM**

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AMMONIA REFRIGERATION'S MULTIPLE FORMS

The emphasis on smaller ammonia charge is bringing about innovations in industrial refrigeration, including packaged and conventional CO₂ / NH₃ systems as well as ammonia DX

— By James Ranson

Bringing NewTon to the U.S.

Mayekawa's CO₂/NH₃ NewTon refrigeration system, a standardized packaged unit with small ammonia charge, has made quite a splash in Japan, with about 500 installations. Now CIMCO Refrigeration is partnering with Mayekawa to bring the system to the U.S. industrial market, where industrial operators are struggling with large ammonia plants and their large charge size, complexity and shortage of experienced technicians.

CIMCO has installed two NewTon units in the U.S. with 10 in the pipeline, said Benoit Rodier, CIMCO's director of business development, at an ATMosphere America 2015 session on industrial refrigeration systems.

The second U.S. installation, in California, has a capacity of 28 TR. It will be run alongside an R507 system to allow the Electric Power Research Institute (EPRI) to compare the performance of both systems.

The NewTon's reduced charge, automatic control and minimal packaging and wiring simplify onsite construction, noted Rodier. Its ammonia section includes a new screw compressor, semi-hermetic IPM motor, flooded evaporator, and double economizer. The unit, which uses a water-cooled condenser, pumps CO₂ to cold storage areas.

Rodier said that despite resistance to using new technology, and the higher price of the CO₂/NH₃ package, its energy savings, safety, maintenance and service make the unit's total cost of ownership affordable. "We have to help the owner to consider the total cost of ownership," he said.

Industrommercial systems

"Industrommercial" is a word coined by Joe Sanchez, application engineering manager at Bitzer U.S., to describe the blending of commercial and industrial systems.

There are ways that commercial and industrial systems overlap, such as with load size, saturated suction temperatures, compression technology and capacity control. Both types are employing natural refrigerants. "Exchanging information and technologies between commercial and industrial will ensure natural refrigerant success," said Sanchez at ATMosphere America 2015.

He cited as an example a CO₂/NH₃ system at a cold storage/blast freezer facility that uses semi-hermetic CO₂ compressors traditionally employed in a commercial application. The system serves a 360 TR load with 14,000 pounds of CO₂.

The project enabled the cold storage facility to take advantage of the benefits of CO₂,

such as its high volumetric capacity, the lack of shaft seals, parallel compression, light-weight piping, and little maintenance.

A challenge for the project was managing the oil because there wasn't a natural way for the oil to come back to the compressors. The system was equipped with an oil rectifier and individual oil separators, but Sanchez recommended considering a DX heat exchanger for rectifying the oil and a common oil separator with a reservoir.

DX system cuts ammonia charge

In their joint presentation at ATMosphere America, Terry Chapp, National Business Development Manager at Danfoss and Jeremy Olberding, Vice President of Sales at Colmac Coil Manufacturing explained the advantages of ammonia DX.

Thanks to advanced electronic controls using state-of-the-art algorithms, ammonia DX systems have become a safe and proven technology that can eliminate the regulatory and liability burden that accompanies large-charge systems.

The speakers cited an ammonia DX installation at the 403,000-square-foot Joliet Cold Storage facility in Joliet, Ill. The installation, which uses economized screw compressors with thermosyphon oil cooling, has a DX ammonia charge of 7,300 pounds (for a load of 1,007 TR) much lower than the estimated ammonia charge for a pumped system (25,175 pounds). It also has lower power consumption as compared to HFCs, the same or lower consumption than a pumped ammonia system, and offers a 2-3 year payback. Its first cost is \$150,000 less than a pumped recirculated liquid system.

Although a few technical challenges had to be addressed in the initial stages of the project, such as stratified/wavy flow in the evaporator tubes and refrigerant distribution in the evaporators, the ammonia DX system is a value-added alternative to HFC systems, the speakers said. It accommodates systems up to 1,800 TR with less than 10,000 pounds of ammonia. **JR**

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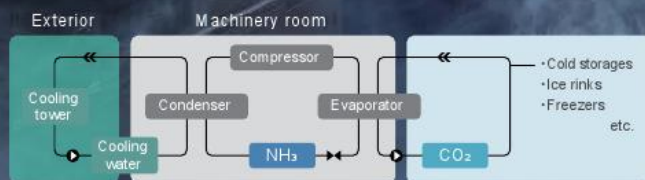
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Scott Martin,
Hillphoenix

HILLPHOENIX'S COMPONENTS QUEST

The OEM wants easier U.S. approval of European components for its thriving transcritical CO₂ business

— By Michael Garry

At ATMOsphere America 2015, held in late June in Atlanta, Scott Martin, director of sustainable technologies for Hillphoenix, raised his hand during the Q&A part of the regulations and standards session. The speaker to whom his question was directed: Randall Haseman, principal engineer, refrigeration and room air conditioning for UL (Underwriters Laboratories), the safety-standards-setting body.

Martin pointed out that Hillphoenix, a major U.S. manufacturer of transcritical CO₂ racks, has been unable to incorporate components like high-pressure copper tubing that have been widely and safely used in Europe for years because they have not been UL-approved in the U.S. Why should that be?, he asked.

Haseman replied that UL would "take a look at that data and most likely accept it."

The issue of component availability has been an especially vexing one for Hillphoenix since it began manufacturing transcritical CO₂ booster systems at its Georgia facilities in 2012, following its purchase of the Denmark-based Advansor brand in 2011. In order for Hillphoenix to get its transcritical racks UL-approved, each component — compressors, controls, valves, switches, oil management devices and more — has to be UL-approved, which can be a long, arduous and expensive process. As Martin said at ATMOsphere America 2015, that requirement excludes many components made and used in Europe, leaving fewer and more expensive components that have passed muster with UL.

"There are few UL-approved components here," Martin, who has led Hillphoenix's development of CO₂ systems, told *Accelerate America* in an interview at the company's Conyers, Ga. headquarters in late June. "That's frustrating because there are so many components and suppliers in Europe. But there are a lot of smaller

manufacturers there that don't want to spend the money to get UL-approved in the U.S., so their components are not available here."

Major component suppliers like Danfoss, Copeland and Bitzer are also frustrated, Martin said. "They've built thousands of components in Europe and face all new requirements to come to the U.S., even though their systems are not dangerous!" With greater resources, those companies have obtained UL approval for many products that Hillphoenix has put in its racks, such as Bitzer and Copeland compressors as well as controls and valves from Emerson, Danfoss, Micro Thermo and Carel, and condenser/gas coolers from Luvata, Baltimore Aircoil, Refplus and Guntner.

Hillphoenix would like to see more cooperation between U.S. agencies like UL and their counterparts in Europe to facilitate technology transfer to the U.S.

Booming business

While the component availability issue has limited competition in that arena, the overall price of Hillphoenix's transcritical racks has dropped over 10% in the past year and continues to fall as manufacturing volume and efficiency increase, Martin said. Even component manufacturers have lowered their prices because of greater volume.

Martin acknowledged that the ROI for a transcritical system, ranging from two to five years, may still be longer than end users would like. But he pointed out that the installation cost can be less and the ongoing savings in energy and refrigerant can be considerable.

Hillphoenix also manufactures cases for transcritical systems, which include electronic

expansion valves and case controllers. The presence of case controllers reduces installation costs by obviating the need to run sensor wires from the cases to a back-room controller.

For the North American market, Hillphoenix as of late June had already booked almost as many transcritical racks in the first half of 2015 (56), as it built prior to 2015 (62). (See "Hillphoenix

Ramps Up Transcritical Production," *Accelerate America*, July-August 2015.) Most of these installations are at supermarkets, though a growing percentage (in the low 20s now) are in industrial settings.

Overall, Hillphoenix's Second Nature product line, which encompasses secondary (including glycol) and cascade as well as transcritical CO₂ systems, has grown to represent close to 30% of its North American business.

Hillphoenix's volume gains reflect the overall surge in uptake of transcritical systems in North America. According to the most recently compiled shecco data reported in GUIDE to Natural Refrigerants in North America 2015, the U.S. now boasts 52 transcritical installations, including those planned for the remainder of 2015 and the start of 2016; a year ago the total was only 14. Similarly, in Canada there are 139 transcritical installations either completed or planned, compared with 93 in 2014.

Hillphoenix's early U.S. installations of transcritical racks include an Angelo Caputo's Fresh Markets warehouse (now attached to a store) in Carol Stream, Ill., and a Whole Foods Market outlet in Brooklyn, N.Y. Other major customers are Roundy's, Aldi, Hannaford, Wegmans and Kroger. The company's Canadian

retail customers for transcritical include Sobeys, Loblaw, Overwaitea and Longo's.

On the industrial side, Hillphoenix has done a transcritical installation for Nestle and Roche Pharmaceuticals. The company has also made transcritical racks for three U.S. ice rinks.

In July 2014, the company achieved a breakthrough by installing a transcritical system in a Georgia-based Sprouts Farmers Market store, inside the warmer climate zone where transcritical systems have tended to lag behind in efficiency. That store has proven otherwise, thereby opening up a broad new market for Hillphoenix. (See "Transcritical System Taking the Heat in Georgia," *Accelerate America*, July-August 2015.) "We have more orders coming from southern stores," said Martin. One of those is a new Food Lion store in Southport, N.C., opening in the fourth quarter. (See story, page 24.)

The Sprouts store in Georgia employs an adiabatic gas cooler, which helps cool the uncondensed CO₂ gas in conditions above 88°F (CO₂'s critical point), thereby improving overall system efficiency. Ejector and parallel compression systems, which also have this effect, have been developed by Hillphoenix and installed in a European store. "We are looking for test sites [for this technology] in the U.S.," noted Martin.

Desire for future-proof solution

Another factor driving interest in transcritical systems is the desire on the part of end users to find a "future-proof" solution that will be immune from EPA regulations. Martin observed that in his 30 years in the industry regulations have led to five generations of synthetic refrigerants, from CFCs and HCFCs to at least three HFC or HFO blends. "But if you go to a natural refrigerant like CO₂ or ammonia or hydrocarbons, you're done."

As for low-GWP HFOs, the latest generation of synthetics, retailers remain concerned about their longevity – and a reprise of the usual EPA-led phasedown, said Martin.

In the natural refrigerants area, CO₂ systems are Hillphoenix's primary focus, but the company also makes self-contained hydrocarbon cases and has supplied an ammonia/CO₂ system to a commissary at the Lackland Air Force Base in San Antonio, Texas, as well as the CO₂ part of an ammonia/CO₂ system installed at an Albertsons store in Carpinteria, Calif. (See "NH₃/CO₂ System

Ready For Takeoff," *Accelerate America*, July-August 2015.) "NH₃/CO₂ systems are definitely viable; the issue is price," said Martin.

Proper contractor training for transcritical systems is still an issue in the industry, and Hillphoenix deals with that through its in-house Learning Center, which includes field training. Martin urges end users not to compromise a transcritical installation by hiring an unskilled or inadequately motivated contractor.

Martin acknowledged that transcritical installations require more collaboration among Hillphoenix and contractors, as well as component suppliers and end users, than conventional systems. "It's the same as it was in the mid-1990s, when we introduced [secondary] glycol," Martin said. "It was complicated and contractors didn't understand it. So we had to work with them, and now it's second nature (pun intended)" **MG**

Q&A with Scott Martin

Scott Martin, Hillphoenix's longtime director of sustainable technologies for Hillphoenix, is one of the industry's leading experts on CO₂ refrigeration, so *Accelerate America* queried him on a few points.

Accelerate America: How long does it take Hillphoenix to build a transcritical rack?

Scott Martin: It takes about two weeks, including the frame and internal assembly.

AA: What's the biggest difference between a transcritical rack and a conventional DX rack?

SM: It's the transcritical rack's use of a high-pressure valve and a gas bypass valve; they're important in supercritical conditions (over 88°F) when pressures can get up to 1,400 psi. There's an algorithm in the controller that looks at the valves and decides where to run the system pressures to optimize efficiency.

AA: Do transcritical racks typically work with an auxiliary condenser or back-up generator?

SM: Yes, either that or a primary generator that backs up the whole store, which is common.

AA: Will Hillphoenix continue to see growth in both transcritical and cascade CO₂ systems?

SM: Both are going to evolve, especially in the short term, which happened in Europe. When we get enough contractors and technicians who understand transcritical, then slowly cascade will go away.

SHORT TAKES

By Jana Topley Lira and James Ranson

WINERY, HOTEL BENEFIT FROM HPWH



The capabilities of CO₂ heat pump water heaters (HPWH) at two end use sites – a winery and a hotel – were revealed at ATMOsphere America 2015.

At the winery, the HPWH – a UNIMO unit from Mayekawa USA MYCOM – uses a 25-40°F propylene glycol/water heat source and a 194°F hot water outlet. It achieved a 24% reduction in energy costs; a 39% reduction in carbon emissions; and an ROI of 3.4 years, said Troy Davis, energy manager for Mayekawa USA MYCOM.

At the hotel, the HPWH featured a 44-54°F chilled water heat source and 194°F hot water outlet. It produced a 22% reduction in energy costs; a 41% reduction in carbon emissions; and a projected ROI of 4.2 years, he said.

Davis emphasized that a CO₂ heat pump can combine a cooling function with a hot water heating function in one small package, increasing the COP of the overall cooling/hot water heating system **● JTL**

TECUMSEH AND MUELLER ANNOUNCE MERGER



Tecumseh Products, Mueller Industries and Atlas Holdings announced a merger agreement last month in which an affiliate of Tecumseh and Atlas will acquire Tecumseh in a deal valued at approximately \$123 million.

The transaction is expected to be completed in the third quarter of 2015.

Tecumseh is a leading manufacturer of hermetically sealed compressors for residential and commercial applications, including hydrocarbon refrigeration while Mueller makes copper tubes, fittings, valves and protection devices for high-pressure applications like those using R744.

As part of the deal, Tecumseh will stay a stand-alone business and continue to operate its global technology bases throughout North America, South America, Europe and Asia. Tecumseh's senior management is expected to remain in place.

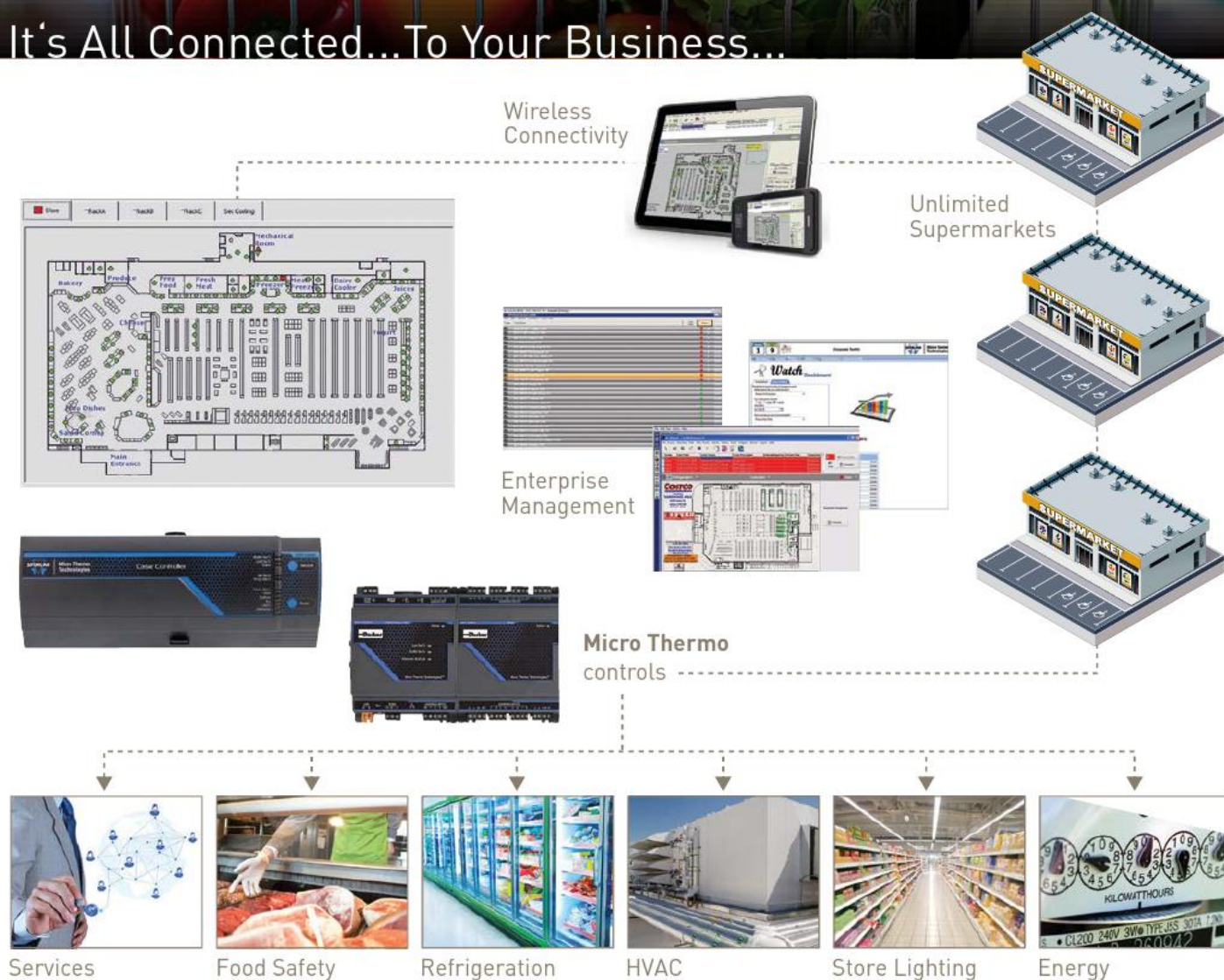
While Tecumseh will continue its main operations at its base in Ann Arbor, Mich., with considerable autonomy, it will become a privately held company and will be delisted from the NASDAQ stock market **● JR**

SANDEN TO DEBUT CO₂ HPWH IN NA

Building on the success of its parent company with CO₂ heat pumps in Japan, Sanden International USA plans to capitalize on the growing U.S. market for heat pumps by introducing CO₂ heat pump water heaters (HPWH) in North America. Sanden's CO₂ HPWH, a split system with no electric element, has been tested in homes across the northwestern U.S.

Field test results presented at ATMOsphere America 2015 by Junya (Joe) Ichikawa, president, Sanden Environmental Products Corporation, revealed that the CO₂ HPWH, which provides domestic hot water to any home in ambient temperatures down to -15°F, is three times more efficient than electric resistance water heaters, and 40% more efficient in cold ambients than HFC refrigerants. The unit can produce over 135 gallons of hot water per day **● JTL**

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