

SEPTEMBER 2018

ACCELERATE

ADVANCING HVAC&R NATURALLY

A M E R I C A

A photograph of two men standing in a grocery store aisle. The man on the left has a beard and glasses, wearing a red lanyard. The man on the right has a mustache and is wearing a red button. Both are wearing white long-sleeved shirts with the Casa Ley logo. The background shows shelves of produce and price tags.

MEXICO'S 1ST TRANSCRITICAL STORE p.44

From left: Juan Manuel Ley-Bastidas
and Rafael Francisco Navarro Torua,
Casa Ley

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Charge/Start up CO₂ systems

Set Up of pack and case controls
Servicing procedures

A Good Summer for Natural Refrigerants

— by Michael Garry

IN these turbulent times, it's good to take note of positive developments. For natural refrigerants, there were several examples of good news in recent weeks, which are covered in this issue.

Food retailers, who will be gathering the last week in September in Atlanta for the Food Marketing Institute's Energy & Store Development Conference, should pay attention to two firsts – the first transcritical CO₂ system to be installed in a Mexican supermarket, by the Casa Ley chain ([page 44](#)); and the first transcritical system to be implemented by Weis Markets, at a store in Randolph, N.J. ([page 38](#)).

With more than 340 installations of transcritical CO₂ in the U.S. and over 210 in Canada (according to sheccoBase), retailers who have been holding back on investing in this technology are beginning to take their first steps. Casa Ley was willing to try out CO₂ even though it is located in a climate that is very warm all year long. The chain is banking on an adiabatic condenser to keep the system out of transcritical mode most of the time, thereby allowing it to run more efficiently than traditional DX systems.

Both Casa Ley and Weis will be studying the performance of their systems over the next year, and we plan to present those findings in *Accelerate America*.

Not all supermarkets are opting for CO₂ alone as a natural refrigerant. Raley's in California, has decided to make an ammonia/CO₂ overfeed system the choice for its first natural installation next year ([page 42](#)), even though there are only four other such systems deployed in the U.S. Meanwhile, another California-based chain, Grocery Outlet, has started testing water-cooled propane self-contained cases as its natural refrigerant system.

These retailers are showing that all three of the main natural refrigerants – CO₂, ammonia and propane – could viably be used in a supermarket. Over the coming years we will be watching the performance and cost effectiveness of these systems to determine which works best in different settings.

Whichever system they choose, end users would benefit from the availability of incentive programs. And to that end, the California legislature on August 30 passed the California Cooling Act, which will offer incentives to supermarkets and other end users in that state to help defray the higher first costs of natural refrigerant systems ([page 28](#)).

Accelerate America's publisher, shecco, supported this bill and sent a letter to its sponsor, Senator Ricardo Lara, with endorsements from 14 businesses involved with natural refrigerants. We congratulate Senator Lara – the recipient of *Accelerate America's* 2018 Person of the Year award – and his staff for this important accomplishment. And now New York is following California with its own HFC-reduction plan ([page 16](#)).

Finally, another breakthrough for natural refrigerants took place in August as the Environmental Protection Agency raised the charge limit for hydrocarbons in domestic refrigerators to 150 g from 57 g, putting the U.S. on a par with the standards used by the rest of the globe ([page 30](#)).

This will pave the way for home appliance manufacturers to come out with home fridges using isobutane in the U.S. market. Next up: raising the global charge limit for commercial stand-alone cases to 500 g from 150 g.

I look forward to celebrating all the good news at the FMI Energy & Store Development Conference. See you in Atlanta!



Michael Garry
Editor

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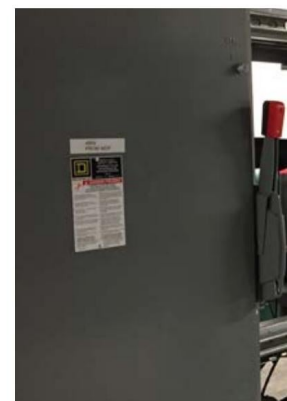
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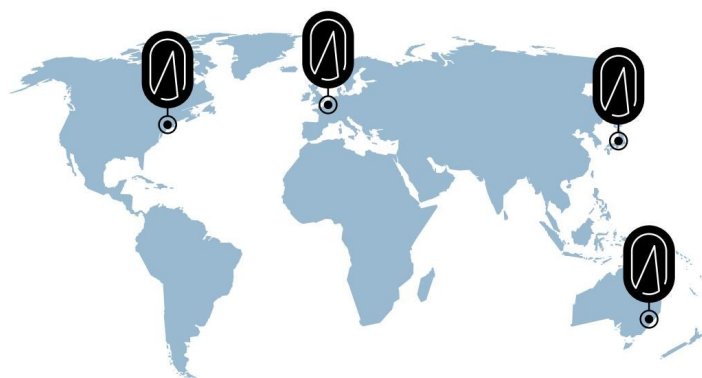
Ammonia and n-butane systems in residential building had higher COPs than R134 and R22 systems, according to Iranian study.

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About Accelerate America

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

<http://acceleratenet.com>

Accelerate America publisher shecco's network spans the globe with offices in Brussels, Tokyo, New York and Sydney.

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FOCUS:

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FOCUS:

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CO₂ in industrial refrigeration

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// ISSUE #36 *June-July 2018*

FOCUS:

Policy

PUBLICATION DATE:

June 7

#GoNatRefs



LETTERS TO THE EDITOR



HURDLES FOR HC STANDARD

In regard to “HC Charge-Limit Increase Approved in Interim IEC Vote” (*Accelerate America*, August 2018), the IEC’s SC61C subcommittee will meet October 17-20 in Busan, South Korea. If the 500-g hydrocarbon charge-limit proposal passes, it will go to final vote, which will take the rest of the year.

For North America, several steps would need to take place before a new IEC standard could be adopted. If the proposal is passed in October, CANENA (Council for Harmonization of Electrotechnical Standards of the Nations in the Americas) could form a committee to develop an updated North American version of UL 60335-2-89. (This may need to wait until the final vote is completed.) It will take a while to get this done. It could be done late next year.

Once the UL-60335-2-89 is updated, the Environmental Protection Agency under the SNAP (Significant New Alternatives Policy) program would need to complete a rule making (which would take a minimum of six months).

Then the big issue shows its ugly head: ASHRAE 15 & 34 would need to be changed and the building codes changed. The best case for that would be: changes could be submitted to the code officials in late 2021 for review and addition into the 2022 standards.

But what are the chances of all this happening in a timely manner?

Charles Hon
Engineering Manager
True Manufacturing,
O’Fallon, Mo.

OPPOSED TO CHARGE-LIMIT INCREASE

I am following your news about natural refrigerants, which I much appreciate. Thanks.

I have followed the discussions about increased limits for the maximum charge of flammable (ASHRAE Class A3) refrigerants like propane, which also was discussed in one of your podcasts.

I don’t think that is a good idea. The focus should be on reducing charge rather than increasing the limits.

The 500 g limit mentioned will increase the risks considerably, and the last thing we need is an accident that probably would put flammable refrigerants on hold for a long time. A small charge is important for minimizing the environmental impact and risks from any refrigerant used.

I have just finished a research project where we developed a heat pump providing 10 kW of heating capacity with a refrigerant charge of 100 g of propane, well below the 150 g limit. I presented

the paper at the Gustav Lorentzen conference in Valencia, Spain.

I worked with the change from R12 to R134a and later from R134a to R600a during my years at Electrolux (many years ago). That was quite an effort for a company producing about 10 million refrigerators/freezers per year with many technical challenges. With the right focus, it was done relatively smoothly.

I think that this time the industry has some work to do before advocating increased charge limits. I know that work is going on, and it would be a mistake to stop the race for the highest capacities with less than 150 g of propane. Let the winners get the commercial benefits from their investments. With time, we will all benefit from that.

Klas Andersson
Klas Andersson Engineering
Lidingö, Sweden

HIGHER CHARGE IS SAFE

(Editor's Note: Marek Zgliczynski, chairman of the IEC SC61C subcommittee responsible for the hydrocarbon charge limit in commercial systems, was asked to respond to the letter from Klas Andersson.)

In my understanding, it is possible to keep the refrigerant charge at very low levels in some applications, like with water-to-refrigerant systems. But in the majority of actual commercial systems, this can have an adverse effect on performance/design/cost.

Future safety standards with larger charges of flammable refrigerants are supposed to maintain or increase the safety level of the present limit, thanks to additional mitigation measures.

Marek Zgliczynski

Manager of Commercial Refrigeration Product Engineering
Embraco, Turin, Italy
Chairman of the IEC SC61C subcommittee

REAL ESTATE ISSUES

Regarding "Lower Charge, Higher Revenues" (*Accelerate America*, August 2018), this is the first instance I have heard where an industrial end user was driven by use of storage space to select a rooftop low-charge ammonia packaged system.

But harkening back to my days with a refrigerated facility design/build firm, it is not surprising that real estate issues are a concern fairly often.

Existing facilities wishing to increase their production are often pressed for space. This can be the case even in new facilities, too, where the storage or production process is deemed more important than utilities like refrigeration. (Storage or production makes money while utilities, including refrigeration systems and the space for them, cost money.) And expanding buildings can cause trouble with fire lanes, egress, site setback, utility arrangements, and encroachment on neighbors.

But I have not heard that this is a big driver for packaged systems, although there certainly would be an advantage.

Eric M. Smith

Vice President and Technical Director
International Institute of Ammonia Refrigeration (IIAR), Alexandria, Va.

TOP-FIVE BENEFITS

Saving costly building space or using the space for other purposes is definitely high on the importance list to our customer, and prospective customers, for Evapcold packaged rooftop low-charge ammonia systems. ("Lower Charge, Higher Revenues" (*Accelerate America*, August 2018)). It is clearly in the top-five benefits along with Inherently safer technology, less regulatory burden, lower energy consumption and faster customer use.

These top-five benefits, and there are others too, can change priority for a customer based on the specific project. It is fairly common that the owner's building is being designed to the extent of the property lines, less setbacks, and getting rid of the machine room allows for more cubic feet of revenue-generating storage or process space in a smaller footprint.

In addition to Western Gateway, we are involved in other projects with top-10 cold-storage and food-and-beverage companies where this benefit has resulted in the incorporation of packaged low-charge ammonia systems into their projects.

Kurt Liebendorfer

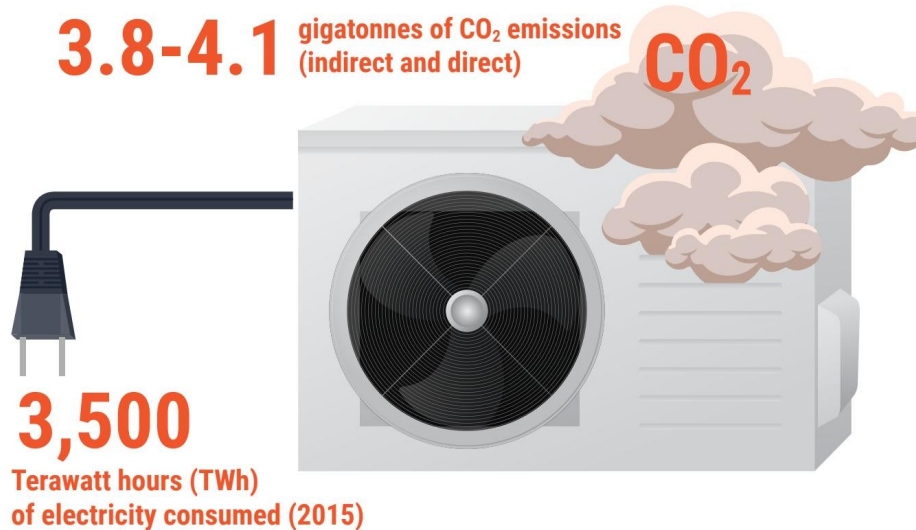
Vice President
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LETTERS ARE WELCOMED!

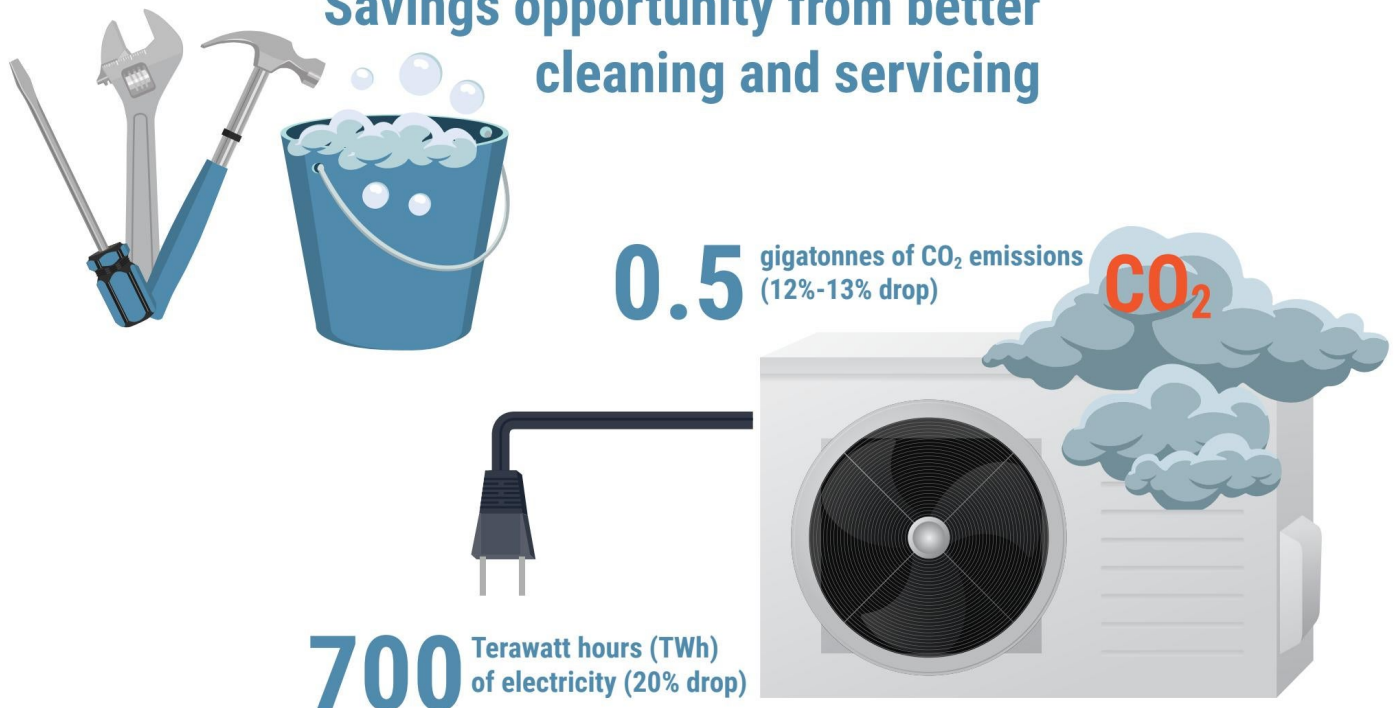
Accelerate America invites readers to submit letters to the editor at michael.garry@shecco.com. They can be about a recent article; an industry issue that readers would like us to cover in greater detail; or the value of *Accelerate America* and *ATMOsphere America* in educating the industry about natural refrigerants, including what we can do better. Letters may be edited for clarity or length. Letters may be edited for clarity or length.

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SEP

13-14**Global Climate Action Summit
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The Global Climate Action Summit will celebrate the achievements of states, regions, cities, companies, investors and citizens with respect to climate action. It will also be a launch pad for deeper worldwide commitments and accelerated action to prevent dangerous climate change.



<http://globalclimateactionsummit.org>



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18-20**Charlie Greer's Ultimate HVAC
and Plumbing Technician
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Technicians will learn how to increase their sales by delivering a superior level of service. This means they'll learn to do a more thorough inspection, draw up a comprehensive list of every single defect they see (in order of priority), and go over it with their customers.



<https://bit.ly/2PwfavQ>

19-21**Women in HVACR: 15th
Annual Conference
Denver, Colo.**

Women in HVACR provides professional avenues to connect with other women in the HVACR industry. It aims to empower women through networking opportunities, mentoring and education.



<https://bit.ly/2K1xTeP>

**19-21****FMI Energy & Store Development
Conference
Atlanta, Ga.**

The event offers an exhibition hall and sessions on refrigeration, energy efficiency, store design and merchandising.



<https://bit.ly/2LTXh7W>



@FMI_ORG

24-28**Refrigerant Week
Online**

Series of webinars hosted by Danfoss experts on topics ranging from global regulation trends to leading-edge CO₂ technologies.



<https://bit.ly/2JsaVkv>



OCT

02-04**AHR Expo Mexico,
Mexico City**

Starting 20 years ago as an extension of the annual AHR Expo, this event in Mexico is held every two years in either Mexico City or Monterrey. It features products and solutions in air conditioning, heating and cooling systems, equipment and components, ventilation, IAQ and more.



www.ahrexpomexico.com



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**03****Natural Refrigerants Workshop:
Mapping The Future
Burlington, Vt.**

Hosted by the North American Sustainable Refrigeration Council (NASRC) and Efficiency Vermont, this free workshop will track future natural refrigerant options in the food retail industry. It is designed for service contractors, food retailers from large chains to small independents and convenience stores, and other commercial refrigeration stakeholders.



<https://bit.ly/2wne7pi>

**07-10****NACS Show 2018
Las Vegas, Nev.**

This event is aimed at convenience and fuel retailing industry professionals with educational sessions and a 400,000-sq-ft expo that includes food equipment, foodservice programs, facility development and store operations.



<https://bit.ly/2BLIKfb>



@NACSShow

08-12**2018 RSES Annual Conference
& HVACR Technology Expo
Albuquerque, N.M.**

The event offers HVAC&R educational sessions for heating, ventilation, air conditioning and refrigeration contractors; service technicians; operations/maintenance managers, engineers and technicians; sales staff; instructors; and students.



<https://bit.ly/2BFuJyx>



@RSESHQ

20-23**NFRA Convention
San Diego, Calif.**

The National Frozen & Refrigerated Foods Convention emphasizes one-on-one business meetings among retailers, manufacturers, sales agents and logistics providers. NFRA provides retailer members with complimentary meeting rooms.



<https://nfraconvention.org>

FMI Energy to Convene in Refrigeration Stronghold

The Energy & Store Development Conference will take place this month in Atlanta, home to many OEMs and component makers

— By Michael Garry

The Food Marketing Institute's 2018 Energy & Store Development Conference, scheduled to run September 23-26, will take place at the Sheraton Hotel in Atlanta — a part of the U.S. where many major refrigeration OEM and component manufacturers are located.

The conference will take advantage of that location by offering a facility tour on the last day at Bitzer's newly enlarged reciprocating compressor plant in Flowery Branch, Ga., and Hussmann's facility in Suwanee, Ga. There will also be a tour of a Kroger Marketplace store and The DeKalb Farmers Market, and an off-site social event at the World of Coca-Cola.

But before then, the conference will feature a wide range of educational sessions on refrigeration, energy, store design and industry trends along with a manufacturer-retailer exchange. The exchange will provide supermarket operators the opportunity to meet more than 100 suppliers of energy management, HVAC, refrigeration, design, construction, and lighting systems.

In addition, at a breakfast on September 25, Tom Land, GreenChill Partnership Program Manager, Stratospheric Protection Division at the U.S. Environmental Protection Agency (EPA), will present the annual GreenChill Achievement Recognition Awards.

Categories include: best emissions rate, most improved emissions rate, distinguished partner, best certified store and store certification excellence.

GENERAL SESSIONS WILL INCLUDE:

- ▶ Emerging Issues: a Blueprint for Food Retailing, with Mark Baum of the Food Marketing Institute.
- ▶ Refrigeration Trends: Choosing and Designing the Right Refrigeration System, with Andre Patenaude of Emerson.
- ▶ Regulatory Update on policy and regulations at the international, national and state levels, with Tim Anderson, Hussmann

REFRIGERATION SESSIONS WILL INCLUDE:

- ▶ Lowering Refrigerant Leak Rates: Best Practices, with Tom Land of the EPA GreenChill Partnership, Jason Flanigan of Meijer and Wayne Rosa of Food Lion.
- ▶ Refrigerated Displays: Maximizing Profits by Enhancing the Shopper Experience, with Robert Mullen, Hussmann and Dan O'Brien, Zero Zone.
- ▶ Effective Installation of Doors on Refrigerated Cases, with Andrew Goldberg of RBS Ahold Delhaize and J.R. Cochran, Dover Food Retail.

▶ Anti-Sweat Heater Controls: What Works, and What Works Best? Speakers include Ethan Bellavance and Ali White, Vermont Energy Investment Corporation.

ENERGY SESSIONS WILL INCLUDE:

- ▶ Leveraging Technology to Respond to Ever-Changing Utility Rates, with Rafik Sarhadian, Southern California Edison, and Gabe Schwartz, Stem.
- ▶ Leveraging Energy Resiliency to Increase Electricity Savings and Future-Proof Your Store, with Lisa Laughner, Go Electric Inc.
- ▶ Harnessing Building Systems Efficiencies through Commissioning and Recommissioning, with Frank Blake, Price Chopper/Market 32 and Dustin Herner, Weis Markets.
- ▶ Energy Storage in the Cold Chain, with Amrit Robbins, Axiom Energy.
- ▶ Conditioning Today's Supermarkets, with Jeff Ollis, SESCO.

For more information or to register, visit <https://bit.ly/2MkUzb8> ■ MG

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In recent years, the refrigeration industry has been discussing and evaluating the environmental impact of the increased concentration of gases in the atmosphere and the greenhouse effect, as well as new laws and regulations for energy efficiency and use of refrigerant gases.

Embraco has been conducting research for many years and believes that the use of natural refrigerants is the future for refrigeration.

Embraco has been applying natural refrigerants, such as **R290** and **R600a**, and found that these alternative solutions reduce the negative effects on the ozone layer and improve equipment's energy efficiency rating. One of **Embraco's** goals is to offer the best refrigeration solutions for customers and educate the market about the importance of adopting alternatives to HFCs gases for the planet's future.

TO LEARN MORE ABOUT NATURAL REFRIGERANT SOLUTIONS,
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AMERICA IN BRIEF

New York State to Phase Out HFCs

New York Governor Andrew M. Cuomo announced on September 10 that he was directing the state's Department of Environmental Conservation (DEC) to issue regulations phasing out the use of HFCs.

New York thus becomes the second U.S. state to engage in HFC-reduction measures, following California, which on August 30 passed the California Cooling Act.

The proposed New York regulations would adopt 2015 and 2016 rules (20 and 21, respectively) adopted under the U.S. Environmental Protection Agency's Significant New Alternatives Policy (SNAP) program, which targeted a number of high-GWP HFCs for delisting from the program in various applications over the next several years.

In April, the EPA dismissed those rules pending a new rulemaking, in response to a U.S. Appeals Court decision last year that narrowed the agency's authority to regulate HFCs.

The New York DEC said in a statement that it has developed a "pre-proposal outline of draft regulation to adopt the 2015 and 2016 USEPA prohibitions on the use of hydrofluorocarbons (HFCs) as substitutes for ozone-depleting substances in applications where safe alternatives are available."

The proposal covers a range of new and retrofit applications, including food refrigeration equipment, cold storage warehouses and stationary air conditioning, with bans taking place between 2020 and 2024.

DEC will be seeking input on this proposal prior to proceeding with a formal rulemaking, with the intent of finalizing a rule in 2019.

State funding is available to accelerate the reduction of the use of HFCs more quickly, Cuomo's announcement said. New York's Environmental Protection Fund (EPF) includes nearly \$9 million for adaption and greenhouse gas mitigation projects,

"While the Trump administration denies climate change and rolls back efforts to protect our planet, New York is picking up the mantle of climate leadership and forging a path forward," Governor Cuomo said. "We are taking action to begin the phase out of the use of hydrofluorocarbons, and I encourage other states to join with New York and California. ■ MG

Mobile CO₂ Training Set for Three Cities

After a successful worldwide tour in 2017 that took in four continents, six countries and 11 cities in 38,000 miles of travel, Danish multinational Danfoss's mobile CO₂ training unit will return to the U.S. this fall.

Installers, service technicians and OEM engineers can register to attend CO₂ training sessions in the unit in Dallas, Texas, in October and November; Atlanta, Ga., in November; and Baltimore, Md., in December.

"We're excited that our mobile CO₂ training unit is returning to the United States to continue leading the way in promoting the benefits of CO₂," said Hans Ole Matthiesen, segment marketing director, food retail at Danfoss.

The complete tour dates are as follows:

Oct. 22-Nov.1: Dallas (Lincoln Tech)
Nov. 6-8: Dallas (RETA National Conference)
Nov. 13-29: Atlanta (United Refrigeration)
Dec. 4-20: Baltimore, Md. (Danfoss)

Registration can be found here:
<https://bit.ly/2NkCAGf>. ■ AW

FBI Installs Propane Refrigerator in Lab

The San Diego, Calif., office of the Federal Bureau of Investigation (FBI) recently purchased a propane (R290)-based laboratory refrigerator for holding evidence, according to equipment supplier SolidCold Corp.

The solid-door unit, the M3R47-2-N model made by Turbo air, "can be used in most any application – commercial kitchen, laboratory, etc.," said Mark DuFloth, president of San Diego-based SolidCold.

The refrigerator, which includes a self-cleaning condenser, covers a temperature range between 33°F and 38°F.

Turbo air, a Long Beach, Calif.-based foodservice equipment manufacturer, has completely transitioned its product line this year to hydrocarbons, either R290 or R600a – the latest in a series of OEMs that have converted to hydrocarbon refrigerants. ■ MG

Güntner Optimizes Adiabatic Condensers

German component manufacturer Güntner is introducing digital controls in its adiabatic condensers that can closely manage water and energy consumption in the condensers, which are often used to boost the efficiency of transcritical CO₂ systems used in supermarkets and cold storage.

"We are now in a big movement inside Güntner worldwide [to] digitalization," said Miguel Garrido, executive VP, Güntner U.S. "This is a big change and we are ready for that."

Güntner's controls optimize the operation conditions of the system specifically for the location in which the unit is installed and through the analysis of extensive weather reports. Based on this information "we can calculate the exact number of hours you need water inside, so we can optimize water consumption," Garrido said. ■ CM & MG



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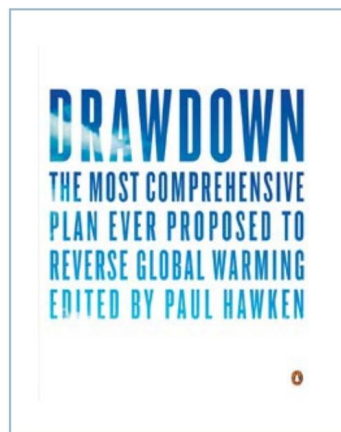
Applying Project Drawdown to HVAC&R

The industry should come together and collaborate with social scientists and story tellers to maximize its potential as the No. 1 Project Drawdown solution to global warming

— By Phil Wilkinson



Phil Wilkinson, chief executive of AIRAH from 2010 to 2016, is now its executive manager – government relations and technical services.



IN April 2017, “Project Drawdown” (www.drawdown.org), a research project that included more than 65 researchers and scientists from 22 countries, ranked refrigerant management No. 1 out of 80 existing (and 20 emerging) solutions for reversing global warming between 2020 and 2050.

The project’s findings were described in a book, *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, edited by Paul Hawken. (See “Refrigerant Management Tops List of Climate-Change Solutions,” *Accelerate America*, April 2017.)

It found that refrigerant management – that is, containing (or destroying) 87% of the refrigerants likely to be released over 30 years – would avoid emissions equivalent to 89.70 gigatons of atmospheric CO₂ (compared to business-as-usual). This would come at a cost of \$902.8 billion under a “plausible scenario.”

Refrigerant management thus represents 8.5% of the total global emissions reduction enabled by all 80 existing solutions under Project Drawdown.

Phasing out HFCs under the Kigali Amendment to the Montreal Protocol – not included in the original analysis – could avoid additional emissions equivalent to 25 to 78 gigatons of CO₂e.

The refrigerant-management chapter in *Drawdown* cites the market availability of natural refrigerants as substitutes for HFCs, noting the need for “addressing the refrigerants coming out of use, as well as transitioning those going in.”

Project Drawdown confirms that our industry has a massive role to play in reducing, and potentially reversing, global warming. It has inspired me to work with others to create a cross-sectoral HVAC&R Project Drawdown approach.

The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) has submitted a plan to Paul Hawken and the Project Drawdown team proposing how its methods could be applied to the HVAC&R industry to make the most of our status as the No. 1 solution to reducing emissions. The following is a description of that plan.

WHY HVAC&R?

A lot of people were surprised when refrigerant management popped up as the No. 1. solution to global warming in Project Drawdown. One of the side effects has been to raise the profile of what is usually an invisible industry: HVAC&R.

It could be useful to reinforce this newfound recognition by making HVAC&R a test case for applying the Project Drawdown model to a sector. Given that HVAC&R includes the No. 1 way of addressing global warming, and is set to expand greatly until the Project Drawdown end date of 2050, what better sector to start with?

“ We will use the same general methodology from Project Drawdown – map, measure and model – and apply it to the solutions for HVAC&R. ”

In Australia, the operation of refrigeration and air conditioning systems consumes about 23% of all the electricity generated in the country, and is responsible for more than 12.5% of total national emissions. Indirect emissions (driven by electricity consumption) from HVAC&R systems typically represent 90% or more of total emissions, so HVAC&R energy consumption clearly has a significant sustainability impact.

We do not have these figures for the rest of the world, and part of the reason for this is that the worldwide industry is fragmented. Communication between HVAC&R organizations and stakeholders around the world is patchy at best. And yet the climate-control solutions developed in one country are generally applicable to other countries.

But the Project Drawdown model would help galvanize collaborative efforts and provide a way of gathering global information.

An effective international knowledge hub would make it easier to share ideas and innovations that could help make the sector more sustainable. It would also highlight knowledge gaps, which could then help prioritize research and collaboration.

As well as identifying and sharing innovations, a global network could bring out individual stories and different approaches to storytelling; these will be vital to helping with behavior change across the sector.

HVAC&R has sustainability impacts through energy consumption, water consumption, indoor environment quality, and refrigerant-related atmospheric changes, all of which are interrelated. And HVAC&R plays a part in almost every other industry. It affects everything from keeping our food fresh, to enabling health and digital infrastructures, to the design and maintenance of high-performing buildings and the industrial and commercial refrigeration services used in manufacturing, production and agriculture.

Yet HVAC&R research projects often struggle to obtain funding due to the industry's low profile and the lack of comprehensive data about the industry's impact. However, the cross-industry nature of HVAC&R could provide a valuable lens through which to view the Project Drawdown challenge. And a common “case” could be used by many projects around the world.

CHANGING BEHAVIOR

Technical or organizational solutions will not work if people do not take them up. So we need to encourage behavioral change in the HVAC&R industry and its users and clients.

In the residential and commercial building sectors, HVAC has created a culture where builders can design and construct thermally underperforming buildings that are then propped up with air conditioning.

In the residential sector (paraphrasing Elizabeth Shove) this has led to houses without eaves, verandas etc. This has the social impact of disconnecting people from nature and their immediate neighbors, which are both critical to a person's well-being. Also, we are seeing a tendency to design to a tight set of requirements for “comfort,” no matter where a building is being built.

The Project Drawdown model seems to have the sophistication to capture some of these other effects of the HVAC&R sector – and could point a way forward. A global network could provide behavioral insights and share successful ways of introducing innovations.

While it was great for refrigerant management to appear at No. 1 in the Drawdown list, the goal is obviously to change it from the largest “opportunity” to the largest “realized opportunity.” Part of the work in a sectoral approach would be to monitor and quantify progress towards that goal in terms of emissions reductions and solutions that contribute to that reduction. For that we need a model that can calculate the emissions produced by the HVAC&R industry worldwide. We will use the same general methodology from Project Drawdown – map, measure and model – and apply it to the solutions for HVAC&R.

REACHING OUT

We have already reached out to some organizations/projects to involve them in a global initiative, and we have started a social media network (Humans of HVACR) with a tool called Mighty Networks that is suited to sharing insights.

Having dedicated HVAC&R organizations gives us a good start to finding experts in the field. However, there are certainly more experts in other places, and one of our goals is to bust out of the industry silo.

We hope to partner with Project Drawdown to draw more interest and support. We would like to know more about how Project Drawdown came up with a list of 100 solutions to give us a guide for doing the same in the HVAC&R sector. We'd also like to know how Project Drawdown overcame culture, language, class and age barriers in building the list.

AIRAH is well-suited to kickstart this because we work with a broad range of government and industry stakeholders. The Institute has been very involved with the development of the Australian Sustainability Built Environment Council (ASBEC) Low-Carbon High-Performance report, and we support its recommendations.

AIRAH is also the driving force behind PRIME, the Australian HVAC&R industry's blueprint for a successful transition to a low-emissions future through Professionalism, Regulation, Information, Measurement and Emission abatement (www.primehvacr.com.au).

As for myself, I'm a mechanical engineer whose cardigan didn't fit. I have a strong social and moral compass about doing the right thing. I'm a passionate supporter of what HVAC&R enables, and I'm good at putting great people together to do great things. I've been through a number of failures in addressing industry emission reductions and have been a deep, systematic thinker on these issues for over 15 years. We need to accelerate progress on the emissions reduction issue and I believe Project Drawdown could be a means of doing that. ■ PW

If you'd like to join the HVAC&R Project Drawdown project, contact me at phil.wilkinson@airah.org.au.

“ The Project Drawdown model would help galvanize collaborative efforts and provide a way of gathering global information. ”

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The Six S's of Refrigeration Selection

An Emerson study found the factors retailers consider most important when choosing a refrigeration system

— By André Patenaude

The dynamics shaping the food retail industry in 2018 represent a continuation of trends we've watched develop over the past several years. These include the migration to urban areas; smaller store footprints; renewed focus on safety and freshness; merchandising flexibility; omnichannel fulfillment models; the lack of qualified technicians; the emphasis on energy efficiency; sustainability initiatives; the internet of things (IoT); and, of course, regulatory uncertainty.

Amidst all of these changes, refrigeration systems are also evolving to align with modern food retailer preferences. To better understand refrigerated system selection criteria, Emerson recently completed a research study of several leading food retailers, asking them which factors are most important when considering the implementation of a new refrigeration system. We compiled the results into six key categories, which we have designated the six S's of selection criteria.

The following is a summary of those findings, which provide further insights into how today's food retail industry trends are impacting refrigeration system decisions.

Serviceability — Technician knowledge is needed to ensure ease of service and maintenance activities. Along those lines, the availability of parts and refrigerants is also important. In addition, retailers reported a preference for refrigeration engine rooms located away from customers, yet relatively easy to access.

Simplicity — Retailers are seeking to minimize complexities by using systems that are easy to understand and diagnose. Many associate system

simplicity with reliability and believe this can be achieved with fewer moving parts, traditional system architectures and proven refrigeration strategies. They feel these characteristics also simplify installation and enable retailers to become operational faster.

Safety — Customer safety is always a top priority, and many retailers are still resisting systems that come with potential safety caveats. Currently, they prefer systems that use nonflammable, non-toxic A1 refrigerants to help ensure a safe shopping environment.

Stability — Retailers consistently cite system reliability as a primary selection criterion. Desired attributes include maintaining consistent temperatures (while minimizing swings), delivering predictable performance, and working according to design specifications.

Smarts — Electronic controls, system connectivity and integration with facility management services via IoT are becoming more important to modern retailers. They understand the value of self-monitoring systems that can detect and diagnose issues, prevent failures and optimize performance, both at the whole system and individual refrigerated case levels. They welcome anything that can help expedite troubleshooting and minimize reliance on repair technicians.

Sustainability — For those retailers driven by corporate sustainability objectives or regional regulatory requirements, the push toward lower-GWP refrigeration strategies is continuing in earnest. Others see the pause in regulatory activity in the U.S. as a chance to weigh emerging options. Meanwhile, reducing energy consumption to minimize operating costs is a concern shared by all.

Based on our study, it's important to realize that every retailer prioritizes the six S's differently. This may be why, among the new refrigeration architectures, no single system type has emerged as the preferred or "ideal" system — a trend that our surveyed group also confirmed. For leaders in our industry, this only points to a large runway of opportunity. Because retailers believe there is still plenty of room for advancement, the retail environment is ripe for new system architectures to take hold.

Meeting these criteria will be a challenge for today's component and equipment manufacturers. The successful refrigeration system designs of tomorrow must borrow the best from what's been done before, without pushing retailers beyond their perceived comfort zones. ■ AP



André Patenaude is director of food retail marketing and growth strategy, Cold Chain, Emerson.



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SOLID PROSPECTS FOR PACKAGED AMMONIA SYSTEMS



Dave Rule, IIAR

But the low-charge units will be up against the traditional industrial business model based on field-built systems, says IIAR president Dave Rule

— By Eda Isaksson and Michael Garry

“If the economics make sense, the transition will take place.”

Packaged low-charge ammonia systems are among the most innovative technologies for industrial refrigeration that have emerged over the past few years, offering much greater safety than traditional overfeed ammonia systems while diminishing an end user’s regulatory burden.

Systems with lower ammonia charges were developed over 20 years ago in Europe, where more than 1,440 units have been installed, according to sheccoBase, a division of shecco, the publisher of *Accelerate America*. The packaged systems have been deployed in a range of settings, including refrigerated and frozen storage, breweries/wineries, HVAC and ice rinks.

In North America, 200+ packaged units have been installed in Canada and 220+ in the U.S., according to sheccoBase. Several North American companies have introduced low-charge packages, including NXCOLD/Hillphoenix ([see page 52](#)), Azane, Evapco, Stellar, CIMCO, among others.

What are the prospects for further adoption of low-charge packaged systems in North America? That was the question posed by shecco CEO Marc Chasserot at “Future of the Industry Debate,” held at ATMOSphere America in June.

Dave Rule, president of International Institute of Ammonia Refrigeration (IIAR), said he believes there will be “at least several hundred” more over the next five years.

What may hold back the uptake of low-charge packages is resistance to change by ammonia contractors. “The resistance is not so much about using ammonia, or CO₂, or any other package – it is more due to the existing business model, which is based on the field-built, designed systems,” said Rule.

“But if the economics make sense,” he added, “the transition will take place.”

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“ The technology is now there to make ammonia and CO₂ more attractive. ”

▶ To assist in the transition to low-charge packaged ammonia systems (containing 500 lbs of ammonia or less), IIAR has developed two new documents that were recently approved by its board and posted on its website (iiar.org): “Low Charge Ammonia Refrigeration Management (ARM-LC) Summary Guide” and “Low Charge Ammonia Refrigeration Management (ARM-LC) Guidelines.”

The documents are intended to help end users, contractors and manufacturers implementing low-charge packages – often with no technicians on site – be compliant with the General Duty Clause of the Occupational Safety and Health Act, which requires that a place of employment be “free from recognized hazards.” (See, “[Paving the Way for Low-Charge Ammonia](#),” [Accelerate America](#), April 2018.)

The IIAR board also recently approved the publication of the new “Ammonia Refrigeration Management (ARM) Program” document for industrial systems using ammonia charges from approximately 500 to 10,000 lbs.

Rule noted that the standards and documents developed by the IIAR are recognized by federal agencies like the Environmental Protection Agency, Occupational Safety and Health Administration and the Department of Homeland Security. In addition, “most of the IIAR standards are recognized by the code bodies,” he said.

U.S. ahead in traditional systems

In terms of ammonia’s traditional usage in industrial applications, particularly field-built systems, the U.S. is “far ahead of most countries,” including Europe, South and Central America and China, said Rule.

He attributed that to the “very well-educated, very well-trained” individuals who work in the ammonia segment, who “understand ammonia” and have overcome “the negative perception around ammonia, particularly outside of industry.” He also referred to “a good technical base of engineers who know how to build field-built systems.”

Regions like Central and South America lack the engineering know-how needed for field-built systems, which forces end users there to “rely on packaged equipment,” Rule said.

Rule acknowledged that the U.S. commercial refrigeration sector is behind other parts of the world in natural refrigerant adoption. However, with the uptake of CO₂ systems and the early use of ammonia packages, “you can see the transition starting to take place, and it will accelerate quickly,” he said, adding, “The technology is now there to make ammonia and CO₂ more attractive.”

The transition will happen faster in commercial refrigeration, according to Rule, due to major external forces. “We’ve got to address the global warming issue and the R22 systems are going away, so the market is looking at the best alternatives,” he explained. “Natural refrigerants are going to be considered heavily” because they eliminate the need to “worry about changing out my system again every 5 to 10 years.” ■ EI & MG

IIAR to Devise Standards for HC Systems

The board of the International Institute of Ammonia Refrigeration (IIAR) has given its approval for the trade group to work with ASHRAE on writing a safety standard for hydrocarbon systems used in commercial and industrial applications.

Because ASHRAE already has a design standard for hydrocarbons, IIAR will be working with ASHRAE’s Standard 15 committee “to determine current gaps in their design standard,” said Dave Rule, president of IIAR.

IIAR’s standards committee will develop language to address the design gaps and submit it to the Standard 15 committee for adoption in the ASHRAE standard, added Rule.

In addition, he said, the IIAR standards committee will develop a separate standard for hydrocarbons to address “installation, maintenance and other safety issues, since [Standard] 15 does not cover these specific areas.” This process will be under ANSI guidelines.

He noted that the standards language for both Standard 15 and the IIAR standard would address commercial and industrial systems using hydrocarbons – not low-charge (150 g or less) cases and refrigerators. Those “are considered to be covered under UL standards,” said Rule.

Last year, IIAR formed a task force, headed by Bruce Nelson, president of Colmac Coil Manufacturing, to address hydrocarbon standards.

IIAR’s foray into hydrocarbons represents its latest effort to expand its reach beyond ammonia to other natural refrigerants. The group is also writing a safety and design standard for CO₂, which should be ready for public review in January, Rule said at the ATMOsphere America 2018 conference in Long Beach, Calif.

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California State Senator Ricardo Lara, with his Accelerate America 2018 Person of the Year Award

“With Washington embracing climate change denial, California is charging ahead to reduce super pollutants and do our part to fight global warming.”

CALIFORNIA PASSES COOLING ACT

Landmark legislation will incentivize natural refrigerant systems and preserve EPA deadlines for HFC replacement

— By Michael Garry

IN a move eagerly anticipated by the HVAC&R industry, the California legislature on August 30 voted to pass the California Cooling Act (CCA), with a concurrence vote in the Senate finalizing the process.

The bill, SB 1013, is the first statewide law to authorize financial incentives for low-GWP refrigeration systems that include natural refrigerants. It directs the California Air Resources Board (CARB) to establish the incentive program to increase adoption of replacement technologies in the supermarket and industrial sectors by overcoming the first-cost hurdle.

The legislation also preserves deadlines that the U.S. Environmental Protection Agency established in 2016 for businesses to transition from HFCs – the fastest growing source of greenhouse gas emissions in California – to alternative refrigerants. The EPA abandoned those deadlines this year in response to a U.S. Court of Appeals ruling in 2017.

The CCA was authored by Senator Ricardo Lara (D–Bell Gardens), who has championed other pieces of legislation on HFC reduction, including SB 1383, which commits the state to reduce HFC emissions by 40% by 2030. *Accelerate America* magazine named Lara its 2018 Person of the Year in June at the ATMOSphere America conference in Long Beach, Calif., where he delivered the keynote address. (shecco is the publisher of *Accelerate America* and organizer of ATMOSphere America.)

Senator Lara introduced the CCA last year at the U.N. Climate Conference in Bonn, Germany, where he and Governor Jerry Brown received the first Climate and Clean Air Award for their work on SB 1383.

“The California Cooling Act shows that cleaner air does not need to be a choice between protecting our planet and growing our economy,” said Lara. “With Washington embracing climate



California State Senator Ricardo Lara, giving the keynote address at ATMOSphere America 2018

change denial, California is charging ahead to reduce super pollutants and do our part to fight global warming.”

The California Assembly voted in favor of the bill on August 29, which was followed by the Senate’s concurrence vote the next day. Brown has until September 30 “to act on SB 1013 or allow it to become law,” said Lara’s office in a statement. Brown’s support is expected, as he proposed \$20 million in incentives for HFC reduction in his 2016-2017 budget; those funds were not approved by the legislature.

Funding for the CCA’s incentive program must still be allocated by the legislature so that CARB can form the program and initiate a stakeholder process to shape its scope and guidelines. The incentive funding would come from the state’s highly competitive greenhouse gas reduction fund (GGRF) program, which is supported by cap-and-trade dollars. The next time the legislature will decide on GGRF funding is June 2019, and those grants would go out in 2020. Brown’s successor as governor next year could also play a role by including incentive funding in the January 2019 California budget.

Lara is running to be California Insurance Commissioner. In the event he is not in the legislature next year, the CCA has three coauthors – Senators Henry Stern and Scott Wiener and

Assembly Member Gonzalez Fletcher – who would be positioned to support incentive funding.

To supplement the GGRF funding, the CCA also provides incentives through the California Utilities Commission and local utilities.

A welcome development

Passage of the bill has been warmly greeted by environmental groups.

“With the passage of the Cooling Act, California has established a comprehensive backstop for federal regulations on HFCs that were recently vacated,” said Avipsa Mahapatra, climate campaign lead for the Environmental Investigation Agency (EIA), Washington, D.C. “This landmark legislation demonstrates how states can champion tangible climate action by moving away from super-pollutant HFCs. In the United States, actions like this would enhance market uptake of climate-friendly technology by increasing economies of scale. Internationally, it will help the U.S. stay on track to meet its global climate commitments, including under the Montreal Protocol’s Kigali Amendment to phase-down HFCs globally.”

Added Christina Starr, EIA Climate Policy Analyst: “We applaud Senator Lara and the California legislature for their leadership in adopting this important

legislation, particularly the innovative approach it takes to incentivizing new technology uptake by end users such as supermarkets. It is a promising model for other states considering climate action on HFCs as part of their commitment to raising the bar on non-federal climate action.”

Observed Helena Molin Valdés, head of the U.N. Environment-hosted Climate and Clean Air Coalition: “The passing of the California Cooling Act will have positive impacts far beyond California by encouraging the global supply chain to adopt less-polluting and more energy-efficient cooling technologies. This bill will drive innovation, is good for business, and helps protect our planet.”

The CCA was supported by public health and environmental groups, including the American Lung Association, Natural Resources Defense Council, Sierra Club, and more than 15 major refrigeration manufacturers including Bosch, GE, LG, Electrolux and Whirlpool.

The CCA’s incentives are designed to “assist end users with upfront costs (including installation) for low global-warming potential systems,” said a Lara staff member. This represents “the first statewide program to help people make this transition,” said Lara, adding that the program “sends the right market signals about investing in new technology.”

The bill will target end users of supermarket refrigeration, cold storage equipment and commercial air conditioning systems. “We are looking at the big end users like supermarkets to get the most bang for the buck,” said Lara.

Funding would be available for equipment in existing as well as new stores. Communities that have been “disproportionately impacted by pollution and climate change” would be first to receive funding, he said, though any end user in California would be able to apply for incentives. ■ MG



Kevin Messner, AHAM

“ We are very pleased with EPA’s action to update its regulations to the most recent safety standards. ”

EPA RAISES HC CHARGE LIMIT FOR HOME FRIDGES

Adopting UL standard, the agency lifts charge ceiling to 150 g from 57 g for isobutane, propane and R441A – a move long-sought by industry.

– By Michael Garry

IN a long-awaited move, the U.S. Environmental Protection Agency last month published in the Federal Register a final rule raising the charge limit for hydrocarbons in domestic refrigerators and freezers to 150 g from 57 g through the adoption of a 2017 Underwriters Laboratories (UL) standard (60335-2-24).

The final rule took effect on September 7.

The rule raises the charge limit (a use condition) for three flammable (A3) refrigerants – isobutane (R600a), propane (R290) and R441A (a hydrocarbon blend) – in new household refrigerators, freezers and combination refrigerators/freezers under the EPA’s SNAP (Significant New Alternatives Policy) program.

The EPA originally approved isobutane for use in domestic refrigerators in 2012, and propane in 2015, with the 57-g charge limit. But the 57-g limit was widely seen as an impediment to the adoption of energy-efficient hydrocarbon refrigeration in the U.S. domestic market, where consumers have purchased about 12 million new R134a household refrigerators and freezers annually. Elsewhere in the world, where 150 g has long been the charge limit for domestic refrigerators, units using isobutane have gained substantial market share.

“Almost all of the refrigerators in America today use a refrigerant that is about 400 times worse for the climate than hydrocarbons, which have been widely used in fridges around the world for decades,” said Avipsa Mahapatra, climate campaign lead for the Environmental Investigation Agency (EIA), based in Washington, D.C., “This rulemaking would further help manufacturers to change that, thereby giving us an opportunity to avoid the same amount of emissions as from taking 800,000 passenger vehicles off the road for an entire year. In a world struggling to limit warming to under 2°C, it would be a shame if the U.S. industry continues to lag behind the rest of the world.”

AHAM is pleased

U.S. industry does appear poised to take advantage of the new rule. “We are very pleased with EPA’s action to update its regulations to the most recent safety standards, which will allow household refrigerators of all sizes and types to be designed and manufactured to use a climate friendly refrigerant,” said Kevin Messner, senior vice president, policy & government relations for the Association of Home Appliance Manufacturers (AHAM). “EPA has shown great leadership and action in this area with the publication of this rule.”

Domestic refrigerator manufacturers have already invested close to \$100 million in gearing up to make conventional home refrigerators with isobutane, said Messner. In May, he said that a hydrocarbon charge-limit increase to 150 g would give manufacturers certainty about moving forward with their plans for using the refrigerant in larger U.S. home fridges. “There’s the final investment that can’t happen till we know what the charge size is,” he said.

The EIA sees the final rule as the first step toward further changes with regard to hydrocarbons. “At long last American consumers will have easy access to purchase climate friendly household fridges without HFCs, but today’s rulemaking also has broader significance,” said Christina Starr, EIA’s Climate Policy Analyst. “It demonstrates that we can eliminate remaining market barriers still posed by outdated safety standards to low-GWP refrigerants in many types of cooling equipment.”

“This standard change and its subsequent incorporation by EPA can and should be replicated in other sectors that are vital to scaling up mitigation of HFC emissions, including commercial refrigeration and room air conditioning where efforts are still underway,” said Starr.

“ At long last American consumers will have easy access to purchase climate friendly household fridges without HFCs. ”

The charge limit for commercial refrigeration stand-alone display cases, 150 g, is under review by the International Electrochemical Commission (IEC), which has proposed raising it to 500 g. The higher charge passed muster in an interim vote, and a final vote on the increase may come by year’s end; if approved, the new IEC standard would then be considered for adoption by individual countries. (See [“HC Charge-Limit Increase Approved in Interim IEC Vote,” Accelerate America, August 2018.](#))

Overcoming adverse comment

The new rule was originally published as a “direct final rule” on December 11, 2017, pending the results of a comment period. On February 28 the EPA withdrew the direct final rule because of some “adverse comments” from stakeholders. (See [“EPA Pulls Charge Boost for Domestic Fridges,” Accelerate America, March 2018.](#)) However, the agency went forward with a proposed rulemaking that resulted in the charge limit being raised to 150 g.

The adverse comments have been addressed in the new rule, allowing the EPA to move to the 150 g charge limit. It does this by incorporating a UL standard 60335-2-24 that increased the charge limit for hydrocarbons in domestic refrigerators to 150 g from 57 g following an assessment of flammability risks.

In addition to raising the charge limit to 150 g, the new EPA rule also adopts the UL’s required testing of refrigeration appliances containing flammable refrigerants, including leakage tests, temperature and scratch tests, and heat-testing requirements “to address the hazards due to ignition of leaked refrigerant by potential ignition sources associated with the appliance,” said the EPA final rule. The tests are intended “to ensure that any leaks will result in concentrations well below the LFL [lower flammability limit], and that potential ignition sources will not be able to create temperatures high enough to start a fire,” it added.

The EPA’s analysis of flammability risks determined that “a release of a 150-g unit does not present a significant flammability risk in the reasonable worst-case scenario for the three refrigerants in household refrigerators and freezers.” The agency pointed out the longstanding widespread use on a global basis of household refrigerators and freezers using the 150-g charge limit. ■ MG



Lowell Randel, GCCA

COURT VACATES DELAY OF EPA CHEMICAL SAFETY RULES

Amendments to the agency's Risk Management Program, which includes large ammonia facilities, now go into effect. But a new update looms

— By Michael Garry

The U.S. Court of Appeals for the District Columbia on August 17 vacated the 20-month delay of the Environmental Protection Agency's updated rule on the safety of chemical plants, including those using ammonia.

The court vacated the EPA's Delay Rule of June 14, 2017, which postponed the effective date of an update to its long-standing Risk Management Program (RMP) until February 19, 2019.

The updated RMP rule will go into effect 45 days after the August 17 ruling unless the EPA petitions for a rehearing or appeal, or earlier industry litigation is reactivated.

Once in effect, deadlines for action established by the updated RMP rule would be measured from June 19, 2017. Thus the one-year deadline for enhanced emergency responder coordination would be June 19, 2018, which means it would already be in effect. Other deadlines in the rule would be reached in 2019, 2021 or 2022.

The EPA has not indicated whether it will appeal the ruling. However, the agency is pursuing new rule-making that would rescind many of the provisions in the RMP updates.

The suit against the delay was brought by New York Attorney General Eric T. Schneiderman, who led a coalition of 11 state Attorneys General. The court described the rule's delay as "arbitrary and capricious," adding that it "makes a mockery of the statute."

In addition, Earthjustice represented the Union of Concerned Scientists, Environmental Integrity Project, and Sierra Club, among other groups, in the case.

The amended RMP rule was developed during the Obama administration. It is an extension of the RMP, which regulates the safety of dangerous chemicals in industrial plants, including those with more than 10,000 lbs of ammonia.

Three categories in update

The updated RMP rule covers three broad areas: ensuring that local responders and community residents are prepared for an accident; preventing catastrophic accidents; and third-party audits.

In the industrial refrigeration industry, the most controversial part of the amended RMP rule involves third party audits. The rule requires industrial refrigeration operators to get an independent audit-only third party – rather

than use its own internal resources, or a company with whom it does other business – to conduct a compliance audit within a year following a reportable accident.

The deadline to comply with the third-party audit rule would be June 19, 2021, though end users would have just a two-year window to select an independent third-party auditor.

However, in May 2018, former EPA administrator E. Scott Pruitt submitted a proposed "reconsideration" rule that would eliminate several provisions of the RMP Amendments rule. In particular, the EPA proposed to "rescind amendments relating to safer technology and alternatives analyses, third-party audits, incident investigations, information availability, and several other minor regulatory changes," said the EPA.

Lowell Randel, vice-president, government and legal affairs, Global Cold Chain Alliance (GCCA), said he expects the reconsideration rule to be finalized by early next year.

The deadlines for the RMP amendment rule are far enough in the future that "the EPA could complete the reconsideration rule before those deadlines hit," said Randel. As a result, the "practical effect" of the court's decision to vacate the delay of the RMP amendment may turn out to be negligible, he noted. ■ MG

REPORT CITES 2017 CHEMOURS MEMO TO EPA SLAMMING NATREFS

In request for meeting with Pruitt, chemical company claimed natural refrigerants are being promoted by 'global competitors,' contrary to U.S. interests.

– By Michael Garry

An article published August 25 by *The Intercept*, an online news site, highlights a memo sent by chemical producer Chemours last year to former U.S. Environmental Protection Agency (EPA) administrator E. Scott Pruitt in which the chemical producer casts natural refrigerants in a negative light and ties them to “global competitors” attempting to “move into position to lead the HFC replacement industry.”

The article, “How a Dupont Spinoff Lobbied the EPA to Stave Off the Use of Environmentally Friendly Coolants” (see <https://bit.ly/2MSflmH>), said that the memo was part of records released by the EPA in response to a Freedom of Information request by the Sierra Club. (This reporter was quoted in the article.) The memo is now publicly available at <https://bit.ly/2C0wmag>.

The Chemours memo, dated May 4, 2017, was a request to meet with Pruitt. Among the attendees would be Mark Vergnano, CEO of Chemours, and Greg Smith, senior director – government affairs, Chemours. The article said the meeting did take place.

In the memo, the company described its investment of “hundreds of millions of dollars” in the development of HFOs, and expressed its “desire to see EPA maintain consistency vis-à-vis HFCs in order to help protect U.S. leadership in this space and protect significant new U.S. investments the company has made in reliance on previous EPA policy decisions.” (The EPA’s regulation of HFCs was upended in August 2017 by a U.S. Court of Appeals ruling.)

Chemours did not respond to a request for comment on *The Intercept* article and the EPA memo. An EPA spokesperson said the agency declined to comment on the article in *The Intercept*.

However, the EPA spokesperson pointed out that under its Significant New Alternatives Policy (SNAP) program, the agency “does not issue company-specific and/or product endorsements,” though it does evaluate refrigerant alternatives and has placed on its “acceptable” list refrigerants “submitted by Chemours and various other companies.”

VYING TO BE HFC REPLACEMENTS

In the section of the memo titled “Continued American Leadership is Needed,” it said, “Without leadership from the United States to compete vigorously to succeed in this segment, global competitors can quickly move into position to lead the HFC replacement industry.”

After discussing HFO manufacturing and HFC anti-dumping cases in China, the memo then said “organizations like Greenpeace and [s]hecco [publisher of *Accelerate America*] promote the use of carbon dioxide, hydrocarbons, ammonia, water and air as the only viable solutions for many applications, including refrigerants.”

“While these options may indeed be preferred for some uses and equipment types,” the memo continued, “in many cases they are significantly more expensive for equipment manufacturers to implement than HFO solutions, and

in some cases, have poor energy performance, higher operating costs, and severe safety risks.”

“Therefore,” the memo added, “continued U.S. leadership and engagement is needed to ensure a level playing field and fair consideration of all options.”

The memo provided no examples of natural refrigerant equipment being more expensive than HFO systems, or having poor energy performance, higher operating costs or severe safety risks.

The Intercept article observed that natural refrigerants are less expensive than HFO refrigerants and called the energy, performance and safety claims “largely incorrect.” It quoted refrigerant consultant Keilly Witman as saying, “They are greatly exaggerating the safety concerns.”

The article also pointed out that, despite its desire for a “level playing field,” Chemours (with Honeywell) “already dominates” the refrigerant arena in the U.S., though a number of U.S. equipment manufacturers are beginning to make headway marketing natural-refrigerant based systems.

The memo seeking an audience with the EPA did not refer to the environmental concerns that have been raised about HFOs, such as their degradation in the atmosphere into trifluoroacetic acid (TFA) that is brought to ground level in rainfall. *The Intercept* article also noted the relatively high GWPs for HFO blends that include HFCs, such as 573 for Chemours’ Opteon XP10 and 1,282 for Opteon XP40. ■ MG



A Sustainable Hotel, Thanks to Hydrocarbons

The Corbie Ring Hotel in Belgium opted for the TripleAqua – a propane-based heating and cooling system that also stores energy

– By Charlotte McLaughlin

The Corbie Ring Hotel, Lommel, Belgium.

Photography by: Charlotte Georis

The Belgian town of Lommel – a jewel of the Flanders region – is rich in the quartz sand used to make the high-quality glass for which the area is famous. It is also home to the largest solar park in Belgium, which produces energy for over 24,000 households.

The town now has another claim to fame – the Corbie Ring Hotel, arguably the most sustainable hotel in Belgium.

During construction of the hotel, which opened in February, owner Jan-Baptist Koch opted to install the TripleAqua, an energy-efficient heat pump employing propane (R290), with a global warming potential (GWP) of three and a charge of less than 11 lbs (5 kg). It is the first hotel to employ the Triple Aqua, introduced in 2015; the unit has also been used in other locations, including office buildings, a cold-storage facility and a supermarket.

TripleAqua has the ability to store heat and cold in buffers for later use in the building, providing heating and cooling simultaneously or individually. It uses three water-loop pipes to

distribute heat (82°F-97°F), cold (54°F-64°F) and return water at ambient temperature. With a COP between four and 10, it can reduce heating and cooling costs by up to 50% compared to traditional heat pumps.

“This is the most sustainable hotel in Belgium thanks to the TripleAqua,” said Bart Beerten, owner of HVAC contractor Willems-Diels, which installed the unit.

Koch nodded in agreement. The owner, who has installed solar panels in his home, has a passion for sustainability. “We asked [Beerten] to look for a good technique to put savings in our pockets, of course, [and one which] is environmentally sound.”

Koch is also owner and manager of two other Corbie hotels – one in Lommel and one in Mol, Belgium, where his parents started the business. Another Corbie hotel is run by his sister Pauline Koch, who is also an artist and responsible for the design of the Corbie Ring Hotel, which incorporates the local area’s high-quality glass.

1 / From left: Bart Beerten, Willems-Diels, and Filip Van Hulle, ECR Belgium.

2 / The hotel's breakfast area.

3 / From left: Hotel owner Jan-Baptist Koch and ECR Belgium's Filip Van Hulle converse alongside the TripleAqua.



1 / The Corbie Ring Hotel has 27 hotel rooms and 20 business apartments, with a small reception area and a breakfast area. It generally caters to business guests.

Located on the roof of the hotel (refrigerant never enters the building), the 113-kW (32-TR) TripleAqua unit provides the hotel's entire space heating and cooling throughout the year. It is connected to 54 internal HVAC units and a floor heating circuit, allowing guests and staff to adjust the temperature in individual rooms and common spaces.

"This is the perfect place to install it, as hotels have different customers with very different needs – one may wish to heat, another may want to cool," said of Menno Van der Hoff, owner/CEO of TripleAqua Licensing Ltd, and inventor of the TripleAqua, for which he received the 2017 Person of the Year award from *Accelerate Europe* (sister publication to *Accelerate America*). "I am convinced this application will take hold."



2 /

MEETING GUESTS' EXPECTATIONS

In choosing a heating and cooling system for the Corbie Ring Hotel, Beerten needed an environmentally sound, cost-effective and long-lasting solution. "The market is getting to more environmentally friendly [solutions]," said Koch. "People expect long-lasting and ecological products and places to stay."

Most hotels install a boiler and a separate VRF split air-conditioning system that traditionally uses high-GWP HFCs. The heat in the other Corbie hotel in Lommel is produced by solar panels on the roof. Beerten installed that hotel's HFC-based VRF AC system only later, as air conditioning was not as popular in 2005 when the hotel first opened.

The TripleAqua has advantages over traditional systems. "With VRF you need multiple copper piping and leak detectors in every room," Beerten explained. "[With the TripleAqua] water just goes through, also in the under-floor heating" – a simpler design for the installer, he said.

3 /

In addition, the hydrocarbons used in the TripleAqua are less expensive than HFCs. "I explained [to Koch] that f-gases will be more expensive in the future," Beerten noted. "Prices of R410A are increasing."

Beerten first met Van der Hoff at an HVAC&R show where the latter was exhibiting the TripleAqua. He approached Filip Van Hulle, sales manager at ECR Belgium (part of the Beijer Ref Group) – who is responsible for TripleAqua sales in Belgium – to discuss various sustainable HVAC&R options.

Van Hulle proposed the TripleAqua to produce all the building's space heating and cooling – in combination with a



BELOW

Corbie Ring Hotel owner Jan-Baptist Koch with TripleAqua

condensing water heater to produce hot water – as an extremely energy-efficient solution.

Beerten also looked at integrating solar energy into the hotel's energy picture. In the end he decided on the TripleAqua together with the condensing water heater, but no solar panels because the heat pump takes up too much space on the roof. The solar park and wind turbines close to the town serve the hotel's energy needs.

According to Beerten, the TripleAqua setup was the best option, as space heating and cooling are generally responsible for the majority of a building's energy consumption. He compared the TripleAqua to the heating and cooling system he installed in the other Corbie hotel in Lommel, and found the TripleAqua to be about 50% more efficient. It also had the highest payback for the end user and was the most environmentally friendly solution, he said. According to Van Hulle, Koch will recoup the cost of the TripleAqua in four years.

Koch placed his trust in Beerten's recommendations. "I looked over it and said, 'If you say this is the best option, I will go for it,'" he recalled.

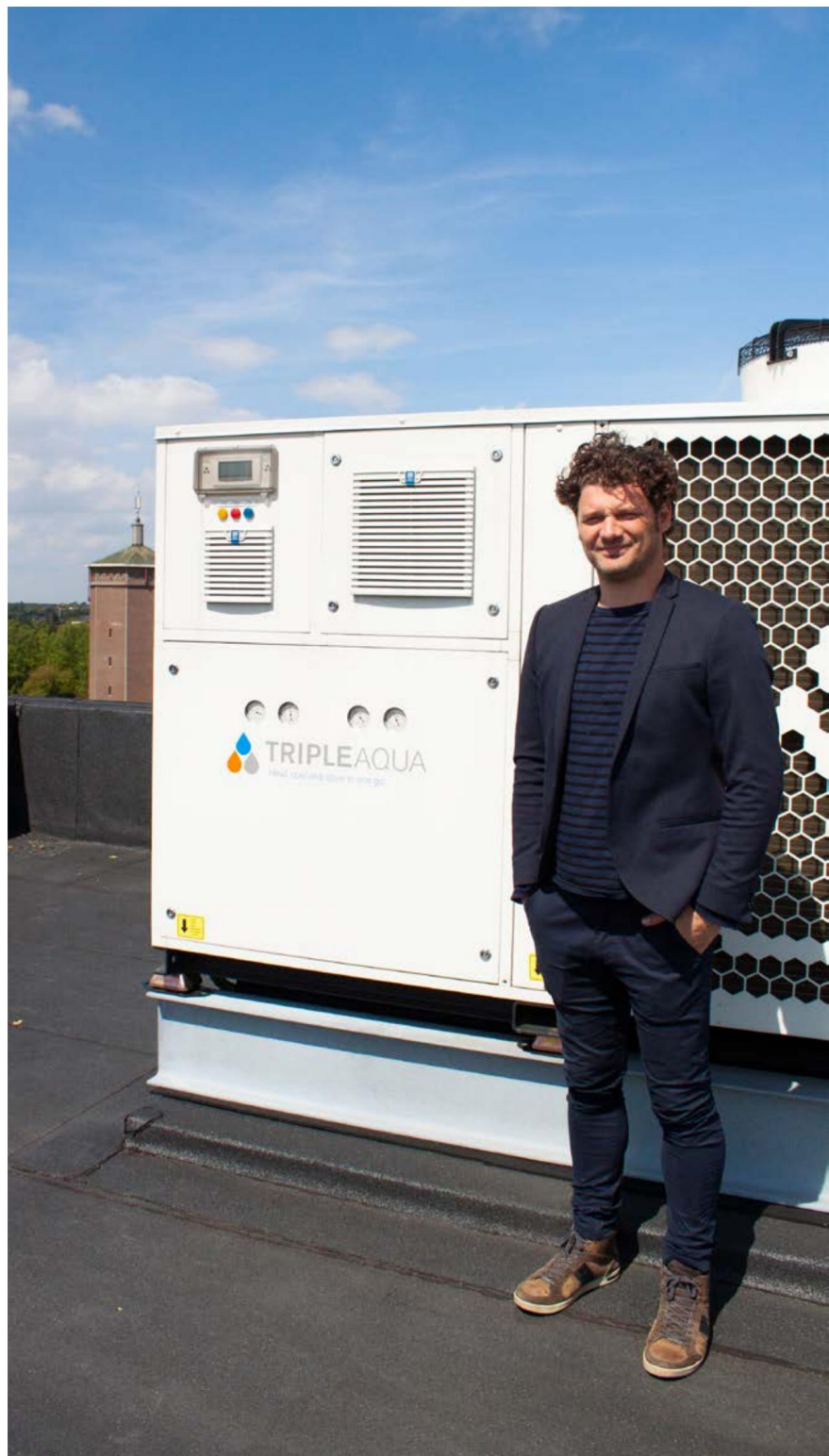
NO REVERSAL

TripleAqua has a number of unique features, Beerten pointed out.

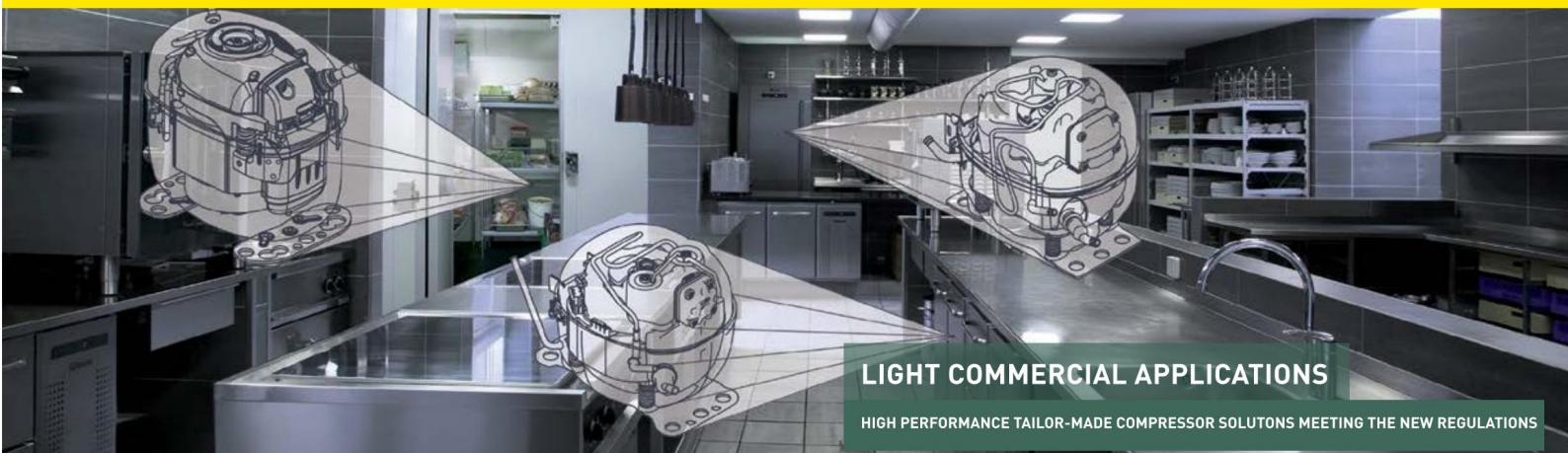
Conventional heat pumps reverse the refrigerant flow, which reduces the efficiency of the heat exchangers. But with TripleAqua, the refrigerant cycle is not reversed between summer and winter mode. This means the heat exchangers are always used for the specific role for which they have been optimized.

In addition, the TripleAqua can take heat from the south of the building, which has glass windows that warm up the reception area, and redistribute it to the north side, which does not get as much sun during the colder winter months.

Koch has been pleased with the TripleAqua, and plans to add a page to the hotel guide on the system's environmentally friendly credentials. He could use the system in the next hotel he is planning. "We will convince them to install the TripleAqua [again]," Beerten said. "We think it's the best solution for a hotel." ■ CM



HIGHLY EFFICIENT HYDROCARBON OPERATED COMPRESSOR TECHNOLOGY



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WEIS MARKETS' JOURNEY TO CO₂



Kevin Small, Weis Markets

“We’re looking for a place where we aren’t looking at another conversion some day.”

The Mid-Atlantic food retailer is piloting its first transcritical CO₂ system, following a successful leak-reduction program and the implementation of a secondary glycol system

– By Michael Garry

Weis Markets, a 205-store food retailer based in Sunbury, Pa., is a GreenChill success story.

The Environmental Protection Agency’s GreenChill Partnership, founded in 2007, offers U.S. supermarkets an opportunity to, among other goals, systematically reduce the refrigeration system leaks that contribute to ozone-layer depletion and/or global warming. Over the past decade, numerous chains, accounting for about 30% of U.S. supermarkets, have cut their leak rates significantly by participating in the voluntary EPA program.

Weis Markets was one of the early supermarket members of GreenChill, joining in 2008. In that year, the chain’s leak rate was about 18%; today it is down to 7.4%. “GreenChill provided us with the tools to measure, monitor and manage our leaks,” said Kevin Small, vice president, construction and development for 106-year-old Weis Markets, whose stores are located across seven Mid-Atlantic states.

GreenChill also encourages supermarkets to reduce the charge of refrigerant used in their systems as well as to transition to environmentally friendly refrigerants. Weis Markets has taken up those goals as well, first by implementing what is now its prototype refrigeration system. This system cut refrigerant charge by about two-thirds by combining medium-temperature secondary glycol (and R404A primary) with a distributed low-temperature platform using R448A.

The latest stage in the Weis Markets’ journey is to deploy its first transcritical CO₂ system – supplied by OEM Hillphoenix with controls from Danfoss and two adiabatic condensers from Baltimore Aircoil (BAC) – in a new 54,000-sq-ft store that opened in Randolph, N.J., in July. That store will serve as a testing ground for the chain to determine whether transcritical will become its next prototype.

Incentivizing technicians

As a strategy to reduce its leak rates, Weis incentivizes its technicians (who are mostly in-house employees) based on leak reduction; the chain has also invested in both stationary and handheld leak detectors. “We have hit this thing hard,” said Small.

On the charge reduction front, Weis has installed the hybrid secondary/distributed system in 15-20 new stores and major remodels.

The distributed low-temperature part of the system reduces charge by putting the equipment “close to the application,” explained Small. On the medium-temperature side, chilled glycol, rather than the primary refrigerant, is distributed to display cases, thereby cutting the charge of the latter.

Users of secondary glycol often observe an uptick in energy consumption due to the power consumed by the glycol pumps. However, Weis has only seen a “nominal increase” in energy, said Small. Both of the pumps (one redundant) in the system use variable speed

1 / Transcritical CO₂ rack at Weis Markets' Randolph, N.J., store

1 /

2 / Paul Burd, Weis Markets



2/



drives to manage energy, noted Paul Burd, manager of refrigeration engineering for Weis. Moreover, maintenance of these systems is much less than that of conventional systems, added Small.

With its first transcritical system, Weis is employing a natural refrigerant, CO₂, which has been steadily growing as an alternative to HFCs and R22 in the U.S. since 2013. As of February 2018, there were more than 340 installations of transcritical CO₂ in the U.S., according to sheccoBase, a division of shecco, publisher of *Accelerate America*.

Weis had been hesitant to invest in a CO₂ system due to some perceived drawbacks, such as the cost premium or the possibility of losing charge in a power outage. "But things got sorted out over the years, and Paul [Burd] said to me, 'it's time for us to try CO₂,'" said Small.

The appeal of CO₂ as a future-proof refrigerant factored into Weis's decision. "We've gone through refrigerant conversions," said Small. "Now there's a conversion from R404A. Are we going to be required to convert from R448A? We're looking for a place where we aren't looking at another conversion some day. So it would be nice to get to a natural refrigerant."

Meanwhile, Weis is using another natural refrigerant – propane – in stand-alone point-of-purchase beverage cases throughout the chain.

Verifying performance

In assessing the current state of transcritical systems with consultants and manufacturers, Weis has found that "transcritical [appears to] reduce energy consumption" compared to its current secondary/distributed prototype, in part because of a 40% reduction in the number of compressors and the absence of glycol pumps, said Small. In addition, "intuitively, it's going to reduce maintenance costs."

But all of this will be examined by Weis over the next year. "Our goal is to use this as a test store to verify that our costs are what we believe them

“ Early indications are that the CO₂ system will meet, and may exceed, our expectations..

”

Energy-Efficiency Improvements

Having cut its direct greenhouse gas emissions through a reduction in refrigerant leaks and charge, Weis Markets has been targeting the indirect emissions generated by electricity use.

It is doing that by installing a variety of energy-efficiency components in its stores, explained Kevin Small, vice president, construction and development for Weis Markets:

- ▶ EC motors in condenser fans.
- ▶ Some doors on multi-deck cases, though “we’re not finding the ROI we need to roll out doors,” said Small.
- ▶ Variable-speed drives for compressor racks, condenser motors, HVAC blower motors and exhaust fans in cooking areas.
- ▶ LED lighting in all display cases.
- ▶ LED lighting in sales areas in about 18 stores this year, with another 15 stores on tap.
- ▶ A demand-response program to reduce power usage during peak days.

to be,” said Small. “I have full expectations that we’re going to be successful and that this will then become our new prototype design.”

“Early indications are that the CO₂ system will meet and may exceed our expectations,” said Burd.

Weis went through a similar process with its secondary/distributed system before it became the current prototype, he said.

In terms of initial costs, the equipment, including the adiabatic condensers, is “just shy of 20%” more than the secondary/distributed system – “worth the education” it will provide, said Small. The premium stems more from the display cases than the system itself, he added.

The cost of installing the transcritical system was “comparable” to that of a secondary/distributed installation, Small said.

This is not the first time Weis has used an adiabatic condenser system. Over the past five years, Weis has been employing it with its secondary/distributed system, noted

Burd. The adiabatic system uses water only in higher ambient temperatures and eliminates the need to engage in expensive water treatment, saving considerably on maintenance costs, he noted.

Hillphoenix – which Weis has found to be very “supportive” and knowledgeable, said Burd – sent its head CO₂ trainer, Rusty Walker, to Weis headquarters to train the chain’s technicians. An experienced CO₂ contractor, AAA Refrigeration Service, Bronx, N.Y., did the installation.

As Weis evaluates the transcritical system over the next year, the comfort level of its technicians will be a “big thing,” said Burd, adding that this can only be obtained through experience. He is confident that equipment parts for the system will be available.

Burd believes that the number of installations of transcritical CO₂ refrigeration in the U.S. will continue to grow. In addition to positive energy estimates, “we’ve seen the cost of [transcritical] equipment and fixtures coming down,” he said. “And the more it’s used, the better the costs will be.” ■ MG

BAC adiabatic condensers used with Weis Markets’ transcritical system



System Specs

Weis Markets’ new store in Randolph, N.J., uses a transcritical CO₂ system with the following specifications:

- ▶ System: Hillphoenix
- ▶ Two adiabatic condensers: BAC
- ▶ Compressors (5 medium-temperature, 3 low-temperature): Bitzer
- ▶ Controllers: Danfoss
- ▶ Low-temperature capacity: 343.2 kBTU/hr at -24°F
- ▶ Medium-temperature capacity: 1,137.3 kBTU/hr at 19°F
- ▶ Low temperature in cases: 260.8 kBTU/hr required at -22°F
- ▶ Medium temperature in cases: 632.8 kBTU/Hr required at 20°F
- ▶ CO₂ charge: 1,100 lbs
- ▶ Defrost: Electric (LT)/ Off-Time (MT)
- ▶ Heat Reclaim: For HVAC and water

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Raley's Opts for Ammonia/CO₂ in Most New Stores

California food retailer selects an uncommon natural solution after a comparison with transcritical CO₂

— By Charlotte McLaughlin and Michael Garry

“Two roads diverged in a wood, and I — I took the one less travelled by.”

— Robert Frost

Faced with the possibility of California regulations capping GWP for refrigerants at 150 in 2022, Raley's, a West Sacramento, Calif.-based chain of 123 stores, has decided to implement a rooftop ammonia/CO₂ refrigeration system in a new Sacramento store next year, as well as other new stores of that size that are typical of the chain.

For smaller, urban stores, Raley's has opted for a transcritical CO₂ system.

Such were the plans delineated by Ed Estberg, Raley's longtime senior director of facilities who retired in 2009 but then became a consultant advising the chain on its refrigeration strategy. He shared this information as a panellist in the food retail session at ATMOsphere America 2018, held in June in Long Beach, Calif.

Raley's has thus chosen for most of its stores a system — ammonia/CO₂ — that has so far been installed in only four U.S. stores. And its version of the system — ammonia DX with liquid-overfeed CO₂ and no CO₂ compressors — differs from the ammonia/CO₂ cascade system used by the other stores.

By contrast, transcritical CO₂ has found a home in more than 340 U.S. supermarkets and over 210 Canadian outlets, according to sheccoBase, a division of shecco, publisher of *Accelerate America*. Mexico also has its first CO₂ system ([see page 44](#)).

Why did Raley's choose to go down a path much less travelled?

Given the distinct chance of needing to use a GWP under 150 in California in 2022,

Raley's, which has tested CO₂ secondary systems, concluded it would need a natural refrigerant-only solution — using a hydrocarbon, CO₂ or ammonia. The flammability of hydrocarbons eliminated it from consideration, leaving transcritical CO₂ or ammonia/CO₂ system, Estberg said. The system would include air conditioning as well as low- and medium-temperature refrigeration.

Raley's didn't find an ammonia/CO₂ system that it liked, so it designed its own. The retailer's version includes: DX ammonia; direct-drive Carlyle 5H compressors in a two-stage configuration; liquid-overfeed CO₂ for low- and medium-temperature cases and AC; water-cooled condensing and heat reclaim with plate heat exchangers; and a total ammonia charge of 120 lbs.

This ammonia/CO₂ system turned out to more closely adhere to Raley's three main criteria — simplicity, reliability and efficiency (SRE) — than a transcritical system, said Estberg.

A SIMPLER SYSTEM

The ammonia/CO₂ system is more “simple” than transcritical CO₂ because it is much like the system the chain has been working with for 25 years, with the same Carlyle compressors, two-stage configuration, control system and oil equalizing system. In addition, the ammonia/CO₂ system would employ solenoid case-temperature control (simpler than a transcritical system's EEVs and case controller, said Estberg) and fewer high-side controls and regulators than a transcritical system. Moreover, the support system for ammonia is more “robust” than that for CO₂.



Ed Estberg, Raley's

Your Refrigeration System," Accelerate America, June-July 2018.)

The one metric for which transcritical comes out ahead is "repeatability." That is, a transcritical system is scalable and can be used in a small or large store, while a small store can't use an ammonia/CO₂ system, Estberg said. Consequently, Raley's will use transcritical for its small "downtown" stores.

Raley's does not include capital and installation cost into its primary criteria because, though cost is "a big factor," the chain "wants to buy and build the best refrigeration system we can," said Estberg. In addition to trying to negotiate the cost down, Raley's plans to tap natural refrigerant incentive funding from the Sacramento Municipal Utility District (SMUD) and the state of California's recently passed California Cooling Act ([see page 28](#)).

Ammonia/CO₂ is more "reliable" than transcritical because it has more standard industry parts, lower operating pressures, low-speed compressors, a proven control system and no high-side regulators. The failure rate of Raley's traditional systems "is virtually zero in 25 years," said Estberg. In particular, "I am pretty happy with the reliability of our compressors."

Raley's geographic area in California features hot summers and mild winters. For Raley's, this favors ammonia/CO₂ over transcritical when it comes to efficiency and energy usage, said Estberg. Raley's modelling suggests a CO₂ transcritical system would cost \$38,000 more in electricity per year for a 40,000-sq-ft store with a 1.6 MBTU load at 13 cents/kWh. He also cited other energy-saving features of the ammonia/CO₂ system, including efficient motors in the open-drive compressors, and no motor heat through the compression cycle. He also noted that in a transcritical system the AC would operate when it is least efficient.

Estberg has developed an EER calculation that he will use to measure baseline and natural refrigerant systems' energy efficiency in real time. ([See "How to Determine the Efficiency of](#)

Ammonia/CO₂ systems have found few supermarket adopters, in part because of concerns about the toxicity and odor of the gas in the event of a leak. But Estberg is "very confident" about the safety of the system. "If you follow IIAR guidelines, it's not really a concern," he said. The odor of the gas, he added, is a positive factor since "it will drive you out of any space before it can do you harm."

Raley's will also employ safeguards to counter a leak of the small ammonia charge – 120 lbs – that its rooftop system will use. These include an open water tower that would serve as a water diffusion system for a major ammonia leak (considered rare), and a sensor paired with an 8,500 cfm exhasut system that would move smaller leaks to the outside.

A two-door chamber will separate the machine room from entry to the store. "It's physically impossible for 100% of the ammonia to end up in the store unless there is a catastrophe and the machine room falls into the building," Estberg said. But even if all 120 lbs of ammonia infiltrated the store, "I don't believe the ppm would be enough to do damage." ■ CM & MG

GROCERY OUTLET MULLS PROPANE AND CO₂

Like Raley's, Grocery Outlet, a 300-store chain of independently owned extreme-value stores based on Emeryville, Calif., sees the handwriting on the wall: a possible 150-GWP cap on refrigerants in California (where many of its stores are located) in 2022.

In response to that, Grocery Outlet is exploring two natural refrigerant options: transcritical CO₂ or propane self-contained display cases with a fluid-loop to remove heat, said Pete Marotta, the chain's director of sustainable store planning/refrigeration, at the ATMOsphere America food retail panel discussion in June. "We have to go to natural refrigerants," he said.

Grocery Outlet, which has begun testing propane cases, is planning tests on both system types in 2020, followed by installations at new stores in 2022, he said.

Transcritical CO₂ comes with challenges, said Marotta, such as costing the chain an additional \$120,000-\$150,000 per store. He indicated he would seek out incentives in California. In addition, some of Grocery Outlet's stores are in remote locations in Washington and Oregon, where qualified CO₂ technicians and parts may be in short supply.

Propane-based cases would be a suitable solution for Grocery Outlet's small (12,000 to 20,000-sq-ft) stores. But Marotta would like to see the hydrocarbon charge limit for commercial cases raised from 150 g to 500 g, particularly for a 12-ft-long line of cases and low-temperature units. (The International Electrotechnical Commission is working on that increase.)





CASA LEY TAKES A SWING AT TRANSCRITICAL

The food retailer – owner of the Tomateros de Culiacán pro baseball team – is the first in Mexico to install an all-CO₂ refrigeration system, testing the technology in the country's hot climate

– By Michael Garry

“ We were surprised to be the first. But we’re proud of that. ”

BELOW

From left: Juan Manuel Ley-Bastidas and Rafael Francisco Navarro Torua, Casa Ley

Photography by:
Cesar Rodriguez

Casa Ley, a major food retailer in Northwest Mexico that operates 246 stores, has formed some fruitful relationships with businesses in the U.S.

One of them started with baseball.

Based in Culiacán in the state of Sinaloa, Casa Ley owns the Tomateros de Culiacán, part of the Mexican Pacific League, which plays from October to January.

In 1980, Juan Manuel Ley, son of company founder Juan Ley Fong ([see story, page 51](#)), met with Peter Magowan, then CEO of Safeway stores and future president of the San Francisco Giants.

Ley and Magowan bonded over their mutual love of baseball. That friendship led to a joint venture the following year in which Safeway gained a 49% stake in Casa Ley, allowing the Mexican chain to enter a period of rapid expansion. (Casa Ley regained full ownership in January 2018.)

Casa Ley's decade-long relationship with another U.S. company, Columbus, Ga.-based refrigeration manufacturer Kysor/Warren, a division of Heatcraft Worldwide Refrigeration, has led to a new opportunity – becoming the first supermarket operator in Mexico to install a climate-friendly transcritical CO₂ refrigeration system in one of its stores, a new 75,347-sq-ft supercenter in Culiacán that opened last month.

“We were surprised to be the first,” said Juan Manuel Ley-Bastidas, son of Ley and current CEO and chairman of Casa Ley. “But we’re proud of that. It validates the work we’re doing.”

Like other stores in Mexico, Casa Ley has also installed propane beverage coolers provided by vendors.

Casa Ley's installation of transcritical refrigeration will be closely watched by other Mexican retailers as well as by those in the Southern regions of the U.S. to see how it performs in the hot ambient temperatures that persist year round in Mexico.

Caring about our kids

Perhaps it shouldn't be surprising that Casa Ley – the fourth largest supermarket chain in Mexico – would be the nation's first retailer to test a transcritical system, given its sense of social responsibility.

"We believe as a company we have to be very responsible to our communities and our customers and employees, said Ley-Bastidas, who became CEO of Casa Ley in 2008 and chairman this year. "And a big part of that is taking care of the environment."

"It's not just for publicity or for marketing," he added. "It's really caring about our kids and communities."

Of course, whatever equipment Casa Ley purchases has to also take productivity into account. "But we believe we can do those in parallel – be responsible and be productive," he said.

In addition, from their analysis of market and policy trends in Mexico and other countries around the world, Casa Ley executives could see that refrigeration technology was moving toward using "less polluting gases," he said. In selecting a transcritical system from Kysor/Warren, "we wanted to get ahead of legislation and stay ahead of the curve."

Mexico, as a participant in the Montreal Protocol, will prohibit the use of R22 in 2024; Casa Ley is working on transitioning away from R22 in the few stores still using it to a lower-GWP drop-in alternative.

In its other stores, Casa Ley uses R404A, but Mexico is expected to ratify the Kigali Amendment, which calls for a phase down of HFCs like R404A. As an Article 5 country, Mexico would have until 2024 to freeze HFC production/consumption at baseline levels, and until 2045 to reduce it by 80%.

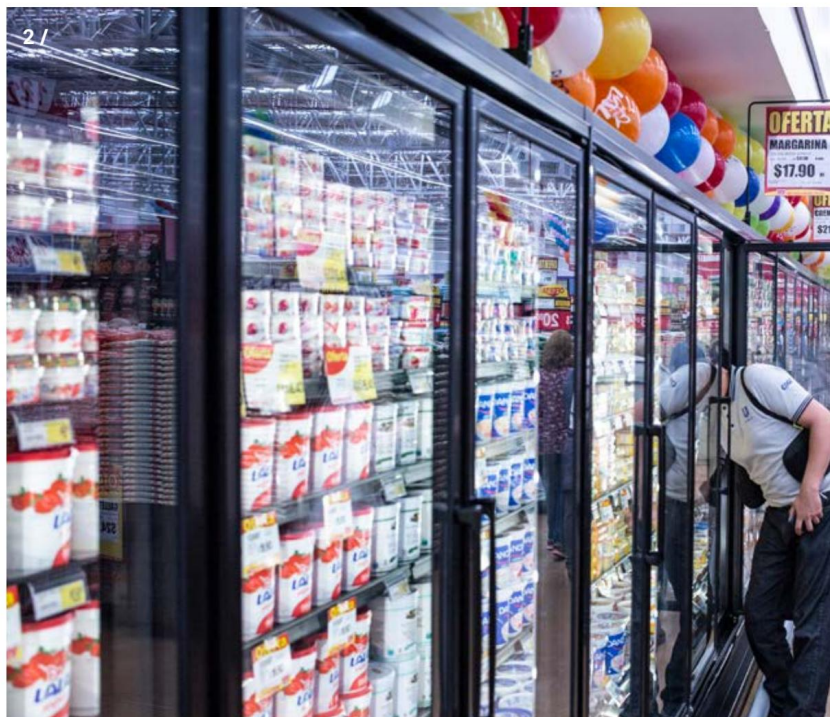
Cost premium

The cost and installation of the transcritical unit and adiabatic condenser came at a premium of about 30% over a traditional DX system, said Ley-Bastidas. But with the expected operational savings, Casa Ley would gain an acceptable ROI for the

1 / New Casa Ley store in Culiacán, Mexico, with transcritical system

2 / Refrigerated cases in the store

3 / Juan Manuel Ley-Bastidas welcoming shoppers to the store at the grand opening on August 15.





system, he added. It was on that basis that Casa Ley decided it could afford to make an initial investment in the technology, said Manuel Ruiz Dorado, head of management acquisitions and sustainability.

Dorado's department "constantly researches the internet, picks the brains of our suppliers and attends trade fairs to look at what's going on and what's new and being used in other parts of the world," said Ley-Bastidas. "We are constantly looking at new ways to do business."

The Casa Ley executive who proposed installing a CO₂ system to the company's management was Rafael Francisco Navarro Torua, senior maintenance manager. The selection of transcritical, he said, was the result of a "search [for] better energy efficiency and because "this is where the retail industry is heading." He coordinated the installation of the system, training, and selection of personnel for the project.

Because this technology is new for Mexico, Kysor/Warren, which designed and manufactured Casa Ley's transcritical system at its Columbus, Ga., headquarters, decided to simplify the design, said Ignacio Varela Chaparro, Kysor/Warren's business development lead and the company's lead for the Casa Ley project. That is why, for example, an adiabatic condenser was used rather than parallel compression and an ejector, though adiabatic condensers are more expensive. (The system also does not include heat reclaim.)

"This is the first [transcritical] store, so they don't have technicians qualified to [handle ejectors and parallel compression]," Chaparro said. "And adiabatic can provide the same energy benefits, maybe more."

Ley-Bastidas acknowledged that Casa Ley's installation of the transcritical CO₂ system will serve as a year-long test of factors like energy consumption and

1 / Low-temperature suction pressure gauge and low-temperature suction header low-pressure switch

2 / Two low-temperature Bitzer compressors

3 / Kysor/Warren transcritical CO₂ rack

4 / CO₂ flash gas tank (left) and flash gas bypass valve

5 / Danfoss rack controller

6 / Electrical panels for display cases and walk-in rooms

7 / Defrost and control panels for walk-in coolers; refrigeration loop piping

maintenance to determine whether the chain will proceed with this technology as a standard for new stores. “It’s too early to tell, but I believe all of our initial premises will be met,” he said.

Ley-Bastidas was encouraged when told that for low temperatures, the transcritical system requires two compressors with low horsepower. According to Kysor/Warren’s Chaparro, the CO₂ rack system’s low-temperature compressors use a total of 7 HP (one 4 HP and one 3 HP), compared to an HFC system that would require three 12-HP compressors for a total of 36 HP for the same capacity. “That’s a huge difference!” Ley-Bastidas exclaimed.

The climate challenge

Undoubtedly the biggest challenge facing retailers in Mexico when it comes to transcritical technology is the hot year-round climate, which in Culiacán includes high humidity. This means that the system will often operate in an environment that is approaching or above CO₂’s critical point of 88°F, when the gas exists as a supercritical fluid (a mix of gas and liquid) and is cooled but not condensed at the gas cooler/condenser outlet; this can undercut the system’s efficiency.

“It was a concern,” said Dorado in regard to the high ambient temperatures of Mexico. “But that is why this is a test to validate what we will see after using the equipment for a year.”

The Güntner adiabatic condenser used by the transcritical CO₂ booster system is able to condense the CO₂ at lower wet-bulb temperatures on hot days, improving the system’s efficiency. The difference between wet-bulb and dry-bulb temperatures of as much as 22°F “provides good conditions” for the use

of the adiabatic unit, said Chaparro. “Adiabatic keeps the system subcritical for as long as possible.”

With the adiabatic condenser, Casa Ley’s transcritical system could consume 5% to 10% less energy than a conventional DX system, Chaparro said, though he stressed that the actual energy consumption remains to be determined. The maintenance of the system, he added, would be the same or less, in part because of case controllers that automatically set parameters like super heat.

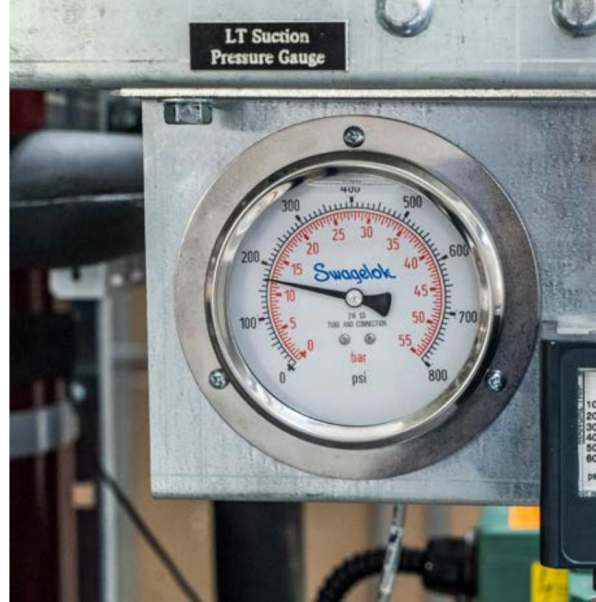
Kysor/Warren, which installed its first transcritical system in the U.S. in 2017, has also placed a transcritical system with an adiabatic condenser at a store in Florida, whose ambient conditions are similar to Culiacán’s. “We know the system can handle those conditions,” Chaparro said.

Torua considers the adiabatic condenser to be “a very good option” for hot climates like Culiacán’s. Moreover, it is “accompanied by a good control system that has given us very good results and at a relatively low cost.”

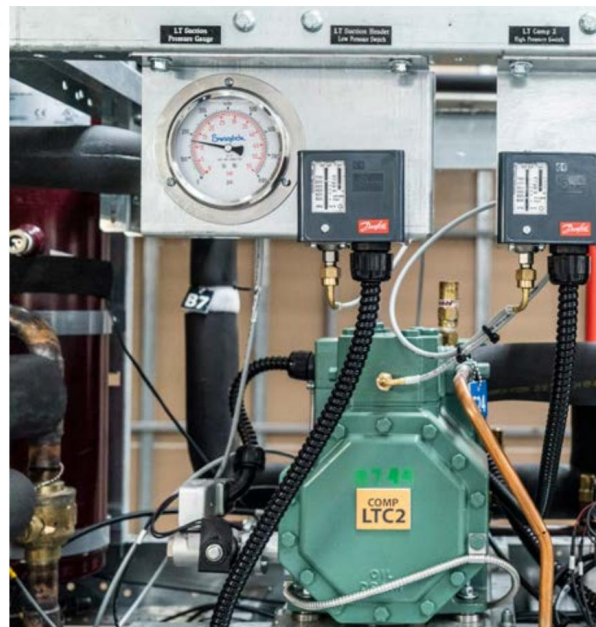
In Georgia, another warm area, a Piggly Wiggly store is using a highly efficient ammonia/CO₂ cascade system made by Kysor/Warren, but Casa Ley did not consider that system, Chaparro noted. (See “The Pig’s NH₃/CO₂ Experiment,” *Accelerate America*, September 2016.)

Vendor training

As the first user of transcritical CO₂ in Mexico, Casa Ley naturally has a keen interest in receiving adequate training for its technicians and contractor on the use and maintenance of this system, which operates at higher pressures than conventional DX systems. For



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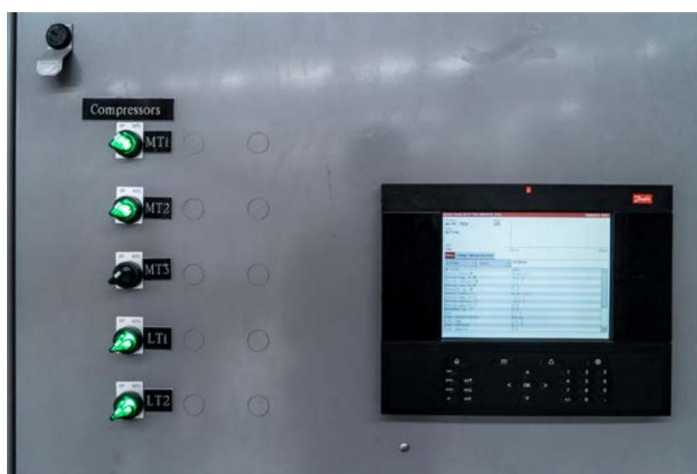
The Greening of Casa Ley

Transcritical CO₂ refrigeration is not the only green technology Casa Ley has invested in.

5 /

About 80 stores have switched to LED lighting while 150 have installed cases with doors. (The new Culiacán transcritical store has both of these features.)

All 246 Casa Ley stores are fitted with automation to control refrigeration, air conditioning and lighting; skylights are present in almost all stores; and the company plans to upgrade fans in all display cases to the latest ECM motor.



6 /

Next year, the company plans to install solar panels on the rooftops of about 25 stores per year, including the new transcritical store. CEO Juan Manuel Ley-Bastidas acknowledged that he would like the cost of storage batteries to come down, but will go forward with the solar initiative.

Casa Ley's energy projects are led by a department created seven years ago to investigate ways to reduce energy consumption and carbon emissions. "Everyday energy costs are more expensive, and we are in a race to beat that," said Ley-Bastidas. "So we are constantly trying to explore new ways to lower energy consumption. It's a race that never ends."

7 /

The company has also started a waste management program aimed at recycling cardboard and plastic.





ABOVE
Güntner adiabatic condenser

RIGHT
Condenser unit for ice flaker (not approved for use with CO₂)

that, its suppliers – Kysor/Warren as well as compressor maker Bitzer and controller maker Danfoss – provided ample support.

“All the people who gave us technology came to Culiacán and gave us lessons on what we have to know to operate the equipment,” said Dorado, adding, “We’re ready to operate the equipment, though part of the test will be to see if we are really ready.”

Training support was a key consideration in selecting suppliers for the transcritical project, said Ley-Bastidas.

Kysor/Warren conducted training sessions in July for 35-40 technicians from Casa Ley and Zavala Refrigeration, the local contractor that installed the transcritical system, said Chaparro. It included two days of classroom instruction on such topics as basic maintenance and start-up/shut-down procedures.

In addition, during the commissioning of the system in early August, Kysor/Warren’s technical sales support (TSS) professionals offered hands-on training for three days at the store.

Kysor/Warren also provided Casa Ley with an illustrated, step-by-step guidebook on basic maintenance, including how to relieve pressures and avoid dry ice formation, as well as a set of CO₂ pressure gauges. The higher pressures produced by transcritical systems is a common concern among technicians unfamiliar with the technology.

Kysor/Warren offers what it calls the “Sleep Well” promise – a pledge that professional maintenance and emergency service by trained technicians will be available for end users of its systems. In Mexico, Kysor Mexico, based in Mexico City, provides this service. “Our technicians are trained and will go to the store to make sure the system is running,” said Chaparro.

In terms of supplies for the first store – such as valves, sensors, and POE oil – Casa Ley has a sufficient stock for routine and unexpected maintenance, said

“ We believe as a company we have to be very responsible to our communities and our customers and employees. ”

Dorado. A supply of refrigerant-grade CO₂ is available at the store, added Chapparo.

The company learned during installation what supplies it would need for “any contingency,” added Eduardo Ugarte Ramos, construction director for Casa Ley.

“I don’t see a problem in regard to the availability of parts in the region,” said Ley-Bastidas. However, Casa Ley is evaluating whether it would have a sufficient supply of parts should it decide to roll out transcritical systems to many stores.

As Casa Ley moves ahead with its test of the transcritical system, it’s clear that Ley-Bastidas will remain actively involved. “I’m a hands-on CEO,” he said. “If my teammates know that I am excited about this, they will be excited, too.” ■ MG



System Specs

Casa Ley's new store in Culiacán, Mexico, uses a transcritical CO₂ system with the following specifications:

- ▶ System: Kysor/Warren
- ▶ Adiabatic condenser: Güntner
- ▶ Compressors (3 medium-temperature, 2 low-temperature): Bitzer
- ▶ Controllers: Danfoss
- ▶ Low-temperature capacity: 76,897 BTU/hr
- ▶ Medium-temperature capacity: 443,842 BTU/hr
- ▶ Low temperature in cases: -20°F saturated suction temperature
- ▶ Medium temperature in cases: 20°F saturated suction temperature
- ▶ CO₂ charge: 927.2 lbs
- ▶ Defrost type: Electric



The Casa Ley Story

Founded by a Chinese immigrant in 1954, Casa Ley has grown to be the fourth largest food retailer in Mexico, with about 25,000 employees and 246 stores located in 60 cities across 10 states in Northwestern Mexico.

Its stores range from 10,764-sq-ft supermarkets to supercenters encompassing up to 108,000 sq ft of sales space. In addition to food, the latter stores sell a wide variety of general merchandise.

Casa Ley's story starts with the immigration from China of Lee Fong, who as a 10 year old in 1911 stowed away on a boat headed to the coastal city of Mazatlán, Mexico, where he joined a wave of Chinese immigrants. Adopted by a Chinese family, he learned Spanish and changed his name to Juan Lee Fong.

Fong grew up to be a savvy businessman who started a series of commercial operations. He eventually opened a store in the remote mountain town of Tayoltita, where he married and started a large family (six sons and three daughters).

Cheated by a friend and colleague, Fong moved with his family to Culiacán, the capital of the state of Sinaloa, and established the Casa Ley grocery company. When he died in 1969, his eldest son, Juan Manuel Ley, assumed control of the family business.

Ley opened the first Casa Ley supermarket in Culiacán in 1970, adding stores thereafter. In 1981, he sold a 49% share of the supermarket chain to Safeway.

In addition to running supermarkets, Ley operated apparel stores, automobile dealerships, and a tomato grower. He also acquired two professional baseball teams, Saraperos de Saltillo (later sold) and Tomateros de Culiacán, and was elected to the Mexican Professional Baseball Hall of Fame in 2006. He died in 2016.

Ley's son, Juan Manuel Ley-Bastidas, was "brought up in this business," working in the stores during the summer, he said. He attended high school in Carlsbad, Calif., studied industrial engineering at the Monterrey Institute of Technology and Higher Education, and earned an MBA at the University of Michigan.

Ley-Bastidas started his career at Casa Ley in 1997 as an assistant store manager, and became CEO in 2008. Following the reacquisition of the 49% stake from Albertsons (which acquired Safeway in 2015), he became chairman, willing to invest in advanced technology like the first transcritical CO₂ system in Mexico.

CARNOT CONTINUES CO₂ DEVELOPMENT

John Miranda, Emergent Cold Technologies



OEM is marketing transcritical systems to industrial facilities while developing a CO₂ condensing unit for retail and industrial applications

– By Michael Garry

Carnot Refrigeration, the Trois-Rivières, Quebec-based pioneer of transcritical CO₂ refrigeration in North America, is continuing to find new customers and develop new technology for its CO₂ systems, including supermarkets, cold-storage and food processing warehouses, ice rinks and data centers.

Helping in that endeavor is Emergent Cold Technologies, Geneva, Ill., which a year ago formed an agreement with Carnot to distribute its products and systems to customers in the U.S.

One of the newest sectors for Carnot's transcritical systems is industrial. (See [“Opportunities for CO₂ in the Industrial Sector,” *Accelerate America*, June-July 2018.](#)) The OEM has installed several transcritical CO₂ systems in industrial plants in Canada, and in June completed its second such installation in the U.S. at a Henningsen Cold Storage warehouse in Grandview, Wash. (See [“Barrier Breakers,” *Accelerate America*, August 2018.](#))

“More companies like Henningsen are going down the CO₂ path,” said John Miranda, Emergent's founder and chief marketer, who was previously president of Guntner US, in an interview at the Global Cold Chain Expo in June.

Miranda sees transcritical CO₂ as a good fit for spiral IQF (individual quick freezing) systems that require -40°F temperature. “We are currently building transcritical CO₂ refrigeration systems for two food freezing projects in the New England region,” he said. “For minus 40°F, they think CO₂ is more effective than ammonia, and they're right.”



Tim Henderson, Hillphoenix

Miranda believes that CO₂ can compete with ammonia at medium temperatures as well. He created an energy model (based on seasonalized weather data) comparing CO₂ and ammonia, and while ammonia prevails at the design point, CO₂'s advantage increases as the ambient temperature drops.

"With CO₂'s ability to float head pressure to 50°F, and the increased coil surface of adiabatic gas coolers, CO₂ can be more efficient at lower ambient temperatures than ammonia," he said. "If you have a significant number of operating hours below 60°F, CO₂ will have comparable or better energy, depending on the number of hours."

He acknowledged that areas like Florida, Eastern Texas and Louisiana are "tough areas" for CO₂ and better for ammonia. But if the cost of "water energy" (water usage, sewer, water treatment and water-pump energy) associated with evaporative condenser systems is included, "then we're less cost, even in those areas."

The exceptional heat reclaim offered by CO₂ for hot water and dehumidification in lieu of natural gas also helps CO₂'s cost-savings argument.

Rooftop units

One of the distinguishing features of the Henningsen system is that it's a modular, rooftop unit, easily scalable to accommodate future expansion of the plant. This configuration also allows the end user to avoid building an equipment room in the plant, noted Miranda.

Carnot is now developing a smaller rooftop CO₂ system – a condensing unit with two compressors that can be linked to one or two evaporators in the cooling area. "It could be an add-on unit

for industrial, addressing spot requirements," Miranda said.

The condensing unit will also serve as a heat pump, reversing the refrigeration cycle in order to defrost the evaporator coils. Like Carnot's data center systems, the unit will be able to offer compression-free "free cooling" when ambient temperatures are low enough (about 40°F or less).

Another selling point for Carnot is the remote-monitoring service from its Quebec headquarters, which is tracking about 70 refrigeration systems for a monthly fee. "They can address about 90% of the activity remotely," said Miranda. "For routine maintenance like changing oil filters, they coordinate with local maintenance people."

Carnot collects data from its remote monitoring operation in order "to learn from the operating data and make the systems better," said Miranda.

With the technological advances that transcritical CO₂ has made in recent years – such as the addition of adiabatic condensers, ejectors, efficient heat reclaim and sensible defrost – "we see CO₂ as a viable solution for all industrial refrigeration applications," Miranda said. ■ MG

"We see CO₂ as a viable solution for all industrial refrigeration applications."

Hillphoenix's Dual Approach to Industrial

Conyers, Ga.-based Hillphoenix, known for its transcritical installations at North American supermarkets, has taken a two-pronged approach to natural refrigerant technology for industrial plants: transcritical CO₂, and low-charge ammonia packaged units designed by NXTCOLD, for which it has an exclusive partnership to promote, design, manufacture and sell the technology in North and Latin America.

"We're seeing marginally more interest in NXTCOLD," said Tim Henderson, industrial program manager, at the Global Cold Chain Expo in June. "But we've talked to several people about CO₂. I don't know that we've talked to anybody about synthetics."

Hillphoenix sold its first NXTCOLD unit to a cold-storage plant in Fargo, N.D.; the unit was started up last month.

In September, Henningsen Cold Storage, which installed a Carnot CO₂ transcritical system at a plant in Grandview, Wash., was expected to install a Hillphoenix system at a facility in Scranton, Pa. replacing a low-temperature R404A system.

The cost of equipment and installation for natural refrigerant equipment is still more than that of synthetic refrigerant equipment, Henderson acknowledged. NXTCOLD costs more than transcritical CO₂, though it is comparable to that of central ammonia systems. "In the near future, as we build more of them, NXTCOLD units will be a lower-cost solution than central ammonia plants," he said.

Henderson alluded to one industrial customer who, presented with HFC, CO₂ and NXTCOLD systems, described them as "good, better, best," though the customer has not yet made a selection.

TRAINING: 'IT TAKES A VILLAGE'

All segments of the HVAC&R industry need to help overcome the natural refrigerants training and labor gap

— By Charlotte McLaughlin and Michael Garry



"It takes a village to raise a good HVAC&R technician."

— Lori Schiavo, RSES

It is no secret that the HVAC&R industry has a labor and skills shortage, particularly for natural refrigerant systems. In 2016, the U.S. Bureau of Labor Statistics (BLS) estimated that 115,000 new HVAC&R workers would need to be trained by 2022 to meet anticipated demand.

There is not just the problem of getting more people to enter the industry; technicians and contractors already trained to work with HCFC- and HFC-based HVAC&R systems will also need to be trained to work with natural refrigerants.

But to solve this training crisis the whole HVAC&R industry needs to come together, said Lori Schiavo, executive vice president of the Refrigeration Service Engineers Society (RSES), Rolling Meadows, Ill.

Schiavo — who has worked for RSES, an HVAC&R training authority, since 2007 — urged manufacturers, industry organizations, contractors, training centers, wholesalers, distributors, unions and community colleges to get involved in running and promoting training programs; she made her pitch in June during the Contractors and Training Panel at the ATMOsphere America conference, organized by shecco, publisher of *Accelerate America*.

"It takes a village to raise a good HVAC&R technician," Schiavo said.

RSES has tried to help the situation by providing a "Hydrocarbon Training Guide" at rses.org. The program offers three options: manual only (study guide), test only, or online training (course and test). The study guide covers such topics as regulations and standards; safety; and maintenance and refrigerant handling.

Next month (October 10-12), RSES will run a series of educational workshops on hydrocarbons and CO₂ as part of the 79th RSES Conference and HVACR Technology Expo at the Albuquerque Convention Center in New Mexico. RSES also offers training through local chapters, company training facilities and schools.

Employers need to make it possible to get technicians into training programs, Schiavo said. "The three most fundamental things" to offer to a technician are time to allow them to train, rewards, and access to the most recent information, memberships, seminars and conferences such as ATMOsphere America, she noted.

Manufacturers like Hillphoenix and Danfoss offer good training programs on their equipment, said another speaker, Bryan Beitler, vice president and chief engineer of Anaheim, Calif.-based Source Refrigeration (a division of Coolsys), winner of *Accelerate America's* 2018 Best Contractor award. "Coolsys companies have primarily utilized training resources from equipment companies to train our technicians on natural refrigerants."

He added that IIAR and RETA have extensive training publications related to ammonia; RETA is developing a CO₂ certification book due this fall. IIAR plans to include a "commercial track" in its 2019 Natural Refrigeration Conference & Expo.

To make the sure that the training ends up being worth it to a contractor, Schiavo recommended requiring employees to sign a memorandum of understanding (MOU) agreement.

"Training is still your time and money, so where's the guarantee that your technician is going to stay with you after they finished their education?" she noted. "One approach is to have a signed agreement at the beginning of the employment, another is a tuition reimbursement plan and a third – my favorite – is a stair-step educational goal program." In stair-step programs, participants work toward a series of goals, in a bite-size format, to achieve a long-term goal.

Training is unavoidable

A third speaker, Steve Gnas, president of Discovery Designs Refrigeration, Mukwonago, Wis., agreed that training could be a challenge for the industry. "As a contractor it's an expense. Every hour that I [train someone] I need to sell to my client, so it needs to be worth it."

But he warned that failing to train could have serious ramifications for a business, causing it to fall behind with current natural refrigerant technology and risking that installations will not be done properly. "As society has changed over the years, so has our need for training," he said.

In agreement with that view was Beitler. "If we're not elevating their skills, we can't send them out to the client," he said. Contractors, he added, should "budget for the costs to prepare technicians to properly service a natural refrigerant system."

Those costs include unbilled time and travel to and from training centers. "Establishing localized training is important for cost containment, and providing a more frequent training experience," said Beitler.

Less training can mean technicians are less efficient, Beitler said. This leads to spending more time on service calls and answering fewer other calls, resulting in a less profitable business in the long run.

At its Anaheim, Calif. headquarters, Source is beginning to offer natural refrigerant training. It recently installed a subcritical CO₂/synthetic refrigeration system at its training center, using equipment from an abandoned store, in a grocery style training area.

Technicians will be trained on how to install, start up and operate the system, which includes a liquid pump that not too many technicians are familiar with; the system may also be used as a guide to transcritical CO₂ operations. Training on propane self-contained equipment is also planned. "Natural refrigerants aren't going away, the opposite is going to happen, so they're something we've got to learn how to work with," Beitler said.



"If we're not elevating their skills, we can't send them out to the client."

— Bryan Beitler, Source Refrigeration



“Cultivate a teaching style that promotes self-discovery vs. memorization of points.”

— Steve Gnas, Discovery Designs Refrigeration

Beitler also suggested encouraging community colleges to incorporate natural refrigerants into their HVAC&R curriculums. “That promotes awareness at the entry level.” He said he tries to hire technicians who have “at least a bit of knowledge on CO₂, ammonia and hydrocarbons.”

Once employers train and retain employees for a while, it is less likely that they will leave. “Sixty percent of those who start the trade stay in it, but those that make it to seven years stay in the trade for life,” Gnas said,

Gnas pointed out that once young people start working for a company, they could take advantage of online training on YouTube, as they are more used to learning this way.

A simple search of YouTube reveals there are many videos for CO₂, hydrocarbon and ammonia refrigeration training that can provide a good introduction to using and installing the equipment. It should also be noted that the videos on YouTube are often European-based, and U.S. requirements may be different.

In the end, Gnas said, the best way to train young technicians is to “cultivate a teaching style that promotes self-discovery vs. memorization of points.”

■ CM & MG

Tapping Family Connections

More work needs to be done to encourage young people to enter the HVAC&R sector, said Steve Gnas, president of Discovery Designs Refrigeration, Mukwonago, Wis., but he acknowledges it’s not always easy. “No one dreams of de-icing an evaporator when they grow up.”

Moreover, the industry is dealing with an educational system that is college-focused. “Few universities have programs directed at training for the refrigeration industry,” he said. Society in general is such that “growing up with tools in your hands is not the norm anymore.”

So where can employers find new candidates? Gnas suggests tapping people whose family members are already in the industry. “People who grew up in the industry know the situation and they are used to the circumstances,” he said.

Another source of talent, said Gnas, could be military veterans who can receive money from the U.S. government to help them finance apprenticeships, and may have “tested high for mechanical aptitude in the service.” Another option: people in other mechanically oriented trades like auto mechanics and machinists.

Attracting veterans is something the ammonia industry has tried to do in recent years. The Ammonia Refrigeration Foundation (ARF), a 12-year-old nonprofit research and training association for the natural refrigeration industry, has already made this part of its ammonia industry apprenticeship program for refrigeration technicians. ([See “ARF Taps Military for Technician Apprenticeships,” *Accelerate America*, January 2018](#)).

Training Timeline

It takes five to seven years to develop a technician, according to Steve Gnas, president of Discovery Designs Refrigeration, Mukwonago, Wis.

Here is how he sees that development evolving:

- ▶ Years 1-2: People are generally supervised 100% of the time and trained to do standardized tasks.
- ▶ Years 3-5: Technicians gain enough confidence to work partially supervised and become proficient at troubleshooting.
- ▶ Years 5-7: Technicians “get cocky” but then learn what they don’t know.
- ▶ After year 7: Technicians “have been humbled by their experience but are proficient at their trade.”

R717 AND R600 FOUND MORE EFFICIENT IN GEOTHERMAL HEAT PUMPS

Ammonia and n-butane systems in residential building had higher COPs than R134 and R22 systems, according to Iranian study

— By Michael Garry

In a new study of the geothermal heat pumps, systems using ammonia (R717) or n-butane (R600) were found to be more efficient than those employing R22 or R134, as well as more economical.

The study, "Development of geothermal heat pumps by using environment friendly refrigerants," was published August 7 in *The Journal of Renewable and Sustainable Energy* by Iranian researchers Vahid Saeidi, Mostafa Mafi and Ali Mohammadi. (See <https://aip.scitation.org/doi/full/10.1063/1.5023657>)

The researchers studied heat pump performance in a 14-story residential building in Qazvin, Iran, with a cooling load of 915 kW (260 TR). They found that the ammonia system with a horizontal closed-loop ground heat exchanger had a COP in the cooling mode of 4.663, which was 5.8% higher than that of a comparable R134a system; n-butane's COP was 4.606, which was 4.5% higher.

The paper also reported similar results for a vertical closed-loop and open-loop ground heat exchangers.

The COP improvements resulted in "reducing the operating cost of the system compared to conventional artificial refrigerants," the paper said.

The study also found R717 and R600 to be better than R22 and R134a in terms of initial system cost.

In the study, the temperature of the refrigerant inlet to the evaporator is 2°C (35.6°F). The outlet temperature of the ground closed-loop heat exchanger is 42°C (107.6°F) in the horizontal mode and 39°C (102.2°F) in the vertical mode, while it's 37°C (98.6°F) in the open-loop heat exchanger.

The paper noted that the results depend on climatic conditions, the soil type, and the condition of the design working system. As a result, "the output data are unique to the same area or case study, and their comparison with the results of other conditions are not approved," it said.

The authors advocated for using the earth "as a renewable heat source/sink which both increases efficiency and creates a diversity of energy sources." Geothermal heat pumps can reduce energy consumption up to 44% compared to air source heat pumps and up to 72% compared to electric resistance heating, according to the National Renewable Energy Laboratory.

They also advocated for natural refrigerants. "The big challenge in the coming years in the HVAC and refrigeration industry is to establish

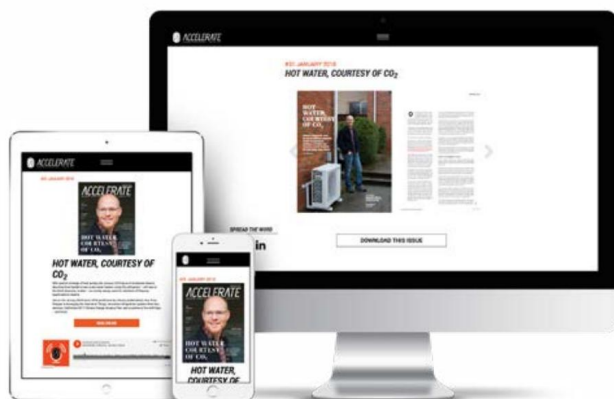
natural refrigerant technology to substitute CFCs, HCFCs and HFCs refrigerants," said Mafi, one of the paper's authors, in an article in ScienceDaily.com.

Oak Ridge Study

At the 13th IIR Gustav Lorentzen Conference on Natural Refrigerants, in Valencia, Spain, in June, a paper presented by experts from the Oak Ridge National Laboratory also showed the energy advantages of ammonia heat pumps. (See "Advancements in NatRefs Cited at Gustav Lorentzen Conference," [Accelerate America](http://AccelerateAmerica.com), August 2018.)

The paper assessed the energy efficiency performance of selected HFCs (R134a and R410A), ammonia and propane in four different heat pump systems. The systems range from a simple configuration made up of four major components to more sophisticated ones using flash tanks. For all systems, the evaporating (10°C) and condensing (40°C) temperatures are fixed, to produce comparable results and allow for an efficient compression process.

In terms of COP, researchers found ammonia to have the highest efficiency in all the cases, particularly compared with R134a. ■ MG



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