

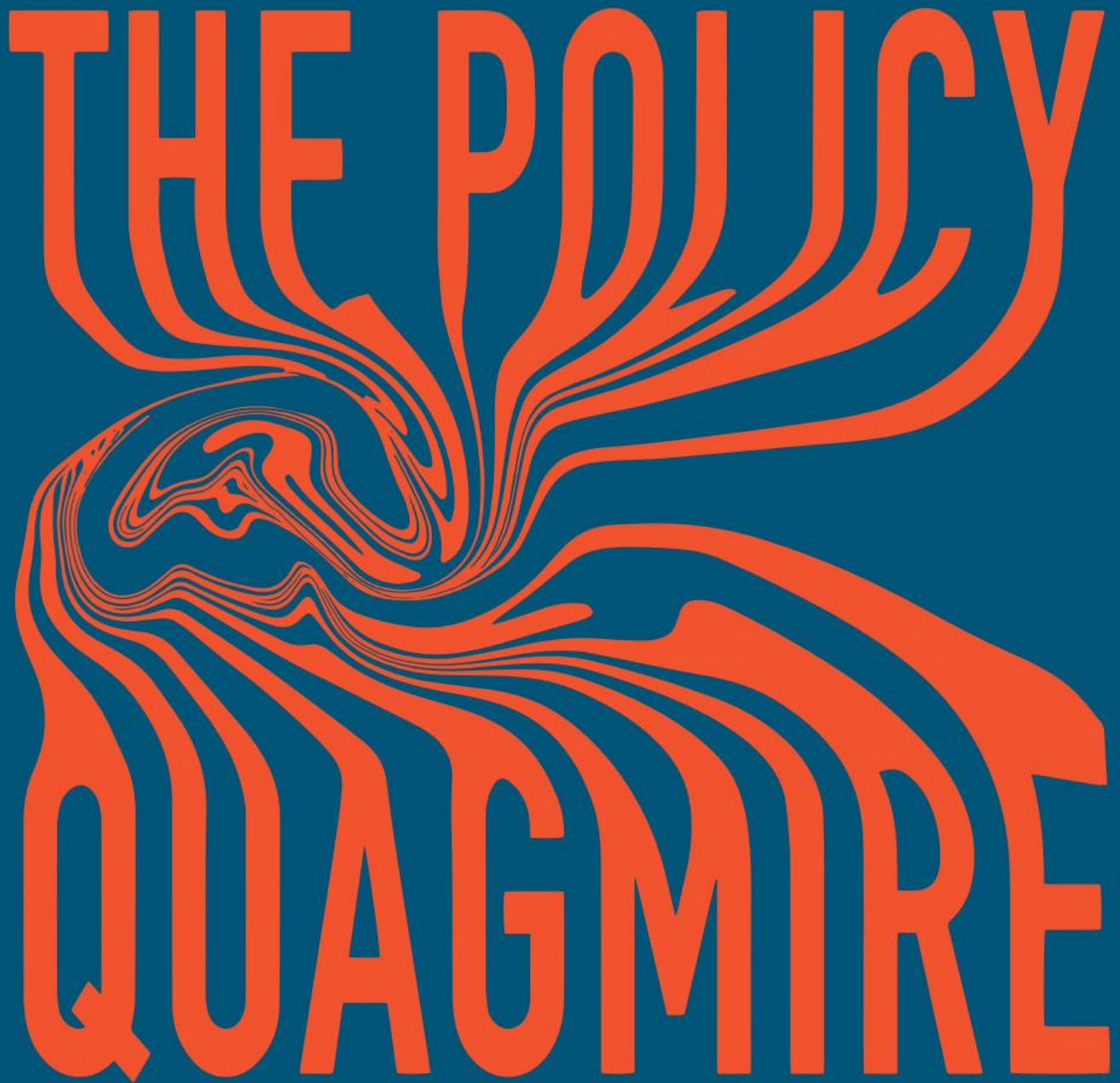
JUNE - JULY 2018

ACCELERATE

ADVANCING HVAC&R NATURALLY

A M E R I C A

THE POLICY QUAGMIRE



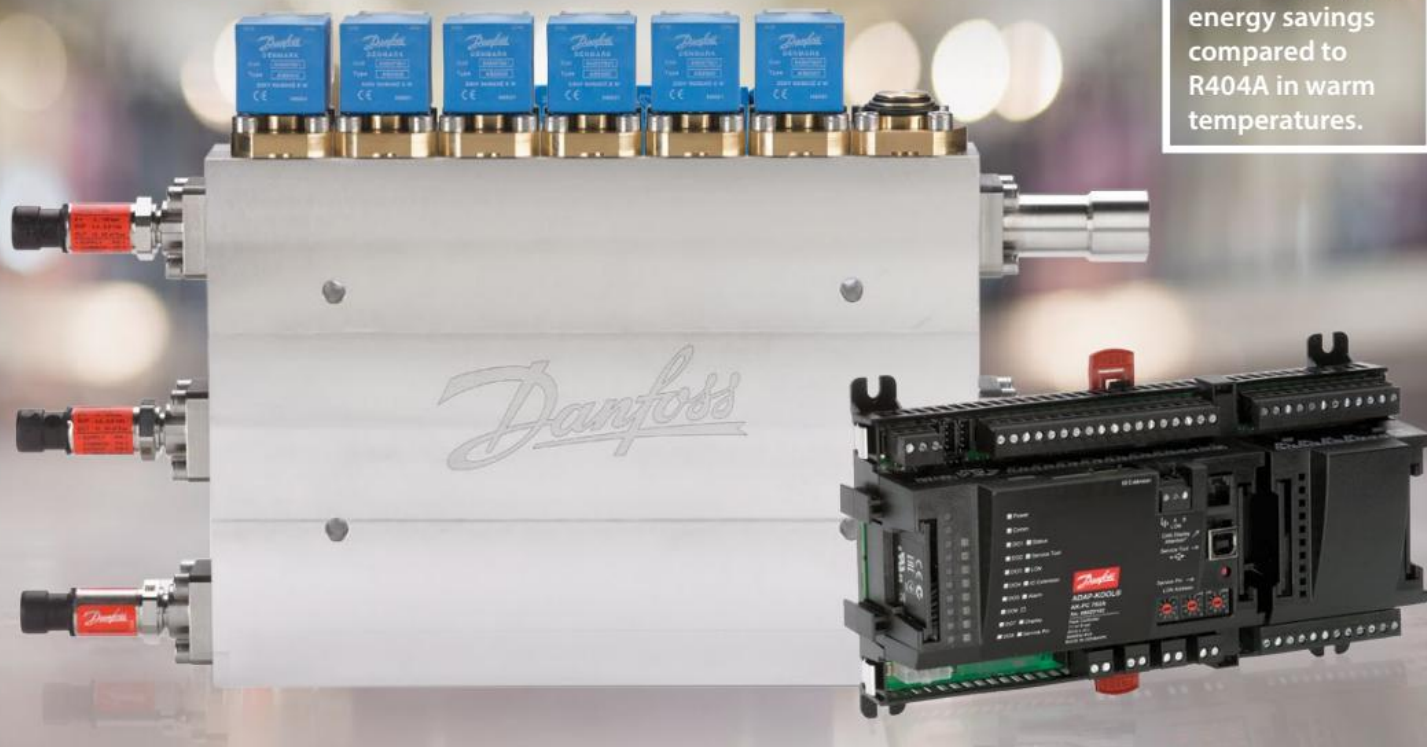
How will the U.S. government and states regulate HFCs and clear a path for natural refrigerants?

ATMOsphere America 2018 program, p. 6.

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Will Trump Refer Kigali to Congress?

— by Michael Garry

Rarely have U.S. businesses and environmental groups been as unified as they are regarding the need for the Kigali Amendment to the Montreal Protocol to be ratified by the U.S. Senate.

However, for the Senate to be able to ratify the amendment, President Trump — with advice from federal agencies like the State Department and the Environmental Protection Agency (EPA) — has to first refer it to that chamber of the U.S. Congress. So right now the ball is in the president's court.

At a May 4 stakeholder meeting at the EPA, speaker after speaker — businesses and NGOs alike — asked the agency to get behind the Kigali Amendment. Later in May, a coalition of 32 companies signed a letter to President Trump urging him to refer the Kigali Amendment to the Senate.

The Kigali Amendment, essentially a global HFC phase-down plan, was created by 197 nations (including the U.S.) in October 2016, and will go into effect next January in ratified countries.

U.S. ratification of the Kigali Amendment would address what I call “The Policy Quagmire” in this month’s cover story, starting on [page 40](#). That is, ratification would clarify the U.S. government’s ability to regulate HFCs, which was unraveled by a U.S. Court of Appeals ruling last August.

Given its bipartisan support, Kigali would probably be ratified once it arrives in the Senate. But will it get there?

Many think so, but I have my doubts. This is the same president who, against the advice of major segments of the business community, a year ago announced his intention to withdraw the U.S. from the Paris climate accord. In terms of business impact, a new

study in *Nature* calculates that the cumulative savings to the U.S. economy of meeting the most ambitious Paris targets could total \$6 trillion in today’s dollars.

Then there is Trump’s penchant for nullifying anything approved during the Obama administration, as Kigali was, and his dismissal of anything designed to address climate change.

Finally, there is a telling anecdote described in a 2016 post on FactCheck.org. titled “Trump on Hairspray and Ozone.” It said that candidate Trump complained that “hairspray’s not like it used to be” because the ozone-depleting chemicals in it had been banned by the original version of the Montreal Protocol in 1987. He argued that the hairspray he used in his well-sealed apartment in Trump Tower in New York could not escape into the atmosphere, so it was no danger to the environment.

FactCheck.org pointed out that the CFCs and HCFCs banned in hair spray (and HVAC&R systems) were not the hair-stiffening agent in the spray, and that notwithstanding the structure of Trump Tower, the gases in his spray did escape into the atmosphere.

The HFCs now used in hair spray would be phased down by the Kigali Amendment. So that may color the way the president sees the issue.

At some point, perhaps not until after the Trump presidency, I believe the U.S. will resume its commitment to the Paris accord and ratify the Kigali Amendment. In the meantime, HVAC&R businesses and end users should proceed as if that were already the case — and make the transition to future-proof natural refrigerants. ■ MG

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By limiting the EPA's authority over HFCs, a Court of Appeals ruling has thrown the U.S. regulatory landscape for refrigerants into disarray. Will the EPA, the White House, Congress, the Supreme Court – or states like California and New York – lead the HVAC&R industry out of this mess?

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The Chinese government is promoting natural refrigerants as alternatives to HCFCs and HFCs, but standards need to be updated.

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The manufacturer has designed its refrigeration fans to meet the growing demand in North America for environmentally friendly, energy-efficient and smart air-movement technology.

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ATMO sphere

Business Case for
Natural Refrigerants

June 12-14, 2018 – Long Beach

PROGRAM

DAY 1 TUESDAY JUNE 12

09:30^{am} / Registration

10:40^{am} / Welcome & Introduction

shecco

11:00^{am} / Technology Trends

Professor Pega Hrnjak

11:30^{am} / Keynote Speech by State Senator Lara

California State Senator Ricardo Lara

12:30^{pm} / Networking Lunch

02:00^{pm} / Market Trends

shecco, Hillphoenix, Carnot Refrigeration, Emerson, Rivacold, Embraco

03:30^{pm} / Networking Break

04:00^{pm} / Utilities Panel

*Electric Power Research Institute (EPRI), Southern California Edison (SCE),
California Energy Commission (CEC), Raley's,
ClimaCheck, Axiom Exergy*

06:00^{pm} / Networking Drinks Reception

*sponsored by Kysor Warren,
Hillphoenix & Carnot Refrigeration*

DAY 2 WEDNESDAY JUNE 13

08:00^{am} / Networking Breakfast

09:00^{am} / Policy Session

*California Air Resources Board (CARB), International Electrotechnical
Commission (IEC), Environmental Investigation Agency (EIA), sheccoBase*

10:00^{am} / Natural Refrigerants Workshop

11:00^{am} / Networking Break

11:30^{am} / Parallel Sessions

INDUSTRIAL REFRIGERATION PANEL

*Campbell Soup, Henningsen Cold Storage, Western Gateway
Storage, KPAC General*

CASE STUDIES: COMMERCIAL REFRIGERATION

*CTS & University of Illinois at Urbana-Champaign, Rivacold,
Embraco, Emerson Commercial and Residential Solutions, CAREL
Industries, Huayi Compressor Group*

CASE STUDIES: HEAT PUMPS

Carnot Refrigeration, YourCleanEnergy, Emerson Commercial and Residential Solutions, Sanden International (USA)

01:00^{pm} / Networking Afternoon

02:00^{pm} / Technomercials

Danfoss, Güntner

05:30^{pm} / Networking Dinner & Accelerate America Awards

sponsored by Kysor Warren, Hillphoenix & Carnot Refrigeration

DAY 3 THURSDAY JUNE 14

07:30^{am} / Networking Breakfast

08:30^{am} / Parallel Sessions

CONTRACTORS & TRAINING PANEL

AMS Mechanical Systems, Climate Pros, CoolSys, RSES, Discovery Designs Refrigeration

CASE STUDIES: INDUSTRIAL REFRIGERATION

Hillphoenix, Evapco & PermaCold, Heat Transfer Technologies, Accent Refrigeration Systems, Frick Industrial Refrigeration & Congebec

10:00^{am} / Networking Break

10:30^{am} / Parallel Sessions

FOOD RETAIL PANEL

Raley's, Sprouts Farmers Market, Lowe's Pay & Save, Grocery Outlet

sheccoBase FOCUS GROUP

sheccoBase, Danfoss

12:00^{pm} / Networking Lunch

01:00^{pm} / The Future of the Industry Debate

Association of Home Appliance Manufacturers (AHAM), International Institute of Ammonia Refrigeration (IIAR), Global Cold Chain Alliance (GCCA), Air-Conditioning, Heating, and Refrigeration Institute (AHRI), North American Sustainable Refrigeration Council (NASRC)

02:15^{pm} / Conclusions

02:30^{pm} / Site Visit

Site visit to Lineage Logistics' cold-storage warehouse in Vernon, Calif., organized by Hillphoenix/NXTCOLD.

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JUNE-JULY 2018

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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://acceleratenews.com>

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

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June-July 2018

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Leading end users

PUBLICATION DATE:

November 24

// ISSUE #31 *January 2018*

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CO₂ heat pump water heaters

PUBLICATION DATE:

January 10

// ISSUE #32 *February 2018*

FOCUS:

Research by Pega Hrnjak

PUBLICATION DATE:

February 14

// ISSUE #33 *March 2017*

FOCUS:

Low-charge ammonia (packaged)

PUBLICATION DATE:

March 13

// ISSUE #34 *April 2018*

FOCUS:

Low-charge ammonia (central)

PUBLICATION DATE:

April 13

// ISSUE #35 *May 2018*

FOCUS:

Hydrocarbons in stores and homes

PUBLICATION DATE:

May 8

// ISSUE #36 *June-July 2018*

FOCUS:

Policy

PUBLICATION DATE:

June 7

// ISSUE #37 *August 2018*

FOCUS:

Accelerate America Awards

AD SUBMISSION DEADLINE:

July 27

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August 1

// ISSUE #38 *September 2018*

FOCUS:

Food retail

AD SUBMISSION DEADLINE:

August 30

PUBLICATION DATE:

September 5

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Development Conference

// ISSUE #39 *October 2018*

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CO₂ in industrial refrigeration

AD SUBMISSION DEADLINE:

October 3

PUBLICATION DATE:

October 8

* Publisher reserves the right to modify the calendar.



#GoNatRefs



LETTERS TO THE EDITOR

THE FUTURE OF SELF-CONTAINED CASES

In regard to "The Rise of Hydrocarbon Refrigeration in Stores & Homes," ([Accelerate America, May 2018](#)), it is good to observe the market maturing to the merits of one natural refrigerant solution vs. another.

Challenges (and time frames) still remain for amendments of codes and standards to support the use of higher charge A3 (flammable) refrigerants in self-contained cases in the U.S. But the likely incremental step of moving to 500 g with R290 through the medium of IEC60335-2-89, subject to conditions of use, is a very welcome one. Not only will that significantly help facilitate the use of A3 refrigerants in larger self-contained display equipment, but it is happening with ongoing technological advancements in design and componentry that make best use of the permissible charge size.

A straightforward competitive race for system energy efficiencies and best store format is ahead, with codes and standards finally evolving to help support the article's lead question: "Will propane take over from CO₂ in supermarkets?" For a multitude of reasons, many noted in the article, self-contained stores will be a significant part of the future for the U.S. grocery market.

The article intimates at a debate over centralized vs. self-contained systems. But within the specific field of self-contained, there will also be much future debate about the merits and rationale of different design applications. Air-cooled, water-cooled or hybrid? Best format size and location? R744 or R290? Open or closed case? How about an open case with the energy profile of a closed case? How about moving away from the vapor-compression cycle?

One certainty is that this publication's content will continue to have relevance in a de-carbonized refrigerant future as a platform to showcase these technologies in the exciting times ahead.

Geoff Amos
Director
NRMS Global Limited
Birmingham, U.K.



CO₂'S ROLE IN THE INDUSTRIAL SECTOR

Thank you for the article covering the increased adoption of transcritical CO₂ in the industrial segment ("[CO₂ Shares Spotlight with Ammonia at IIR](#)," [Accelerate America, May 2018](#)). I am a firm believer there is no one single solution for the future of refrigeration and this article highlights this fact well.

CO₂ offers the unbelievable advantage of being the only viable A1 (nontoxic, nonflammable) natural refrigerant. For many years, it has existed in industrial applications as a low-temperature solution with subcritical condensing, using refrigerants such as ammonia on the high side. However, transcritical CO₂ offers a UL-approved, one-refrigerant solution. Now that technology like ejectors and adiabatic gas coolers are more prevalent, end users are seeing the efficient side of transcritical CO₂ as well.

BITZER US has received a lot of positive feedback on our subcritical and transcritical CO₂ compressors in many industrial applications like blast freezing, ice rinks, and food processing. We look forward to this trend continuing to develop and complement our ammonia line of compressors and compressor packages.

As the commercial and industrial refrigeration worlds continue to collide, the industrial segment will more than welcome the trouble-free, long life of a semi-hermetic CO₂ compressor. It will not replace ammonia but it will join forces to provide long-term environmentally safe solutions.

Joe Sanchez
Director of Engineering
BITZER US, Inc.
Flowery Branch, Ga.

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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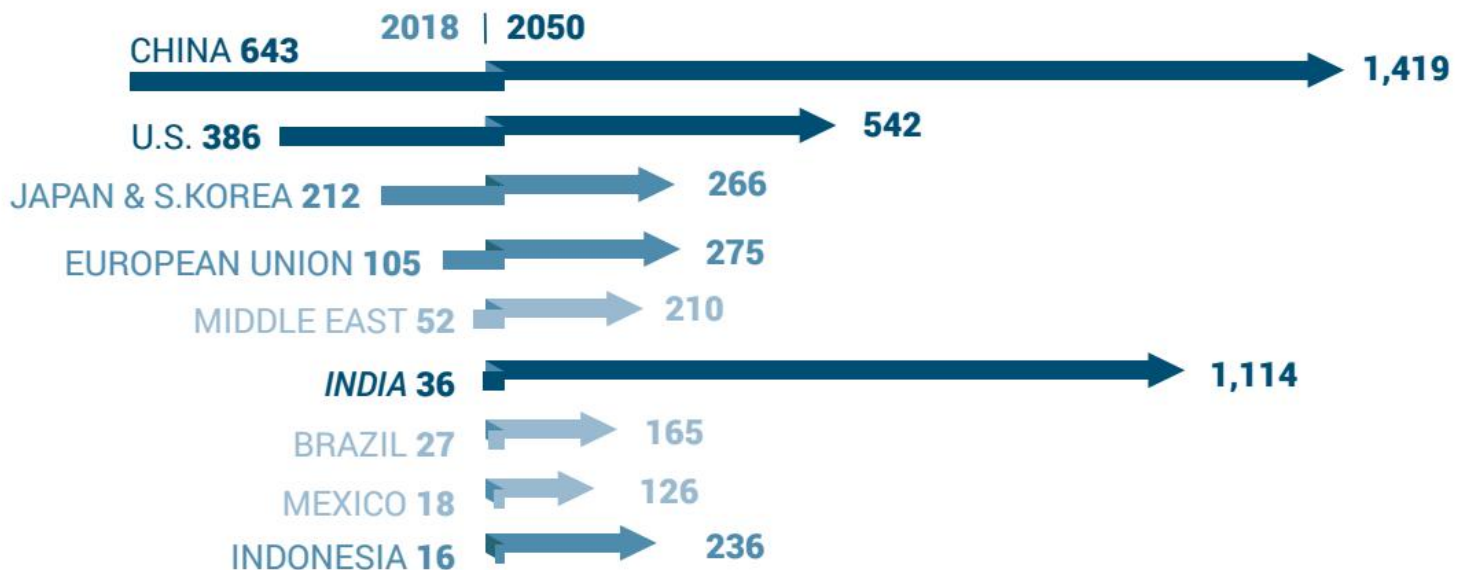
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- Estimated energy savings in India from switch to R290 room ACs with efficiency improvements over business-as-usual R410A ACs: **15%*****



*The Future of Cooling: Opportunities for energy-efficient air conditioning, International Energy Agency (IEA)

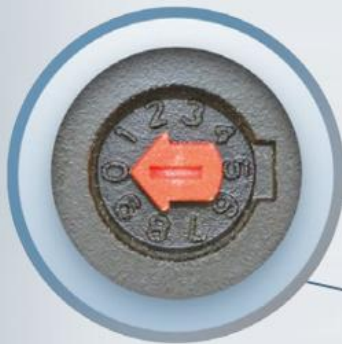
** Hydrocarbons21.com (<https://bit.ly/2GrTLOP>)

***Energy Efficiency Gains with Lower Global Warming Impact: A Profile of Air Conditioners Using R290, Council on Energy, Environment and Water (EEW), NRDC, IGSD



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<https://bit.ly/2dlbd1l>



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12-14**ATMOsphere America
Long Beach, Calif.**

The preeminent event covering natural refrigerants in North America, ATMOsphere America features 15 educational sessions with leading end users, manufacturers, policy makers and industry experts, along with exhibits from major providers of natural refrigerant technology.



<http://www.atmo.org/America2018>



#ATMOAmerica

14**Garden City Ammonia Program (GCAP) Ammonia Safety Day
Kansas City, Kan.**

Fields represented include engineering, safety, environmental, process engineering, operations, mechanical and utility maintenance.



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



@NH3Training

23-27**2018 ASHRAE Annual Conference
Houston, Texas**

The technical program covers professional development, research, fundamentals and applications, systems and equipment, system management (controls) and some specific design arenas (such as residential buildings and cogeneration plants).



<https://bit.ly/2KPf5QW>

25-27**Global Cold Chain Expo
Chicago, Ill.**

Event is geared toward retail, foodservice, processing, production, distribution, logistics, and transportation representing frozen, refrigerated, ambient and fresh operations. It will be co-located with the United FreshTEC Expo.



<http://www.globalcoldchainexpo.org>

25-27**United FreshTEC Expo
Chicago, Ill.**

Event features the technology used to harvest, package, process, trace, or deliver fresh products, including fresh produce, healthy foods and floral. It will be co-located with the Global Cold Chain Expo.



<http://www.unitedfreshshow.org>





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With increasing global demand for sustainability, natural refrigerant technologies are meeting the world's highest standards for energy efficiency and refrigerant usage. Embraco will attend the 2018 ATMOsphere expo as a gold sponsor to discuss their case study "Full-motion compressor reduces noise and improves efficiency in medical refrigerators" and solutions for the Food Retail industry.

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06/12-14/2018 – Long Beach, CA



embraco

JUL

9-12**Herrick Conferences
Lafayette, Ind.**

This event provides an opportunity for practitioners and researchers in industry, government, consulting offices, laboratories and universities to exchange engineering information on compressor technology, new refrigerants and refrigeration technology and efficiency, as well as on high-performance building technology.



<https://engineering.purdue.edu/Herrick/conferences>

9-12**GCAP Implementation of Process
Safety Management for Industrial
Ammonia Systems
Garden City, Kan.**

Garden City Ammonia Program (GCAP) is a privately owned trainer for industrial refrigeration operators. GCAP provides training for more than 850 companies and more than 2,400 students per year.



<http://www.ammoniatraining.com/111-2/>

**9-15****40th Meeting of the Open-Ended Working
Group of the Parties to the Montreal
Protocol
Vienna, Austria**

The Montreal Protocol, responsible for the phase-out of ODS, is now organizing the phase-down of HFCs via the Kigali Amendment. The amendment goes into effect January 1, 2019, in ratified countries.



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



#MontrealProtocol

14-17**Cultivate 18
Columbus, Ohio**

This event is for horticulture professionals including retailers, producers, installers, and suppliers. Attendees also include growers, gardeners, marketers, and sales reps.



<http://www.cultivate18.org>

16-18**World Food Logistics Organization
(WFLO) Institute Latinoamérica 2018
Mexico City, Mexico**

This event offers more than 40 classes about the science of frozen products, the supply chain and the field of logistics and cold storage.



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



WHAT'S NEXT?



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AMERICA IN BRIEF

Hillphoenix Systems In 87% of GreenChill Stores

Conyers, Ga.-based Hillphoenix announced late last month that its refrigeration equipment is installed in 87% of the total number of supermarkets certified by the Environmental Protection Agency's GreenChill Partnership over the past year.

The GreenChill Certification program recognizes stores – at Platinum, Gold and Silver levels – for utilizing environmentally friendly refrigeration systems, including Hillphoenix's transcritical CO₂ systems.

"Our commitment to developing and further improving these technologies illustrates to our customers and the industry that we are dedicated to providing quality, sustainable products to help companies future-proof their business," said Scott Martin, director of business development and industry relations.

Last year, Hillphoenix won the Store Certification Excellence (non-supermarket) award from GreenChill as the commercial systems manufacturer with the most systems installed in GreenChill certified stores in the past year. ■ MG

Grenada Stores Promote NatRefs on Refrigerators

The Caribbean island of Grenada's National Ozone Unit (NOU) – whose slogan is, "Protect the Ozone Layer, it protects you!" – announced that two local appliance stores are affixing NOU-provided magnetic stickers to every home refrigerator that declare the use of natural refrigerants.

The natural refrigerant in question is isobutane (R600a), the hydrocarbon refrigerant widely used in home fridges outside of the U.S. (where the charge cap of 57 g limits its use).

"This appliance uses Natural Refrigerants," the green, blue and white stickers state, adding, "Naturally Cool, Climate Friendly, Energy Efficient."

The two local appliance stores in St. George's, Grenada – Courts Grenada Limited (UNICOMER) and L A Purcell – have aligned with a natural refrigerant promotion program organized by NOU and the Cool Contributions Fighting Climate Change (C4) Project. ■ MG

EPA Proposes To Rescind Parts of RMP Rule Update

The administrator of the U.S. Environmental Protection Agency (EPA), E. Scott Pruitt, last month signed a proposed rule that would eliminate several provisions of the final Risk Management Program Amendments rule issued on January 13, 2017.

In particular, the EPA is proposing 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 in a prepublication release of the proposed rule.

The EPA is also proposing to modify amendments relating to local emergency coordination and emergency exercises, and to change the compliance dates for these provisions.

The agency will hold a public hearing on the proposal at its headquarters in Washington, D.C., on June 14, 2018.

The Risk Management Program (RMP) is a longstanding EPA regulation calling for safety measures in plants with dangerous chemicals, including those with more than 10,000 lbs of ammonia. The RMP-update rule was finalized shortly before President Trump took office but was then delayed until February of next year.

"We welcome the proposed EPA rule," said Lowell Randel, director of government affairs, International Institute of Ammonia Refrigeration (IIAR), and principal, The Randel Group. "It acknowledges many of the concerns we raised in the original rule-making process by proposing to rescind the independent third-party audit provision and the information-sharing provision." ■ MG

7-Eleven Debuts Self-Chilling Cans

Irving, Texas-based 7-Eleven announced last month the introduction in the U.S. of what it calls the first "self-chilling cans," whose temperature drops below room temperature when the consumer activates a CO₂-based cooling mechanism.

The cans – containing 7-Eleven's proprietary Fizzics Sparkling Cold Brew Coffee – are being tested at 15 Los Angeles-area 7-Eleven stores.

The self-chilling cans are the creation of Irvine, Calif.-based The Joseph Company International, which dubs them the Chill-Can and

calls the cooling system MicroCool. The Joseph Company said it spent 25 years developing the technology, which is available for commercial licensing. The company sees the cans as particularly suited to consumers in areas with limited refrigeration, and participants in leisure activities such as camping, fishing, and boating.

The system utilizes a "built-in heat exchange unit" in concert with reclaimed CO₂ to create the chilling effect, said The Joseph Company.

To cool the can, a consumer places it on a flat surface, turns it upside down and

twist the base, which triggers a hissing noise that lasts 75-90 seconds.

The can technology offers "a new level of convenience to customers who want to enjoy a chilled drink whenever and wherever they are," said Tim Cogil, 7-Eleven director of private brands.

The self-chilling can has been recognized by the Environmental Protection Agency (EPA), NASA and the U.S. Army.

According to *Packing Digest*, previous self-chilling cans from drinks giant Pepsi used R134a as the refrigerant.

■ CM & MG



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How to Determine the Efficiency of Your Refrigeration System

A simple EER calculation will enable you, in real time, to measure a system's energy efficiency

— By Ed Estberg

There are many reasons to understand the efficiency of the refrigeration systems installed in supermarkets.

First, operators need to understand the energy consequences of their compressor and condenser selections. In addition, government agencies and utilities that incentivize energy efficiency need an accurate way to rate built-up installed systems.

Refrigeration systems will vary by store, and operators should be free to choose store size, equipment type, and refrigeration load per store or per square foot. Each owner has a different style of store operation, and should be allowed to merchandise as they wish.

Once operators have chosen a floor plan, the selection of a refrigeration system should be based on efficiency, cost, maintenance, and other factors. Incentives should be based on actual efficiency and not an estimated rating, but it can be difficult to get real energy numbers for a mechanical refrigeration system.

My definition of refrigeration efficiency is a very simple: EER (energy efficiency ratio), which is the number of evaporator BTUs rejected by the compressor/condensers to the atmosphere per kilowatt-hour of electricity purchased. These should be real numbers, and can only be achieved on-site and after start-up.

It sounds simple! Unfortunately, there are many variables in a supermarket, so getting the correct values to use in a formula is almost impossible.

First, the evaporator loads vary during a typical 24-hour operating day because of customer activity, defrost schedules and store conditions, which can have a major effect on loads. The ambient temperature and humidity are also always changing,

and this affects air-cooled condensers and evaporative condensers, along with store conditions. The air-conditioning system must also be included in this calculation.

Getting information from fixture manufacturers is difficult. They had to pick a set of conditions for testing, and those exact conditions are almost never present in the store. The same holds true for the compressor and condenser manufacturers.

EER formula

During my investigation of an ammonia/CO₂ all-natural solution, I came upon the idea of rating the refrigeration systems. I felt we needed to know the EER of ammonia/CO₂ vs. transcritical CO₂, for example, but I could not find any real numbers that would meet my very simple EER requirement.

To calculate a very simple EER, you need to know the amount of electricity (watts) consumed at a given time, and the exact total evaporator BTU load at that same time.

Here is my solution, based on the type of system I am proposing to be our "SRS" (Sustainable Refrigeration System), our name for an all-natural system. (Tentatively, that will be a DX ammonia system over a CO₂ liquid-overfeed system for both medium- and low-temperature.)

► Submeter the wattage for the following equipment as a group:

- Refrigeration compressors
- Air-conditioning air-handler motors and compressors
- Condensing water pumps
- Tower fans
- Main air-fluid cooler fans
- De-super heater air-fluid cooler fans
- Heat-reclaim water pumps

► Calculate the THR (total heat of rejection) at any given moment:

- Using an ultrasonic flow meter or balance-valve pressure drop, establish water flow in gallons per minute (GPM) on the condenser water circuit, space-heating water reclaim circuit, and the domestic hot-water reclaim circuit. All three are plate heat exchangers with high-side refrigerant on one side and water on the other.
- Accurately measure the inlet and outlet temperature of the water to calculate temperature difference (TD) in the three circuits, with instrumentation set to two decimal points.
- The formula $\text{GPM} \times 8.34 \times \text{TD} \times 60$ for each circuit will give you the THR (in BTUH) of each plate heat exchanger. Add the three together to obtain the entire system THR (in BTUH).
- Multiply the THR by a factor of .81 for direct-drive compressors and by .69 for semi-hermetic or hermetic compressors, to obtain true evaporator load. This factor adjusts for heat of compression and internal motor heat.
- Divide the system evaporator load by the kWh to get the EER, or BTUs/kWh.

With our energy management system, we can make this calculation every few seconds, establishing an EER that can be logged and averaged over time, for any time period, based on the memory capacity of our controllers.

The air-conditioning system should be included in the calculation because its performance has a major effect on the operation of the food fixtures and coolers, and also because we reject some refrigeration heat through the AC system.

Since 100% of the BTUs are rejected by the heat reclaim systems and the water tower, the total load can be accurately calculated by the formula.

The water-flow rate (GPM) should be measured at start-up. Once the flow rate is established, it will be constant unless there is a pump malfunction or a

scaling condition occurs in the piping. We will be using VFDs on the pumps, but only for cycling and making a smooth daily switch-over. The pumps will run at full speed 24/7/365 to maintain velocity in the plate heat exchangers. VFDs will also control all DMCS (dual-medium condensing system) fans.

With this system, I project we will determine the very simple EER as well as the following information:

- Load changes from open to closed hours.
- Load changes based on ambient outside temperatures.
- Load deviations from manufacturer ratings or RS sheet information.
- How much the EER changes with outside conditions.
- How store temperature and humidity actually affect the load.

At Raley's, we have installed this EER-measurement system at one baseline (R449A DX) store in Santa Clara, Calif., and plan to install it at three more by January 2019. When we start installing all-natural systems, those stores will also have the system.

With this EER information, we will be able to make an educated efficiency evaluation of our baseline and all-natural refrigeration systems (ammonia/CO₂ and transcritical CO₂), and determine the efficiency benefits of the latter. It will also equip us to earn utility incentives. ■ EE

Ed Estberg served as senior director of facilities for Raley's from December 1989 to May 2009, when he retired. Since then, he has been acting as a consultant on refrigeration systems. He began his career in 1963 as a refrigeration mechanic for Hussmann, and was president of Refrigeration Design Contractors Inc. from 1974 to 1989.

Lessons From a Low-Charge Ammonia Installation

The world's first deployment of the Evapcold packaged low-charge system was an opportunity to invest in the future that has paid dividends for Western Gateway Storage

— By David W. Bornemeier

After purchasing Western Gateway Cold Storage, located in Ogden, Utah, in 2011, my wife Becky and I found ourselves needing additional freezer space to meet more demand from existing customers as well as the growing regional demand in the Western U.S. Turning down business due to capacity constraints was downright depressing.

But we were faced with a critical decision — whom to entrust as our refrigeration equipment supplier — that would literally make or break our company.

Here are two key lessons we learned in making that decision.

Lesson 1: Educate the End-User Design Team

During the design and estimating process, we assumed big general contractors that have food/distribution construction divisions would have their finger on the pulse of the latest freezer technology. However, during the design phase, our experience was that even large general contractors and their lead estimators needed “a crash course in refrigeration design.”

It is NOT unreasonable to assume that these division-specific general contractors have up-to-date knowledge. Isn't this why they claim to have specific construction specialties and why they can charge for this expertise? But this assumption cost us both time and money.

End-users should instead rely more on a famed Ronald Reagan approach, “Trust, But Verify.” Without this verification process, end-users are all too often left to simply do as their contractors

have done in the past — and contractors have LESS motivation to change from systems that have worked. Change is hard, but necessary, and end users should demand it. But they first need to educate themselves about the latest technology.

Lesson 2: Verification and Self-Education Pays Off

Rapid technology advances are not isolated now to just the latest smartphone release; new technology and design innovations in many fields often hold much potential. However, early adopters have been known to get burned. So our task was to find the latest refrigeration technology that had the best chance for decades of trouble-free service.

It's our responsibility as end-users to ask the tough questions that can sometimes make you feel foolish when asking them. Nonetheless, I believe that you can't ask “Why?” too frequently. In the long run, our verification process led us to the best solution for our refrigeration system.

In particular, it was the following two questions — born of curiosity — that led us to our refrigeration solution: “Why isn't there a compact industrial refrigeration system that can be located up and out of the way?” and “If HFCs are to be phased out, why is my general contractor offering it as a viable long-term solution for us?”

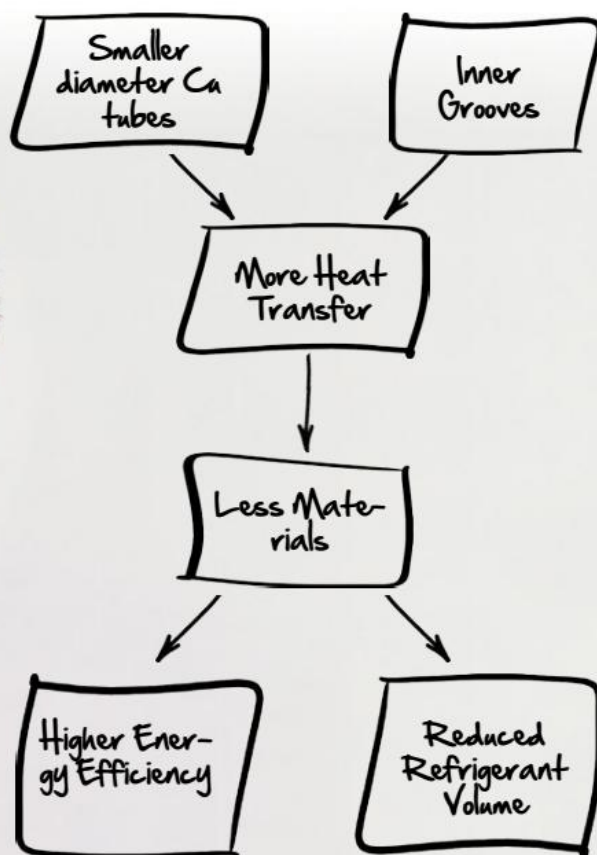
That was in March of 2015. In this article, I will give the results from our use of “Trust, but Verify” and “Why?” questions.

We had these expectations for our new freezer system: Maintain 1.2 million cu ft of storage space at a minimum of -20°F while at the same time drastically reducing our potential environmental regulatory burden through use of natural refrigerants, all without sacrificing energy efficiency or safety, or increasing our maintenance requirement.

To accomplish this, we decided to entrust our freezer expansion to the new Evapcold low-charge ammonia package from equipment manufacturer Evapco.

Before I provide the results we have seen from the Evapcold system, please realize that I have not been compensated by the Evapco folks. No discounts were given for being the world's first installation of their new flagship product. Anyway, we had a good reason not to take them even if they had been offered: No excuses for failure. Again, we needed our refrigeration system simply to work, period. Both of our reputations were (and still are) on the line. And the results are in: the Evapcold low-charge units just plain work. Our bet paid off spectacularly and specifically in these ways:

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IMMEDIATE BENEFITS

- ▶ We experienced a massive reduction in installation time and associated cost, though the savings in field labor were offset, in part, by the Evapcold unit cost.
- ▶ Due to the much reduced system layout, our energy costs were reduced relative to a traditional system, and we qualified for local utility incentives of nearly \$60,000.
- ▶ Our risk of cost overruns from poor contractor estimation, poor project management, design errors/omissions or other unforeseen conditions was fully contained by aligning with a well-established company.
- ▶ Our pollution insurance cost was reduced by over 50% when compared to a traditional system using 10 times the ammonia profile.

LONG-TERM BENEFITS

- ▶ Our system has a ZERO GWP (global warming potential) and ZERO ODP (ozone depletion potential), which is the best “insurance” to withstand current and future U.S. Environmental Protection Agency regulations.
- ▶ Evapco offers one-stop responsibility for all system components (compressor, valves, pipe fittings, controls, etc.) The blunt reality is that your building, and most refrigeration system components, will last longer than most contractors will be in business.
- ▶ One-stop responsibility has already translated to a lower annual maintenance bill and future peace of mind for our company. Having the manufacturer oversee design AND construction of the our refrigeration system eliminated the communication risk and the ensuing finger pointing that can happen when one entity is in charge of design and another only in charge of install. I have built using both methods and, given the option to decide, will never separate responsibility for design and installation of a refrigeration system. Our Evapcold units have been refreshingly low-charge/low-maintenance/low-drama.
- ▶ Safety will be a lasting legacy of our new building. ALL refrigerant is contained outside active areas of our freezer, eliminating accidental contact with people, product and product-handling equipment in the refrigerated space.

UNINTENDED BENEFITS

- ▶ The design of the Evapcold units unlocked space in our machine room that has been used for an additional building tenant, which has increased revenue.
- ▶ The ability to resell a used compressor, evaporator, etc., is common. But the secondary market for an entire refrigeration system is less common. However, the Evapcold units we purchased have resell potential. Imagine, many decades from now, swapping out your entire refrigeration system with the same relative ease that you change out your home washer and dryer – unplug, remove, install, plug in. Our building design allows us this very valuable future option that would otherwise require a major retrofit to provide the same benefit.

Because of the immediate and long-term benefits – with no significant net-cost difference over traditional stick-built system design – we see no reason why low-charge package units should not be the new standard for industrial refrigeration. Further, while HFC/HCFC refrigerant systems can, in some cases, be less expensive up front, their regulatory profile and environmental impacts put purchasers of these systems in the same category as the kid who pees in the pool: Only one sees the benefit while everyone else suffers the consequence.

Western Gateway bet on its future, and we believe the future is bright, with even more room for innovation. But if the only thing we were left with is knowing we pulled our weight in modernizing our state’s cold storage logistics chain and utilized a powerful, yet sustainable, refrigerant that helps my family and our entire state literally breathe easier – I would be cool with that, too. ■ DB



David W. Bornemeier is an entrepreneur, investor, and old-fashioned American businessman. He serves as president and CFO at Western Gateway Storage Co., and president and CFO at Mountain Brand Ice.

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OPPORTUNITIES FOR CO₂ IN THE INDUSTRIAL SECTOR

Carnot's distributed transcritical system avoids ammonia's regulatory burden while offering energy and maintenance advantages

— By Michael Garry

As a pioneer in manufacturing transcritical CO₂ refrigeration systems, Quebec-based Carnot Refrigeration has produced more than 250 these systems over the past decade, mostly for food retailers like Sobeys.

More recently, 15 of Carnot's transcritical CO₂ systems were made for industrial applications like cold storage and food processing, said Marc-André Lesmerises, its founder and president, in a webinar on May 16 called "Greening the Cold Chain: CO₂ in the Industrial Sector." It was hosted by shecco-Base, the market development arm of Brussels-based shecco, which publishes *Accelerate America*.

"The more I work with CO₂ [in the industrial sector], the more I see opportunities," Lesmerises said. By contrast, ammonia, the dominant refrigerant for industrial applications, presents challenges like its toxicity and the complexity and size of ammonia systems, he added.

CO₂ also enables a sharp reduction in regulatory compliance costs (such as labor), which "we have found to be the most important benefit for [industrial] end users," said John Miranda, founder and chief marketer of Geneva, Ill.-based Emergent Cold Technologies, who participated in the webinar with Lesmerises. Last year Emergent signed an agreement to distribute Carnot's CO₂ systems in the U.S.

For industrial operators, Carnot — which recently doubled its production space in a new facility — is producing packaged transcritical CO₂ units that include gas cooler and evaporators. The units can be installed on a mezzanine or outdoors and don't require a mechanical room.

Lesmerises and Miranda outlined a number of the features of Carnot's industrial transcritical system, including several energy-saving elements. For example, it incorporates a hot-gas defrost system that saves condenser fan energy by "harnessing the pressure of CO₂," said Miranda.

Lesmerises pointed to the substantial heat-reclaim capability of the transcritical CO₂ system, which can be used for everything from space heating, hot water and dehumidification to dock heating, under-floor warming and reheating for food processing. With heat reclaim, "you improve so drastically the overall efficiency of your system, which gives you a system that nothing can compare to," he said.

The transcritical system leverages an adiabatic condenser/gas cooler to reduce condensing temperature in warm climates, thereby saving energy by preventing CO₂ from entering its supercritical phase.

"Adiabatic is what brought CO₂ back to the table and it's able to carve away some of the hot days that made CO₂ historically inefficient with air-cooled

condensers," Miranda said at the IIAR Natural Refrigeration Conference & Expo in March.

In more than 30 of its transcritical systems, Carnot has included ejectors, with which "we see huge benefits to overall efficiency," said Lesmerises. Like adiabatic systems, ejectors enable the CO₂ system to operate efficiently in warm climates, he added.

Carnot also optimized the CO₂ industrial system by "operating at higher suction [temperature] levels as a result of proximity [to the load] and lower piping pressure losses," Miranda said.

Smaller piping

The Carnot transcritical system also offers structural advantages compared to ammonia systems, Miranda said. For example, it employs significantly smaller piping, and eliminates an evaporative condenser, water basin/pump system, diffusion tank, refrigerant pumps and circulation vessels.

On the maintenance side, the CO₂ system eliminates oil-pot draining, compressor-shaft seal replacement and belt adjustments.

"One of the most critical things to make CO₂ work for industrial applications is proper oil management," Miranda said at the IIAR Conference. "You want to keep the oil managed and in the rack and not out in the system." ■ MG

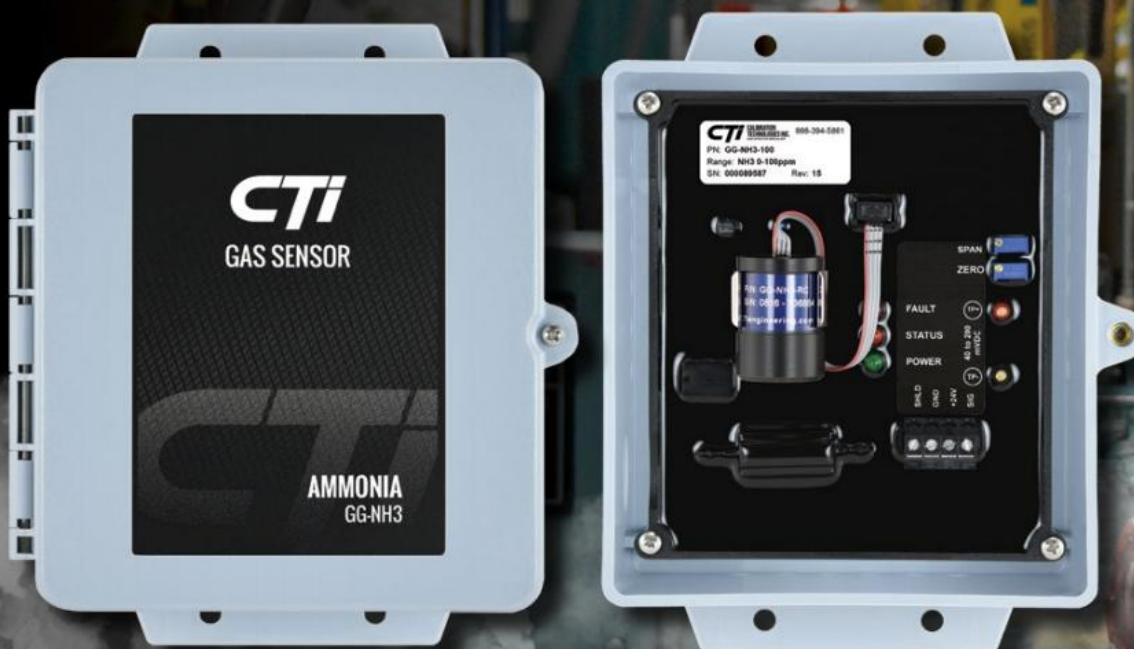


From left, John Miranda, Emergent Cold Technologies; and Marc-André Lesmerises, Carnot Refrigeration

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TEWI TELLS THE WHOLE (FOODS) STORY

A first-of-its-kind propane/CO₂ cascade system outperforms a baseline HFC system in Total Equivalent Warming Impact

— By Mark Hamstra



The three low-temperature propane chillers atop a Whole Foods store in Santa Clara, Calif.

Photography by: Marc Chasserot

Whole Foods Market is encouraged by the overall environmental results it is seeing at a supermarket in Santa Clara, Calif., that in 2016 became the first store in the U.S. to install a central propane/CO₂ cascade refrigeration system.

Tristram Coffin, director of sustainability and facilities for the Northern California Division of Austin, Texas-based Whole Foods, provided updated information about the system's performance in a recent webinar sponsored by equipment manufacturer Emerson. The Santa Clara store is a test location for the U.S. Environmental Protection Agency's Significant New Alternatives Program (SNAP).

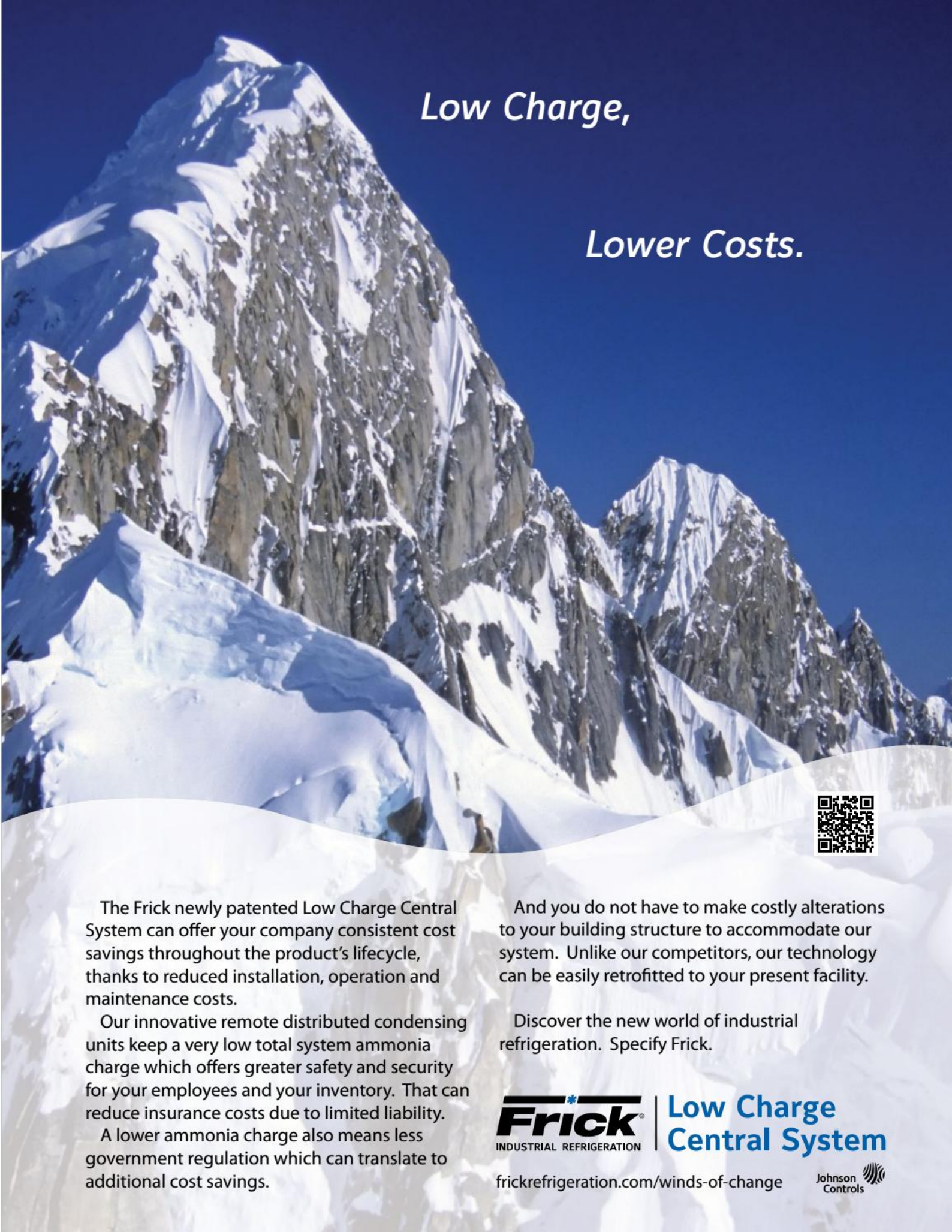
As described previously ([see "Whole Foods Pushes the Propane Envelope," Accelerate America, October 2016](#)), the Whole Foods store in Santa Clara features seven rooftop propane (R290) chillers, three for low-temperature refrigeration and four for medium-temperature refrigeration. The propane does not enter the store — it is used to cool the CO₂, which in turn provides the cooling for the refrigerated cases and other equipment inside.

The system, from Carnot Refrigeration, uses 40-45 lbs of propane in each of the medium-temperature chillers, and 35 lbs of propane in each of the low-temperature chillers, as well as 1,730 lbs of CO₂.

The propane/CO₂ cascade system is one of several types of natural refrigerant systems being evaluated by Whole Foods, including transcritical CO₂, ammonia/CO₂ cascade and self-contained propane cases. "We are looking at whether chillers and/or other opportunities will exist for us in the future, but [the propane/CO₂ system] has been a good case study for us, and the industry, for that matter," said Coffin.

When analyzed from a Total Equivalent Warming Impact (TEWI) perspective — which measures both indirect emissions from the energy used to run the system and the direct emissions from refrigerant leakage — the propane/CO₂ system at the Santa Clara store delivers better overall results than a baseline store using an HFC refrigeration system, Coffin said.

In a presentation at the ATMosphere America conference in San Diego last June, Coffin noted that natural refrigerant systems, including the propane/CO₂ system, emit about 1,500 times less CO₂e than the baseline HFC store, resulting in a much lower TEWI for the stores using natural refrigerants; this is primarily due to the higher leak rate for the HFC system, and the vastly higher GWP for HFCs.



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▶ In an email, Coffin explained that the HFC refrigeration installation that the company used for the comparison – a highly efficient, distributed 407A DX system with hybrid condensers – provided “an extremely aggressive baseline.” As a result, some of the earliest of the 25 systems using natural refrigerants (including 15 all-natural systems) that the company installed experience higher energy use relative to the baseline, but newer natural systems perform more efficiently, and the energy use at the Santa Clara store has been “comparable” to the baseline, Coffin said.

“We never expected the energy usage on any of the natural systems to beat out that of the baseline; hence our focus on TEWI,” he said. “However, [natural] systems built and installed today I am sure would give our baseline system a run for its money on energy use alone.”

Other metrics

Whole Foods considers a broad set of measures to evaluate the sustainability of its refrigeration systems, he said. In addition to energy use and emissions, the company also takes into account factors such as regulatory compliance and risk avoidance.

The overarching goal, he said, is always to have a stable, dependable system.

“Stable system operation – whether it’s refrigeration, electrical, plumbing, whatever the case may be – is extremely important, because if the core systems go down, we are not able to do what we do best, which is sell groceries,” said Coffin.

In the Santa Clara system, with the significant quantity of propane used (265 to 285 lbs), safety is also critical – “a number-one priority for all parties involved,” Coffin said. To that end, the system includes multiple leak detectors, alarms and other safety features designed to facilitate the dispersal of the gas in the event of a leak or intentional release. The safety features also include a flare device that was added after the original installation, at the request of local authorities, Coffin said.

It is important when using flammable refrigerants to maintain open communications with the proper authorities at all levels, Coffin said. Engaging the authorities helps them become more familiar with the a system, he said, and gives them an understanding of its risks and safety features.

“It’s important from an educational perspective, so that folks realize how these systems work right off the bat, rather than trying to beg for forgiveness after the fact,” he said.

Overcoming obstacles

A major constraint on the installation of natural refrigeration systems remains the higher costs for equipment and installation, although as such systems become more common in the marketplace costs are expected to decrease, Coffin said.

In addition, although contractors and technicians are becoming more comfortable working with natural refrigeration systems, additional training and education are still needed, he noted.

He also supports more coordination among the industrial and commercial channels to advance the use of natural refrigeration systems.

“There has tended to be a gap for many years as it relates to industrial applications and commercial applications, but I think there is really an opportunity to learn and really marry the two, so that we can move forward as an industry as a whole,” said Coffin. ■ MH



Bullish on Self-Contained R290 Units

Whole Foods Market, which has installed self-contained propane cases in more than 100 of its supermarkets, is especially optimistic about the prospects for this equipment, said Tristam Coffin, director of sustainability and facilities for the Northern California Division of Austin, Texas-based Whole Foods,

The cases use very low charges of refrigerant, have very low leak rates, allow merchandising flexibility, offer reduced costs for installation and maintenance, and provide energy cost savings of 30% to 50% over both self-contained and traditional direct exchange rack systems, Coffin said.

“The hydrocarbons have proven to be very successful and efficient refrigerants,” he said.

The regulatory environment continues to pose obstacles to the more widespread adoption of natural refrigeration systems, Coffin said, citing as an example the restriction on the size of the propane charge that can be used for self-contained coolers.

“Because we are limited to a 150-gram limit, it definitely creates a challenge for end users and [equipment manufacturers] and engineers of record to design systems that are applicable for the grocery industry,” he said.

Some of the codes and standards, said Coffin, “are prohibiting the forward motion of some of the natural refrigerants.”

Tristam Coffin, Whole Foods Market

Photography by: Scott Chasserot

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CO₂ SERVES DUAL PURPOSE AT URBAN FARM STORE

Heat reclaimed from a transcritical CO₂ refrigeration system is used to warm a greenhouse on the roof of a Delhaize supermarket in Brussels, Belgium.

— By Andrew Williams

Rooftop greenhouse at a
Delhaize store in Brussels,
Belgium

Photography by
Anna Salhofer.



1 / The greenhouse sits alongside solar panels on the supermarket roof.

2 / David Schalenbourg, Delhaize Belgium.

3 / Produce grown in the rooftop greenhouse is sold in the store below.

In a European first, heat reclaimed from the transcritical CO₂ refrigeration system in a Delhaize supermarket in Brussels, Belgium, is being used to warm the greenhouse of the store's rooftop Urban Farm.

This is also the first greenhouse in Europe on top of a supermarket, said David Schalenbourg, director of department – building projects, format & maintenance at Delhaize Belgium (part of the Ahold Delhaize Group). “It’s a new concept.”

Up on the roof, seasonal produce – such as strawberries, tomatoes and eggplants – is grown in the open air and in the greenhouse, and then sold underneath in the Delhaize store. The supermarket, located in the Boondael section of Brussels, was remodelled in 2016, and the rooftop farm opened in October 2017.

The purpose of the Urban Farm is to shorten the food chain, improve sustainability and make use of rooftop space that traditional supermarkets generally fail to exploit. “Growing produce on the roof and selling it only in the supermarket downstairs eliminates emissions related to transporting food to market,” Schalenbourg said.

In looking for a suitable spot to put a farm on a rooftop, Delhaize Belgium's sustainability team recognized the synergy between “an efficient store with a CO₂ installation from which we had excess energy, and an Urban Farm project with a greenhouse that needed to be heated,” he explained.

Delhaize Belgium is proud of the Urban Farm's role in the community. For example, local schoolchildren can learn about the food supply chain – from planting and harvesting to the shop floor – in classrooms on site. “We want people to be part of this story,” Schalenbourg said.

Delhaize Belgium is one of 21 local brands in the Ahold Delhaize Group, which includes U.S. chains Food Lion, Hannaford Supermarkets, Stop & Shop and Giant Food. All told, the group operates some 6,500 stores around the world,

By 2050, Ahold Delhaize is aiming to reduce its global greenhouse gas emissions by 40%-70% compared to 2010 levels. So far, natural refrigerant-based systems have been installed in 13% of the group's stores.





Heat reclaimed from the rack warms the greenhouse on the roof.

▶ RECLAIMING HEAT FROM CO₂ RACK

The linchpin of the Urban Farm store is the CO₂ transcritical rack provided by Danish manufacturer Advansor. While Delhaize Belgium reclaims heat from CO₂ systems in other stores to produce space heat and hot water, at the Boondael store, the engineers went one step further, heating the greenhouse as well.

The Urban Farm store thus tackles two sources of CO₂ emissions – food waste through the supply chain, and refrigeration (in terms of refrigerant choice and energy consumed and also avoided through heat reclaim), Schalenbourg said.

"It's a holistic approach – there is this interaction between both ideas," he noted.

One challenge the Delhaize Belgium team faced in this store was adding another floor on top of the building. "Structurally, it was quite a challenge," Schalenbourg said. "We had to ensure that the existing structure was sufficient to support the solar panels, greenhouse and layers of soil that we put on top of the building."

REPLICATING THE PROJECT

Delhaize Belgium plans to build Urban Farms in other high-density city environments. "Urban Farms bring the greatest added value to city centers, which is why we're looking at other Belgian cities," Schalenbourg said. "Other cities are eager to welcome the Urban Farm concept."

In evaluating buildings, Delhaize Belgium is checking feasibility at the structural level and at the urban level (permits and local acceptance).

The Boondael project involved remodelling an existing store in a densely populated area of Brussels, nearby residential buildings. "We're exploiting space which would normally be neglected or used only for technical installations," says Schalenbourg.

The efforts of Schalenbourg and his colleagues are dramatically reducing the average GWP of the refrigerants used by Delhaize Belgium's store portfolio. "More than half of Delhaize Belgium-operated stores are already on CO₂," he said.

At first, Delhaize Belgium focused on larger supermarkets, partly because its smaller stores are operated by franchisees. Now the company is trying to put transcritical CO₂ technology in smaller stores like convenience outlets. In fact, the retailer is currently expanding its franchise network more quickly than it can find new franchise holders, and the change of strategy is opening the door to natural refrigerants in convenience stores. "We're taking more of them on to our side – then my team goes in," Schalenbourg said.

Schalenbourg cites energy efficiency and immunity from any future synthetic refrigerant phase-down regulation among the most compelling reasons to opt for CO₂ systems. "We're passing the message on to our affiliated partners – CO₂ is the way to go."

Schalenbourg is also confident that the Urban Farm will help to raise the profile of natural refrigerants like CO₂. "There is a certain complexity in explaining to non-professionals what it's all about. This kind of project makes it possible to tell a compelling story." ■ AW

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KEEPING FIT WITH CO₂

A Swiss gym near Zurich installed a CO₂ heat pump to heat its saunas and showers

— By Charlotte McLaughlin

Solar Fitness and Wellness Unit, Dübendorf, Switzerland

Photography by:
EMPA/ Mark Zimmermann

Working out in a gym is supposed to be good for the mind and body. But sometimes the gyms themselves need help improving their environmental footprint.

One operator – the Solar Fitness and Wellness Unit, which opened last year at the Swiss Federal Laboratories for Materials Science and Technology (EMPA) campus in Dübendorf, Switzerland, near Zurich – wants to be a gym that makes a difference for the environment.

All the gym's electricity demand – for equipment like stationary bikes and treadmills – is satisfied by energy from the sun, with its saunas and showers heated by a CO₂ heat pump.

The building contains three saunas, workout equipment and locker rooms, and is part of a wider building project run by NEST (Next Evolution in Sustainable Building Technologies), an EMPA initiative.





1 /

"Our objective is to be able to meet an energy-intensive need such as wellness entirely through renewable energy," said Peter Richner, deputy director of EMPA and strategic manager of NEST.

NEST is not just aiming to use renewables but also to reduce energy demand. "We want to operate the facility with one sixth of the energy that it would need with conventional operation," added Mark Zimmermann, innovation manager for NEST.

The goal is to reduce the electricity that the three saunas – the Finnish sauna, the bio sauna, and the steam bath – consume annually to 20,000 kWh from 120,000 kWh.

NEST was able to reduce electricity consumption by using a high-temperature CO₂ heat pump from Swiss company Scheco AG, which delivers hot water at temperatures of up to 248°F (for the Finnish sauna) and down to 86°F (for the shower water).

The heat pump achieved a coefficient of performance (COP) of approximately three, and by itself reduced the Solar Fitness and Wellness Unit's energy consumption by some two-thirds. The capacity of the heat pump is 5.4 TR thermal and 1.6 TR electric.

Heat and moisture recovery from the sauna and steam bath also reduced ventilation loss by 50%.

1 / Finnish sauna

2 / CO₂ heat pump and storage tank

There is also a control system that responds to bookings of the wellness modules "and only heats them up when necessary," said Zimmermann. Improved heat insulation ensures that heat losses are only minimal.

In addition, 26.2-ft quadruple glazing, from Glas Troesch, on the building's north façade further insulates the building.

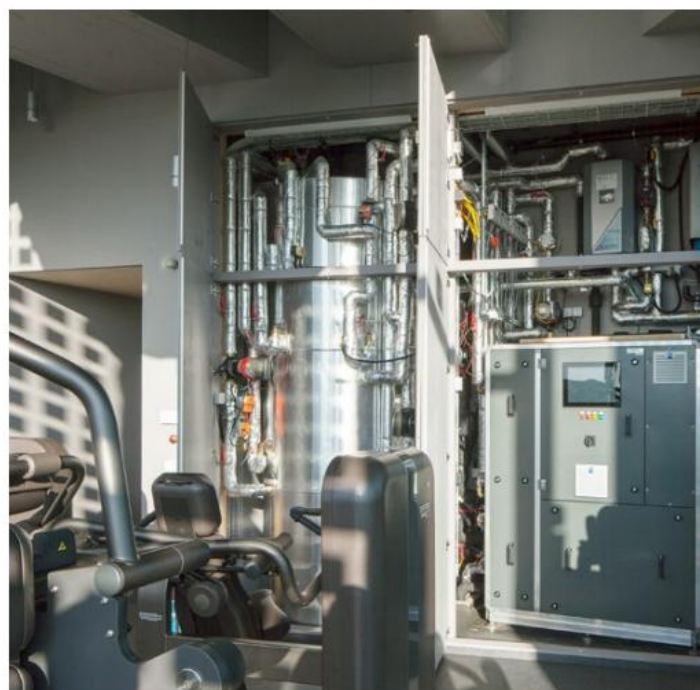
On the roof, solar generation from three photovoltaic systems provides 20,000 kWh of electricity per year. Gym users generate the rest of the electricity themselves by using the fitness equipment. A solar thermal system produces additional warm water.

The underlying energy concept was developed jointly by EMPA researchers, the NTB International University of Applied Sciences and Technology at Buchs, and Lucerne University of Applied Sciences and Arts.

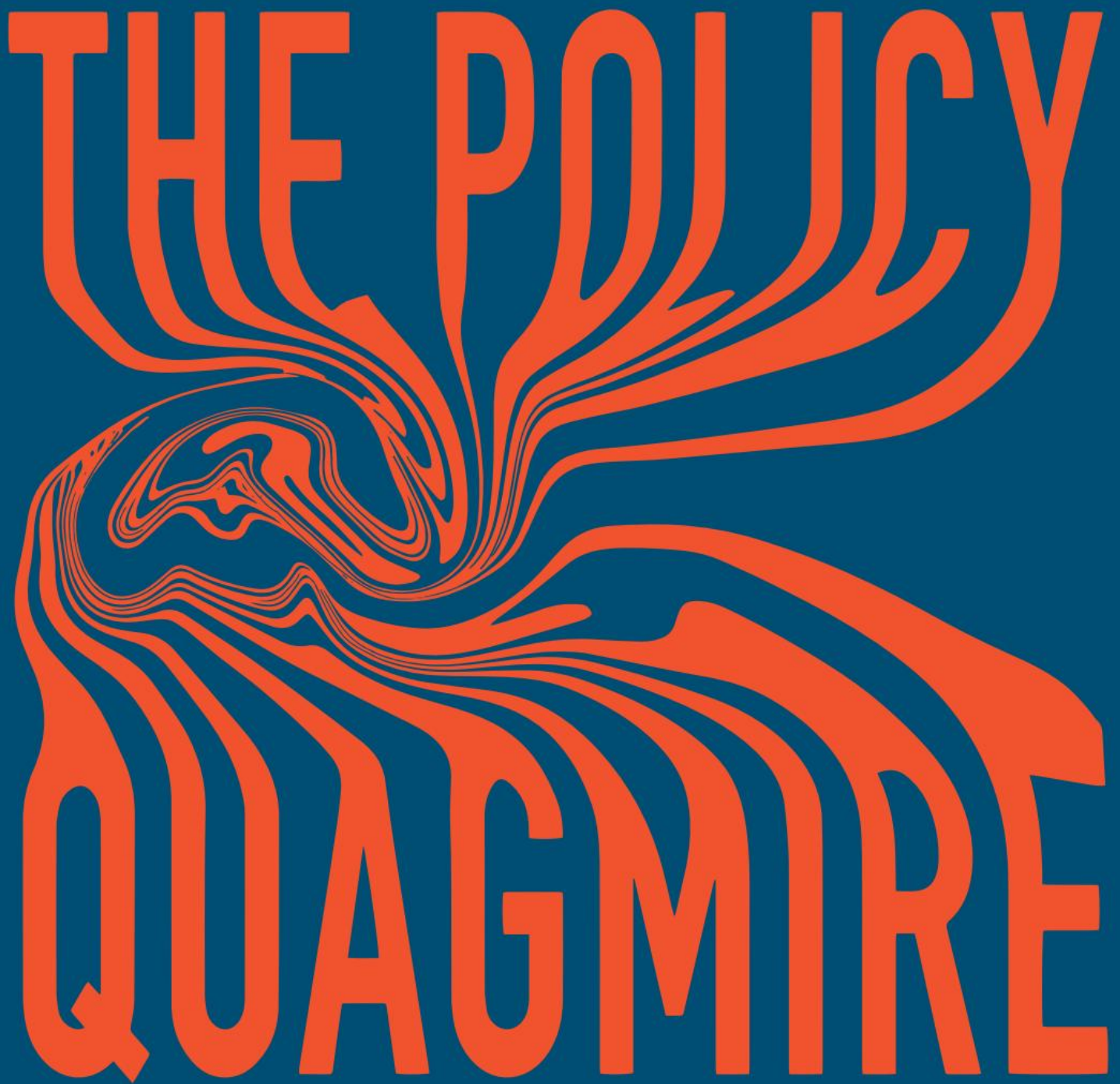
"In the Solar Fitness and Wellness Unit, representatives of every link in the value chain work together in partnership on a new sustainable solution – manufacturers of individual components, building technicians, planners, and potential customers," EMPA's Richner said.

■ CM

2 /



THE POLICY QUAGMIRE



By limiting the EPA's authority over HFCs, a Court of Appeals ruling has thrown the U.S. regulatory landscape for refrigerants into disarray. Will the EPA, the White House, Congress, the Supreme Court – or states like California and New York – lead the HVAC&R industry out of this mess?

– By Michael Garry



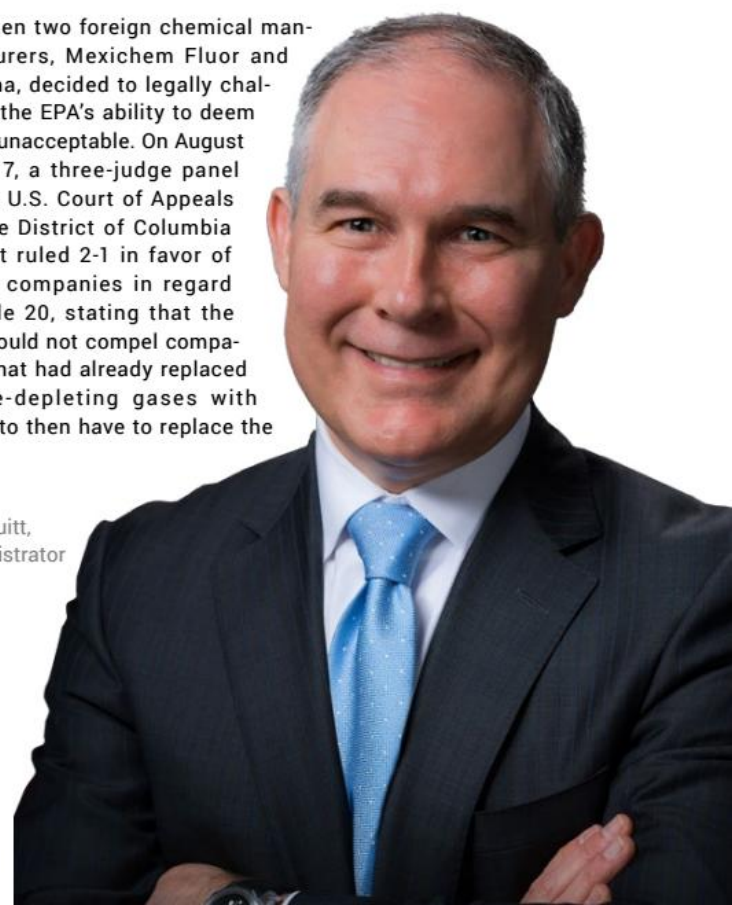
In the U.S., until August of 2017, there was a basic understanding in the HVAC&R industry that the U.S. Environmental Protection Agency (EPA) regulated, not only ozone-depleting refrigerants (CFCs and HCFCs) but also high-GWP refrigerants, notably HFCs.

The EPA derived its authority to phase out CFCs and HCFCs from Title VI of the Clean Air Act (Stratospheric Ozone Protection), enacted in 1990 to put the U.S. in compliance with the global Montreal Protocol agreement. Under Section 612 of Title VI, the EPA in 1994 established its SNAP (Significant New Alternatives) program to identify acceptable and unacceptable substitutes for the ozone-depleting gases being phased out.

HFCs such as R134a, R410 and R404A were originally deemed acceptable substitutes because they were not ozone depleting. But as the climate-change issue gathered urgency in the 2000s, the EPA realized that HFCs were extremely potent greenhouse gases (GHGs) – hundreds or thousands of times more potent than CO₂, the most prevalent GHG.

So in 2015, the Obama administration's EPA – which aggressively addressed the growing threat of climate change – issued Rule 20 under the SNAP program; this, for the first time, switched previously acceptable HFCs like R404A and R507 to the unacceptable list for specific applications like commercial refrigerants and motor vehicle air conditioning, with deadlines for each application. Then in 2016, Rule 21 further "delisted" HFCs from acceptability for other applications, including cold-storage warehouse refrigeration.

But then two foreign chemical manufacturers, Mexichem Fluor and Arkema, decided to legally challenge the EPA's ability to deem HFCs unacceptable. On August 8, 2017, a three-judge panel of the U.S. Court of Appeals for the District of Columbia Circuit ruled 2-1 in favor of these companies in regard to Rule 20, stating that the EPA could not compel companies that had already replaced ozone-depleting gases with HFCs to then have to replace the



E. Scott Pruitt,
EPA administrator



MEXICHEM FLOOR V. EPA

► HFCs with low-GWP alternatives – including natural refrigerants – on its acceptable substitutes list. (Rule 21 is still under review.) Title VI, the court said, allows the EPA to compel the replacement of only ozone-depleting gases, not HFCs.

However, the court said that the EPA still could declare HFCs to be unacceptable – and therefore preclude companies that had not yet replaced ozone-depleting refrigerants from using HFCs.

But by limiting the EPA's authority over HFCs, this single legal ruling threw the U.S. regulatory landscape for refrigerants into disarray, creating massive uncertainty for manufacturers and many commercial and industrial end users of HVAC&R equipment that were planning to transition out of HFCs to lower-GWP refrigerants, including natural refrigerants and HFOs/HFO blends.

Over the past several years OEMs like Hillphoenix and True Manufacturing and component makers like Danfoss and Emerson have ramped up natural refrigerant-based technologies to serve as substitutes for HFC systems. And U.S. chemical producers Chemours and Honeywell have invested heavily in HFOs and HFO blends as substitutes for HFCs.

Honeywell and Chemours were intervenors (with the Natural Resources Defense Council) in the Mexichem case; they unsuccessfully appealed the ruling to the full Court of Appeals, and have asked the Supreme Court to review the case.

The Mexichem case leaves many questions in its wake about whether and how HFCs will ultimately be regulated. In effect, the case has created a policy quagmire in which the EPA, Congress, the White House and the Supreme Court – as well as proactive states like California and New York – are all trying to find their footing in order to offer clarity to the HVAC&R industry.

"There is uncertainty," said Avipsa Mahapatra, climate campaign lead for the Washington, D.C.-based Environmental Investigation Agency (EIA). "In totality, it is a chaotic situation."

The U.S. Supreme Court has not yet weighed in on the Court of Appeals ruling, "The odds of it reaching the Supreme Court are not high, but you never know," said Francis Dietz, vice president of public affairs for the Washington, D.C.-based Air-Conditioning, Heating and Refrigeration Institute (AHRI). "The odds would be better if there had been conflicting decisions by different courts. But this has to do with the ability of federal agencies to regulate, and sometimes the court finds that interesting."

THE EPA'S GUIDANCE

Unlike intervenors NRDC, Chemours and Honeywell, the EPA waited several months before responding to the Court of Appeals' August 2017 ruling. But it finally did on April 27, publishing in the Federal Register a "Notification of Guidance" that outlined the steps it

would take; these include nullifying the EPA's Rule 20 rule on HFCs, and initiating a notice-and-consent rulemaking process to revisit how to "address HFC listings under the SNAP program in light of the court's opinion," the EPA said in the guidance. (The guidance can be read here: <https://bit.ly/2kE8X2l>.)

On May 4, the EPA held its first stakeholders meeting on the new rulemaking process, with more than a hundred people attending from companies and environmental organizations.

In nullifying Rule 20, the EPA actually went further than the court mandated. The court vacated Rule 20 "to the extent it requires manufacturers to replace HFCs with a substitute substance." However, this "partial vacatur" still left the EPA with the ability to classify HFCs as unacceptable as a replacement for ozone-depleting gases in systems that still used those gases. The EPA did away with that aspect of Rule 20 as well. The agency justified its sweeping interpretation by saying it would "dispel confusion and provide regulatory certainty"

to stakeholders while the rulemaking process plays out.

NRDC took strong issue with the EPA's move to cancel Rule 20 in its entirety. "Striking the valid portions of the HFC rules through 'guidance' without a proposal and opportunity for public comment is a clear violation of basic administrative law," wrote Lissa Lynch, the NRDC's staff attorney, Climate and Clean Air program, in a blog post on the NRDC website. "NRDC will likely go to court to challenge this latest lawless act from the Pruitt EPA." Lynch, who represented the NRDC at the May 4 stakeholders meeting, also expressed concern that the EPA might go on to "tear down the entire SNAP program."

Christina Starr, climate policy analyst for the EIA, who also attended the May 4 meeting, agreed that the court ruling upheld the EPA's ability to regulate the refrigerants that replace ozone-depleting refrigerants like R22 still in use. "ODS [ozone-depleting substances] are still used in end users like supermarkets," Starr said. "EPA should continue to pursue using its authority because it has an obligation to ensure the smooth, safe transition out of ODS."

The SNAP program, she added, with its lists of acceptable and unacceptable refrigerants, "is a tried-and-tested method that provides certainty to the market."

But the EIA is optimistic that in the EPA's rule-making process, "we're quite likely to see portions of the rules upheld" because of the broad industry support for "continuing to have certainty about when you can and can't use gases," said Starr.

Starr also pointed out that in the EPA guidance, the agency "spent most of its time on the question of how it would move forward with a rule reflecting the court decision." This includes exploring other options such as "retroactive disapproval" and alternative statutory authority like the Toxic Substances Controls Act. At the May 4th meeting, the EPA also spoke of "keeping SNAP going and still needing to list low-GWP substances," she said.

In the meantime, end users and manufacturers that had been complying with the SNAP rules until the EPA's guidance, and are trying to plan for the next three to five years, "should not take the EPA's short-term guidance as a signal that you are getting a blank check on HFCs," said Starr. "You should be thinking that the EPA is still looking at ways to regulate HFCs, especially when you replace old equipment."

The guidance has not adversely affected sales of True Manufacturing's R290-based display cabinets. "It hasn't slowed us down at all," said Todd Washburn, True's director of sales & marketing, retail and display division,

at the National Restaurant Association (NRA) Show in Chicago, held May 19-22. "If there's a choice between and HFC and a natural refrigerant, we're not getting people saying 'I don't want the natural refrigerant, low-GWP option.' We're not seeing resistance due to SNAP."

The court ruling and guidance do afford some OEMs more time to transition out of HFCs, Washburn acknowledged. "Before it was right around the corner. Now they have more time."

INDUSTRY PUSHES FOR KIGALI

While HFC regulations have taken a step back in the U.S., they have taken a major step forward on a global basis as a result of the Kigali Amendment to the Montreal Protocol. The amendment, enacted by 197 countries, including the U.S., in October 2016 in the capitol of Rwanda, calls for a step-wise phase-down of HFCs, with different timelines for developed and developing countries. According to the NRDC, Montreal Protocol scientists estimate that the Kigali Amendment alone will avert 0.22°C to 0.44°C of surface temperature increase by 2100.

As of early June, 37 of the 197 parties to the amendment have ratified it – more than the 20 required for the amendment to take effect on January 1, 2019 in ratified countries. (For an updated list of ratified countries, go to <https://bit.ly/2yHgTsJ>.)



► The U.S. government – which had helped negotiate the Kigali Amendment under Obama – has not yet ratified it, despite the overwhelming industry desire for ratification.

The process for ratification involves the Trump administration, with the signoff of the State Department and the EPA, referring the amendment to the U.S. Senate, which could ratify it with a two-thirds affirmative vote. There are conflicting legal opinions about whether ratification of Kigali would automatically trigger EPA authority to regulate HFCs, or whether that would require separate Congressional action, noted AHRI's Dietz.

Both Starr and Lynch remarked on the virtually unanimous support for the Kigali agreement at the May 4 stakeholder meeting. "To EPA's apparent surprise, speaker after speaker spoke up in favor of ratifying the Kigali Amendment and in favor of transitioning away from HFCs toward climate-friendly chemicals," wrote Lynch in the NRDC blog.

Ironically, even Arkema and Mexichem – which succeeded in scuttling the EPA's regulation of HFCs in the Court of Appeals case – "stood up in support of the Kigali Amendment," said EIA's Starr.

On May 18, manufacturers of natural refrigerant equipment – Hillphoenix, Danfoss North America, Emerson, Johnson Controls, Lennox International and Structural Concepts – joined a group of 26 other manufacturers as signatories to a letter to President Trump urging him to submit the Kigali Amendment to the Senate for ratification. "Failure to ratify the Kigali Amendment would transfer competitive advantage from America to other countries, like China," the letter said.

Because of this massive industry support for the Kigali Amendment, many HVAC&R industry observers believe it will ultimately be ratified. One such observer is Erik Solheim, executive director of the United Nations Environment Program (UNEP), according to a recent article in business-standard.com.

The Trump administration has indicated it was studying the economic impact of the Kigali accord in the U.S. In April the AHRI and the Alliance for Responsible Atmospheric Policy released a report on that very topic. The study said ratification would result in, at a minimum, 33,000 new U.S. jobs and a \$12.5 billion increase in U.S. annual economic output by 2027. Moreover the report warned that unless the Kigali Amendment is ratified, U.S. exports of products using refrigerants would fall to 6.2% from 7.2% as a share of the global market; on the other hand, if it is ratified, the U.S. share would jump from 7.2% to 9.0%.

The study did not specifically refer to the natural refrigerants sector of the U.S. economy. EIA's Mahapatra noted that the impact on economic growth cited in the report "could have been even bigger if it considered the entire spectrum of alternatives, including natural refrigerants." However, the data considered in

the study for exports was "not based on refrigerants," said EIA's Starr.

AHRI, which supports ratification, has had "some very productive meetings with folks in the White House and the EPA" about the Kigali Amendment, said AHRI's Dietz, and plans to confer with the State Department following the recent confirmation of Mike Pompeo as Secretary of State. "We're just making the case that Kigali is good for business," he said. "That's our story."

Dietz noted that President Trump, not known for withholding his opinions, has not commented on the Kigali Amendment. "To us, that's a good sign."

Although the Trump administration withdrew from the Paris climate accord, Dietz believes the Kigali Amendment is different because it is more prescriptive and therefore offers "more global certainty and predictability for business."





That certainty is far preferable to a scenario where different regions as well as different U.S. states set differing standards for HFC reduction, Dietz said. California, in particular, has actively developed plans to regulate HFCs as part of its GHG-reduction policy.

While the Trump administration mulls what to do about the Kigali Amendment, Congress has stepped into the HFC debate. In February, U.S. Senators John Kennedy (R-La.) and Tom Carper (D-Del.) introduced a bill to empower the EPA to

issue rules phasing down HFCs through a cap-and-trade program and through “the advancement of environmentally friendly technologies.” The bill – the American Innovation and Manufacturing Act – would conform to the Kigali Amendment, and give the EPA the regulatory authority over HFCs that the Appeals Court said it was lacking.

Last year, in the House of Representatives, Reps. Scott Peters (D-Calif.), Carlos Curbello (R. Fla.) and others introduced a bill that would create a task force to study ways to reduce short-lived climate

pollutants (SLCPs), dubbed “super pollutants,” which include HFCs, methane and black carbon. “Super pollutants are the low-hanging fruit in the fight to slow climate change,” said Peters.

The bills, which would need to be enacted in the current session of Congress that ends next January or be resubmitted, “show bipartisan support for this issue,” said EIA’s Mahapatra.

States take action

During the Trump administration, some U.S. states have pushed back against the EPA’s rollback of environmental regulations.

“States are uncertain about what the feds will do, and they are concerned the government won’t do anything, or not enough,” said Dietz. “So they want to make sure something gets done in their states. From [AHRI’s] point of view, we would like the states to wait to see if the administration submits the Kigali Amendment and it gets ratified.”

On June 1, the U.S. Climate Alliance, a bipartisan coalition of governors from 16 states and Puerto Rico, announced its commitment to reduce SLCPs, and issued a challenges for others to follow its lead.

The Alliance plans to release an action plan at the Global Climate Action Summit in September 2018.

California's sector-specific HFC bans in new stationary equipment:

1



non-residential refrigeration
(GWP > 150) as of 2020



residential refrigeration
(GWP > 150) as of 2021



air-conditioning
(GWP > 750) as of 2021

Ban on sale of high-GWP HFCs

2



(GWP > 2,500) as of 2020

HFC phase-down

3



Details to be specified at a later stage

Financial incentives

4



The Alliance includes California, Colorado, Connecticut, Delaware, Hawaii, Maryland, Massachusetts, Minnesota, New Jersey, New York, North Carolina, Oregon, Puerto Rico, Rhode Island, Vermont, Virginia and Washington. It represents 40% of the U.S. population and a \$9 trillion economy, greater than the third largest country in the world.

California, which leads the Alliance's HFC initiative, has been the most proactive state in addressing SLCPs. In March 2017, the California Air Resources Board (CARB) officially adopted an SLCP Strategy, which targets reductions of HFCs, methane and black carbon. It aims to reduce HFCs by 25% below business-as-usual emissions by 2020, and by 40% below 2013 levels by 2030.

The SLCP Strategy calls for the imposition of strict GWP caps on HFCs in new stationary equipment, including a 150 GWP maximum for non-residential refrigeration as of 2020 and residential refrigeration as of 2021, and a 750 GWP limit on air conditioning as of 2021. It

would also ban refrigerants in all applications with a GWP greater than 2,500 as of 2020, which would be lowered to 1,500 at a later date. CARB is also planning for an HFC phase-down based on the Kigali Amendment. The agency has been working to finalize the new regulations by 2019.

In March of this year, CARB reacted to the Court of Appeals decision on HFCs by incorporating into state regulations the EPA's SNAP rules for commercial refrigeration.

Last year representatives of CARB held a fact-finding session at ATMosphere America (hosted by shecco, publisher of this magazine) in San Diego, Calif. CARB will participate in a policy session at this year's ATMosphere America June 12-14 in Long Beach, Calif.

A particularly significant move was undertaken in February by California Senator Ricardo Lara, who introduced the California Cooling Act. Notably, this bill would establish an incentive program for lower-GWP alternatives to HFCs, including natural refrigerants ([See article on page 47](#).)

In New York, the state government has been taking inventory of HFC emissions and developing "appropriate policies to manage and reduce HFC emissions," said the New York State Department of Environmental Conservation. In 2014, New York reported that HFCs made up 4.6% of the state's 218 million metric tons CO₂e GHG emissions, or about 10 million metric tons.

In his State of the State address in January, New York Governor Andrew Cuomo announced that the state will develop a strategy to reduce HFC emissions by incentivizing the use of climate-friendly alternatives. The state will also develop new building codes to encourage the use of climate-friendly refrigerants and provide free audits and technical assistance to help businesses identify opportunities to reduce emissions and costs.

By providing assistance for switching to cleaner alternatives, "this proposal will save businesses and consumers money, cut down on energy usage and help protect New Yorkers from the worst effects of climate change," said Governor Cuomo. ■ MG

U.S. Capitol Building



Senator Lara Fights for NatRef Incentives

Last November, at the 23rd UN Climate Change Conference in Bonn, Germany, California Senator Ricardo Lara proposed the California Cooling Act (CCA) to combat what he termed the “silent assassin” of HFCs in refrigerators and air conditioners “that threaten our global climate.”

It wasn't the first time Lara championed legislation targeting HFCs. His Super Pollutant Reduction Act (Senate Bill 1383), which became law in 2016, committed California to reduce HFC emissions by 40% below 2013 levels by 2030.

Lara formally introduced the CCA (Senate Bill 1013) in February, and, after making it through three committees, the bill was passed by the California Senate on May 30. It now goes to the Assembly for committee hearings.

The CCA, which will formalize certain provisions of federal rules adopted by California in March, has gained the most attention for its provision allowing the California Air Resources Board (CARB) to provide financial incentives to businesses switching to low-GWP refrigeration systems, including those using natural refrigerants.

However, the legislature would have to separately approve the allocation of incentive funding from the state's highly competitive greenhouse gas reduction fund (GGRF) program, which is supported by cap-and-trade dollars.

Final action on the bill will take place at the end of August, followed by a decision on incentives. If both pass, CARB would start making incentives available in 2019, with amounts determined on a case-by-case basis.

In a webinar last month on the CCA hosted by the North American Sustainable Refrigeration Council (NASRC), a Lara staff member said he is optimistic the bill will pass the Assembly and be signed into law, and is “cautiously optimistic” that incentive funding will be approved.

To supplement the GGRF funding, the bill would also provide incentives through the California Public Utilities Commission (CPUC) and local utilities.

An example of such funding is a program launched last year by the Sacramento Municipal Utility District (SMUD), which offers GHG-reduction incentives as well as energy-efficiency incentives for natural refrigerant systems. (See “Game Changer,” *Accelerate America*, May 2017.) “We haven't gotten any final applications [for incentives] yet, but have received many inquiries from a range of customers who are considering their options,” said Kathleen Ave, climate program manager, SMUD.

HELP WITH UPFRONT COSTS

The CCA's incentives are designed to “assist end users with upfront costs (including installation) for low global-warming potential systems,” said the Lara staff member.

The bill will target end users of supermarket refrigeration, cold storage equipment and commercial air conditioning systems. Funding would be available for equipment in existing as well as new stores.

The CCA is not the first attempt to establish state incentives for HFC reduction. In his proposed 2016-2017 budget, California Governor Jerry Brown included \$20 million for such incentives. However, without sufficient expressions of support from the HVAC&R community, those funds were not approved by the legislature. The staff member said that \$20 million “is in the ballpark of the amount we hope for.”

Lara will discuss the CCA on June 12 at the ATMOsphere America conference in Long Beach, Calif. (part of his Senate district); he and his staff are seeking feedback on the CCA from stakeholders attending the event. He also encourages end users of refrigeration and air conditioning equipment to send letters of support (preferably on official letterhead) to mike.peterson@sen.ca.gov and attend hearings on the bill at the legislature.

“In order for the program to be funded, we need to be able to make a strong argument that businesses will utilize this,” said the staff member. “Letters of support carry quite a bit of weight.” ■ MG

Senator Ricardo Lara





Colmac Coil's shell-and-helix cascade heat exchanger

Special Designs for Low Charge

A cascade heat exchanger from Colmac Coil and a shell-and-tube evaporator from Isotherm feature unique designs that reduce the ammonia charge

— By Michael Garry

At the IIAR Natural Refrigeration Conference & Expo in March, two companies — Colmac Coil and Isotherm — debuted unusually designed heat exchangers for small charges of ammonia. Here is an overview of each.

TUBES WOUND IN A HELIX

Colmac Coil, Colville, Wash., which is known for its evaporators and condensers, unveiled its first cascade heat exchanger at the IIAR Conference

The SHX shell-and-helix heat exchanger was designed initially for ammonia/CO₂ cascade packaged systems, said Jeremy Olberding, vice president of sales for Colmac, in a presentation at the IIAR Conference. "We saw more and more packaged equipment. It made sense to enter the market." Colmac plans to design the system to also accommodate glycol and other secondary refrigerants.

The key characteristic of the compact vertical system is its 30 nested tubes, intertwined and wound in a helix inside a shell. "It's a great way to get the most amount of surface in a compact space," as well as reduce the cost, said Olberding. The tubes carry the CO₂ from the top of the heat exchanger, with liquid ammonia percolating up around the helixes from the bottom, wetting the outside of the tubes.

The unit carries a very small charge of ammonia (less than one lb) with capacities offered in 5, 15 and 40 TR. It supports up to 1,700 psi inside the tubes and 300 psi outside.

Olberding said the Colmac heat exchanger addresses many of the challenges of an ammonia/CO₂ cascade system, such as oil return, defrosting, distribution of refrigerant, and, perhaps most significant, the risk of CO₂ leaking into the ammonia, creating system-clogging ammonium carbamate. "We designed a feature so you wouldn't have to worry about [ammonium carbamate]," which includes a sensor that shuts down the system when minute quantities are detected, he said.

ENHANCED SHELL-AND-TUBE

Following more than two years in development, Isotherm, Arlington, Texas, introduced a new version of its low-charge ammonia SX (shell-and-tube DX) evaporator, this time with an enhanced tube, at the IIAR Conference.

The tube, which is enhanced on the outside to facilitate boiling, is designed for secondary glycols and other viscous fluids. A version for CO₂ is undergoing testing, said Adnan Ayub, president/CEO of Isotherm.

Hundreds of units of the previous version have been sold globally, in capacities between 20 and 1,000 TR, he said.

According to Ayub, the enhanced-tube SX evaporator offers a lower ammonia charge and higher efficiency than standard shell-and-tube flooded, plate-and-frame flooded, and shell-and-tube spray evaporators. In addition, the new SX model makes the tubes accessible for cleaning while offering freeze protection and simple oil management, he said.

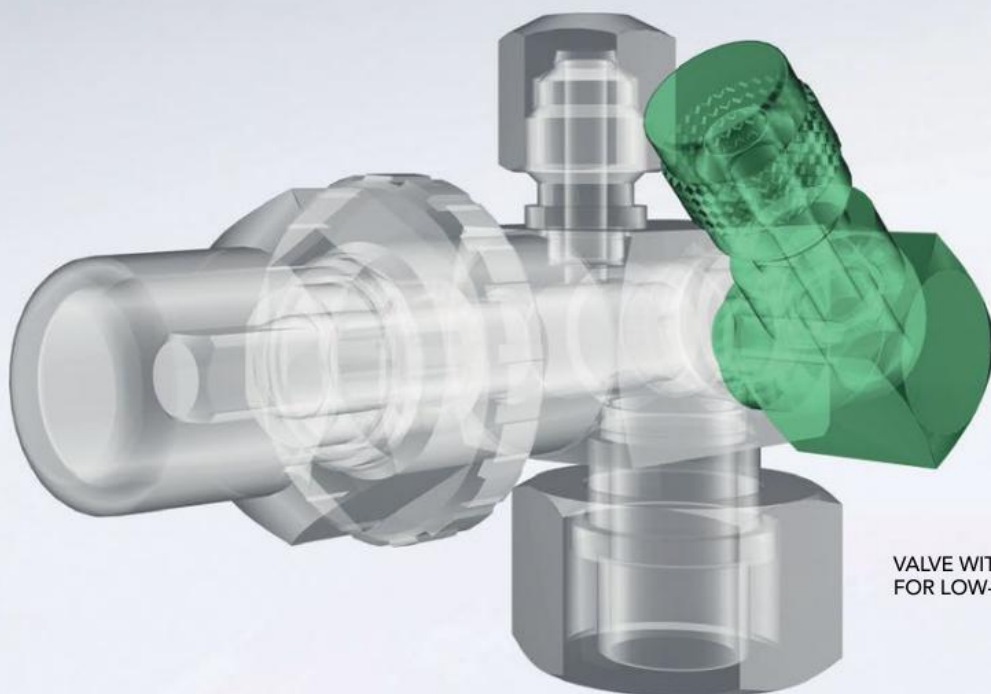
In a comparison with other evaporators at 109 TR, the new shell-and-tube's ammonia charge was 18 kg, compared to 200 kg for plate-and-frame flooded; 80 kg for shell-and-tube spray, and 155 kg for shell-and-tube flooded.

Ayub provided some examples of the new evaporator in field tests. In one case, it is being used at an 80 TR California winery, with wine flowing at 200 gpm, and an ammonia charge of 44 lbs. The temperature is lowered from 65°F to 55°F, with a saturated suction temperature of 35°F.

"Low charge is really being emphasized for ammonia, and that is what motivated us to design this shell-and-tube SX evaporator," Ayub said. "The charge for ammonia is relatively low compared to traditional evaporator technologies."

■ MG

1977-2017
40
Anniversary



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FOR LOW-GWP REFRIGERANTS

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DENALINE 2018. ONGOING EVOLUTION



HORIZONTAL WATER
CONDENSER



FLANGED VALVES
FOR CO2 PS 150 BAR



LIQUID RECEIVERS ALSO
WITH TUBE CONDENSER
FOR CO2 PS 130 BAR



CAST IRON VALVE
FOR NH3 AND CO2
PS 150 BAR



LIQUID/GAS INDICATORS
ALSO FOR ELECTRONIC
SENSORS PS 150 BAR



ROTALOCK VALVES
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More Foodservice Equipment Goes Natural

Manufacturers at the NRA Show continue to convert to propane as end users increasingly embrace hydrocarbons

— By Michael Garry and Mark Hamstra



At the NRA Show in Chicago

Equipment exhibitors at the 99th annual National Restaurant Association Show in Chicago in May said they are seeing increasing adoption among their customers of refrigeration equipment using hydrocarbon refrigerants, particularly propane (R290).

In interviews at the show with *Accelerate America*, several of these vendors said they are converting all of their equipment to R290 and phasing out HFCs, while some continue to offer both R290 and synthetic refrigerant systems. Many are looking forward to the charge limit on R290 eventually increasing to 500 g from 150 g.

TRUE SEES WIDE ACCEPTANCE OF R290

The foodservice and food retail markets are more than ready for the adoption of R290 as a refrigerant in their self-contained display cases, according to Todd Washburn, director of sales and marketing in the retail and display division of O'Fallon, Mo.-based True Manufacturing.

True, which has extensive experience with natural refrigeration systems in Europe, has converted about 85% of its self-contained display cases in the U.S. to R290. The units are "free-flowing into the marketplace and are widely accepted, with virtually no pushback," said Washburn.

He said True's R290 cases are 20%-30% more efficient than comparable HFC cases, with two-thirds of the savings coming directly from the refrigerant change.

"You don't need as much R290 to remove the heat," Washburn noted.

In addition, True's manufacturing process has virtually eliminated leaks of R290, he said.

In the latest tribute to the company's engineering efficiency, True recently received a 2018 Energy Star Excellence Award for Product Design from the U.S. Environmental Protection Agency and Department of Energy.

In an example of market acceptance, small-format retail outlets such as dollar stores and convenience stores have



Todd Washburn, True, with air-curtain R290 cabinet

been rolling out cases using R290 as a refrigerant for some time, Washburn said.

"I would argue that if you went into most new or remodeled [small-format] stores, you are going to see R290 in some form or fashion," he said.

Self-contained propane cases provide flexibility for end users, as they can be installed and removed

individually without connecting and disconnecting them from a central refrigeration system. They are also easier to maintain, Washburn said.

He said he believes supermarket operators would welcome the opportunity to outfit their entire stores with self-contained propane cases, especially if the limit on the maximum propane charge is raised to 500 g from 150 g.

"Everyone is trying to figure out what the future is in propane," said Washburn. "But we don't know where the endgame is going to be on the propane charge."

Raising the limit on the size of the charge would expand True's options for equipment design, he said.

DELFIELD TO COMPLETE CONVERSION IN '18

All Delfield-brand refrigeration products will use hydrocarbon refrigerants by the end of this year, said Sara Sunderman-Kirby, product manager at Delfield, a division of Mount Pleasant, Mich.-based Welbilt.

About 75% of the brand's current product offerings use R290, including all of

its standard products, she said, noting that one of the company's large chain customers pushed the company to convert to propane "quicker than we had planned to."

Sunderman-Kirby said a small minority of customers — about 5% — remain "adamantly" opposed to equipment using R290, however, because of its flammability.

"I don't think they have been educated properly," she said. "We try to educate them that this is where the whole industry is moving."

Delfield, which has trademarked the GreenGenius name for its R290 refrigeration systems, is introducing a new refrigerated prep table using R290 later this year, she said. Other prep tables, including a pizza prep table, have already been converted. Other equipment that remains to be converted to R290 includes its specification product lines.

The company touts the GreenGenius system as being 15%-20% more efficient than HFC refrigeration systems, said Sunderman-Kirby. The increased efficiency can be attributed to both

the propane itself and the equipment design, she said.

Sunderman-Kirby agreed that raising the limit on the propane charge to 500 g would help introduce new, more efficient refrigeration equipment at less cost to customers. "Right now we need to have two circuits in some equipment to meet the charge limitations."

In addition, some of the products in the company's line of blast chillers, which are manufactured overseas, can't be offered in the U.S. because of the propane charge limitations.

Another new feature for users of Delfield refrigeration equipment is an app that allows Delfield technicians to conduct remote monitoring and diagnostics. It also generates alerts when the equipment is not functioning properly.

"With this app, [technicians] can go in and see, for example, if the condenser is running weird or the evaporator temperature is off, so they have some intelligence before they go into the situation," said Sunderman-Kirby. "They will be more proactive than reactive — when they do show up there, they will know what's going on."

In fact, Sunderman-Kirby used the app herself to diagnose a problem she had setting up the display equipment at the NRA Show, and the technician was able to solve the problem remotely without making a service call.

BEVERAGE-AIR EYES 100% CONVERSION

Beverage-Air Corp., Winston-Salem, N.C., a division of Italian conglomerate Ali Group, is rapidly converting its foodservice refrigeration equipment to R290, said Erica Motes, VP of sales.

About 90% of the company's products have already made the transition, including its under-counter refrigerators, sandwich prep units, reach-ins, ►

Delfield R290 unit with remote-monitoring capability



merchandisers and bar units, she said, noting that the company's entire product line is expected to feature R290 refrigeration by the end of 2019.

"We feel this is the socially responsible thing — to make the most efficient equipment, and do the right thing by [our customers] for the environment," said Motes, citing the low GWP and zero ozone depleting potential of propane.

The company's large chain customers have readily adopted the new refrigerant, and in fact have encouraged its use in Beverage-Air's equipment, she said.

"We have more end users who want to know that they are doing the socially responsible thing and using an environmentally friendly refrigerant," said Motes. "We have a number of chains that encourage us to get ahead of the technology and move it forward."

Equipment using R290 can be anywhere from 10%-50% more efficient than synthetic refrigerants, said Nick Schriener, engineering manager at Beverage-Air. He attributed the increased efficiency largely to the technology that manufacturers rolled out in connection with R290.

The use of R290 has allowed Beverage-Air to expand the capacity of some pieces of equipment. In one of its sandwich prep coolers, for example, the company added about 30% to its capacity.

In development at Beverage-Air are variable-speed condensers that could further augment the efficiency of R290 systems, Schriener said.

The proposed increase in the propane charge limit would allow Beverage-Air to revamp some of its equipment to operate on a single refrigerant circuit using a larger charge, he said.

Although some in the industry initially had concerns about the availability of technicians trained to service propane systems, Motes said such fears have, to her knowledge, proven unwarranted.

All of the major service companies now have technicians who are trained for servicing propane cases, and the right tools for doing so, she said.

Beverage-Air is doing its part by offering hands-on training sessions around the country to teach technicians and students about its equipment and how to properly service it.

"We can't certify them, but we can educate them on our product, so they know what it looks like, they know where to clamp, they know where to check, and they know what the proper tools are," she said, noting that using the actual equipment in these training sessions is important.

LOW DEMAND FOR R290 AT TRAULSEN

Laura Gutkowski, sales development manager, Traulsen, said the Fort Worth, Texas-based company, unlike other manufacturers at the NRA Show, has not seen much interest in R290-based refrigeration systems from its foodservice customers, which include a large number of operators in the school channel.

In fact, the company had no equipment featuring propane as a refrigerant on display at the NRA Show.

"It's not our message," said Gutkowski. "We understand that energy efficiency is important, and protecting the environment is critical, but we have to listen to our customer base, and if they say they don't want something, we can't force them to have it."

Traulsen continues to offer both equipment using synthetic refrigerants and equipment using R290, she said, but many customers remain wary of the flammability of propane. In fact, she said, some have equipment specs that specifically prohibit the use of flammable refrigerants.

Beverage-Air R290 units



Gutkowski estimated that about 5%-10% of Traulsen's customers are using R290 systems, although that number is growing as more customers transition to hydrocarbons.

Traulsen has been using HFO blends, including R440A and R450A, as replacements for HFCs, despite the court ruling earlier this year that the EPA cannot force companies to replace HFCs with lower-GWP refrigerants.

"We're still meeting the same timeline," said Gutkowski. "By January 2019, R134a will be gone, and then by January 2020 all the freezers will be converted over."

Traulsen is following the timeline for the reduction of HFCs set by the California Air Resources Board, she said, because it has several customers in California and it has already invested in the changeover.

Gutkowski said Traulsen's testing has not shown any improvements in efficiencies from using R290, compared with R134a, though other manufacturers see better efficiency with R290.

"We have extremely efficient systems," she said. "We don't rely on the refrigerant to give us the efficiency."

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MOMENTUM BUILDING FOR NATREFS IN CHINA

The Chinese government is promoting natural refrigerants as alternatives to HCFCs and HFCs, but standards need to be updated.

— By Andrew Williams & Devin Yoshimoto



Natural refrigerants are well placed to gain momentum in the Chinese HVAC&R market as the country prepares to leapfrog from HCFCs to solutions based on ammonia, CO₂ and hydrocarbons, bypassing HFCs altogether.

That was the message imparted at the ATMOSphere China conference in Beijing, held April 9-11.

The conference – the first ATMOSphere event to be held in China – took place at the Sheraton Grand Beijing Dongcheng Hotel in the Chinese capital. It was hosted by shecco, publisher of *Accelerate America*.

“China has an opportunity to jump straight from HCFCs to natural refrigerants,” said Mauro De Barba, senior product marketing manager at Eliwell by Schneider Electric, one of the conference speakers. “China is rapidly adopting natural refrigerant solutions.”

Yet as technology suppliers sell more natural refrigerant-based systems to the Chinese market, conference panelists stressed the need to improve training and local availability of components to allow these solutions to fulfil their market potential.

“Natural refrigerant technologies are complex, so support and training will be key to increasing their uptake,” De Barba said.

Torben Funder-Kristensen, head of public and industry affairs at Danfoss, also expects natural refrigerants to play a greater role in China in the future.

“Technology development of applications using natural refrigerants is gaining momentum here,” he said.

Government to phase down HFCs

The Chinese government is expected to implement the Kigali Amendment to the Montreal Protocol on phasing down HFCs. (As of early June, China had not yet ratified the amendment.)

“All the controlled substances under the Kigali Amendment will be phased out by 2045,” said Zhong Zhifeng, vice-chief of Division III in the Chinese Ministry of Environmental Protection – Foreign Economic Cooperation Office (MEP-FECO). “These HFC applications will be 100% eliminated. In normal industries, we will never use HFCs.”

1 / Zhong Zhifeng, MEP-FECO, Government of China

2 / Wenhua Wang, China Chain Store & Franchise Association

Photography by: Ben Beech



1 /

Added Zhifeng: "We have a very clear direction forward: we're developing alternatives."

Zhifeng expects to see quick progress in the room air-conditioning segment in particular, with a 45% reduction in HCFC consumption by 2020. Propane has been targeted as the refrigerant for that application.

China to revise standards

While China builds up production capacity for natural refrigerant technologies in the room air-conditioning sector, the government is developing standards for alternative refrigerants like hydrocarbons, Zhifeng said.

"Our current domestic standards are not helpful for promoting alternatives," he acknowledged. "We're revising standards to improve safety levels and promote natural refrigerants, which are the future market trend."

André Paz Rosa, senior R&D manager (Asia Pacific) at Embraco, identified safety concerns, lack of knowledge among light commercial refrigeration equipment manufacturers, and the fact that the Chinese government is yet to put in place its HFC phase-out plan, as the biggest obstacles to wider uptake of hydrocarbons in China.

Ricardo Maciel, president of the light commercial division at the compressor manufacturer Nidec, cited the high level of investment required to convert compressor production lines from HCFCs and HFCs to hydrocarbons as another hurdle to their wider adoption in China.

Yet a likely global increase in the hydrocarbon charge limit to 500g, putting in place HFC phase-out regulations worldwide, and tighter new energy-efficiency standards in China will all boost the market for hydrocarbons in the Chinese market, according to Pedro Olalla, sales director, Huayi Compressor Barcelona.

Pushing efficiency in retail

Representatives of top Chinese HVAC&R industry associations took to the ATMOSphere China stage, showing a united front in pushing China's industrial, commercial and consumer sectors towards a sustainable future with natural refrigerants.

Representing the China Chain Store & Franchise Association, Wenhua (Wendy) Wang said the organization was actively encouraging its members to be more energy efficient through new technology, including natural refrigerants. For example, German retailer METRO has installed the first transcritical CO₂ system in China. (See [Accelerate China, Spring 2018](#).)



2 /

However, Wang cited several significant barriers, notably the need for safety standards, that need to be overcome before more natural refrigerant implementation can be realized.

"In China, supermarkets are located in areas with dense populations; that's why safety regulations are strict," she said. "We need the government to form these safety standards and help boost confidence in the market."

Representing the China Household Electrical Appliances Association, Vice-President Lei Wang described the widespread use of R600a in China's household refrigerators and the industry's commitment to employing R290 in room air-conditioning units as two means to deliver energy efficiency for its members.

"In the air-conditioning sector, we have come to realize that R290 will be the ultimate and final solution for us because it will meet our environmental sustainability requirements, and the efficiency is very high," said Wang.

NH₃/CO₂ to become mainstream

Ammonia systems, meanwhile, are making inroads in the Chinese industrial refrigeration market, despite attracting the attention of the Chinese public and government when two fatal ammonia-related accidents occurred in 2013. This, in turn, has resulted in strict regulation of the refrigerant, said Jin Ma, representing the Chinese Association of Refrigeration (CAR). CAR is creating and enforcing design and operational standards that guarantee safety when working with ammonia systems.

Meanwhile, Ma expects large-scale cascade NH₃/CO₂ refrigeration systems to become mainstream. "We now have 100 to 200 sets of these systems that have come up in the last few years," she said. "This will be the future trend."

The Shandong Meijia Group Co. Ltd., a leading Chinese seafood and frozen-food processing company, opted for an ammonia-CO₂ cascade system in its Keyuan factory.

Xiaohua Guo, the group's executive vice-president, outlined four "tangible benefits" of the new system: increased safety, higher energy efficiency, environmentally friendly operation, and the use of automatic or remote controls that reduce the need for manual labor.

End users such as Swiss multinational Nestlé and Shandong Meijia are also adopting ammonia systems for industrial refrigeration, helping to broaden understanding and acceptance of the technology in China.

Nestlé began replacing its CFC and HCFC systems with natural refrigerants in 1986. Today, its commitment to adopting natural refrigerants for HVAC&R applications wherever possible is helping to bring the technology to new parts of the world.

In China – Nestlé's second-largest market – the firm uses packaged ammonia chillers in many of its refrigeration plants, said Daiqian Zhang, from Nestlé China Ltd.

Ammonia chillers provide chilled water for process cooling and for humidity and temperature control in hygienic zones, while larger ammonia systems are used for freezing ice cream.

Nestlé has installed ammonia refrigeration systems in its Hong Kong, Shuangcheng, Tianjin and Guangzhou factories, and packaged ammonia chillers at sites in Qingdao, Shanghai, Tianjin and Taizhou.

The success of these installations is helping Nestlé to convince local governments unfamiliar with ammonia that this natural refrigerant can be used safely, Zhang said. ■ AW & DY



Xiaohua Guo, Shandong Meijia Group



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ENGINEERING YOUR SUCCESS.

ebm-papst Stays Ahead of the Curve

The manufacturer has designed its refrigeration fans to meet the growing demand in North America for environmentally friendly, energy-efficient and smart air-movement technology

— By Michael Garry and Mark Hamstra

Lou Moffa, ebm-papst, at its U.S. headquarters in Farmington, Conn., with 1,250-mm diameter EC axial fan



In whatever direction the commercial refrigeration market goes, ebm-papst is ready.

"Our products are usually waiting for the industry to catch up," said Lou Moffa, market manager for commercial refrigeration at ebm-papst.

The company manufactures fan systems for a wide range of uses, including supermarket display cases and rooftop condensers for stores and cold-storage warehouses.

Founded in Germany in 1963, ebm-papst, which has its U.S. headquarters in Farmington, Conn., has long taken that proactive approach to environmental sustainability and energy conservation. In 2010 the company established its GreenTech standard, which stipulates continuous improvements in the efficiency and environmental friendliness of its products and its manufacturing processes.

"Each new product we develop has to be better than the last one in terms of economy and ecology," said company co-founder Gerhard Sturm.

This also means that ebm-papst's fans "are manufactured with a focus on high reliability and long life that further reduces environmental waste compared to other products with shorter operating lives," said Moffa.

The focus on green prepared the company well for the growing commitment to environmental goals by refrigeration OEMs — one of the company's main customer bases — and end users in North America. This includes the transition to energy-efficient natural refrigeration systems that use smart controls.

To meet their customers' needs, ebm-papst's products have a number of distinctive features, all designed for noise

reduction, energy efficiency and overall system optimization. "Any OEM that has a principal objective to save energy should use our products," said Moffa.

For example, the company specializes in fans that use an external-rotor motor and electrically commutated (EC) technology – brushless DC motors with integrated AC to DC conversion – which is more cost effective in the long run than AC technology, according to Moffa. EC technology is the "heart of GreenTech," the company says in its literature.

Because of the brushless design, EC motors and fans can operate wear-free compared to brush motors, and provide an extended service life due to their lower operating temperature, Moffa said. The EC technology also allows the fans to be easily speed-controlled and monitored, so they can respond flexibly to performance requirements, he added.

The company prides itself on its ability to provide "fan assemblies," or complete fan systems that include the blades, the motor and venturi that have been designed to work together optimally. These include both "plug-and-play" catalog fans that can be built into refrigeration systems, and custom-made sheet-metal designs to meet the needs of specific installations. "Our goal is always to provide the best overall product for the end customer," Moffa said.

Another function that ebm-papst incorporates into its fans is a cleaning functionality dubbed "reverse on start" or "reverse on command." The fan can be programmed to spin in reverse automatically for a short period of time upon start-up of the condenser to blow out any debris – leaves or plastic bags, for example – that may have been sucked in during the forward motion of the fan.

The reverse action of the fans can be a boon to an end user such as a supermarket operator, whose maintenance staff may be stretched too thin to check up on the condition of the coil area as often as necessary.

While ebm-papst is a global manufacturer, some production takes place in the U.S., where it has operated since 1983. The company's U.S. presence today includes 275 employees in 20 regional offices, and it maintains an air testing lab, a sound testing chamber and computational fluid dynamics (CFD) simulation capabilities. ([See article, page 61.](#))

A natural fit

Because of the way ebm-papst's refrigeration products are designed, they can all be used in refrigeration equipment that uses natural refrigerants, including display cases that employ hydrocarbons such as propane.

"Our products for the refrigeration market have always been compatible with the hydrocarbon world," said Moffa. They work seamlessly with ammonia and CO₂ as well, he added.

The key to supplying fans that can be deployed in systems that use flammable refrigerants such as propane is that the fan motors must be designed not to be a source of ignition, he explained. The fan motors in this line of products were engineered not to spark, he said.

Moffa noted that ebm-papst has a long history of working with natural refrigeration technologies, especially larger CO₂ systems, in Europe, which he said gives the company an advantage as it seeks to expand in the U.S. by supplying fans that can be used in a variety of natural refrigeration systems.

"We see what happens first in Europe," Moffa said. "That's why a lot of our products were ready from the beginning to meet all of these requirements, which is a good place to be."

Moffa maintains close contact with ebm-papst's market managers and research and development teams in Europe so he can receive the latest solutions from those markets, where innovations in natural refrigeration – often spurred by regulatory activity – tend to be deployed before they reach the U.S.

He also supplies information to his European R&D team about what changes are needed to accommodate the U.S. market.

"The U.S. always has some slight differences," Moffa said.

In Europe, ebm-papst is known for its high levels of efficiency and is often the first choice of manufacturers there, he said. In the U.S., the company faces more competition for its fan products, although Moffa said the increasing focus on efficiency in the U.S. should help drive interest in ebm-papst products.

He said he's encouraged by the potential expansion of natural refrigerants through the proposed increases in the size of propane charges that could be used in certain applications. ►

► The potential of smart technology

Among the innovations that ebm-papst has made available in Europe – and have potential for more widespread installation in the U.S. – is BUS communication connectivity. BUS technology facilitates the sharing of data among equipment components and among computing devices. (See, “[Smart Refrigerator Fans Join the Internet of Things](#),” *Accelerate America*, March 2017.)

In the larger fans that the company supplies for the air-conditioning technology used to cool data processing facilities, such connectivity is almost expected, Moffa said, but it has more limited acceptance in the commercial refrigeration space. While BUS communication is sometimes incorporated in North American rooftop refrigeration systems, it has yet to realize its potential in the refrigerated display case market.

“We feel this is the future of these products,” Moffa said, noting that the ability of ebm-papst to provide such “smart” technology is often high on the list of attributes he promotes to potential customers. The company is unique in its ability to take the BUS communication feature available in the larger rooftop fans and “apply it to our popular 200-mm diameter bottle cooler and display case fans,” he said.

The BUS-capable fan assembly is priced at a slight premium over conventional products, but the overall benefits, including energy savings through speed control and the ability to remotely monitor the fans in a system, can yield a rapid return on investment, said Moffa.

By using the BUS communication technology, individual fans can be controlled to speed up or slow down in 10-rpm increments based on the demands of the system, Moffa explained.

“It is reactive to the conditions based on the controller,” he said. “If somebody changes the set point of the display case temperature, the fan can react. It can react differently during defrost mode and other times of the day, to changes in ambient temperature, or based on case load. You can have multiple settings in a single unit, based on how detailed the controller is.”

In addition, BUS communication technology can also enhance the efficiency of equipment maintenance, by alerting technicians to the need for replacement parts, for example. It’s a concept that has been widely used to support building maintenance systems, but has been slower to catch on among users of refrigerated display cases, according to Moffa.

“You can now have that controller report that a specific fan, fan No. 7, for example – because each fan has a unique

address as part of that controller BUS communication – is coming to the end of its life, so the next time you have a maintenance person in the area, he can have that fan on his truck and he’ll replace it while he’s going to that location to perform another job,” Moffa explained. “Instead of having the maintenance person run back and forth to fix things and put fires out all the time, he can literally have the store’s system tell him what is next on the maintenance list.”

In Europe, the use of BUS communication technology has primarily focused on the increased efficiency it can provide, he said, but there, too, the industry has a significant opportunity to leverage the technology for proactive maintenance. He likened the technology to the gauges and alerts on a car’s dashboard that signal when the car is low on gas or needs an oil change.”

Moffa said that when the industry comes to demand this functionality, which he believes it will eventually, ebm-papst will be ready to provide it.

“Our message to the industry is, we’re ready to supply the product when you’re ready to make these advances,” he said.

■ MG & MH



BUS-enabled fan assembly for display cases or bottle coolers

TOUR OF EBM-PAPST FACTORY

At its manufacturing facility in Farmington, Conn., ebm-papst tests and assembles many of its fans for the North American market, including those for small commercial display cases and large commercial rooftop units.

Accelerate America recently took a tour of the facility, guided by Lou Moffa, market manager, commercial refrigeration for ebm-papst.

All of its fans are “designed for best air flow, lowest noise and best efficiency,” said Moffa. All sheet-metal cutting, stamping, forming, rolling welding, and painting are done at the facility.

In the facility’s air test chamber, ebm-papst can test a customer’s rooftop condenser or other unit and “determine the correct fan for the job, how strong it should be – not too big or underpowered,” said Moffa.

The facility also has a sound chamber equipped with multiple microphones, which allow it to measure how quietly a display case or rooftop condenser fan is operating. “Noise is subjective, like music,” said Moffa. “But here we can measure what the actual differences are.”

In assembling its smaller display-case axial fans with diameters of 200 mm or 172 mm, ebm-papst “ensures that this proven design continues to perform for years to come in the harsh environment of a supermarket display case that it was designed to work in,” said Moffa. Features such as form-in-place gaskets and a fully encapsulated stator are part of the external rotor design, “which makes the fan more compact and robust,” he added.

In addition, ebm-papst “balances the blades” electronically during assembly to keep the bearings from wearing out prematurely. “It’s like balancing your car tires,” he said. As a result, the fans can last eight or more years, after which they can be “easily replaced.”

Deep venturi

ebm-papst’s larger rooftop axial fans – the AxiBlade line – are constructed with a “deep” venturi. That means the fan housing contains an “optimized design to maximize efficiency and provide quiet operation,” Moffa said. By contrast, some manufacturers “will just mount a fan in a sheet-metal cutout.”

ebm-papst also assembles centrifugal fans, both backward-curved impellers (air drawn in over motor and discharged radially) and forward-curved impellers. These fans are used in industrial air conditioning and air handling applications like data center cooling.

Customization is available for ebm-papst’s larger fans. “Choosing the right fan to do the job is part of our job,” said Moffa. “Most people don’t go to school to learn about fans. So we have a dedicated team of application engineers who talk to our customers and make sure they are picking the right fan.”

The company also offers “FanScout” fan selection software to help customers select the right fan.

FAN ENERGY CALCULATOR

The following is an example of an energy-saving calculation for ebm-papst’s ACi 4420 ML axial EC fan for refrigerated display cases, compared to an AC fan, and based on values inserted at <https://www.greentech.info/calculator>.

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80% ANNUAL OPERATING HOURS IN %



13.49 ELECTRICITY COST IN CENTS/KWH



Annual Results	AC FAN	EBM-PAPST FAN	SAVINGS
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CO ₂ EMISSIONS	24,107 lbs	2,604 lbs	21,503 lbs
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