

JANUARY 2019

ACCELERATE

ADVANCING HVAC&R NATURALLY

A M E R I C A

R290

THE FUTURE
OF RETAIL
REFRIGERATION?



JUNE 17-18, 2019
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Monday 17

Technology Trends

Market Trends

Industrial Refrigeration
Case Studies

Technomercials

Commercial End User Best Practice*

Commercial End User Panel

Technomercials

Technomercials

ATMO Business
Connect Afternoon

Dinner & Awards

Tuesday 18

Policy Session

Utilities Panel

Commercial Refrigeration
Case Studies

Technomercials

Industrial End User Best Practice*

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Technomercials

ATMO Business
Connect Afternoon

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*Private Meeting

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Exciting Times for Hydrocarbons

— by Michael Garry

In the bleak landscape that is the current U.S. Environmental Protection Agency (EPA), there was one shining moment last September for the environment — and natural refrigerants.

That's when the EPA raised the charge limit for hydrocarbons in domestic refrigerators to 150 g from 57 g, finally putting the U.S. at the same level as the rest of the world.

The EPA has opened the door for the natural refrigerant isobutane (R600a) to be used in millions of full-size home fridges throughout the U.S. ([Page 45](#).) This is by far the biggest advance in natural refrigerant adoption in the U.S. since CO₂ and hydrocarbons emerged as viable alternatives 20 or so years ago.

It should also make the public more aware of natural refrigerants and why they are better for the environment than traditional synthetic refrigerants. With greater public awareness could come wider acceptance and adoption of naturals by the commercial and industrial sectors.

Consumers are already beginning to take notice. I received an email from Jodi Norris, of Flagstaff, Ariz., asking when she would be able to replace her 1990 refrigerator with an isobutane model. ([Page 8](#).) The answer is no later than 2022, and probably sooner than that.

Meanwhile, opportunities for the hydrocarbon propane (R290) in commercial refrigeration are starting to ramp up. ([See cover story, page 38](#).)

While transcritical CO₂ is the dominant natural refrigerant technology being installed in North American supermarkets, self-contained R290 cases, for both medium and low temperatures, are gaining serious traction.

Initially used as spot merchandisers that complement a centralized refrigeration system, R290 cases are beginning to be seen as a viable full-store solution. Moreover, some retailers, like Hannaford Supermarkets, envision R290 cases as practical replacements for any number of aging HFC cases that are part of a central system. This approach could bring R290 into thousands of additional existing supermarkets, dramatically boosting the uptake of natural refrigerants in North America.

As with domestic isobutane fridges and transcritical CO₂ commercial systems, the U.S. is way behind Europe in deploying R290 display cases.

But progress is undeniable in North America, and with flammability concerns addressed, R290 could prove to be the natural refrigerant for supermarkets that breaks through in a big way in this part of the world.

Already the number of U.S. stores that use glycol-loop hydrocarbon systems — the mark of multi-case deployment — is about 100, according to sheccoBase. AHT Cooling Systems USA says that the number of U.S. stores where more than half of the refrigerated load uses its propane cases is more than 70. That's on top of the thousands of supermarkets run by Target, ALDI US and Whole Foods Market that have added air-cooled R290 beverage coolers and ice cream island cases in various store locations.

And this is all with a charge limit of 150 g. If a 500-g charge limit is approved this year and eventually comes to the U.S., R290 will take off even more. ■ MG



Michael Garry
Editor

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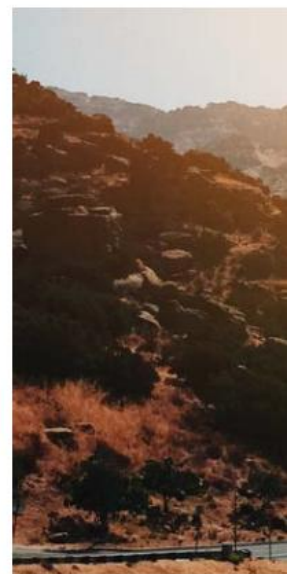
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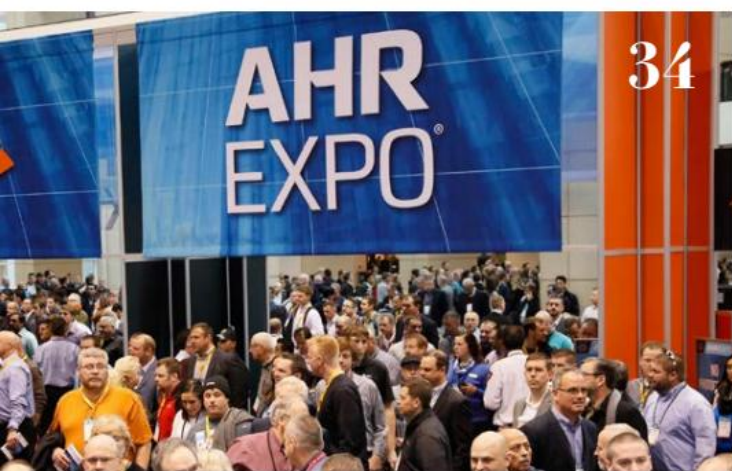
Preparing for the global HFC-reduction scheme to take effect on January 1, countries discussed energy efficiency, support for natural refrigerants, improving compliance mechanisms, and more at a meeting in Quito.

// Policy

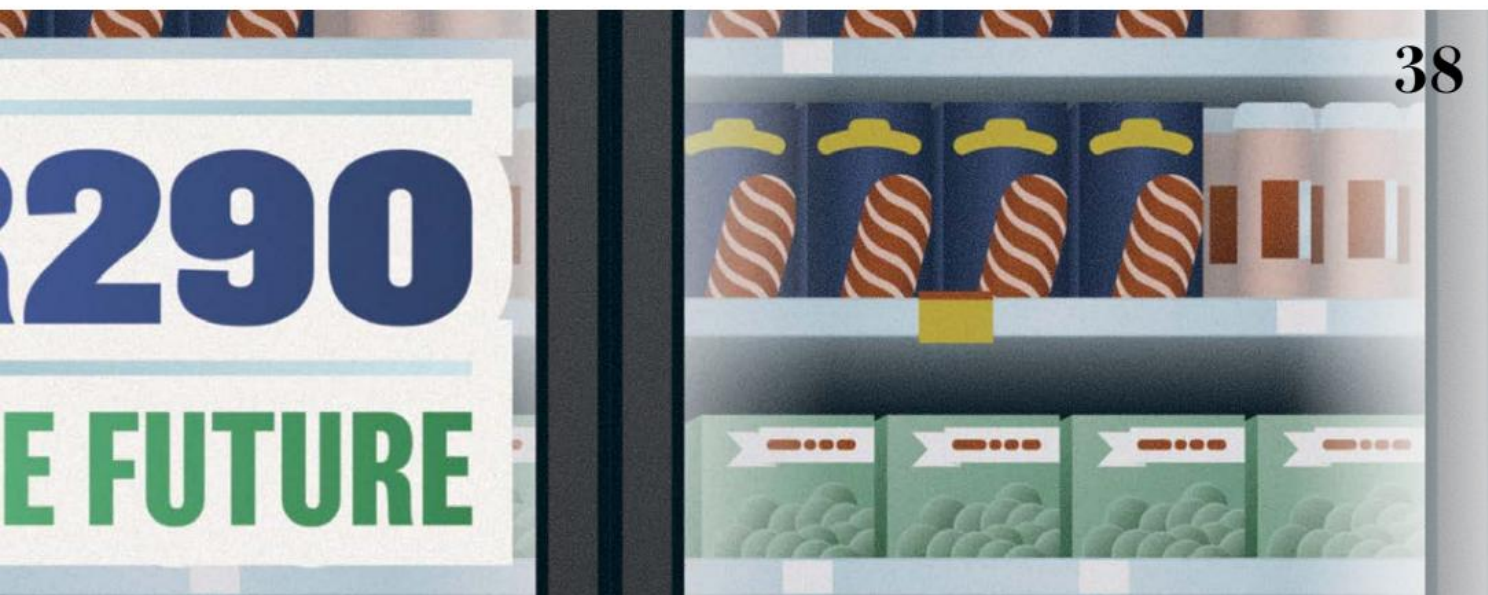




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Propane self-contained display cases, popular in Europe, are gaining traction in the U.S. among chains like Hannaford as a retrofit opportunity in existing stores and a complete-store solution.

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Barred by local codes from using ammonia in a new industrial plant, Angelic Bakehouse found transcritical CO₂ to be a handy substitute.

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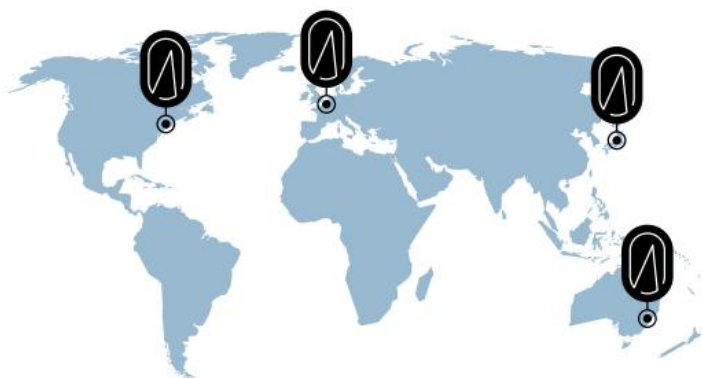
To justify end-user incentives, Efficiency Vermont will oversee a store pilot comparing energy savings of a CO₂ system to that of an HFC system.

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JANUARY 2019

ACCELERATE

ADVANCING HVAC&R NATURALLY A M E R I C A



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://acceleratenam.com>

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

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EDITORIAL CALENDAR

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AD DEADLINE:

August 2

// ISSUE #42

February 2019

FOCUS:

Ammonia/CO₂ and transcritical CO₂ in industrial refrigeration

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IIAR Natural Refrigeration & Expo (Phoenix, 3/3-6)

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Policy & Standards Update

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September 2019

FOCUS:

Food Retail

PUBLICATION DATE:

September 3

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FMI Energy & Store Development Conference (Dallas, September 8-11)

// ISSUE #43

March 2019

FOCUS:

Low-Charge Ammonia (Packaged)

PUBLICATION DATE:

March 27

AD DEADLINE:

March 22

// ISSUE #46

June-July 2019

FOCUS:

Accelerate America Awards

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July 10

AD DEADLINE:

July 3

// ISSUE #49

October 2019

FOCUS:

CO₂ in Industrial Refrigeration

PUBLICATION DATE:

October 22

AD DEADLINE:

October 18

* Publisher reserves the right to modify the calendar.



#GoNatRefs



LETTERS TO THE EDITOR

AMMONIA INSTEAD OF SYNTHETICS

In "Low-Charge Ammonia: Packaged or Central?" (*Accelerate America*, November-December 2018), I found it reassuring to read about the latest innovative ways in which manufacturers are applying ammonia as a refrigerant.

Reduced-charge packaged systems and remote condensing systems are enabling the use of ammonia where synthetic refrigerants might otherwise be selected. End users can enjoy ammonia's high efficiency, low cost, low environmental impact, stable long-term performance, and long-range market availability – attributes that can't be universally assigned to synthetic refrigerants.

I also note that while ammonia end-users must always comply with some regulations, handling of synthetic refrigerants is also regulated – a fact that must not be overlooked. The benefits of an energy-efficient, low-charge, robust, long-lifespan ammonia-based refrigeration system is worth it for any facility with a significant refrigeration load, and a plan to stay in business.

The International Institute of Ammonia Refrigeration (IIAR) welcomes inquiries from anyone seeking additional information about the use of ammonia or carbon dioxide as an alternative to synthetics.

Eric M. Smith

*Vice President and Technical Director
International Institute of Ammonia Refrigeration. Alexandria, Va.*



CONSUMER QUERY ON HOME FRIDGES

I have learned much from your articles. Any chance you could comment on the process or possible timeframe for consumers in the U.S. to have purchase options for domestic refrigerators based on the new 150-gram hydrocarbon charge-limit standard?

We've been waiting "with bated breath" since we learned of the hydrocarbon refrigerant issue back in 2011, and I don't know how much longer our current 1990 refrigerator can hold out. I have no sense of whether they will take months or years.

I'm only asking as a curious consumer. This issue has dragged on for so long that I think many of us have given up hoping, though few people, even within the environmental or climate-conscious sector of the public, are aware of it.

Jodi Norris

Flagstaff, Ariz.

Editor's Note: Full-size isobutane refrigerators and freezers will be available in the U.S. no later than 2022, and possibly sooner. See page 45.

NHL SKATING ON THIN ICE

The cover story, "Ice Rinks: Which Refrigerant is Best," in the [November-December 2018 issue of *Accelerate America*](#) presents a comprehensive overview of the available replacements for the currently used R22 and R134a refrigerants in ice rinks.

The article is especially poignant when placed in the context of rapidly approaching climate tipping points, which will entirely remove humanity's capacity to reverse course. There is now scientific agreement that 21st century temperature rises must be kept below 1.5°C in order to avert full-scale climate catastrophes. Computer modeling by authoritative climate scientists estimate that currently we are on a trajectory towards a 4.0°C increase by 2100.

HCFCs and HFCs are powerful greenhouse gases. The global warming potential (GWP) of the most commonly used HCFC, R22, is 1,810. The GWP of the most commonly used HFC, R134a, is 1,430.

HCFCs and HFCs are slated to be phased-out under the terms of the Montreal Protocol. What refrigerants will replace HCFCs and HFCs for ice making and air-conditioning is a vital question facing the National Hockey League (NHL). Obviously their replacements should have very low or zero global warming potential, and be benign to the environment.

According to the NHL, the league aspires to use "innovative technologies to transform our business" and to inspire "our communities and partners to lower emissions, conserve water, reduce waste and more."

These are worthy aspirations, but the NHL is skating on thin ice in partnering with Chemours to achieve these goals. Chemours is a spin-off of DuPont, the inventor and largest producer of CFCs and the largest corporate contributor to ozone-layer depletion.

When scientists first discovered that CFCs were destroying the ozone layer, DuPont vigorously denied the danger its product was posing to life on earth, and campaigned to delay any governmental regulations to reduce the use of CFCs. The company then maneuvered to maintain its domination over the refrigerants market with new generations of fluorocarbons, HCFCs and HFCs. Together with other fluorocarbon manufacturers, they strove to block the uptake of natural refrigerants.

Today, Chemours is following DuPont's game plan. Chemours markets HFOs as the refrigerants of the future – the sustainable replacements for HCFCs and HFCs. In fact, as the *Accelerate America* article pinpoints, Chemour's HFO blends Opteon XP40 (R449A) with a GWP of 1,282, and Opteon XP10 (R513A) with a GWP of 573, are potent global-warming substances, nearly on par with the climate-destroying chemicals they are to replace. How is that sustainable?

Similarly, just as DuPont for years denied the harm that CFCs caused to the ozone layer, Chemours today denies the potential danger to the environment from the accumulation of trifluoroacetic acid (TFA), derived from some of their major HFO products.

To date, DuPont and its corporate counterparts have never taken any fiscal or

legal responsibility for the extensive human health and property damage their fluorocarbon refrigerants have wrought worldwide. Will Chemours assume liability for the future damage from HFOs?

Fortunately, as the *Accelerate America* article concludes, two natural refrigerants (CO₂ and ammonia) are well poised to "become the de facto future proof alternatives for ice rinks".

The NHL acknowledges hockey's historic connection to the natural environment. The league could take immediate steps towards corporate environmental stewardship by suspending its partnership with Chemours, and embracing the use of natural refrigerants in all new and retrofitted arenas. Indeed, as the NHL states, "When your sport is so much more than a game, you have to play it forward."

Janos Maté

Senior Consultant
Greenpeace International
Vancouver, B.C.

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.



U.S. Climate Alliance's Roadmap for Reducing HFC Emissions

WHAT INDIVIDUAL STATES CAN DO



Transition Away from HFCs by Meeting or Exceeding Reductions from Vacated EPA SNAP Rules and Kigali Amendment

ADOPT REGULATIONS

SUPPORT RATIFICATION OF KIGALI AMENDMENT

LIMIT USE OF HIGH-GWP REFRIGERANTS

DEVELOP INCENTIVE PROGRAMS FOR NEW LOW-GWP SYSTEMS

REQUIRE PUBLIC AGENCIES TO PROCURE LOW-GWP SYSTEMS



Commercial Refrigerant Management via Leak Reduction

ADOPT REFRIGERANT MANAGEMENT PROGRAM

DEVELOP INCENTIVES TO RETIRE OR RETROFIT OLD SYSTEMS

IMPLEMENT RECORD-KEEPING AND REPORTING



Collect and Destroy Used Refrigerants at End-of-Life

MANDATE OR INCENTIVIZE COLLECTION AND DESTRUCTION

INCLUDE OLD EQUIPMENT COLLECTION IN UTILITY EFFICIENCY PROGRAMS

Source: United States Climate Alliance, "From SLCP Challenge to Action: A roadmap for reducing short-lived climate pollutants to meet the goals of the Paris Agreement," September 2018

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05-06**Bitzer 2-Day
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07-09**The NAFEM Show,
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<https://bit.ly/2FC1lLz>



@TheNAFEMShow

12, 2 PM^{EST}**EPA GreenChill Webinar: Benefits
of Partnering with GreenChill for
Small and Independent Grocers,
Online**

Webinar features Rene Tanner and Scott Marble of the Port Townsend Food Co-op.



<https://bit.ly/2S8csNy>



@EPAgreenchill

13-14**Emerson CO₂ Learning Sessions,
Rancho Cardova, Calif.**

Designed for service technicians, manufacturers and end users, this event covers terminology, mapping of cascade and transcritical systems, efficiency optimization in warm ambient climates, and more.



<https://bit.ly/2P0maQf>



@Emerson_News

26, 2 PM^{EST}**Emerson E360 Webinar:
Regulatory Forecast – Refrigerant
Rulemaking in 2019,
Online**

Rajan Rajendran and Jennifer Butsch of Emerson will discuss: developments at the U.S. Environmental Protection Agency and the California Air Resources Board; the Kigali Amendment; Section 608; and other topics.



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



@Emerson_News

27-28**Emerson CO₂ Learning Sessions,
Elmsford, N.Y.**

Designed for service technicians, manufacturers and end users, this event covers terminology, mapping of cascade and transcritical systems, efficiency optimization in warm ambient climates, and more.



<https://bit.ly/2P0maQf>



@Emerson_News

MAR

03-05

HVAC Excellence: National HVAC&R Educators and Trainers Conference, Las Vegas, Nev.

This conference, designed for HVAC&R instructors, trainers and administrators, covers physics, emerging technologies, new educational delivery methodologies and regulatory changes, among other topics.



<https://bit.ly/2sjeD6k>



@Esco_Group

03-06

2019 IAR Natural Refrigeration Conference & Expo, Phoenix, Ariz.

Event includes an energy efficiency program, expo hall, technomercials, technical program, government and code update and NASRC commercial track.



<https://bit.ly/2Fgz7VD>



@IARnews



12, 2 PM^{EST}

EPA GreenChill Webinar: Real-World Applications and Operation of Ammonia/Carbon Dioxide Systems, Online

Webinar features Rob Arthur and Jim Armer of CTA as well as food retailer(s) to be announced.



<https://bit.ly/2ABO4hd>



@EPAgreenchill

13-14

Emerson CO₂ Learning Sessions, Cudahy, Wis.

Designed for service technicians, manufacturers and end users, this event covers terminology, mapping of cascade and transcritical systems, efficiency optimization in warm ambient climates, and more.



<https://bit.ly/2P0maQf>



@Emerson_News

17-18

Seafood Expo North America/Seafood Processing North America, Boston, Mass.

Seafood Expo North America/Seafood Processing North America is for seafood buyers in retail, restaurants, catering, foodservice and processing. It features global suppliers of seafood, new products, equipment and services.



<https://bit.ly/2E8qZlt>



@Emerson_News

AMERICA IN BRIEF

Walmart's McClendon Joins NASRC Board

The North American Sustainable Refrigeration Council (NASRC), a U.S. nonprofit focused on supporting natural refrigerant adoption in the supermarket sector, announced in December that Jim McClendon, director of energy efficiency for Walmart, has joined its board of directors.

"I'm really excited to be a part of this forward-thinking organization," said McClendon in the NASRC announcement. "As we navigate the uncertainties of the refrigeration landscape, it seems apparent that legacy approaches and technologies will not sustain the industry. Whether in terms of refrigerants, efficiency, or practice, we must be innovative and insist on new, lower-carbon solutions."

Since 2005, McClendon has led Walmart's initiatives to reduce their total energy consumption in new and existing stores, contributing to their greenhouse gas emissions goals. Walmart is the largest U.S. retailer in sales volume.

With over 20 years of experience in the HVAC&R industry, McClendon can offer perspectives from a variety of stakeholders, including end users, engineering and design firms, and service contractors, said NASRC.

"We are thrilled to welcome Jim to our board of directors," said Peter Dee, chair of the NASRC Board, and sales & service director for Danfoss Food Retail. "He is an outstanding addition to the industry leaders who currently sit on the board, and his expertise will no doubt contribute to our mission of addressing the hurdles of natural refrigerants."

■ MG

Alaska Town Getting CO₂ Heat Pumps

The city of Seward, Alaska, is on its way to installing a transcritical CO₂ heat pump that taps into seawater to provide heating for four municipal buildings.

In late November, Seward's City Council voted to accept a \$725,000 grant from the Alaska Energy Authority for the district heating project. The city will add up to \$156,497 to cover the cost of the project, according to the *Peninsula Clarion*.

YourCleanEnergy, an Anchorage, Alaska-based consulting firm, which designed a similar CO₂ heat-pump system for the Seward-based Alaska SeaLife Center in 2016, is a consultant and designer for the Seward municipal-building project. (See "Tapping CO₂ and Seawater in the Last Frontier," *Accelerate America*, May 2016.)

"Our intent is to use [Mayekawa's] Unimo CO₂ [heat pumps] or equal to avoid synthetic refrigerants," Andy Baker, owner of YourCleanEnergy, told *Accelerate America*.

The source heat will come from ocean tides "that flush back and forth in deep alluvial gravel" in nearby Resurrection Bay, Baker said.

The four Seward buildings include City Hall, City Hall Annex, Community Library and Fire Hall. The system will employ approximately 14 double HDPE (high-density polyethylene) loops with propylene glycol between the shore (where they will be 200 ft deep) and the library 400 ft away, explained Baker.

It's estimated that the heat pump system will save the city \$25,000 annually in heating costs, said the *Peninsula Clarion*.

■ MG

Chloroform Emissions Threaten Ozone Layer

An MIT study published in December in *Nature Geoscience* identifies chloroform – used in the manufacture of R22 – as a threat to the recovery of the ozone layer, according to the MIT News Office.

The researchers found that between 2010 and 2015, emissions and concentrations of chloroform in the global atmosphere increased significantly. They traced the source of these emissions to East Asia.

The researchers predict that if chloroform emissions continue to increase, the recovery of the ozone layer – made possible by the phase out of CFC and HCFC gases via the Montreal Protocol – could be delayed by four to eight years.

"[Ozone recovery] is not as fast as people were hoping, and we show that chloroform is going to slow it down further," said co-author Ronald Prinn, a professor of atmospheric science at MIT. "And certainly a conclusion here is that this needs to be looked at."

■ MG

CAREL Expands Production Plant

Italian component manufacturer CAREL broke ground in December on an expansion of its U.S. production facility in Manheim, Pa., from 35,000 to 70,000 sq ft as part of its global expansion strategy.

The company has rolled out CO₂ and hydrocarbon-based technology in the U.S., Europe and China.

This year the firm debuted the CAREL/Carrier EmJ modulating ejector line in the North American market. It is working on bringing its CO₂ condensing unit controller, the Hecu Sistema, and its Heez R290 cooling system, to the United States. (See page 34.)

"The extension of the plant at Manheim follows the implementation, in the same plant, of the first U.S. programmable controller production line, completed last summer, and shows the interest of the Group in the North American market," said Francesco Nalini, the CAREL Group's CEO. "We expect this country to represent a significant accelerator for CAREL's growth, which will be based on innovation, energy efficiency and customer care."

■ CM

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What It Takes to Be a First-Rate HVAC&R Technician

Though the responsibilities and demands of a tech job are many, career opportunities have never been better

— By Juan Carosso

The following is excerpted from At Your Best as an HVAC/R Tech, published in 2018 by Skyhorse Publishing.

The shortage of HVAC&R technicians mirrors the growing shortfall across the U.S. in all the skilled trades.

The average age across the skilled trades in the U.S. is 55 years old. Retirement is right around the corner and not enough young HVAC&R technicians are coming up the ranks.

Therefore, once you've acquired the skills, training and experience as an HVAC&R tech, you will also have the flexibility to decide where you want to work and live. Your skills are portable, and they are always in demand.

As an HVAC&R tech, you can choose to work as an employee for any number and type of employers, or you can choose to strike out on your own and be your own boss. You are only limited by your abilities, your ambition and your personal circumstances.

JOB RESPONSIBILITIES

HVAC&R technicians have a wide variety of responsibilities, depending on the specific role and job. At a minimum, an HVAC&R tech must be able to effectively:

- ▶ Install, assemble and repair furnaces, heat pumps, dehumidifiers, refrigeration systems and air conditioning units with associated wiring and controls.

- ▶ Study and follow blueprints, drawings and building codes to ensure proper fabrication and placement of ductwork in the building.

- ▶ Maintain and adjust HVAC and refrigeration equipment and associated blowers, burners, thermostats, electrical circuits, controls and other components.

- ▶ Test performance of equipment to ensure each unit operates safely and at peak output and cost efficiency.

- ▶ Rework, reroute and repurpose existing HVAC&R systems to properly address a new client need.

- ▶ Direct other workers on proper layout, sheet-metal cutting, preassembly and installation of ductwork.

MINIMUM REQUIRED SKILLS

Becoming a successful HVAC&R technician first requires that you acquire the minimum set of skills and experience to even be allowed on a jobsite. Consider the following as a bare-bones checklist of what you will need:

- ▶ Solid comprehension of reading and math.
- ▶ To be detail-oriented and aware of work and surroundings.
- ▶ Troubleshooting, problem-solving and reasoning skills.
- ▶ Knowledge of machines and tools, including their use and maintenance.
- ▶ Knowledge of materials, methods and tools involved in construction.
- ▶ Knowledge and use of principles in

precision technical plans, blueprints, drawings and models.

- ▶ To read and understand work-related manuals and documents.

- ▶ To install equipment and wiring to meet technical specifications.

- ▶ Effective workplace communication skills, both oral and written.

- ▶ Time management to complete tasks within expected period.

- ▶ To work and interact well with others.

- ▶ To concentrate on tasks without being distracted.

- ▶ To consider the cost vs. benefit of doing something before doing it.

- ▶ Certified, comprehensive understanding of the requirements set forth in EPA Section 608 of the Clean Air Act of 1990.

WORK SITE CONDITIONS:

As you can imagine, the work conditions and jobsite requirements vary widely for every HVAC&R technician. Still, you can expect some combination of the following:

- ▶ Work done outdoors at very high and low temperatures.
- ▶ Work done indoors in cramped, closed quarters, regardless of conditions.
- ▶ Hazardous equipment such as hand and power tools and heavy equipment.
- ▶ Hazardous materials such as ladders, scaffolding and unstable, high places.
- ▶ Requirement to wear protective clothing and accessories.
- ▶ High and uncomfortable noise levels.
- ▶ Early start times and often late finish times.



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PHYSICAL DEMANDS:

- ▶ Lift, pull, push, carry and hold heavy items.
- ▶ Use and maneuver hand and power tools.
- ▶ Bend, stand and walk, often carrying heavy items.
- ▶ Be physically active all day.
- ▶ Kneel, crawl, stoop and crouch in confined spaces.
- ▶ Maintain balance while in unstable position.
- ▶ Accomplish difficult manual tasks in confined spaces.

EARNING POTENTIAL

Your potential income as a skilled HVAC&R technician will vary according to each local market and your skill/experience level and specialization. But by adopting and truly internalizing the mindset of a craftsman, you will be able to maximize your income as an HVAC&R technician.

According to the U.S. Department of Labor, in 2016 the national average income for an HVAC&R technician ranged from a high of \$73,350 to a median of \$45,910 to a low of \$28,440.

But given the growing nationwide demand for HVAC&R techs, you can look at the “national average income” levels as simply a reference point – a starting point. Be confident that your unfailing commitment to delivering the highest quality work product you can, and having a great attitude about your craft and job, will put you at the high end of the wage scale in quick order.

The easiest, fastest way I found to see what you can earn as an HVAC&R technician, wherever you may live in the U.S., is to use the tools at www.CareerOneStop.org.

CAREER OPTIONS

As a skilled HVAC&R technician, you have a wide variety of industries and specializations you can pursue. You can work for someone else, choose to be a union member or an independent, non-union HVAC&R technician, or you can strike out on your own.

You also have several career paths to follow, each equally well-paying and very much in demand. Each is a specialization and skilled trade in and of itself, so you would have to expand your training and certifications accordingly. You can consider:

- ▶ Residential air conditioning and heating
- ▶ Light commercial air conditioning and heating
- ▶ Commercial refrigeration.
- ▶ Green heating systems, including solar, geothermal and hydronics.

IS IT FOR YOU?

If you were wondering, this is one of the “Kitchen Table Moments” that will lead you to a very important decision. You need to do some self-reflection to decide whether becoming an HVAC&R technician is right for you. There are no shortcuts.

Friends and family: Ask around. Someone you know probably is or knows a successful HVAC&R technician who would be happy to answer your questions about what it is like, what it takes, and how to go about it.

YouTube: Sit back and watch some videos. There are countless videos available to you that can provide insights to any aspect of the HVAC&R profession. You can also check out additional valuable information on video and how-to sites like Vimeo, WikiHow, eHow and Instructables.

Local union office: Visit your local union office. Given the shortage of skilled HVAC&R technicians across the U.S., you will find the local union office happy to help you learn more.

Assessment testing: Take a skills and interest assessment test. Whether at school, online, at a local employment agency office or some other location, these assessment tests are easy and quick to take. There are no wrong or right answers. The results simply give you an insight into interests and careers you might consider pursuing further.

Here are two examples: O*NET Interest Profiler at www.MyNextMove.org; and Interest Assessment and Skills Matcher at www.CareerOneStop.org. ■ JC



Juan Carosso has over 30 years' experience in business development for startups and turnaround companies. He also manages a real estate investment business and has renovated properties across the U.S. His relationship with tradespeople and contractors revealed a lack of qualified candidates, and he has since made it his mission to expose people to, and educate them in, the opportunities that the skilled trades provide.

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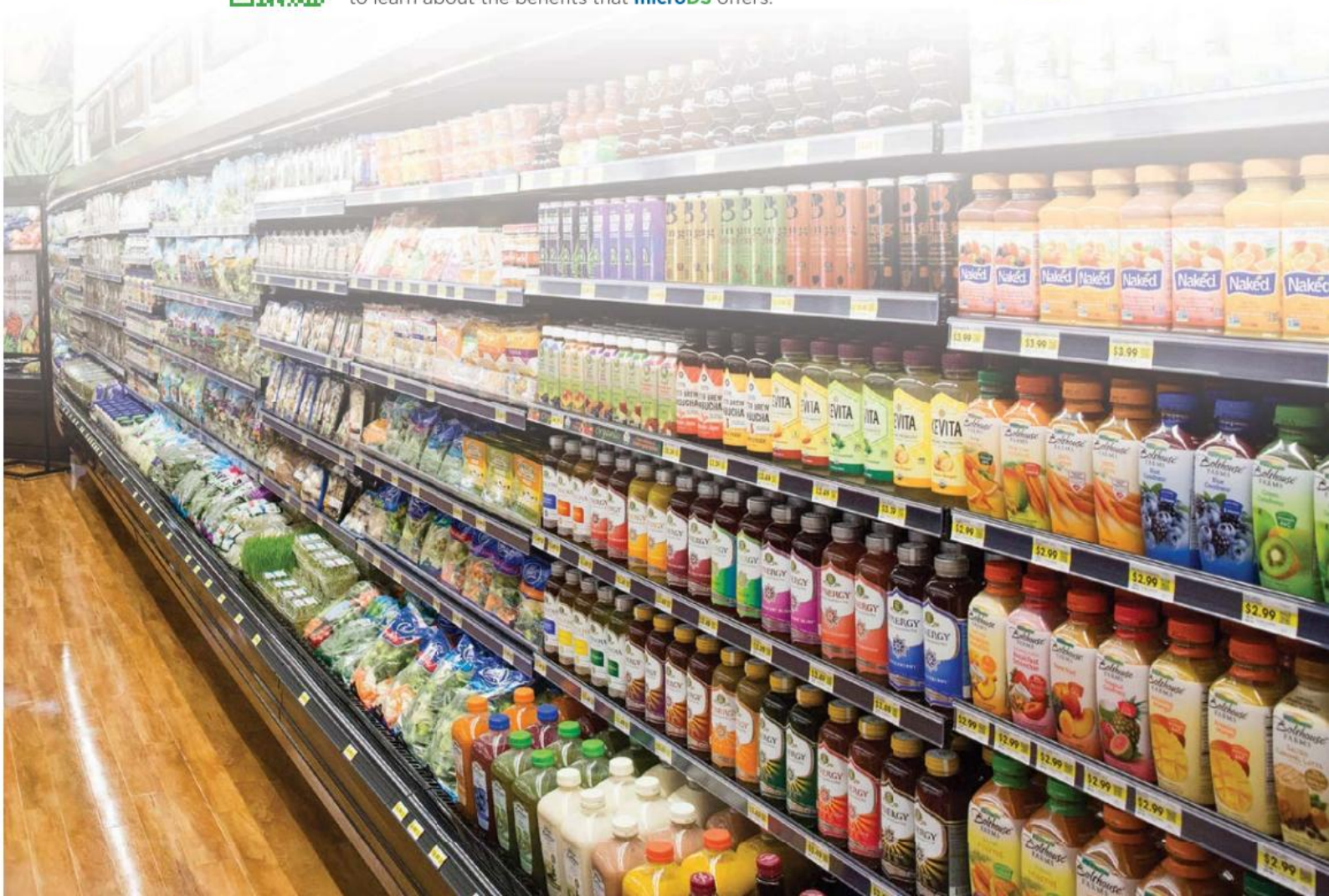
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Expectations for 2019

Retailers, industrial operators, manufacturers and a contractor weigh in on what natural refrigerant systems they expect to use or sell this year

—By Michael Garry

Ed Estberg, refrigeration consultant for *Raley's*, a California-based supermarket chain, which he said will use more natural refrigerant equipment in 2019:

"The current [natural refrigerant] design is a mini-charge ammonia vapor compression system cooling a CO₂ liquid-overfeed system. Raley's has one replacement store starting construction in March that will have this all-natural refrigeration system for both product refrigeration and air conditioning. The mechanical system is now being assembled. Raley's did no natural refrigeration systems in 2018, though it did a partial natural system in 2009 and another in 2017."

Harrison Horning, director of maintenance, *Hannaford*, a Maine-based supermarket chain, which he said will have more natural refrigerant systems in 2019:

"Several new stores are planned for construction in 2019, and natural refrigerant systems (CO₂ and/or R290) will be included in each new store design."

"Hannaford has been working on a concept that includes self-contained, glycol-cooled R290 cases for frozen food and ice cream; and a secondary glycol loop to medium-temperature cases and walk-in coolers."

"We are testing this concept in new stores, but it could be useful in existing stores where we need to replace a limited amount of equipment but not the entire system. We hope to pilot this in existing stores in 2019 and 2020." (See [page 38 for more details](#).)

John Stuit, chief of design and construction for the engineering directorate at the Defense Commissary Agency (DeCA), Fort Lee, Va.:

"DeCA will install fewer natural refrigeration systems in 2019 than in 2018 due to a lower level of investment in equipment replacements. However, the percentages of natural refrigeration will be larger. In Europe, 100% of new equipment installation will be CO₂ transcritical systems and will use energy strategies such as ejectors with the CO₂ systems in warmer European climates south of the Alps."

"In the United States we continue to use CO₂ systems in relatively cool climates such as the California coastline, and are investigating micro-charge distributed HFO systems in hot-climate areas of the Southwest."

"DeCA continues to evaluate long-term alternatives to traditional f-gas refrigeration. We have found the European market for natural refrigerants to be mature with capable maintenance

contractors. In the United States, we have experienced service difficulty with non-traditional systems particularly in hot climates."

Ricardo Garcia, director of engineering and projects, *Frialsa*, a Mexican cold-storage operator:

"At the end of 2018, Frialsa started up a new distribution center in Tijuana, Mexico with a 700-TR NH₃/CO₂ cascade system. In February 2019 we will start up a distribution center in Lima, Peru, using a 640-TR NH₃/CO₂ system. Frialsa will also have expansions at Mexico facilities during the rest of the year with natural refrigerants."

Bing Cheng, senior manager, utilities, environmental and sustainability programs at *Campbell Soup*:

"Campbell Soup has a program to phase out our R22 equipment and utilize either CO₂ or ammonia/glycol systems. We commissioned three new CO₂ systems in 2018 (two ammonia/CO₂ cascade systems and one transcritical CO₂ system) and will commission one cascade ammonia/CO₂ system for a freezer in Denver, Pa., this spring."

Mike Lynch, vice president of engineering, *U.S. Cold Storage*:

"U.S. Cold Storage only uses natural refrigerants and will continue to do so in the future. In 2018, USCS utilized the following: 61% anhydrous ammonia and 39% carbon dioxide. I expect this ratio to remain relatively stable through 2019, with one new facility and an expansion of three existing facilities."

Brandon J. France, director of packaged refrigeration systems, *Stellar*, a U.S. contractor:



"We see an increased interest in the [industrial] market in general. The acceptance of CO₂ will increase as people become more comfortable with the technology. Ammonia has always been acceptable; however, there is often a perception that it is much more dangerous than it really is.

"Therefore, it is very important to educate users on ammonia safety, including proper installation, maintenance, and other safeguards such as secondary refrigerants, which greatly reduce the ammonia charge as well as the potential for exposure to ammonia."

Caleb Nelson, VP business development, Azane, U.S. manufacturer of low-charged ammonia packaged systems:

"The market uptake of the [low-charge ammonia] Azanechiller and Azanefreezer in 2019 will be more than in 2018. We've had a few projects that have been brewing for several years and we expect them to finally materialize in 2019. Low-charge ammonia represents a significant sea change for several industrial users that move toward technology change with caution. As users learn that our low-charge technology is actually very mature (25+ years while

undergoing continuous improvement), it helps with the transition."

Kurt Liebendorfer, vice president, Evapco, U.S. manufacturer of low-charge ammonia packaged units:

"Evapco expects, and is already experiencing, a significant uptake in sales in 2019 for its Evapcold packaged low charge ammonia refrigeration systems product line. The market adoption of this new technology is growing, as was seen in our expanding 2018 sales, which were 63% higher than 2017; we forecast an additional 70% sales growth in 2019 over last year.

"This strong growth is the result of several factors, including increasing demand from owners and end-users for industrial refrigeration solutions that lower their risk and operating cost, as well as contractors that love the plug & play packages and quicker schedules.

"In addition, the Evapcold units in the field have been operating very successfully and we stay close to those customers to assure customer satisfaction. Evapco's significant investment in R&D, product development and testing over the last five years is paying off, and we continue

to invest in the support and expansion of the Evapcold family of products, with new models and configurations planned to be released this year."

Jim Nonnie, executive vice president, Temprite, U.S. manufacturer of oil separators and refrigerant oil management products:

"For North America, assuming the U.S. economy rebounds from a sluggish fourth quarter, we expect continued growth of CO₂-related equipment in 2019. "

Paul Noreen, director, adiabatic sales North America, Baltimore Aircoil Company (BAC), U.S.-based maker of evaporative cooling products, including adiabatic condensers used with transcritical CO₂ systems:

"We expect about the same as 2018 for adiabatic condensers with a possible 5%-10% upside.

Market and industry trends are leaning in this direction. We also see more customers considering natural and lower-GWP refrigerants. The U.S. economy is very strong and sentiment is positive." ■ MG

NORTH AMERICAN COUNTRIES DIFFER ON HFCs

Canada reduction plan starts in 2019; Mexico approves Kigali; U.S. on sidelines

— By Michael Garry

The three nations making up North America — Canada, the U.S. and Mexico — are each at different stages in HFC reduction as 2019 begins.

Canada, having in 2017 ratified the Kigali Amendment to the Montreal Protocol calling for a global HFC phase down, will start cutting HFC consumption in 2019 by 10% from the baseline level (the consumption of HFCs and HCFCs from 2011 to 2013) under a plan launched last year.

That will leave Canada with 17,206,786 metric tons of HFCs in terms of CO₂e equivalent; in 2036, when the amount is slated to be cut by 85%, it will be down to 2,867,798 metric tons.

The Canadian plan also puts caps on the GWP of gases that can be used in specific applications. Starting on January 1, 2020, stand-alone commercial refrigeration systems will be limited to 1,400 and 1,500 GWP for medium- and low-temperature units, respectively, while centralized refrigeration systems and condensing units will be held to a 2,200 GWP refrigerant.

Much of the Canadian regulation focuses on imports since HFCs are commonly imported into Canada in bulk for use in the manufacturing, servicing and maintenance of refrigeration and air-conditioning equipment, and in the manufacture of foam-blowing products.

"Industry in Canada and around the world has made major progress in phasing out ozone-depleting substances over the past 30 years," said Catherine McKenna, Canada's minister of environment and climate change when the Canadian plan was announced in 2017. "We will do the same with HFCs, ensuring a clean environment and strong economy for our children and grandchildren."

MEXICO APPROVES KIGALI

Mexico voted to accept the Kigali Amendment in September 2018. As an A5 (developing) country, it will freeze average production/consumption in 2024 at the baseline, which is the average production/consumption of HFCs in 2020, 2021 and 2022.

The U.S. Senate, still waiting for a referral from the Trump administration, has not yet ratified the Kigali Amendment, despite widespread industry support for ratification. Meanwhile, the U.S. Environmental Protection Agency's 2015 high-GWP HFC phase-out plans, which were shelved by a Court of Appeals in 2017, are being revisited by the agency in a rule-making process launched last year.

Component manufacturer Emerson believes the EPA will release new HFC regulations in 2019 in the first or second quarter, said Jennifer Butsch, regulatory affairs manager — air conditioning for Emerson, at the company's E360 Forum on January 15 at the AHR Expo in Atlanta, Ga. "Hopefully the EPA will continue the process of listing refrigerants as necessary for industry to move forward."

Beginning this year, leak repair regulations under Section 608 of the Clean Air Act, are being extended from ozone-depleting refrigerants to HFCs. However, last September, the EPA announced it would seek to rescind those rules as they applied to HFCs.

Meanwhile California, New York, Connecticut and Maryland are pursuing their own HFC reduction plans, with other states expected to follow suit. ■ MG

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CALIFORNIA STARTS HFC BANS – WITH MORE TO COME

R404A and R507A are among the high-GWP refrigerants scrapped in supermarket systems as CARB considers low-GWP limits for new equipment

– By Michael Garry

California's bans on high-GWP HFCs, based on regulations enacted by the U.S. Environmental Protection Agency (EPA) – but rolled back at the national level last year – went into effect in the state on January 1 for a number of supermarket applications as part of the implementation of the California Cooling Act (Senate Bill 1013).

The prohibitions derive from the EPA's Significant New Alternative Policy (SNAP) Program, Rules 20 and 21. Rule 20 was vacated last year as a result of a U.S. Court of Appeals ruling in August

2017, while Rule 21 is expected to also be vacated by the courts.

Meanwhile, in California, bans of R404A and R507A took effect on January 1 for new and retrofit supermarket central systems and remote condensing units; and all retrofit stand-alone units, low- and medium- temperature.

January 1 also marked the start of bans for R404A, R507A, R410A, R134, and R407A, C and F in new medium-temperature stand-alone units with a compressor capacity of less than 2,200 BTU/hr and not containing a flooded evaporator.

Starting January 1, 2020, these high-GWP refrigerants will be banned in additional new stand-alone cases, including medium-temperature units with a compressor capacity of less than 2,200 BTU/hr and containing a flooded evaporator; and in medium-temperature units with a compressor capacity equal to or more than 2,200 BTU/hr, with or without a flooded evaporator.

In low-temperature stand-alone cases, R404A, R507A, R410A and R407A, C and F will be banned starting in 2020. Those refrigerants will be prohibited starting January 1, 2021, in refrigerated food processing and dispensing equipment.

For new compact household refrigerators and freezers, R404A, R507A and R134a, among other refrigerants, will be banned starting January 1, 2021; the following year, they will be banned in new non-compact or built-in units.

On January 1, 2023, R404A, R507A, R410A, R134A and R407A will be prohibited in new cold-storage warehouse systems.



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Under the new California law, manufacturers cannot sell equipment or products that use banned HFCs manufactured after their respective prohibition dates.

The California Air Resources Board (CARB) plans to enact further restrictions on HFCs via its SLCP (Short-Lived Climate Pollutant) Strategy, which was approved in March 2017.

These actions are all intended to help California meet its HFC emissions reduction goal under Senate Bill 1383, which is 40% below 2013 levels by 2030.

In addition to regulating HFCs, the California Cooling Act establishes an incentive program for early adoption of low-GWP technology in refrigeration systems. In order for CARB to implement the program, the legislature must first allocate funding. Once funding has been allocated, CARB can proceed with implementing the incentive program.

Other states began emulating California in 2018, with Connecticut, Maryland and New York announcing plans to develop regulations that will phase out the use of HFC. ([See "Three States Follow California's Lead on HFCs", Accelerate America, October 2018.](#))

In December, Jay Inslee, governor of Washington state, unveiled a \$273 million climate action plan – including \$959,000 to phase out HFCs – that would reduce greenhouse gas emissions to 25% below 1990 levels by 2035. ([See page 28.](#))

All five states are part of the U.S. Climate Alliance, a bipartisan coalition of governors from 17 states and Puerto Rico, which announced last June its commitment to reduce SLCPs, including HFCs.

Harrison Horning, director of maintenance for Hannaford Supermarkets, Scarborough, Maine, suggested that state regulation of HFCs "will get us back to where we were one or two years ago" when the EPA was delisting high-GWP HFCs.

On the other hand, "We might begin to see a state-by-state listing of what's acceptable and not acceptable," said Jennifer Butsch, regulatory affairs manager – air conditioning for Emerson, at the company's E360 Forum on January 15 at the AHR Expo in Atlanta, Ga. "We prefer one consistent approach across the federal level."

More restrictions on HFCs

California regards the SLCP Strategy as the final piece of its plan to cut HFCs by 40%. The first phase will be to limit the GWP of refrigerants (two or more lbs) used in new stationary air-conditioning equipment to below 750 starting in 2023. Emerson expects CARB to announce a final regulation by December 2019, said Butsch. "AHRI [Air-Conditioning, Heating & Refrigeration Institute] and NRDC [National Resources Defense Council] recommended that step, so there is some certainty this will go through."



Jennifer Butsch, Emerson

There will be no additional rulemaking in California for chillers, which will follow SNAP Rule 21.

The SLCP Strategy also contains prohibitions on refrigerants (more than 50 lbs) with a GWP of more than 150 for new stationary refrigeration beginning in 2022. "This will be debated at stakeholder meetings until July," said Butsch. "I'd anticipate the charge limit might move up; 150 seems low to us and many in the industry." A final regulation for refrigeration is expected by March 2020, she added.

In addition, the SLCP plan calls for a blanket ban on production, import, sales, distribution or entry into commerce of refrigerants with a GWP of 1,500 or more, effective in 2022.

CARB has proposed an exception in the blanket ban for reclaimed refrigerants used in maintenance; however, the reclaim process has not been defined yet, said Butsch, adding, "They don't want reclaimed refrigerants from other states." Another exception has been proposed for R410A in air conditioners, which can't be retrofitted with lower-GWP refrigerants.

CARB will engage with stakeholders several times in 2019, Butsch said. "I would encourage everybody to communicate with CARB – they are looking for information," she said."

■ MG



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WASHINGTON GOVERNOR PROPOSES CUTTING HFCS

Jay Inslee, a potential presidential candidate in 2020, earmarks \$959,000 to phase out HFCs as part of a climate-action plan.

— By Michael Garry

Jay Inslee, governor of Washington state, in December unveiled a \$273 million climate action plan — including \$959,000 to phase out HFCs — that would reduce greenhouse gas emissions to 25% below 1990 levels by 2035.

The proposal, which would need to be enacted by the Washington legislature, includes a transition to 100% clean energy and ultra-efficient buildings, as well as the elimination of HFC “super pollutants.”

Phasing out HFCs alone would enable Washington to cut 2 million metric tons of CO₂e greenhouse gas emissions by 2035 — “a significant step toward meeting the state’s reduction targets,” said Inslee in a policy brief. In total the plan targets an emissions reduction of 16 million metric tons.

Inslee noted that use of HFCs “is growing rapidly throughout our state and the country,” with annual emissions equaling the amount of climate pollution from several hundred thousand cars and trucks.

“[The] international community and business leaders have recognized HFC pollution as a serious threat and the transition to climate-safe alternatives as an economic opportunity,” he added.

Inslee co-founded the U.S. Climate Alliance, a bipartisan coalition of governors from 17 states and Puerto Rico committed to reducing short-lived climate pollutants (SLCPs), including HFCs. (In November, the newly elected governors of Michigan, Illinois and

Wisconsin pledged to join the alliance; Illinois has since joined.)

The U.S. Climate Alliance is advocating that states transition away from HFCs and meet or exceed emission reductions expected from the Kigali Amendment to the Montreal Protocol and the vacated rules previously set by the Environmental Protection Agency’s Significant New Alternatives Program (SNAP).

If Inslee’s HFC-reduction program is enacted, Washington would join U.S. Climate Alliance members California, New York, Maryland and Connecticut as states that have launched HFC-reduction programs.

Opposes EPA HFC revisions

Washington was also one of 15 U.S. states and the District of Columbia that sent a letter in November to the EPA “strongly opposing” its proposed revisions to updated Section 608 leak repair and maintenance regulations for HFCs. The states urged the EPA to withdraw the proposed rule and fully embrace the appliance-maintenance and leak-repair provisions as they apply to HFCs.

In June 2018, Washington joined nine other states and Washington, D.C., in a lawsuit to protect the EPA’s SNAP rule regulating HFC emissions.

Washington is also part of the Pacific Coast Collaborative (PCC), a West Coast initiative for climate action. Inslee joined other West Coast governors, the B.C. environment minister, and the mayors of six major West Coast cities to sign the Pacific North America Climate Leadership Agreement at the



Jay Inslee, governor of Washington

Clean Energy Ministerial (CEM7); the agreement aims to slash greenhouse gas emissions and advance a clean energy economy, with a focus on energy systems, buildings, transportation, and waste management.

Also during CEM7, PCC members signed the Pacific Coast Climate Leadership Action Plan, which addresses ocean acidification; the integration of clean energy into the power grid; and efforts to address short-lived climate pollutants (SLCPs), which include HFCs.

Inslee is exploring a run for president in 2020 that would be based on fighting climate change. He has not yet officially announced his candidacy but voanews.com reports that in October he started a political action committee and raised \$112,000 through November for a potential run, according to federal election filings.

In 2007 he wrote a climate-change book called *Apollo’s Fire*, which describes economic opportunities in reducing greenhouse gas emissions. ■ MG

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British Columbia Rebates Target Heat Pump Water Heaters

Canadian province offers up to \$4,000 to installers of units, including Sanden's CO₂ models.

— By Charlotte McLaughlin and Michael Garry

The Canadian province of British Columbia is offering substantial rebates to homeowners who install heat pump water heaters, including the CO₂ unit that Sanden has been marketing in North America over the past two years.

The rebates are part of a \$24 million (CAD) program launched last September that provides up to \$14,000 for a home and \$200,000 for a commercial business to switch to high-efficiency heating equipment and to make building-envelope improvements. The program is the result of a partnership comprising the EfficiencyBC, the Canadian government, BC Hydro, FortisBC, BC Housing and many local governments, including cities like Vancouver, Victoria and Campbell River.

"So the city of Vancouver will provide a rebate if you want to switch from fossil fuels to a CO₂ heat pump," said John Miles, Los Angeles-based general manager, eco products for Sanden International USA, in an interview at AHR Expo in Atlanta, Ga., in January. "Depending on the application, it can be up to \$4,000." This would cover the cost of the equipment, cutting installed cost in half or better, he added.

Commercial buildings, multi-unit residential buildings and non-profit housing in British Columbia are also eligible for incentives of \$40-\$70 per metric ton of greenhouse-gas reductions, up to \$200,000; upgrades could include switching to electric water-heating equipment.

Rebate details are available at <https://efficiencybc.ca/incentives/>.

Rebates are key to driving adoption of CO₂ heat pump water heaters rather than more commonly used gas units, Miles noted. "Utilities are starting to get wise and realize they need to push change to make change."



John Miles, Sanden, with 119-gal CO₂ heat pump water heater

LARGER WATER TANKS

At AHR Expo, Sanden showcased a 119-gal water tank for its heat pump system; the company has also added a 200-gal tank to go along with its earlier 43- and 83-gal models.

"The new tanks are aimed this year at the commercial market," including large multi-family buildings, restaurants and institutions, said Miles, adding the smaller tanks are geared to the residential market.

For example, Kingway Apartments, a 24-unit town house development in Seattle, employs one Sanden heat pump with a 43-gal tank per residence. (See "Hot Water, Courtesy of CO₂," *Accelerate America*, January 2018.) By contrast, the 324-unit Monterey Pines apartments, a low-income complex in Richmond, Calif., that is supported by grant money, uses a centralized system consisting of 96 heat pumps and 60 119-gallon tanks, one of Sanden's largest deployments.

In total, Sanden has installed "a couple of thousand" CO₂ heat pump water heaters in North America, Miles said.

While climate-friendly CO₂ heat pump water heaters are five to six times more efficient than gas heaters, gas is about five to six times less expensive than electricity, so operational costs are "a wash." Adding solar panels, however, makes the heat pump free to operate, he noted.

Progress remains slow for the heat pump water heater industry as a whole in North America, Miles said. "The mainstream HVAC industry is super slow at changing." Still, he added, "the signs are all there and it looks like it could increase." He added that, at the AHR Expo, "the acceptance of CO₂ water heaters is growing." ■ CM & MG

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THE KIGALI AMENDMENT: NEXT STEPS

Preparing for the global HFC-reduction scheme to take effect on January 1, countries discussed energy efficiency, support for natural refrigerants, improving compliance mechanisms, and more at a meeting in Quito

— By Marie Battesti

After seven years of negotiations, on October 15, 2016, 197 parties (countries) to the Montreal Protocol at a meeting in Kigali, Rwanda, adopted the Kigali Amendment, calling for a global phase-down of HFCs.

The amendment requires ratifying developed (non-A5) countries to cut HFC production and consumption by 10% in 2019 compared to annual average values from 2011-2013, leading to an 85% reduction by 2036. Developing (A5) countries have a more lenient schedule, with most starting a freeze in 2024 and concluding with an 80% cut by 2045; others will start in 2028 with a freeze and finish with an 85% reduction by 2047.

For all this to happen, at least 20 countries had to ratify the amendment, which happened in November 2017 with Sweden becoming the 20th party to ratify (the 19th country plus the

European Union). And on January 1, ratified non-A5 countries had to launch their HFC phase down efforts as the amendment officially took effect.

Leading up the official launch of Kigali, the countries met last November in Quito, Ecuador, at the 30th Meeting of the Parties to the Montreal Protocol (MOP 30) to negotiate practical arrangements for its implementation. These included technical provisions such as approved technologies for the destruction of HFCs and new data-reporting requirements.

The parties also addressed a range of lingering issues, such as the rise in emissions of R11 (an ozone-depleting CFC with a GWP of 4,000) in China; the need for technologically neutral safety standards; the development of energy-efficient HVAC&R technologies; and support for natural refrigerants in developing countries.

CFC-11 EMISSIONS IN CHINA

The Environmental Investigation Agency last July revealed that several Chinese companies were still using R11 – officially banned globally by 2006 – in rigid polyurethane foam (used predominantly as insulation by the construction industry).

The parties raised concerns over the possible inability of the Protocol institutions and compliance mechanisms to face up to R11 violations. Delegates stressed the need to implement more effective watchdog mechanisms to overcome the unexpected rise of CFC-11 emissions, and prevent the Protocol's potential loss of credibility.

"It is critical to invest in systemic changes to aid continued compliance and also address the related issue of refrigerant banks, which could avoid up to 97 billion [metric tons] of carbon-equivalent emissions globally between 2020 and 2050," said Avipsa Mahapatra, climate campaign lead in the EIA's U.S. office.

In Quito, the Parties committed to ensuring that the phase out of R11 is sustained, and to share information on any illegal use or production of R11 to the relevant bodies of the Montreal Protocol.

TECH NEUTRALITY ON SAFETY STANDARDS

European Commission representative Philip Owen stressed the need for the Montreal Protocol to be technology neutral in analyzing and identifying the safety standards needed to achieve the HFC phase down.

Owen was referring to the role of the Ozone Secretariat – the part of the United Nations Environment Programme that organizes Montreal Protocol meetings – in providing parties with safety standards that will enable them to fulfill their obligations under the Kigali Amendment.

SUPPORTING ENERGY EFFICIENCY

The parties discussed the need to support the development of energy efficient refrigeration, air-conditioning and heat pump technologies while phasing down HFCs.

To that end, the Technical Economic Assessment Panel (TEAP) – a Montreal Protocol body – recommended that the parties update the Multilateral Fund, which finances projects in emerging economies and enables access to financial institutions.

The parties warned against making access to funding unnecessarily complex, which could jeopardize the Montreal Protocol's objectives. They stressed keeping the interests of consumers at the center of the new funding architecture, by, for example, mitigating the price of energy-efficient technology.

SUPPORTING NATREFS

Emerging economies are showing interest in leapfrogging HFCs and adopting natural refrigerants to replace the HCFCs being phased out globally under the Montreal Protocol by 2030.

For example, representatives of Chile and Cameroon said that they were interested in natural refrigerants as a means of transitioning from HCFCs to very low GWP refrigerants. Most developing countries will freeze consumption of HFCs by 2024, with their first reduction steps starting in 2029.

"There is definitely very high interest in natural refrigerants in Africa," a delegate from Cameroon said. "I believe there is great potential as well, especially for hydrocarbons."

Chile and Cameroon are eligible for financial assistance under the Multilateral Fund.

Claudia Paratori Cortés, from Chile's Office of Climate Change in the Ministry of Environment, highlighted progress made by South America in adopting transcritical CO₂ technology.

"Chile prioritizes the adoption of natural refrigerants," said Paratori Cortés. "We are trying to leapfrog from HCFCs to natural refrigerants, and we are trying to avoid HFOs as much as possible."



"I see great potential for the development of natural refrigerants in Chile," she added. "Many supermarkets are moving to CO₂ transcritical technology. Other industries, such as cold storage, are also examining opportunities to adopt this technology."

Writing in the Winter 2018 issue of *Accelerate Europe* (a sister publication to *Accelerate America*), Sophie Geoghegan, climate campaigner for EIA, said the Kigali Amendment "will raise awareness of the need to rapidly transition away from HFCs. Widespread awareness-raising will help prevent HFC systems with high global warming potentials from being locked in before the phase down begins." ■ MB

ABOVE

Quito, Ecuador, site of MOP 30



AHR Expo Highlights, Part 1

CAREL, Embraco and BAC were among the component makers showcasing natural refrigerant products at the massive trade show in Atlanta

— By Michael Garry

The AHR Expo continued to prove it is one of the largest exhibitions of HVAC&R equipment in the world in its latest iteration at the Georgia World Congress Center in Atlanta, January 14-16, held concurrently with ASHRAE's Winter Conference.

With a decided focus on HVAC among the 1,824 exhibitors, the expo did not have a substantial number of natural refrigerant products on display for the 45,078 attendees. Still many component makers supporting CO₂ and hydrocarbon applications were on hand. The following is an initial sampling, to be followed next month with more examples.

CAREL's energy-saving cooler system

Italian component maker CAREL plans to start North American marketing of its Heez propane (R290) beverage cooler technology, which, the company says, can reduce the energy consumption of a cooler by 52% below the U.S. Department of Energy's 2017 standard.

The Heez system, which includes a controller, controller display, electronic expansion valve (EEV) and a BLDC inverter single-rotary compressor, was displayed in a 14.02 cu-ft vertical closed cooler at the AHR Expo, and will be featured at the NAFEM Show in Orlando, Fla., in February.



CAREL's Heez R290 cooling system

CAREL makes the system's components, except for the compressor, which is designed by CAREL and manufactured by QING AN. The Heez system also incorporates two variable-speed DC fans.

With the Heez system, "every device in the refrigeration cycle is modulated," said Brandon Marshall, application manager refrigeration for CAREL's U.S. division located in Manheim, Pa. "The compressor slows down as the temperature is reached, the valve maintains the evaporator's efficiency with low super heat, and the fans modulate."

For the AHR Expo cooler, at an internal temperature of 38°F +/- 2°F, the Heez system enables the unit to consume 1.08 kWh/day, which is 52% less than the DOE standard and 39% less than the 2017 ENERGY STAR standard. The numbers are based on third-party energy tests by Regent, said Marshall.

The system also cuts temperature pull-down time in half, Marshall added.

CAREL showed a medium-temperature version of the system at AHR Expo; another medium-temperature and two low-temperature models are expected.

Heez was launched in North America a year ago and "is reaching full commercialization in 2019," Marshall said. It will serve beverage coolers, as well as under-counter and upright refrigerators and freezers.

Customers for the system include beverage brands and OEMs of self-contained retail and foodservice refrigeration equipment. Heez-based equipment has been installed in Europe and South America, he noted.

The Heez system also features NFC and Bluetooth connectivity, enabling technicians and end users to monitor and manage performance via a new mobile app called Applica. "You can turn lights on and off, activate energy-saver mode, slow down the compressor, increase the set point, monitor alarms and load parameter lists," said Marshall. "There is also an area on the app for contractors that simplifies commissioning and servicing of the equipment."

CAREL has also developed a cloud service called Armilla that tracks all of its cooler equipment and offers data on a software-as-a-service basis.

Marshall acknowledged that the Heez system is "a little more expensive" than comparable systems but "most bottle coolers do not incorporate DC [inverter] technology, electronic expansion valves and variable-speed fans." He also pointed out the considerable energy savings enabled by the technology.

Embraco's variable-speed compressors

Brazilian compressor manufacturer Embraco sees highly efficient variable-speed compressors for R290 "taking off" in North America since "we started promoting it" a year ago, said John Prall, application engineer for Embraco.

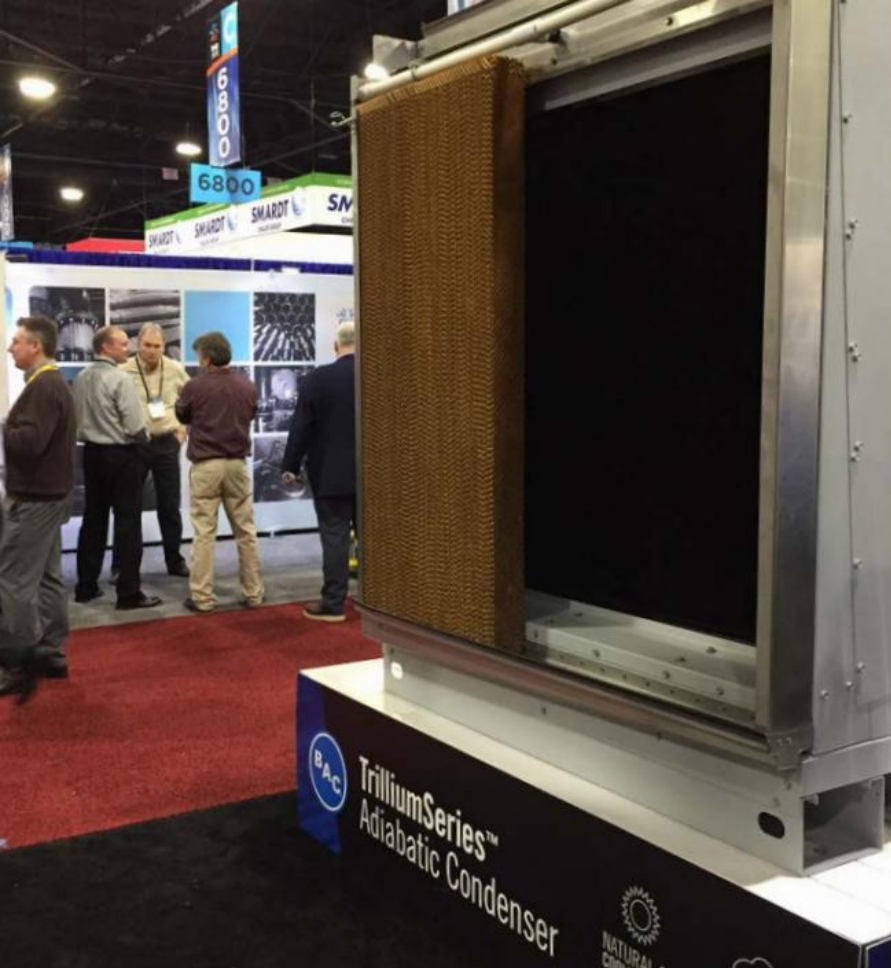
He shared his views on the R290 market at the AHR Expo, where Embraco introduced an R290 variable speed compressor, model FMFT415U, at the show that has a 20% higher capacity than previous models.

"Variable speed is the way to achieve energy targets in a cost-effective way, particularly for freezers," Prall said.

Marek Zgliczynski, director of research and development for Embraco, pointed out that by saving compressor energy, variable-speed units generate less waste heat in air-cooled commercial systems, reducing the burden on a store's air-conditioning system.

The cost of a variable-speed compressor may be higher than a conventional compressor, "but people don't understand that the return is quick – a few months for a freezer," Zgliczynski noted.

Prall explained that the cost of a variable-speed compressor may range from zero to 50% higher than a conventional unit. But its energy efficiency reduces the cost of other components in a self-contained case, rendering the overall cost of an optimized case the same as a standard HFC case that is not optimized.



Baltimore Aircoil Company's adiabatic condenser

BAC's larger adiabatic condensers

Baltimore Aircoil Company (BAC) recently released larger versions of its Trillium adiabatic condenser, which can be used to support installations of transcritical CO₂ systems at larger supermarkets and industrial plants.

The larger models can handle capacities of "over 4,000 MBTUs," said Philip Hollander, BAC's business manager for North American Refrigeration, at the AHR Expo. One of the adiabatic condensers is being used in a very large industrial plant in the U.S.

While smaller retail outlets like those operated by ALDI US have used the Trillium units for CO₂ transcritical systems, "we are seeing CO₂ systems applied at larger supermarkets as well as industrial sites," said Hollander.

Adiabatic condensers enable transcritical CO₂ systems to operate in the more efficient subcritical mode in warm weather.

BAC works with customers to show that the Trillium condenser can save energy and thus generate a payback for the investment in the system, Hollander said. The payback, he added, is at most three years, and often "dramatically less," depending on the climate, electric rates and other factors.

BAC expects to see more growth in the transcritical CO₂ market in the U.S. this year as food retailers loosen their purse strings for capital investment after a period of retrenchment over the past few years, he said. ■ MG

shecco CEO: Stakeholders Can Push for Incentives in California

As the California legislature considers how much funding to provide for natural equipment subsidies under the California Cooling Act, industry stakeholders can push for those subsidies until the summer of 2019, said shecco CEO Marc Chasserot at the AHR Expo.

"This will be an opportunity to get some incentives for natural refrigerant-based equipment in supermarkets and industrial applications," said Chasserot during a presentation called "Global Market and Policy Trends for CO₂ and Ammonia in Refrigeration."

(Stakeholders interested in communicating with relevant parties in the California government in regard to the incentives program should email klara.skacanova@shecco.com.)

Other highlights of Chasserot's presentation include:

- ▶ There are now more than 615 transcritical CO₂ systems installed in stores in North America, including more than 370 in the U.S. and more than 245 in Canada.
- ▶ Europe remains the leader in transcritical CO₂ with more than 16,000 installations, which accounts for about 14% of all stores.
- ▶ Transcritical CO₂ systems are being installed in some challenging high-ambient environments, such as Jordan, India, Russia and Mexico.
- ▶ More than 6,000 stores are using CO₂ condensing units or mini-boosters globally.
- ▶ More than 420 low-charge ammonia systems are used in North America, including more than 200 in Canada and more than 220 in the U.S.

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R290

THE FUTURE OF RETAIL REFRIGERATION?



Propane self-contained display cases, popular in Europe, are gaining traction in the U.S. among chains like Hannaford as a retrofit opportunity in existing stores – and a complete-store solution

— by Michael Garry

At a meeting of the Consumer Goods Forum in 2010, where some major food retail chains were discussing developments in natural refrigerant refrigeration technology for new stores, there was “the elephant in the room,” recalled Harrison Horning, director of maintenance for Hannaford Supermarkets.

“It was, what are we going to do about the thousands of existing stores in the U.S.?” he said. “And it’s still the elephant in the room. Maybe by 2020, 10 years later, we’ll have an answer.”

One possible answer that Horning is starting to explore is whether self-contained display cases using propane (R290) as the refrigerant could be systematically employed in existing stores to replace cases at the end of their life. That would be a way of incorporating a natural refrigerant in the many thousands of existing stores in need of updating.

New store construction has been sparse for Hannaford in the last five years, but existing stores are in continuous need of upkeep. “A lot of the time we need to replace a few cases here, a lineup there,” said Horning. “So we’re looking to get a natural or low-impact solution that will address replacement of existing cases – not necessarily everything at once.”

To prepare for that approach, Horning is testing R290 in complete frozen-food lineups in some new stores, in combination with a glycol/water secondary loop system serving medium-temperature cases.

Hannaford was one of the pioneers of transcritical CO₂ in U.S. supermarkets, installing the first such system at a store in Turner, Maine, in 2013. (See [“Does Transcritical CO₂ Refrigeration Deliver?” Accelerate America, November 2014.](#)) Since then the Scarborough, Maine-based chain – now a part of the Ahold-Delhaize – has installed transcritical refrigeration in another new store, as well as an existing store.

But Hannaford, like many other U.S. food retailers including Target, ALDI US and Whole Foods Market, has been widely deploying self-contained R290 cases in hundreds of stores as spot add-on or replacement merchandisers in stores mainly served by central rack systems.

Now, a growing number of U.S. retailers, including Hannaford and Lidl (both with European parents) regard R290 self-contained cases as a partial or even full-store solution in lieu of a central rack-based system. The equipment is being supplied by



▶ such manufacturers as AHT Cooling Systems USA, Hussmann and True Manufacturing, among others.

The transition to partial- or full-store deployments of self-contained R290 cases, many supported by glycol loops to remove heat, has already gained considerable traction in Europe alongside many transcritical installations. (There are more than 1,700 hydrocarbon glycol-loop stores in Europe, according to sheccoBase.) But with U.S. retailers not facing the same federal regulatory pressures to phase out old refrigerants, can R290 experience a similar uptake here?

André Patenaude, director food retail, growth strategy for Emerson Commercial & Residential Solutions, sees R290 and other natural refrigerant system adoption growing regionally in states like California and others in the U.S. Climate Alliance that have committed to reducing HFC emissions. "Integrated R290 display cases have landed in North America and we're going to hear more about them this year," he said.

Overall, there has been a marked shift toward R290 self-contained cases in North America over the past 2-3 years, said John Prall, application engineer for Embraco. "On the development side, we're seeing few applications still using HFC gases."

Prall envisions the appeal of plug-in R290 cases particularly for urban stores, a growing format where "you can't get large condensers or there's no room for a machine room," said Prall. (CO₂ condensing units, used outside of North America in small stores, are being tested in Vermont; [see page 48.](#))

Two issues continue to circle around R290 cases – the charge limit of 150 g and the flammability of propane, an A3 refrigerant. Many observers believe a higher charge limit of 500 g – which may be approved by the IEC this year – is needed to fully realize R290's potential, but others are confident that the current level is sufficient.

As for flammability, a number of industry studies have attested to the propane's safety as a low-charge refrigerant, given proper system design and handling. The latest study on the flammability of A3 refrigerants, by the Air Conditioning, Heating



Harrison Horning,
Hannaford
Supermarkets

and Refrigeration Technology Institute (AHRTI) – the research arm of AHRI – has recently been completed. "We are reviewing a draft report and expect to finalize it before April," said Xudong Wang, director of research for AHRI.

INSPIRATION FROM HEB

The idea of testing R290 as a primary store refrigerant was proposed to Hannaford by Clive Samuels, president of Coolsys Energy Design, an engineering consulting company based in Princeton, N.J. "They said, 'You need to try this' and pulled up the HEB [R290 store]," said Horning. "I didn't see this one coming."

In July 2013, HEB (H.E. Butt Grocery, San Antonio, Texas) became the first U.S. grocer to install propane-based self-contained cases from Hussmann throughout an entire store. "The use of R290 in the cases has proven to be very safe and reliable," said Charlie Wernette, principal engineer, design & construction for HEB, in a recent email. "We have had zero R290 leaks."

The store's energy use "is on par with similar stores in our chain," said Wernette. The units have experienced "an abnormally high rate of compressor losses and we continue to work

with Hussmann to determine the root cause." Since 2013, Hussmann has redesigned its R290 self-contained systems, creating its new microDS line, noted Richard Gilles, senior product leader for Hussmann's Distributed Systems Group. "We're protecting the compressors better via more robust controls," including high-pressure switches and high-temperature cutouts. (See "Hussmann Debuts Self-Contained Propane Cases," *Accelerate America*, November-December 2018.)

Hannaford's 20,000-sq-ft store in Mechanic Falls, Maine, which opened last year in July, offered the chain its first opportunity to test the installation of a complete lineup of low-temperature R290 cases (from Hussmann), whose excess heat is removed by a loop of glycol that's chilled to 45°F by a R407A rack/chiller (a rack combined with a heat exchanger).

The glycol loop is what allows R290 cases to be used on a full-store basis, said Hussmann's Gilles. "With the [glycol] loop, you get more capacity and it allows us to use larger cases. It's also scalable so you can have as many cases as you want."

Since then, Hussmann has introduced the microDS line of R290 cases; waste heat from these cases is withdrawn by a closed glycol loop with temperatures running between 50°F and 115°F, and cooled by a roof-mounted dry fluid cooler.

Operationally, Horning considers the low-temperature R290 cases to be "pretty efficient," adding, "We have no reason to doubt that." But Hannaford's focus with natural refrigerants is more on their substantial reduction of greenhouse-gas emissions than on "a 5%-10% swing in energy," he noted.

Regarding upkeep, he has had to address overheating in some R290 units, though it "was an easy fix." He is not aware of any propane leaks in R290 cases. Maintenance at the Mechanic Falls store is "normal" and "simpler than a rack," though he noted the system is only six months old. Hussmann allows technicians to monitor and diagnose issues in the R290 cases via their cell phone.

As its next step, Hannaford plans to deploy the microDS system in 2019 at a new 39,000-sq-ft store in Ballston, N.Y. "This is a chance to make it better and [continue to] see how it could apply in existing stores" as well as new stores, Horning said.

Unlike the Mechanic Falls store, the Ballston store will use a fluid cooler to chill the glycol for the R290 cases; it will be an adiabatic model, which "gives us a comfort level" on hot days, Horning said. The glycol loop will also be used for heat reclaim.



*sheccoBase data

sheccoBase

AIRPORT POPEYES CHOOSES PROPANE

Mack II Inc., which operates three Popeyes Louisiana Kitchen restaurants in the Hartsfield-Jackson Atlanta International Airport, plans to replace the refrigerators in one of the outlets in February with propane (R290) units from Victory Refrigeration.

The new units are part of a five-year remodeling process that will close the restaurant for three to four weeks, said Cheryl Evans, maintenance supervisor for Mack II, which runs a number of other franchised outlets at the airport, including Baja Fresh Mexican, Phillips Seafood and Atlanta Bread. The Popeyes restaurant being remodeled is the chain's highest-revenue unit in the world, with more than \$6 million generated annually, she said.

The R290 fridges – at a sandwich station and workstation, and an under-counter cooler – will reside in the kitchen behind the serving counter. The freezers are not being replaced.

While the Popeyes corporate office typically dictates equipment choices to franchisees, “they listen to what I say now,” said Evans.

She selected the Victory units because they offer “the only doors we don’t destroy” and are the only units “that meet all of the temperature requirements in airport inspections.” Doors, she added “are the key to keeping the temperature correct.”

Victory has switched all of its equipment to R290, Evans noted. She has concerns about R290 because “nobody is really trained on it.” On the other hand, based on videos she has seen, “it doesn’t look like it’s that difficult.” Mack II trains its own technicians.

She was also concerned about R290’s flammability since the fridges will be adjacent to fryers. “I talked extensively to the factory before I made the decision and I felt like we could handle the changes.”

She is also encouraged by the warranty on the units, which provide three years parts and labor and five years on the compressor.

Evans has been using Coilpod dust hoods to periodically clean condenser coils in her refrigerators and freezers. The hoods enable vacuuming of dust and debris from the unit without scattering it in the store. “I love [the dust hoods],” she said. “This enables us to clean coils during regular work shifts without the overtime expense of making this a night job.”

“It’s exciting to see a big company like Hussmann have catalog [R290] equipment now,” said Horning, adding that this enables merchandisers to continue operating with familiar equipment. “There’s definite interest in R290 self-contained [among U.S. manufacturers]. They are taking it seriously.”

Horning expects to test the R290 low-temperature cases as freezer replacements in an existing store near Ballston as well as others this year or in 2020. “We’ll start putting in new cases and connecting them to a cooling loop,” he said. He envisions replacing medium-temperature cases with models served by a glycol loop connected to a rack converted to a chiller. “That’s a lot less expensive than replacing everything. We do it piecemeal as a maintenance activity like today.”

GLYCOL FOR MEDIUM TEMPERATURES

On the medium-temperature side of the two new R290 stores, Hannaford is employing an R448A rack/chiller to cool glycol to 20°F, and delivering it to the medium-temperature cases and walk-in coolers as a secondary cooling agent (in contrast to the low-temperature cases, where glycol condenses R290). Horning believes Hannaford has overcome the energy penalty traditionally associated with pumping secondary glycol through a store as a cooling agent.

“We’re using copper piping that is sized a little bigger than normal so the pressure drop is less and the pump energy is less,” he explained. In addition, Hannaford saves “a ton” of energy through the adroit adjustment of compressor head pressure during the cold New England winter.

Though it will use R448A in the rack/chiller in the Ballston store (and in a condensing unit serving two walk-in freezers), and R407A in the Mechanic Fall store, Hannaford is planning to build three new stores in 2019 and 2020 that will employ CO₂ in the rack/chiller to chill secondary glycol, along with R290 low-temperature cases, creating an all-natural store. Horning had originally expected to install transcritical CO₂ systems in those stores, but his merchandisers preferred cases not designed for CO₂.

Hannaford also expects to supplement its glycol-loop low-temperature R290 cases with air-cooled medium-temperature R290 units like the beverage and island cases it is already using in some stores. A small low-temperature lineup of cases could also be air-cooled, “but you have to be sure to manage the heat gain in the hot season,” Horning said.

He leaves open the door to using more air-cooled or water-cooled R290 medium-temperature cases instead of secondary glycol as another possible natural refrigerant "end game."

Meanwhile, the combination of R290 frozen-food cases and secondary glycol medium-temperature cases represents "a significant improvement over what we have, and moves us toward the end game," said Horning.

The cost of the natural refrigerant systems Hannaford is evaluating is comparable to that of its previous standard (an HFC system optimized for the chain's climate zone), and the pilot stores "will help us validate this assumption," said Horning.

Meanwhile, Hannaford has not yet settled on a final standard, though transcritical CO₂ has been its new-store standard to date.

Horning acknowledges a particular fondness for the "plug-and-play" capability of R290 cases. "By the time I get to the end of my career, I'd love to know that when you are replacing cases in the middle of the night it can be as easy as wheeling them in and plugging them in," he said.



Gary Cooper, Lowe's Markets

The second U.S. retailer after HEB to employ R290 Hussmann cases on an extensive basis in a supermarket was Lowe's Markets, a 153-store Texas chain. In 2014 Lowe's installed 35 glycol-loop condensing units, each containing 5.1 oz or less of propane, along the top of an 88-door freezer lineup in a Lubbock store. Heat of rejection is 250,000 BTU.

The system "exceeded our expectations," said Gary Cooper, director of refrigeration for Lowe's. "It's been very robust in uptime." In a "door-to-door comparison," the R290 system consumes 25% less energy than a comparable HFC condensing unit measured in a lab.

Cooper is now evaluating the Hussmann MicroDS R290 system. "Propane is a viable solution," he said.

AHT'S WIDE REACH

AHT Cooling Systems USA, Ladson, S.C. (acquired last year by Daikin), is a veteran supplier of self-contained R290 cases for food retail, air-cooled and glycol-loop, low- and medium-temperature, in spot as well as partial- or full-store configurations. (See, [*"The Rise of Hydrocarbon Refrigeration in Stores and Homes," Accelerate America, May 2018.*](#))

Globally, AHT supplies self-contained propane cases in full-store layouts to more than 7,000 stores (many in Europe). In the U.S., AHT has supplied more than 70 stores where more than half of refrigerated load uses propane cases, with the number of those stores growing to 100 this year, said Drew Tombs, president of AHT Cooling Systems USA. "We see more [U.S.] retailers accepting of full-store propane."

AHT customer Wild Fork Foods, which offers only frozen foods, particularly meat, poultry and fish, opened three roughly 5,000-sq-ft stores in South Florida in December, and equipped them each with 40-50 air-cooled AHT R290 frozen-food cases. The cases include both horizontal chest units throughout the store and vertical reach-ins that are built into the perimeter wall, overhanging the retail space.

The single-circuit Wild Fork cases all have doors or lids, and defrost themselves (so no drains), noted Tombs. The stores use an R448A split system in the cold room. (AHT will introduce a propane model this year.)

Wild Fork installed the R290 cases to be "more environmental" and because "it was conducive to what we wanted to do," said Layli Sobhani, head of brand and marketing for the retailer. In particular,



Meanwhile, the International Electrotechnical Commission (IEC), the body that sets widely followed reference standards for charge limits, is expected to start its final vote on whether to increase the charge limit to 500 g for A3 refrigerants in mid-March, and conclude in mid-May, said Marek Zgliczynski, Embraco's director of research and development, who chairs the IEC SC61C subcommittee.

The vote would also include allowing the use of up to 1.5 kg of A2L (mildly flammable) refrigerants in plug-in cases for the first time, noted Zgliczynski, adding that A2Ls could then compete with hydrocarbons as a refrigerant for self-contained cases, especially in bigger models. However, "propane and isobutane are our preferred refrigerant," said Embraco's Prall.

If passed, the standard would be published in August. Then countries and regions could use it as a reference to enact binding standards.

Meanwhile, OEMs and component makers have taken 150 g "much further than they thought they could by changing design parameters," said Jeff

Fordeck, director, strategic accounts and global product management for compressor maker Tecumseh, Ann Arbor, Mich. For example, they have started using smaller-diameter 5-mm "Microgroove" condenser tubing that "gives great performance without extra charge."

Moreover, in the U.S., a charge limit increase from 150 to 500 g may not get through the gauntlet of agencies that need to approve it – UL, the Environmental Protection Agency and code bodies – "for another five to six years," said Kit Fransen, director, North American product management for Tecumseh. "So we'll have to live with 150 g for a while."

But that does not appear to slowing the progress of R290 adoption in thousands of U.S. stores, and growing. ■ MG

GRADUAL U.S. ROLLOUT FOR ISOBUTANE HOME FRIDGES

One of the signature moments for natural refrigerants in the U.S. last year occurred in September when the U.S. Environmental Protection Agency (EPA) raised the charge limit for three hydrocarbons – isobutane (R600a), propane (R290) and R441 – in new home refrigerators and freezers to 150 g from 57 g under the Significant New Alternatives Program (SNAP).

The higher charge limit enables appliance manufacturers to supply U.S. consumers with full-size refrigerators using isobutane – which had not been possible when the charge limit was 57 g. (Smaller-size isobutane fridges using up to 57 g have been available.) The U.S. will thus join other large global markets like Europe and China, where millions of full-size isobutane fridges have been marketed for more than 15 years.

But when will U.S. consumers start seeing the full-size isobutane refrigerators in stores?

No later than 2022, said Kevin Messner, senior vice president, policy & government relations for the Association of Home Appliance Manufacturers (AHAM), based in Washington, D.C. That's the year that California has set for the prohibition of high-GWP HFCs like R134a in full-size home fridges; similar bans will apply to built-in units the following year.

The EPA's national deadline of 2021 for high-GWP refrigerants in home units fell into limbo last year following the suspension of SNAP rules for these gases. "California is where the action is," said Messner, who hopes similar regulations in other states will mirror what California has done. Differing dates "would be a barrier for the transition" to isobutane,

2022 received industry support as a deadline because "it generally takes three years to redesign and retool for a new energy standard," Messner said. While some manufacturers have already

started gearing up for the change, they couldn't make a big investment "until EPA finalized the regulation."

Still, consumers could start seeing isobutane units sooner than 2022, though "this year would be quick," said Messner.

Lixin Chen, a sales representative for J & C International, a Canadian compressor manufacturer, thinks the new isobutane fridges could start emerging in 2019, with "more and more next year." J & C supplies such OEMs as Frigidaire, Electrolux and Haier/General Electric.

"Eventually, the U.S. [home fridge market] will be 100% isobutane," he said, citing the higher efficiency of the units.

The efficiency of isobutane compared to R134a stems from the former's denser molecule, which "moves heat better," said Messner, though he declined to say how complete units would perform.

CO₂ SAVES THE DAY

Barred by local codes from using ammonia in a new industrial plant, Angelic Bakehouse found transcritical CO₂ to be a handy substitute.

— By Charlotte McLaughlin and Michael Garry

While ammonia remains the primary refrigerant in industrial refrigeration — increasingly in low-charge configurations — there are times when it can't be used.

Sprouted bread maker Angelic Bakehouse, based in Cudahy, Wis., discovered one such no-ammonia-allowed scenario in early 2017 when it decided to build a 22,000-sq-ft plant in an existing building in Cudahy located near the heavily trafficked Milwaukee airport. Local codes forbade the use of ammonia that close to the airport.

"So [Angelic Bakehouse] needed to find another way," said Rusty Walker, corporate trainer for Conyers, Ga.-based Hillphoenix, during the ATMOsphere America conference last year in Long Beach, Calif. (The conference was organized by shecco, publisher of *Accelerate America*.)

Angelic Bakehouse, which produces healthy wraps, breads, crisps, buns and other assorted baked goods at 17 ammonia-refrigeration production plants across the U.S., looked into several other options for the Cudahy location, including HFOs. Ultimately the company decided to "try it with CO₂," said Walker. "CO₂ is natural."

Hillphoenix, one of the leading manufacturers of transcritical CO₂ systems for supermarkets in North America, supplied an industrial-sized model for this facility.

The Cudahy transcritical CO₂ system is comparable to one that would be used by a supermarket, Walker noted. "It's a simple booster rack. From an operational standpoint there is no difference. That's what makes it so easy for my contractors."

The contractor in this case, Zone Mechanical, "has done a lot of this type of work, and they've been through a lot of different [CO₂] training," he said, adding, "One of the things you have to do in this industrial application is to make sure you have a good partnership with the contractor who is going to put this in."

The Cudahy plant's CO₂ transcritical system provides 283 TR at medium-temperature (25°F) to cool the package area and loading dock; and 123 TR at low-temperature (-20°F) for five blast freezers and one freezer storing 420 lbs of packaged bread. The high-side part of the system — four 10-HP compressors for low-temperature and six 30-HP compressors for medium temperature — resides in a standard machine room located on the roof.

The system, Walker pointed out, uses electric defrost, Micro-Thermo controls, Bitzer compressors with a variable frequency drives (VFD) on the lead compressors per suction group, Luvata air cooled gas coolers with VECM-driven fan motors, Güntner evaporators, hot water reclaim for the processing area, and a heated sub-soil design under the freezer slab. "We do a little bit of sub-cooling inside the receiver on the suction side," he added.



Rusty Walker, Hillphoenix

GOOD PERFORMANCE PROJECTED

Walker cited a Bitzer study projecting that the Cudahy CO₂ plant would perform well compared to one using an HFO blend (R448A), saving about 9% on energy consumption annually.

Given Cudahy's northern location, there is less risk of the transcritical CO₂ system hitting the "transcritical point" (around 88°F) where the system becomes less efficient, Walker noted, though like most northern climates, higher temperatures are not uncommon in the summer.

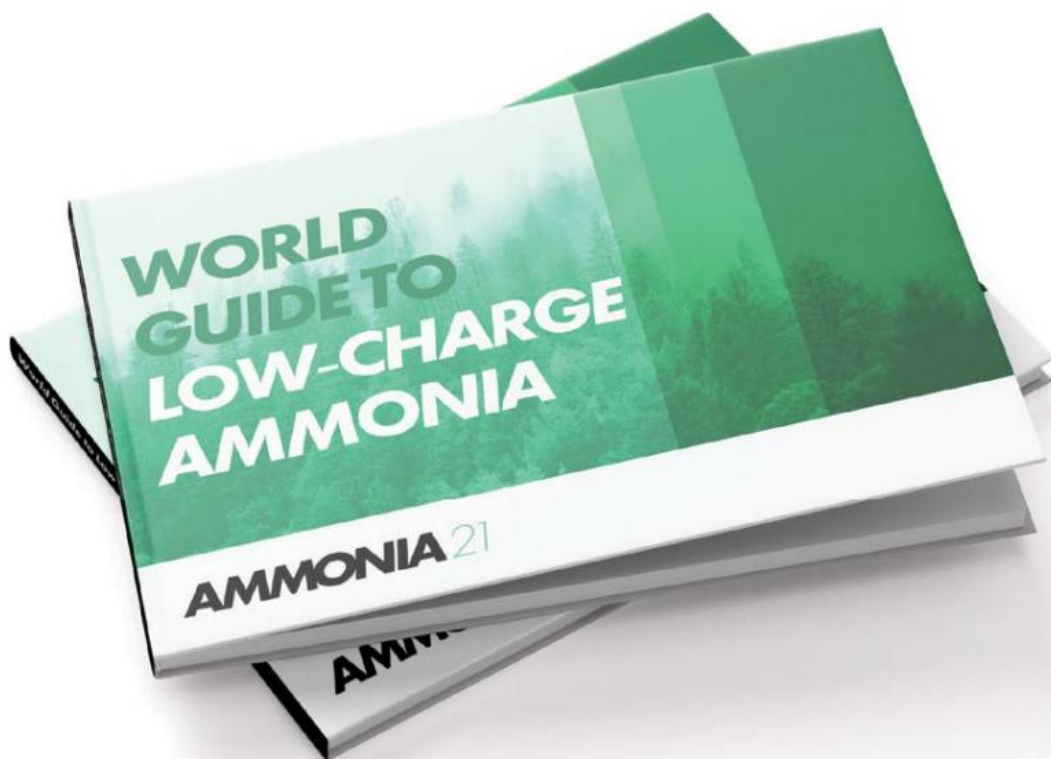
In any event, a few heatwaves will not effect the calculation of overall energy performance. "The energy cannot be looked at in a snapshot," he explained. "Energy has to be looked at [over the course of year] and that's where get the 9% savings."

In addition, the "total installed cost comparison and ROI were favorable," said Walker. ■ CM & MG



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VERMONT TO TEST CO₂ CONDENSING UNIT

To justify end-user incentives, Efficiency Vermont will oversee a store pilot comparing energy savings of a CO₂ system to that of an HFC system

— By Michael Garry



Ali White and Ethan Bellavance, VEIC

Efficiency Vermont, an efficiency utility under the auspices of the non-profit Vermont Energy Investment Corp. (VEIC), is overseeing a test of a CO₂ condensing unit in a supermarket, one of the first such installations in the U.S.

Intended to start in the second quarter of 2019, the pilot will measure the energy efficiency of the condensing unit in comparison with that of an HFC unit. The ultimate goal is to award financial incentives to purchasers of a more energy-efficient system, explained Ali White, energy consultant for VEIC.

"Our job is to highlight the business case for installing a CO₂ condensing unit," said Ethan Bellavance, senior energy consultant for VEIC.

In addition to electricity savings, Efficiency Vermont is looking at the potential for "higher-grade waste heat to offset fossil fuel consumption" as a result of the higher compressor discharge temperatures associated with CO₂, said Bellavance.

Efficiency Vermont sees a CO₂ condensing unit as the right size for small- and medium-size refrigeration loads at the state's many small "mom-and-pop" stores as well as convenience stores, micro-breweries and dairies, White said. "We're focusing on [a system] that is in between a self-contained propane case and a rack system."

These businesses have "simultaneous cooling and heating loads" that currently use HFC condensing units but could benefit more from a CO₂ system, she said, adding, "We see the CO₂ condensing unit having a lot of potential for the Vermont market."

In the test, the CO₂ condensing unit will chill glycol, which will serve a "couple of loads," while an HFC unit will serve other loads, said Bellavance. The study will meter

the energy usage of each system and compare their BTU per watt per hour.

Rare in the U.S.

CO₂ condensing units, while widely employed in Europe and Japan, are rare in the U.S. But Energy Vermont, funded by Vermont utility rate payers, found a North American manufacturer willing to produce one for the test, as well as a Vermont contractor and a retailer willing to conduct the pilot. (Names of the parties were not available.)

"CO₂ condensing units offer tremendous potential for commercial refrigeration applications, from large supermarkets to small-format convenience stores," said Danielle Wright, executive director of the North American Sustainable Refrigeration Council, in a statement. "This technology makes the transition to low-GWP refrigerants more economically feasible by allowing for retrofit options and offering efficiency gains."

In October, NASRC and VEIC collaborated on a one-day natural refrigerants workshop sponsored by Danfoss and True Manufacturing in Burlington, VT. At the workshop, White discussed the CO₂ condensing unit pilot.

Founded in 1999, Energy Vermont is the first energy efficiency utility designed to be separate from an electric utility, which typically handles efficiency incentives in-house, noted White.

Among its research projects, Energy Vermont looks at energy efficiency in refrigeration. "We're seeing a reason for end users to move to natural refrigerants for environmental and economic benefits," said Bellavance.

Efficiency Vermont runs a statewide Efficiency Excellence Network of skilled service providers, providing training to design, install and service efficient systems. Before installing a CO₂ condensing unit, "we would have a conversation with refrigeration technicians to make sure they are comfortable taking on a new refrigerant with higher pressures," said Bellavance. ■ MG



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