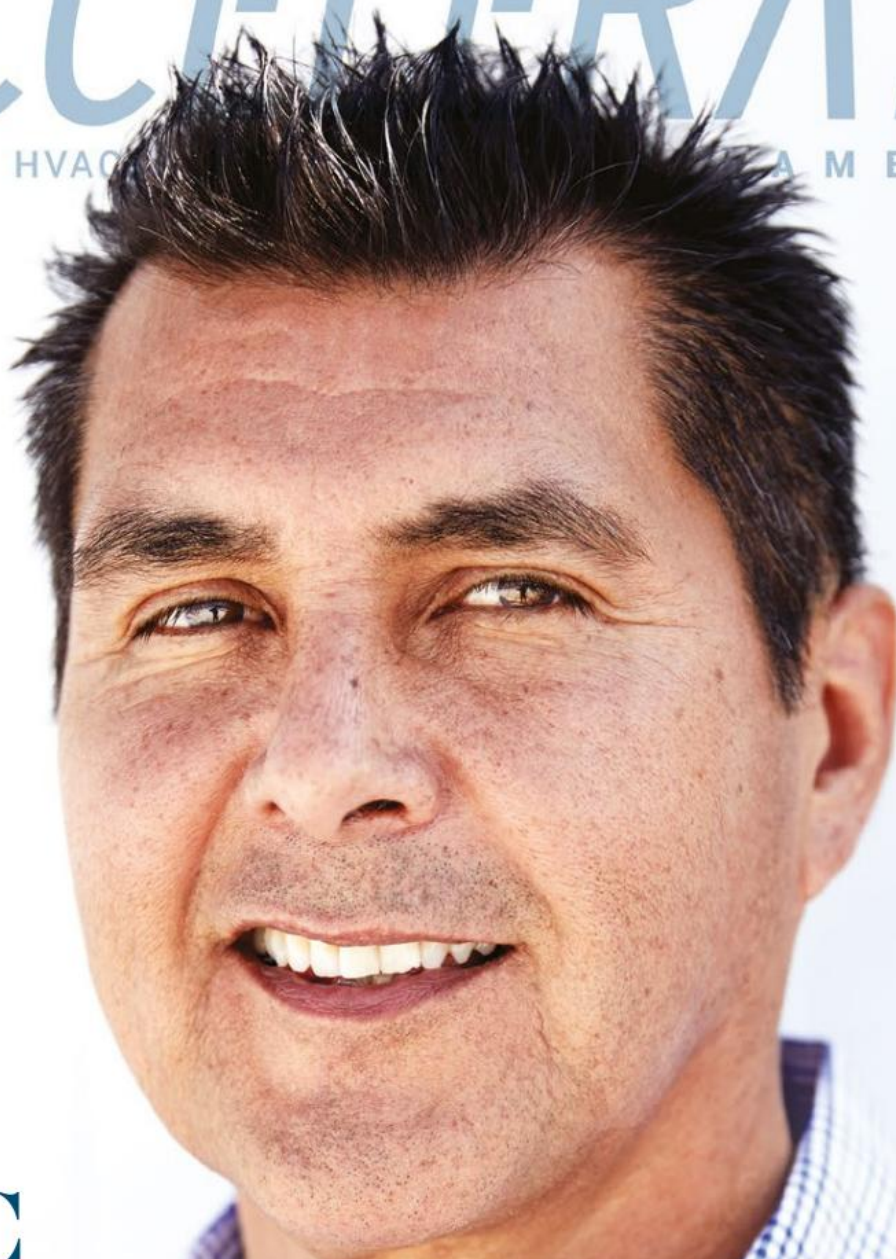


MARCH 2018

ACCELERATE

ADVANCING HVAC BUSINESS AMERICA



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Impact

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NH₃ Ice Rinks

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GENERAL
EMBRACES
ULTRA-LOW-CHARGE
AMMONIA**

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The Only Future-Proof Investment

“Fool me once, shame on you; fool me twice, shame on me.” So goes the old adage. But what about “fool me three times”? That would surely raise some serious questions about one's credulity.

In the HVAC&R industry, the major chemical companies originally created CFCs like R12 and HCFCs like R22 that were effective refrigerants but later found to deplete the ozone layer in the atmosphere necessary for human health. The problem was addressed on a global basis through the 1987 Montreal Protocol agreement with the phase-out of those chemicals.

However, HFCs – the replacement for CFCs and HCFCs – proved to be powerful greenhouse gases (as were CFCs and HCFCs), contributing to the growing environmental crisis of climate change. This problem is starting to be addressed on a global basis through the Montreal Protocol's 2016 Kigali amendment, with the planned phase-down of HFCs.

Now we are at stage three. The next generation of synthetic refrigerants, HFOs and HFO blends, has entered the marketplace as low-GWP replacements for HFCs. Actually, the GWP of HFO blend R448A, which is being marketed as a replacement for very high GWP HFCs, is still high at 1,273. But a pure HFO like R1234yf is just 4, so it is indeed a low-GWP alternative for certain applications.

But HFOs come with their own issues. One is the creation of toxic hydrofluoric acid (HF) as a degradation product of the combustion of HFOs that fall into the A2L flammability category; another is the breakdown of HFOs in the atmosphere into trifluoroacetic acid (TFA), which comes down to earth in rainfall.

These side effects of HFOs are being studied by a number of groups around the world. For example, ASHRAE, in its 1806 project, will consider a risk assessment of the creation of hydrofluoric acid in the combustion of A2L refrigerants.

Starting on [page 18](#), we report on a recent study commissioned by the Norwegian Environment Agency on the environmental and health effects of HFO refrigerants, notably the impact of TFA. This study is based on a review of the scientific literature as well as interviews with stakeholders.

The current consensus, according to the study, is that TFA's effect on the environment will be negligible. However, that's hardly the end of the story, for the study also says that major “knowledge gaps” in the understanding of the long-term effects of HFOs/TFA need to be filled before it can be definitively concluded that they are safe to use.

In particular, a major uptick in the use of HFOs as an HFC replacement would introduce much higher quantities of TFA (a highly durable substance) into the environment, with consequences still not known.

The report even says that given these uncertainties, “phasing out HFOs (and consequently TFA), or emission reduction strategies ... will help reduce the risk to human and environmental health.”

Of course, there is an alternative to HFOs that does not pose potential future risks to the environment – natural refrigerants. In this and every previous issue of *Accelerate America*, we show the ways CO₂, hydrocarbons and ammonia can be used efficiently and effectively in a multitude of applications. It's the only future-proof investment you can make. ■ MG



Michael Garry
Editor

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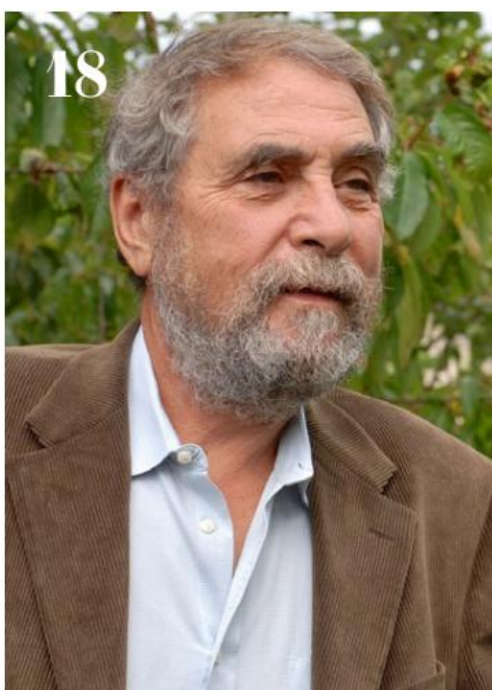
It says knowledge gaps on TFA toxic-
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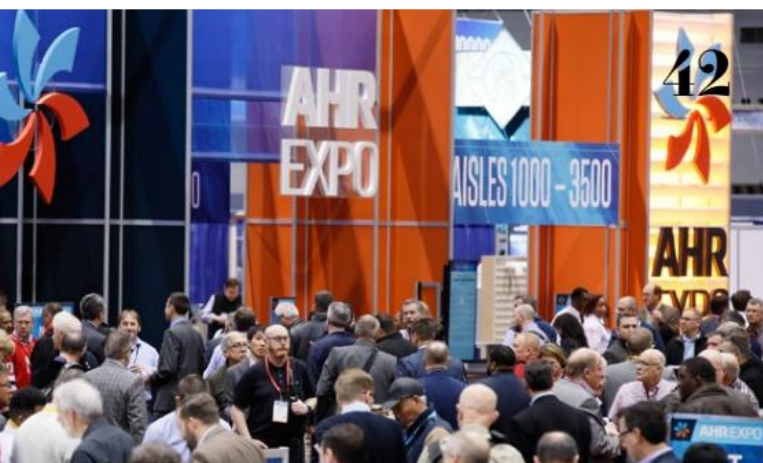
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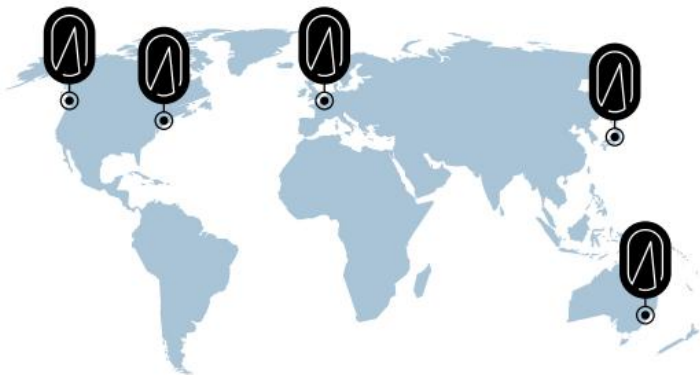
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//Technology

MARCH 2018

ACCELERATE

ADVANCING HVAC&R NATURALLY AMERICA



About Accelerate America

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

<http://acceleratenet.com>

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

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March 2018

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VOLUME 4 **33**

// ISSUE #30 *November-December 2017*

FOCUS:

Leading end users

PUBLICATION DATE:

November 24

// ISSUE #31 *January 2018*

FOCUS:

CO₂ heat pump water heaters

PUBLICATION DATE:

January 10

// ISSUE #32 *February 2018*

FOCUS:

Research by Pega Hrnjak

PUBLICATION DATE:

February 14

ISSUE #33 *March 2017*

FOCUS:

Low-charge ammonia (packaged)

PUBLICATION DATE:

March 13

// ISSUE #34 *April 2018*

FOCUS:

Low-charge ammonia (central)

AD SUBMISSION DEADLINE:

April 5

PUBLICATION DATE:

April 10

PRINT DISTRIBUTION:

IARW-WFLO Convention

// ISSUE #35 *May 2018*

FOCUS:

Self-contained hydrocarbon refrigeration

AD SUBMISSION DEADLINE:

May 3

PUBLICATION DATE:

May 8

PRINT DISTRIBUTION:

National Restaurant Association (NRA) Show

// ISSUE #36 *June-July 2018*

FOCUS:

Policy & incentives

AD SUBMISSION DEADLINE:

May 31

PUBLICATION DATE:

June 5

PRINT DISTRIBUTION:

ATMOsphere America,
Global Cold Chain Expo

// ISSUE #37 *August 2018*

FOCUS:

Accelerate America Awards

AD SUBMISSION DEADLINE:

July 27

PUBLICATION DATE:

August 1

// ISSUE #38 *September 2018*

FOCUS:

Food retail

AD SUBMISSION DEADLINE:

August 30

PUBLICATION DATE:

September 5

// ISSUE #39 *October 2018*

FOCUS:

CO₂ in industrial refrigeration

AD SUBMISSION DEADLINE:

October 3

PUBLICATION DATE:

October 8

* Publisher reserves the right to modify the calendar.

#GoNatRefs



LETTERS TO THE EDITOR



KIGALI: A NO-BRAINER

It was interesting to see the piece entitled "[Trump Administration Focuses on Economic Impact of Kigali](#)," in the February issue of *Accelerate America*. It is hard to imagine that this administration is still questioning the economic benefits of the global HFC phase-down to American businesses.

Since the publication of that piece, two major developments have already shown that such uncertainty is misplaced.

First, a bipartisan bill called the American Innovation and Manufacturing Act ([see page 30](#)) was introduced that would direct the Environmental Protection Agency to implement a regulation implementing the Kigali Amendment by the end of this year. The co-sponsors of this bill, from Louisiana and Delaware, make clear the economic benefits this would have for their states and U.S. industry as a whole.

Secondly, California state Senator Ricardo Lara introduced the California Cooling Act, a landmark proposal that outlines a plan for the California Air Resources Board to implement state-level regulations to phase out many HFCs, while also providing financial incentives that would help California businesses and consumers cover some of the costs of purchasing new climate-friendly cooling systems. (See, "[California Reacts to Court Ruling on HFCs](#)," *Accelerate America*, February 2018.)

Both of these efforts come in the wake of a recent federal court decision being appealed to the Supreme Court that rolls back federal regulations to reduce HFCs. A broad coalition of industry and environmental groups are supporting these efforts, underscoring the importance of a swift ratification of the Kigali Amendment by the U.S. Senate.

Either way, once the Kigali Amendment goes into effect January 1, 2019, any country that did not ratify it would be restricted from trading in HFCs with countries that did under the treaty's "non-party trade provisions." Twenty-five parties to the Montreal Protocol have already ratified the Kigali Amendment, triggering its entry into force in 2019. U.S. companies could be restricted from selling to trading partners in countries including Canada, Mexico, the European Union, China, and Japan. So, the decision to participate in the Kigali Amendment should be an easy business decision.

The U.S. can either seize this opportunity to lead the global market transformation, or laggardly try to lock itself into dead-end technologies. Regardless of the policy decision to ratify the Kigali Amendment, the transition away from HFC refrigerants is already well underway here in the United States. Delaying ratification will not only adversely affect the American industry that has already invested millions of dollars in the research and development of next-generation cooling and the jobs they support, but will also undo the great American legacy at the Montreal Protocol.

Avipsa Mahapatra

Climate Campaign Lead
Environmental Investigation Agency
Washington, D.C.

AN EARLY ADVOCATE

I truly enjoyed the February article about Pega Hrnjak ("[Pega's Quest](#)."). I did not realize that he was an early advocate of natural refrigerants and that is what drove his interest in reducing refrigerant volumes, specifically ammonia. I look forward to his keynote address in June at ATMosphere America.

Harry Schmitz

Senior Account Supervisor
Kellen Company
New York, N.Y.

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.

REFRIGERATION TECHNOLOGY FOR A BETTER WORLD

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WITH NATURAL SOLUTIONS

With increasing global demand for sustainability, natural refrigerant technologies are meeting the world's highest standards for energy efficiency and refrigerant usage. They lower CO₂ emissions, have very low global warming potential and consume up to 45% less energy than hydrofluorocarbons (HFCs). In fact, technologies that use natural refrigerants already comply with new EPA regulations while helping OEMs achieve the Department of Energy's minimum efficiency performance standards for 2018 and 2019.

TO LEARN MORE ABOUT COMMERCIAL REFRIGERANT STANDARDS AND
NATURAL REFRIGERANT SOLUTIONS, VISIT **EMBRACO.COM**

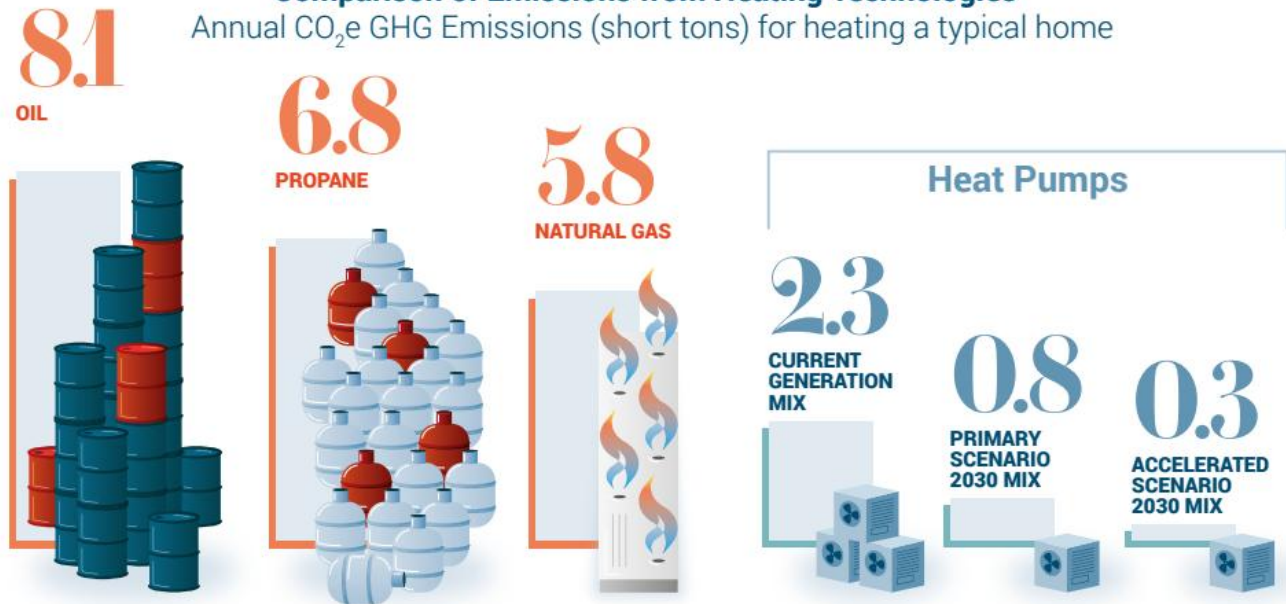
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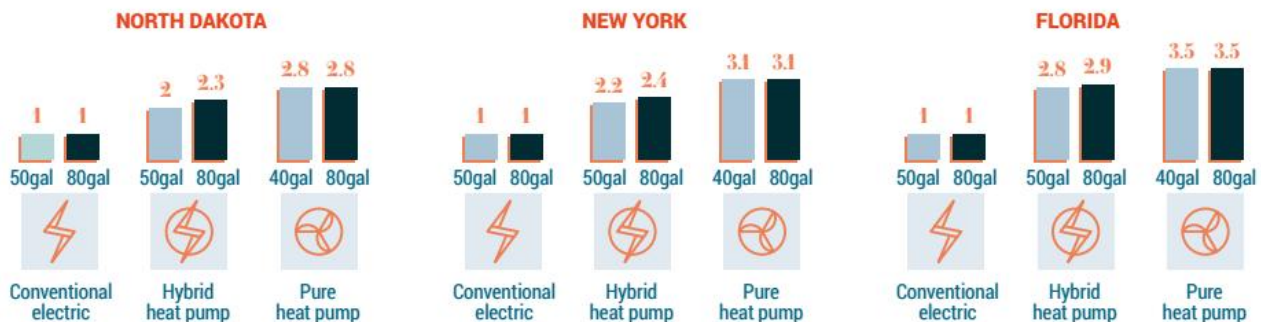
Heat Pumps' Efficiency and Impact on the Environment

Comparison of Emissions from Heating Technologies*

Annual CO₂e GHG Emissions (short tons) for heating a typical home



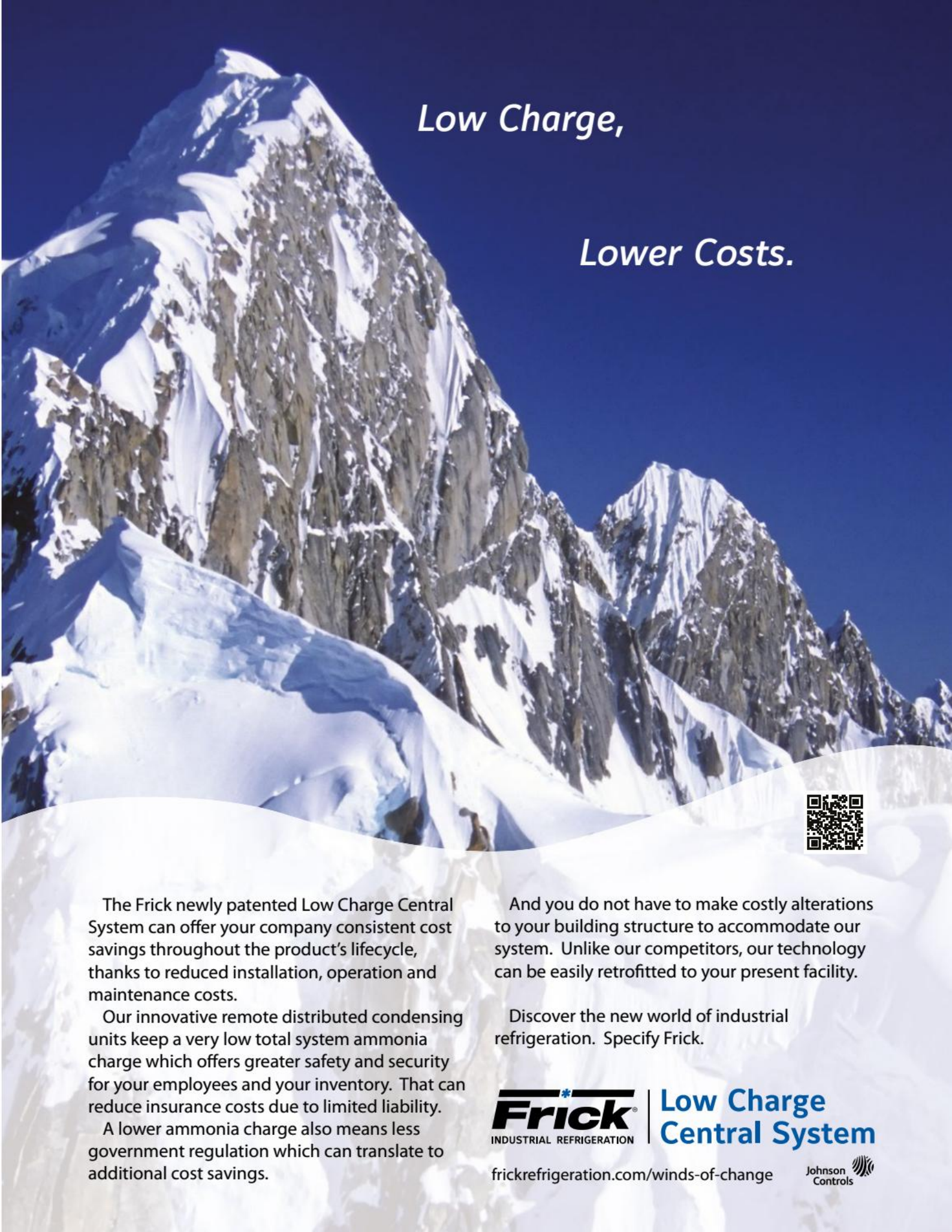
Annual COP for Water Heaters in Cold, Intermediate and Hot Climate States**



CO₂ Heat Pump Water Heaters' Energy Savings ***

Kingway Apartments, Seattle





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**Low Charge
Central System**

frickrefrigeration.com/winds-of-change

Johnson
Controls 

MARCH

18-21

IIAR 2018 Natural Refrigeration Conference & Expo Colorado Springs, Colo.

Event is dedicated to the ammonia and natural refrigeration industry. It includes educational sessions and expo for manufacturers, contractors, trainers, and service providers.



www.iiar.org

20 2PM EASTERN

EPA GreenChill Webinar: Regulatory Update on Section 608 and SNAP Online

GreenChill is an EPA partnership with food retailers to reduce refrigerant emissions and decrease their impact on the ozone layer and climate change.



<https://epawebconferencing.acms.com/sections608and612/>



21-25

The NAMA (National Automatic Merchandising Association) Show Las Vegas, Nev.

This event is for vending, coffee services, micro market and foodservices professionals, including operators, brokers, distributors, machine manufacturers and suppliers.



thenamashow.org



21-25

CMPX 2018: Canadian Mechanical & Plumbing Exposition Toronto, Canada

The CMPX Show is directed at plumbing, HVAC and mechanical contractors, installers, technicians, wholesalers, engineers, architects, building managers, retailers and others.



www.cmpxshow.com



#cmpx2018

25

Danfoss CO₂ Intro Training Baltimore, Md.

One-day class gives overview of system manager and case control and how they both relate to CO₂; an overview of CO₂ rack control; and the computer setup of service tool.



<http://bit.ly/2lb7hlx>

25-28

Edison Electric Institute (EEI) National Key Accounts Workshop Orlando, Fla.

Semi-annual event is for national, chain, and multi-site energy users, who can learn about public policies affecting the energy industry, meet with utility account and energy supply representatives, and view new technologies, products, and services.



www.eei.org

APRIL

04-05

Emerson Integrated Learning: CO₂ As a Refrigerant Brantford, Ontario, Canada

Training for technicians on CO₂ refrigeration, including terminology, best practices, efficiency optimization, gas cooler control, system comparisons, start-up and shut-down sequences, and regulations/codes.



<http://bit.ly/2tvjWmu>

05, 1PM- 4PM EASTERN

ASHRAE Webinar: Designing Toward Net-Zero Commercial Buildings Online

This course covers the design and operating principles for energy-efficient buildings as well as the technologies needed to achieve a net-zero energy building design, including HVAC, lighting and appliances.



<http://bit.ly/2lh6hm6>

APRIL 9-11

National Frozen & Refrigerated Foods Association (NFRA) Annual Executive Conference Tempe, Ariz.

This event, limited to 150 attendees, brings top frozen and refrigerated food decision-makers together to network with trading partners.



<https://nfraexecutiveconference.org>



10 2PM EASTERN

EPA GreenChill Webinar: Small independent Grocers Participating in GreenChill Online

GreenChill is an EPA partnership with food retailers to reduce refrigerant emissions and decrease their impact on the ozone layer and climate change.



<https://epawebconferencing.acms.com/small-grocers/>

26-27

MCEE Montreal, Canada

MCEE is a plumbing, HVAC&R, hydronic, electrical and lighting expo.



mcee.ca



29-02

IARW-WFLO Convention Amelia Island, Fla.

This event is for senior-level executives at temperature-controlled warehousing and logistics companies and industry suppliers..



<https://www.gcca.org/convention>

AMERICA IN BRIEF

Colmac Coil Debuts NH₃/CO₂ Heat Exchanger

Colmac Coil Manufacturing, Colville, Wash., has introduced a Shell and Helix heat exchanger designed for ammonia/CO₂ cascade refrigeration systems.

The patent-pending heat exchanger offers all-stainless steel construction "for corrosion resistance and long life" as well as a compact design for "large heat transfer surface in small volume," the company said in a statement, adding that it is cost effective compared to other heat exchangers in the market.

In addition, the heat exchanger's "multiple helix design" allows expansion and contraction of tubes during large changes in temperature and pressure, "with very low resulting strain and stress, reducing the risk of failure and leaks," Colmac said. This addresses a major concern about ammonia/CO₂ heat exchangers – that the ammonia and CO₂ would come in contact with each other, forming system-clogging ammonium carbamate.

Other features include:

- ▶ High tubeside (CO₂) pressure capability, up to 1,700 psig (119 bar).
- ▶ Nesting of the multiple helically formed tubes in both radial and axial directions, which results in equal spacing of the tubing and uniform flow distribution on the shell side.
- ▶ Multiple shell-side connections, which allow reversing the flow of the ammonia and CO₂ for reverse-cycle hot-gas defrosting.

Colmac also markets a low-charge-ammonia ADX (advanced direct expansion) system, which has been installed in multiple U.S. locations. ■ MG

Petition Calls for Faster Code Changes

The North American Sustainable Refrigeration Council (NASRC) has issued a call for signatures on a petition urging codes and standards bodies to expedite the revision of existing codes and standards to allow for greater use of low-GWP refrigerants in commercial refrigeration.

"We respectfully request that the codes and standards bodies that serve our industry review their process, procedures, and timing to reform them to better meet industry needs," said NASRC, a nonprofit focused on natural refrigerant adoption by supermarkets, in its petition.

The petition, which can be signed by individuals or on behalf of companies and organizations, can be found at <http://bit.ly/2ETYUmL>. ■ MG

Star and CEC Form New Azane Company

U.K.-based Star Refrigeration Ltd. and Controlled Environments Construction (CEC), Tustin, Calif., has announced the signing of a joint venture forming Controlled Azane Refrigeration, Inc.

The agreement was signed on Jan. 25, 2018.

The agreement incorporates Star's U.S.-based Azane Inc., which makes low-charge ammonia chillers and freezers. Azane installed one of its chillers at a [Campbell Soup plant in Napoleon, Ohio](#).

Rick Loesel, president and CEO of the new company, also based in Tustin, said the mission of the venture is to be "the leading provider of low-charge ammonia refrigeration systems in North America." ■ MG

Industry, AHRI Condemn Trump's Metal Tariffs

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI), in conjunction with 25 other trade associations, sent a letter to President Donald J. Trump, Commerce Secretary Wilbur Ross and U.S. Trade Representative Robert Lighthizer on February 27 stating it does not support tariffs on steel and aluminum due to price impacts on HVAC&R manufacturers and consumers.

President Trump imposed import duties on steel and aluminum at a rate of 25% and 10%, respectively, despite pressure to compromise from leading Congressional Republicans. He exempted Canada and Mexico and left open the possibility of negotiations with other countries.

"As major users of steel and aluminum, we have been proactive in explaining to the administration that the HVACR and water heating industry would be negatively impacted by an increase in tariffs, as would the consumers that rely on the products we manufacture," AHRI President and CEO Stephen Yurek said in a press release.

U.S. Industry groups are also worried about jobs that may be lost as a result. "It is our belief that global tariffs and quotas on imports of these products will injure the purchasers of these products and will lead to the loss of thousands of American jobs," they said in the letter sent to Trump.

According to the White House, the tariffs should be placed on the two metals due to reports that concluded steel and aluminum imports threatened US national security, based on investigations undertaken between April 2017 and January 2018 by the U.S. Department of Commerce.

But, the groups argued, "U.S. historical and current data shows that the remedies prescribed in the Reports will significantly raise input costs for industries that use these products."

The EU is expected to engage in trade retaliation and will hold talks on the issue during a March 22-23 summit in Brussels. ■ CM



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a  company

Training and Culture Can Solve the Technician Shortage

Contractors need to offer solid training opportunities and establish a culture of loyalty and pride to attract and keep technicians

By Todd Ernest

Let me be controversial for a moment: there is not a shortage of technicians, at least not everywhere. But there is a shortage of contractors willing to invest in new talent.

There are some really good companies that are investing in programs to get their workforce trained, but there are more that are not.

I recently hired a technician who said that at his last company, his service manager told him, "Why should I train a guy who will then leave and go somewhere else for an extra buck?" I would say that he has a point but he is looking at it from the wrong perspective.

I believe that the only thing worse than training employees and having them leave, is to not train them, and have them stay! I have found, though, that if you have a good training program and a pool of people to choose from, you can continually fill your pipeline of technicians.

At Climate Pros, Inc. University (CPIU), our in-house training program, we have our own "Master's degree of HVAC/R." Here we take them from the basics and bring them up to a full-on refrigeration mechanic. It is a place to get the rest of your education to become a well-rounded service tech who can go anywhere in the world and be successful.

TRADE SCHOOLS OR HIGH SCHOOLS

Of course, you need a good pool of applicants and there is no question that it varies by geography. We have no problem finding new technicians to enter the industry in some areas, but in others, we couldn't pay people enough to get them to work. It really depends on the region as far as I can see. We have offices in seven states across the country and some areas are much harder than others, that is for sure.

Most major metropolitan statistical areas (MSAs) have a trade school for HVAC mechanics and/or auto mechanics. Both of these trade schools are a great place to find candidates to fill the hopper with potentially good recruits. There, they get the basics and if they are worth their salt, you can turn them into really good technicians.

But if your company is in a remote area or these trade schools don't exist near you, you have to tap the high schools, starting with guidance counselors. You have to educate them on the opportunities offered by the trades.

Most of the school counselors spend so much time guiding kids to become college graduates, that they have no idea that a seasoned refrigeration mechanic is a six-figure income earner with great benefits.

At Climate Pros, our journeymen mechanics make north of \$150k annually with benefits. In addition, once they have mastered their craft, the world is their oyster and they are able to go anywhere to earn a great living.

"I believe that the only thing worse than training employees and having them leave, is to not train them, and have them stay!"



The schools today don't know this and they are not teaching this to the kids. We have to be the advocates and get into the schools to educate them. If we don't, who will?

CULTURE OF LOYALTY

I agree that "loyalty" rarely exists anymore and it can easily happen that you train a tech and he leaves at the first offer of a raise from a competitor. We keep talking about this shortage and so the techs realize that they are in high demand and now are starting to demand more money.

But to me the solution is your company culture. You must instill a culture that penetrates deep into the organization so that technicians won't leave. You can't keep them by throwing money at them because there will always be someone who will, at least for a time, throw more.

If you have a culture of loyalty and honesty/integrity in a relationship-driven company, you can attract and retain good people, as we have for many years at Climate Pros.

The military has been a great resource for us to find great people. That's because recruits from the military have a sense of loyalty and core values that often compliment their skills and turn them into great technicians. However, I believe you have to be the right kind of company in order for that to work for you.

There are two important things that a successful company needs in order to attract and retain former military personnel. These items are not relevant only to the military, but I think weigh more heavily for them than private-sector people.

First and foremost is a culture that supports loyalty and pride. For military folks, sense of duty, loyalty and pride for their country is essential to being successful. This is what is driven into them constantly while they serve our great country.

For them, if your company promotes those same types of core values, you are laying the groundwork for them to come right into an environment for which they are conditioned.

Second, you need structure, process and procedures. Again this is what they are used to. If you're a company in disarray, not only will you have a hard time retaining military people, but just about anyone else with the skill sets you desire.

At Climate Pros, we are still in our infancy and refining our programs. But we believe that investing in our people will pay dividends in the future. ■TE

Todd Ernest is the president/CEO of Climate Pros, Inc., a Chicago-based contractor that he founded in 2006, starting with "just myself and a van." The company now has over 150 employees and operates in seven states.



Norwegian Report Assesses HFOs' Environmental Impact

It says knowledge gaps on TFA toxicity need to be addressed – and risks can be reduced by phasing out HFOs

By Michael Garry

A report commissioned by the Norwegian Environment Agency on the environmental impact of trifluoroacetic acid or TFA – the atmospheric by-product of HFOs – recommended that a number of “knowledge gaps” needed to be addressed before TFA’s ultimate effect on the environment can be determined.

Moreover, HFOs’ environmental risks will grow with use, the report said, adding that phasing out HFOs and other measures will reduce those risks.

Released in December, the report, “Study on environmental and health effects of HFO refrigerants,” is based on a review of the academic and “grey” literature on the topic, as well as consultation with stakeholders, including an HFO manufacturer, a reclaimer of HFO refrigerants, academic experts, a non-governmental organization and a refrigeration industry association.

The report, prepared by U.K.-based Risk and Policy Analysts, noted that currently the consensus among academic experts is that “TFA will have a negligible effect on the environment.” However, it pointed out a number of “knowledge gaps” that would need to be filled to support that conclusion, including studies on the cycle of TFA in the atmosphere and hydrosphere, the amount of TFA used globally, other potential sources of TFA in the environment.

Notably, the report said the risks presented by TFA – a highly durable chemical – increase if emissions of HFOs such as R1234yf increase. “[TFA] is very persistent and concentrations of TFA will only be expected to increase,” it said.

As a result, the report suggests taking preemptive measures in regard to HFOs. “Phasing out HFOs (and consequently TFA), or emission reduction strategies along with best practice measures that help ensure efficient capturing of HFO/TFA during recycling operations, will help reduce the risk to human and environmental health.”

The largest risk to human health, the study added, “is likely to be close to areas of production facilities and urban areas where it is used in devices for personal and domestic use.”

HFO consumption projections

The study reported on existing HFO consumption projections through 2050, and modeled two scenarios from 2051 to 2100, one having a consumption freeze and the other a phase-out. Peak emissions of HFOs and other low-GWP refrigerants could exceed 500,000 metric tons per year by 2050, it said.

The HFO R1234yf has an atmospheric lifetime of about six days, after which it degrades completely into TFA, the report said. In the atmosphere, TFA is partitioned into droplets of clouds, rain and fog, “with wet precipitation assumed to be the major source of TFA in the biosphere,” the report said.

TFA is found in a wide range of water bodies, including rivers, streams, lakes and wetlands, with the highest concentrations on terminal water bodies such as salt lakes, playas and oceans. In freshwaters, TFA is thought to be solely human-made (anthropogenic). It also enters soils on its way to aquatic environments.

Of tested aquatic organisms, only the alga *Raphidocellis subcapitata*) “displayed sensitivity to TFA,” said the study.

TFA has been shown to cause some toxicity in plants and soil organisms, the report said. But no studies have been reported on concentrations of TFA in crops for human consumption, both raw and processed foods, it noted.

In a study on toxicity of TFA, the study reported that the ECHA (European Chemicals Agency) critiqued studies on pre-natal development toxicity in a rat or rabbit. “ECHA considers that there is not sufficient weight of evidence from several independent sources of information which would allow to assume/conclude that the substance does not have a particular dangerous property, i.e., reproductive toxicity,” the report said.

“Phasing out HFOs (and consequently TFA), or emission reduction strategies along with best practice measures that help ensure efficient capturing of HFO/TFA during recycling operations, will help reduce the risk to human and environmental health.”

A request for comment on the study was sent to HFO makers Honeywell and Chemours. Honeywell did not respond and Chemours declined to comment.

According to the website of EFCTC (European Fluorocarbons Technical Committee), of which Honeywell and Chemours are members, “over 200 metric tons of TFA are present naturally in coastal and deep-ocean seawater. HFCs and HFOs will add only 0.1% to the amounts already naturally present.”

Janos Maté, a senior consultant in the political business unit of Greenpeace, pointed out that “the literature indicates that TFA accumulation in salt water is from natural sources, but entirely from anthropogenic [human-made] sources in fresh-water ecosystems.”

Greenpeace’s Response to HFOs Study

Janos Maté, a senior consultant in the political business unit of Greenpeace, has been a campaigner for more environmentally friendly refrigerants since 1992. In 2010, he received the EPA Montreal Protocol Award for his work to protect the ozone layer and the climate.

He submitted the following response on behalf of Greenpeace to the Norwegian Environment Agency’s study on HFOs:

The Norwegian Environment Agency 2017 “Study on environmental and health effects of HFO refrigerants” is a welcomed addition to the much-needed discourse on HFOs. It underscores the necessity for further research regarding sustainability of HFOs. From a precautionary perspective such research should be conducted by independent bodies prior to governments authorizing the large-scale uptake of HFO refrigerants and other HFO products.



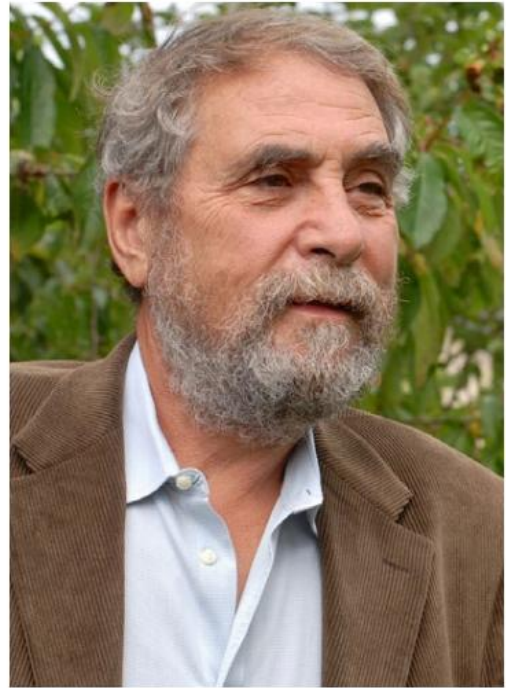
The study's key conclusions reflect some of the concerns that Greenpeace has been raising over the years:

- ▶ There is insufficient knowledge on the tolerable thresholds of TFA accumulation in the environment. What level of HFO use will result in catastrophic levels of TFA accumulation? What is the TFA accumulation tolerance level of nature?
- ▶ The large-scale uptake of HFOs must be prevented until there is a full understanding of peak production levels of HFOs and other TFA-producing substances, and their long-term TFA contribution to the environment. If we wait till the harmful effects of TFA accumulation are fully manifested in the environment, it may be too late.
- ▶ The peak production and emissions levels of HFO refrigerants and other TFA-producing compounds are unknown. The Norwegian Environment Agency study focuses on HFO refrigerants. However, according to a 2015 Swedish Department of Energy paper, the most prominent HFO refrigerant, HFO-1234yf, is already marketed as an aerosol propellant. Governments have to date failed to set any production quotas on HFO products, even though from a precautionary perspective such quotas are warranted.
- ▶ Industry is creating HFO/HFCs blends, where the bulk of the blended compound (at least 60%), is HFC-32, with HFC-1234yf or HFC-1234ze being minor components. These blended compounds are marketed as HFOs, with their implied low-GWP rating. In actuality the GWP of HFO blends is relatively high compared to the GWPs of natural refrigerants. The GWP of most HFO blends range between 150 to 1800, while the GWP of natural refrigerants are 0 for ammonia, 1 for carbon dioxide, 5 for propane and less than 20 for isobutane.
- ▶ The chemical industry has a sorry track record with its CFC, HCFC and HFC fluorocarbon products. They have caused extensive environmental damage and endangered life on the planet.

While the chemical companies have earned massive profits from the sale of these products, and from the transition from one generation of fluorocarbons to the next, they have failed to contribute towards solving the global crises their products have caused. The costs of cleaning up have been left to the public purse.

Governments must not repeat this pattern. There is no credible reason for governments to accept at face value industry's claims regarding the safety and technological benefits of HFOs. Who will pay the mitigation costs should the large-scale production of HFOs result in yet another global crisis?

Janos Maté,
senior consultant in
the political business
unit of Greenpeace



Based on these concerns Greenpeace calls on governments to take the following measures:

- ▶ Set production quotas on HFOs so that industry is curtailed in its commercial aspirations for these products.
- ▶ Immediately ban the use of HFOs as aerosols.
- ▶ Require that industry commit to paying for all mitigating costs, through a liability contract, should the large-scale production of HFOs in the future result in severe damage to the environment.
- ▶ List HFOs in the Annex of Controlled Substances of the Kigali Amendment on HFCs. Including HFOs in the Annex will enable accurate accounting of the volume of HFOs being produced and consumed, the amount of TFA being released into the environment, and enable reporting and licensing to help prevent the illegal trade of HFCs mislabelled as HFOs.
- ▶ Greenpeace calls on governments to vigorously support the uptake of cooling technologies using natural substances by: enacting modern day standards and policies that reflect the current state of technology; providing financial incentives to encourage their further development and rapid uptake; and applying governmental purchasing powers towards cooling technologies that use natural refrigerants or other cooling methodologies that avoid the reliance on fluorocarbons. ■ MG

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Saving Money Overnight

Night curtains on open cases can cut energy expenditures up to 36% per hour, says one manufacturer

By Charlotte McLaughlin

Sometimes the solution to a complex problem can be surprisingly simple.

Take night covers, for example.

Commonly referred to as “night blinds” or “night curtains,” aluminium night covers provide an economical way to shield a supermarket’s medium-temperature open display cases during off hours, protecting perishables foods from ambient heat and light.

They work like the window shades that supermarket employees pull down at night when the store is closed. Preventing cold air from being lost, the blinds enable the refrigeration system to work less. The energy and monetary savings can be considerable.

The U.S. Environmental Protection Agency’s Energy Star program estimates refrigeration and lighting accounts for more than 50% of the total energy used by an average supermarket. Given that supermarket profit margins are on the order of 1%, Energy Star estimates that \$1 in energy savings is equivalent to increasing sales by \$59.

At the AHR Expo, held in Chicago in January, Scott Werhun, senior business development manager (USA) for Canadian night-curtain manufacturer Econofrost, provided test results on the energy saved by using night curtains. The tests were conducted by utility Southern California Edison at its Refrigeration Technology and Test Center (RTTC) in Irwindale, Calif.



The tests found that aluminium night covers can cut energy expenditures on average up to 36% for every hour that the covers are in use.

TWO-YEAR PAYBACK

Food retailers like Whole Foods Market, Sprouts Farmers Market, Trader Joe’s and Kroger have found the payback for installing the night covers to be quick – just two years, he said.

One Save-A-Lot supermarket in Detroit saved 13,440 kWh, which translated into \$1,100 annually in electricity costs, by installing the covers on display cases, according to Econofrost.

The Arizona retailer Bashas’ also saved substantially with the night covers. The covers reduced the energy used by its refrigeration system by an average of 40% in the retailers’ stores, said Econofrost.

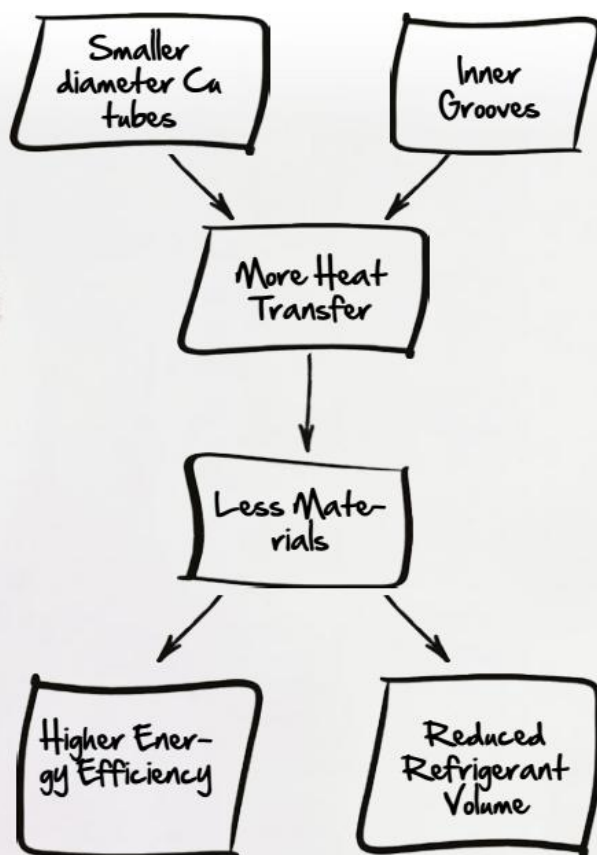
The covers can keep display cases at optimal temperatures for up to 15 hours after the shades have been rolled up, said Econofrost. They are also a good way to avoid losses when a power outage occurs.

A Bashas’ supermarket that installed the covers was able to avoid throwing out \$8,000 worth of produce after a power failure occurred, according to Werhun. The food stayed at the same temperature for three hours while the refrigeration system was not working even though outside temperatures were 115°F, Econofrost said.

“We have a similar story in a Kroger store in Virginia that installed [the night covers] before a 2017 hurricane,” he said. No food was discarded when the power came back on in this store, either.

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U.S. LAGS IN FLAMMABLE REFRIGERANT SAFETY

ASHRAE Research Project 1807 cites technician training, refrigerant odorization and other requirements in place in other regions

By Mark Hamstra

As the U.S. adopts the use of larger charges of flammable hydrocarbon refrigerants, it can learn from the safety standards and guidelines already in place in other regions, said Bill Goetzler, managing director, Navigant Consulting.

Speaking at the AHR Expo in Chicago in January, Goetzler cited the results of a new report on this topic that Navigant compiled for the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The report, dubbed ASHRAE Research Project 1807: Guidelines for Flammable Refrigerant Handling, Transport, Storage, Equipment Servicing, Installation and Dismantling, evaluates the risks of using flammable refrigerants throughout the lifecycle of the equipment and the potential opportunities for mitigating those risks.

Covering A3 and A2L refrigerants, the report is expected to be released publicly this month.

Hydrocarbon refrigerants are currently more widely used in other regions, including Europe, Japan, Australia and Canada. For the ASHRAE 1807 research, Navigant examined the systems and processes used in those regions, and identified gaps with the U.S. where standards and practices could be improved.

The research covered residential and commercial air conditioning and refrigeration systems, and examined practices in place for all stages of the product lifecycle, excluding the manufacturing stage for the equipment and refrigerants and the final destruction stage for the refrigerants.



RISKS VARY DURING LIFECYCLE

Of the lifecycle stages examined in the report, installation/service and removal/dismantling of equipment and refrigerants were deemed the most high-risk because of the potential for a release of refrigerants in proximity to an ignition source. The storage and transportation stages were deemed low risk, and the routine operation stage was deemed moderate risk.

While thorough regulations and procedures around the safe storage and transportation of flammable and hazardous materials in general are already well-established in the U.S., Goetzler said other countries have certain additional restrictions that are not in place in the U.S. and should be considered. Other practices and guidelines from around the world noted in the report include requirements for the odorization of flammable refrigerants, restrictions on the proximity of refrigerants to heat sources during storage and transport, and limits on storage to minimize the risk of theft.

“It’s important when we talk about flammable refrigerant safety to pay particular attention to the risks throughout product lifecycle.”



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Installation and service are the areas where proper guidelines, training, certification and standards are most important, Goetzler explained. The lines carrying flammable refrigerants may be opened during various servicing operations, and service personnel also may be working with a high-temperature ignition source.

"Those are really places to be very careful and to be sure we've got standards and guidelines in place to minimize the risk," Goetzler said. "That's why it's important when we talk about flammable refrigerant safety to pay particular attention to the risks throughout the product lifecycle, not just during operation. There are a lot of controls in place, but during service — well, as we know, all kinds of things can go wrong."

In the U.S., the researchers identified as a gap the lack of training and certification requirements for technicians specific to flammable refrigerants. Certification is required in Europe, Japan and Australia, for example (although not in Canada). In addition, other regions around the world have standard emergency procedures after the detection of a leak, as well as standards for leak testing and for safely charging equipment.

Although the operational stage of systems using flammable refrigerants poses less safety risk than installation and service due to the safeguards built into the equipment, the report does cite some examples of standards and guidelines in other regions that address operational issues. These include requirements for ventilation rates, the use of leak detection alarms, and restrictions on the proximity of combustion devices to equipment containing flammable refrigerants.

"That would be, of course, very challenging in the United States where we've got furnaces, boilers, water heaters very proximate to air conditioners," said Goetzler. "But, that sort of requirement does exist in other places."

Other operational issues the report identified as gaps in the U.S. include guidelines for the use of non-permanent fittings. In fact, another ASHRAE research project is looking specifically at the risks of leakage from a variety of fittings.

In addition, while the U.S. has guidelines and restrictions surrounding venting of refrigerants during the dismantling and decommissioning of equipment, those guidelines are primarily tied to the environmental impact rather than the flammability of the refrigerants. But Canada, for example, specifies how flammable refrigerants should be recovered and has requirements for the disposal of the refrigerants and the temporary shutdown of systems.

MITIGATING RISKS

The report concludes that the risks of using flammable refrigerants can be mitigated through rigorous regulations, codes and standards. And, although code and standard development must be adapted to each individual country, which could take several years, the adoption of international model codes and multinational standards could accelerate the process.

In developing safety standards, Goetzler said, it is important to closely examine existing regulatory regimes and to take local building practices into consideration. In developing technician training, a range of equipment and building types should be considered. In addition, he said, there must be stringent enforcement mechanisms for following these procedures in order to motivate safe practices.

"In summary, I think we know most countries have accepted the importance of flammable refrigerants as alternatives," said Goetzler. "There's a broad range of readiness to safely deploy flammable refrigerants."

Additional research about the use of flammable refrigerants is forthcoming, including ASHRAE Research Project 1806 (Flammable Refrigerants Post-Ignition Risk Assessment) and 1808 (Servicing and Installing Equipment Using Flammable Refrigerants: Assessment of Field-Made Mechanical Joints), which focuses on systems using R32.

Safety and risk management research firm Gexcon US, which released a report on the fire hazards of ASHRAE A3 refrigerants for the Fire Protection Research Foundation last year, is the prime contractor for the ASHRAE 1806 project, slated for completion late this year. This project, which covers both A2L and A3 refrigerants, will consider a risk assessment of the creation of hydrofluoric acid in the combustion of A2L refrigerants, Goetzler said.

Creative Thermal Solutions, a research and consulting firm specializing in heating, air conditioning and refrigeration systems, is leading the research for ASHRAE 1808, which is expected to be completed soon. ■ MH

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THE OTHER KIGALI PROGRAM

K-CEP seeks to help developing nations optimize cooling efficiency

By Mark Hamstra

Developing countries are getting some help improving the efficiency of their air conditioning and refrigeration systems while reducing their F-gas emissions.

That's thanks to the Kigali Cooling Efficiency Program (K-CEP), formed last year in the wake of the Montreal Protocol's Kigali Amendment, which seeks to phase down the use of HFCs in refrigeration and air conditioning systems.

"The genesis for the Kigali Cooling Efficiency Program was a request from developing countries for support to improve the energy efficiency of cooling in tandem with the efforts that they will need to make, and the world needs to make, to phase out and down F-gases," said Dan Hamza-Goodacre, executive director of K-CEP.

The overall goal, he said, is to "significantly increase and accelerate the climate and development benefits of the Montreal Protocol refrigerant transition by maximizing a simultaneous improvement in the energy efficiency of cooling."

K-CEP, which describes itself as a "philanthropic collaboration," received \$52 million in funding from donors to help spur more efficiency as the use of air conditioners in developing countries rapidly escalates. Researchers predict that the number of room air conditioners around the world will increase by about 700 million, to 1.6 billion, between 2015 and 2030, according to the ClimateWorks Foundation, which is one of the foundations supporting K-CEP. K-CEP's secretariat, the Efficiency Cooling Office, is located at the ClimateWorks Foundation in San Francisco.

Although K-CEP is geared to support developing countries, it is working with European and North American research firms and other experts to provide that support.

K-CEP has partnered with shecco, the publisher of Accelerate America, which is providing industry research. A recent report covers the use of energy-efficient commercial refrigeration systems. K-CEP also commissioned a white paper, "Freezing in the tropics: Asean's air-con conundrum," produced by Eco-Business.

K-CEP directs its activities through four "windows," or areas of opportunity and focus:

Strengthening for Efficiency

This involves working with countries to integrate more consideration of cooling efficiency into their efforts around the Kigali Amendment, and with manufacturers and others involved in the cooling industries to look for opportunities to make their systems more efficient.

"Developing country capacity and ownership is critical for environmentally friendly, energy-efficient cooling," said Hamza-Goodacre. "K-CEP supports efforts to enhance the energy efficiency capacity of developing countries by offering support for staff, training and knowledge resources, advice for governments, and funding to integrate energy efficiency into projects."

Policies, Standards and Programs

This involves helping developing-country governments understand the costs and benefits of more efficient cooling, and then to identify policy opportunities, such as rebate programs and others, to support higher efficiency cooling.

This window also includes helping to identify opportunities for corporate members of the Consumer Goods Forum to purchase more efficient cooling technology.

"A number of those members, like Carrefour, Tesco and Walmart, have already made very helpful commitments from the F-gas transition side but they could also benefit from integrating more efficiency into those purchasing choices and hopefully reaping the cost savings from the energy savings," said Hamza-Goodacre.

Finance

In addition to its own grant-making, K-CEP is seeking to leverage further financing to implement energy efficiency plans, policies, standards and programs and to widen access to cooling.

Access to Cooling

K-CEP is also seeking to increase the accessibility of environmentally friendly, energy-efficient cooling in developing countries. It is doing so by working to elevate the profile of cooling as a development priority.

"To avoid 'lock-in' of high-carbon technologies, access to cooling must be a development priority," said Hamza-Goodacre. ■ MH

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Senators Introduce Bill Giving EPA Power over HFCs

The bipartisan legislation would nullify recent court ruling stripping EPA of regulatory authority on HFC replacement

By Michael Garry

Two U.S. senators have introduced a bipartisan bill to ensure that the Environmental Protection Agency has the authority to oversee the phase-down of HFCs in the U.S. in order to support next-generation technologies.

U.S. Senators John Kennedy (R-La.) and Tom Carper (D-Del.) introduced the bill, the American Innovation and Manufacturing Act, last month with Senators Bill Cassidy (R-La.), Chris Coons (D-Del.), Susan Collins (R-Maine) and Jeff Merkley (D-Ore.) as co-sponsors.

The bill comes in the wake of – and would effectively nullify – the U.S. Court of Appeal decision stripping the EPA of the ability to require incumbent users of HFCs to replace them with climate-friendly refrigerants. (See [“U.S. Court Denies Request to Rehear HFCs Case,” Accelerate America](#), February 2018.)

In particular, the bill would empower the EPA to issue rules phasing down HFCs through a cap-and-trade program and the “advancement of environmentally friendly technologies.” It would also conform to the Kigali Amendment to the Montreal Protocol, which calls for a global phase-down of HFCs.

Carper said that the bill helps the U.S. “meet its obligations under the amended Montreal Protocol – a true win-win.” The U.S. Senate, however, has not yet ratified the Kigali Amendment. The Trump Administration recently said it is mulling the economic impact of the Kigali Amendment as it decides whether to refer it to the Senate for ratification. (See [“Trump Administration Focuses in Economic Impact of Kigali,” Accelerate America](#), February 2018.)

Moreover, if the Kigali Amendment is ratified, the Kennedy-Carper bill would be moot since “there’s a provision [under Title 6] in the Clean Air Act that the U.S. Environmental Protection Agency has the authority to implement that amendment,” said Jeff Holmstead, partner, Bracewell LLP, a Houston-based law and government relations firm, at a recent Hudson Institute meeting.

Jobs bill

Kennedy designed the bill “to provide much-needed certainty for businesses in Louisiana and other states on the worldwide transition towards next-generation coolants,” his office said a statement.

“On the surface, this bill seems more complicated than high school chemistry, but really it’s pretty simple. It’s about jobs,” said Kennedy. “And it’s about protecting the investment by Louisiana companies in new technologies and protecting Louisiana jobs.”

In particular, Honeywell operates a plant in Geismar, La., that makes HFOs, an HFC replacement that will experience a slowdown in the absence of HFC regulation. Delaware, Carper’s state, is home to HFO producer Chemours.

But the bill would also support natural refrigerants as a replacement for HFCs.

Meanwhile, the bill has the backing of both industry and environmental groups. “We applaud the introduction of this bill and thank these senators for their leadership,” said Stephen Yurek, president and CEO of the Air-Conditioning, Heating, and Refrigeration Institute (AHRI).

David Doniger, senior strategic director for the Natural Resources Defense Council (NRDC) called the bill “a critical step” in enabling the U.S. to “maintain its leadership in the development of climate-friendlier alternatives and for American industry to seize the global economic opportunity in the market for alternative chemicals and products.” ■ MG



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EPA Pulls Charge Boost for Domestic Fridges

But a proposal to raise the charge limit for three hydrocarbons to 150 g from 57 g is still expected to go forward

By Michael Garry

The U.S. Environmental Protection Agency announced February 28 that it has withdrawn a “direct final rule” that would have raised the charge limit to 150 g from 57 g for three hydrocarbon refrigerants in domestic refrigerators and freezers.

The reason for the withdrawal was the receipt of “adverse comment” from stakeholders during a comment period that ended January 25, the agency said in a “prepublication version” of the document it submitted for publication in the Federal Register. The EPA added that it would address “all significant comments in any subsequent final action,” which would be based on a parallel proposed rule that was identical to the direct final rule.

The withdrawal notice, signed by EPA administrator Scott Pruitt, applied to SNAP Rule 22: “Protection of Stratospheric Ozone: Revision to References for Refrigeration and Air Conditioning Sector to Incorporate Latest Edition of Certain Industry, Consensus-based Standards.”

The direct final rule – along with the parallel proposed rule – was published in the Federal Register on December 11, 2017. Both rules would raise the charge limit (a use condition) for three flammable (A3) refrigerants – isobutane (R600a), propane (R290) and R441A (a hydrocarbon blend) – in new household refrigerators, freezers and combination refrigerators/freezers under the EPA’s SNAP

(Significant New Alternatives Policy) program.

The rules would do this by incorporating a new standard (60335-2-24) announced last year by Underwriters Laboratories (UL) that increased the charge limit for hydrocarbons in domestic refrigerators to 150 g from 57 g following an assessment of flammability risks.

The agency originally said it was issuing the increase in charge limit as a direct final rule because “EPA views this as a noncontroversial revision and anticipates no adverse comments. This action does not place any significant burden on the regulated community and ensures consistency with industry standards.”

The 57 g limit is generally seen as an impediment to the adoption of energy-efficient hydrocarbon refrigeration in the U.S. domestic market. Elsewhere in the world, where 150 g has long been the charge limit for domestic refrigerators, hydrocarbon units have gained substantial market share.

A PROCESS MATTER

Given that the EPA still has an identical proposed rule in the Federal Register, consideration of the charge-limit increase is expected to go forward, albeit without a new comment period.

“It’s really more of a process matter,” said Christina Starr, climate policy analyst, Environmental Investigation Agency, who submitted a favorable comment on the direct final rule to the EPA. She added that the “few [adverse] comments that raised concerns can be addressed without changing the substance of the rule.”

“The delay is unfortunate and unnecessary, but in my view it should still be feasible for EPA to respond and issue the final rulemaking this year,” she said.

One of the adverse comments on the proposed final rule, available in the public docket at www.regulations.gov (under docket number EPA-HQ-OAR-2017-0472) came from Robert Keys, New York, who described himself as “a retired Battalion Chief from the New York City Fire Department” who served for over 30 years.

“This change concerns me because I have not heard anything about it in any of the fire service journals such as *Firehouse* or *Fire Engineering*,” he wrote. “I wonder if this change has been vetted by the fire service? I am concerned about the implications of this change on firefighter safety.” ■ MG

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KPAC GENERAL'S GREAT LEAP FORWARD

The California cold-storage operator replaced an antiquated R22 system at an old facility with an ultra-low-charge ammonia packaged system at a new state-of-the-art facility

By Michael Garry

Ronnie Ceballos,
KPAC General

Photography by:
Megan Miller



Like many small businesses, cold-storage operator KPAC General started modestly.

In the late 1980s, it leased a building in Bell Gardens, Calif., and installed a patchwork refrigeration system that was a "Heinz 57 of different used components," said Ronnie Ceballos, vice president and general manager.

Upon that foundation, Ceballos, a CPA, and his late brother John, who had previously run a trucking concern, provided 50°F storage for a Chino, Calif., cheese company. They later took in grapes and stone fruits from a Chilean importer. From that point, the business grew significantly.

In 2007, the Ceballos brothers sold their company, then called General Cold Storage, to KPAC (Konoike-Pacific), a Japanese operator that today also owns two cold-storage facilities in Wilmington, Calif., near the Port of Long Beach.

Inevitably, the Bell Gardens facility, with its 14-package refrigeration system that used R22, "started to deteriorate and was not efficient," said Ceballos. "We decided to build our own facility from the ground up," buying property in 2014.

That building, a state-of-the-art cold-storage warehouse located close to Bell Gardens in South Gate, Calif. (south of downtown Los Angeles), had its grand opening in July 2017, though it did not start full operation till January of this year. It stores a variety of protein products, cheese and frozen foods. The Bell Gardens warehouse has been shuttered.

Of course, in opening a new cold-storage facility, Ceballos had to answer the \$64,000 (actually much more than that) question: what refrigeration system should we install?

The answer turned out to be ultra-low-charge ammonia packaged units from NXCOLD, a Los Angeles based start-up that is now made and distributed in the U.S. by Conyers, Ga.-based OEM Hillphoenix. (See story, [page 41](#).)

The 84,000-sq-ft (3.86 million-cu-ft) South Gate warehouse consists of five rooms – one large freezer room (-10°F) and four convertible rooms (two at 32°F -34°F, one at 48°F, and one at 55°F -60°F), as well as a 45°F-50°F dock area.

Eight rooftop ("penthouse") NXCOLD units were installed, two above the freezer, one above each of the convertible rooms and two

“ *There's a move to get rid of man-made refrigerants. So why not take a look at natural refrigerants?* **”**

above the dock area. With all of the components packaged in the units, cool air is ducted down into each storage area.

The total capacity of the eight units ranges from 320 TR to 360 TR, with a total ammonia charge from 150 lbs to 240 lbs. This translates to an ultra-low charge ratio of between .47 to .67 lb/TR. (See System Specs on [page 40](#).)

Why did Ceballos select NXCOLD for this critical piece of his business? For a number of reasons, but, importantly, because he sees it as "the way of the future."

NXCOLD NEARBY

While there were several other companies marketing low-charge packaged ammonia systems, including Evapco, Azane, Mayekawa and Stellar (see [page 48](#)), Ceballos personally knows NXCOLD's inventor and chief technology officer, John Scherer. Scherer is also manager of engineering at Los Angeles Cold Storage, where NXCOLD units have been installed for several years. That helped Ceballos get acquainted with the technology.

"We saw the NXCOLD units operate at LA Cold Storage," said Ceballos. "And we knew [Baker Cold Storage] in Long Beach was going to use them exclusively." (See, "[Up on the Roof](#)," *Accelerate America*, September 2016.)

Having used R22 at its Bell Gardens warehouse, Ceballos was intent on moving away from not only R22 (which is being phased out as an ozone-depleting gas) but other man-made high-GWP refrigerants like HFCs.

While the U.S. Environmental Protection Agency is currently restrained from regulating HFCs, California is planning an aggressive phase-down program in line with that prescribed by the global Kigali Amendment. "There's a move to get

rid of man-made refrigerants,” noted Ceballos. “So why not take a look at natural refrigerants?”

The two other KPAC facilities in Wilmington, Calif., employ a natural refrigerant – ammonia – in a traditional engine-room, large-charge overfeed design. But Ceballos was attracted to the idea of using packaged low-charge units located on the rooftop rather than in an engine room.

“Not requiring an engine room in itself was huge,” he said. “You don’t need all the piping through the warehouse, and all the ammonia pushed through by large compressors.” He also liked using the area that would have gone to an engine room for “revenue-producing storage space.”

The relative simplicity of the NXTCOLD units – and the fact that the refrigeration is distributed among eight units – was also a plus for Ceballos. “If you have an issue with one, you don’t have to be concerned about the whole facility.”

Moreover, the NXTCOLD units have redundant features to provide an operational cushion. The four units for the convertible rooms each have two compressors, though they can operate with just one if the other is not working. The freezer and dock areas are each served by two units, though one can handle the load if necessary.

The distributed nature of the NXTCOLD system makes it easy to add additional units in the event of an expansion. Ceballos compared it to “going to Home Depot and buying a window air conditioner for a room in your house.”

Each rooftop NXTCOLD unit at the South Gate facility was installed with an accompanying mini water tower. Ceballos considered a central water tower but decided it was better to customize each unit with its own water tower.



1 / New KPAC General facility in South Gate, Calif.

MINIMAL CHARGE

Ceballos was also impressed by the minimal amount of ammonia used in the packaged units. “At KPAC’s other two facilities, there’s probably 1,000 to 1,200 gallons of ammonia,” he said. At South Gate, the total charge ranges from 30 to 47 gallons. “We’re talking a huge reduction in the amount of ammonia, so we fly under the radar for regulatory compliance.” In California, 500 lbs of ammonia triggers a high-level of government scrutiny, compared to 10,000 lbs at the federal level. ►

Other Environmental Features

In addition to its ultra-low-charge ammonia refrigeration system, KPAC General's new cold-storage facility in South Gate, Calif., is equipped with several other environmental features:

- ▶ Trucks that back into the loading dock make a seal with the dock before the truck door is opened, so no cold air is lost, keeping the cold chain intact.
- ▶ Dock plugs allow trucks to run their refrigeration systems using warehouse electricity instead of their engines.
- ▶ High-speed doors that sense a forklift and open and close quickly are used instead of vinyl curtains at entrances to cold storage rooms
- ▶ The facility has motion-sensitive lights that turn off when no one is present.

2/



3/



2 / Evaporator fan in NXTCOL unit

3 / VFD controls for evaporator fans and compressors

4 / Two of eight NXTCOL rooftop units with mini water towers

5 / Inside components of NXTCOL unit

6 / Controls for NXTCOL unit

To reduce its ammonia charge to under one lb/TR, the NXTCOL units dispense with many of the refrigerant-holding components typically found in ammonia systems, such as receivers and accumulators. Instead, the refrigerant travels directly from the condenser to the evaporator to the compressor.

In addition, the system is able to control the refrigerant mass within the evaporator by "keeping the quality level at the level it needs to be," NXTCOL's Scherer told *Accelerate America* in 2016. It does that by means of an electronic refrigerant injection control (ERIC) mechanism, which uses multiple-point liquid-ammonia injection with varying tube diameters. "We inject it [into the evaporator circuits] when we need it, not when we don't need it," he said.

In transitioning from R22 to ammonia, Ceballos acknowledged he was a "little leery" about the toxicity of ammonia. But he was reassured by the small amount of charge in the NXTCOL units, which limits the liability from ammonia leakage. Even in the event of a leak of the entire charge in one of the eight units – a simultaneous leak from multiple units being highly unlikely – "you wouldn't harm anybody or products." He expects to pay lower insurance premiums as a result.

UTILITY STUDY

KPAC General's NXTCOL units are the subject of a study sponsored by Southern California Edison (SCE) examining their energy efficiency and demand-response opportunities, compared to that of its previous R22 system.

According to Paul Delaney, senior engineer for SCE, the utility is spending \$230,000 on this analysis, which is being done by Cypress, Ltd., an energy consulting firm based in Coto de Caza, Calif. SCE will use the results of the study to justify paying KPAC General an incentive to defray the cost of the system. The incentive for the NXTCOL units is projected to be about \$82,000, said Delaney.

Refrigerated warehouses offer a "prime-time opportunity for demand-response/load management" using precisely

4/



5/



6/



“We’re talking a huge reduction in the amount of ammonia, so we fly under the radar for regulatory compliance.”

controlled low-charge-ammonia packaged units, said Delaney. The NXTCOLD units, he added, are designed to handle demand response. “You just tell the PLC [controller] what to do. It uses open ADR 2.0 protocol.” SCE is determining the optimal hours to shift demand.

Delaney sees food processing, walk-in coolers in supermarkets, industrial air conditioning and data centers as other incentive-earning applications for low-charge ammonia packages.

Ceballos credited NXTCOLD with “providing value-added services regarding utility rebates and incentives.”

Based on his own inspection of current utility bills, Ceballos estimated that the energy costs of the South Gate facility are about 20% less than those at the old building, even though the new building holds 50% more space.

The cost of the NXTCOLD system, he said, was comparable to – and maybe a little less than – that of a conventional flooded ammonia system with a central engine room.

One additional cost in installing penthouse NXTCOLD units is the engineering and steel required to secure the roof.

Ceballos expects the maintenance cost of the NXTCOLD units to be less than that of a conventional system because of the absence of extensive piping. “If you have a leak, you’re not running through the gamut of lines to figure out where the leak is,” he said.

GEORGIA VISIT

Ceballos acknowledged that being one of the first companies to invest in a relatively new technology is “a bit of a gamble.” But he was reassured that OEM Hillphoenix has partnered with NXTCOLD to manufacture and distribute the units. “It’s a positive for NXTCOLD and Hillphoenix as well,” he said.

Ceballos visited Hillphoenix’s production facilities in Conyers, Ga., and found that “they run a class A operation.” He also went to Bitzer’s facility to see how its compressors – used in six of his eight NXTCOLD units – were made, and also came away impressed.

For Ceballos, one challenge presented by the NXTCOLD units was a two-month delay in receiving them while NXTCOLD made design enhancements. (Installation of the units, though, is typically a one-day affair.) Since their installation, NXTCOLD has been on-site fine-tuning the units “to make sure they are running optimally,” he said. Mericle Mechanical, a local contractor, has participated in fine-tuning and maintaining the units.

He added he has been satisfied with their performance to date and would select the NXTCOLD units in any future cold-storage development.

Ceballos was supported in exploring and ultimately purchasing a relatively new refrigeration system by KPAC’s management team, including its president, Richard Burke, who took over in



7/ A convertible room, with a temperature of 55°F-60°F

SYSTEM SPECS



KPAC General’s new South Gate facility and its NXTCOLD refrigeration have the following characteristics:

- Size of facility: 84,000-sq-ft (3.86 million-cu-ft)
- Refrigerated spaces: large freezer room (-10°F); four convertible rooms (two 32°F-34°F, one 48°F, and one at 55°F-60°F); and a 45°F-50°F dock area.
- Eight NXTCOLD penthouse units: two above the freezer, one above each of four convertible rooms and two above dock area.
- Freezer units (each): 60 TR; ammonia charge 30-45 lbs; MYCOM compressor
- Convertible-room units (each): 20-30 TR; ammonia charge 15-25 lbs; two Bitzer compressors
- Dock units (each): (30 TR; ammonia charge 15-25 lbs; Bitzer compressor
- Total capacity: 320 TR to 360 TR
- Total ammonia charge: 150 lbs to 240 lbs
- Charge ratio: .47 to .67 lb/TR.
- Electric defrost
- G ntner evaporators; Alfa Laval condensers
- Logic Micro-Systems controls
- Ductwork into refrigerated space
- Danfoss valves and controls, including electronic refrigerant injection control (ERIC)
- VFD for compressor and evaporator fans
- Two NH₃ detectors
- One cooling tower/unit

8 / Dock area showing freezer-door entries



9 / Ducting from the NXTCOLD unit into the dock area

2014. "[Burke] has brought a fresh, aggressive, pioneering management style and was willing to take a chance on this new technology," he said.

Ceballos invoked two California icons in describing KPAC's approach. "I kind of liken us to the old Western style, Ronald Reagan thing," he said, and added, quoting John Wayne, "Courage is being scared to death and saddling up anyway."

Another motivation was not wanting to fall behind the times. "We didn't want to have a plaque that says, 'The last conventional refrigeration system in California,'" he said. "We wanted to go in a new direction, and [low-charge ammonia] looked like the way to go – the way of the future." ■ MG

Hillphoenix's Expanded Portfolio

Last September, Conyers, Ga.-based OEM Hillphoenix announced the addition of NXTCOLD ultra-low-charge ammonia systems to its industrial refrigeration portfolio, making the patented technology available to customers in North America and Latin America for cooler, freezer and blast freezer applications.

Hillphoenix also offers transcritical CO₂ to industrial and commercial operators.

"With our manufacturing capabilities and our core competencies focused in the arena of natural refrigerants, [NXTCOLD] gives us the ability to add ammonia to our portfolio and deliver more options to our customers and the marketplace," said David Neu, vice president, industrial refrigeration for Hillphoenix, in a statement.

NXTCOLD's ultra-low-ammonia charge of 6 oz to 8 oz/TR is the lowest-charge ammonia refrigeration solution available for large refrigeration facilities, said Hillphoenix. The units are delivered preassembled after undergoing rigorous quality control inspections, leading to less complicated installation and start-up than traditional industrial systems, the company added.

"The addition of NXTCOLD to our industrial refrigeration product offering is another example of our deep commitment to delivering natural refrigerant system alternatives that help our customers achieve their goals," said Eduardo Navarro de Andrade, senior vice president of product strategy and innovation for Hillphoenix. "It's imperative that we continue to look ahead and carry through on our commitments to deliver technologies that help shape the landscape of the future."

The NXTCOLD company, based in Los Angeles, has installed units in cold-storage facilities in California, including a Los Angeles Cold Storage facility, and a Neptune Foods seafood storage warehouse in San Pedro, Calif., among other locations.

AHR EXPO ROUNDUP, PART 2

More coverage of CO₂ and hydrocarbon developments at the giant event

By Charlotte McLaughlin and Michael Garry



At the AHR Expo in Chicago in January, there were 2,155 exhibiting companies occupying over 534,000 sq ft of floor space, including many featuring products or services related to natural refrigerants. Typically, these exhibitors increased the scope of their natural refrigerant equipment from previous expos.

In this second account of natural refrigerant exhibitions at the AHR Expo, *Accelerate America* covers several CO₂ and hydrocarbon component manufacturers, their products and their perspective on the marketplace.

(For the first installment, see "AHR Expo Roundup," *Accelerate America*, February 2018.)

DANFOSS SEES NO CO₂ SLOWDOWN

Danfoss, a global manufacturer of high-efficiency controls, compressors, and drives, perceives no change in demand for CO₂ refrigeration in the U.S. retail sector, despite uncertainty surrounding U.S. policy on HFC phase-down regulation.

"Our sales team continues to receive inquiries for CO₂," said James Knudsen, segment manager - food retail at Danfoss. "The interest in this technology seems to be continuing to grow as a portion of capital spending by supermarkets"

Though the U.S. Senate has not yet ratified the Kigali Amendment to the Montreal Protocol that calls for a global phase-down of HFCs, retailers are still going forward with plans to test or introduce this technology.



Danfoss Multi Ejector

"Retailers are still testing and evaluating," Knudsen noted. "Of course, there are some retailers that have adapted to CO₂ like ALDI."

Danfoss's multi ejector for transcritical CO₂, in trial release globally, is being tested by U.S. OEMs, with a few ejectors "headed for the field," said Knudsen. One is already used in a Hillphoenix transcritical CO₂ booster system installed at a Sprouts Farmers Market in Woodstock, Ga., according to Hillphoenix.

Knudsen sees individual states, particularly California, continuing to push for control of refrigerants with high GWP. This is providing impetus to continue on the path toward natural refrigerants in food retail sustainability plans.

"California is leading the way, and, along with a possible consortium of 14 states, the U.S. Climate Alliance, is providing leadership for climate policy," said Knudsen. "This gives retailers the need to consider naturals in their longer-term plans for refrigerants, regardless of national policy. Clearly on a global scale, CO₂ is being either adopted or at least tested in every region as the food retail large-system solution."

SANHUA'S GREEN TECH LINE

Chinese manufacturer Sanhua is starting to work with a number of North American OEMs on hydrocarbon (R290 and R600a) and CO₂ applications of its Green Tech Line of components for those refrigerants.

"We have generally had good acceptance of our solutions," said Michael Smith, marketing communications director for Sanhua's Jackson, Miss.-based U.S. headquarters (soon to move to Houston), at AHR Expo, where the Green Tech Line was showcased. Many are for R290 and supermarket-focused. "We are just starting to scratch the surface."

Sanhua's Green Tech Line, introduced in Europe in 2016 and in North America in 2017, includes (for R290) microchannel heat exchangers, electronic expansion valves, thermostatic expansion valves, four-way reversing valves, piston check valves, ball valves and solenoid valves as well as pressure sensors, sight glasses and filter driers. For CO₂, it includes electronic expansion valves, stainless steel ball valves and stainless steel check valves.

Many of the OEMs working with Sanhua are "especially interested in microchannel [heat exchangers] and electronic valve solutions that allow for greater system efficiency and less refrigerant charge," he said.

Microchannel technology provides greater system efficiency and up to 50% less refrigerant charge, "allowing design engineers to optimize new systems to satisfy current and pending government regulations," he noted.

Additional benefits include less weight, smaller size, and minimum galvanic corrosion and performance degradation over the life of the application.

Electronic valves offer more options for flow control when used with an appropriate controller, he added.



Sanhua's Green Tech Line, including two R744 stainless steel ball valves at right and R290 components

CASTEL SEES U.S. CO₂ MARKET LAGGING

For Italian component maker Castel, the difference between the North America market for CO₂ refrigeration technology and the European market remains considerable.

Most of the commercial refrigeration being built in Europe is now with CO₂, said Alessandro Farina, R&D application manager at Castel. "There is a growing number of [companies] selling CO₂. CO₂ products have a strong growth rate every year."

But the company's sales so far in the U.S. market have been slow.

"Customers in Canada are buying faster than in the U.S.," he said, though customers who came to the component supplier's AHR Expo booth were interested in understanding CO₂ further.

At the AHR Expo, Castel showed a full range of its CO₂ transcritical products like ball valves, expansion valves, coils, connectors and check valves.

Farina noted that warmer European countries, such as Italy, that have not installed as many CO₂ systems as countries in Northern Europe, will soon do so in a big way.

"In Italy it has become more expensive to make old [HFC based systems] than CO₂ ones," he said. "The Southern European market is growing very fast."

BLISSFIELD'S ALL-STEEL HEAT EXCHANGERS

Blissfield Manufacturing Co., a Blissfield, Mich.-based division of BMC Global, is positioning its all-steel, continuous-tube, no-joints condensers and evaporators as suitable for high-pressure CO₂ applications in self-contained beverage coolers.

"I would say the industry standard now is copper and aluminum," said Brandon C. Farver, chief operations manager at Blissfield. "That is really where everyone is. We're much more of a niche player."

The steel design has been approved by UL to work with higher pressures. "CO₂ especially does require a higher pressure [unit]," Farver added. "We manufacturer in all-steel 3/8-, 5/16-in. tube size to accomplish it." The heat exchangers are also low maintenance because of the clog-free steel, according to Blissfield.

These CO₂ condensers are mainly used in beverage coolers, though the demand has been small in the recent years, as stand-alone coolers have gravitated to propane refrigerant. "We've had smaller OEMs coming in talking about [an R134a] replacement," he said.

Blissfield stocks a range of propane-ready products for smaller commercial refrigeration units. It is also the North American supplier of Dorin compressors, and exhibited with the Italian company at the AHR Expo.



Blissfield offers CO₂ heat exchangers

REGAL INTRODUCES MOTOR FOR R290 CASES

Regal Beloit Corp., a Beloit, Wis.-based manufacturer of electric motors and other devices, has designed a new motor and fan for commercial refrigeration applications compatible with the refrigerant R290.

The motor and fan, called the "GlacAir Air-flow Solution," is compatible with R290 and is certified by ATEX (a European Union directive that controls the manufacturing of flammable and explosive products in pressured environments).

ATEX certification means the motor has been designed not to generate any sparks, noted James Steele, Regal's commercial refrigeration group business leader, at the AHR Expo. ATEX is "European-based as that's where propane started and now it's been adopted here in the U.S." The system is also UL- and CE-certified.

The GlacAir has an axial-flux electronically commutated motor (ECM) that helps increase the energy efficiency of commercial refrigeration cases such as displays and reach-in coolers, along with vending machines. The product consumes 85% fewer watts compared to a shaded pole motor, according to Regal.

"Recognizing the critical need for end users to reduce watt usage, we focused on a solution that not only offers that 85% reduction but also increases motor efficiency by 12% compared to a standard ECM," said Sylvia Feng of Regal. It also includes a universal voltage feature.

The fan motor also has a smaller design and lower noise level that is compatible with hydrocarbon-based products; it offers a 4 dBA noise reduction from that of a standard ECM. Steele explained that smaller propane compressors make less noise than other models, leaving the sound of the fan more noticeable. However, that "noise goes away and you don't hear our motor," he said. "It's a much more pleasant experience."

The company has also integrated a BlakBox diagnostics tool that allows near-field and power-line communication to analyse "motor failure based on temperature data, speed and torque, and provide the opportunity for preventative maintenance," said Regal. ■ CM & MG



Regal's R290 fan motor

Vilter Brings CO₂ to Industrial Sector

Vilter will debut its first reciprocating compressor for cascade systems at IAR Conference as it develops transcritical screw compressor

By Michael Garry



Vilter's 550 CO₂ reciprocating compressor

Vilter Manufacturing, a Cudahy, Wis.-based subsidiary of Emerson, will introduce its first CO₂ subcritical reciprocating compressor (the 550 high-pressure series) for cascade systems, and update the status of a CO₂ transcritical screw compressor – both for industrial applications – at the IAR Natural Refrigeration Conference & Expo in Colorado Springs, Colo., March 18-21.

The new products are further evidence of the growing interest in CO₂ refrigeration in the industrial sector, both in ammonia/CO₂ cascade systems and CO₂-only transcritical applications.

As it enters the industrial space with CO₂ compressors, Vilter is able to leverage Emerson's CO₂ experience, as well as its "reach throughout the cold chain," noted Antonio De Lourdes, senior project engineer for Vilter.

"This year we are releasing the CO₂ subcritical unit to be used with our already existing compressor units/packages in cascade systems," said De Lourdes.

Vilter has solicited customer input during extensive testing of the 550 high-pressure series during the past two years. The tests consisted of high-pressure ammonia lab testing within Vilter, subcritical CO₂ lab testing at

Emerson's Helix Center, and beta-site testing at a cold storage facility.

The 550 compressor, Vilter's first CO₂ reciprocating unit, is designed for a maximum discharge pressure of 750 psig, running at speeds between 700 rpm to 1,800 rpm, with a maximum displacement of 225 cfm, in 2-, 4- and 8-cylinder models. It can be used in such applications as cold storage, ice rinks and fishing boats.

The 550 series compressor unit extends Vilter's subcritical CO₂ portfolio by adding to existing single-screw compressor units that range up to 3000 cfm.

In designing the 550 compressor, Vilter employed the same "bottom-end" components – crankshaft and connecting rods – used in its standard 400 series compressors with a different top end – piston and valving – to accommodate CO₂, said De Lourdes.

De Lourdes observed that in cascade ammonia/CO₂ systems, a lingering concern for customers is that leaks in the ammonia/CO₂ heat exchanger will lead to the two refrigerants mixing and creating ammonium carbamate, which could clog the system. Those leaks happened in early European installations, though he has not heard of any such occurrences in the U.S.

Notwithstanding those concerns, Emerson and Vilter believe the combination of ammonia and CO₂ in one cascade system "will be the future," he said.

Large transcritical compressor

For transcritical CO₂ systems, Vilter is testing a high-pressure low-displacement (HPLD) single-screw compressor. "This will be the first transcritical rotary screw compressor in the industrial market of its size," said De Lourdes, adding that an update on the tests will be provided at the IAR Conference.

The HPLD compressor has the following characteristics: 1,200 to 3,600 rpm; at 3,550 rpm, 128 cfm to 243 cfm (7 different sizes); current maximum discharge pressure, 800 psi; testing to a maximum discharge pressure of 2,000 psi for CO₂ transcritical applications; and no slide valves/capacity control with VFD/fixed-volume ratios.

De Lourdes estimated that the HPLD compressor could take the place of multiple racked reciprocating compressors.

The HPLD compressor is also intended to eliminate the need for a flash tank and a parallel compressor in a transcritical system. "You reinsert the [flash] gas into the economizer port and it acts like a parallel compressor," De Lourdes said. "So you eliminate an extra vessel and help the cost come down."

■ MG



Small-diameter
MicroGroove tubes

Sub-Zero Tests 5-mm Tubes with R600a

In a project with the ICA and Optimized Thermal Systems, the home fridge manufacturer is examining the use of small-diameter copper condenser coils with up to 57 g of isobutane

By Michael Garry

Sub-Zero, Inc., Madison, Wis., a manufacturer of residential refrigerators and freezers, is engaged in a project to explore the advantages of MicroGroove copper tubes with outer diameters of 5 mm in appliances using up to 57 g of flammable R600a (isobutane) refrigerant.

The project includes Optimized Thermal Systems, Inc. (OTS), a software developer based in Beltsville, Md., and the International Copper Association (ICA), New York.

According to a January press release from ICA, engineers from Sub-Zero approached OTS for assistance in using CoilDesigner, OTS' heat exchanger design and simulation software tool. "The primary objective was to design a condenser coil that would equal the performance of the existing (baseline) coil while lowering the refrigerant charge," said the ICA release. "Secondary objectives were to reduce the total footprint of the coil and the total tube-and-fin material mass."

The baseline condenser coil in the OTS study uses quarter-inch copper tubing, flat plate fins and a low fin density. The condenser has two refrigerant circuits, with each circuit serving an independent vapor compression cycle for the refrigerator and freezer compartments.

"The idea was to explore [5 mm] diameter to address the [hydrocarbon] charge limit of 57 grams," said Anderson Bortoletto, principal design engineer for Sub-Zero.

According to ICA, OTS has developed a CoilDesigner model of the condenser and validated it against experimental data.

Equipped with that model, Sub-Zero created a prototype coil, and has begun a "component-level and system-level assessment of its heat transfer performance," said Bortoletto, adding that Sub-Zero will release the results of its experimental work to the ICA.

Sub-Zero plans to share the results to "promote the visibility of this technology," he said. "We're a small company and we can't drive 5 mm ourselves. We need others to see the benefits and jump in so everybody benefits."

The Sub-Zero research is taking place with the policy on federal hydrocarbon charge limits in flux. The U.S. Environmental Protection Agency (EPA) recently withdrew a "direct final rule" that would have raised the charge limit

to 150 g from 57 g for hydrocarbon refrigerants in domestic refrigerators and freezers because of adverse feedback from stakeholders. (See [page 32](#).)

However, an identical proposed rule raising the charge limit remains in play, and the EPA said it would address adverse feedback in any subsequent final action based on the proposed rule. There is a lot of push [in the U.S.] to go to 150 grams," said Bortoletto.

The European Union and other regions have long used a 150 g limit for hydrocarbons in domestic refrigerators.

If the hydrocarbon charge limit were raised to 150 g, the need for the ICA project would be less, though there would still be an interest in the "overall heat transfer enhancement and the material savings," resulting from the 5 mm tubing, he said.

Sub-Zero makes hydrocarbon-based refrigerators for the international market where the limit is 150 g – using 5/16-in. (7.9 mm) and 1/4-in. (6.35 mm) tubes – but not so far in the U.S. with its 57 g limit. But with 5 mm tubes, the 57 g limit would be viable for domestic fridges, Bortoletto said.

41% volume reduction

The OTS optimization study was conducted to identify condenser designs that could reduce the internal volume and lower the refrigerant charge.

The 5-mm tube designs were evaluated and compared to the baseline design and significant reductions were found in internal tube volume, said the ICA release, adding, "The best 5-mm design reduced the internal tube volume by as much as 41% as compared to the baseline, along with a 57% reduction in coil footprint."

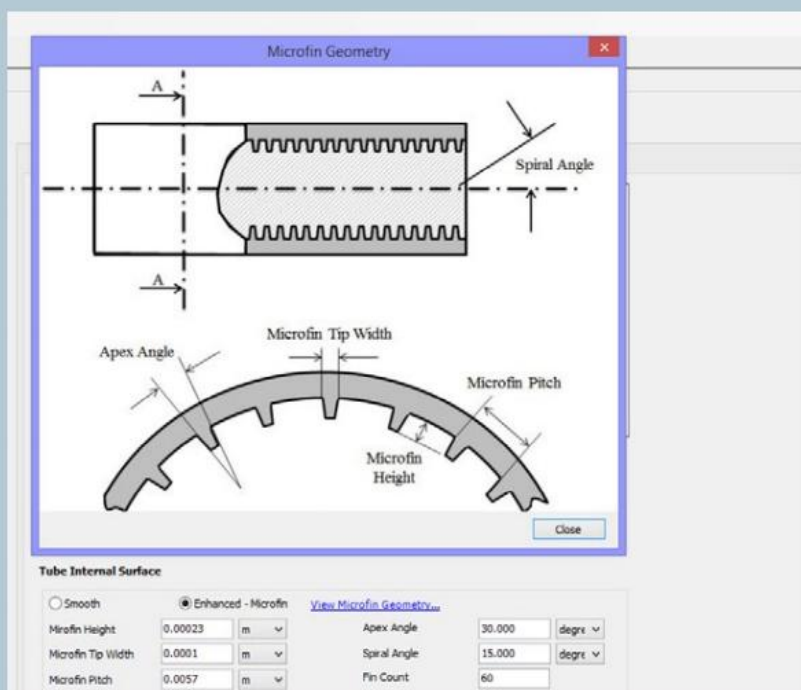
The new designs used "wavy-herringbone" fins with a reduced fin thickness as compared to the baseline. Other variables included the horizontal and vertical spacing of the tubes; number of tubes per bank; fin density; wavy-fin-pattern depth; tube circuitry; and tube length.

The design criteria, as compared to the baseline design, included: heat rejection and subcooling greater than or equal; and saturation temperature drop kept within one degree.

Multiple factors contributed to an increase in airside pressure drop with the smaller-diameter tube coils, including fin type, face area of the coils, and fin density, said ICA. "Nonetheless, for this application, reduced internal volume was considered to be more important than the airside pressure drop. The fan motors used in this system can overcome the increased resistance and compensate for the increase in airside pressure drop."

ICA called the study "a starting point for the development of high-performance condenser coils for this application." With a high-performance condenser, it added, "condenser fan speed can be reduced, resulting in a quieter refrigerator unit. Also, less fouling could be useful in the condenser, requiring less maintenance."

"R600a will play a key role in refrigeration systems for many years to come," said Nigel Cotton, MicroGroove team leader for the International Copper Association. "As MicroGroove tubes and coils are uniquely suited for use with propane, so they are also well-suited for isobutane. The Sub-Zero study has set a benchmark for the use of MicroGroove with R600a." ■ MG



CoilDesigner screen shot showing how MicroGroove details are entered in the user interface.



Stellar NH360 packaged low-charge-ammonia system

Stellar's Low-Charge Entry

Its NH360 packaged units offer an ammonia charge under 1 lb/TR in a variety of industrial settings

Stellar, a designer, manufacturer and installer of industrial refrigeration systems, has entered the low-charge ammonia arena with its NH360 packaged refrigeration systems that offer less than 1 lb/TR (typically 0.90 to 0.98) ammonia charge.

The company has already installed a number of these systems, including an 1,800-TR unit at a New Jersey distribution warehouse; a 450-TR unit at a New Jersey food plant; multiple units amounting to nearly 5,000 TR at a Chicago pharmaceuticals plant; and three 450-TR units at a food plant in Bakersfield, Calif.

Accelerate America was able to query Brandon France, Stellar's director of packaged solutions about the NH360 brand.

Accelerate America: How did you get the charge so low?

including our patented evaporator with integrated separator and surge capacity. Also, using secondary refrigerants can keep the ammonia package to a compact and critical charge.

AA: What components do you use?

low-charge solutions, which include ammonia-only, ammonia with a secondary refrigerant such as glycol or CO₂ brine, or ammonia/CO₂ cascade. Evaporators are typically located in the cold storage area.

AA: Are these rooftop/outside ground installations or inside?

rooftop when provided with an optional integrated enclosure.

AA: Are these all new plants? Any extensions? Retrofits?

where a client needs to add capacity or has chosen to replace HFC units with low-charge ammonia or CO₂ units.

Brandon France: We use a variety of technologies depending on the situation, including our patented evaporator with integrated separator and surge capacity. Also, using secondary refrigerants can keep the ammonia package to a compact and critical charge.

BF: We use standard industry components and apply them in innovative ways to achieve

low-charge solutions, which include ammonia-only, ammonia with a secondary refrigerant such as glycol or CO₂ brine, or ammonia/CO₂ cascade. Evaporators are typically located in the cold storage area.

BF: Our packaged systems can be installed indoors, or outdoors on the ground or rooftop when provided with an optional integrated enclosure.

BF: Our packaged systems have been installed in a variety of applications such as

in new plants, plant additions (i.e. extensions) and retrofits where a client needs to add capacity or has chosen to replace HFC units with low-charge ammonia or CO₂ units.

AA: How does the equipment/installation cost compare to that of stick-built systems with similar TR?

before leaving our facility. We also see significant savings when an integrated enclosure is provided that houses the NH360 package in lieu of a traditional machine room.

AA: How does time of installation compare?

size of the project. For example:

- 1) In cases where the client chooses to install the units indoors in a new facility, the NH360 packages are built concurrent with the machine room. Once the machine room floor is cured, the NH360 packages can be installed. In one instance, we offloaded two skids and set them in place in about 4 hours.
- 2) Packaged systems with integrated enclosures can all be set in a matter of hours with little or no interruption to the client's production at existing plants. At new plants these units can easily be delivered and set with little disruption to the project site.
- 3) Units can be shipped directly to the client, requiring only offload and tie-ins to be made by the on-site contractor.

AA: How do efficiency and maintenance costs compare?

platform. The preventative maintenance routine and energy usage are in line with those of a traditional machine room.

AA: Are you replacing any HFC units with the NH360?

utilize natural refrigerants. Recently we have seen an increased interest from prospective clients who wish to replace R22 chillers as well as systems using other HFC refrigerants with ammonia and/or CO₂.

AA: What's driving interest in it?

implemented programs on their own to phase out high-GWP and high-ODP synthetic refrigerants. Others see refrigerants such as R22 being phased out and do not want to switch to another HFC refrigerant only to have it phased out as well. Natural refrigerants such as ammonia and CO₂ offer a solution that will not be phased out in the future as the result of environmental regulations.

BF: Field labor is significantly reduced since the NH360 units are built out of the weather in a quality-controlled factory and tested

BF: The savings can be anywhere from two to four months, depending on the

On another note, mainly outside of the food and beverage industry we see a reluctance to switch to ammonia as many are worried about its safety. Our NH360 packaged systems offer the one of the lowest charges in the industry at less than 1.0/TR. When combined with secondary refrigerants such as glycol, the ammonia is isolated to the machine room or integrated skid enclosure and away from the rest of the plant and production personnel. The secondary refrigerant is then pumped through the plant.

AA: How much interest is there in low-charge packaged ammonia units in general? Is it growing?

need to add capacity and/or wish to eliminate the use of HFC refrigerants in their facilities. For clients considering ammonia, low-charge is an absolute must from a regulatory and safety standpoint..

AA: How is the NH360 different from competitive low-charge packages?

needs. The custom solutions we offer include the following:

- 1) With our without enclosure.
- 2) Units can include secondary refrigerant pumps integral to the NH360 package.
- 3) We also offer a variety of standard and custom secondary refrigerant pump packages, cooling tower pump packages, and general pump packages.
- 4) Our underfloor warming skids use recovered heat to warm glycol that is pumped under the floor in large freezers for underfloor warming.
- 5) Cooling towers can be located above the NH360 enclosure and supported directly from the enclosure's optional super structure. This often proves to be the most economical solution when retrofitting a plant since the roof of an existing plant is not normally designed to support the weight of the package. Modifying the roof to support the package is very disruptive to plant operations. The cost to modify the roof also often outweighs any financial advantage that would normally be derived by installing packaged equipment.

Turning Stadiums into Hockey Rinks

CIMCO's ammonia systems travel to outdoor venues for NHL games

By Mark Hamstra

The 31 professional hockey teams in the National Hockey League (NHL) normally play in warm indoor arenas. But since 2003, the NHL has been staging occasional outdoor winter contests, played on temporary ice rinks, in football stadiums and baseball parks across the U.S. and Canada — a feat made possible by CIMCO Refrigeration's mobile ammonia refrigeration systems.

Toronto-based CIMCO, a division of Toromont Industries Ltd., designed and built two, 53-foot mobile trailers for the NHL that each holds self-contained ammonia refrigeration systems. The systems use an 800-lb charge of ammonia to cool a 40% ethylene glycol mix, which is then pumped through piping sandwiched between a grid of aluminum plates assembled atop the outdoor playing field. A waterproof cover is placed over the plates, and workers spray water on top to form a two-inch-thick sheet of ice.

“They would need a whole row of trailers using some other refrigerant to do what we do with one trailer using an ammonia system.”



Ammonia equipment in CIMCO's mobile trailer used to make outdoor ice rinks for the NHL

The refrigeration aspect of the process is virtually identical to that used in standard, permanent ice rink structures, said John Bell, Ontario service manager at CIMCO, who oversees the NHL outdoor series.

The CIMCO system has always used ammonia as a primary refrigerant because of its efficiency, he said.

"They would need a whole row of trailers using some other refrigerant to do what we do with one trailer using an ammonia system," Bell said.

The NHL launched outdoor games in 2003 with its NHL Heritage Series, and followed that up with the NHL Winter Classic Series. They were such a success that the league added the Stadium Series in 2014, which has included up to four games per year played in various venues around North America.

Although CIMCO began building temporary refrigeration units for the very first outdoor NHL game in 2003 in Edmonton, Alberta, it created the first mobile trailer unit in 2008. The company then built a duplicate trailer system so that the NHL could stage two outdoor games at around the same time. The NHL owns the trailer systems, although CIMCO sets them up and operates them at the outdoor venues, stores them when not in use and maintains them year-round.

The NHL provides the staffing to assemble the rink structure, and also provides a generator to power the refrigeration equipment on site, Bell explained.

The trailers each contain two screw compressors from Frick, which Bell said are rugged enough to withstand the rigors of long over-the-road travel. (See [page 52](#) for a full list of the equipment in each of the two trailers.)

"It's not that the trailer has much of an issue when it's sitting at the back of a stadium operating away, but after that it goes on the highway back up to Canada and goes through a few potholes to get here," he said. "So they have to be pretty rugged duty to manage that."

AN INDUSTRIAL-REFRIGERATION RECRUITING OPPORTUNITY

The Ammonia Refrigeration Foundation (ARF) recently saw an opportunity to leverage the NHL's outdoor Stadium Series as an educational tool to create awareness about the industrial applications of natural refrigeration technologies.

The most recent game in the series, a contest between the Washington Capitals and Toronto Maple Leafs at the Navy-Marine Corps Memorial Stadium at the U.S. Naval Academy in Annapolis, Md., created an opportunity for the Alexandria, Va.-based ARF to showcase the refrigeration technology to potential workers and groups that seek to find careers for military veterans.

"Because we as a foundation are advocating for talent development in every way, from the people who work on the equipment to the people that design and create the equipment, this was a hands-on practical application they could see, touch, hear and smell," said Lois Stirewalt O'Connor, executive director of the ARF. "We were fortunate that it just landed right in our backyard."

She said the industry is currently seeking to fill about 40,000 positions, and is looking in particular at military veterans as potential recruits. (See, *"ARF Taps Military for Technician Apprenticeships," Accelerate America*, January 2018.)

After hearing an ad for the game while at an airport, she reached out to Dave Malinauskas, president of CIMCO Refrigeration, on a hunch that it was his company that built the refrigeration system. Her guess was correct, and from there Stirewalt O'Connor arranged a meet-and-greet session between the CIMCO technicians on site and 12 engineering students from the area who are members of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), along with a host of government agencies.

Attendees included representatives from the Department of Defense's Soldier for Life and SkillBridge programs, the U.S. Chamber of Commerce Hiring our Heroes program, the Department of Homeland Security, the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency, and members of the local refrigeration, manufacturing and contracting communities.

Stirewalt O'Connor said she thinks the event helped raise awareness for career opportunities in the industry.

"My thought process was, unless you are aware of the possibilities and what the practical applications are of industrial refrigeration, you are not going to go into it as a career field," she said.

“Facilities in need of a replacement of their ice plant may consider natural refrigerants, such as ammonia or CO₂.”

MAJOR EQUIPMENT IN EACH CIMCO NHL TRAILER

- ▶ 1 Frick 250-hp screw compressor
- ▶ 1 Frick 200-hp screw compressor
- ▶ 2 Vahterus plate-and-shell evaporators
- ▶ 1 Evapco 40-hp evaporative condenser with 3-hp integral sump pump
- ▶ 2 Armstrong 50 hp glycol pumps
- ▶ 1 starter panel
- ▶ 1 breaker panel
- ▶ 1 lighting panel
- ▶ 1 CIMCO programmable logic controller (PLC) system

Both the trailers and the systems undergo periodic rigorous inspections to ensure they are operating properly, Bell said.

One of the few differences between the trailer-based system and the thousands of ice rink systems CIMCO has installed across Canada and the U.S. is the inclusion of a sump pump for operating in warmer conditions, such as in the southern U.S. In addition, CIMCO built a heating unit to warm the glycol if the ice gets too cold due to ambient temperatures, which can cause the ice to crack, Bell noted.

GREEN MISSION

The use of ammonia trailers fits the NHL's "green" mission to minimize the impact of the league's activities on the environment, said Lois Stirewalt O'Connor, executive director of the Ammonia Refrigeration Foundation.

"They are trying to keep everything clean and natural, and that's what natural refrigerants are, so this fits right in," she said.

On its website (NHL.com), the NHL promotes the use of natural refrigeration technologies, including ammonia and CO₂ systems.

"Facilities in need of a replacement of their ice plant may consider natural refrigerants, such as ammonia or CO₂," the website states, noting that both are better for the environment than synthetic refrigerants because of their low GWP and Ozone Depleting Potential (ODP).

The NHL also suggests installing high-efficiency compressors, NEMA (National Electric Manufacturers Association) premium efficiency motors and variable-speed drives on pumps for additional energy savings. In addition, ice surface temperature controls can help maintain desired temperatures and minimize energy use, the website explains. ■ MHI

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