

APRIL 2017

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ADVANCING HVAC R E I C A

Refrigerant
Management
Rated No. 1
In Project Drawdown

p. 6

CO₂ Condensing Units
Coming to U.S.?

p. 20

CO₂ Saves
DeCicco & Sons
A Bundle

p. 30

RICARDO
GARCIA
FRIALSA

AMMONIA / CO₂
SOUTH OF THE
BORDER

p.34

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The Power of Refrigerants

— By Michael Garry



“It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness.”

— Charles Dickens, *A Tale of Two Cities*

As the world knows, the first few months of the Trump presidency has seen an unprecedented, unfathomable attempt to undermine basic environmental protections of the air and water, reject the established science of climate change and pursue an agenda based on “alternative facts.”

Many in the HVAC&R industry have wondered how these policies would impact efforts to phase out climate-damaging refrigerants and less efficient refrigeration and air conditioning equipment. The administration’s proposed budget provides some answers, such as slashing funding for energy standards and targeting the elimination of vital programs like Energy Star the GreenChill Partnership ([see page 24](#)).

And yet for all of the gloom engendered by these moves, there are reasons for hope, and even optimism, that common sense and respect for nature may yet prevail.

First is the national and global pushback, from states, NGOs, businesses, scientists and regular folks, as evidenced by the non-partisan March for Science, on Earth Day, April 22, followed by the global People’s Climate Movement march on April 29.

And I am particularly heartened by recent developments on the refrigerants front.

The biggest development, of course, was last October’s Kigali Amendment to the Montreal Protocol, calling for a phase-down of HFCs by 197 countries, including the U.S., that would lower global warming by 0.5°C (0.9°F) by 2100. In addition, California is continuing to advance its plan to cut HFC emissions in the state by 40% below 2013 levels by 2030.

But the development that I found most amazing was the publication on April 18 of *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, edited by Paul Hawken, who heads the research project behind the book, Project Drawdown. ([See page 6](#)).

This book and its associated website (www.drawdown.org) calculate the impact of 80 existing climate-change mitigation approaches on reducing atmospheric CO₂-equivalent emissions between 2020 and 2050, along with their costs and savings.

Many of the top solutions are what you would expect, such as onshore wind turbines (No. 2 in greenhouse gas reductions) and solar farms (No. 7). Others are more surprising, like family

planning (No. 6). But what may be the most eye-catching metric was the book’s choice for the No. 1 solution for reversing climate change: refrigerant management! This alone would cut emissions by 89.70 gigatons compared to business-as-usual over 30 years.

Those of us working in the natural refrigerants arena have been aware of the power of refrigerants to influence global warming, but I was still impressed that it secured the No. 1 spot on the list.

One reason for this result is that refrigerant management is the “low-hanging fruit” in the tree of climate remediation; another is its global reach. In this issue, for example, we document the natural refrigerant strategy of our first Mexican cover subject, cold-storage operator Frialsa ([page 34](#)), and cover natural refrigerant trends in Japan, Europe and Australia.

I recommend reading the book. It will make your day. ■ MG

ACCELERATE

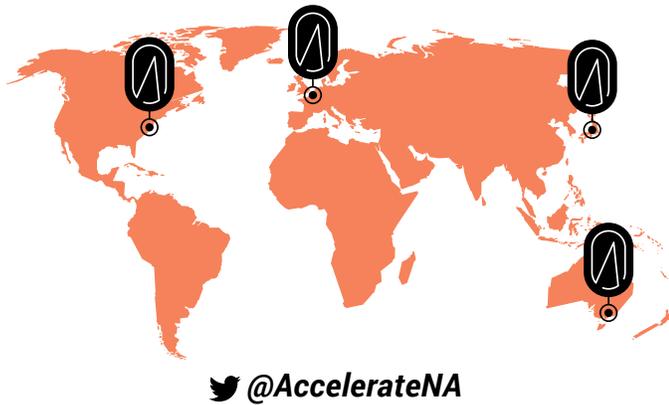
ADVANCING HVAC&R NATURALLY

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.

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03 EDITOR'S NOTE
by Michael Garry

10 EVENTS GUIDE

06 REFRIGERANT
MANAGEMENT TOPS
LIST OF CLIMATE-CHANGE
SOLUTIONS

12 IN BRIEF

INFOGRAPHIC

OPINIONS

08 PROJECT DRAWDOWN'S
RANKING OF CLIMATE-
CHANGE SOLUTIONS

16 Are We Upside Down
Because We're Down
Under, or Is the Rest of
the World the Same?
- by Ian Tuena





34
END USER
COVER
STORY
NH₃/CO₂
SOUTH OF THE
BORDER



42
EVENTS
NATURAL
REFRIGERANT
SHOW MEDLEY

TRENDS

20 CO₂ CONDENSING UNITS
ARE A HIT OVERSEAS

POLICY

24 TRUMP'S BUDGET AIMS TO END
EPA'S GREENCHILL PROGRAM

26 IIR-2 TAKES CHARGE

END USER

30 TRANSCRITICAL CUTS ENERGY
COSTS BY \$74,000 FOR
DECICCO & SONS

TECHNOLOGY

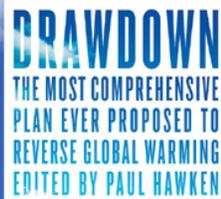
50 BRINGING LOW CHARGE
TO AMERICA



30

ABOUT ACCELERATE AMERICA

55 EDITORIAL CALENDAR



DRAWDOWN
THE MOST COMPREHENSIVE
PLAN EVER PROPOSED TO
REVERSE GLOBAL WARMING
EDITED BY PAUL HAWKEN

Refrigerant Management Tops List of Climate-Change Solutions

In new book, Project Drawdown calculates impact of 80 strategies on cutting greenhouse gas emissions over 30 years

— By Michael Garry

A new book documenting 80 climate-change mitigation approaches ranks refrigerant management as the No. 1 global solution in terms of estimated atmospheric CO₂-equivalent reductions between 2020 and 2050.

The book, *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, edited by Paul Hawken, calculates that refrigerant management — one of seven solutions in the “materials” category — would eliminate emissions equivalent to 89.70 gigatons of carbon dioxide (compared to business-as-usual) at a cost of \$902.8 billion under a “plausible scenario” pursued over the 30-year period.

In the chapter on refrigerant management, the impact analysis is described as including “emissions reductions that will be achieved through the 2016 Kigali [Montreal Protocol] accord, as well as additional practices to manage refrigerants already in circulation.” Over 30 years, “87 percent of refrigerants that may be released can be contained.”

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

OTHER TOP SOLUTIONS

Nine other top approaches, in order of ranking include: onshore wind turbines (84.60 gigatons), reduced food waste (70.53 gigatons), plant-rich diet (66.11 gigatons), tropical forests (61.23 gigatons), educating girls (59.60 gigatons), family planning (59.6 gigatons), solar farms (36.9 gigatons), silvopasture (31.19 gigatons) and rooftop solar (24.60 gigatons). If onshore and offshore wind turbines (14.10 gigatons) were combined, their total emissions reduction would be 98.70 gigatons, putting overall wind energy in first place.

In addition to evaluating 80 existing approaches to climate change, the book also describes 20 emerging solutions like microbial farming and smart highways.

If all 80 current approaches were used under the plausible scenario, the total impact would be a reduction of 1,051.01 gigatons of CO₂-equivalent, at a net cost of \$27,405.68 billion, and a net savings of \$73,874.52 billion. Refrigerant management represents 8.5% of the total emissions reduction.

More ambitious estimates were also made, including “drawdown scenario,” in which refrigerant management rank No. 2 at 96.49 gigatons, and “optimum scenario,” in which refrigerant management would rank No. 3, also at 96.49 gigatons.

The book is based on “Project Drawdown,” a research project headed by Hawken that includes more than 250 researchers and scientists from 22 countries. Its aim: to create a list of the most effective existing solutions for arresting and reversing global warming, the impact they could have if scaled and their cost.

The research tracks “a blueprint that already exists in the world in the form of humanity’s collective wisdom, made manifest in applied, hands-on practices and technologies that are commonly available, economically viable and scientifically valid,” writes Hawken, in the book.

The project defines drawdown as “the point in time at which greenhouse gases peak and begin to decline on a year-to-year basis.” The project’s ultimate goal, the book stresses, is not just to slow the pace of global warming but to reverse it. Drawdown would not be achieved under the plausible scenario, but is possible under the drawdown scenario and more likely under the optimum scenario, the book says.

More information on the book and Project Drawdown is available at www.drawdown.org. Online technical summaries for each solution will be available May 1, 2017. ■ MG

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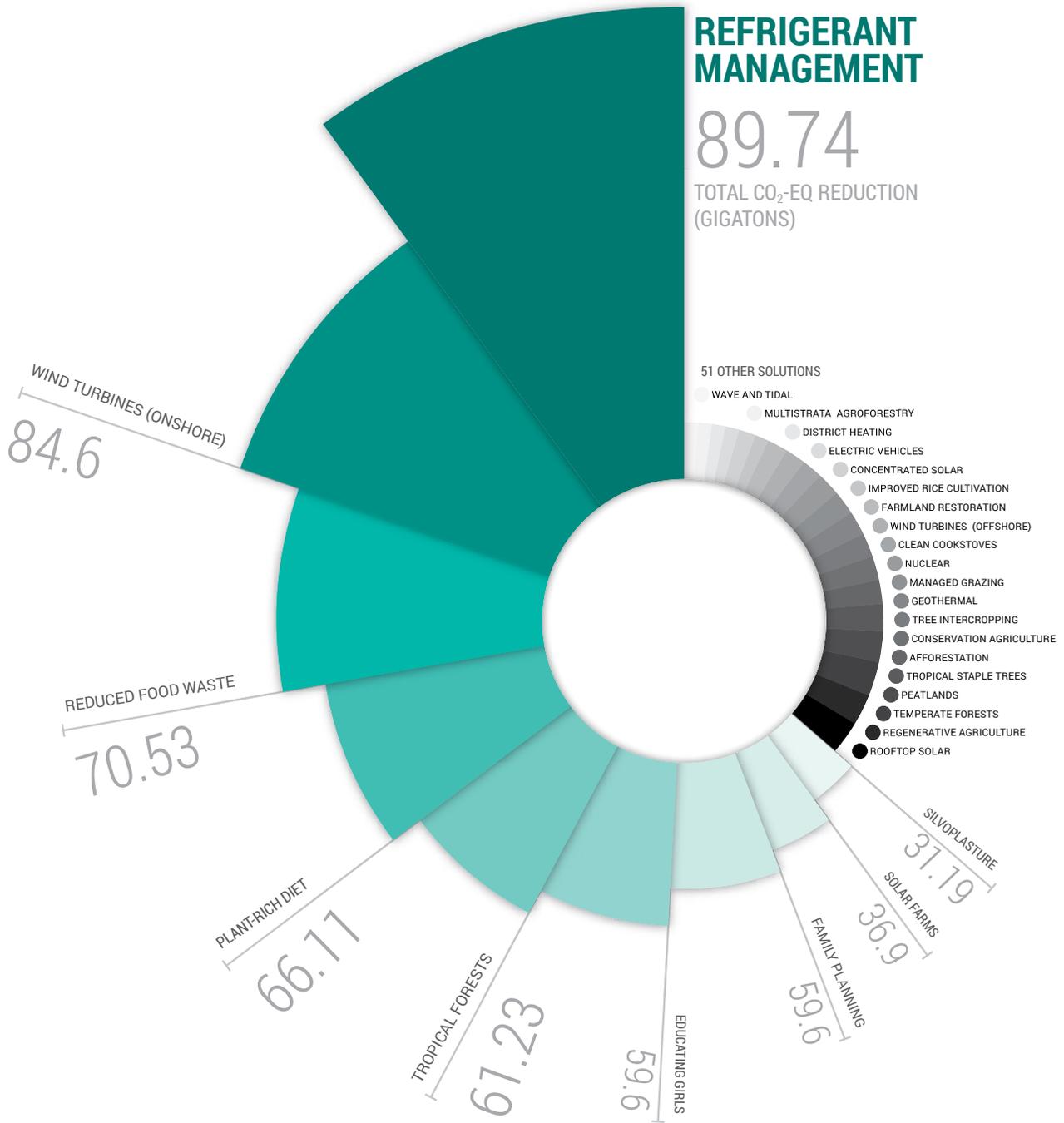


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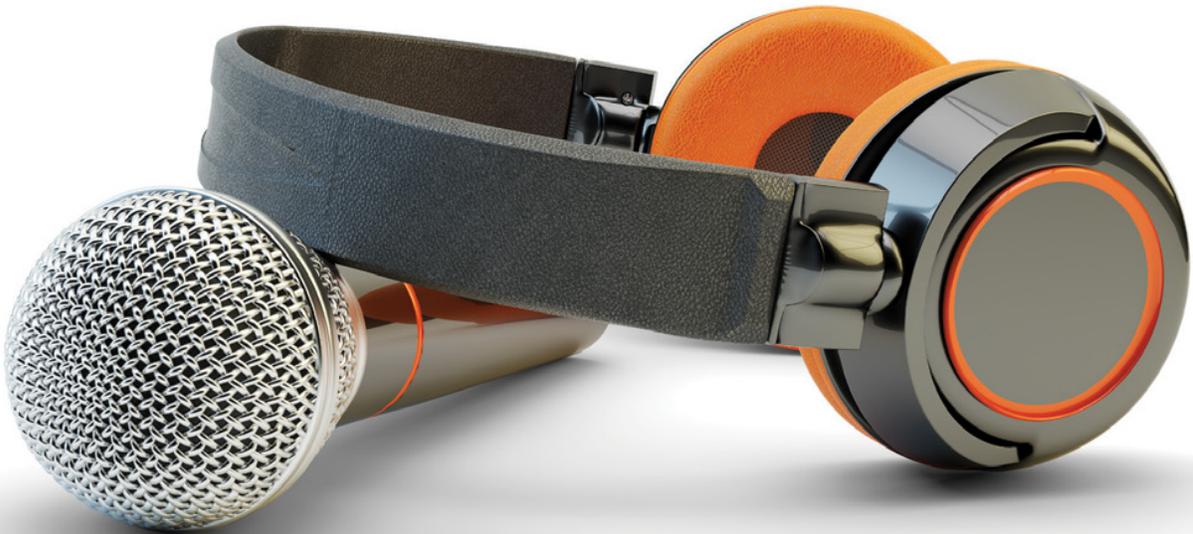
*Under "plausible scenario" between 2020 and 2050. Total CO₂-EQ Reduction of all 80 Solutions: 1,051.01 Gigatons
 Source: *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, edited by Paul Hawken

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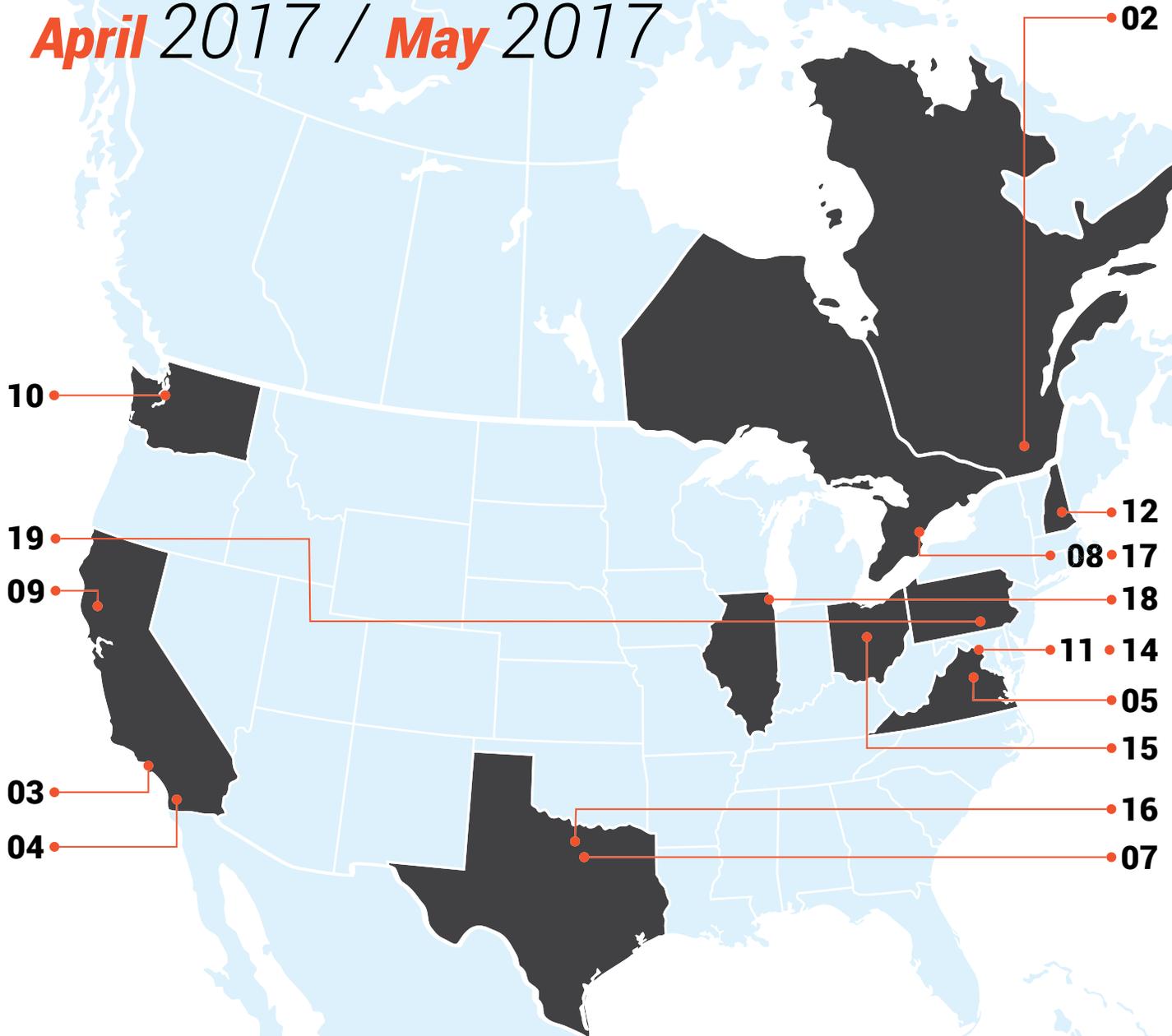


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EVENTS GUIDE

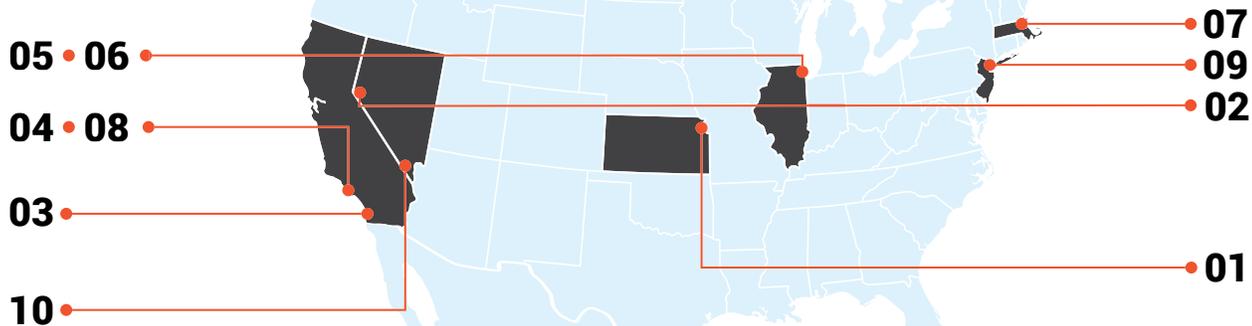
April 2017 / May 2017



01 • 06 • 13 •))))

- **01** April 25, Online at 2 pm EST
GreenChill Webinar: Using Refrigeration Batteries to Manage Energy Use
www: [www: www.epa.gov/greenchill/events-and-webinars](http://www.epa.gov/greenchill/events-and-webinars)
- **02** April 26-27, Montréal, Québec
MCEE
www: [www: www.mcee.ca/](http://www.mcee.ca/)
 @MCEE2017
- **03** April 28, Buena Park, California
29th Annual RETA LA CA #2 & Inland Empire Ammonia & Refrigeration Safety Seminar
www: <http://reta.com/events/EventDetails.aspx?id=918286&group=>
- **04** April 30 - May 2, San Diego, California
Supply Chain Conference
www: <http://www.gmaonline.org/forms/meeting/Microsite/SupplyChain17.0>
- **05** May 1-3, Reston, Virginia
AHRI Spring Meeting
www: <http://www.ahrinet.org/News-Events/Meetings-and-Events/AHRI-2017-Spring-Meeting.aspx>
 #AHRISpring
- **06** May 2, Online at 2 pm EST
International Institute of Ammonia Refrigeration's (IIAR's) Resources for Using NH₃ and CO₂
www: <https://epawebconferencing.acms.com/nh3co2refrigerants/>
 #SNAXPO
- **07** May 2-3, Irving, Texas
DFW Ammonia Refrigeration Regional Conference
www: <http://reta.com/events/EventDetails.aspx?id=922540&group=>
- **08** May 2-4, Toronto, Ontario
SIAL Canada
www: [www: www.sialcanada.com](http://www.sialcanada.com)
 @SIALCANADA #SIALCanada
- **09** May 3-5, Santa Rosa, California
37th Utility Energy Forum
www: <http://utilityforum.org/>
 @UtilityForum #2017UEF
- **10** May 3-6, Seattle, Washington
CNU 25: Seattle - Congress for New Urbanism
www: <https://www.cnu.org/cnu25>
 @NewUrbanism
- **11** May 8-9, Washington, D.C.
Energy Efficiency Global Forum (EE Global 2017)
www: <http://eeglobalforum.org/>
 @ToSaveEnergy #EEGlobal
- **12** May 9, Concord, New Hampshire
Concord NH Ammonia Safety Day
www: <http://reta.com/events/EventDetails.aspx?id=949306&group=>
- **13** May 9, Online at 2 pm EST
GreenChill Webinar: Strategies for Reducing Refrigeration System - Charge Size
www: <https://www.epa.gov/greenchill/events-and-webinars>
- **14** May 15-17, Washington, D.C.
Better Buildings Summit
www: <https://betterbuildingsinitiative.energy.gov/summit>
 @BetterBldgsDOE #BBSummit17
- **15** May 16-19, Columbus, Ohio
15th NARCE - North American Rink Conference and Expo
www: <http://www.narce.com/>
- **16** May 17-18, Arlington, Texas
NFMT High-Performance Buildings & Workplaces
www: <http://www.nfmt.com/highperformance/default.aspx>
 @HPBWConference #HPBW17
- **17** May 17-18, Toronto, Ontario
IFMA Facility Fusion Conference & Expo - International Facility Management Association
www: <http://facilityfusion.ifma.org/toronto/>
 @IFMA #facilitiesmanagement
- **18** May 21-24, Chicago, Illinois
NRA Show
www: <https://show.restaurant.org/>
 @NRAShow #NRAShow17
- **19** May 21-25, Hershey, Pennsylvania
Eastern Energy Expo 2017 - AREE / OESP / PPA - Trade Shows
www: <http://easternenergyexpo.com/>
 @2016EEE

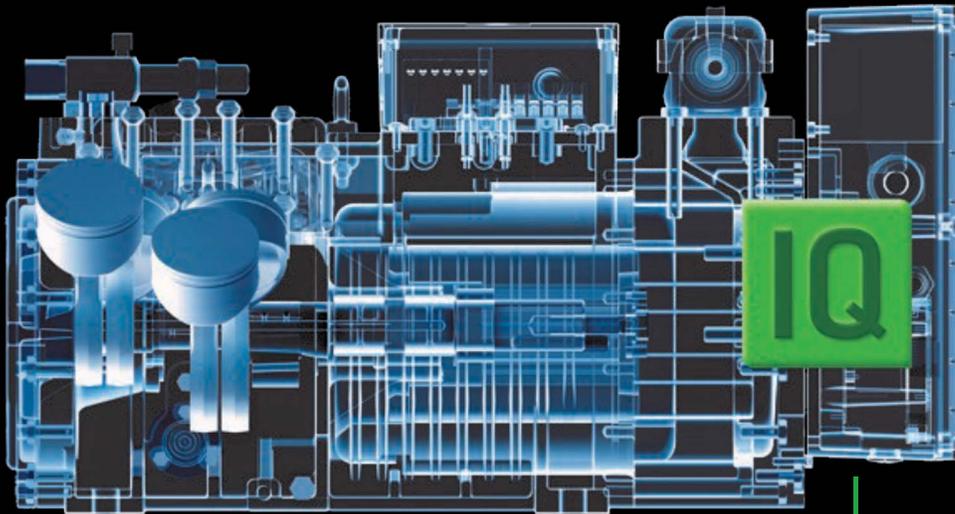
EVENTS GUIDE *June* 2017



- **01** June 1, Kansas City, Kansas
GCAP's Kansas City 9th Annual Region 7 Ammonia Safety Day
 www: <http://www.ammoniatraining.com/kansas-city-ammonia-safety-day/>
 #AHRIspring
- **02** June 4-6, Incline Village, Nevada
American Frozen Food Institute (AFFI), Food Logistics Forum
 www: <http://www.affi.org/event/food-logistics-forum-0>
 @AFFI
- **03** June 5-7, San Diego, California
6th ATMOSphere America
 www: [www: www.atmo.org/America2017](http://www.atmo.org/America2017)
 @ATMOEvents #ATMOAmerica
- **04** June 7-8, Long Beach, California
35th West Coast Energy Management Congress (EMC)
 www: <http://www.energyevent.com/>
 #EMCexpo
- **05** June 13-15, Chicago, Illinois
Global Cold Chain Expo
 www: <http://www.globalcoldchainexpo.org/>
 @coldchainexpo #GCCE
- **06** June 13-15, Chicago, Illinois
United Fresh 2017
 www: <http://www.unitedfreshshow.org/>
 @UnitedFresh
- **07** June 14-15, Boston, Massachusetts
Northeast Buildings & Facilities Management Show & Conference 2017
 www: <http://proexpos.com/NEBFM/>
 @NEBFM
- **08** June 24-28, Long Beach, California
ASHRAE Annual Conference
 www: <https://www.ashrae.org/membership-conferences/conferences/2017-ashrae-annual-conference>
- **09** June 25-27, New York, New York
Summer Fancy Food Show
 www: [www: www.specialtyfood.com](http://www.specialtyfood.com)
- **10** June 25-28, Las Vegas, Nevada
IFT17 - Institute of Food Technologists
 www: <https://www.iftevent.org/>
 @IFT

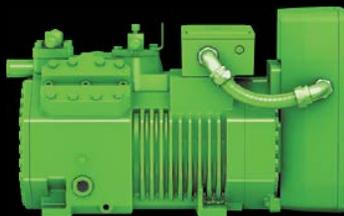


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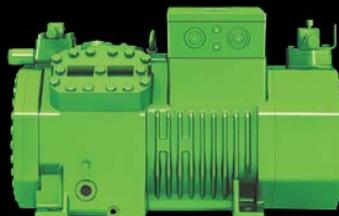


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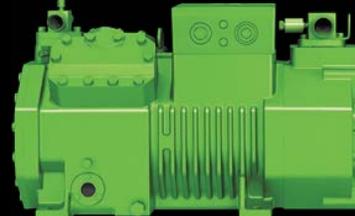
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IN BRIEF

POLICY

DOE CHALLENGED FOR DELAYING EFFICIENCY STANDARDS

WASHINGTON, D.C. – Following a Trump administration decision to block six energy-efficiency standards from taking effect, a coalition of states and NGOs has taken legal action against the Department of Energy (DOE). The coalition charges the DOE with violating both the federal Energy Policy and Conservation Act (EPCA) and Administrative Procedures Act (APA) by failing to publish final standards for walk-in coolers and freezers, portable air conditioners and other equipment in the Federal Register by March 15, 2017. The standards are projected to save households and businesses up to \$23 billion over 30 years.

More information at: <http://bit.ly/2pT9iCW>

EVENTS

NATREFS TO FACILITATE HCFC PHASE-OUT IN CHINA

SHANGHAI, China – As Stage II of China's HCFC Phase-out Management Plan gets underway, China's HVAC&R industry leaders are increasingly looking towards natural refrigerants as the preferred solution. Catering to this interest, a considerable number of natural refrigerant-based HVAC&R solutions were on display at China Refrigeration 2017. Panelists at the Ozone2Climate Industry Roundtable – held alongside China Refrigeration 2017 – discussed progress made with natural refrigerant technology around the world and its application in the Chinese market. "Things are moving in the right direction," said Shaofeng Hu, network coordinator for the United Nations Environment Program (UNEP).

More information at: <http://bit.ly/2q3Ymis>

AMMONIA/CO₂

AMMONIA/CO₂ SYSTEM CALLED ARGENTINA'S FIRST

BUENOS AIRES, Argentina – Mayekawa has installed an ammonia/CO₂ cascade system in Isidro Casanova Partido de la Matanza in Buenos Aires province – what it called the first such system in Argentina and the second in Latin America. Work on the Argentinian installation began in 2016, and it has been running since January 19, 2017, boasting very high efficiencies for a warm ambient climate. "Results on cooling and freezing of products were achieved faster than foreseen," said Mayekawa Argentina's Ivan Fraccarolli, with its department of projects.

More information at: <http://bit.ly/2pSZSap>

TECHNOLOGY

DANFOSS OPENS NEW RESEARCH CENTER IN FLORIDA

TALLAHASSEE, Fla. – With the opening of its new Application Development Center (ADC) here, Danfoss now has its fourth such facility worldwide. The others are in Nordborg, Denmark; Oragadam, India; and Haiyan, China. In the ADCs, Danfoss and OEMs have the chance to test new cooling solutions and reduce energy demand. Currently the buildings sector accounts for 40% of global energy use, from residential buildings and offices to hospitals, supermarkets, and data centers.

More information at: <http://bit.ly/2ohUcHi>

HYDROCARBONS

EMBRACO PREDICTS BRIGHT FUTURE FOR HYDROCARBONS

JOINVILLE, Brazil – Hydrocarbons and CO₂ will take center stage in the greener refrigeration of the future, according to a position paper published this month by Brazilian compressor manufacturer Embraco entitled "Light Commercial Refrigeration: Refrigerants Outlook 2017." In a policy statement in the paper, Embraco pledges to "support proactively [the] use of natural refrigerants without any compromise for safety of appliances including technician training." The paper recommends going directly to hydrocarbons as the final refrigerant option for the future.

More information at: <http://bit.ly/2p3pUan>

HYDROCARBONS

HFC PHASE-DOWN DRIVING NEW FLAMMABILITY STANDARDS

NORTHBROOK, Ill. – The current revision of flammable refrigerant standards is being driven by the global HFC phase-down, according to participants in the Flammable Refrigerants Webinar Series on Codes and Standards Activities, hosted by Underwriters Laboratories (UL), the U.S. safety certification body. "The Montreal Protocol has driven the [U.S.] Environmental Protection Agency (EPA) to adopt regulations, which in turn drive UL and ASHRAE standards, which in turn are referenced in the building codes," said Randall J. Haseman, UL's principal engineer for refrigeration and room air-conditioning equipment.

More information at: <http://bit.ly/2pTo64r>

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Are We Upside Down Because We're Down Under, or Is the Rest of the World the Same?

Thoughts on training, HFOs and natural refrigerants, from the Australian perspective

— By Ian Tuena

Since taking on what I now realize is an enormous task as president of the Australian Refrigeration Association, I must give credit to my predecessor Tim Edwards for the fantastic job he did during his presidency and full credit to those who head all of the various industry organizations. There is an amazing amount of work being done. So let me start...

At the recent AIRAH Refrigeration 2017, I stood up and asked this question of the presenter: "Where were you 10 years ago?" I received a few glares and during the break was immediately approached by a couple, obviously questioning my question as well as quickly claiming how much the industry has done. To a degree, there was truth in their statement, but my question is this:

Why have we allowed ourselves, in this country, to be in a position where the freight train has arrived at the station, while the industry is standing on the tracks just milliseconds from disaster? 

Ian Tuena is president of the Australian Refrigeration Association. He is also managing director of The Natural Refrigerants Company Pty Ltd., which provides a range of cooling solutions using CO₂, ammonia and hydrocarbons. It counts supermarkets, the food processing industry, the chemical industry and the cold storage sector among its customers.





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► Engineering, training challenges

To evaluate what makes me say that, we need to look at where we currently are. The federal government in Australia signed both the Paris COP21 agreement and the Kigali Agreement. Because of this, we are about to enter the next refrigerant change: to HFOs, and hopefully to a significant increase in the use of natural refrigerants because this is our only choice. All of the suite of refrigerants now available have engineering issues that we, as manufacturers, consultants, design engineers and refrigeration mechanics, will have to deal with. The refrigerants we now have as a choice, except for air or water, will all be flammable, toxic or high pressure.

There is broad industry agreement that we are poorly trained and ill prepared for this transition. This is exactly what a small group was forewarning the industry about over 10 years ago. Yet here we are in what was an avoidable situation if we had listened and prepared the industry for the inevitable. We are now rolling out R32 and a range of HFOs as the industry alternative, with little or no knowledge of what we are really dealing with and how they should be treated.

R32 and the bulk of HFOs are class A2L and therefore are flammable. Their material safety data sheets reveal that the products of combustion are highly toxic (as was the case for all CFCs and HFCs). R32 is listed on the Kigali list of refrigerants to be phased out, so it is only another interim measure. But it is needed to support existing equipment as we progress through the transition.

There is little data available on the long-term exposure effects of HFOs, and their effect on the environment as they break down. Environmental groups are concerned about the effect such chemicals may have on waterways in the future. There are, at best, some doubts as to whether this group of chemicals is the right solution. At worst, will they go the same way of their predecessors due to their environmental impact?

Industry consensus

That being said, there is – for the first time in a long time – a lot of industry consensus on some major issues facing the industry.

In particular, the industry is united on the issue of a skills-based national licence. We need the federal Australian government to support this issue and not abdicate its responsibility in this area. They were, after all, the ones who committed the industry to this path.

The industry is united in the view that we need to re-educate the existing pool currently operating in the industry. This is right through – apprentices, tradesmen, engineers, consultants, and manufacturers. Again, we need support from the government through legislation. The industry could self-fund via “educational levies” on ALL refrigerants.

The industry on the whole is united in the view we ALL have to work together and be united in one voice if we are to gain recognition by the government as an industry in our own right and by the public as a vital service in today’s society.

The industry is united in the fact that our skillsets have been eroded and declined significantly. We need to regain those skills urgently.

This consensus gives me hope that we can, even at this late hour, turn around from where we are and get off the track before the train hits us. We have, however, a lot of heavy lifting to do and very little time in which to do it.

We can no longer look for the reasons why we cannot do this. Rather, we have to look for solutions as to how we can and we must do it united, for the benefit of the entire industry – not the commercial interests of a few.

This is the challenge to the industry: to get the important things in the right order, act on them, and be active instead of reactive.

So my question is this: Is it just the Australian industry that has failed to plan until this late stage, or is the rest of the world in the same boat? ■ IT

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Johan Hellman, Green & Cool

CO₂ Condensing Units Are a Hit Overseas

For convenience stores and small supermarkets, the compact transcritical systems are popular in Japan and growing in Europe as OEMs release new models. Will they come to the U.S.?

—By Charlotte McLaughlin, Jan Dusek & Andrew Williams

A 2016 Nielsen report on the retail sector revealed strong growth globally for small format stores. “Perhaps the new retail mantra should be ‘go small or go home,’ as the ‘bigger is better’ paradigm has been challenged virtually everywhere,” said Steve Matthesen, global president of retail at Nielsen.

In the U.S. that trend is evident in the growth of such outlets as Aldi, the impending arrival of Lidl, and the advent of Whole Food Market’s 365 by Whole Foods Market outlets.

To better serve smaller store formats with a natural refrigerant system, Hillphoenix launched its AdvansorFlex transcritical CO₂ system, a downsized version of its Advansor booster system for mainstream supermarkets. As of last June, 30-40 U.S. stores had already installed the AdvansorFlex.

But another transcritical CO₂ system in the form of a condensing unit may be the next refrigeration technology targeting small supermarkets and convenience stores, if developments in Japan and Europe are any indication.

Lawson CO₂ stores

The market for CO₂ transcritical refrigeration has taken off in a big way in Japan – largely thanks to the growing popularity of condensing units in convenience stores, with over 2,200 installations in place at the end of 2016.

Japan's three largest convenience store chains – Lawson, 7-Eleven and Family Mart – all have outlets that use CO₂ condensing unit technology. Currently, around 5% of the three retailers' 44,000+ stores in Japan use CO₂ as the refrigerant.

The Japanese Ministry of Environment (MOE), in its effort to combat rising HFC emissions in the commercial refrigeration sector, has played a major role in increasing natural refrigerant uptake by providing subsidies for food retail refrigeration systems and display cases. For the 2016 Japanese fiscal year, MOE allocated 7.3 billion yen (\$61.4 million) to subsidize refrigeration costs in the commercial and industrial sectors in Japan.

Panasonic, one of the primary OEMs in Japan, had installed CO₂ condensing units in more than 1,800 stores in Japan as of September 2016, and was aiming for 2,000 stores by the end of March 2017, said Hidekazu Tachibana, group manager in the Refrigeration System Department, part of the Refrigeration and Air-conditioning Devices Business Division at Panasonic.

"Our next target market is Europe," said Tachibana, adding that Panasonic's two-stage compression CO₂ outdoor condensing unit will prove popular in small retail stores in Europe.

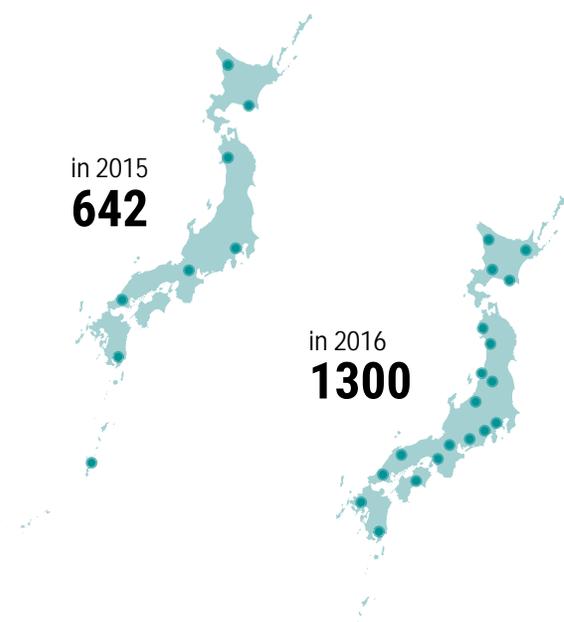
Panasonic also has plans to enter the U.S. market with CO₂ condensing units for smaller retail and foodservice locations, following its acquisition of U.S. refrigeration manufacturer Hussmann in 2016. ([See "Panasonic's Hussmann Acquisition Signals Confidence in CO₂," Accelerate America, April 2016.](#))

Panasonic's CO₂ condensing units produce average energy savings of approximately 20% compared with its R404A systems, according to the firm's research. Moreover, Panasonic estimates that it reduced the size of its CO₂ condensing units by 34% and the weight by 20%, compared to HFC counterparts.

Panasonic has also introduced a new adjustable pressure control model in its CO₂ condensing unit that reduces the maximum pressure of the CO₂ transferred to the display cases by one-third – from 9 MPa to 6 MPa.

"In addition, our store controller optimizes the refrigerant flow" to maintain the correct pressure, said Panasonic's Tachibana.

Meanwhile, Japanese OEM Mitsubishi Heavy Industries Thermal Systems (MHI) is also seeking new markets for its new 10-HP condensing units.



Growing European market

Drawing inspiration from their Japanese rivals, European companies are beginning to launch their own CO₂ condensing units, though currently large rack systems dominate the transcritical CO₂ market in Europe, with more than 9,000 installations.

Transcritical CO₂ OEM Advansor, a division of U.S.-based Hillphoenix, launched its first series of CO₂ condensing units in 2013. Ever since then, demand has been "big and growing," said Jens Kallesøe, director of internal sales and projects at the Danish firm.

Other European companies are following suit with SCM Frigo, Carrier Transicold UTC (under the banner Green & Cool) and SANDEN Europe having all developed their own CO₂ condensing unit models.

Advansor's first condensing unit installations were for the pharmaceutical industry and small business. "Now gas stations and publicly administrated institutions such as kitchens" are also seeking this equipment, Kallesøe said.

He estimated that 300 condensing units were currently running in Europe as well as 15-20 in the U.S.

"Condensing unit technology is not rocket science," said Mads Holst Nielsen, Advansor's R&D manager. "They are basically [like the] bigger CO₂ booster systems, but with smaller pipes. So if [an end user has] already installed a bigger CO₂ system, a condensing unit will be like a walk in the park."



Advansor's compuSUPER XXS CO₂ condensing unit

▶ Nicola Pignatelli, SCM Frigo's managing director, believes that the market for CO₂ condensing units has developed significantly in recent years. "We have noticed an increasing demand for low-capacity units, so we are very near to reaching cost parity and to having almost a full switch to CO₂ products," he said.

SCM Frigo has already sold 100 units of its new CUBO2 line of CO₂ condensing units with capacities up to 30 kW. In the next two years, Pignatelli is aiming to "reach a production of 3,000 pieces per year" and hopes to roll out the line to new markets.

"We are already largely expanding sales [for other CO₂ applications] in the Pacific regions [Australia, New Zealand] and also in South America, especially in Chile," he said. "We are also looking at the U.S. market, hoping that new political trends will keep on supporting the use of natural refrigerants."

Condensing units are often placed outside, where they can be mounted on the wall at the back of the store, noted Mirko Bernabei, technical director at SCM Frigo. The cooling is transferred through pipes to displays on the shop floor. "This will also help the distributors with stock and logistics and will optimize the installation's footprint," he said.

SANDEN Europe is also confident. "In 2017, several thousand SANDEN CO₂ condensing units will be installed – remote units or plug-in solutions," said Sylvain Gillaux, European sales and marketing manager at SANDEN Environmental Solutions.

Gillaux believes condensing units could be more beneficial even in larger stores – with several CO₂ condensing units beside each other to provide more cooling capacity – than alternative CO₂ solutions. "Easy and versatile installation, limited footprint and weight, excellent sound pressure level and unmatched flexibility are the main advantages quoted by clients," he said.

“ If [an end user has] already installed a bigger CO₂ system, a condensing unit will be like a walk in the park. ”

– Mads Holst Nielsen, Advansor

Gillaux added that the CO₂ condensing units have also performed well in warm climates. "We've had good experience for three years in Japan where temperatures reach up to 45°C (113°F) during the summer [and] good operations in France last summer where temperatures were over 38° C (100°F) in several installations."

Last October, Green & Cool formally launched its CO₂Y condensing for the European market. The CO₂Y is a small stand-alone condensing unit suited to less demanding refrigeration applications such as small cold rooms, display cases, or gas stations.

The unit is "basic and cheap, but still bears state-of-the-art eco-performance," said Johan Hellman, sales engineer at Green & Cool.

The condensing unit complies with EU Ecodesign regulations. Prior to the launch, it underwent field tests in Sweden, Finland and the U.K. With a maximum capacity of 5.5 kW at ambient temperatures of up to 30°C (86°F), it features a DC rotary compressor that can be regulated at various speeds up to 100 rotations per minute.

The control system incorporates a small microprocessor linking the unit to the cloud. This allows users to monitor the unit's operation remotely from a mobile phone.

"The 2-9 kW segment, which CO₂Y falls into, has enormous future potential since there has not been an economical environmentally friendly alternative until now," said Joakim Westerberg, responsible for refrigeration appliances at Kylkvalitet, a Swedish supplier of Green & Cool systems. ■ CM, JD & AW

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Trump's Budget Aims to End EPA's GreenChill Program



The successful partnership with food retailers, which has led to many natural refrigerant installations, would be potentially transferred to a “non-government entity.”

—By Michael Garry

The Trump administration's 2018 budget proposal to Congress targets the elimination of the U.S. Environmental Protection Agency's GreenChill Partnership, a successful voluntary program supported by numerous U.S. supermarket chains, according to an internal EPA memorandum published by the *Washington Post*.

GreenChill, launched in 2008, would be one of several EPA Climate Partnership voluntary programs impacting the HVAC&R industry that would be eliminated – and potentially transferred to a “non-governmental entity” – under the budget proposal, including Energy Star, Green Power Partnership, Combined Heat and Power Partnership and SmartWay.

The purpose of the program cuts is to “[free up] resources from voluntary programs to re-prioritize funding for programs tethered to statutes,” said Julia Valentine, an EPA spokesperson, in an email response to *Accelerate America*.

The EPA memorandum was written by David Bloom, the Acting Chief Financial Officer and dated March 21, 2017. Under “NPM [National Program Manager] Specific Policy Direction,

it states that the Office of Air and Radiation (OAR), working with the Office of General Counsel (OGC) “should begin developing legislative options and associated groundwork for transferring ownership and implementation of Energy Star to a non-governmental entity. OAR also should explore similar transfer opportunities for the remaining partnership programs. OAR should work with OCF [Office of the Chief Financial Officer] and OGC to identify any legislative language needed to transfer voluntary programs.”

The GreenChill program has helped participating food retailers, on average, to reduce refrigerant emissions (mostly HFCs and HCFCs with high global warming potentials) from 25% to 12.5%, according to EPA data. The program's store certification program has recognized the installation of numerous natural refrigerant systems, including 18 transcritical CO₂ systems in 2015 and through mid-March 2016. Major food retailers participating in GreenChill include Kroger, Albertsons, Whole Foods Market, Food Lion, Hannaford Supermarkets, Sprout's Farmers Market, and Weis.

The EPA has estimated that if supermarkets nationwide reduced emissions to the current GreenChill average of 12.5%, they would generate cost savings of \$169 million in refrigerant replacement costs while preventing the annual emission of 29 million metric tons of carbon dioxide-equivalent and 196 tons of ozone depletion potential (ODP).

In addition to the elimination of voluntary programs, the Trump budget calls for the reduction of \$629,000 and four full-time employees in the Stratospheric Ozone Domestic Programs; those include the Significant New Alternatives Policy (SNAP) program, which approves and delists refrigerants, and refrigerant management requirements under Section 608 of the Clean Air Act. “The program should prioritize work on the most critical alternative chemicals,” said the EPA. The budget would also eliminate the Stratospheric Ozone Multilateral Fund (encompassing \$8,928,000), which assists developing countries meet their Montreal Protocol commitments.

The Trump proposal, if passed by Congress, would cut the EPA's overall budget by 31%. ■ MG

The complete memorandum on the Trump budget proposal can be found here: <http://wapo.st/2nJpgPV>



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IIAR-2 Takes Charge

The IIAR's updated ammonia safety standard, along with several of its other standards, are becoming a reference for other code and standards bodies

—By Michael Garry and Charlotte McLaughlin

In November 2015, the International Institute of Ammonia Refrigeration (IIAR) released an updated version of its IIAR-2 operational and safety standard for ammonia refrigeration.

Under the revision, the 33-year-old IIAR-2 standard, for the first time, addresses ammonia equipment outside the machine room such as low-charge ammonia packaged systems, as well as explicitly covering ammonia/CO₂ systems.

It hasn't taken long for other code and standards bodies to notice the updated IIAR-2 standard as well as other IIAR standards, and start incorporating them into their latest codes, said Jeffrey Shapiro, president of the International Code Consultants and a long-time IIAR code consultant, at the IIAR's Natural Refrigeration Conference & Heavy Equipment Expo, held in San Antonio, Texas, February 28-March 1.

The aim of the IIAR, he said, is "not to fix model codes as much as it is to have model codes simply reference IIAR as the organization that knows how to develop regulations in the ammonia refrigeration industry."

And IIAR standards have, in fact, become "mandatory enforced documents by reference" under a number of model codes. For example, the 2018 International Fire Code (IFC) refers to IIAR standards 2, 7 and 8; the International Mechanical Code refers to IIAR codes 2, 3, 4 and 5; the National Fire Protection Association (NFPA) 1 fire code refers to IIAR standards 2, 7 and 8; and the National Electrical Code (NEC), recognized in all 50 states, recognizes IIAR-2. The 2018 Uniform Mechanical Code (UMC), which is almost completed, "will have IIAR standards 2, 3, 4 when it's finished," said Shapiro.

More importantly, he noted, in the 2018 International Fire code "we sit on a par with ASHRAE-15," ASHRAE's guide to the safe design, construction, installation, and operation of refrigeration systems. He called this a subtle change with a huge consequence for the ammonia refrigeration industry. "The code used to say follow ASHRAE-15 for ammonia and also follow IIAR-2. Now the code says for anything other than ammonia go to ASHRAE-15, but for ammonia, don't go to ASHRAE-15, go to IIAR-2."

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“Should we allow flammable [A2L] refrigerants to be piped throughout buildings for refrigeration systems and air conditioning?”

▶ On Shapiro’s agenda for 2021 is to get the International Mechanical Code and the NFPA-1 to at a minimum put ASHRAE-15 and IAR-2 on a par “so that we don’t direct people to ASHRAE-15 for ammonia.”

Another significant development is that ASHRAE-15 in January approved taking ammonia out of ASHRAE-15 in the next edition. “That was approved by the technical committee and will be out for public review,” said Shapiro, asking for IAR members’ support for the change.

“It’s a huge step in the right direction for the ASHRAE technical committee to recognize the value of IAR-2 as a stand-alone standard,” he said.

In addition, in the 2018 UMC, IAR was successful in getting a change in the chapter on refrigeration (chapter 11), “which entirely eliminates ammonia refrigeration from the code,” he said. “The UMC will have an exception that says for ammonia systems, see IAR-2.”

Shapiro also pointed out that, with the inclusion of ammonia detection requirements in IAR-2, the 2018 International Fire Code does not include ammonia refrigeration in its “comprehensive set of detection regulations.” The IAR is now looking at refining rules for the number and placement of detectors.

Shapiro urged the audience to be advocates at the local level for the adoptions of the new codes, “which benefit this industry.”

For the next round of code changes that would take effect in 2021, the International Code Council has set a January 1, 2018 deadline for receiving suggestions for changes, Shapiro noted. Complicating this deadline is that many of the 2018 codes will not be available until this September.

“If there is anything on your mind that you want fixed while you’re still in business and not retired in 2024, you need to get that information relatively quickly to the [IAR] standards committee,” he said.

Concerns about A2Ls

One of the key developments in the refrigeration industry is the emergence of A2L refrigerants, typically HFO blends that are classified by ASHRAE as having low flammability.

ASHRAE is currently processing two amendments regarding A2Ls, an addendum D for air conditioning and an addendum H for industrial and commercial refrigeration systems.

ASHRAE is “moving to expand A2Ls,” and the UMC and the International Fire Code plan to include them in 2018 editions, while UL is developing standards to accommodate A2L equipment, Shapiro said.

But Shapiro, who has a degree in fire protection engineering, took a highly critical view of A2Ls.

“This is a huge issue for the entire refrigeration industry right now,” he said. “Should we allow flammable refrigerants to be piped throughout buildings for refrigeration systems and air conditioning? The real concern is fire risk.” He added: “The rush to market can be consequential in a negative way.”

Shapiro recounted hearing at a committee meeting the argument that A2Ls were not that bad. “Someone said, ‘If we had a fire but didn’t ignite anything in the room, and the fire went out, that is an acceptable outcome of A2L refrigerants,’” he said. “So I want to ask you, is that an acceptable outcome in your house, or your business?”

Ammonia, classified as a B2 refrigerant (low flammability and toxic above 400 ppm) has the advantage of emitting a pungent odor that serves as an alert, while A2Ls don’t have that characteristic, he said. “You’re going to smell the ammonia but you’re not going to know the ASLs are there. We’re putting all of our eggs in the leak detection basket.

“I think ammonia is highly overlooked in these environments because relatively speaking I’d rather know there’s a problem than rely on a detector’s algorithm,” he said.

■ MG & CM



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Transcritical Cuts Energy Costs By \$74,000 for DeCicco & Sons

Small N.Y. grocer compared first transcritical store to an equivalent store using R404A to arrive at annual savings

—By Michael Garry

DeCicco & Sons, a seven-store food retailer based in Pelham, N.Y., saved \$74,000 in energy consumption and power demand over a 12-month period as a result of using a transcritical CO₂ booster refrigeration rather than a traditional HFC system.

DeCicco compared its store in Larchmont, N.Y., which has operated a transcritical system from Hillphoenix for 15 months, with another of its stores in Ardsley, N.Y., which has a conventional R404A system. His utility rate is 18.8 cents/kWh.

Both stores were similar in size and refrigeration load (1 million BTUs medium temperature, 200,000 BTUs low temperature); they also employed the same equipment, such as LED lights, motion sensors, night curtains, anti-sweat heaters and variable-frequency drives, except for the refrigeration system. (The Larchmont store also has 100 kW solar panels, which were not included in the comparison.)

“Even in months when I expected the CO₂ system to be higher [in energy consumption] like June-September, it never really was,” said John DeCicco, Jr., president of the company, in a presentation in late March at the AAA Refrigeration/Hillphoenix 8th annual Symposium in Tarrytown, N.Y. He attributed that to the system’s Trillium adiabatic condenser, from Baltimore Aircoil, which keeps the temperature of CO₂ gas from exceeding 88°F, CO₂’s critical point.

“During the winter months, there was a really big savings,” he added. The reduction in energy consumption alone was about 292,000 kWh over the 12 months, a savings of \$55,000. The power demand reduction over that period was 720 kW, or 60 kW/month. The energy savings, he noted, allows for a two-to-three-year payback on the premium paid for the transcritical system over a traditional system.

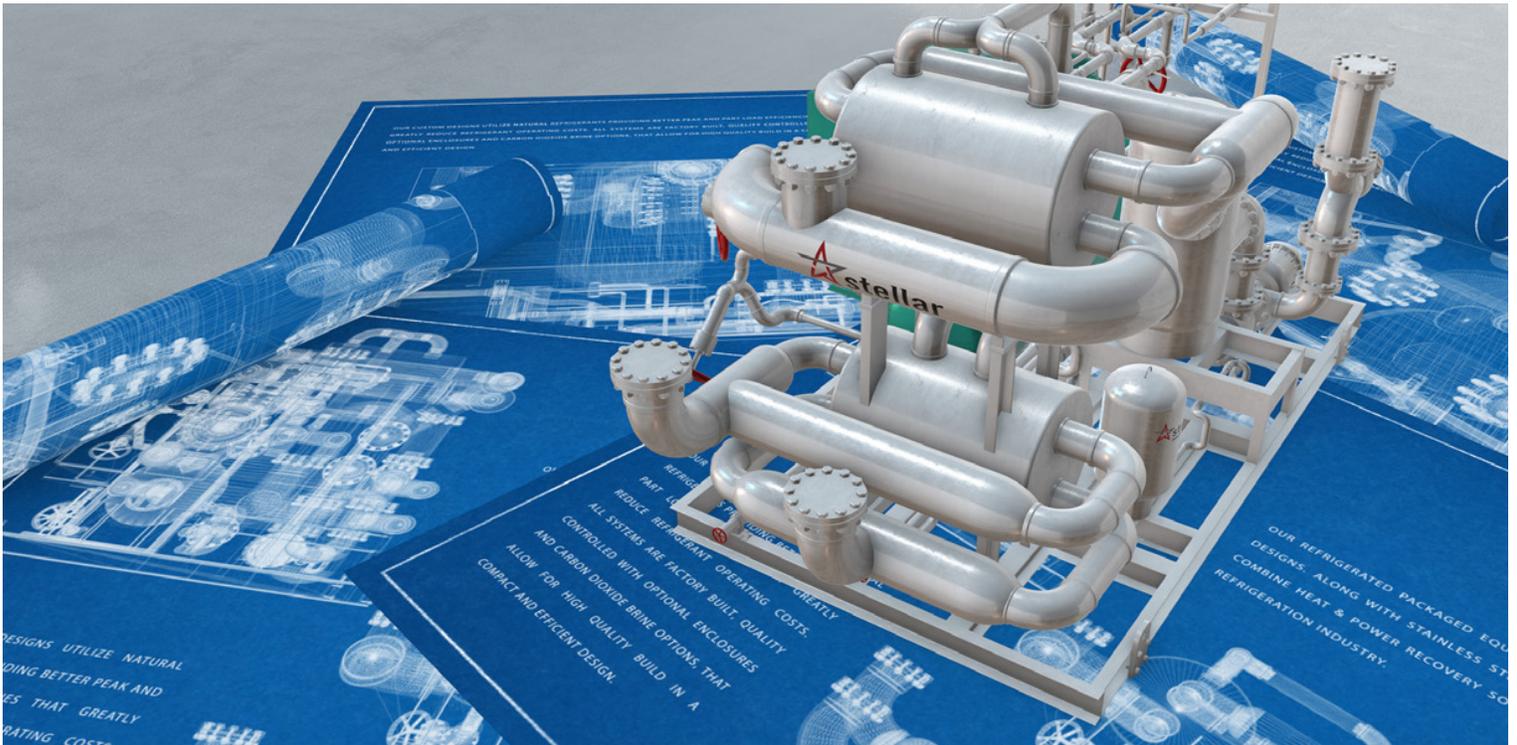
Though DeCicco has received energy incentives from his local utility, Con Edison, they have not yet been for the transcritical refrigeration system, despite its energy-saving record. However, he expects to leverage those savings to earn incentives for future transcritical installations.

In addition to the savings in energy consumption and demand, the transcritical system offers 1.1 million BTUs in recovered heat, used for hot water, the entrance vestibule and in the kitchen. “That’s the cherry on top of the cake,” said DeCicco.

Another benefit of transcritical CO₂ refrigeration is that “we have had excellent temperature control and better shelf life,” said DeCicco. “Meat lasts longer, and produce is fresher.” In addition, installation requires only one electrical connection to all cases and smaller-diameter copper piping.



From left: John DeCicco, Jr., and his father



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Transcritical CO₂ rack in Larchmont, N.Y., store

▶ DeCicco has also installed a Hillphoenix transcritical system in a store in Millwood, N.Y., that opened last December, and in a retrofit of an existing store in Pelham, N.Y., where it has been running for seven months. The Larchmont and Millwood stores, each 24,000 sq. ft., employ 1,000 lbs. of CO₂ in their transcritical system. The retailer plans to retrofit another store, in Harrison, N.Y., with a transcritical system this year, as well as open a new store in Somers, N.Y., with a transcritical system.

Transcritical caveats

DeCicco offered some caveats concerning transcritical refrigeration. For one, installers and maintenance contractors must understand case controllers, which are “the lifeblood of the system.” His own employees were not familiar with case controllers and are still learning their nuances, though AAA Refrigeration, his contractor, is well versed in this technology.

He also advised having “good drawings” showing case wiring. “You’re running four to five loops that go out to the case controllers,” he said. “Knowing how you’re going to do that ahead of time makes a big difference.”

DeCicco stressed that the initial commissioning of a transcritical CO₂ system – such as making sure that all sensors are in place and reading correctly – is “crucial” to its successful operation.

His system supplier, Hillphoenix, “has been with us at all of the start-ups and has been a tremendous help,” he said. He recommends commissioning at least one week prior to start-up. “It will make a huge difference later on.” He noted that he has experienced “minimal [CO₂] leaks with the system.

And he recommended keeping a full charge of CO₂ on hand in the event of a large leak. “I haven’t had one, but just in case, it’s piece of mind,” he said. Securing refrigerant-grade CO₂ “can be a little difficult” but is getting easier with time.

In promoting the transcritical system to his environmentally minded customers, DeCicco prefers to use the term “natural refrigerant” rather than CO₂, because of the latter’s link to climate change (though CO₂ as a refrigerant is vastly better for the climate than HFCs). “Try to say natural refrigerant; it helps tremendously,” he advised the audience.

At DeCicco’s latest transcritical store in Millwood, N.Y., he has also installed five self-contained propane under-counter sandwich-prep units in the deli. “They have a huge potential for energy-savings and efficiency,” said DeCicco. “Whenever self-contained propane is available, that’s the way we’re going. ■ MG

“Even in months when I expected the CO₂ system to be higher [in energy consumption] like June-September, it never really was,”



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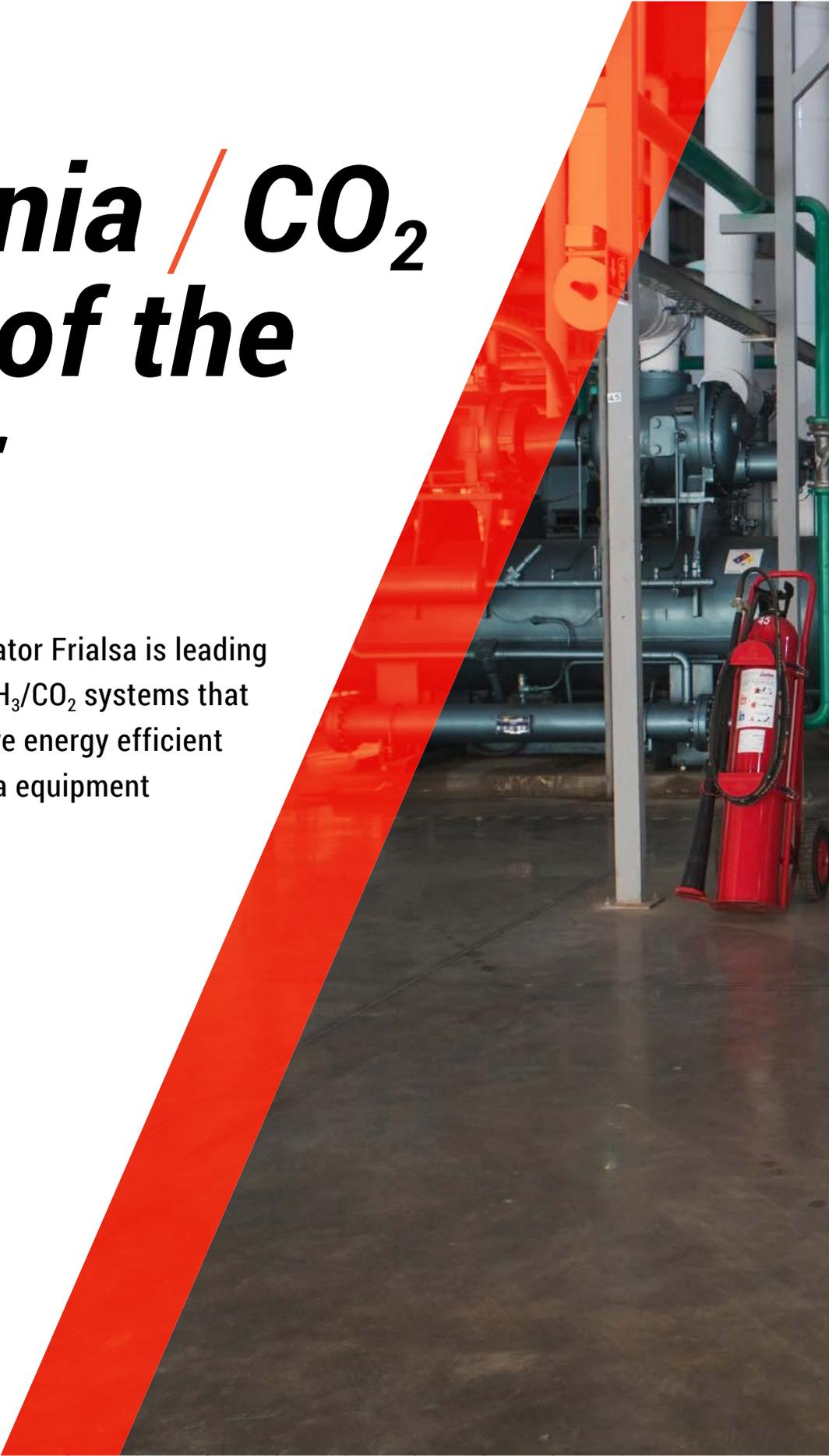
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Ammonia / CO₂ South of the Border

Mexican cold-storage operator Frialsa is leading its country's adoption of NH₃/CO₂ systems that are safer and 15%-20% more energy efficient than conventional ammonia equipment

By Michael Garry





Ricardo Garcia, in the NH₃/CO₂ engine room at Frialsa's cold storage facility in Tepeji del Rio, Mexico



Frialsa's NH₃/CO₂ plants

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▶ Two natural refrigerants, ammonia and carbon dioxide, have each proven to be highly effective working fluids, NH₃ favoring the industrial sector, CO₂ the commercial sector.

But a growing number of end users in North America in both sectors are finding that the marriage of the two natural refrigerants within a single refrigeration system can offer advantages that each refrigerant can't necessarily deliver alone.

The first North American cold storage operator to embrace the concept of a combined NH₃/CO₂ cascade refrigeration system, United States Cold Storage, now has them in 12 of its 36 facilities. ([See "Shaking Up Industrial Refrigeration," *Accelerate America*, April 2015.](#)) On a smaller scale, two food processing companies, Imuraya and Wholesome Harvest Baking, are using Mayekawa's NewTon NH₃/CO₂ packaged system for freezing applications. ([See "Freezing Bread with the NewTon," *Accelerate America*, February 2017.](#))

And even in food retail, four U.S. supermarkets have installed an ammonia/CO₂ cascade system, including a Piggly Wiggly store in Columbus, Ga. ([See "Saving Energy with Ammonia/CO₂," *Accelerate America*, September 2016.](#))

South of the border, the natural-refrigerant tandem is also bearing fruit, as Frialsa Frigoríficos, Mexico's largest cold-storage operator, has made NH₃/CO₂ its standard refrigeration system. Starting in 2010, Frialsa now uses this technology at five of its 24 facilities (see map, this page).

Four of the five plants – in Monterrey, Tepeji del Río, Toluca, and Veracruz – were constructed with an NH₃/CO₂ cascade system from M&M Refrigeration, while at the fifth – in Culiacán Sinaloa – an expansion of the facility has been equipped with a packaged NH₃/CO₂ unit from Tewis (installed by Bohn). Frialsa plans to install an NH₃/CO₂ cascade system this year at two new plants encompassing 26 million cu. ft.

In Tepeji, the main, 9.8-million-cu.-ft. building and its NH₃/CO₂ system were constructed in 2014, and Frialsa is working on a 5-million-cu.-ft. expansion of the facility expected to open this summer. The expansion will also be served by the main building's NH₃/CO₂ system.

Overseeing Frialsa's transition to NH₃/CO₂ technology is Ricardo García, director of engineering and projects, who joined Mexico City-based Frialsa in 1994. He is responsible for all of Frialsa's environmental projects, including management of energy generated at wind farms, and delivering 50% of electricity needs at 12 Frialsa warehouses.

“ We were hearing that if you go to low temperatures, the energy efficiency of CO₂-ammonia would be better than regular ammonia systems. ”

Appeal of NH₃/CO₂

Comprising 66.2 million total cu. ft. across its 24 facilities (and growing to nearly 100 million cu. ft. this year), Frialsa is not only the leading cold-storage operator in Mexico and Latin America, but also one of the largest in North America. Frialsa is a member of The World Group, a North American partnership of independent refrigerated/frozen food warehousing companies.

The 34-year-old company offers refrigerated and frozen storage and transport for a wide range of products, including fruits and vegetables, dairy, meat, seafood, deli, bakery and ice cream – “every kind of food you can imagine,” said García. Its extensive logistics network makes about 150,000 deliveries annually.

The temperatures produced at the Tepeji plant in four convertible freezing/cooling rooms range from -13°F for freezing (beef, poultry, pork, ice cream and seafood) to 40°F for cooling (milk, yogurt) and 40°F at the dock. The capacity of the plant runs between 700 and 800 TR. (At its Monterrey, Mexico, warehouse, Frialsa’s NH₃/CO₂ system handles blast freezing down to -30°F.)

With its vast holding capacity, the potential for energy savings greatly attracted Frialsa to NH₃/CO₂ cascade refrigeration, said Garcia.



CO₂ reciprocating compressors



NH₃/CO₂ cascade condenser with pump stations



NH₃ screw compressor



From left: NH₃ evaporative condenser and rain collector tank

▶ “We have to freeze a lot of product,” he said in an interview with *Accelerate America*. “We were hearing that if you go to low temperatures, the energy efficiency of CO₂-ammonia would be better than regular ammonia systems.” Frialsa’s conventional ammonia systems include two-stage and gravity-flooded recirculated systems. (It also operates some plants with R507A or R404A.)

US Cold Storage has reported that its NH₃/CO₂ cascade systems are on average 5.8% more energy efficient than a conventional ammonia system. Frialsa has found the average energy efficiency of its NH₃/CO₂ systems to be even greater – between 15% and 20%, depending on local electricity rates, said García, noting that the lower the temperature, the greater the efficiency of the system. “Consumption of energy will be lower working with CO₂-ammonia.”

Moreover, as García started bidding for NH₃/CO₂ cascade systems vs. regular ammonia equipment, he found to his surprise that capital costs were comparable. “You may buy more equipment with CO₂-ammonia but at the end of the day the cost is real similar [to a conventional system],” he said. Installation costs are also about the same.

García noted that Frialsa did not receive government incentives or loans for installing

the NH₃/CO₂ equipment. Mexico’s government offers low-interest loans to help finance the installation of energy-efficient equipment.

Less ammonia, less risk

In NH₃/CO₂ cascade systems, ammonia, a potentially toxic chemical, is confined to the engine room, vastly reducing the charge compared to what is used in conventional ammonia systems, and greatly improving the safety of plant employees. Ammonia is employed simply to condense CO₂ into a liquid, which is the only refrigerant channeled to the cooling and freezing areas.

For example, at the Tepeji plant, the engine room, which is located next to – but outside of – the main storage building, employs about 1,100 lbs. (500 kg) of ammonia (in concert with about 30,000 lbs. of CO₂), compared with 10,000-15,000 lbs. of ammonia at conventional facilities. (Frialsa’s other NH₃/CO₂ cascade systems use a similar amount of ammonia and CO₂.)

This year, Frialsa installed its first ultra-low-charge ammonia/CO₂ packaged unit to support the expansion of its Culiacán Sinaloa plant.

System Specs

Frialsa’s NH₃/CO₂ system at its plant in Tepeji del Rio has the following characteristics:

- » Size of plant (with expansion): **14.8 million ft³**
- » No. of convertible freezer/cooling rooms: **4**
- » Temperatures: **-13°F (freezing); 40°F (cooling); 40°F (dock)**
- » NH₃ charge: **1,100 lbs.**
- » CO₂ charge: **30,000 lbs.**
- » Capacity: **700-800 TR**
- » NH₃/CO₂ system (M&M Refrigeration)
- » NH₃ screw compressors (Howden)
- » CO₂ reciprocating compressors (Sabroe)
- » NH₃/CO₂ cascade condenser (Vahterus)
- » Evaporative NH₃ condenser (Evapco)
- » Rain collector tank (generally used May to September) for evaporative condenser
- » Controls (M&M Refrigeration)
- » CO₂ and ammonia sensors in the engine room
- » CO₂ sensors in the cooling and freezing rooms.



“We're fine with ammonia, but if you can reduce the amount, it is a great relief.”

- ▶ The packaged unit contains only about 200 lbs. of ammonia and roughly 10,000 lbs. of CO₂; like the M&M system, it confines ammonia to the high side and uses only CO₂ in the cooling/freezing areas. “It could be on the roof, but we are putting it on the ground outside the building,” said Garcia.

In addition to cost and energy considerations, it is very important for Frialsa to remove ammonia from cooling and freezing rooms. “When you think about ammonia leaks, we decided to put it just in the engine room – there is less ammonia, and less risk,” said Garcia. “We're fine with ammonia, but if you can reduce the amount, it is a great relief.”

Using CO₂ in the freezing and cooling areas rather than ammonia also helps safeguard stored food products in the event of a refrigerant leak. “A lot of our customers are happy about that,” said Garcia. “Our insurance company is, too.” Some of Frialsa's customers specifically request storing their products at facilities that use NH₃/CO₂ refrigeration.

Government regulations are another factor favoring adoption of NH₃/CO₂. In Mexico, anything over 10 kg of ammonia can qualify an industrial facility as “high risk” by the Ministry of Labor and Social Welfare (STPS), said Garcia.

But low-charge systems require less documentation and less demanding emergency plans than a conventional ammonia plant. “If we have a leak, we have just ammonia in the engine room; we don't have to move all the people outside the building, as we would do if there was an ammonia leak in the building.”

STPS's safety requirements and enforcement are very similar to those set in the U.S. by the Environmental Protection Agency and the Occupational Safety and Health Administration. And, as in the U.S., governmental inspections at facilities that use ammonia have been stepped up in Mexico, Garcia noted.



Freezer room



Dock



Electrical room with 1,000 kW emergency plant

Local training

When M&M Refrigeration installed Frialsa's first NH₃/CO₂ system in Toluca in 2010, M&M trained Frialsa's internal and third-party technicians on how to maintain the technology. Since then, said Garcia, "we're dealing only with Mexican technicians" (contractor Watco S.A. de C.V.) who know how to work with NH₃/CO₂ systems.

One key maintenance consideration is the upkeep of the cascade condensers that condense CO₂ by evaporating ammonia. They are designed to keep the two refrigerants from mixing; however, if they did come in contact, they would form ammonium carbamate, a white, powdery salt that tends to clog pipes and valves. "We have not experienced this problem," said Garcia.

Another technical requirement is eliminating moisture, which reacts with CO₂ to create corrosive carbonic acid. To accomplish that, Garcia pulls a vacuum during the start-up of the equipment that lasts for several days.

The interest in NH₃/CO₂ systems among cold-storage operators is growing in Mexico, said Greg Robison, vice president of sales for M&M Refrigeration. In addition to the four Frialsa plants, a La Vista facility in Zamora, Mexico, is using M&M's technology, and M&M has received four to five more bids in the country, he said. "Requests in Mexico are pretty strong. That's mainly because we got our foot in the door at Frialsa. People down there are starting to say, 'This is a good thing; let's think about switching.'" ■ MG



Ricardo Garcia, Frialsa

Leading the NH₃/CO₂ Market

Starting in 2004, M&M Refrigeration, based in Federalsburg, Md., has led the development and implementation of NH₃/CO₂ cascade systems for industrial applications. To date, the company has installed these systems at an industry-leading 55 locations, mostly in the U.S., but also in Mexico and Asia. (See "Pioneer of Low-Charge," *Accelerate America*, March 2016.)

In addition to Frialsa, other NH₃/CO₂ customers include United States Cold Storage, Wegmans Food Markets, Circle Foods, Eastern Fisheries and Lineage Logistics.

The systems range in capacity between 25 and 1,950 TR and as much as 5,250 HP for applications such as spiral freezers, refrigerated warehouses and blast freezers, with temperatures ranging from -60°F to 45°F.

M&M continues to get "a tremendous number of requests for CO₂ systems," said Charles Toogood, M&M's vice president

of business development. "Some are looking for low-charge ammonia."

"There's a strong and growing market for ammonia/CO₂ in the U.S., Mexico, and all over the world," said Greg Robison, vice president of sales for M&M.

In designing NH₃/CO₂ systems, M&M caters to an industrial customer's particular charge and cost requirements, said Robison. "Every job is different; there's no cookie-cutter." The use of an evaporative condenser, for example, will lower energy consumption but come with a higher ammonia charge. "Could we reduce the charge? Yes, but with a penalty on efficiency," said Robison.

M&M offers end users an energy dashboard that consolidates information from multiple locations so an owner or manager can compare costs, energy consumption and efficiency targets.

M&M can monitor its customers' overall refrigeration performance from its Maryland headquarters.

Toogood acknowledged that M&M is starting to see competition for its NH₃/CO₂ cascade systems from low-charged packaged ammonia units, often deployed on rooftops above storage areas. But he pointed out that applications like spiral freezing with ultra-low-temperature requirements "are better suited for cascade NH₃/CO₂ systems."

Robison noted that M&M offers its own low-charge ammonia packaged chillers, as well as packaged NH₃/CO₂ and straight ammonia units. In a scenario where a plant with a 400,000-sq.-ft. cooler needs a new 10,000-sq.-ft. freezer, a low-charge rooftop unit "fits that application perfectly."

Natural Refrigerant Show Medley

Three major HVAC&R trade shows in 2017 offered some technological twists and high-efficiency innovations supporting eco-friendly cooling

—By Michael Garry

The three major HVAC&R trade events that have taken place in 2017 – the AHR Expo, the NAFEM Show and the IIR Natural Refrigeration Conference and Heavy Equipment Expo – featured a number of important new natural refrigerant systems and components. [\(See “Highlights from AHR Expo.” *Accelerate America*, February 2017, “OEM’s Flock to Hydrocarbons.” and “IIR’s Natural Refrigerant Show.” *Accelerate America*, March 2017\).](#)

The following is a roundup of some of the more unusual refrigeration technologies showcased at the events, including magnetic cooling, thermochemical cooling and air cooling, along with some key energy-efficiency innovations in the ejector, valve and compressor arenas.



From left: Danfoss CCMT regulating valve and CTM multi-ejector

AHR Expo

Danfoss's energy-saving multi-ejector

Global component and controls manufacturer Danfoss regards its energy-saving CTM multi-ejector to be “a very important development” that allows transcritical CO₂ systems to be “more efficient than HFC systems in all climates,” said James Knudsen, segment manager, food retail for Danfoss.

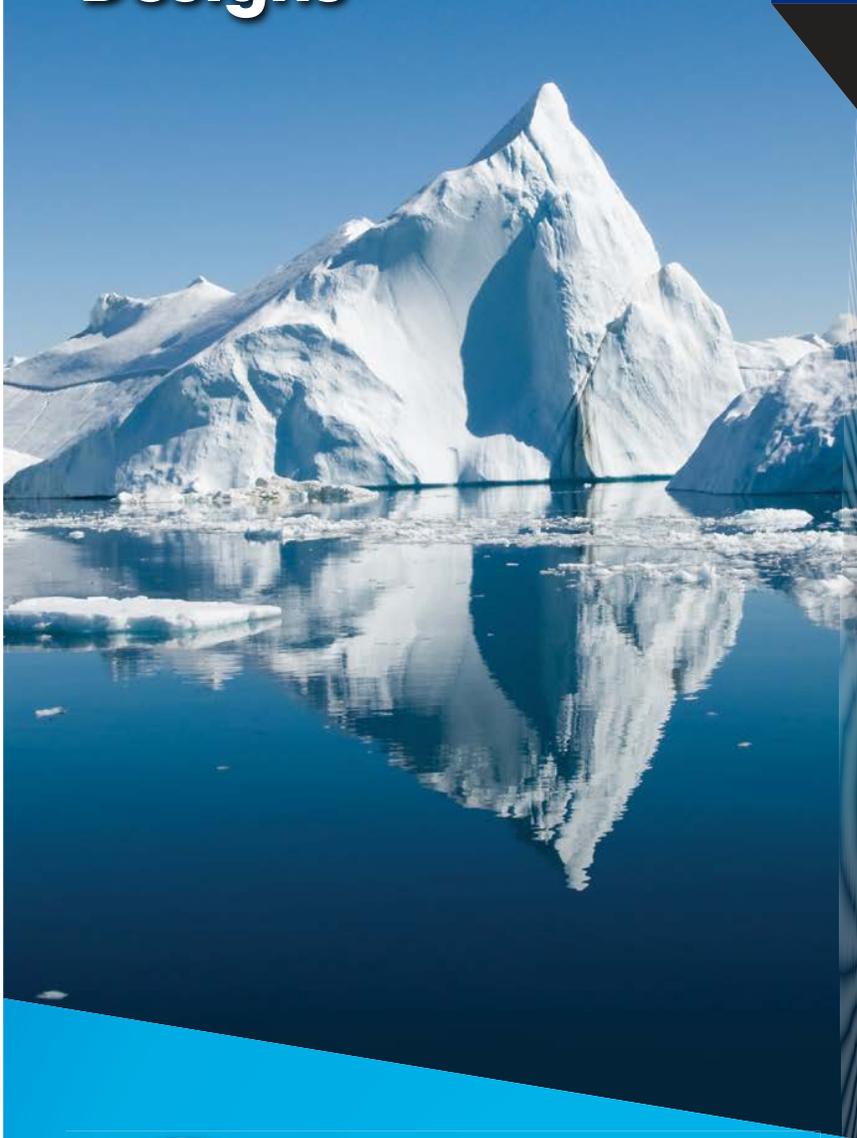
Danfoss has about 30 test installations of the gas ejector in Europe and Africa and is in the process of running its first U.S. retail installation in the Atlanta area, said Knudsen, adding, “All major OEMs are testing in in their labs.”

Notably the multi-ejector contains up to six ejectors of varying sizes, allowing it to modulate to different ejectors depending on load demands.

“We’re really excited about it,” Knudsen said.

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▶ Working with a parallel compressor in a transcritical CO₂ system, the ejector saves between 10% and 20% on energy consumption (depending on the ambient temperature) compared to a conventional booster transcritical system, he said. “The hotter it gets, the more an ejector saves.” Moreover, it “reduces compressor power to the point where in large systems you could eliminate a compressor, which helps to reduce first cost.”

In North America, parallel compression in transcritical systems is just beginning to be used in the field, Knudsen noted.

The Danfoss ejector, which won the 2017 AHR Expo Innovation Award in the refrigeration category, is essentially a sold-state pump with no moving parts that saves energy by increasing the pressure of CO₂ gas being compressed by a low-HP parallel compressor, thereby reducing overall compressor load. “Instead of the parallel compressor handling 40% of the gas, it handles 80% of the gas,” said Knudsen. “That’s where you save energy. Without an ejector, the parallel compressor doesn’t get as much bang for the buck.”

Having a ball with valves

Both Parker Hannifin and Mueller Industries have new ball valves for transcritical CO₂ systems, which were first shown at the AHR Expo in January.

Parker’s EBV(T)-PR ball valve with integrated pressure relief – rated at 70 bar and available up to 1-1/8 in. in diameter – comes with a check valve built into it, so that an outside check valve is not needed.

“[The ball valve] can be used to isolate the evaporator,” said Dustin Searcy, product manager – electric valves for Parker Hannifin’s Sporlan division. “You would want one in the suction line and one in the liquid line. They both open if the pressure in the [evaporator] increases by five pounds above the pressure on the other side of the ball valves.

Parker also unveiled a new SER-HP electronic expansion valve rated at 90 bar for transcritical CO₂ systems. “For stores with CO₂, we are seeing a demand for higher pressure rated components,” Searcy said.

Parker has also upgraded its Micro Thermo controller for transcritical systems to control “high-side” valves – the gas cooler and flash gas bypass valves, said Louis Morris, manager, applied engineering, Micro Thermo Instrumentation Group. “This maximizes the COP of the transcritical rack systems.”

Meanwhile Mueller Industries has introduced a ball (shut-off) valve rated at 130 bar, up to 2-1/8 inch in diameter, for transcritical CO₂ systems – what it calls the first such valve in the world to be UL-rated. In the past, “installers for CO₂ could get copper-iron tubing to fit up to 2-1/8 inch but had no UL-rated shutoff valve to go with it,” said Christopher Mueller, vice president and general manager – joining systems, Mueller Streamline, Memphis, Tenn. ▶



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Structural Concepts' deli case with magnetic refrigeration

The NAFEM Show

Carter-Hoffman's gridless fridge

Carter-Hoffman is partnering with French refrigeration manufacturer Coldway to market a "gridless" refrigerated transport cart for catering, banquet and other applications.

The unit, developed by Coldway, employs a closed, ammonia-based thermochemical system that produces refrigeration without a compressor. It can remain off the electrical grid up to eight hours, and requires seven hours on the grid to be recharged. The system can deliver cold and heat ranging from -30°C to 200°C.

"We're putting it into commercial refrigeration," said Paul Emerich, food technology manager for Carter-Hoffman, based in Mundelein, Ill. "It can be used for catering and convention centers." Coldway, he noted, markets the technology for use in transporting medical supplies and in military applications.

Carter-Hoffman displayed the unplugged unit in February at the NAFEM Show in Orlando, Fla., where it maintained a 38°F temperature all day long.

The Coldway technology generates cold using an ammonia evaporator chamber, coupled with a separate reactor containing proprietary salts and graphite. When the valve connecting the two containers is opened, the liquid ammonia vaporizes, producing cold air that is blown where needed; the gaseous ammonia is channeled to the reactor, where it is absorbed by the salts, releasing heat.

When the ammonia is depleted, the unit is plugged in and the cycle is reversed; heat supplied by electricity causes the salts to release the ammonia, which travels back to the evaporator, condenses and is ready to resume cooling. The unit is capable of several thousand charging cycles with no loss in performance, according to Carter-Hoffman.

Still testing magnetic cooling

In June of 2016, at the Food Marketing Institute's Connect conference, the French firm Cooltech Applications and Structural Concepts, a refrigerated display case manufacturer based in Muskegon, Mich., announced that Structural Concepts would be incorporating Cooltech's magnetic refrigeration system in some of its cases. (See "The Next Refrigeration System?" *Accelerate America*, September 2016).

Magnetic refrigeration leverages the magneto-caloric effect, in which a material (such as a gadolinium alloy) heats up when subjected to a magnetic field and cools down when removed from it. The material cools a water/glycol mixture, which cools the display case.

At the NAFEM Show, Structural Concepts displayed a closed service deli case using the Cooltech system. The display case company is still testing the technology and has not yet brought it to market, noted Jeff Schneider, senior vice president of sales, marketing and strategic planning for Structural Concepts.

"Will it produce enough BTUs? We have not reached any conclusions yet," he said. "We're still fine-tuning it." Structural Concepts is also still examining the energy consumption of the system.

The Cooltech technology is currently more feasible for closed cases that require less cooling capacity. "We want to use the magnetic system in our whole product line, but it won't work now in an open case," said Schneider.

Structural Concepts' cases are "too big" to accommodate under-150 g charges of hydrocarbons, he added.



Carter-Hoffman gridless refrigerated cart

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Guy Evon Cloutier, CTC Group, with two-stage screw compressor

IIAR Natural Refrigeration Conference & Heavy Equipment Expo

Fujian Snowman targets North America

Fujian Snowman, a Chinese manufacturer of industrial and commercial refrigeration systems and equipment, is entering the North American market with a slew of high-efficiency compressors designed for natural refrigerants.

"We're selling compressors to get started in North America," said Guy Evon Cloutier, chairman and CEO of CTC Group, a Canadian maker of refrigeration systems for ice and snow applications, of which Fujian Snowman has a majority interest.

Fujian Snowman will sell compressors to "strategic partners," including contractors, assemblers and OEMs, said Cloutier. The company plans to grow quickly in the U.S. via acquisition "to expand the scope of our products and services from compressors to engineered systems," he added.

Founded in 2000 as an ice machine maker by Lin Ru Jie, Fujian Snowman in recent years has acquired Italian compressor manufacturer RefComp, and Swedish compressor makers OPCON AB and SRM. Its manufacturing subsidiary, Snowkey, produces 10,000 compressors annually, with plans to double that production, said Cloutier.

As an OEM, Fujian Snowman produces ammonia/CO₂ systems, including one for cold storage operator Swire (parent company of US Cold Storage) in Xiamen, China. "We're also promoting ammonia/CO₂ systems in the states," said Cloutier.

Fujian Snowman showcased several of its compressors at the IIAR Natural Refrigeration Conference & Heavy Equipment Expo earlier this year in San Antonio, Texas. One prominent example was the SRS-1210S semi-hermetic two-stage screw compressor, which Cloutier called "a game changer." Suitable for ammonia, the compressor can be used in quick-freezing, freeze-drying, ship refrigeration and ultra-low-temperature cold storage. It includes a VI capacity control and variable-speed drive.

Also on display was the SRH-18M open-type high-pressure screw compressor, suitable for ammonia or CO₂. Typical applications of the compressor include a high-temperature ammonia heat pump and an ammonia/CO₂ cascade refrigeration system.

Other compressors at the Fujian Snowman booth included the SRC-S-353LOS semi-hermetic propane screw compressor; the SRS-12L semi-hermetic high-efficiency variable-speed ammonia screw compressor; and the SPT41-8H CO₂ semi-hermetic piston compressor, a 9 HP unit suitable for transcritical CO₂ systems at up to 160 bar.

Ultra-low-cooling with air

At the IIAR Natural Refrigeration event, Mayekawa showcased its PascalAir ultra-low-temperature system, which the Japanese OEM has begun marketing in the U.S. The system uses air – one of the "Natural Five" refrigerants employed by Mayekawa's refrigeration technology – as the sole cooling agent to achieve temperatures ranging from -58°F to -148°F.

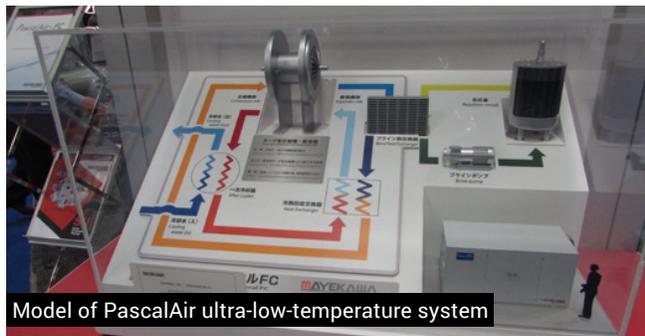
"There's a lot of interest in the U.S.," said Troy Davis, energy manager for Mayekawa USA MYCOM.

In Japan, the PascalAir is primarily employed for freezing tuna and other seafood. "At really low temperatures, the cell structure of the tuna is better than in slower freezing processes," said Davis. Other uses of the system include pharmaceutical cold storage and plastics recycling,

The PascalAir system achieves ultra-low temperatures by leveraging what's known as the Brayton cycle (in reverse), a process also used in airplane air-conditioning. It takes advantage of the fact that air generates heat when compressed and absorbs heat when expanded. When compressed air is cooled and then expanded, its temperature drops considerably. Unlike typical refrigerants, air never changes phase during the process.

In the air cooling cycle, explained Davis, air is warmed in a heat exchanger and then compressed in a compressor/turbine. The warm compressed air is cooled by water from a cooling tower and is further cooled in the heat exchanger. It then goes into an expander, where it is adiabatically cooled down to ultra-low temperatures.

This air cooling process was actually invented and used in the 1850s to cool meat traveling from Australia to England, said Davis. "It wasn't efficient then; we've made it efficient." ■ MG

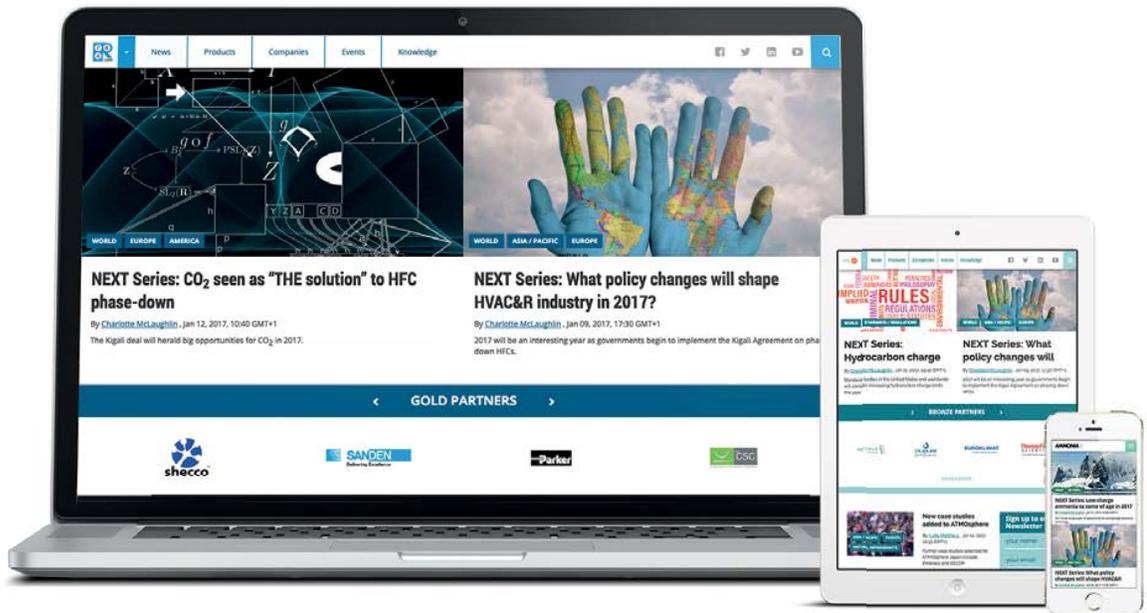


Model of PascalAir ultra-low-temperature system

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Caleb Nelson, Azane with reverse-cycle defrost valve

Bringing Low Charge to America

Azane is leveraging the know-how of its Scottish parent Star Refrigeration to penetrate the U.S. industrial market with low-charge-ammonia freezers and chillers

—By Michael Garry and Charlotte McLaughlin

Three years ago, U.K. manufacturer Star Refrigeration launched its U.S. subsidiary, Azane, named for the low-charge-ammonia packaged systems Star has been marketing in Europe for the past decade.

Today, San Francisco-based Azane is one of several OEMs trying to penetrate the industrial refrigeration market with factory-built packaged freezers and chillers that use a fraction of the ammonia typically found in industrial systems. The units are manufactured in Chambersburg, Pa.

The company's Azanefreezer, a condensing unit for freezer applications, uses about five to six pounds of ammonia per TR, while its Azanechiller employs

less than two pounds per TR. The condensing units have cooling capacities ranging from 26 to 110 TR, the chillers from 60 to 300 TR.

Azane is positioning the units as natural alternatives to R22 and HFC systems in small- to medium-sized cold storage warehouses, though the chiller is applicable to any application – including HVAC, industrial and ice rinks – that can use a chilled fluid.

Accelerate America spoke to **Caleb Nelson**, Azane's vice president for business development, to learn more about how the company aims to take advantage of the U.S. regulatory environment, what direction he sees the industrial refrigeration sector moving in, and the advantages of using its systems.



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Accelerate America: How does having a European parent give Azane an advantage in the U.S. market?

Caleb Nelson: Star has been selling low-charge technology for 25 years, and packages for the last decade. So it's not brand new to us; we've done it and worked the bugs out. Star saw the changes in legislation in the U.S. and in California, and saw the need for low-charge solutions. So it brought the chillers and freezers to the U.S. and started Azane to sell them.

Accelerate America: How has the market been in the U.S. for Azane's packaged low-charge-ammonia freezers and chillers?

Nelson: The U.S. cold storage industry has been slow to try low-charge packaged freezers. So we haven't seen widespread adoption of the freezers but we get a lot of interest and we send out lots of quotes. We're getting ready to build a freezer system for some energy testing at a lab to justify incentives for the technology.

Where Azane has seen the most success is on the chiller side, where we've sold units for process cooling and air conditioning. This year we're going to do energy monitoring on an AC system that we installed in Ohio last summer.

Accelerate America: Is one of the drivers that low-charge-ammonia chillers are more efficient than HFC units?

Nelson: Yes, and end users also want a high-quality industrial system that's going to last for 20 to 25 years, as opposed to replacing a commercial HFC chiller in 10 to 12 years.

“ Where Azane has seen the most success is on the chiller side. ”

Accelerate America: And they don't have to worry about the EPA SNAP program's delisting of HFCs like R404A and R507A for new cold storage warehouses in 2023.

Nelson: At the moment, traditional HFC chiller manufacturers want to use something like [HFO blend] R513, which has a 573 GWP. It's not on the EPA list for delisting, but would be phased down under the Kigali agreement because it contains R134a.

Accelerate America: Do you see low-charge ammonia competing with HFO blends for the chiller market?

Nelson: There are going to be people who don't want to deal with ammonia and want to keep riding the synthetic train. And there are the people who are used to using 10-year-lifespan chillers because they don't know if they're going to be in their building for the next three years, and want the cheapest offering.

But the cost of the HFO refrigerants is going to be pretty astronomical. And there is still going to be a traditional benefit to the efficiency and industrial quality of ammonia. There are definitely corporations that have made the decision to use natural refrigerants because they believe it's the right thing to do.

Accelerate America: It seems that the low-charge-ammonia chiller market is getting some traction with several manufacturers coming out with new units.

Nelson: Yes, I agree. They're all following the trend. The technology is really nothing new – it's just the packaging of it. It's the availability of something factory-built and packaged and low charge. There are benefits to that, and we have sold lots of low-charge-ammonia packages in Europe.

It's just a matter of the concept gaining traction among end users in the U.S., and we are headed in the right direction by looking at [utility] incentives. On the commercial side, people who are used to paying x for a [traditional chiller] system are not really thinking about the fact that they have to buy two of those systems in the lifespan of one of the ammonia systems. On the Industrial side, where low-charge ammonia is compared to traditional ammonia, there are still energy savings to be had with low-charge ammonia but it's more of a question about safety, regulation, and the cost to build a machinery room and the benefit you get in not needing to build a system on-site from scratch. With packages that can be ground or roof-mounted, there's much more flexibility.

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Lower cost of ownership

Accelerate America: What is the payback on the low-charge packaged system?

Nelson: It varies but we typically see payback in five years or less. It's definitely a lower cost of ownership, especially if you're looking at a water-cooled system that has water consumption. Our air-cooled chillers can be on par with the efficiency of an evaporative condenser system or a water-cooled system, and an air-cooled unit is cheaper to operate.

Accelerate America: What does your reverse-cycle defrost valve do?

Nelson: This is a unique patented feature of our freezer system that makes it more efficient than electric defrost or traditional hot-gas defrost systems. When our system needs to defrost, it shuts down and the four-part ball valve does a 90° turn, allowing the system to run like a heat pump. It basically sends hot compressor discharge gas to the evaporator and refrigerates the condenser.

Accelerate America: With the Azanefreezer, is the evaporator in the unit or in the refrigerated space?

Nelson: We've got flexibility. With a penthouse design, the evaporators are above the ceiling like a penthouse. They pull air from the space and cool it with the ammonia evaporator and then reject it back into the space. The air path is up through the ceiling - up there and back down. It's really an end-user preference. They may want a penthouse because they don't want an evaporator hanging down into the space where they can hit it with a forklift.

We have much more flexibility going into existing systems, especially when people are phasing out R22 and they already have evaporators hanging from the ceiling and they are fine with that. They just hang our ammonia evaporators there and put our condensing unit on the roof or the ground.

Our Azanechiller unit is a full refrigeration system in that it contains the evaporator in the package. We then just provide chilled water or glycol to the load depending on application. The benefit of this is 100% containment of ammonia in the outdoor package.

Accelerate America: Do you sell your units directly to the end user or through a contractor?

Nelson: Good question! Many times this is driven by the owner. If the owner understands the benefits of low-charge-ammonia and is decided on the technology, then they may come direct to Azane before they have chosen a contractor. But many times, they will simply guide their contractor partner to procure one of our systems.

We prefer selling through a contractor so that we can build a strong partnership and get the job done successfully. Many contractors come to us for quotes, which we, of course, gladly welcome. Some of the contractors are starting to see the benefit of low-charge ammonia themselves and are not threatened by it. They see the opportunity for their business to grow without significant staffing increases by playing a key role in ushering these systems in. Plus, our Azanefreezer still requires evaporators with interconnecting ammonia piping installed onsite. On top of installation, there's still start-up, commissioning and service and maintenance so the contractor is still as important as ever. ■ **MG & CM**



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Focus: Utility Incentives

Distribution at ATMOSphere America, June 5-7

Ad submission deadline: May 16

Issue #26

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Focus: Accelerate America Award Winners

Ad submission deadline: June 14

Issue #27

July-August 2017

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Focus: Utilities & Incentives

Ad submission deadline: July 19

Issue #28

September 2017

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Focus: Food retail: CO₂ vs. propane-Distribution at FMI Energy & Store Development Conference, Sept. 24-27

Ad submission deadline: Sept. 13

Issue #29

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Focus: HVAC: Progress in North America

Ad submission deadline: Oct. 12

Issue #30 (Vol. 4)

November-December 2017

Publication date: Nov. 28

Focus: Top 25 Movers & Shakers

Ad submission deadline: Nov. 22

Additional Topics:

- ▶ Ice Rinks
- ▶ Data Centers
- ▶ Contractors
- ▶ Training
- ▶ Residential/Commercial Buildings
- ▶ Pharmaceutical/Scientific
- ▶ Chemical/Manufacturing
- ▶ Mobile Air Conditioning
- ▶ Research



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