

MARCH 2020

ACCELERATE

ADVANCING HVAC&R SUSTAINABLY

MAGAZINE

North America

Colossal CO₂ System at Yosemite Foods - p.37

Europe

Coop Italy Embraces CO₂, Energy Saving - p.49

Australia

Hydrocarbon ACs Gaining Traction - p.57

Finding the Right Natural Refrigerant System for Industrial Refrigeration

Stakeholders debate whether to use low-charge ammonia, ammonia-CO₂ or CO₂.

p. 26



Announcing Accelerate24.news, the one-stop destination for breaking news on sustainable cooling and heating from around the world!

Read about the
latest developments
impacting all natural
refrigerants –
CO₂, ammonia and
hydrocarbons.

It's all on
Accelerate24.news.



SIGN UP

for a regional newsletter highlighting the top stories, delivered every Tuesday!

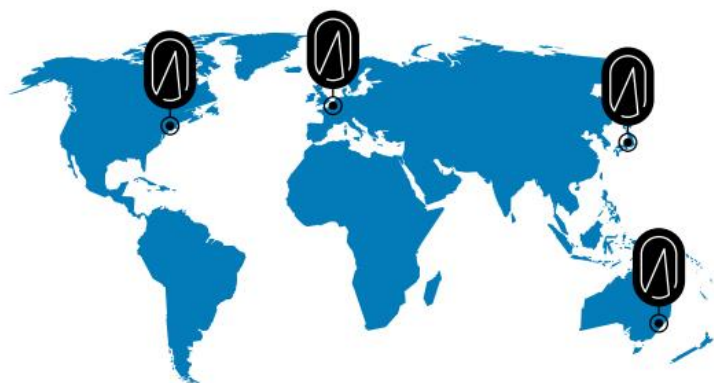
www.accelerate24.news

Brought to you by shecco, the recognized global authority on natural refrigerant news, and publisher of *Accelerate Magazine*.
R744.com, ammonia21.com and hydrocarbons21.com.

ACCELERATE NEWS
ADVANCING HVAC&R SUSTAINABLY WORLDWIDE

ACCELERATE

ADVANCING HVAC&R SUSTAINABLY MAGAZINE



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

About Accelerate Magazine

Brought to you by the worldwide experts in natural refrigerant news, *Accelerate Magazine* is the first global news magazine written for and about the most progressive business leaders working with natural refrigerant solutions in all HVAC&R sectors. It builds on the legacies of five regional magazines: *Accelerate America*, *Accelerate Europe*, *Accelerate Australia/New Zealand*, *Accelerate China* and *Accelerate Asia*, and is published in coordination with the Japanese language magazine, *Accelerate Japan*.

About Accelerate24.news

Accelerate24.news is a 24-hour global website providing up-to-the-minute news on sustainable cooling and heating, with a focus on natural refrigerant-based technologies. Leveraging the expertise of our journalists and analysts in North America, Europe and Japan, Accelerate24.news covers in one place what is found on R744.com, Hydrocarbons21.com and Ammonia21.com, the leading websites on CO₂, hydrocarbons and ammonia over the past decade.

Sign up [here](#) to receive a regional Accelerate24.news newsletter highlighting the top stories, delivered every Tuesday.

WANT TO ADVERTISE?

/ Ad Coordinator

Silvia Scaldaferri
silvia.scaldaferri@shecco.com
 +39 331 961 395

GOT A STORY IDEA?

/ Editor in Chief

Michael Garry
michael.garry@shecco.com
 +1 203-778-8770

March 2020
 // Volume 1, Issue #108

Founder & Publisher

Marc Chasserot
marc.chasserot@shecco.com

Editor in Chief

Michael Garry
michael.garry@shecco.com

Deputy Editor

Ilana Koegelenberg

Associate Editor/Europe

Tine Stausholm

Associate Editor/Asia-Pacific

Devin Yoshimoto

Contributing Writers

Pilar Aleu
 Pauline Bruge
 Jan Dusek
 Zita Laumen
 Rena Okabe
 Caroline Rham
 Tomoro Sato

Ad Coordinator

Silvia Scaldaferri

Art Director

Juliana Gómez

Graphic Designer

Matjaž Krmelj

Photography Editor

Scott Chasserot

Photographers

Ben Beech
 Tomoro Sato

The views expressed by the contributors are not necessarily those of the Publisher. Every care is taken to ensure the content of the magazine is accurate but we assume no responsibility for any effect from errors or omissions.

Published by shecco SPRL. All rights reserved. Reproduction in whole or in part is prohibited without prior written permission of the copyright owner.

In this issue

- 03** **About Us**
- 06** **Editor in Chief's Note**
The Remaining Question
- 08** **Editorial Calendar**
- 10** **Opinion**
NatRefs: Still in a Class
by Themselves
By Andre Patenaude
- 14** **Letters to the Editor**
- 16** **Infographic**
U.S. States Enacting
HFC-Reduction Regulations

// Global Trends

- 18** **Kigali Update**
- 20** **Cooling-as-a-Service
Incubator Program
Announces Winning
Companies**
- 24** **World in Brief**
- 26** **Cover Story**
Finding the Right Natural
Refrigerant System for
Industrial Refrigeration

// Americas

- 36** **Region Intro**
Events March - April
- 37** **End User**
**Colossal Industrial
Transcritical CO₂ System
Custom-Made for Yosemite
Foods**
- 42** **Event**
**Natural Refrigerants
at AHR Expo**
- 46** **Policy**
**Six More U.S. States Pursue
HFC Bans**

// Europe, Middle East & Africa

- 48** **Region Intro**
Events March - April
- 49** End User
Coop Italy Embraces CO₂ and Energy Saving
- 52** Event
NatRefs Dominate EuroShop

// Australia & New Zealand

- 56** **Region Intro**
Events March - April
- 57** End User
Hydrocarbon HVAC Systems Gaining Traction in Australia
- 60** End User
Australian Wholesaler Chooses CO₂ Over Ammonia and HFCs for Cold Storage

// Asia Pacific

- 64** **Region Intro**
Events March - April
- 65** Event
End Users and Manufacturers Mark NatRef and Energy Progress at ATMosphere Japan
- 68** Market
Hydrocarbons Going Mainstream in Japan
- 74** Event
Thai Environment Minister to Speak at Natref Event in Bangkok
- 76** Alternative Technology
Ice-Free Ice Skating
- 77** Saving Energy
Monitoring, Measuring and Improving Refrigeration Performance
- 78** New Research
Boosting the COP of Small-Capacity Transcritical CO₂ Systems
- 80** Thought Leader Q&A
Marek's Hydrocarbon Update
- 82** **Editorial Corner**

The Remaining Question

— by Michael Garry

As natural refrigerants continue to become the future-proof, go-to solution in commercial, industrial and residential sectors around the world, the remaining question is: Which natural refrigerant is best for a particular application?

In this issue, we address that question for industrial refrigeration, not only in the cover story but also in several other articles.

It is often said that there is no perfect refrigerant for all applications, and that is certainly true about natural refrigerants. While they are all environmentally friendly and a necessary replacement for synthetics, they also have operational challenges that need to be addressed. It becomes a complex balancing act to determine which is best for a given application, considering such factors as first cost, efficiency, safety, charge limits, technician availability and many others.

In our cover story, we compare three natural refrigerant options: centralized low-charge ammonia, packaged ammonia/CO₂ and transcritical CO₂, all of which have become serious players in the industrial marketplace.

The industrial refrigeration industry has recognized in recent years that it's important from a safety and regulatory perspective to reduce the amount of ammonia in a system as much as possible. That enables ammonia, an extremely efficient gas, to be employed not just in industrial settings, but also in applications like retail refrigeration and commercial air conditioning.

One of the ways ammonia charge can be reduced and kept away from the refrigerated space is to use it in conjunction with another refrigerant like CO₂, which does the actual cooling. Systems that use this approach like Mayekawa's packaged

NewTon system have become popular in Japan and other regions.

The cover story compares the use of the NewTon system with that of centralized low-charge ammonia. It also examines the new kid on the industrial block, transcritical CO₂, as used by Henningsen Cold Storage in the U.S., which also employs centralized low-charge ammonia systems.

Transcritical CO₂ rack systems, traditionally seen in supermarkets, have become increasingly popular in the industrial sphere in recent years. While high pressures and efficiency challenges have to be dealt with in these systems, some operators like the fact that transcritical CO₂ eliminates ammonia and its safety/regulatory issues from the equation.

There are some good examples of industrial-level CO₂ installations in this issue. On [page 38](#), we show how Yosemite Foods selected a massive transcritical CO₂ system for its new pork-processing facility in California (U.S.); on [page 60](#), we describe why South Coast Stores, an Australian wholesaler, opted for a transcritical CO₂ system that uses solar energy as well as waste heat from the refrigeration system.

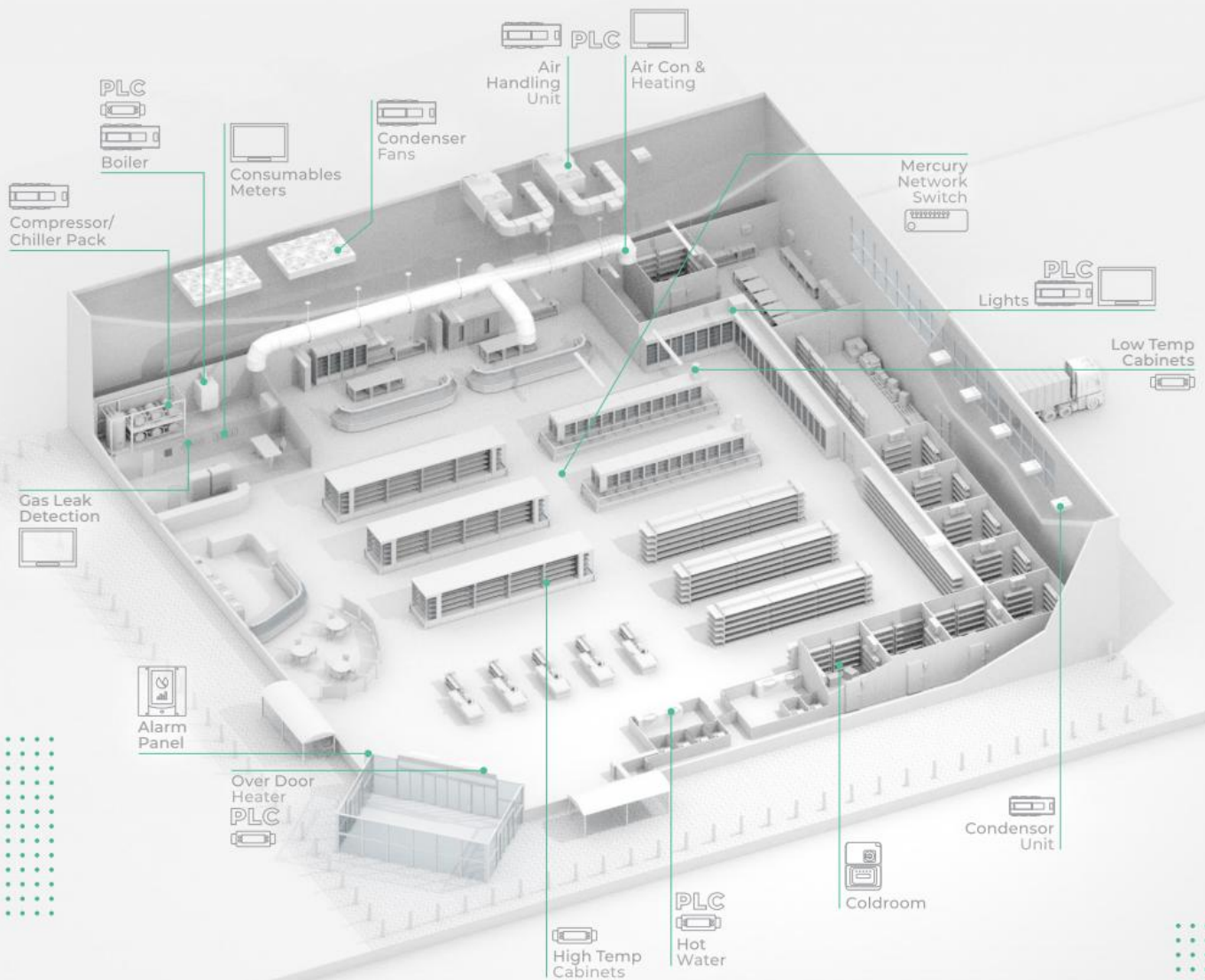
In our coverage of the ATMosphere Japan conference (organized by shecco, publisher of *Accelerate Magazine*) on [page 65](#), we talk about cold storage operator Hamamatsu Itaku Soko, which replaced a 22-year-old R22 system with transcritical CO₂. The system came from Japanese OEM Nihon Netsugen Systems, which has installed a whopping 170 transcritical systems in the industrial refrigeration sector in Japan.

Will all of these natural refrigerant technologies continue to play a role in industrial refrigeration, or will one take over market share? Time will tell, but we'll be watching.



Michael Garry
Editor in Chief

IoT Control & Monitoring



Since 2000, RDM solutions have been designed upon the Internet of Things (IoT). Our full building control and monitoring options provide data collection, analysis and monitoring.

Suitable for both primary and secondary systems, we have a full range of products, including Ammonia Rack and Transcritical CO₂ controllers for Gas Cooler, Compressor, Evaporator, Condenser and Plate Head Exchanger control. With advanced load shedding algorithms to help your system cope in fault conditions.

**IP at
Device
Level
since
2004**

Editorial Calendar for Accelerate Magazine, 2019-2020

Each issue of *Accelerate Magazine*, published 10 times annually, covers natural refrigeration and sustainable cooling/heating across all major business sectors, including commercial, industrial and residential. The magazine targets end users and other key stakeholders, including manufacturers, contractors, policy makers, the financial community, academic experts and others.

Each issue features a Cover Story that addresses a major topic in the global natural refrigeration industry. It also contains a Global Trends section and other sections of worldwide relevance such as Servitization of Cooling, Digitalization, Alternative Technology, Saving Energy, New Research and Thought Leader Q&A.

In addition, the magazine offers regional sections on North America, Europe, Australia, Japan, China, Southeast Asia and Africa; each section covers End Users, Technology, Market, Events and Policy. Other regular sections include Editor in Chief's note, Opinion, Letters to the Editor, Global Events Guide, Infographic, Kigali Amendment Update and World in Brief. The magazine is available online at <https://accelerate24.news/magazines/>; in addition print copies are distributed at major industry trade shows and conferences.

Accelerate Magazine takes full-page advertising as well as fractional ads for its Marketplace sections that target specific trade shows.

The editorial calendar is subject to change by the publisher.



// ISSUE #101

June 2019

Cover Story:

NatRefs 101: Tracing the growth of natural refrigerants through the first 100 issues of *Accelerate Magazine* from around the world.

Print distribution: ATMosphere America (Atlanta, June 17-18)

// ISSUE #102

July/August 2019

Cover Story:

Impact of IEC's new 500-g charge limit for hydrocarbons. What are the next steps?

// ISSUE #103

September 2019

Cover Story:

HFOs: How Much is Too Much?

Print Distribution: FMI Energy & Store Development Conference (Dallas, Texas, September 8-11); ATMosphere Asia (Bangkok, Thailand, September 25)

// ISSUE #104

October 2019

Cover Story:

How Do We Cool a Warming World (Without Making It Warmer)?

Print Distribution: ATMosphere Europe (Warsaw, Poland, October 16-17)

// ISSUE #105

**November/
December 2019**

Cover Story:

Year One of Kigali: Is it enough?

// ISSUE #106

January 2020

Cover Story:

Women in Natural Refrigerants

Print Distribution:

AHR Expo (Orlando, Florida, February 3-5); ATMosphere Japan (Tokyo, February 10)

// ISSUE #107**February 2020****Cover Story:**

EuroShop 2020: Meet the future of retail refrigeration.

Marketplace Advertising for EuroShop.**Print Distribution:** EuroShop (Düsseldorf, Germany, February 16-20); ATMosphere Cape Town (Cape Town, South Africa, March 10)**// ISSUE #108****March 2020****Cover Story:**

Finding the Right Natural Refrigerant System in Industrial Refrigeration.

Marketplace Advertising for IIAR Natural Refrigeration Conference and Heavy Equipment Expo.**Print Distribution:** IIAR Natural Refrigeration Conference and Heavy Equipment Expo (Orlando, Florida, U.S., March 15-18); ATMosphere Ibérica (Málaga, Spain, March 31)**// ISSUE #109****April 2020****Cover Story:**

Project Drawdown Update: the continuing impact of refrigeration management and alternative refrigerants.

Publication Date: April 7**Ad Deadline:** March 31**// ISSUE #110****May 2020****Cover Story:**

The three mega trends transforming HVAC&R: natural refrigerants, servitization and digitalization.

Publication Date: May 5**Ad Deadline:** April 28**Marketplace Advertising for ARBS****Print Distribution:**

ATMosphere Australia (Melbourne, May 18); ARBS (Melbourne, May 19-21)

// ISSUE #111**June 2020****Cover Story:**

The Training Revolution: How IoT, AI, virtual reality and robotics will fill the technician void.

Publication Date: June 9**Ad Deadline:** June 2**// ISSUE #112****July-August 2020****Cover Story:**

The Clean Cooling revolution.

Publication Date: July 14**Ad Deadline:** July 7**// ISSUE #113****September 2020****Cover Story:**

How the servitization business model is enabling sustainable cooling worldwide.

Publication Date: September 8**Ad Deadline:** August 31**Marketplace Advertising for Mostra Convegno ExpoComfort****Print Distribution:** Mostra Convegno ExpoComfort (Milan, Italy, September 8-11); FMI Energy & Store Development Conference (Baltimore, Maryland, U.S., September 21-24); ATMosphere America, Co-Located with Global Cold Chain Expo (Dallas, Texas, September 28-30)**// ISSUE #114****October 2020****Cover Story:**

How natural refrigerants are changing the heating and cooling of buildings.

Publication Date: October 6**Ad Deadline:** September 24**Marketplace Advertising for Chillventa****Print Distribution:** Chillventa (Nuremberg, Germany, October 13-15)**// ISSUE #115****November 2020****Cover Story:**

Making sustainable cooling smarter through digitalization.

Publication Date: November 10**Ad Deadline:** November 2**Print Distribution:** ChinaShop 2020 (Shanghai, November 19-21)**ISSUE #116****December 2020-January 2021****Cover Story:**CO₂ vs. hydrocarbons in commercial refrigeration.**Publication Date:** December 15**Ad Deadline:** December 7

NatRefs: Still in a Class by Themselves

Natural refrigerants check key boxes for owners and operators who are preparing for a dynamic future and a rapidly changing equipment landscape.

— By Andre Patenaude

For more than a decade, natural refrigerants have factored prominently in the search for environmentally friendly refrigeration in both commercial and industrial sectors.

During this time, we've seen the introduction of propane (R290) in microdistributed, self-contained cases; increased global adoption of CO₂ (R744) in centralized systems; and the emergence of ultra-low-charge ammonia (R717), by itself and integrated with CO₂ in cascade systems.

And in this new decade, we will likely continue to see the use of natural refrigerants progress along these established lanes.

The drivers for natural refrigerant adoption haven't changed significantly since their introduction. Because legacy refrigeration strategies rely on the use of high-GWP HFC refrigerants, companies with sustainability objectives or regulatory imperatives have been the first to make the transition to lower-GWP alternatives. Among these options, natural refrigerants are considered immune from regulatory-mandated GWP caps.

The phase down of HFCs remains a focus of environmental regulations around the globe. For example, the 2016 Kigali Amendment to the Montreal Protocol calls for a gradual phase down in both the production and consumption of HFCs by more than 80% over the

next 30 years. To date, 92 countries have backed this initiative. ([See page 18.](#))

Some national and regional initiatives are taking a more aggressive approach toward meeting what appears to be the ideal target of 150 GWP for refrigerants.

- The California Air Resources Board (CARB) is proposing a 150-GWP limit on new stationary refrigeration systems containing more than 50 pounds of refrigerant, starting January 1, 2022.
- The European F-Gas Regulation will prohibit the use of refrigerants above 150 GWP in new multi-compressor commercial refrigeration equipment in systems above 40 kW (11.4 tons), starting in 2022.
- Environment and Climate Change Canada (ECCC) is taking a more step-wise approach to its HFC phase down, but it also has lower-GWP targets in its sights.

Throughout the relatively short history of refrigeration, it's been said that there's no such thing as a perfect refrigerant — and that's certainly the case with natural options. But natural refrigerants check key boxes for owners and operators as they prepare for a dynamic future and a rapidly changing equipment landscape.

Natural refrigerants are among the very few alternatives capable of meeting some of these more aggressive GWP targets. R290 has a GWP of 3; CO₂ has a GWP of 1; and ammonia has a GWP of 0. From environmental and regulatory perspectives, this puts them in a class by themselves.

CHARACTERISTICS AND CAVEATS

With decades of field use and research, the performance characteristics of natural refrigerants are well known. However, each refrigerant has operating caveats that equipment owners must carefully consider before investing in a long-term refrigeration strategy.

- **R290** offers excellent energy efficiencies, but is classified as an A3, or flammable, refrigerant. Safety regulations limit its use to small charges globally from 150g to 500g. This has made R290 a natural fit for small-capacity, self-contained cases that require a lower charge and are hermetically sealed at the factory.

- **CO₂** is a high-pressure refrigerant with a low critical point (87.8°F/31°C) that determines its modes of operation (subcritical, or below the critical point; transcritical, or above the critical point). It also has a high triple point where the refrigerant will turn to dry ice. While systems are designed to manage these characteristics, operators must have access to qualified technicians to properly service the system.

- **Ammonia** has been used in industrial refrigeration for the past century, but as a B2L, its toxicity presents challenges to equipment owners. Tightening safety regulations and the risk of exposure have led to the introduction of system architectures that move ammonia out of occupied spaces and feature very low charges.

When evaluating which natural refrigerant is best for your operation, often the store format and specific applications will dictate the refrigerant choice. Generally speaking, R290 is well suited for either a smaller-format store or as a spot merchandising option (via stand-alone display cases) for larger

stores. CO₂, on the other hand, makes the most sense in larger stores seeking a centralized architecture alternative to HFCs. Ammonia is relatively rare in commercial applications but is finding its way into innovative architectures designed to mitigate its risks while benefiting from its excellent performance characteristics.

R290, from integrated cases to microdistributed: R290 rose in popularity in the U.S. when the U.S. Environmental Protection Agency's SNAP (Significant New Alternative Policy) Rules 20 and 21 took effect in the mid-2010s. Manufacturers worked within the 150g charge limit to create self-contained, integrated cases, in which the refrigeration system (compressor and condensing unit) is built into the display case. These flexible and efficient units then evolved into a microdistributed approach for small stores, where multiple units share a water/glycol loop to remove excess heat. This approach provides very-low-GWP total-store cooling while keeping charges low, typically operating with 90% less refrigerant than a centralized system.

It's important to point out that in larger display cases, these small charge limits require the use of more compressors than would be needed for other approaches. But with the prospect of future charge-limit increases, operators may have the potential to more than double the size (and capacity) of current R290 applications in North America.

CO₂ transcritical booster: Globally, CO₂ came into prominence more than a decade ago in large supermarkets where centralized architectures are preferred. And since that time, CO₂ transcritical booster system technology has continued to improve, offering an all-natural solution for both

low- and medium-temperature cooling. It's called *transcritical* because it is designed to operate at temperatures and pressures above CO₂'s critical point. Compared to traditional HFC systems, CO₂ transcritical boosters represent a completely different approach to system operation and servicing — requiring operators to acquire the services of trained CO₂ technicians and implement strategies for power outages in order to mitigate “stand-still” pressure while the system is off.

Because of the refrigerant's unique characteristics, CO₂ transcritical booster systems can also experience declining energy efficiencies in warm climates. Equipment manufacturers have developed new strategies to improve CO₂-system energy efficiencies in these regions, including parallel compression, adiabatic gas coolers and ejectors.

Ammonia/CO₂ hybrid subcritical (cascade):

CO₂ cascade systems are designed to utilize CO₂ in the low-temperature (LT) suction group where the refrigerant stays below its critical point (or subcritical) and operates at lower pressures, much like a traditional HFC. Typically, an HFC (or HFO/HFC blend) is used in the medium-temperature (MT) circuit, where heat produced from the LT circuit is discharged (i.e., cascaded) into a heat exchanger and into the suction stage of the MT circuit. However, the recent introduction of ammonia as the MT refrigerant has transformed this configuration into an all-natural refrigerant option.

This hybrid design mitigates the challenges of each natural refrigerant: keeping CO₂ pressures low and distributing it to LT cases, and glycol to MT cases, while utilizing an ultra-low charge of ammonia that keeps the circuit isolated on the roof and away from occupied spaces.

WEIGHING OPPORTUNITY AND OPERATIONAL COSTS

In light of the global regulatory climate and trend toward environmentally friendly refrigeration, natural refrigerants will continue to proliferate along these well-established paths of least resistance. Still, there is much to consider for system operators, who must weigh the opportunity costs for selecting a natural refrigerant option.

Safety, of course, is the first consideration. Fortunately, manufacturers have poured a great deal of effort into ensuring the operational safety of natural systems; among these include pressure relief strategies, specially designed components, leak-detection devices, and guidance to owners and operators on how to operate and maintain their systems properly. System maintenance is critically important, and technicians trained to service systems utilizing these newer refrigerants and technologies are in high demand. Accordingly, compared to traditional systems, hiring the right technicians to ensure proper safety and service can come with an added cost, so it's important to factor this into the total cost of system ownership throughout the equipment's lifecycle.

But for those companies seeking a future-proof refrigeration strategy that will both satisfy future regulatory targets and establish them as a sustainability leader, natural refrigerants are on the very short list of options. ■ AP



Andre Patenaude, Director, Solution Integration for Emerson, is responsible for supporting system-related innovation and leveraging Emerson's global cold chain to drive adoption of integrated solutions in North America. He most recently led marketing efforts pertaining to Emerson's food retail and chiller markets. Prior to that, he had managed Emerson's global CO₂ development.

Patenaude has more than 35 years of industry experience in sales, marketing, training and business development of HVACR system architectures and applications with compression and component technologies. He has been a certified Mechanical Engineering Technologist C.E.T. since 1984, and is a member of ASHRAE, RSES and OACETT.



OFFICINE MARIO DORIN SINCE 1918

DORIN
INNOVATION



Retail Business



Marine Applications



Railway Air Conditioning



Ice-Cream Industry



Industrial Refrigeration



Wholesale



CD Series of compressors for CO₂ transcritical application is the result of more than three decades systematical research and experience of Dorin Engineers. The reliability, sustainability and efficiency of these machines make them the flagship reference for the market nowadays:

CD500 - the largest 6 piston, 39.85 - 98.58 m³/h

CD400 - the best seller 4 piston, 9.48 - 35.47 m³/h

CD4 - the newest 4 piston, 4.67 - 9.21 m³/h

CD2 - the smallest 2 piston, 1.60 - 4.60 m³/h

Eco-Friendly solution for cold chain systems

Do it all with Dorin CO₂ Compressors!

**Save the planet, Choose Natural,
Choose Dorin!**

COME MEET US!

March, 05-07 | **BUSWORLD TURKEY**, Istanbul - TR

March 10 | **ATMOsphere Cape Town**, Cape Town - ZA

March, 15-18 | **IIAR**, Orlando - US

March, 31 | **ATMOsphere Ibérica**, Malaga - ES

April, 15-17 | **ICCC 2020**, Nantes - FR



Letters to the Editor

RETROFITS AND CAAS

Regarding "King of the Retrofits," ([Accelerate Magazine, February 2020](#)) about Biedronka, 900 CO₂ retrofit stores is quite impressive. It's great to see these types of initiatives, and I do think it's a matter of time until we see the same level of transition here in the U.S.

I was also surprised by the concept of the cooling-as-a-service (CaaS) model. ("South Africa to Host 'Matchmaking' Educational Event on Cooling-as-a-Service," [Accelerate Magazine, February 2020](#).) It's interesting how everything now is packaged and sold "aaS" and while I agree with the spokesperson for Biedronka that it would cut into profits, it may be better than overleveraging to fund the necessary capital investment. Pretty interesting stuff.

Jerry Lozano
Sales Engineer
Baltimore Aircoil Co.(BAC)
Jessup, Maryland (U.S.)

MAKING THE RIGHT CHOICE

By switching from environmentally harmful and inefficient synthetic refrigerants to natural refrigeration systems, Nestlé reduced electricity consumption by more than 25%!! (Nestlé Uses Natural Refrigerants to Reach Sustainability Goals," [Accelerate Magazine, January 2020](#).) It is a great story, and I love to see how companies can improve profitability by making the right choice.

David Fauser
Director of Sales and Marketing
Cimco Refrigeration
Toronto, Canada

SAVING WITH INTEGRATED SYSTEMS

Regarding "South Africa to Host 'Matchmaking' Educational Event on Cooling-as-a-Service" ([Accelerate Magazine, February 2020](#)), we could be interested in [the cooling-as-a-service model]. But with our "total energy" integrated transcritical CO₂ system [refrigeration, air conditioning and heating], the customer also has an advantage to spend less money during their first investment and have a higher energy efficiency with just one installation compared to installations for refrigeration, for a heat pump and for a chiller.

Luca Rossi
Project Manager
Biaggini Frigoriferi
Cadenazzo, Switzerland

CORRECTION

In "HVAC&R Moves to 'Industry 4.0'" ([Accelerate Magazine, February 2020](#)), the following comment was originally attributed incorrectly. It should have been attributed to Enrico Mirandola of Resource Data Management. "An open system is key. We cannot have just one supplier deliver the data. So, because there are very different data that can be put together, having an open system enables us to put all of it together and make it available for more people in a nice way. That could be remote, like on the Cloud, but not necessarily."

Accelerate Magazine regrets the error.

LETTERS ARE WELCOMED!

Accelerate Magazine invites readers to submit letters to the editor to michael.garry@shecco.com. Letters may be edited for clarity or length.



For Every Refrigerant & Application

Oil Separators • Oil Reservoirs • Liquid Receivers • Oil Management Products



***Compatible with:
Transcritical & Subcritical CO₂, Ammonia, HCs,
and Other Natural & Manmade Refrigerants***

• Proven Energy Savings • Cleaner Systems

www.temprite.com

email: temprite@temprite.com

1.800.552.9300

1.630.293.5910

FAX: 1.630.293.9594

WASHINGTON
OREGON
CALIFORNIA
NEVADA
UTAH
ARIZONA
NEW MEXICO
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
ALABAMA
GEORGIA
LOUISIANA
FLORIDA
MAINE
VERMONT
NEW HAMPSHIRE
MASSACHUSETTS
RHODE ISLAND
CONNECTICUT
NEW YORK
PENNSYLVANIA
DELAWARE
MARYLAND
MISSISSIPPI

ALASKA
HAWAII
PUERTO RICO

California, New Jersey, Washington,
Vermont

Colorado, Hawaii, Oregon, Connecticut,
Delaware, Maryland, New York, Rhode
Island, Massachusetts, Pennsylvania and
Maine.

Other U.S. Climate Alliance States:
*Illinois, Michigan, Minnesota, Montana,
Nevada, New Mexico, North Carolina,
Virginia, Wisconsin and Puerto Rico*



Are you a Small or Extra Large?



No matter what size your store footprint, from a small format store to a large chain grocery store, Hillphoenix, the pioneer in HFC-free CO₂ refrigeration systems has a CO₂ system sized to fit your exact needs. Why CO₂? It's a less expensive refrigerant option. It poses no threat to the environment. It's an abundant, renewable resource. It solves any compliance issues you'll likely see for today and the future. And it is where all the refrigeration technology is heading.

Hillphoenix

A DOVER COMPANY

Advansor™ and AdvansorFlex CO₂ Systems are the ideal solution for everything from small to extra large sized retail establishments. Now all the benefits of efficient, economical and environmentally friendly CO₂ refrigeration can fit any-sized retail operation, anywhere.

Kigali Update

Ninety-two countries (plus the European Union) have accepted, ratified or approved the Kigali Amendment to the Montreal Protocol as of March 6, 2020.*

The countries that have done so since September 27 include: Bhutan, Vietnam, New Zealand, Mauritius, Lesotho, São Tomé and Príncipe, Jordan, Argentina, Guinea, Somalia, Mozambique and Lebanon.

The Kigali Amendment was enacted on October 15, 2016, by 197 countries (plus the EU) in Kigali, Rwanda; it took effect on January 1, 2019. The Amendment calls for the phase down of the production and use of HFCs by developed and developing countries following the acceptance, ratification or approval of the amendment by each country.

The 49 developed (Non-Article 5) countries started with a 10% HFC phase down in 2019 (compared to a baseline of average HFC production/use in 2011-2013), except for Belarus, the Russian Federation, Kazakhstan, Tajikistan and Uzbekistan, which start with a 5% phase down in 2020. All developed countries will end with an 85% HFC phase down by 2036. Thirty-one countries plus the EU have so far accepted, ratified or approved the Amendment.

The 148 developing (Article 5) countries fall into two groups. The majority will start a freeze in 2024 at a baseline of average HFC production/use in 2020-2022; those countries will end with an 80% HFC phase down by 2045. The other Article 5 countries (Bahrain, India, Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, and the United Arab Emirates) will start a freeze in 2028 at a baseline of average HFC production/use in 2024-2026; those countries will end with an 85% HFC phase down by 2047. So far, 61 Article 5 countries (both groups) have accepted, ratified or approved the Amendment.

Here is a list of the 92 countries along with the EU that have accepted, ratified or approved the Kigali Amendment as of March 6.

* Based on data from United Nations Treaty Collection (<https://bit.ly/2pg0sgF>)

** With territorial exclusion in respect of Greenland

*** For the European part of the Netherlands

Developed (Non-Article 5) Countries

Participant	Acceptance(A), Ratification, Approval(AA)
Andorra	Jan 23, 2019 A
Australia	Oct 27, 2017 A
Austria	Sep 27, 2018
Belgium	Jun 4, 2018
Bulgaria	May 1, 2018
Canada	Nov 3, 2017
Croatia	Dec 6, 2018
Czech Republic	Sep 27, 2018 A
Cyprus	July 22, 2019
Denmark**	Dec 6, 2018 AA
Estonia	Sep 27, 2018
European Union	Sep 27, 2018 AA
Finland	Nov 14, 2017 A
France	Mar 29, 2018 AA
Germany	Nov 14, 2017 A
Greece	Oct 5, 2018
Hungary	Sep 14, 2018 AA
Ireland	Mar 12, 2018
Japan	Dec 18, 2018 A
Latvia	Aug 17, 2018
Lithuania	Jul 24, 2018
Luxembourg	Nov 16, 2017
Netherlands***	Feb 8, 2018 A
New Zealand	Oct 3, 2019
Norway	Sep 6, 2017
Poland	Jan 7, 2019
Portugal	Jul 17, 2018 AA
Slovakia	Nov 16, 2017
Slovenia	Dec 7, 2018
Sweden	Nov 17, 2017
Switzerland	Nov 7, 2018
United Kingdom of Great Britain and Northern Ireland	Nov 14, 2017

Developing Countries (Article 5)

Participant	Acceptance(A), Ratification, Approval(AA)
Albania	Jan 18, 2019
Argentina	Nov 22, 2019
Armenia	May 2, 2019 A
Barbados	Apr 19, 2018
Benin	Mar 19, 2018
Bhutan	Sep 27, 2019
Burkina Faso	Jul 26, 2018
Chad	Mar 26, 2019
Chile	Sep 19, 2017
Comoros	Nov 16, 2017
Cook Islands	Aug 22, 2019 A
Costa Rica	May 23, 2018
Côte d'Ivoire	Nov 29, 2017 A
Cuba	June 20, 2019
Democratic People's Republic of Korea	Sep 21, 2017
Ecuador	Jan 22, 2018
Ethiopia	July 5, 2019
Gabon	Feb 28, 2018 A
Ghana	Aug 2, 2019
Grenada	May 29, 2018
Guinea	Dec 5, 2019
Guinea-Bissau	Oct 22, 2018
Honduras	Jan 28, 2019
Jordan	Oct 16, 2019
Kiribati	Oct 26, 2018
Lao People's Democratic Republic	Nov 16, 2017 A
Lebanon	February 5, 2020
Lesotho	Oct 7, 2019
Malawi	Nov 21, 2017
Maldives	Nov 13, 2017
Mali	Mar 31, 2017 A

Participant	Acceptance(A), Ratification, Approval(AA)
Marshall Islands	May 15, 2017
Mauritius	Oct 1, 2019
Mexico	Sep 25, 2018 A
Micronesia (Federated States of)	May 12, 2017
Montenegro	Apr 23, 2019
Mozambique	January 16, 2020
Namibia	May 16, 2019 A
Niger	Aug 29, 2018
Nigeria	Dec 20, 2018
Niue	Apr 24, 2018
Palau	Aug 29, 2017
Panama	Sep 28, 2018
Paraguay	Nov 1, 2018 A
Peru	Aug 7, 2019
Rwanda	May 23, 2017
Samoa	Mar 23, 2018
São Tomé and Príncipe	Oct 1, 2019
Seychelles	Aug 20, 2019 A
Senegal	Aug 31, 2018
Somalia	Nov 27, 2019
South Africa	Aug 1, 2019
Sri Lanka	Sep 28, 2018
Togo	Mar 8, 2018 A
Tonga	Sep 17, 2018
Trinidad and Tobago	Nov 17, 2017
Tuvalu	Sep 21, 2017
Uganda	Jun 21, 2018
Uruguay	Sep 12, 2018
Vanuatu	Apr 20, 2018
Vietnam	Sep 27, 2019 AA

Cooling-as-a-Service Incubator Program Announces Winning Companies

Five technology providers from around the world have been selected to pilot the pay-as-you-go business model.

— by Ilana Koegelenberg

After receiving 35 project proposals from around the world for its cooling-as-a-service (CaaS) incubator program, Switzerland-based Basel Agency for Sustainable Energy (BASE) has chosen the five technology providers that will pilot the first CaaS projects. Providers were chosen from India, Grenada, Costa Rica, Nigeria, and Argentina.

CaaS is an alternative financial model to the traditional upfront purchasing of equipment, using a pay-per-service model instead.

The proposals are for highly efficient air-conditioning or refrigeration solutions using low-GWP or natural refrigerants. The five winners will receive free support from BASE to integrate CaaS into the business models for their systems. This will include assistance on technical, legal and financial aspects, including contractual arrangements, pricing strategy, financial structuring, risk mitigation mechanisms, among others. At the end of the incubator program, the aim is to have providers fully equipped to launch their first demonstration project.

Following its global call for proposals last month, BASE received 35 applications

from 18 countries representing a variety of cooling applications and technologies. “We are delighted to see so much interest from technology providers to implement the CaaS model,” said Thomas Motmans, Sustainable Energy Finance Specialist at BASE.

BASE is the leader of the Cooling as a Service Initiative (<https://bit.ly/39jsJsb>) partnering with the Kigali Cooling Efficiency Program (K-CEP). The initiative aims to decrease energy consumption and greenhouse gas (GHG) emissions from cooling by promoting a pay-per-service model – as opposed to conventional up-front payment – to finance efficient cooling systems. The CaaS model is endorsed by the Global Innovation Lab for Climate Finance.

“Cooling as a Service can help the much needed transformation of the cooling sector so that the cooling needs of consumers, businesses and governments can be met without blowing the world’s carbon budget,” said Dan Hamza-Goodacre, Executive Director of K-CEP, on the CaaS Initiative website.

The following are descriptions provided by BASE of the companies that have been selected to trial the CaaS business model:

LEADER IN HIGH PRESSURE **CO₂** COOLING
AND REFRIGERATION SYSTEMS

PASSION INNOVATION THOROUGHNESS

INNOVATIVE COOLING SOLUTIONS BUILT
FOR **ENVIRONNEMENTAL SUSTAINABILITY**

WE OFFER

- Design and engineering
- Manufacturing
- Project management
- Commissioning and help desk 24/7

WE SERVE

- Industrials
- Supermarkets
- Sports centers
- Data centers

WE ARE

- Working to make Eco-friendly refrigeration a global standard

CARNOTREFRIGERATION.COM

INFO@CARNOTREFRIGERATION.COM

1 855 376-5959





BGH (Argentina)

Grupo BGH boasts 106 years of history in innovation, development and commercialization of cutting-edge technology products and services. It provides answers to the needs of businesses, public organizations and consumers across Latin America and Africa.

The company has four business units: BGH Eco Smart develops energy-efficiency and smart-building solutions, integrating professional heating and air conditioning products and services; BGH Consumer manufactures consumer electronics; BGH Tech Partner develops digital transformation solutions for organizations; and Positivo BGH manufactures, sells and distributes personal computers, laptops and tablets.

KoolBoks (Nigeria)

Although global warming is more prevalent now than ever with record temperatures on all continents, Africa in particular broadly illustrates the negative impact this extreme heat poses for millions of people, especially low-income earners. Many Africans face significant risks because they lack electricity and therefore lack refrigeration and other forms of cooling that can protect food and vaccines.

KoolBoks is focused on democratizing the way the world experiences cooling. The company's goal is to develop ice-cooling systems through research and development and make them affordable and accessible to those that need them the most.

CoolCrop (India)

CoolCrop develops decentralized cold storage systems that can be owned and operated by farmers, farmer co-operatives, or entrepreneurs to store perishable produce immediately after harvest; this reduces on-farm waste and distress sales during low-priced market conditions. It has also developed a price-forecasting system in the form of a market-analytics app, which helps farmers make better marketing decisions for their perishable crops. Integrating these technologies with renewable energy technologies, especially solar powering systems, is CoolCrop's domain expertise.



CoolCrop works with partner entities such as non-governmental organizations, self-help groups, financing institutes, market committees and government agencies to better realize the storage needs of farmers or farmer co-operatives; it designs and creates systems best-suited to cater to the challenges they face.

Cooling Tech Ltd (Grenada)

Cooling Tech Ltd is a solutions provider and qualified dealer for Carrier's commercial and residential air conditioning systems and refrigeration solutions in Grenada and throughout the wider Caribbean region. It designs, supplies, installs, services, repairs, replaces and commissions all sizes of air conditioning and refrigeration equipment to optimize the performance of its customers' facilities, whether a single building or multiple sites. Its main focus is state-of-the-art, high-efficiency equipment and high-quality services driven by a commitment to provide energy-efficient solutions while conforming to the Montreal Protocol's "green" initiatives to protect the environment.

Grupo Clima (Costa Rica)

Grupo Clima is a Costa Rican business group with over 50 years of experience in air conditioning, refrigeration, building-automation systems and electro-mechanical installations. In these years, as one of the largest contractors in the region, Grupo Clima has participated in

some of the most important projects of the Costa Rican economy.

About 15 years ago, they started working on buildings that optimized controllability and comfort for users. Nowadays, their service also focuses on energy saving as providers of the latest technology and building automation, covering HVAC, plumbing, electrical and other systems.

■ IK

“ We are delighted to see so much interest from technology providers to implement the CaaS model. ”

- Thomas Motmans, BASE

Industrial Strength Gas Detection

for all industrial refrigerants



Built for industrial environments. Our sensors thrive where others fail.

- ◇ Available for Ammonia and Carbon Dioxide
- ◇ Designed for extreme temperatures: -50°F to +130°F (-45°C to +55°C)
- ◇ Encapsulated circuitry prevents corrosion and withstands high pressure wash downs
 - ◇ Specifically designed to prevent false alarms
- ◇ Every sensor passes rigorous testing and includes a 2-year warranty
- ◇ All items are in stock with fast and easy domestic or international shipping
- ◇ SafeCell technology continuously checks the cell's electrical viability

WEB: ctiengineering.com

EMAIL: sales@ctiengineering.com

World in Brief

EPA Rescinds HFC Leak Rules

The U.S. Environmental Protection Agency (EPA) announced on February 26 that it is rescinding a 2016 Obama administration rule that extended refrigerant leak repair requirements to HFCs and HFOs for equipment containing more than 50lbs (23kg) of refrigerant, including most supermarket and industrial applications.

The new rule – “Protection of Stratospheric Ozone: Revisions to the Refrigerant Management Program’s Extension to Substitutes” – will go into effect 30 days after its publication in the Federal Register.

In particular, the EPA is rescinding the following requirements for HFCs and HFOs:

- ▶ Repairing appliances that leak above a certain level and conducting verification tests on repairs.
- ▶ Periodically inspecting for leaks.
- ▶ Reporting chronically leaking appliances to the EPA.
- ▶ Retrofitting or retiring appliances that are not repaired.
- ▶ Maintaining related records.

The EPA originally established refrigerant leak repair requirements and associated recordkeeping and reporting provisions for ozone-depleting substances (ODS), such as CFCs and HCFCs, under section 608 of the Clean Air Act (CAA). On November 18, 2016, the EPA extended the requirements to “non-exempt ODS substitutes” like HFCs and HFOs.

The EPA noted that its new rule does not rescind the other provisions in the 2016 rule that were extended to HFCs and HFOs. The new rule also leaves regulations pertaining to ODS intact. ■ MG

CARB Proposes New Plan for California Stores

The California Air Resources Board (CARB) has announced a proposal that would require supermarkets with refrigeration systems containing more than 50lbs (22.7kg) of refrigerant to convert to lower-GWP options.

The CARB proposal, presented at a workshop on January 30 in Sacramento, California (U.S.), outlines two options for the state’s supermarkets. The first is to reduce the company-wide average refrigerant GWP to 1,400 by 2030. The second is to reduce the baseline refrigerant “GHG potential” by 55% by 2030. Larger companies with more than 20 stores will also have to meet interim targets in 2026.

The new proposal is part of a larger regulatory package aimed at enabling

California to meet strict HFC-reduction targets as outlined in the SB 1383 bill, according to a blog on the Environmental Investigation Agency (EIA)’s website.

The EIA estimates that an average 50% reduction of refrigerant GWP would cut California’s annual emissions by more than 22 million metric tons of CO₂e.

During the Sacramento workshop, CARB also announced an F-Gas Reduction Incentive Program (FRIP), to be launched this summer.

CARB seeks stakeholder feedback on its proposal, which can be sent to HFCReduction@arb.ca.gov. ■ TS

Cimco Builds 50th CO₂ Ice Rink

Cimco Refrigeration, a Toronto, Canada-based industrial refrigeration contractor, has built its 50th CO₂ ice rink in North America, the company announced in a news release.

This milestone marks “a major advancement in Cimco’s pledge to provide eco-friendly ice refrigeration options to communities throughout North America,” the company said.

The majority of the 50 rinks were retrofits that replaced synthetic refrigerants and produced “substantial energy savings of up to 50% over previous systems,” the company said.

CO₂ refrigeration systems, it added, “provide the optimum balance of performance, efficiency and safety, and are ideal for both new installations and retrofits of existing systems.” ■ MG

KFC Installs HC-Mix AC System in Australia

A KFC outlet in Seven Hills (a suburb of Sydney), has installed a hydrocarbon-based air conditioning system, according to a statement from Italian compressor OEM Frascold, which supplied the compressors for the system.

The air-conditioning system uses two 15kW (4.3TR) Frascold reciprocating compressors with Engas’ M50 mixture of hydrocarbon refrigerants.

The M50 mixture consists of propane (more than 75%), propylene (less than 16%), ethane (less than 8%) and butane (less than 1%).

The end user chose a hydrocarbon-based system due to its energy-efficiency benefits compared to the store’s 20-year-old R22 system, according to Shaun Bailey, Managing Director of local contractor Bailair Pty Ltd, which installed the system.

The system was installed in April 2019. ■ DY

EU on Track with HFCs Phase Down

The European Environment Agency has published a report stating that the EU's F-gas phase down is on track to reach the goal set out under the F-gas Regulation 517/2014, which requires EU member countries to cut their emissions by two-thirds by 2030.

The "Fluorinated Greenhouse Gases 2019" report, published on February 4, is based on data collected by EU member states between 2007 and 2018. Some of the key findings are that the supply and import of f-gases decreased by 14% and 7% in 2018, respectively, compared to 2017. The report also found that GHG emissions caused by f-gases have been decreasing since 2015.

However, this doesn't mean that all is well, according to the Environmental Investigation Agency (EIA).

While stressing that the EU's F-gas Regulation is the best in the world, and that it has already achieved a level of HFC reduction not envisioned by the Kigali Amendment until 2024, the EIA says the new report ignores the fact that "significant" illegal trade is taking place in Europe.

An EIA analysis of trade data indicates that HFCs equivalent to 119 million metric tons of CO₂ were imported into the EU in 2018, but only 111.8 million were reported by companies to the F-gas register, meaning that more than 7% of the imports went unreported. ■ TS

Enex Acquired by CCC Holdings Europe

On February 17, CCC Holdings Europe (CCCHE) S.p.A., a holding company based in Italy, announced the acquisition of Enex S.r.l. by Roen Est S.p.A., a CCCHE subsidiary.

Roen Est – an Italian manufacturer of heat exchangers and ventilation units for the commercial and industrial segments of the HVAC&R industry in Europe – was itself acquired by CCCHE on February 3.

Founded in 2004, Enex is a pioneer and technology leader in CO₂-based refrigeration and commercial air conditioning and heating systems, having installed over 1,500 transcritical CO₂ systems to date. Enex, which reported nearly €10 million (US\$11 million) in revenues in 2019, has approximately 50 employees, and a factory based in Treviso, Italy. ■ MG

Daikin Exhibits Propane Cabinets in Japan

In the latest move to highlight its natural refrigerant offerings, giant Japanese OEM Daikin exhibited AHT's propane (R290)-based upright refrigerated display cabinets for the first time at the Supermarket Trade Show (SMTS) 2020, held in Chiba, Japan, February 12 to 14.

In February 2019, Daikin completed its acquisition of Austrian commercial refrigeration firm AHT Cooling Systems, a major manufacturer of R290 equipment with over one million propane-based cabinets installed worldwide. This followed its 2018 acquisition of Tewis, a Spanish CO₂ refrigeration system developer.

At this year's SMTS, Daikin exhibited AHT's Vento Green R290-based upright refrigerated display cabinet along with an R290 two-door freezer chest. ■ DY

Deadline Approaching for CO₂ Survey

The deadline for participating in a survey for the "World Guide to Transcritical CO₂ Refrigeration" is March 15, 2020; it shouldn't take more than 20 minutes to complete. The survey can be accessed at <https://bit.ly/39hLLis>

Anyone working with CO₂ technology is invited to partake in the survey, which will support the development of the guide. The guide will be published by shecco (publisher of *Accelerate Magazine*) to help promote CO₂ refrigeration globally.

shecco encourages HVAC&R manufacturers, contractors, end users and other stakeholders and industry experts to participate in the survey. The aim is to identify key market and technology trends

and evaluate transcritical CO₂'s potential across different regions of the world.

The guide will examine the various commercial and industrial applications of transcritical CO₂, including supermarkets, small stores, convenience stores, cold storage and food processing.

It will be published in three parts over the coming months, with the final complete version going live by the end of June. The Guide will be free to download.

shecco also recently published the "World Guide to Low-Charge Ammonia" (at <https://bit.ly/32NTPW0>), with plans to complete a similar guide on hydrocarbon refrigerants by the end of the year. ■ IK

NH₃

NH₃/CO₂

CO₂

Finding the Right Natural Refrigerant System for Industrial Refrigeration

Stakeholders debate whether to use low-charge ammonia, ammonia-CO₂, or CO₂.

— By Michael Garry



Inexpensive and highly efficient, ammonia (NH₃) has for decades dominated the industrial refrigeration landscape. But the refrigerant's position has evolved in recent years.

For one thing, ammonia's unavoidable toxicity has led to an industry-wide effort to develop systems that use far less charge than traditional liquid-overfeed systems. This has resulted in the proliferation of low-charge technologies, from central DX and packaged units to systems that combine ammonia and CO₂. More recently, transcritical CO₂ systems, which have been used predominantly in food retail, have begun to emerge in industrial facilities as an option that removes ammonia altogether.

So now two natural refrigerants, ammonia and CO₂, or a combination of both, are competing for space in cold storage and industrial plants. Any of them is superior to synthetic refrigerants like R22 or HFCs, but which of the natural options is best for a given application?

One of the more popular industrial options to emerge in recent years is the NewTon ammonia/CO₂ secondary packaged system, produced by Japanese OEM Mayekawa. Mayekawa said last year that it expected to sell 330 sets of NewTons during its current fiscal year, which runs from April 2019 to March 2020. (The number of sets is equal to the number of compressors used; some NewTon units contain more than one compressor.) This would bring the total number of sets sold past 2,000 (95% in Japan) since the system was introduced in 2008.

The first Mayekawa NewTon system in Australia was installed and commissioned last July in a new cold-storage distribution center in Western Sydney; the work was handled by Tri Tech Refrigeration Australia, Sydney, Australia. (See [Australia Gets Its First Ammonia/CO₂ NewTon Systems](#), *Accelerate Magazine*, November-December 2019.) The project encompassed five

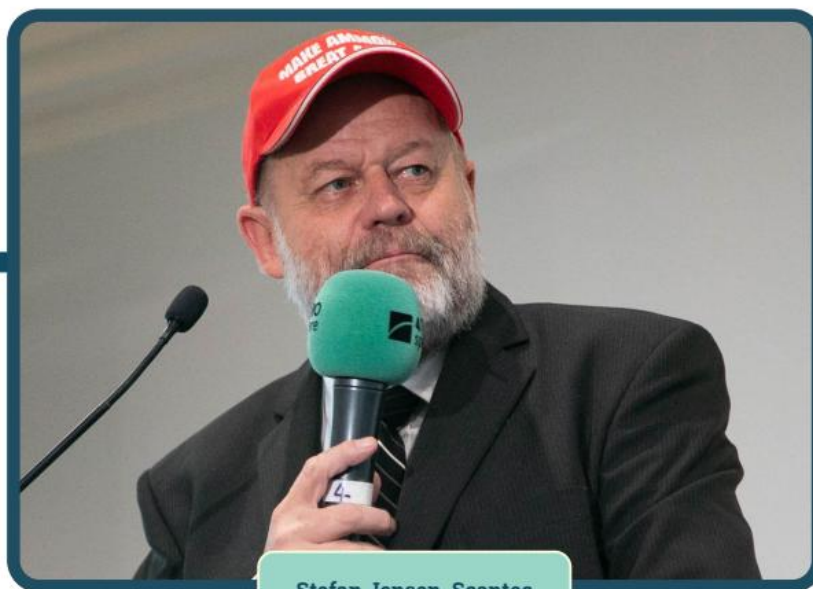
NewTons: three medium-temperature NewTon-C units supplying 708kW (201.3TR) of cooling capacity; and two low-temperature NewTon R6000 units providing 198kW (56.3TR) of capacity. The combined cold-storage area is 44,094m³ (1,557,165ft³).

Mack Hajjar, Projects Engineer for Tri Tech, noted last October that "based on energy usage data obtained so far, overall typical compressor power consumption is considerably lower than a conventional two-stage pumped [liquid-overfeed] ammonia plant servicing an industrial cold store of a similar size."

Hajjar's energy assessment was challenged by Stefan Jensen, Managing Director, Scantec Refrigeration Technologies, Brisbane, Australia, who designed and constructed what he calls the first stick-built centralized low-charge ammonia system "of the modern era" in 2012-2013, in Perth, Australia. That system proved to be 67% more efficient than a comparable R404A air-cooled system in the same area belonging to the same end user, he said.

In a letter to *Accelerate Magazine* (January 2020), Jensen cited a paper "Comparing Energy Consumption and Life Cycle Costs of Industrial Size Refrigeration Systems," authored by T. Lund, M. Skovrup and M. Holst of Danfoss, and presented in August 2019. "In all three jurisdictions investigated (Rome, Frankfurt and Oslo), the R744/R717 (CO₂/NH₃) cascade system is less energy efficient than the equivalent dual-stage R717 system with liquid overfeed."

For example, the Danfoss study found COPs of 4.35, 4.15 and 3.60 for two-stage liquid-overfeed ammonia systems for the highest loads examined (900kW/256TR low temperature; 2,700kW/768TR medium temperature) in Oslo, Frankfurt and Rome, respectively; by contrast the comparable ammonia/CO₂ cascade systems had COPs of 3.92, 3.76 and 3.35.



Stefan Jensen, Scantec

Jensen's favorite energy metric is specific energy consumption (SEC) in kWh/m³*a (m³ for refrigerated space, a for annum). He pointed out that according to a paper authored by Mayekawa researchers H. Asano and N. Mugabi, the best SEC achieved by NewTon systems is approximately 35kWh/m³ for a distribution center with a refrigerated volume of 44,000m³(1,553,845ft³). The paper, "Actual Energy Conservations by Using NH₃/CO₂ Refrigeration System," was published in the proceedings of the 3rd International Conference of Saving Energy in Refrigeration and Air Conditioning (ICSERA), held in 2013.

Jensen compared the SEC for the NewTon with that of a low-charge DX two-stage ammonia system. According to ICR 2019 paper #466, "Real Energy Efficiency of DX NH₃ versus HFC," authored by Jensen, a centralized DX NH₃ system delivers an SEC of 20-24 kWh/m³*a when servicing a distribution center with a refrigerated volume of 44,000 m³, compared to the 35kWh/m³*a for the same volume cited by the Mayekawa researchers.

Jensen doesn't believe in ammonia-inventory reduction at all costs. "The art is to reduce the ammonia inventory and at the same time improve energy efficiency compared with a stick-built ammonia liquid overfeed system and transcritical CO₂," he said. "This is an art that isn't mastered by many, but [ammonia's] transport and thermodynamic properties make this a task that is nevertheless achievable."

Energy-efficiency improvement "is the path to long-term survival of the ammonia industry as a whole," Jensen said. "Nothing will match the energy performance of an ammonia refrigeration system done well. The industry has to start doing these systems well or lose significant market share."

But he acknowledges that some operators are willing to pay an energy penalty to keep ammonia out of the refrigerated space.

To do an ammonia system well, Jensen said, equipment suppliers need to understand "how ammonia behaves during

evaporation in tubes and what causes that behavior." In addition, contractors need to know "what determines the optimum operating envelope for evaporators, and specify the correct design parameters to suppliers."

Another important design feature needed to maximize energy efficiency in low-charge ammonia refrigeration systems is to minimize or eliminate the presence of liquid in suction lines during all operating conditions. "This is exactly what a centralized, low-charge ammonia system does," Jensen said.

Jensen pointed to the potential risk associated with ammonia/CO₂ cascade heat exchangers: If the ammonia and CO₂ mix, they form ammonium carbamate, which seriously impacts operation. In one case Jensen cited, a system was shut down for four months, and repair costs were half the original cost of the system. In the U.S., "insurance costs for NH₃/CO₂ cascade are escalating and driving users towards centralized low-charge ammonia."

Supporting Energy Claims for NewTon

Tri Tech's Hajjar agrees that a two-stage DX ammonia system is, in principle, more efficient than its ammonia/CO₂ cascade counterpart.

Ammonia DX systems have a number of advantages, Hajjar noted, including no liquid-ammonia pumping requirement, high-efficiency, speed-controlled reciprocating compressors, no high- or low-side heat exchangers, no wet-return losses, no suction superheat and no (or less) hot-gas relief load if defrost drainers are used.

An end user who uses reticulated subcritical CO₂ and/or water-cooled condensing with cooling towers, like a NewTon system, is "deliberately sacrificing energy efficiency for increased safety and in some cases [reduced] cost," said Hajjar. "In our [NewTon] application, the question was not whether to use a secondary refrigerant, but which one and how – DX or pumped ammonia were definitely out of the question."

He stands by his previous comments that the NewTon's energy consumption is considerably lower than that of a conventional two-stage pumped-ammonia liquid-overfeed system when comparing similar-size facilities.

"Our claims are based on an extrapolation of power data obtained in a two-to-three month winter period between when the [NewTon units were] commissioned and when the [November-December *Accelerate Magazine*] article was published," Hajjar explained. "When extrapolated, we calculated 1GWh p.a. (per annum) of power consumption."

But that estimate was low because in spring/summer the power consumption would be higher, he acknowledged. "Realistically, power consumption would be closer to 1.5GWh p.a." This translates to 34.09kWh/m³a for a 44,000m³ (1,553,845ft³) facility, which is consistent with what Mayekawa researchers Mugabi and Asano predicted – 35 kWh/m³a for NewTon in a 44,000m³ space.

By contrast, if a site like the one in Australia with the first NewTon units were to instead use conventional two-stage pumped ammonia, "I would expect energy usage of 3GWh (68kWh/m³a)," said Hajjar. He referred to figure 8 in Jensen's paper, "Real energy efficiency of DX NH₃ versus HFC," where "the bulk of conventional two-stage pumped ammonia systems consume 40-70 kWh/m³a."

Hajjar also noted that SEC, as a performance metric, "doesn't normalize for proportion of low-temperature/medium-temperature, door usage, geographic

location, facility layout, etc. Realistically it is more of a general guide for efficiency comparisons."

It should also be noted, said Hajjar, that the NewTon ammonia system is not a conventional cascade system, because it uses CO₂ as a secondary fluid only. "It relies on a more efficient ammonia vapor-compression cycle for refrigeration, instead of compressing and reticulating CO₂ in a vapor-compression cycle on the low stage."

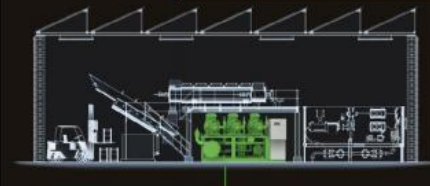
"So while the NewTon NH₃/CO₂ secondary system sacrifices COP due to their hot- and cold-side heat exchangers, done principally to make the plant safer, there are many features that compensate for this, making the NewTon system very efficient, nonetheless," continued Hajjar. "As a result, it is important to consider the configuration of ammonia/CO₂ cascades when making comparisons, and so the COP comparisons made in the Danfoss study, for example, may not always apply."



Mack Hajjar, Tri Tech
Refrigeration Australia

MARKETPLACE

2020-IIAR Natural Refrigeration Conference & Heavy Equipment Expo
Booth # 401



YOU EXPECT EFFICIENCY, FLEXIBILITY AND PROCESS RELIABILITY. WE HAVE THE AMMONIA COMPRESSOR PACK

The Ammonia Compressor Pack (ACP) from BITZER promises high efficiency at full and part-load operation with high reliability, even in complex industrial refrigeration and process cooling applications. The modular design of the ACP combines two or three compressors, a common oil separator, and a frequency inverter to provide a broad range of operation in high, medium or low temp applications. Additional highlights include compressor and controls redundancy, and the units are designed to be service friendly.

Bitzer

BITZER US, Inc. // www.bitzerus.com // marketing@bitzerus.com

BAC BALTIMORE AIRCOIL COMPANY



IIAR Expo Booth #629

TrilliumSeries™
Adiabatic Products



freor

Standards have changed.
Are you ready?

RE/THINK
REFRIGERATION

www.freor.com #ThinkingGreen

30 years anniversary
zudek



low charge air cooled ammonia chiller
www.zudek.com IIAR 2020



The ultra-reliable, low-charge solution.

With Evapcold low charge ammonia systems, you can drastically reduce your ammonia charge while also increasing your system reliability. Evapcold Packaged Refrigeration Systems have been thoroughly tested in EVAPCO's industry-leading R&D and run-testing facilities and are also very successfully operating in the field. Guaranteed system performance and reliability is a key advantage with Evapcold. Its industrial design and components, product features, and low ammonia charge make it the best choice to eliminate the business disruptions from less reliable alternatives.

This includes:

- IIAR-2 and ARM-LC compliance
- Fully-rated equipment
- Robust factory testing
- Hot gas defrost
- Pumped liquid recirculation design
- Component redundancy options

And that's only the beginning. Talk to your local EVAPCO representative or visit evapco.com to discover all the ground-breaking benefits of Evapcold Packaged Refrigeration Systems and new chiller packages. We are EVAPCO—the team you can count on for life.



Since 1976 | An Employee-Owned Company
Commercial HVAC | Process Cooling | Industrial Refrigeration | Power

The NewTon's other energy-enhancing features, he said, are as follows:

- ▶ The medium-temperature and low-temperature NewTon systems are independent. Therefore the effective medium-temperature suction pressure and low-temperature interstage pressures are independent, and can be therefore optimized for each respective system. By contrast, in a two-stage system, the medium-temperature suction and low-temperature interstage must be common, and under certain circumstances not optimized for either stage, or optimized for one stage but not the other.

- ▶ The medium-temperature system uses a single-stage economized cycle. The low-temperature system uses a two-stage cycle with both its respective high- and low-stage cycles economized. This is inherently more efficient than a single-stage medium-temperature cycle providing intercooling for a single-stage low-temperature cycle.

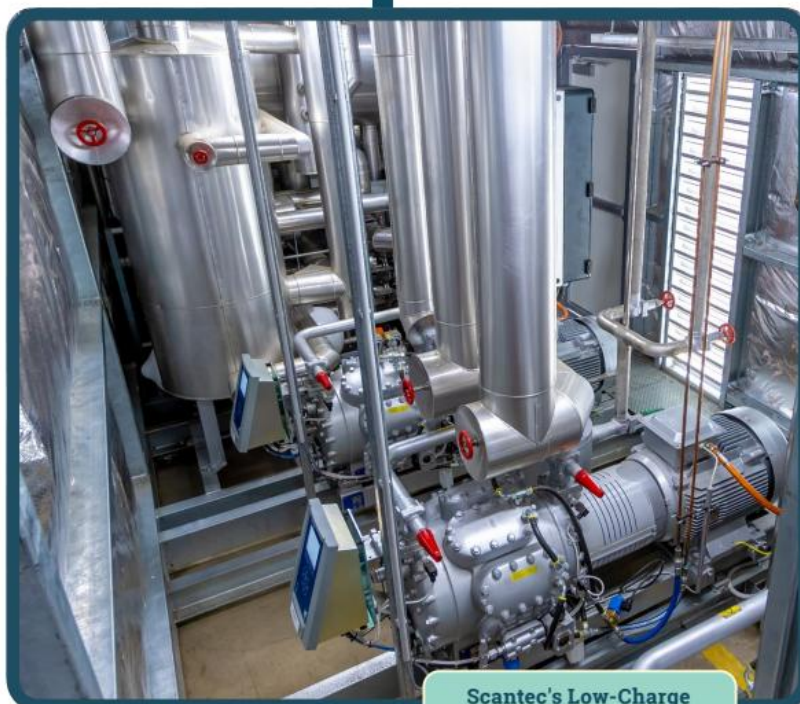
- ▶ The NewTon system does not use hot-gas defrost. A conventional pumped ammonia system uses hot-gas defrost, which relieves a considerable amount of hot gas to suction, thereby increasing energy consumption; with some even relieving to the low-temperature stage, making the system less efficient. It is possible to use defrost drainers to mitigate hot-gas relief loads and return only liquid to the medium-temperature vessel, but "conventional" pumped-ammonia systems don't always do this.

- ▶ The NewTons have permanent magnet motors, which are high-efficiency motors.

- ▶ NewTon systems don't have a tendency to draw air and moisture in at negative pressures like conventional low-temperature ammonia open-drive compressor systems, because NewTons don't have shaft seals. Over time, energy penalties due to trapped non-condensables and water accumulation, which appear in conventional ammonia systems, may not manifest themselves in NewTon plants.

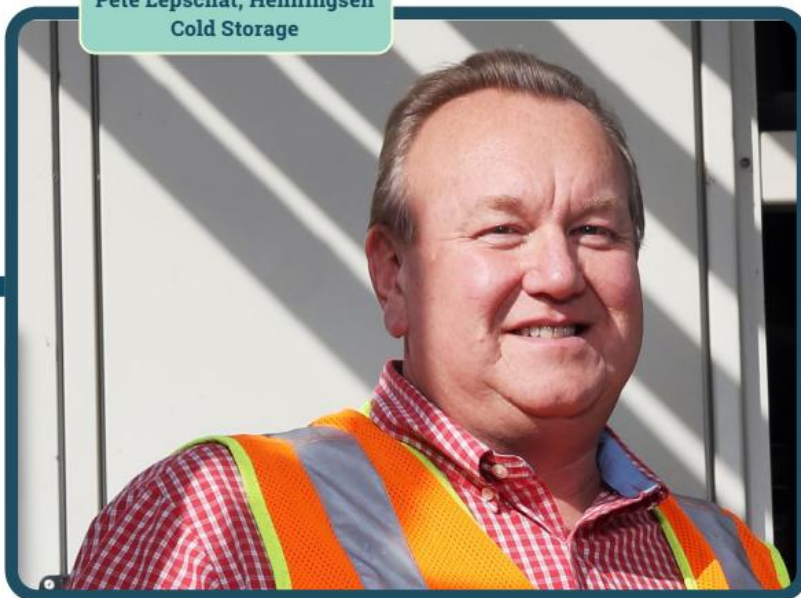


NewTon Systems



Scantec's Low-Charge Ammonia DX System

Pete Lepschat, Henningsen
Cold Storage



CO₂ vs. low-charge ammonia

While some operators are reducing ammonia charge in low-charge or ammonia/CO₂ systems, a growing number of industrial facilities are opting for a “no-charge” ammonia system, that is, transcritical CO₂. According to Terry Chapp, Principal, Collaborative Solutions, Terry Chapp & Associates, CO₂ systems are better suited for industrial systems with smaller capacity – from 50TR (176kW) to 300TR (1,055kW) – than ammonia systems, which can cover up to 2,500TR (8,792kW). Jensen acknowledged that for smaller warehouses – under 5,000-10,000m³ (176,573-353,147ft³) in refrigerated volume – the additional cost of a centralized low-charge ammonia system compared to a transcritical CO₂ system would require “too long a return on investment.”

CO₂ systems are still regarded as working better in relatively cooler climates, though optimized systems have improved efficiencies in warmer climates.

One CO₂ operator in the U.S. is Henningsen Cold Storage, based in Hillsboro, Oregon (U.S.), which, in June 2018, installed its first transcritical CO₂ system – one of the first industrial transcritical systems in the U.S. – at an 111,000ft² (10,312m²)

facility in Grandview, Washington (U.S.). It supplies 187TR (658kW) of refrigeration capacity, 157 (552) for a freezer and 30 (106) for a dock area.

Henningsen, which runs 12 cold-storage warehouses, mostly in the Pacific Northwest part of the U.S., is one of the most efficient operators in the North American refrigerated warehouse industry. Its facilities, including ammonia and CO₂ systems, average 0.569 kWh/ft³*a (20.3kWh/m³*a), compared to an industry average of 1.13 (40.4). (Henningsen is measuring the energy consumption of the entire facility, not just the refrigerated space.) Under the direction of Pete Lepschat, director of engineering, Henningsen has built several low-charge central ammonia systems that use substantially less ammonia than the company’s traditional plant. (See “[For Henningsen, Less Is More](#),” *Accelerate America*, November-December 2016.)

In contrast to Jensen’s DX ammonia systems, Henningsen uses a “minimalist overfeed model,” which Lepschat believes saves more money. At the company’s first warehouse in Salem, Oregon, built in 2013-2014, he installed Evapco evaporator coils with a 1.2-1 overfeed ratio (for



Specific Energy Consumption of Industrial Natural Refrigerant Systems

Type of System	SEC (kWh/m ³ *a)	Refrigerated Space (m ³)
NewTon NH ₃ /CO ₂ secondary	35 ¹	44,000
Low-Charge NH ₃ DX	20-24 ²	44,000
2-stage pumped NH ₃	24-87 ²	27,000-215,000
Transcritical CO ₂	13.7 ³	135,213

Source:

1. Mayekawa
2. Scantec Refrigeration Technologies
3. Henningsen Cold Storage, which measures the SEC of its entire facility, not just the refrigerated space



every 1.2 part of liquid ammonia, one part evaporates), compared to the 3-1 ratio at a traditional Henningsen facility.

Another technique Henningsen employs to cut ammonia charge is to use what Lepschat calls a “pump-down system” in lieu of a high-pressure receiver. The system features a small vessel that maintains a low-level of ammonia and is continuously feeding the gas to a low-pressure receiver via a subcooler.

In its second low-charge warehouse in Salem, built in 2017, Henningsen was able to reduce SEC to 0.288kWh/ft³*a (10.3kWh/m³*a), the lowest in the company, and one of the lowest in the cold-storage industry. This became the standard for all future facilities, including the first CO₂ warehouse in Grandview. (Henningsen converted another warehouse, in Scranton, Pennsylvania (U.S.), to transcritical CO₂ in 2018.)

The installed cost of the Grandview CO₂ system was \$534,000 less than the Salem ammonia system; between \$200,000 and \$400,000 was saved by not building a machine room, which also cut 5-6 weeks in installation time. The reliability of the CO₂ system and low-charge-ammonia standard has been the same. But on an energy basis, the Grandview CO₂ system, which uses an adiabatic gas cooler, had much higher energy costs than the standard facility’s system, though that was before several energy-efficiency measures were added. Those included: dock dehumidification, evaporator/condenser fan control, hot-gas defrost, gas cooler optimization, compressor VFDs and a glycol pump VFD. In the subsequent commissioning of the system, the low-temperature suction setpoint was changed from -25°F (-32°C) to -16°F (-27°C). In addition, evaporator and gas cooler fan speeds were changed from fixed to modulating.

In Lepschat's most recent data, which covered January 2019 through January 2020, the Grandview CO₂ system has an SEC of 0.384kWh/ft³*yr (13.7kWh/m³*a), well below the average for Henningsen's facilities (which is itself considerably below the industry average) but still 25% above the standard Salem number. But Henningsen is working with system manufacturer Carnot Refrigeration to improve rack efficiency, Lepschat noted. In addition, he aims to improve his fan control systems. With those changes, "I think we will either match Salem [on energy consumption] or actually do better."

In other areas, the CO₂ system is saving Henningsen money compared to the standard low-charge ammonia plant in Salem. For example, the CO₂ system uses far less water in its adiabatic gas cooler, which also reduces the sewer bill, and it requires no water treatment. In addition, an ammonia facility requires a full-time engineer to keep an eye on it, while a CO₂ plant does not. Maintenance on the CO₂ system takes place just twice annually, and generally involves minor upgrades "like changing the oil on your car," said Lepschat. And a CO₂ facility can dispense with U.S. federal regulatory updates for PSM (process safety management) and RMP (risk management plan) that are needed at an ammonia warehouse; Lepschat estimates he saved "six figures" at the CO₂ facility by not having to develop an initial PSM/RMP plan.

In the event that energy parity with Salem's standard is approached or matched, the savings on other factors would result in operating costs at the Grandview facility that are up to 20% better than Salem's, said Lepschat.

Another factor favoring transcritical CO₂ is heat recovery. "CO₂ has a pretty big advantage in this area," said Lepschat. This is because the sensible and latent portions of the discharge gas are almost

the inverse of those for NH₃, that is, 70% of the rejected heat is sensible and 30% latent for CO₂, as opposed to 30% sensible & 70% latent for NH₃, he explained. That means a CO₂ system is better for generating hot water and space heating than an ammonia system.

At the Grandview facility, heat reclaim is used to warm the floor under the freezer and to minimize defrost in the freezer by getting rid of moisture in the dock area. The system defrosts with hot gas.

Another consideration is the number of compressors used. At Grandview, Henningsen employs 15 semi-hermetic reciprocating compressors in its CO₂ system. "So if one goes down, we have 14 to back it up," Lepschat said, and replacement costs are not high. "Redundancy is built in." By contrast, an ammonia system may use one large screw compressor, with one expensive replacement unit.

Jensen said that some CO₂ systems may have better annualized energy performance than large-scale centralized ammonia systems with liquid overfeed because these CO₂ systems employ multiple small reciprocating compressors and have very little or no liquid in the suction lines.

Given everything he knows now, Lepschat was asked which refrigerant he would lean toward for future plants, ammonia or CO₂? "I never say never, but as of today I see no advantage to building an ammonia refrigerated facility." ■ MG

Americas

End User

Colossal Industrial
Transcritical CO₂
System Custom-Made
for Yosemite Foods

Policy

Six More U.S. States
Pursue HFC Bans

Event

Natural Refrigerants
at AHR Expo

Events

1. March 14-18

IIAR 2020
Orlando, Florida

2. March 15-19

MCAA Annual Convention
Maui, Hawaii.

3. March 16-18

ACCA Conference & Expo
St. Louis, Missouri

4. March 16-18

National HVACR
Educators and Trainers
Conference
Las Vegas, Nevada, U.S.

5. April 2, 4pm CET

Webinar (in Spanish): How
the Pay per Use model
seeks to revolutionize the
refrigeration industry
Register at:
<https://bit.ly/3cApu1x>

2 de abril, 4 p.m. CET

Webinar (en español):
Cómo el modelo de Pago
por Uso busca revolucionar
la industria del frío
Registrarse en:
<https://bit.ly/3cApu1x>

Colossal Industrial Transcritical CO₂ System Custom-Made for Yosemite Foods

The 4MW (1,137.38TR) system, one of the largest-capacity transcritical configurations in the world, operates well in warm ambient temperatures and generates considerable heat reclaim.

— by Ilana Koeglenberg

In 2017, Owner Michael Lau and his team at Yosemite Foods Inc. (formerly Yosemite Meat Co.), based in Modesto in central California (U.S.) had a vision: to expand this family-owned pork processing company with a larger, state-of-the-art facility, allowing space for business growth, improved efficiency and the ability to have future capacity available.

They found what they were seeking 31 miles northwest – an abandoned facility in Stockton, California.

In 2018, Yosemite contracted with Commercial Refrigeration Services (CRS)/Sphere, a South Africa-based manufacturer, to design, manufacture and ship five transcritical CO₂ refrigeration racks amounting to 4MW (1,137TR) of

cooling capacity to the Stockton facility. California-based contractor Coolsys did the installation. It is one of the largest transcritical installation in terms of cooling capacity in the world.

The system was commissioned In April 2019. Yosemite has stated it is happy with the way it is running, as it is quiet and is showing signs of being energy efficient. “So far, the system has performed to expectations providing refrigerated cooling for product storage and hot water through heat recovery,” said Lau last October.

REASONS FOR CO₂

At its Modesto facility, Yosemite, like many large food processors, uses an old ammonia system. Why did it choose transcritical CO₂ for the new location?

Yosemite had a number of criteria for its new refrigeration system. It had to:

- ▶ Be environmentally best-in-class.
- ▶ Be safe.
- ▶ Use a non-corrosive substance as the refrigerant.
- ▶ Eliminate as many emergency and life-safety issues as possible.
- ▶ Generate a significant amount of reclaimed heat.
- ▶ Be cost effective on both first and operating costs.



Yosemite Foods' CO₂ refrigeration racks were manufactured in South Africa.

A CO₂ system ticks all these boxes and thus became the refrigerant of choice after an exhaustive study.

"We researched all different refrigerant systems and decided on CO₂ based on the evaluation of many factors," explained Lau. "Our company saw benefits in choosing CO₂ with the tightening regulatory environment in California. Additionally, CO₂ provides a story to incorporate into our future path as a leader in energy efficiency and as a low-GHG food processing facility."

"Although CO₂ [technology] is often more expensive than conventional synthetic refrigerant systems on smaller scales, the

CO₂ solution becomes financially acceptable when implemented on larger scales, as in this case," noted Shaun Hadfield, Managing Director, CRS/Sphere.

Another benefit of CO₂ over other natural refrigerants is that it is a non-toxic substance that is safe for use in the food industry; thus, an intermediate glycol system is not required between the CO₂ and the refrigeration coils, said Hadfield. "The other added saving to the client for this project was the reduction of space required for the refrigeration racks; the plant room area was made smaller, enabling the client to maximize on his production area," he said.

STATE-OF-THE ART REFRIGERATION

The Stockton facility is 199,993ft² (18,580m²) in size, of which 110,000ft² (10,219m²) comprises refrigerated space. This is divided into processing areas, cold-rooms, freezer rooms, and snap chills.

The heart of the CO₂ system consists of five CRS/Sphere compressor racks, each with 13 semi-hermetic compressors. Each rack is split up into three suction groups; one at -13°F (-25°C) for freezer space and chill tunnels; one at 20°F (-6.7°C) for processing spaces, cooler storage and shipping and receiving; and one at 38°F (3.3°C) for parallel compression, required during transcritical operation. Each rack operates independently from the others,

and loads are dispersed among them so that each refrigerated space has backup.

To efficiently operate a system such as this, key elements included electronic expansion valves for each evaporator (required in a CO₂ system); distributed controls giving operators a visual indication of refrigeration, defrost, alarm, cleaning, etc.; and distributed smart controls that enable “zone like” control strategies for temperature monitoring, leak detection, defrost and refrigeration control, as well as electronic valve control.

Remote defrost panels are located near the evaporator loads, minimizing wiring requirements for high- and low-voltage needs. Variable-speed evaporator fan controls were included, following

California’s Title 24 requirements for a refrigerated warehouse such as this.

Controls allow the fan speed to vary, minimizing fan energy. A Danfoss system was selected as the controls, allowing central oversight, but also “smart” local independent control.

“In selecting CO₂ as the refrigerant of choice, this enabled the design to take in a more ‘commercial’ approach in an ‘industrial’ setting,” noted Bryan Beitler, Vice President Special Projects, CoolSys.

All piping is copper, either type K or “iron copper.” Loop piping allows one main piping system from each rack to accommodate branch circuits from the refrigerated spaces. The racks use Bitzer

semi-hermetic compressors, equipped with variable-speed drives on the lead compressors, and standard components rated for higher pressures.

The inclusion of adiabatic condensers/ gas coolers enables the system to function efficiently in a high ambient environment. They bring the ambient temperature down to the wet-bulb temperature, reducing the discharge pressure of the refrigeration system and making it more efficient. This also ensures that minimum potable water is used and, where possible, that reclaimed water is used to have a water-neutral installation. The adiabatic technology works best in high ambient with low relative humidity. “There is an additional cost to adding adiabatic, but using the

Five CO₂ racks are used at Yosemite Foods.



water when required saves energy," said Hadfield. "Making use of adiabatic gas coolers can lead up to approximately 20% of energy savings compared to dry coolers in the summer months."

Also, thanks to built-in parallel compression, an additional roughly 10% energy saving can be obtained compared to a standard booster system. When ambient temperatures are low enough, the system will automatically shift to subcritical mode, disabling the parallel compressor function.

Heat reclaim is a big energy saver in CO₂ systems. "With CO₂ operating in transcritical conditions, it is possible to make use of up to 80% of the total heat rejection, which is not achievable with other refrigerants," explained Hadfield. This heat comes at no additional operating cost to the refrigeration system and can be used for domestic hot water, space heating, warming glycol for under-slab heating, and hot water used for wash downs. Each rack is equipped with high-side plate heat exchangers for extracting the majority of heat used for the system's hot water needs. Should more heat be required, it

is possible to manipulate the system to operate under transcritical conditions to supply the required heat without a high penalty in operating cost.

Defrosting for low temperature evaporators is accomplished with hot gas. Unlike a traditional CO₂ hot-gas defrost solution, which uses low-temperature discharge gas, CRS decided to use medium-temperature discharge gas to gain as much sensible heat to reduce the defrosting period. A four-pipe system is used, with controls on the rack to supply gas volume to the system, and localized suction check-valve assemblies installed at each coil. Using hot gas allows further use of the system's waste heat, minimizing electrical resistant heat needs.

CHALLENGES FOR CRS

Since CRS is South African-based, it had to learn about UL certifications – not only conforming to UL manufacturing standards but also making sure it used UL-certified components. This meant that a great deal of research was needed with the help of expert consultants from the U.S., as well as researching suppliers that have all the required UL certificates.

Exporting a complete rack to the U.S. was another new task that required learning the legalities and logistics of transporting machinery and components. "While considering different methods for transport you can have high-cost variances and varied lead times, depending on shipping vs. flying the equipment to the overseas destination," said Hadfield.

Notwithstanding these challenges, the size and ambition of Yosemite's CO₂ installation represents a new direction for industrial refrigeration in the U.S. "It is an exciting new chapter with respect to natural refrigerant use; the possibilities are extraordinary for use of CO₂ with facilities such as this," said Beitler. ■ IK

YOSEMITE'S REFRIGERATION, BY THE NUMBERS

- ▶ Five CO₂ racks
- ▶ 65 compressors
- ▶ 2,450 compressor HP
- ▶ 87 evaporators
- ▶ **Full system capacity:** 4MW (1,137.38TR)
- ▶ **Low temperature:** -32°C (-25.6°F) suction
- ▶ **Medium temperature:** -6°C (21.2°F) suction
- ▶ **High temperature:** 3.3°C (38°F) suction
- ▶ **Heat reclaim capacity:** 2.2MW at 20%-30% of full capacity
- ▶ **CO₂ charge/rack:** 2,200lbs (998kg)

SUPPLIERS

- ▶ **Racks:** CRS/Sphere
- ▶ **Compressors:** Bitzer
- ▶ **Liquid receiver, oil separator, oil reservoir, and filter drier:** Temprite
- ▶ **Strainer, solenoid valve, and PD Valve:** ESK
- ▶ **Brazed plate heat exchangers:** SWEP
- ▶ **Oil regulator and oil filter:** Emerson
- ▶ **Pressure gauges:** Ashcroft
- ▶ **High pressure valve, bypass valve, controlled relief:** Danfoss
- ▶ **Safety valves and changeover valve:** Refrigerera
- ▶ **SS ball valves:** Castel

ADAP-KOOL® the way you work

Benefit from easy service and installation



Take user-friendliness to the next level

The new AK-CC55 case controller platform provides world-class efficiency and operational tools that fulfill all sustainable operational requirements in food retail applications. It relies on advanced Danfoss algorithms to control refrigerated display cases and cold rooms. Via a Bluetooth display, users can communicate with the controller using the new AK-CC55 Connect smartphone app.

Download AK-CC55 Connect



App Store



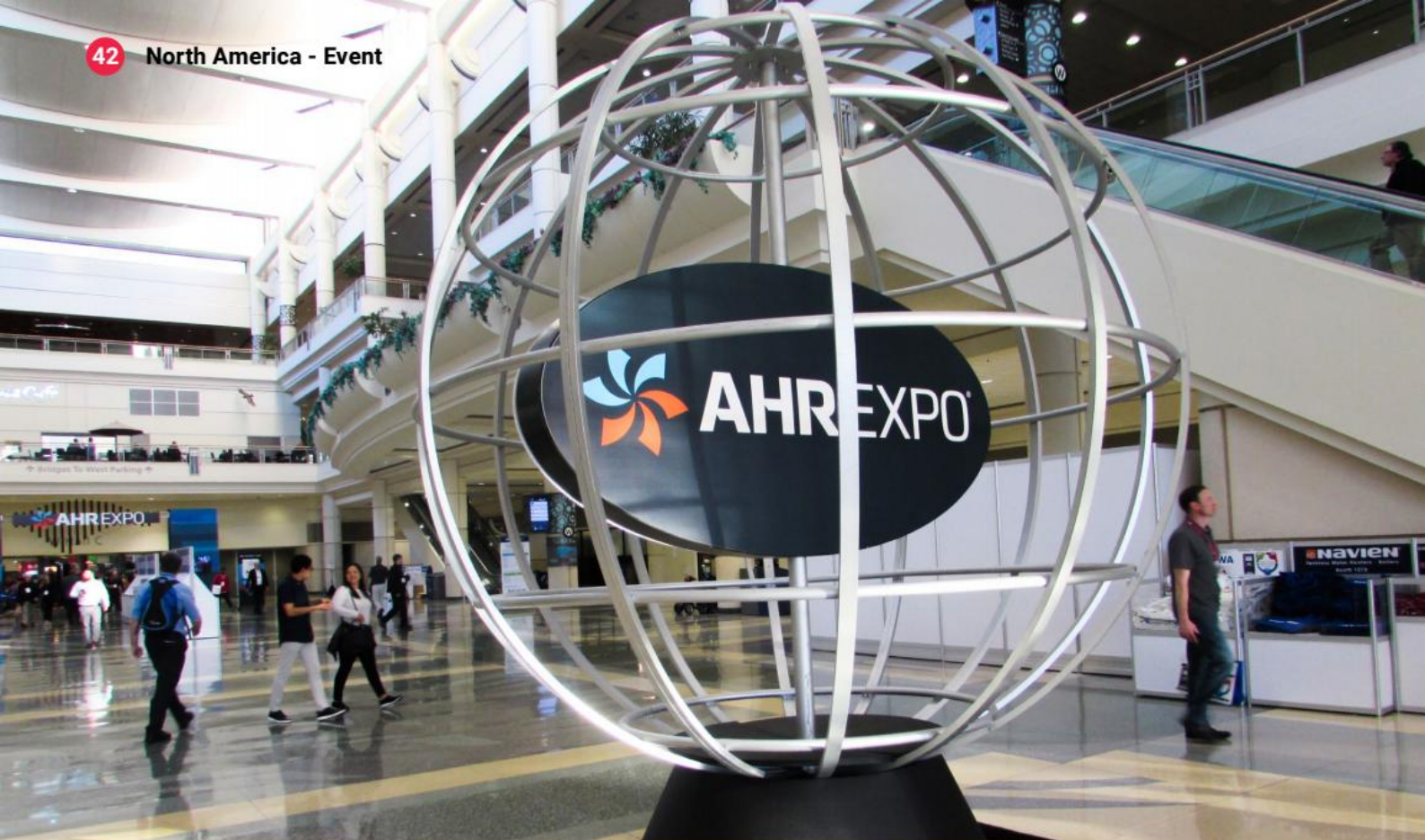
Google Play

Learn more at
casecontrol.danfoss.com



ENGINEERING
TOMORROW

Danfoss



Natural Refrigerants at AHR Expo

Rivacold and Danfoss CO₂ products stand out, while Nidec introduces R290 compressors

— by Michael Garry and Tine Stausholm

The AHR Expo, which took place in Orlando, Florida (U.S.) February 2-5, is heavily focused on HVAC, and less so on refrigeration, and consequently natural refrigerant systems are not widely seen on the exhibition floor.

Nonetheless, some natural refrigerant-based refrigeration products were showcased, including the following examples.

RIVACOLD'S CO₂ CONDENSING UNITS

Italian manufacturer Rivacold is bringing to the U.S. market transcritical CO₂ medium- and low-temperature condensing units capable of serving cold rooms and up to five display cabinets.

The company is securing UL certification for the condensing unit range, called CN CO₂NNEXT, and expects it to be available for sale in "June or July," said Tommaso Scavone, regional sales manager for Rivacold, in an interview at the Rivacold booth at AHR Expo.

Rivacold, which has a U.S. office in Atlanta, Georgia, showcased the CN system, including the condensing unit, cold room evaporator and control system,

Transcritical CO₂ condensing units are common in Japan and are gaining traction in Europe, where Rivacold has installed them at more than 500 stores, said Scavone. However, they are rare in the U.S. marketplace, where transcritical rack systems of various sizes are the standard for food retail.

Rivacold also offers a CO₂ condensing unit for a "single set" application, called the SN Split CO₂NNEXT, as well as UL-approved packaged R290 units for cold rooms.

Scavone highlighted the CN system's low noise and the speed with which it can be installed. "It's preset in the factory and is plug and play," he said. In addition, the "maintenance faucets" make it possible to "isolate the machine and carry out the necessary maintenance operations in safety," according to Rivacold literature.

The CN system is twice the cost of an HFC condensing unit to compensate for the higher pressures, acknowledged Scavone. However, there is a five-year average payback on the premium paid for the CN system, based on its higher energy efficiency, said Giuseppe Vitri, product manager for Rivacold and the designer of the CO₂ range.

The efficiency is driven by a BLDC hermetic compressor with a capacity modulation between 25% and 100%, EC fans and customized electronic control software, according to Rivacold literature, which says the CN is 16% more efficient than an HFC system with a semi-hermetic compressor and AC inverter. The system improves efficiency by 3% via subcooling with a suction/liquid heat exchanger; low-temperature models use an intercooler.



The CN range, which includes four medium-temperature and three low-temperature models, is designed for ambient temperatures up to 43°C (109°F), and is "still very efficient" up to 32°C (89.6°F), said Vitri. The capacities for the medium-temperature models (at 0°C/32°F to -10°C/14°F evaporating temperatures) range from .56kW/.16TR to 9.97kW/2.83TR; the capacities for the low-temperature models (at -25°C/-13°F to -35°C/-31°F evaporating temperatures) range from .98kW/.28TR to 7.9kW/2.24TR.

DANFOSS EJECTOR: PRODUCT OF THE YEAR

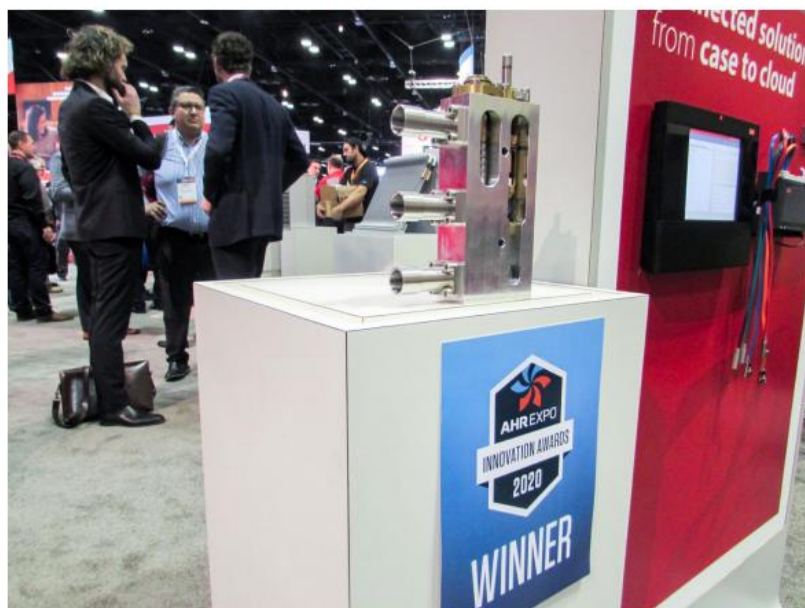
Danish manufacturer Danfoss won the AHR Expo Innovation Awards' Product of the Year for its CO₂ Adaptive Liquid Management (CALM) solution. The product also won in the refrigeration category.

The 10 Innovation Award category winners were announced in October 2019, while the Product of the Year was named at the AHR Expo on February 4.

The CALM solution combines a liquid ejector and an adaptive liquid control case controller algorithm to fully utilize the evaporator surface in display cases and cold rooms, according to Danfoss. The technology provides up to 10% greater energy efficiency compared to standard CO₂ refrigeration solutions, the company said.

The ejector works by pulling liquid refrigerant from the suction side and injecting it into the evaporator. With this technology, Danfoss aims to assist end users in making the transition to CO₂ refrigerant while saving energy, maintaining system reliability and ensuring food safety, Danfoss said.

Danfoss also won in the cooling category with its Interlaced Micro Channel Heat Exchanger (iMCHE), which integrates multiple circuits into a single coil.



Danfoss' award-winning liquid ejector

NIDEC BOOSTS EFFICIENCY OF COMPRESSOR LINE

Nidec Global Appliance (incorporating Embraco-branded compressors) unveiled its NEX compressors, the fourth generation of its 20-year-old NE fixed-speed compressor line for stand-alone commercial display cabinets.

The focus of the NEX line is propane (R290) refrigerant, though it is available for non-flammable HFO blends as well, said Michel Moreira, Business Sr. Manager, Commercial Refrigeration Business, Nidec Global Appliance.

The NEX compressors offer 10% higher efficiency than their predecessor line, the NEU compressors, said Moreira. NEX units range in HP from ½ to 1, compared to NEU's 1/3-3/4HP range. NEX compressors' displacement ranges from 10cc to 21cc, greater than the previous maximum of 18cc, noted Moreira. The NEX also features a low noise level, he added.

The higher efficiency of the NEX compressors make them compliant with the EU's Ecodesign energy standard, and prepares OEMs for the next energy standards issued by the U.S. Department of Energy (DOE) in four years, said Moreira.

Moreira observed that, in the U.S., the adoption of R290 in stand-alone glass-door merchandisers (GDMs) and stainless-steel foodservice refrigerators has been "massive" since the DOE's 2017 energy standard was released. The DOE's standard covers the majority of stand-alone commercial cases, while in Europe, the energy standard "focuses on some GDMs, not everything."

"In energy regulations for commercial cabinets, the U.S. is almost 10 years ahead of Europe," said Marek Zgliczynski, director of research and development for Nidec Global Appliance. ■ MG & TS



Nidec NEX compressor

NEW OWNERS FOR CO₂ HEAT-PUMP-WATER-HEATER BUSINESS

U.S. based John Miles and Maho Ito announced at the AHR Expo in Orlando Florida (U.S.) that they have jointly acquired Japanese OEM Sanden's CO₂ heat-pump-water-heater business, which they had been marketing on Sanden's behalf in North America for the past six-to-10 years.

"Sanden wanted to spin off the business to concentrate on their core business," said Miles, managing director of the new company, called ECO₂ Systems. "This afforded us the opportunity to purchase rights to sell the water heaters in the North American marketplace." He declined to cite the terms of the transaction.

Miles added that while he and co-owner Ito will focus on North America, they could sell the CO₂ heat pump water heater anywhere in the world outside of Australia, where Sanden is still selling it.

Sanden will continue manufacturing the systems, and selling them to ECO₂ Systems. "We are a master distributor," said Miles. The systems come with outdoor refrigeration circuits and indoor water tanks, sized at 43, 83 and 119gal (163, 314 and 450ltr)

As co-owners of their own company, Miles and Ito "will be able to laser-focus on the well-being of natural refrigerant heat pump water heaters," he said. "We'll be able to be a bit more agile in taking advantage of opportunities that come our way." Ito is based in Detroit, Michigan (U.S.) while Miles resides in Los Angeles, California (U.S.).

CO₂ heat pump water heaters, which have flourished for years in Japan under several manufacturers, represent a tiny segment of the heat-pump-water-heater market in the U.S., which is dominated by models using R134a. According to Miles, less than 100,000 heat pump water heaters are sold in the U.S. annually, of which Sanden's CO₂ models – the only CO₂ models in the marketplace – represent about three-quarters of one percent. However, sales have been steadily growing over the past few years.

Apartment buildings, sometimes supported by government subsidies, and commercial buildings like restaurants have shown the most growth in sales of CO₂ heat pump water heaters, Miles said.



COOL FORWARD THINKING

When **Reliability** meets **Innovation**

With a history of 135 years in commercial refrigeration Kysor Warren joins the Epta Group's **innovative** spirit. A melding of **reliability** and **creativity**, offering customers the latest technologies in **natural refrigeration**.



Six More U.S. States Pursue HFC Bans

Like nine other states in the U.S. Climate Alliance, they are adopting vacated SNAP rules set by the EPA.

— by Michael Garry



Julie Cerquiera, US Climate Alliance

Six more U.S. states — Colorado, Hawaii, Oregon, Maine, Massachusetts and Rhode Island — are pursuing HFC-reduction plans that would adopt now-vacated rules established by the U.S. Environmental Protection Agency's SNAP (Significant New Alternatives Policy) Rules 20 and 21.

These states follow similar activity by nine other states. California, Vermont, Washington and New Jersey have passed legislation to adopt HFC use limits based on the SNAP rules; in addition, Connecticut, Delaware, Maryland, Pennsylvania and New York have committed to similar regulatory action under existing laws or pending bills. (Delaware also recently announced the "Cool Switch Low Impact Refrigerant Program," which will incentivize the use of low-GWP refrigerants.)

The EPA abandoned rules 20 and 21 following U.S. Court of Appeals rulings stating that federal law did not support the rules. This prompted the state action. (See [page 16](#) for map showing state activity.)

For example, last October, Pennsylvania's Department of Environmental Protection (DEP) said that it would be proposing HFC regulations by the end of 2020, according to Beth Rementer, spokesperson for DEP.

All of these 15 states are among the 24 (plus Puerto Rico) making up the U.S. Climate Alliance, which has pledged as a group to reduce HFC emissions in the absence of federal direction, though bipartisan federal HFC legislation has recently been introduced in both chambers of Congress (see <https://bit.ly/39OoOTQ>).

The state activity is getting attention at industry events. At Emerson's E360 breakfast at the AHR Expo last month, Jennifer Butsch, Regulatory Affairs Manager AC for Emerson, noted the recent HFC-reduction moves made by Hawaii, Colorado and Oregon.

U.S. CLIMATE ALLIANCE'S MODEL RULE

In Colorado, the Air Pollution Control Division is proposing Regulation Number 22 to the Air Quality Control Commission (AQCC) to satisfy requirements the state's General Assembly set forth in its Colorado Air Pollution and Control Act. Part B.I of the regulation bans the use of HFCs in certain manufacturing and end uses by adopting SNAP program prohibitions on these substances.

The provision also refers to following a “model rule” published by the U.S. Climate Alliance, which is a “framework that is designed to ensure all the states have substantially similar rules,” said Julie Cerqueira, Executive Director of the U.S. Climate Alliance. “It is essentially a mirror of SNAP.”

The Colorado Air Pollution Control Division estimates that if the state adopts the model rule, it would reduce emissions by 560,000 metric tons of CO₂e in 2025 and 1.15 million metric tons of CO₂e in 2030. On February 20, the AQCC reviewed draft rules of the HFC- reduction requirements.

In Hawaii, the legislature passed House Bill 2492 (<https://bit.ly/2HFaSzv>) on January 23 to “preserve federal regulations on the use of hydrofluorocarbons in state law.” In addition, the bill directs the Hawaii state energy office and the environmental management division of the department of health “to study how to increase the use of refrigerants with low global warming potential and recommend how to establish a state program that supports the elimination of legacy uses of hydrofluorocarbons.” The bill is scheduled to be heard by the state’s Consumer Protection and Commerce Committee on February 13.

In Oregon, the legislature passed House Bill 4024 (<https://bit.ly/2uYR4EG>) on January 27; the bill is now in the House Committee on Energy and Environment. It prohibits certain products that use or contain HFCs “from entering into commerce in Oregon” if the product was manufactured after a specified date. It also follows the prohibitions outlined in SNAP rules 20 and 21.

URGENT ACTION ON CLIMATE CHANGE

Rhode Island’s Department of Environmental Management (DEM) announced on February 18 that Rhode Island, Massachusetts and Maine are preparing to regulate HFCs. (See <https://bit.ly/39Ms1TX>.)

“We must use every tool at our disposal to take urgent action on climate change,” said Governor Gina M Raimondo, in a statement. “In the absence of federal leadership, I’m proud to stand with governors on both sides of the aisle who recognize the dangers of HFCs. It’s time to regulate these harmful pollutants.”

As part of the regulatory process related to HFCs, Rhode Island’s DEM will hold workshops with manufacturers and other stakeholders this spring to discuss the proposed regulatory changes. DEM anticipates filing new regulations this summer to phase down HFCs and replace them with less harmful alternatives.

The governors of Massachusetts and Maine also commented on their HFC-reduction initiatives. “I am proud to join with the other governors in the U.S. Climate Alliance in moving to prohibit the use of HFCs and bring Massachusetts closer to achieving its ambitious greenhouse gas reduction targets,” said Governor Charlie Baker. “For the Commonwealth to meet our goal to reach net-zero emissions by 2050, we will need to act to curb high-emitting sources like HFCs, and this plan represents a great opportunity to combat climate change and preserve our environment.”

“HFCs are the heavy hitter of climate change, inflicting significantly more damage than CO₂ in much smaller doses,” said Maine Governor Janet Mills. “With safer alternatives now available, the gradual phase out of these super pollutants makes sense for consumers, businesses, and our environment. I am proud to join with other governors from the U.S. Climate Alliance in taking this step. Our actions show that, regardless of what happens – or doesn’t happen – in Washington, states can forge important progress in fighting climate change.”

■ MG

“*In the absence of federal leadership, I’m proud to stand with governors on both sides of the aisle who recognize the dangers of HFCs.*”

- Gina Raimondo, Governor
of Rhode Island

Europe, Middle East & Africa



Event
NatRefs Dominate EuroShop

End User
Coop Italy Embraces CO₂
and Energy Saving

Events

- 1. March 18-20**
GCCA European Cold Chain Conference
Rotterdam, Netherlands
- 2. March 31**
ATMOsphere Ibérica 2020
Malaga, Spain
- 3. April 1**
IRAC, Ireland's Refrigeration & Air Conditioning Exhibition
Dublin, Ireland
- 4. April 15-17**
6th IIR Conference on Sustainability and the Cold Chain
Nantes, France



Fortunato Della Guerra, INRES-coop

Coop Italy Embraces CO₂ and Energy Saving

The cooperative retail network will soon have 54 stores with transcritical CO₂ refrigeration, including the latest energy-saving technology.

— By Tine Stausholm

Coop Italy, a network of seven large consumer-led cooperatives, and more than 90 smaller ones, constitutes the largest retail food chain in the country, with more than 1,000 supermarkets, and more than 100 hypermarkets.

It has a long history, with the first shop opening in 1854 in Turin.

As part of their mission statement, the coops are committed to “safeguard the environment.” This commitment includes taking measures to “optimize performance and retrieve heat,” according to Coop Italy’s environmental policy, adopted in 2005.

This environmental mission led the Italian coops to become early adopters of natural refrigerants. The first system with CO₂ in a secondary circuit was installed in 1999, and the first using CO₂ as the primary refrigerant in a low-temperature circuit in 2003.

Transcritical CO₂ is now the system of choice for INRES-coop, the company responsible

for the design and commissioning of refrigeration systems for the coops.

The only exceptions are very small systems and retrofits, which use R448A.

As of December 2019, the company had installed 46 transcritical systems, with eight new ones expected in the next few months, according to Fortunato Della Guerra, Technical Director of INRES-coop.

Della Guerra outlined Coop Italy’s refrigeration strategy last month at a networking event during EuroShop in Düsseldorf, Germany. The event was organized by Epta and shecco (publisher of *Accelerate Magazine*).

“Today, CO₂ is the standard for us for larger supermarkets; we are still trying to find a good solution for smaller ones,” he said. “Just last Saturday, we had a new opening with a less-than-40kW (11.4TR) transcritical CO₂ plant, so we are interested in developing this technique.”

INRES didn’t settle on a specific transcritical CO₂ technology from the start, but used several different types over the years, installing its first system with parallel compression in 2015, its first Epta

FTE system in 2017, and the first with ejector technology in 2018. The company also has installations with sub-cooling and heat-recovery features.

“We had at first a test base to try different types of plants and techniques,” Della Guerra said. “Then three years ago we started with a fully developed CO₂ system.”

As an example of INRES-coop’s willingness to embrace and integrate a number of different technologies, Della Guerra shared a case study from Modena, Italy, where INRES carried out a full refurbishment of an existing 1,500m² (16,146ft²) supermarket.

New features in the supermarket include transcritical CO₂ refrigeration integrated with HVAC, mechanical free cooling using an existing air handling unit, adiabatic cooling and parallel compression, heat recovery for hot-water production, and cold recovery for the AC system.

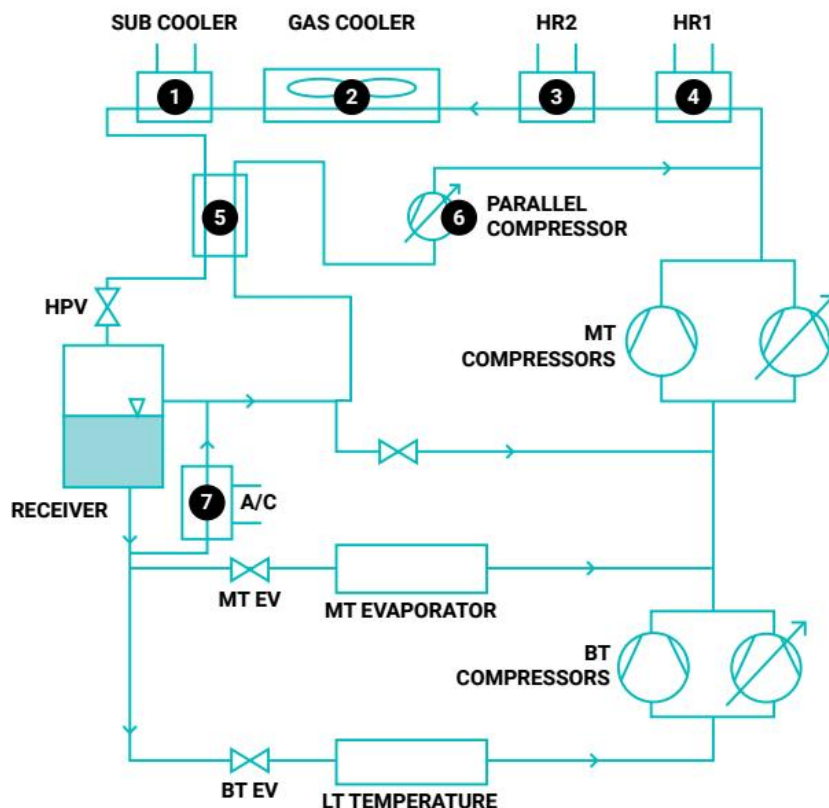
All these features, combined with LED lighting, passive insulation, and the use of intelligent Building Energy Management System (iBEMS) software, produced a 36% reduction in energy consumption for the refurbished store.

Modena coop's energy-efficiency measures

Source: INRES-coop



- 1 Cold recovery from HVAC
- 2 Adiabatic cooling
- 3 Air Pre/Post heating
- 4 Tap hot water production
- 5 Internal Recovery (IHx)
- 6 Parallel compressor
- 7 Cold recovery to HVAC



Energy-saving techniques

Della Guerra stressed that the underlying reason for the better performance of CO₂ is that it's new technology that refrigeration technicians "pay more attention to" and use optimal set points to guide their work. By contrast, servicing of older HFC systems often descends into "anarchy," where the technicians use their accumulated know-how, but not optimal set points, leading to poorer maintenance and decreased system performance.

"Therefore, it's not important only to build a plant, but it's super important to run it, because each plant in our experience runs for more than 15, sometimes 20 years, and we don't want to change for 20 years," Della Guerra said.

To underline his point about the importance of set points, Della Guerra gave two examples of medium- and low-temperature systems, where changing the

evaporation set point from -14°C to -10°C (6.8°F to 14°F) and from -35°C to -33°C (-31°F to -27.4°F), respectively, reduced the daily energy consumption in the medium-temperature system by 6%, and by 9.2% in the low-temperature system.

Della Guerra also stressed the importance of cabinet doors when addressing potential energy savings, telling his audience that INRES-coop has been using doors on frozen cabinets since 2006, and on medium-temperature cabinets since 2011. New coop stores now use closed cabinets as standard, and in a medium temperature system the energy savings are typically 7%-20%, he said. ■ TS

Battle of the GIANTS

...not really



Choose your giant
depending on your application



Sustainable solutions for
industrial refrigeration
- *CO₂ and Ammonia* -

#Efficient

#HighCapacity

#FriendsByNature



TEKO

www.teko-gmbh.com

NatRefs Dominate EuroShop



EuroShop

The World's No. 1 Retail Trade Fair

16 – 20 February 2020

Düsseldorf, Germany • www.euroshop.de

The giant retail trade show featured an array of CO₂ technology, including small, outdoor and integrated systems, along with advances in digitalization.

— by Ilana Koegelenberg and Tine Stausholm

EuroShop, the massive retail trade show that takes place once every three years, had plenty of encouraging news for natural refrigerant enthusiasts.

Despite worries about the coronavirus, there was a high turnout at the event, held in Düsseldorf, Germany, February 16-20; there were 94,000 attendees, more than 70% from outside Germany, and 2,300 exhibitors from 57 countries.

At EuroShop's three refrigeration halls, the most noticeable trend was the clear emphasis on natural refrigerants. While no HFC or HFO equipment was observed, virtually every stand showed off CO₂ and/or hydrocarbon products, reflecting the widespread acceptance of this technology in the European marketplace.

Confirmed at EuroShop was the expansion of CO₂ beyond mid-sized commercial retail applications – a trend that has been emerging worldwide. A number of companies displayed solutions for smaller convenience stores and large industrial projects.

German OEM Teko was one of them, launching its ROXSTAmicro CO₂ condensing unit for smaller convenience stores. The ROXSTAmicro is an air- or water-cooled unit for plug-and-play cabinets offering the same performance as similar propane (R290) units, but

without the flammability risk, said Teko. It is suitable for applications up to 5kW (1.4TR) for medium-temperatures and as low as 500W (.14TR) for low temperatures, thereby expanding Teko's overall range to include solutions from 500W to 550kW (156TR). The unit will be commercially available before the end of 2020.

Carrier presented its new Power CO₂OL transcritical CO₂ system, capable of delivering up to 550kW low-temperature capacity, and up to 1,500kW (427TR) for medium temperatures. The Power CO₂OL uses modulating vapor ejectors, allowing the compressors to operate at higher suction pressure.

CO₂ Moving Outdoors

Going small/large wasn't the only CO₂ trend at EuroShop. Several companies also introduced products for outdoor installation.

One of them was Danfoss, which introduced its Optyma iCO₂, a plug-and-play stackable condensing unit for medium-temperature applications with a cooling capacity of 1.5 to 4.7kW (0.43 to 1.3TR). The capacity is suitable for display-cabinet lineups of 1.5m to 10m (5 to 33ft), but the unit can also be used to refrigerate cold rooms.

With the Optyma, Danfoss aims to bring CO₂ refrigeration to a new segment of convenience stores that have reduced

indoor space. The unit will be commercially available later in 2020, and Danfoss is already planning a range extension, said John Broughton, Global Application Expert at Danfoss.

Another company with a new outdoor CO₂ offering is Swiss OEM Biaggini Frigoriferi. The company introduced TotalGreEnergy, an integrated transcritical CO₂ booster system that includes refrigeration, heating and air conditioning.

The TotalGreEnergy is a ready-to-install unit, aimed at supermarket applications and suitable for all climates. The system can save up to 30% in energy consumption, compared to traditional HFC systems and other CO₂ booster systems, according to Luca Rossi, Project Manager at Biaggini Frigoriferi. The saving is mainly due to an added subcooling section, and the "unique machine architecture," Rossi said.

The TotalGreEnergy system is customizable and available in refrigeration and HVAC-only versions. It is already commercially available in four size configurations. The smallest version with two fans has a chiller capacity of 15-35kW (4.3-10TR) while the largest, with five fans, offers 55-135kW (15.6-38.4TR).

Another CO₂ offering at EuroShop was German manufacturer Wieland's K65 copper-iron pipes, which, unlike pure copper pipes, are capable of handling the pressures involved in CO₂ refrigeration. Wieland's pipes are mainly copper, but contain 2% iron, thus making them stronger but, like pure copper pipes, still lightweight and easy to work with and weld, said Wieland.

The pipes are not only suitable for CO₂ applications, but are also used by Wieland customers for chiller tubes, according to Sales Manager Florian Diesch.

1 / Teko's ROXSTAmicro CO₂ condensing unit

2 / Frost-trol cabinets

3 / John Broughton of Danfoss, with Optyma condensing unit

4 / Biaggini Frigoriferi's TotalGreEnergy system; Luca Rossi at right



Integrated systems that combine cooling and heating were also noticeable, like the Biaggini Frigoriferi TotalGreEnergy system. It's becoming ever more popular to use integrate functions to save energy, by, for example, using the waste heat from refrigeration for heating and/or hot water production.

An important reason for manufacturers to develop ever more energy efficient products is the new EU Ecodesign and Energy Labeling Regulations, which will come into effect in March 2021, promising stricter energy efficiency requirements for the commercial refrigeration industry, and a shift in products in retail.

The European HVAC&R industry association Eurovent, with participation from the European Commission, hosted a seminar on February 17 at EuroShop to elaborate on the upcoming legislation. The aim was to offer the attending HVAC&R professionals an introduction to the new product requirements.

Omnipresent Digitalization

Digitalization (sometimes called Industry 4.0) was everywhere as manufacturers showed off new innovations in controls and data management.

One example was the aforementioned Optyma iCO₂ from Danfoss, which can be connected with the company's ADAP-KOOL case controller solution to enable remote monitoring and management. The ADAP-KOOL is part of Danfoss' Smart Store Concept, which intends to save not only energy and heating costs, but also reduce service calls and overall carbon footprint.

Another noticeable EuroShop trend is related to display cabinets and their aesthetics. Not only are the cases becoming more pleasing to the eye, but there also seems to be increased focus on making them as compact as possible.

Manufacturers are paying more attention to visibility and the flow of stores, offering display cases lower in height so that customers can see over them. One example of this is from Spanish manufacturer Frost-trol.

As part of the trend of sprucing up products, there were also several examples of transparent cases – for example from Frost-trol and De Rigo – allowing the customer to gain better visibility into the cabinet.

■ IK & TS

Networking Event Focuses on NatRefs

Italian OEM Epta and shecco's ATMosphere Network held a joint networking event at EuroShop, focusing on natural refrigerants and their role in sustainable retail. (shecco is the publisher of *Accelerate Magazine*.)

The event took place on February 18 at Epta's EuroShop booth at Messe Düsseldorf in Germany, and was supported by the EU funded Life-C4R project.

Keynote speaker Fionnuala Walravens, Senior Campaigner at the Environmental Investigation Agency, spoke about how the climate crisis will affect companies and all of us individually, and how natural refrigerants can help us achieve the Paris Agreement's goal of limiting global warming to 1.5°C (2.7°F), by potentially shaving off up to 0.4°C (0.7°F) of the expected temperature increase.

Walravens described how, with current worldwide carbon-reduction commitments, we are on track for a 3.2°C (5.7°F) temperature increase. If we are to live up to the goals of the Paris Agreement, we need to commit to a further 7.6% reduction of our CO₂e emissions, and that is where natural refrigerants come into the picture, she said.

Francesco Mastrapasqua, Advocacy & Regulatory Affairs Manager for Epta, spoke about the Life-C4R project, which is coordinated by Epta. The project plans to prove that it is possible to completely replace HFCs with CO₂-based refrigerants in any climate or market conditions.

Rounding off the afternoon, before the networking reception, was Fortunato Della Guerra, Technical Director at INRES-Coop, who talked about transcritical CO₂ refrigeration from the view of a retailer, and Mike Baker, managing director of AJ Baker, who talked about the company's 100-year history.

THANK YOU!



A MELTING POT OF PEOPLE, ENERGY FOR CHANGE

Multiculturalism, heterogeneity, multiple identities. Men and women of all races, cultures and professions come together in Arneg to build synergy and drive change. **The strength of the Arneg Group lies in its people** and its companies. People are the driving force behind responsible growth for the future of the planet.

Thanks to everybody who made this adventure unique, and see you again at Euroshop 2023!



Australia & New Zealand



End User
Hydrocarbon HVAC Systems
Gaining Traction in Australia

End User
Australian Wholesaler Chooses
CO₂ Over Ammonia and HFCs
for Cold Storage



Events

- 1. March 19-20**
Sydney Build Expo
Sydney, Australia
- 2. March 23-24**
AIRAH Refrigeration
Melbourne, Australia

Hydrocarbon HVAC Systems Gaining Traction in Australia

Room cooled by Polaris "HideAway" hydrocarbon system

Office building replaces R22 units with Polaris hydrocarbon systems, cutting energy by 65%.

— by Ilana Koegelenberg

About a year ago, Polaris Technologies, an Australian HVAC OEM based in the northern Sydney suburb of Frenchs Forest, launched its hydrocarbon-based air-conditioning units, opening the HVAC market in Australia to hydrocarbons.

These included the "HideAway Series," ducted packaged units that don't require an outdoor unit, and the Intelligent Series, split systems with inverter technology that are designed to replace R22 HVAC systems by leveraging existing equipment. Both series employ M60, a hydrocarbon refrigerant blend from Engas consisting of under 35% propane, more than 60% propylene, less than 5% isobutane, and less than 1% butane.

Polaris offers a range of hydrocarbon-based HVAC solutions, from large 600kW (170.6TR) units to small commercial packaged units and wall-mounted

split systems. The patented Polaris equipment comes with a two-year commercial warranty.

To date, Polaris has installed around 65 hydrocarbon systems in Australia in light-commercial applications, according to Tony Power, its Managing Director. "Feedback has been excellent," he said.

A recent installation took place at a one-story office building in Terrey Hills, Northern Sydney, occupied by Unisson Disability, a provider of disability insurance. There, aging R22 HVAC systems were replaced with Polaris equipment for both cooling and heating.

When the time came for an upgrade, the owners wanted to do their best to reduce their impact on the environment and, therefore, requested low-GWP natural refrigerant systems. A local contractor, RCS-Air, selected the Polaris systems in

keeping with the owner's instructions. The new systems use 50% less refrigerant than the previous one, including .54kg (1.2lbs) of M60 per HideAway unit, and 1.9kg (4.2lbs) per Intelligent Series unit.

The Polaris systems were commissioned in early December and have delivered comfortable 22°C (71.6°F) conditions. Ambient temperatures at the site in Sydney have reached up to 45°C (113°F) this Australian summer while humidity exceeded 80%.

The tenant commented that during start-up mode, the temperature was pulled down to a comfortable level within 30 minutes.

The reverse-cycle Polaris systems are expected to cut energy consumption in excess of 65% compared to the old energy-hungry R22 systems, according to Power. "These energy savings and the simplification of the installation process have resulted in a win for the owners and for the environment," he said.

R22 RETROFITS

The original R22 equipment comprised four 35-year-old 16kW (4.5TR) R22 packaged units along with four 35-year-old ducted R22 split systems (two were 32kW/9.1TR, two were 14kW/4.0TR).

The four R22 packaged units were replaced by four 10kW (2.8TR) HideAway packaged units, which were connected to existing ductwork so as to minimize disruption within the building. The HideAway units, which can operate up to 60°C (140°F) ambient temperature, do not require an outdoor unit "and the roof line is now very tidy," Power said, adding that they are so efficient that they have a lower capacity than the R22 packaged units.

In addition, four 16kW Intelligent Series condensing sets replaced the two 32kW R22 split systems, while two 14kW Intelligent series sets replaced the two 14kW R22 split systems.

In replacing the R22 split systems, RCS-Air kept the original pipework and 72kW (20.5TR) rooftop air-handling units (AHUs), modifying the pipework slightly to make the Polaris system reverse-cycle. By leveraging the existing equipment, RCS Air cut installation time by 30%.

Finally, a small 5kW (1.4TR) M60 wall-mounted split system from Pioneer was installed.

RESISTANCE IS DECLINING

Although the barriers to using hydrocarbons in HVAC are real, Power said Polaris is getting an increasing number of inquiries from the community wanting to learn more about natural refrigerants, GWP and potential energy savings. Still, there is a problem with HVAC contractors with attitudes of "it's never been used before, why should we start now," as well as a lack of local literature that promotes the uptake of hydrocarbon systems, he explained, adding that it will take time and effort to increase the uptake of natural refrigerant systems in Australia.

But progress is being made. "There are so many positives around hydrocarbons, and resistance from specifiers has fallen significantly over the last 12 months in particular," said Power. "And as a manufacturer, the use of Engas M60 has far

surpassed MEPS [minimum energy performance standard] levels." As long as strict safety standards are adhered to, he only has positive things to say about hydrocarbons.

Even RCS-Air is convinced that hydrocarbons is a suitable replacement. The contractor has installed more than 50 hydrocarbon HVAC units, all from Polaris, explained Zac Fay, General Manager of RCS-Air. "Commissioning was very easy, and we had no issues, despite high temperatures above 40°C (104°F) at the time," he said. "The Intelligent Series units are easy to install; it took less than a day."

Polaris also partners with low-charge ammonia HVAC system specialists, installing large-capacity natural refrigerant HVAC systems successfully in Australia for many years. "These systems outperform, at every level, polluting legacy chemical HVAC equipment supplied by the large manufacturers," said Power. ■ IK

“There are so many positives around hydrocarbons, and resistance from specifiers has fallen significantly over the last 12 months in particular.”

- Tony Power, Polaris Technologies



Polaris' hydrocarbon condensing units

ARBS 2020

AIR CONDITIONING, REFRIGERATION BUILDING SERVICES EXHIBITION



Registration
NOW OPEN

SOURCE PRODUCTS SHARE SOLUTIONS CONNECT @ARBS

Visit Australia's only international HVAC+R & building services trade exhibition, with the largest range of suppliers, products and solutions, all under one roof. Featuring the highly regarded Speaker Series, the new IBTech Insight Series and the celebrated ARBS Industry Awards, ARBS 2020 should not be missed. **REGISTER ONLINE NOW**

MCEC // MELBOURNE

arbs.com.au

AUSTRALIAN WHOLESALER CHOOSES CO₂ OVER AMMONIA AND HFCs FOR COLD STORAGE



Transcritical CO₂, leveraging waste heat and supported by solar energy, was found to be the lowest-cost option for South Coast Stores.

— by Ilana Koegelenberg

Adiabatic gas cooler for transcritical CO₂ system

South Coast Stores, an Australian wholesaler in the remote town of Nowra, New South Wales, has opted for a CRS/Sphere transcritical CO₂ system that uses solar energy and employs the waste heat from the refrigeration system for hot water and heating requirements.

The cold-storage component was commissioned in January, followed by the retail space in February. Other refrigeration options, including ammonia and HFCs, were rejected.

South Coast Stores is a joint venture between V&C Food Distributors, and Cream of the Coast, the Streets Ice

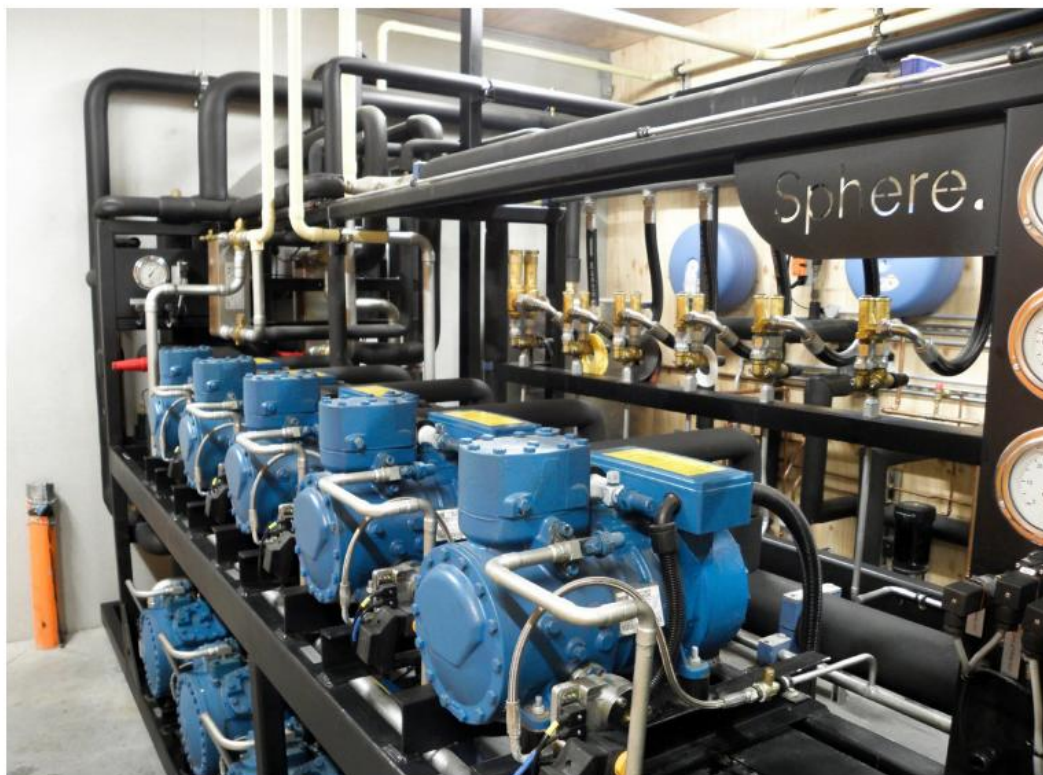
Cream distributor in Nowra. The aim of the venture was to replace the aging facilities of these two companies, both of which were nearing the end of their lives, with a new, modern building.

The new facility includes an extensive dry-storage area, large freezer storage primarily for ice cream, a large cool room primarily for dairy products, an ante room with truck-loading bays, a meat-processing area with a work-in-progress cool room, and an extensive retail area with chilled and frozen display cases and an aged-meat display case.

The facility has many design features to limit energy use, including thick concrete

walls, well-insulated roofing, under-slab heating with refrigeration waste heat, underfloor heating in the retail area, domestic hot water (from waste heat) and a 100kW solar installation.

South Coast Stores hired Australian engineering consultancy Minus40 Engineers to assist with the design of the facility. Its task included assisting the builder during the early design, selecting the insulation paneling and the refrigeration, air-conditioning and hot-water services, assisting with the selection of refrigeration and paneling contractors, and inspecting the site work of both contractors.

CRS/Sphere transcritical CO₂ rack

WHICH REFRIGERANT?

South Coast Stores was sensitive to the risks associated with HFC use and the future availability and cost of candidate HFCs, such as R407F and R448A. It was therefore open to the idea of using long-term replacement refrigerants such as CO₂ or ammonia, said Michael Bellstedt, Managing Director of Minus40. "Minus40 advised against the use of any HFC refrigerant at an early stage of the project, based on the known phase down and environmental risks of synthetic refrigerants."

Minus40 conducted an extensive budget analysis and modeled the expected annual energy consumption of both considered options, ammonia and CO₂. Ammonia is more energy efficient, but not enough to compensate for its higher capital costs. (He did not provide energy consumption data.)

"The commercial viability of an ammonia plant versus a CO₂ plant with solar PV was found to be unattractive, and therefore a full CO₂ plant with booster and parallel compressors and an adiabatic gas cooler was chosen as the lowest-cost option," said Bellstedt. The CO₂ system provides 256kW (55.8TR) of total cooling capacity.

Small- to medium-sized refrigeration systems are relatively more costly with ammonia than with CO₂ (though this differential reduces for larger plants), according to Bellstedt. "The payback on the additional capital cost, both of the

refrigeration plant and enhanced building requirements, was found to be in excess of the expected life of the [ammonia] plant, and therefore the decision was taken to go down the CO₂ path only for tender purposes."

SYSTEM SPECS

South Coast Stores' transcritical CO₂ system has the following features:

- ▶ **Freezer (low-temperature) capacity:** 108kW (13.7TR) at -25°C (13°F) SST
- ▶ **Medium-temperature capacity:** 148kW (42.1TR) at -7°C (19.4°F) SST
- ▶ **Compressor supplier:** Frascold (Italy)
- ▶ **Rack Manufacturer:** CRS/Sphere (South Africa)
- ▶ **Rack arrangement:** Six medium-temperature compressors, three booster (low-temperature) compressors, two parallel compressors
- ▶ **Gas cooler, desuperheater and evaporator coil supplier:** HC Heat Exchangers (South Africa)

"Transcritical CO₂ in this application made sense over freon for obvious reasons and is far more cost effective over ammonia in this application," noted Shaun Davis of MB Refrigeration, the refrigeration contractor for the project.

The CO₂ system had a "negligible incremental upfront investment cost relative to a freon system," added Mark Brennan, Director of Cream of the Coast.

ENERGY CONSIDERATIONS

Bellstedt noted that he is an "avid proponent" of natural refrigerants for all applications of refrigeration and air conditioning. Moreover, he believes that ammonia will provide "the most energy efficient solution in nearly every application, and I consider this statement to be indisputable."

However, he added, every application needs to be considered individually, as the energy penalty associated with the use of CO₂ "can in some cases be small enough to render the additional cost of implementing an ammonia system unviable." Often, spending only some of the cost differential on a solar PV system "can negate the energy penalty or render the remaining energy benefit of an ammonia system even less viable."

In this case, due to the relatively mild summer climate in Nowra, operation of the CO₂ system in less efficient "transcritical mode" is expected to be rare, even in Australian summer months of January and February, explained Bellstedt.

In addition, other site considerations and even end-user prejudices can render an ammonia system unsuitable or unpalatable, said Bellstedt. "Hence, whilst my first preference will always be an efficient, charge-minimized ammonia system, situations in both commercial and industrial applications exist where a CO₂ system can be preferred."



Controls for transcritical CO₂ rack

THE RIGHT CONTRACTOR

Finding the right contractor to assist with the installation was critically important, explained Cream of the Coast's Brennan. "Making sure the contractor had experience with CO₂ systems and the support of the manufacturers/suppliers was a key factor in selecting our partner," he said. Contractor MB Refrigeration was the choice.

"The choice of location (Nowra) for such an innovative project was unfortunate as it limited the choice of interested contractors," explained Bellstedt. "MB Refrigeration must be applauded for their enthusiasm for the project, and for the competitive pricing submitted by them. This made the project commercially attractive to the client."

MB Refrigeration made the commitment during the tender phase to work with a preferred local refrigeration contractor during the installation and commission to ensure that local skills are developed to support service work after the warranty period. This was a key factor for South Coast Stores in its decision to choose MB Refrigeration.

This was also the first transcritical CO₂ installation in Australia using Frascold

compressors, confirmed Giovanni Lo Nero, Sales Area Manager for Frascold. Frascold came on board when the contractor MB Refrigeration insisted on using its compressors.

One of the major challenges during the project was unrelated to the refrigeration system. Significant delays were experienced during the building approval process, ultimately delaying the project by more than 12 months. This delay coincided with a change in local arrangements for the preferred supplier of evaporators, resulting in a dramatic and unacceptable increase in local pricing. Therefore, the system design had to be switched to other suppliers, further delaying the project's completion, explained Bellstedt.

MB Refrigeration used this opportunity to offer hot-gas defrost as opposed to the specified warm-glycol defrost, significantly simplifying the site installation. "The wisdom of the decision to move to hot-gas defrost will be evaluated in the coming months, but initial observations indicate that the technology works well," said Bellstedt. ■ IK

FOR ALL FOOD RETAIL NEEDS

Embraco has a **R-290 REFRIGERATION** solution



Ideal solution for your **MBP** applications



Energy savings and stability for your frozen island operating with **Variable Speed Technology**



Compact and top efficient compressor designed for R-290



Modularity for your reach-in with pre-charged R-290 deck

Sealed Units



Leading R-290 technology for ice machines: a reliable product for **high performance requirement**



High quality and compact **Condensing Units**



Discover everything that our digital tools can do for your business
products.embraco.com



A channel for the refrigeration market.
Join us at: refrigerationclub.com

embraco
Nidec

Asia Pacific



Market

Hydrocarbons Going
Mainstream in Japan

Event

End Users and Manufacturers
Mark NatRef and Energy Progress
at ATMOSphere Japan

Event

Thailand Highlights
NatRefs as Key to
Emissions-Reduction
Agenda



Events

- 1. March 18**
Cold Chain Summit 2020
Taguig City, Philippines
- 2. March 26-28**
HVACR Expo Pakistan
Lahore, Pakistan

End Users and Manufacturers Mark NatRef and Energy Progress at ATMOSphere Japan



Masashi Yokosawa, Executive Officer and General Manager, AP Company

The transition to natural refrigerants and more efficient systems was outlined by retailers Lawson, Metro and Tokyu Department Store, pub operator AP Company, cold storage operator Hamamatsu Itaku Soko, and OEMs Panasonic, Nihon Netsugen Systems and Mayekawa.

— By Devin Yoshimoto

At the opening of ATMOSphere Japan 2020 last month in Tokyo, Shinichiro Uto, head of Japanese c-store chain Lawson's store development division, highlighted the increasing urgency of Japan's transition towards sustainable technology.

"Surprisingly in 2018," said Uto, "Japan topped the list of countries globally damaged by climate-change related extreme weather events."

He referenced the Global Climate Risk Index 2020 report, published by environmental think tank Germanwatch in December last year. The annual report analyzes and ranks countries most affected by weather-related events including storms, floods and heat waves.

Lawson, a leader in Japan's transition to natural refrigerants, was one of several end-user companies and manufacturers that reported on their recent projects at the conference, held February 10 at the Shinagawa conference center. (ATMOSphere Japan is organized by shecco, publisher of *Accelerate Magazine*.)

Uto highlighted the recent opening of Lawson's first freon-free store, in Kanagawa Prefecture, which employs CO₂ and hydrocarbon refrigeration equipment, the latter for the first time. Lawson aims to reduce CO₂ emissions per store by 30% by 2030; the adoption of CO₂ refrigeration systems is a part of this effort, with some 3,700 stores already using the equipment as of this year.

Metro Cash and Carry Japan, a division of German retailer Metro AG, discussed how it reduced its electricity use by close to 60% by replacing HFC display cases with propane (R290) plug-in units, provided by AHT.

"We have recently retrofitted 200 R290 plug-in cabinets in three of our stores," said Kenji Funamori, Construction and Fitting Manager in Metro Cash and Carry Japan's Asset Management Department. "It is the first such case of such a large-scale retrofit for us in Japan. Our electricity demand has been greatly reduced and we have also reduced our maintenance and repair costs."

Tokyu Department Store, a Japanese department store chain owned by Japanese railway conglomerate Tokyu Group, presented a case study on its recent installation of several CO₂ plug-in display cases at one of its underground department/food retail outlets located in Shibuya, one of Tokyo's largest commercial districts.

"We'd like to further expand the adoption of these freon-free cabinets," said Tatsuya Tamura, General Affairs Department Facility Manager for Tokyu Department Store.

In a first for ATMOSphere Japan, a company from the food-service sector – AP Company, which runs more than 250 Japanese style Izakaya (pubs) in and around Tokyo as well as overseas – participated in an end-user session, signaling the rise of the foodservice industry's interest in natural refrigerant systems.

Masashi Yokosawa, Executive Officer and General Manager for AP Company, spoke about the company's effort to build a sustainable business model through its farm-direct-to-consumers program.

Citing the company's philosophy of "creating shared social as well as economic value," Yokosawa pointed to the impact of energy use and refrigeration on farmers. He also noted the high cost of natural refrigerant equipment, and encouraged the industry to make it more affordable for businesses like his.

GROWTH IN THE INDUSTRIAL SECTOR

Japan's industrial refrigeration sector is increasingly adopting natural refrigerant systems as it seeks to phase out the use of R22 over the next few years. "Among our members who were surveyed, the use of R22 went from nearly 80% in 2012 to 58% in 2018," said Shigekatsu Koganemaru, Board Member of the Japan Association of Refrigerated Warehouses (JARW), who also presented during ATMOSphere Japan. "In the same time, the use of natural refrigerants has gone from 17% to 31%."

Japanese cold storage operator Hamamatsu Itaku Soko reduced energy use by up to 35% at its Yonezu Cold Center facility after replacing a 22-year-old R22 system with a transcritical CO₂ system. Japanese OEM Nihon Netsugen Systems supplied the system.

"Our old R22 unit was reaching its lifetime end," said Kenichi Suzuki, President of Hamamatsu Itaku Soko. "Three or four years ago, we looked for freon-free alternative options for replacement of our freon equipment. And then we learned that the Japanese Ministry of Environment was offering natural refrigerant subsidies. And then we learned about CO₂ refrigeration systems at that time."

Showing the continuing development of large industrial transcritical CO₂ systems by Japanese OEMs, Hiroyuki Tamanaga, Cold Chain Business Division Director for Panasonic Appliances Company, talked about the company's efforts to develop transcritical CO₂ systems for larger capacities during the Technology Leadership Roundtable session.

Tamanaga referenced the company's recent development of an 80HP transcritical CO₂ rack aimed at Japan's cold storage industry, "further enriching the choice of natural refrigerant systems for our customers."

Tamanaga also recognized the natural refrigerant industry's increasing competitiveness and said that it was a positive sign for the industry. "Several companies should be developing green refrigerants," said Tamanaga. "This is ideal for Japan. We would like to catch up with other companies who are already established in this space."

Katsuhiko Harada, President of Japanese OEM Nihon Netsugen Systems, updated the audience on the number of transcritical CO₂ systems – 170 – that the company has installed for the industrial refrigeration sector in Japan. "We started in the north in Hokkaido and have moved down into the south into warmer climates in Kyushu," he said.

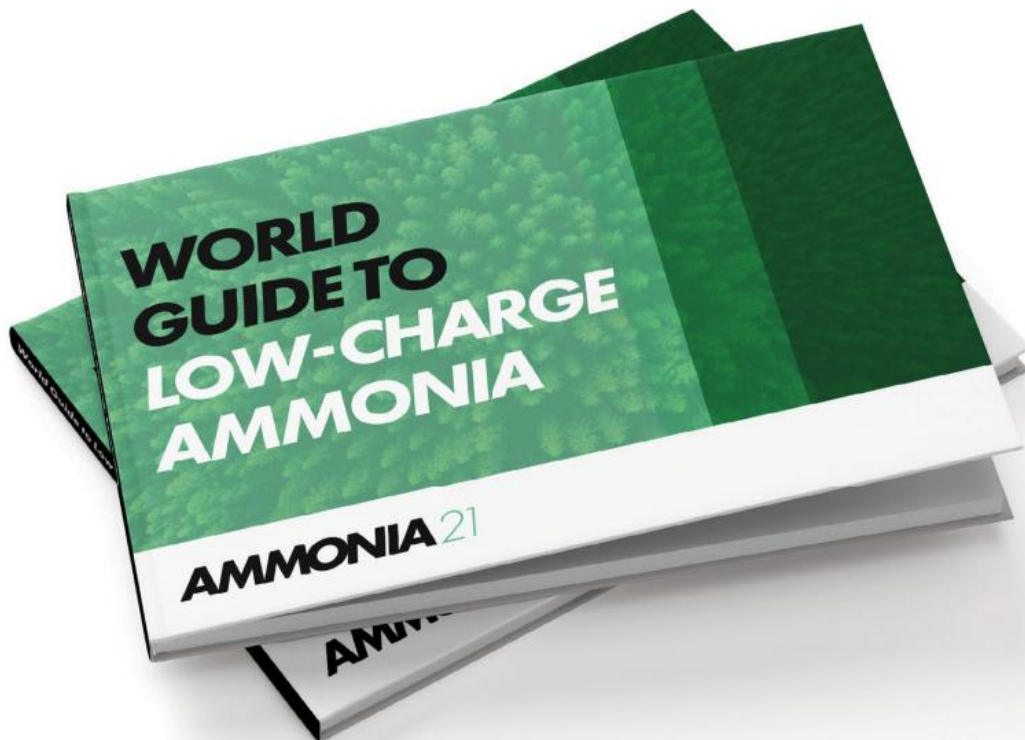
While the adoption of transcritical CO₂ systems continues to grow in Japan's industrial refrigeration market, the growth of NH₃/CO₂ systems was highlighted as well. "As of December 2019, 2,128 sets of NH₃/CO₂ secondary refrigerant cooling systems have been installed," said Makoto Ehara, General Manager for Japanese OEM Mayekawa, which manufactures the NewTon NH₃/CO₂ system.

In the concluding session, Jan Dusek, COO of shecco, commented on the natural refrigerant innovation he has seen in Japan. "Over the last five years R&D for natural refrigerant systems has accelerated in Japan," said Dusek. "Expect more innovation to come in the 2020 to 2025 period." ■ DY



World Guide to Low-Charge Ammonia

- Market analysis • Technology trends
- Case studies • Policy updates • New applications



The first comprehensive guide to the global low-charge ammonia industry!

Thank you to our supporters!



VAHTERUS



|SSP|KÄLTEPLANER.CH|



info@sheccobase.com

+32 2 230 3700

brought to you by

sheccoBase 



Hydrocarbons Going Mainstream in Japan

Major manufacturers have exhibited hydrocarbons at Japan's two largest commercial food retail and food service exhibitions for the first time — signaling a turning point for the Japanese market.

— By Devin Yoshimoto



Katsuhiko Harada, Nihon Netsugen Systems, at SMTS 2019.

-
- 1 / Nihon Netsugen Systems' Propane Waterloop System at SMTS 2020
 - 2 / Daikin's AHT Brand R290 Showcase at SMTS 2020
 - 3 / Hoshizaki's R600a Commercial Refrigerator at HCJ 2020
 - 4 / Panasonic's R290 and R600a Bottle Coolers at SMTS 2020
 - 5 / Sanden's Hydrocarbon Open-Type Display Case at SMTS 2020
 - 6 / Mitsubishi Electric's R290 Condensing Unit and Display Case at SMTS 2020

For the past decade, CO₂ has been the dominant natural refrigerant adopted by Japan's commercial food retail industry, with more than 12,000 installations as of February.

The uptake of hydrocarbons, on the other hand, has remained limited. While an estimated 2.5 million pieces of hydrocarbon plug-in equipment are operating today globally, Japanese manufacturers have largely forgone the technology in the food retail and food service sectors in favor of CO₂ due to the country's strict views on safety.

This has been clear from walking around the trade show floors of Japan's two largest food retail and food service exhibitions, Supermarket Trade Show (SMTS) and HCJ (Hoteres, Caterex and the Japan Food Service Equipment Show, three exhibitions held at the same time). The same few local distributors of imported hydrocarbon plug-in refrigerators, freezers and bottle coolers would showcase their products year after year with minimal visibility and little fanfare.

However, 2020, so far, has marked a turning point in hydrocarbon interest. Japan's biggest names in commercial refrigeration either exhibited hydrocarbon equipment aimed at the Japanese market for the first time, or they highlighted hydrocarbons in a way not seen before. (Japanese OEMs already have well-established hydrocarbon manufacturing capacity and sales channels in Southeast Asia — where hydrocarbon equipment is getting endorsed at the highest levels; see [page 74](#).)

Major OEMs as well as end users have boldly endorsed the potential of

hydrocarbon equipment. Combined with rapidly developing environmental policies and technology standards, hydrocarbons have stepped out of the shadows and into the mainstream — becoming the stand-out theme for natural refrigerants at these two trade shows.

FIRST MOVER

The first big step was taken last year by Japanese OEM Nihon Netsugen Systems (NNS) at SMTS 2019. Originally a supplier of large industrial refrigeration systems, NNS entered the commercial refrigeration market exhibiting solely propane (R290) systems.

This was a first for a traditionally conservative sector, and yet NNS President Katsuhiko Harada had already been quite successful in introducing new CO₂ technology to Japan's industrial refrigeration sector. NNS seems to be aiming for first-mover advantage with hydrocarbons in the commercial sector, as well.

This year, NNS appeared to double down on its hydrocarbons messaging, spotlighting the word propane (in Japanese) on the signage at the top of its booth. The company's highlighting of hydrocarbon systems in 2020 no longer seems out of place.

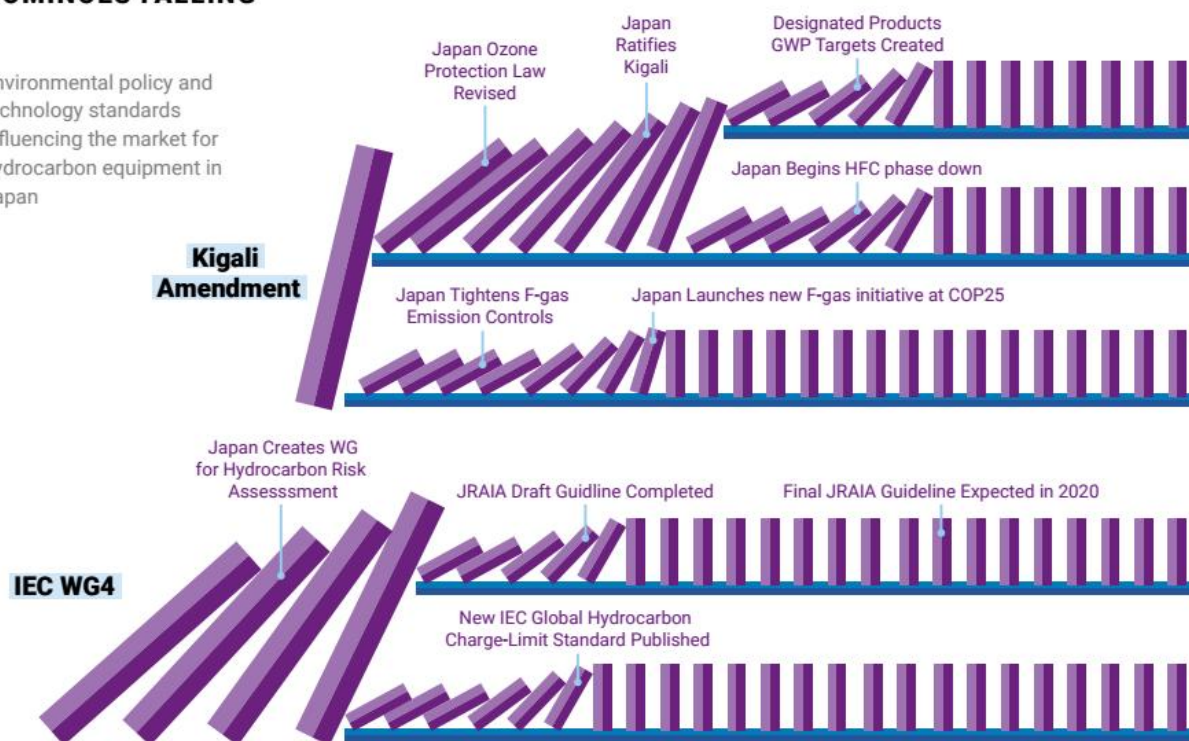
REGULATIONS TIGHTEN, STANDARDS PROGRESS

In addition to the market push by first movers like NNS, the tightening of environmental regulations and the development of hydrocarbon standards has also boosted interest in hydrocarbons

In Japan, the two main regulations controlling the import, manufacturing, use

DOMINOES FALLING

Environmental policy and technology standards influencing the market for hydrocarbon equipment in Japan



and disposal of f-gas equipment in commercial refrigeration are the Ozone Layer Protection Law and the Fluorocarbons Emission Restraining Law. The Japanese government has acknowledged that the country's annual f-gas recovery rate has never exceeded 40% since the Fluorocarbons Emission Restraining Law was first implemented in 2002.

Last year, Japan strengthened the Fluorocarbons Emission Restraining Law by implementing "direct penalties" that punish users who improperly dispose of f-gas equipment. Additionally, company names and the locations of users who leak over a certain amount of f-gases will be made public. This new law will go into effect on April 1.

In addition, Japan reinforced its focus on f-gas emission controls on the world stage at the COP25 United Nations Climate Change meeting in Madrid, Spain; there, Japan's Minister of the Environment, Shinjirō Koizumi,

launched the Fluorocarbons Life-Cycle Management Initiative, seeking a greater international focus on lifecycle f-gas controls, with Japan leading the way.

Meanwhile, Japan ratified the Kigali Amendment to the Montreal Protocol in 2018, revised its Ozone Layer Protection Law and began its domestic phase down of HFC manufacturing and imports on January 1, 2019. This in turn spawned Japan's "Designated Products" list, which requires manufacturers and importers to meet a target GWP value for certain types of equipment by a specific year. The selection of an official low-GWP alternative refrigerant for commercial refrigerators is currently in progress, and is being influenced by a number of factors, though some experts believe hydrocarbons are a likely candidate.

On the standards side, hydrocarbon technology has seen big developments in the past year that have had a major impact on Japan's standards formation process.

The International Electrotechnical Commission (IEC) published its new higher (500g) flammable-refrigerant charge limit for commercial refrigeration on June 20 of last year. Simultaneously, the Japan Refrigeration and Air Conditioning Industry Association (JRAIA) announced that it would issue its official guideline on the safe use of hydrocarbons in March 2020. The JRAIA is also working on the Japanese Industrial Standard (JIS) version of the IEC standard, with experts predicting its publication in 2020.

This combination of environmental policy changes and technology standards development is signaling a solid opportunity for hydrocarbon-based commercial refrigeration equipment to proliferate in the Japanese market. Japanese manufacturers highlighted this at their trade show booths this year.



World Guide to Transcritical CO₂ Refrigeration

- Market analysis • Technology trends
- Case studies • Policy updates



- Supermarkets • Convenience stores • Industrial refrigeration

Join the Supporters!



info@sheccobase.com

+32 2 230 3700

brought to you by
sheccoBase



Lawson's first freon-free store, where several pieces of R290 and R600a equipment, supplied by Hoshizaki, were installed.



Kenji Funamori, METRO Cash and Carry
Japan

END USERS TAKE ADVANTAGE

With manufacturers increasingly confident in the potential for hydrocarbons in Japan, major end users are beginning to pay attention and take advantage. Metro Cash and Carry Japan, a division of German retailer Metro AG, reduced its electricity use by close to 60% by replacing 200 HFC display cases at three locations with R290 plug-in units in February 2019. The cabinets were supplied by Austrian OEM AHT through its distribution partnership with NNS.

In September, Japanese convenience store chain Lawson opened its first freon-free store, where it is using hydrocarbons for the first time for its smaller plug-in upright and under-counter refrigerators and ice makers. The store is built as an "environmentally friendly model store" and is located on the Shonan Fujisawa Campus of the prestigious Keio University, in Kanagawa Prefecture — about one and a half hours southwest of Tokyo.

Japanese OEM Hoshizaki, which has long been a provider of hydrocarbon equipment overseas, supplied hydrocarbon plug-in equipment for the first time in Japan at the Lawson store. It subsequently exhibited an isobutane (R600a) commercial refrigerator at HCJ 2020 in February, marking the OEM's public hydrocarbon debut in Japan.

Just a few years ago, hydrocarbon equipment was not seen as a viable option for Japan. However, judging from this year's SMTS and HCJ exhibitions, it seems that this has completely flipped. Pioneering manufacturers are educating the market, environmental policy and technology standards have taken significant steps forward, and major end users are taking notice.

Japan has led the world this past decade in adopting CO₂ commercial refrigeration systems. Could hydrocarbons be next?

■ DY

NATURAL
REFRIGERANTS
FASTER TO MARKET
#GoNatRefs
www.shecco.com



Sustaining our atmosphere

Contact us for options to get involved

EUROPE

europa@shecco.com
(+32) 2 230 3700

JAPAN

japan@shecco.com
(+81) 3 4243 7095

AMERICA

america@shecco.com
(+1) 503 737 5061

THAILAND HIGHLIGHTS NATREFS AS KEY TO EMISSIONS-REDUCTION AGENDA

Around 100,000 R290 commercial refrigerators and air conditioners made by Thai manufacturers are expected to be in the Thai market this year.

— by Devin Yoshimoto

Natural refrigerant-based technologies, notably those using propane (R290), are set to play a key role in Thailand's greenhouse gas (GHG) emission reduction efforts, according to Varawut Silpa-archa, Thailand's Minister of Natural Resources and Environment.

Silpa-archa made this point at a meeting titled "Green Cooling Revolution: RAC NAMA Fund and the Future of Thai Industry," held February 17, in Bangkok, Thailand.

Silpa-archa said the use of natural refrigerants like R290 in split-type air-conditioners, household refrigerators, commercial refrigerators, and chillers would be essential to achieve Thailand's Nationally Determined Contribution (NDC), which aims to reduce GHG by 20% to 25% compared to business as usual by 2030.

"The Government of Thailand is therefore placing great emphasis on the promotion of energy-efficient and climate-friendly cooling technologies due to their ultra-low global warming potential (GWP) while strongly promoting new business opportunities, R&D and knowledge transfer," said Silpa-archa.

The goal of the RAC NAMA event was to "hail the achievements of the RAC NAMA Fund in initiating a transformation in the Thai refrigeration and air-conditioning

(RAC) sector towards the use of climate-friendly and energy-efficient cooling technologies with natural refrigerants," according to a statement released by EGAT (Electricity Generating Authority of Thailand) and GIZ Thailand.

Already, approximately 100,000 green cooling products are expected to be in the Thai market this year, [and] "this number is projected to increase to 50% of market share in the next three years," said Thepparat Theppitak, Deputy Governor of Power Plant Development and Renewable Energy, EGAT. By 2030, according to EGAT, 3.5TWh per year of energy use will be saved and 1.75 Mt of CO₂ emissions will be eliminated.

The RAC NAMA (Refrigeration and Air Conditioning Nationally Appropriate Mitigation Action) project provides



From left: Thepparat Theppitak, Deputy Governor – Power Plant Development and Renewable Energy, Electricity Generating Authority of Thailand (EGAT); Patana Sangsrirojana, Deputy Governor – Strategy, EGAT; Varawut Silpa-Archa, Minister of Natural Resources and Environment, Ministry of Thailand; Georg Schmidt, Ambassador, the Embassy of the Federal Republic of Germany; Margaret Lee Tongue, Chargé d'Affaires, the British Embassy; Dr. Raweewan Bhuridej, Secretary-General of Office of the Natural Resources and Environmental Policy and Planning (ONEP); Tim Mahler, Country Director, GIZ Thailand and Malaysia. Photo by GIZ.

financial, technology and policy support to Thailand's refrigeration and air conditioning industry; the RAC NAMA Fund is the main financial instrument of the project.

The RAC NAMA project is being implemented by GIZ, Germany's International Cooperation Agency, in partnership with the Thai Government, represented by the Office of Natural Resources and Environmental Policy and Planning (ONEP), and the Department of Alternative Energy Development and Efficiency (DEDE). The NAMA Facility, a joint initiative of Germany and the U.K., commissioned the project to GIZ in 2016; it will run until March 2021.

The total amount of the RAC NAMA Fund is 8.3 million Euro (approximately 300 million Baht or US\$10.6 million). It has resulted in nine Thailand-based

OEMs using natural refrigerants in their production processes, eight training centers being established nationwide and 150 trainers being trained. The fund is hosted by EGAT.

ENERGY-EFFICIENCY BENEFITS

At the RAC NAMA event, SIAM MAKRO PLC. (Makro), one of Thailand's largest membership-based food wholesalers, spoke about the energy-efficiency benefits and the track record of its roughly 10,000 R290 plug-in display cases at its stores.

"Energy efficiency and environmental consciousness are two key values that our company follows," said Anan Watcharapongvinij, Ph.D., Director-Construction and Facilities Management

at Makro, during a panel session titled, "Green Cooling Talk – Global Trend and Thai Perspective." "We are truly supportive of this and have been following this trend of using green refrigerants in our cabinets and refrigerators for over 13 years."

Makro, which has around 130 outlets, provides food products to retail businesses, restaurants, caterers, and other business operators throughout Thailand. "Thirty to forty percent of total energy consumption comes from our refrigeration systems," said Watcharapongvinij. "Today, we are really glad we are receiving support from the government to support this initiative since it will help reduce costs not only for us but also for our customers." ■ DY

“The Government of Thailand is therefore placing great emphasis on the promotion of energy-efficient and climate-friendly cooling technologies.”

- Varawut Silpa-archa, Thailand's Minister of Natural Resources and Environment



From left - Ekkapong Tangsirimanakul and Kim Tangsirimanakul, Patana Intercool; Philipp Pischke, GIZ; and Pattanapong Tangsirimanakul, Patana Intercool. Photo by GIZ.

Patana Intercool's Transition to Propane

Immediately following the RAC NAMA Fund event on February 17, media participants were invited on an exclusive on-site tour of Patana Intercool, a Thailand-based manufacturer and exporter of commercial refrigerators and display cases for supermarkets, convenience stores, cafes and restaurants.

The company aims to completely phase out of freon and replace it with propane (R290), said Ekkapong Tangsirimanakul, Managing Director of Patana Intercool.

"Three years ago, we already completed our transition to using cyclopentane (a foam blowing agent used for refrigerator insulation that is a low-GWP alternative to HFCs) in the production process," said Tangsirimanakul. "Now we are in the process of moving to our new initiative, which is to completely convert the refrigerants we use to R290 by 2025."

Patana is one of the nine Thai manufacturers participating in the RAC NAMA initiative. The company received market-introduction support to help stimulate sales of the equipment.

During the tour, Patana presented the section of its mini-showcase production line where R290 charging and testing equipment is installed. Tangsirimanakul said the company has begun offering R290 mini-showcases, bottle coolers, stainless steel refrigerators and cake showcases. "A few more pieces of R290 equipment for our production line are still on the way as we are aiming to expand our R290 production capacity," he said.

ICE-FREE ICE SKATING

Synthetic polymers create authentic skating experiences without water and refrigeration.

— by Tine Stausholm

Since the 1960s, synthetic ice made from plastic polymers has been available. But the battle to recreate the glide properties of real ice – and an authentic skating experience – has been an uphill one, preventing widespread adoption despite the energy- and water-saving advantages.

Now, however, the development of new high-density polymers has created materials that come very close. One of these, Glice Eco-Ice, has a glide effect only 2% slower than real ice, according to manufacturer Glice's website.

"Glice looks like ice, glides like ice, but isn't ice," said Co-Founder and CEO Viktor Meier.

Glice, headquartered in Switzerland, was founded in 2012 with a mission to provide sustainable ice sports, and has sold more than 1,000 rinks worldwide since then. Glice Eco-Ice rinks can now be found in more than 80 countries around the world.

Glice was present with an ice rink at the Swiss pavilion during the 2016 Summer Olympic Games in Rio, Brazil, and in 2019 the company replaced the world's largest refrigerated outdoor skating rink in Mexico City with a 4000m² (43,000ft²) Eco-Ice rink.

The upside to this technology is that it is delivered in large panels, needing only assembly – and no refrigeration or water – to function. Normal skates can be used, and a 200m² (2,153ft²) Glice Eco-Ice rink can save 10,000ltr (2,642gal) of water and the average energy consumption of 200 households per month, Glice said.



On top of this, Glice's Eco-Ice material is high-density and hard wearing, and the company offers a six- or 12-year warranty, depending on the thickness of the panels chosen.

Older synthetic ice materials required a lubricant like silicone to work, but in Eco-Ice the lubricant is contained in the material, and is released when the skate blades cut open the molecules. This lack of added lubricant also makes for easier maintenance, the company said. Depending on whether the rink is indoor or outdoor as well as the level of use, regular maintenance consists of daily to weekly vacuum cleaning and scrubbing, and a pressure wash once every month to every year.

Glice is not the only company marketing synthetic ice materials for skating rinks. Other companies include U.S.-based PolyGlide Ice and Xtraice, headquartered in Spain. ■ TS

Monitoring, Measuring and Improving Refrigeration Performance

VaCom's EnergyDashboard System cuts energy usage at a California warehouse by 39%.

By Michael Garry

While the analysis of operational data to improve the performance and maintenance of HVAC&R systems is all the rage, VaCom Technologies, a La Verne, California (U.S.)-based energy consulting and refrigeration controls firm, has been offering software to help industrial operators optimize their HVAC&R systems for many years.

VaCom introduced its cloud-based EnergyDashboard system in 2003 "to improve performance and reliability as well as measure savings resulting from energy-efficiency measures," said Doug Scott, president of VaCom. It assesses temperature, pressure, flows, power usage and other system data, and measures efficiency of components in kW/TR.

Approximately 50 companies now use EnergyDashboard in various forms, mostly for built-up industrial refrigeration systems in food and beverage plants and refrigerated warehouses. Other applications include commercial refrigeration racks, HVAC, process chillers and heat pumps.

In one case study posted on VaCom's website (vacomtech.com), a multinational food and agricultural products company, which operates a 50,000+ft² (4,645+m²) protein-storage warehouse in California, noticed gradually rising utility costs, both in energy consumption and demand. The largest user of

energy at the facility was the refrigeration system, which had been declining in performance and efficiency over time, partly due to the company's inability to retain onsite refrigeration or energy-engineering personnel.

VaCom's Performance Monitoring Service Team accessed the facility's refrigeration control system via a secure connection to the EnergyDashboard tool. System performance data was continuously measured and analyzed, and multiple energy-saving and performance improvements opportunities were identified, including equipment failures, behavioral changes, and setpoint changes. Each opportunity was analyzed financially and ranked according to its payback and criticality to operations.

"The key learning over 17 years of using EnergyDashboard is that the technical data collection and analytics platform must be balanced with skilled engineering attention and person-to-person communications," said Scott. "Equipment failures can be avoided by early identification or providing the means to 'deep dive' as part of root-cause analysis. Automatic notification of improper setpoint changes may be sufficient for correction, or discussion may be required. We often provide cost impacts (how much money is being lost) to provide justification for immediate maintenance action and expense."

The upshot of the warehouse's use of EnergyDashboard was a 39% reduction in total facility daily energy usage, and an annual savings of 800,000 KWh, equating to \$120,000, and 182 metric tons of CO₂e emissions, according to VaCom. The facility is dedicated to maintaining the savings through a continuous program involving all stakeholders. ■MG

BOOSTING THE COP OF SMALL-CAPACITY TRANSCRITICAL CO₂ SYSTEMS

A subcooling system equipped with thermoelectric modules improves cooling capacity up to 33%, and COP up to 24%, a study found.

— By Michael Garry

It is well known that at high ambient temperatures, transcritical CO₂ refrigeration systems typically operate in “transcritical mode,” causing low energy efficiencies in refrigeration facilities.

To address this issue, manufacturers have developed several energy-enhancing technologies, including ejectors, parallel compressors and subcooler systems, among others. These have been used especially in large centralized systems with positive results.

However, according to a 2019 study, these measures are not suitable for small-capacity systems due mainly to the cost and the complexity of the enhancements. The study presents a new subcooling system equipped with thermoelectric modules, “which, thanks to [their] simplicity, low cost and easy control, are very suitable for medium and small capacity plants.”

The study – “Improvements in the cooling capacity and the COP of a transcritical CO₂ refrigeration plant operating with a thermoelectric subcooling system” – was published in *Applied Thermal Engineering*, Volume 155, June 5, 2019,

pages 110-122 (<https://bit.ly/2TrBLN1>). The authors were D. Astrain, A. Merino, L. Catalán, P. Aranguren, M. Araiz, D. Sánchez, R. Cabello and R. Llopis.

According to the study’s abstract, the developed methodology (computational tool) finds the gas-cooler pressure and the electric voltage supplied to the thermoelectric modules that maximizes the overall COP (coefficient of performance) of the system; it takes into account the ambient temperature, the number of thermoelectric modules used and the thermal resistance of the heat exchangers included in the modules.

The maximum improvement in the cooling capacity with this technology is 33%, and the maximum COP gain is 24%, the study said.

The study found that, with 20 thermoelectric modules, there is an improvement of 25.6% in cooling capacity and 20% in COP, compared to the base cycle of CO₂ in a small cooling system refrigerated by air. Compared to a cycle that uses an internal heat exchanger, the improvements drop to 19.5% and 12.2%, respectively. ■ MG



Welcome to the world's largest
database on Natural Refrigerants.



sheccoBase 

Find out more
www.sheccobase.com



Marek's Hydrocarbon Update

The leader of the global effort to raise hydrocarbon charge limits in commercial cases was Marek Zgliczynski, who is tracking how they are being adopted regionally.

— by Michael Garry

On May 9 of last year, in the culmination of a fierce, five-year debate over the amount of hydrocarbon refrigerant that can be safely used in commercial refrigeration, the International Electrotechnical Commission (IEC) approved an increase in the charge limit for A3 (flammable) refrigerants to 500 g (17.6 oz) from 150 g (5.3 oz) in self-contained commercial refrigeration display cases.

This change – as well as a rise in the charge limit for A2 and A2L (low flammable) refrigerants to 1.2 kg (2.6 lbs) from 150 g – was incorporated into IEC standard 60335-2-89, edition 3.0. It is one of the most important advances for natural refrigerants in recent years, and sets the stage for what could be a significant rise in the adoption

of hydrocarbon-based self-contained display cabinets. (See "500 g," *Accelerate Magazine*, July-August 2019.)

The leader of the effort to raise the charge limits was Marek Zgliczynski, Chair of the IEC SC61C subcommittee, as well as director of research and development for Nidec Global Appliance (formerly Embraco). He is also a member of several other global and regional standardization bodies (ISO, CEN, CENELEC, UL and CANENA) and of ASHRAE. During his long career in HVAC&R, which began in 1979, he has earned three U.S. patents and a Gold Whirlpool Quality Team Award.

In recognition of his industry leadership, Zgliczynski was named *Accelerate Magazine*/Europe's Person of the Year for 2019 last October at the ATMosphere Europe conference in Warsaw, Poland, his native city. (See, "*Accelerate Magazine*/Europe Award Winners Named," *Accelerate Magazine*, November-December 2019.)

The IEC charge-limit increases still need to be adopted in some form by regional standards bodies. *Accelerate Magazine* caught up with Zgliczynski at the AHR Expo in Orlando, Florida (U.S.) last month, and asked him for an update on the adoptions, and other hydrocarbon-related questions.

// *Accelerate Magazine*: CANENA, the North American standards body, is developing the new hydrocarbon charge-limit standard for the U.S. and Canada. What can you tell us about that?

Marek Zgliczynski: The CANENA WG (Working Group) 12 is meeting every month to update the equivalent UL and CSA standards. The target implementation date is the end of 2021.

What was proposed for discussion was a 500g hydrocarbon charge limit for open cabinets and a 300g limit for closed cases. In other words, a maximum of 13 times LFL (lower flammability limit) for open cabinets and eight times LFL for closed cabinets. Only in leak tests for closed cabinets would they allow more than 50% of LFL; IEC is probably changing in that direction as well.

In the U.S., they want to include remote commercial systems, which were excluded from the charge-limit increase in the IEC 60335-2-89 standard. That's not so much for hydrocarbons as for A2Ls, low-GWP chemicals. This would basically integrate the best of the IEC 60335-2-40 standard for air conditioners inside the commercial refrigeration standard to cover cold rooms and remote systems.

The IEC maximum threshold for flammable refrigerants is 1.2kg. But in the U.S., they may make it 4kg, which is 13 times the LFL of A2Ls.

// *Accelerate Magazine*: Europe is usually a leader with natural refrigerants. How are they progressing with a new charge limit for hydrocarbons?

Marek Zgliczynski: In Europe, CENELEC TC61 approved the new -89 standard as a new working item in December, and is working on the conversion of it into the EN version. Because of the IEC 60335-Part 1 updates, it was not voted in parallel with the IEC. From what I understood, CENELEC is not going to touch anything in the IEC standard. But they have to see that the standard is aligned and harmonized with all of the European directives. For example, the EN standard is intended to become a harmonized standard with the EU Machine Directive. This will take all of this year. The final vote target date is March 2021.

// *Accelerate Magazine*: What about in other countries?

Marek Zgliczynski: In Japan, Working Group WG3 under the Japan Refrigeration and Air Conditioning Industry Association (JRAIA) is working on a Japanese version of the IEC -89 standard. Japan is going fast, with some limitations. For example, the leakage tests will not allow more than 50% of LFL. The target date for publication is in 2020.

In Australia and New Zealand, the comment period for the new edition of the AS/NZS 60335-2-89 standard ended on February 3. The publication target date is June 2020.

Some nations, such as Brazil, have already introduced the new IEC Edition 3.0 inside their standardization system. ■ MG

“What was proposed for discussion [in North America] was a 500g hydrocarbon charge limit for open cabinets and a 300g limit for closed cases.”

- Marek Zgliczynski, IEC and Nidec



Visit the archive!

All the previous *Accelerate* content
is shelved in our library at:

www.accelerate.shecco.com

brought to you by:



**Be the first to read it &
never miss the latest news!**

Sign up for a regional newsletter highlighting the top stories, delivered every Tuesday!

SIGN UP NOW

www.accelerate24.news



Want more natural refrigerants news?



www.R744.com



www.ammonia21.com



www.hydrocarbons21.com

Follow us!



shecco



@shecco



@sheccomedia



shecco TV



ATMO CAPE TOWN

10 March 2020
Cape Town

ATMO IBÉRICA

31 March 2020
Málaga

ATMO AUSTRALIA

18 May 2020
Melbourne

ATMO AMERICA

28-30 September 2020
Dallas, TX

ATMO FRANCE

November 2020
Lyon

ATMO ASIA

November 2020
Manila

ATMO JAPAN

15 February 2021
Tokyo

ATMO EUROPE

March 2021
Brussels

More info on www.ATMO.org