

SEPTEMBER 2019

ACCELERATE

ADVANCING HVAC&R SUSTAINABLY

MAGAZINE

Walmart's
Transition to
Low-GWP
Refrigerants

p.38

To Russia
with CO₂

p.42

Propane ACs
Emerge in
China

p.68



HFOs

How much is too much?

R1234yf emissions in the atmosphere produce trifluoroacetic acid (TFA), which descends to earth in rain. A look at the long-term implications.
p. 30



ATMO sphere

Business Case for
Natural Refrigerants

16-17/10/2019 – Warsaw

You don't
want to miss
this year's
**ATMO
Europe!**

KEYNOTE SPEAKERS



REFRIGERATION MATTERS

Prof. Toby Peters
University of Birmingham



GLOBAL TECH TRENDS

Prof. Armin Hafner
NTNU



GLOBAL MARKET & POLICY TRENDS

Klara Zolcer Skacanová
shecco



MARKET TRENDS IN POLAND

Maurycy Szwajkajzer
ENRECO

INDUSTRY 4.0: IOT

Delhaize, Nestlé, Crowley Carbon, Resource Data Management, CAREL, Eliwell, Carrier

POLICY & INCENTIVES

European Commission, French Ministry for the Ecological and Inclusive Transition, Belgian Federal Public Service for Health and Environment, Environmental Investigation Agency

END USER TECHNOLOGY CASE STUDIES

Carrefour & Danfoss, Biedronka, & CAREL, METRO & TEKNO, Verny & Embraco, Greenyard Frozen & Parasense/Bacharach

SOME OTHER HIGHLIGHTS INCLUDE:

- End User Panel
- Accelerate Magazine Awards/Europe Ceremony
- Natural Refrigerants in Central & Eastern Europe
- Exclusive Interview with Carrier Executive Pierre Boyer
- Several networking breaks & dinner reception

! STANDARD REGISTRATION DEADLINE: 16 September

• LATE REGISTRATION: 16 September - 16 October

View full programme: <http://bit.ly/ATMOEurope2019Programme>

Register today to secure your spot: <http://bit.ly/ATMOEurope2019Register>

A Quick Look at This Issue

END USERS

Walmart responds to Green America's 'Cool It!' Campaign. ([Page 38](#)) ... **METRO AG** and **Globus** open CO₂ stores in Russia. ([Page 42](#)) ... **Diamantis Masoutis** and **SPAR** stores use EPTA's FTE CO₂ system. ([Page 48](#)) ... New Zealand's **Eastland Port** deploys country's largest hydrocarbon system. ([Page 54](#))

TECHNOLOGY

Embraco's **John Prall** comments on variable speed compressors. ([Page 12](#)) ... **The Global Cooling Prize** announces finalist ceremony. ([Page 24](#)) ... Tecnofreddo launches line of **commercial propane air-source heat pumps**. ([Page 50](#)) ... Bitzer expands CO₂ training efforts in Australia and New Zealand. ([Page 52](#)) ... ITC develops prototype **transcritical CO₂ system** that integrates **supercritical CO₂ extraction**. ([Page 62](#)) ... Thailand launches training program on the safe use and handling of **propane refrigerant**. ([Page 64](#)) ... Sanden Intercool Group plans to convert entire portfolio to **hydrocarbons and CO₂** by 2022. ([Page 66](#)) ... Dearman's transport refrigeration unit uses **liquid nitrogen** to generate both power and cooling. ([Page 70](#))

MARKET

Natural refrigerants highlighted in **Italian survey** of HFC-alternative technologies. ([Page 46](#)) ... Australian retailers seek future-proof solutions at **Metcash Expo**. ([Page 56](#)) ... Mayekawa's sales of the **NH₃/CO₂ NewTon system** since launch will exceed 2,000 sets this fiscal year. ([Page 58](#)) ... Japanese makers of margarine, beer and ice embrace transcritical CO₂ at **FOOMA**. ([Page 60](#)) ... Chinese companies produce nearly 160,000 **R290 ACs**. ([Page 68](#)) ... **Professor Armin Hafner** takes the measure of CO₂ refrigeration. ([Page 72](#))

POLICY

Update on the countries that have ratified the **Kigali Amendment**. ([Page 22](#)) ... **NRDC/Climate Finance Advisors** paper recommends four financing models for efficient cooling. ([Page 26](#)) ... **HFOs**: How much is too much? ([Page 30](#)) ... **Vermont** gives financial incentives to natural refrigerant systems. ([Page 40](#))



In this issue

03 A Quick Look at This Issue

06 About Us
About *Accelerate Magazine*
/Editorial Calendar

08 Editor's Note
The Only Future-Proof Solution

10 Letters to the Editor

12 Opinion
A Winning Combination - R290
and Variable Speed Compressors

By John Prall

14 Global Events Guide
September - October 2019

18 Nominations Open for
Accelerate Magazine Awards/
Europe

20 Infographics
Cooling's Impact on United
Nation's Sustainable
Development Goals

// Global Trends

22 Kigali Update

24 Global Cooling Prize
Announces Ceremony
for Finalists

26 Report Recommends Four
Financing Models for
Efficient Cooling

28 World in Brief

30 Cover Story
HFOs: How Much is Too Much?

// North America

38 End User
Walmart Asserts It's
Transitioning to Low-GWP
Refrigerants

40 Policy
Vermont Utility Gives
Incentives for NatRef
Systems

// Europe

- 42** End User
To Russia With CO₂
- 46** Market
NatRefs Highlighted in First Italian Survey of HFC-Alternative Technology
- 48** End User
EPTA Expands FTE Installations in Greece and the Canary Islands
- 50** Technology
Tecnofreddo Launches Commercial R290 Air-source Heat Pumps

// Australia

- 52** Technology
Bitzer Expanding CO₂ Training Efforts in Australia and New Zealand
- 54** End User
Commercial Port to Deploy New Zealand's Largest Hydrocarbon System
- 56** Event
Small Grocers Seek Future-Proof Equipment at Metcash Expo 2019

// Japan

- 58** Market
Sales of the NewTon are Soaring
- 60** Event
Margarine, Beer and Ice Makers Are Adopting Transcritical CO₂ in Japan

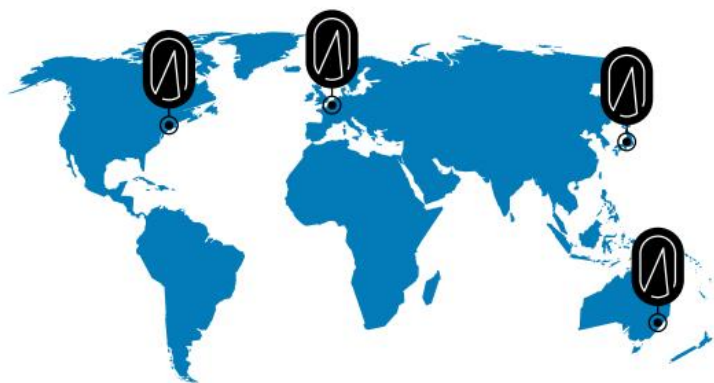
// China & Asia-Pacific

- 62** Technology
ITC's Project Blue Bird About to Take Flight
- 64** Technology
Training the Trainers on R290 AC in Thailand
- 66** Technology
Sanden Intercool Group Is Pushing Natural Refrigerants in Southeast Asia
- 68** Market
Chinese Companies Report Production of Nearly 160,000 Propane Room ACs

- 70** Alternative Technology
Nitrogen on Double Duty in Transport Refrigeration
- 72** Thought Leader Q&A
Taking the Measure of CO₂: Interview with Professor Armin Hafner
- 78** Editorial Corner

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.com 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.

WANT TO ADVERTISE?

/ Ad Coordinator

Silvia Scaldaferrì
silvia.scaldaferrì@shecco.com
+39 331 961 395

GOT A STORY IDEA?

/ Editor in Chief

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

September 2019
// Volume 1, Issue #103

Founder & Publisher

Marc Chasserot
marc.chasserot@shecco.com

Editor in Chief

Michael Garry
michael.garry@shecco.com

Associate Editor/Europe

Tine Stausholm

Associate Editor/Asia-Pacific

Devin Yoshimoto

Contributing Writers

Pilar Aleu
Pauline Bruge
Jan Dusek
Eda Isaksson
Zita Laumen
Rena Okabe
Caroline Rham
Tomoro Sato
Klara Zolcer Skacanov

Ad Coordinator

Silvia Scaldaferrì

Art Director

Juliana Gómez

Graphic Designers

Matjaž Krmelj
Anna Salhofer

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.

Editorial Calendar, 2019-2020, Volume 1

// ISSUE #101

June 2019

Cover Story:

NatRefs 101: Tracing the growth of natural refrigerants through the first 100 issues of *Accelerate* magazines 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, September 8-11); ATMosphere Asia (Bangkok, Thailand, September 25)

// ISSUE #104

October 2019

Cover Story:

How do NatRefs stack up in first cost, efficiency, maintenance – and TCO?

Publication Date: October 2

Ad Deadline: September 20

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

// ISSUE #105

**November/
December 2019**

Cover Story:

Year One of Kigali: Where do we stand?

Publication Date: October 28

Ad Deadline: October 21

Print Distribution: The 31st Meeting of the Parties to the Montreal Protocol (Rome, November 4-8)

// ISSUE #106

January 2020

Cover Story:

Women in Natural Refrigerants

Publication Date: January 8

Ad Deadline: December 20

Print Distribution:

AHR Expo (Orlando, Fla., February 3-5)

// ISSUE #107

February 2020

Cover Story:

How are NatRefs transforming heating and cooling of buildings?

Publication Date: February 6

Ad Deadline: January 27

// ISSUE #108

March 2020

Cover Story:

Which NatRef is Best: CO₂, Ammonia or Hydrocarbons?

Publication Date: March 5

Ad Deadline: February 21

Print Distribution: IAR Natural Refrigeration Conference and Heavy Equipment Expo (Orlando, Fla., March 15-18)

// ISSUE #109

April 2020

Cover Story:

How CO₂ heat pumps make electric cars go further

Publication Date: April 8

Ad Deadline: March 27

// ISSUE #110

May 2020

Cover Story:

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

Publication Date: May 6

Ad Deadline: April 24

The editorial calendar is subject to change by the publisher.

The Only Future-Proof Solution

— by Michael Garry

When Professor Gustav Lorentzen of the Norwegian University of Science and Technology (NTNU) in the late 1980s developed the modern transcritical cycle for CO₂ refrigeration, the world needed an environmentally friendly refrigerant. The primary refrigerants used at the time, CFCs, were found to be harmful to the atmospheric ozone layer, and were targeted for a phase out by the Montreal Protocol, signed in 1987.

Two more generations of halogenated refrigerants, HCFCs and HFCs, followed, with damaging effects on the ozone by the former and on climate change by both. Undeterred, the chemical industry came up with the latest generation of halogenated gases, HFOs, which are the subject of this month's cover story ([page 30](#)).

Pure HFOs such as R1234yf and R1234ze(E) have very low GWPs (though blends combining HFOs and HFCs have substantially higher GWPs) and don't hurt the ozone layer. Are they safe for the environment? The chemical industry insists that they are, but the real answer is, it depends.

In particular, it depends on how widespread the most popular HFO, R1234yf, becomes. Released into the atmosphere, R1234yf decomposes within a few weeks into trifluoroacetic acid, which is brought down to earth via rain – in effect, acid rain. Like any acid, TFA is harmful to the environment and humans in high enough concentrations. And unlike HFOs, TFA and its salts are very durable and long lasting. So the question is, will enough HFOs produce enough TFA to create yet another refrigerant-related environmental hazard that will ultimately need to be regulated?

Initial studies on TFA have concluded that, for the foreseeable future – perhaps up to 2050 – not enough of it will be produced by fugitive R1234yf emissions and other sources to be harmful. But that is hardly the last word on the subject.

A major 2017 study commissioned by the Norwegian Environment Agency, discussed at length in the cover story, points to many gaps in our knowledge of TFA's



Michael Garry
Editor in Chief

long-term environmental impact. It also projects the amount of HFOs that could be used through the year 2100, and addresses many other aspects of TFA.

The Norwegian study ultimately recommends a phase out of HFOs, or at least an emissions-reduction strategy, even without current evidence of harmful effects. This is an application of the "precautionary principle," which states that "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation," according to the UN's 1992 Rio Declaration on Environment and Development.

At a minimum, as Greenpeace has contended, HFOs should be listed in the Annex of Controlled Substances of the Kigali Amendment to the Montreal Protocol. This would enable an accurate global accounting of the volume of HFOs being produced and consumed, and the amount of TFA being released into the environment, and enable reporting and licensing to help prevent the illegal trade of HFCs mislabelled as HFOs.

Of course, the best solution is simply to avoid HFOs as much as possible and use instead natural refrigerants, the only future-proof HVAC&R solution.

■ MG

Millions of types – always unique!

$$\frac{\dot{Q}_c}{\int \frac{dB(A) \times E \times P^2}{AC + EC}} \times \frac{L \times B \times H}{(Cu + VA + Epoxy) \times \sum_{i=1}^{4.0 \text{ mm}} LT_i} \times \left(\frac{NH_3 + CO_2 + \text{propane}}{\sum_{i=1}^{1234 \text{ yf}} R_i + H_2O/\text{glycol}} \right) = 1$$



No matter what your requirement is:

As a leading manufacturer of first-class heat exchange technology for refrigeration engineering and air-conditioning, Guntner provides high-quality products for high operational safety and impresses with know-how and consulting expertise, especially also in the area of natural refrigerants like CO_2 and NH_3 . With the modular type of variety of the FLAT Vario and heat exchanger coils that offer the ideal combination of maximum capacity and minimum tube volume, optimized for each fluid, we are setting a new standard. Millions of types, but only 1 parameter that counts: You! Let us know your requirements.

For further information on our **FLAT Vario**, please visit our website.



Guntner U.S. LLC
+1 847-781-0900
info@guntner.com

www.guntnerus.com



Letters to the Editor

CHALLENGING THERMOACOUSTICS

According to the article ("[Turning Heat Into Sound Into Cold](#)," *Accelerate Magazine*, July-August 2019), for SoundEnergy's THEAC-25 device to produce 25 kW of cooling, a heat source temperature of at least 160°C (320°F) is required. The amount of waste heat energy, I guess, is a few times higher than 25 kW. An extra 2 kW of electricity is also required for pumps. The space required for the system is 4-by-4 m (13-by-13 ft) wide and about 80 cm (31 in) high, and it weighs 1,100 kg (2,425 lbs). This system costs \$50,000 US.

Using waste heat is a climate friendly idea, and *Accelerate*/shecco does a great job introducing such technologies. But if there is such a high-grade heat source available, isn't a mini-absorption chiller, for example, with ammonia-water, more affordable and compact? And how expensive should the electricity be to replace a conventional compact and much cheaper vapor compression refrigeration system with this system? Also, the environmental impact of producing and running this "waste heat recovery" system shouldn't be forgotten.

It is also well-known fact that thermoacoustics is less/much less efficient than vapor compression cycles. Thermoacoustic refrigeration is not a very new technology; the reason it hasn't been seen in the market widely is low efficiency and high cost. In the past decades it has only been used in niche applications, like space shuttles.

Mazyar Karampour
Senior Innovation Engineer
Electrolux
Stockholm, Sweden

EDITOR'S RESPONSE:

The SoundEnergy system has a heat transfer efficiency of 40%-50%, which may be less than traditional vapor-compression cycles, but it is aimed at companies producing waste heat that otherwise wouldn't be utilized. THEAC-25 can instead turn that into a resource using minimal electricity. Also with no vapor compression or refrigerants, the system requires less maintenance than traditional systems, and with the minimal electricity input required, it is suitable for off-grid locations. Also, the price for THEAC-25 units are expected to decrease as production scales up.

NOT WAITING FOR NEW STANDARD

In regard to "[500 g: How the new IEC charge limit for hydrocarbons will shake up commercial refrigeration](#)" (*Accelerate Magazine*, July-August 2019), AHT has been delivering commercial refrigeration equipment utilizing R290 into North America since 2013. We believe that there is a clear benefit for the use of R290 for self-contained equipment and we can provide our complete portfolio based on today's standards.

Our product roadmap is aligned to manage any future transitions, based on final market-specific regulations, but we will not take a "wait and see" approach. We feel there is a growing market demand for these types of products to support not only new stores but, more importantly, replacement projects for under-performing and "end-of-life" systems." AHT's system solutions are ready to help food retailers meet their sustainability goals today.

Drew Tombs
President
AHT Cooling Systems
USA Ladson, S.C.

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.



Our brand is only the tip of the iceberg

services

sustainability

*research and
development*

customer listening

vision



There's much more below the surface. All Arneg Group products are also characterised by imagination, courage, ethics, common sense and respect for people and nature. That is why, with our 20 production plants and 16 international offices, the Arneg Group is global leader in commercial refrigeration and excellent furnishing solutions for small, medium and large stores.



www.arneg.it



A Winning Combination

Variable speed compressors – along with R290 – offer better energy efficiency, faster ROI and a smaller carbon footprint

— By John Prall

Combining variable speed compressors (VSCs) with natural refrigerants is becoming a winning combination for businesses across the globe, and it's easy to see why. VSCs offer a number of benefits that can lead to increased equipment lifespan, temperature stability and energy savings.

When used with natural refrigerants like propane (R290), the combination can lead to not only a significant reduction of global warming potential (GWP), but also a quicker return on investment (ROI); this is due to the ability to use a smaller compressor to get the same cooling capacity as a larger HFC-based system. The myriad benefits of VSCs that utilize natural refrigerants increasingly make them the logical choice in commercial, light-commercial and medical applications.

Variable speed compressors have a "soft start," meaning the compressor starts at a lower speed before ramping up after a few minutes. This method of operating dramatically reduces the starting currents of the motor, reducing stress and prolonging the motor's life.

Since VSCs do not use start relays, start capacitors or run capacitors, and may not need overloads, potential failure modes of the systems are reduced.

Finally, VSCs have longer running times with fewer starts and stops. Through the use of VSCs, businesses can prolong the life of their equipment and maximize energy savings on that application, reducing costs and contributing to a much quicker ROI.

Efficient R290

Natural refrigerants like R290 are another major key for minimizing energy costs, increasing ROI and reducing impact on GWP. Switching from R404A to R290 can reduce energy consumption by 10% to 20%, and also switching from a traditional on/off compressor to a VSC can reduce consumption another 20%.

When compared to an HFC-charged compressor, the combination of a natural refrigerant with a VSC leads to a more compact and efficient cooling system, freeing up more merchandising space in commercial cabinets while keeping the same external dimensions of the equipment. This allows more design versatility for manufacturers and layout flexibility for stores.

Businesses that have adopted VSCs and natural refrigerants have benefited from increased energy savings and a minimized carbon footprint. In vertical commercial freezers, the switch from on-off compressor to VSCs can result in an energy-savings payoff within the first six months, reducing energy consumption by 33%.

These compressors are also highly effective for medical applications with higher sensitivity to temperature oscillations, as VSCs can achieve better product temperature stability and uniformity.

Equipment that combines VSCs and natural refrigerants is now being offered by major refrigeration companies, and this combination continues to be one of the most logical, cost-effective ways to increase equipment lifespan, reduce environmental impact and increase ROI in almost any refrigeration setting. ■ JP



John Prall serves as a technical support engineer at Embraco North America. His responsibilities include providing engineering technical support for commercial and aftermarket customers, including assisting customers in selection and application of hermetic compressors.

Natural Alternatives to HFCs are the Smart Choice in Refrigerants...

...and in Foam Insulation.

**Environmentally responsible Ecofoam® polyurethane insulation
offers the high R-values manufacturers need – without HFCs.**



ecofoam®
BY FOAM SUPPLIES, INC.

As the world transitions away from HFC refrigerants, leading HVAC/R manufacturers are also eliminating HFCs from their foam insulation by specifying Ecofoam®. Formulated with Ecomate®, our patented, HFC-free blowing agent technology, Ecofoam has NO global warming potential (GWP) and NO ozone depletion potential (ODP). Plus, by providing higher R-values, Ecofoam improves energy efficiency, further contributing to a more sustainable future.



www.foamsupplies.com

**Better products.
Better for the environment.**

AMERICAS

September 8-11

Energy & Store Development Conference, Dallas, Texas

The event covers store development and design, refrigeration, energy-efficiency and store maintenance.



<https://bit.ly/2MkUzb8>



@FMI_ORG

September 10-15

FEBRAVA 21st International Refrigeration, Air Conditioning, ventilation, Heating and Air Treatment Fair, Sao Paulo, Brazil

FEBRAVA showcases innovative products and launches for the entire HVAC&R chain.



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



<https://www.linkedin.com/showcase/febrava-br/>

September 24

GreenChill Webinar: Ozone Layer Update, Online

U.S. Environmental Protection Agency's GreenChill program hosts webinar featuring Paul Newman of NASA.



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



@EPAGreenchill

October 1-4

National Association of Convenience Stores Show, Atlanta, Ga.

The NACS Show features thousands of products and services that convenience stores and fuel retailers sell and use.



<https://bit.ly/30wHrac>



@NACSONline

October 8-11

RETA National Conference, Las Vegas, Nev.

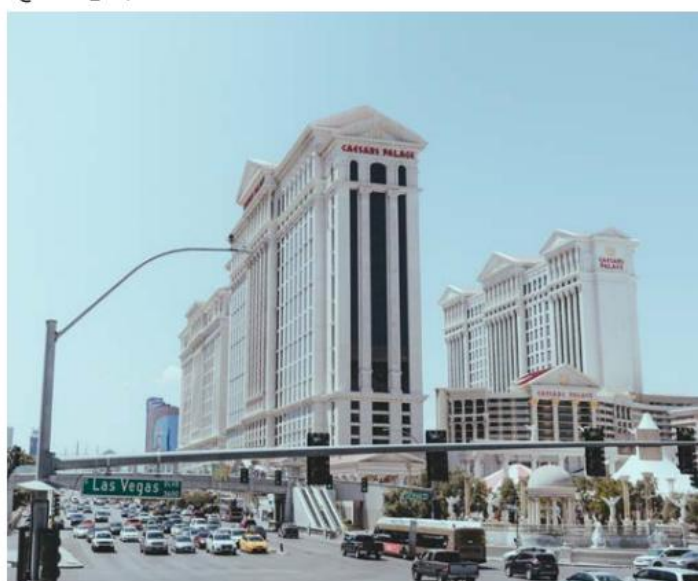
The Refrigerating Engineers & Technicians Association's National Conference offers hands-on training, workshops, technical presentations, networking events, and an exhibit hall.



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



@RETA_HQ



Las Vegas, Nev.

September 9-11

11th International Conference on Compressors and their Systems, London, United Kingdom

The program will include a full session dedicated to industrial issues of a non-technical nature, in addition to the traditional keynote addresses, research and technical papers, podium papers and discussions.



<https://bit.ly/2JR3aDo>

September 25-25

TEKNO+HVAC 2019, Abu Dhabi, United Arab Emirates

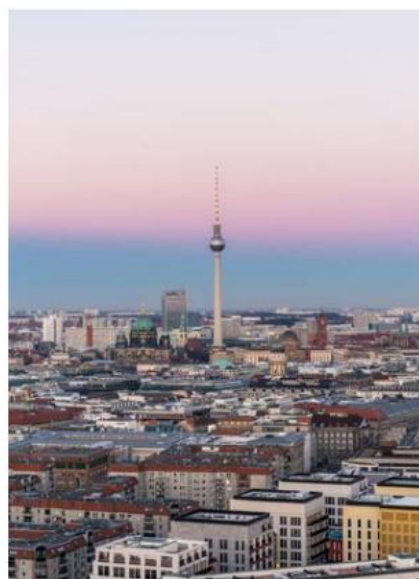
The event, now in its second year, will showcase exhibitors in the HVAC industry as well as engineering and technology solutions.



<https://bit.ly/2xPm483>



@TEKNO_HVAC_ME



Berlin, Germany

October 2-5

ISK-SODEX Istanbul 2019, Istanbul, Turkey

This HVAC&R exhibition provides focus on products in the sector with the cooperation of associations, magazines and international exhibitors.



<https://bit.ly/2JDc2xt>



@ISK_Sodex

October 16-17

ATMOsphere Europe 2019, Warsaw, Poland

This is the European edition of the global ATMOsphere conference series dedicated to natural refrigerants-based technologies, and features tailored content in a multifaceted program.



<https://bit.ly/2LX8Qym>



@ATMOEvents

October 24-25

Sustainable Retail Summit, Berlin, Germany

This Consumer Goods Forum event showcases examples of today's leading retail industry challenges and how to overcome them. It covers the entire sustainability eco-system.



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



@CGF_The_Forum

ASIA PACIFIC & AUSTRALIA

September 11-12

The Future of HVAC 2019, Brisbane, Australia

Organized by AIRAH, this is the sixth edition of an annual event for HVAC&R professionals, focused on where the industry is heading and how it's achieving its objectives.



<https://bit.ly/2GCNJh5>



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

September 25

ATMOsphere Asia 2019, Bangkok, Thailand

Coinciding with the Bangkok RHVAC trade show, ATMOsphere Asia will debate local/International f-gas policy, industrial refrigeration, market-ready solutions for food retail, and homegrown innovation.



<https://bit.ly/30ElciR>



@ATMOEvents

September 25-28

Bangkok RHVAC 2019, Bangkok, Thailand

The fair, the second largest exhibition in the Asia Pacific region, features buyers, importers, manufacturers, traders, distributors, wholesalers, retailers and department stores, and offers contact with end-users and local consumers on the public day.



<https://bit.ly/2u95XSQ>



<https://www.facebook.com/ditprhvac>

October 9-11

Refrigeration & HVAC Indonesia Jakarta, Jakarta, Indonesia

This event describes itself as the first and largest exhibition in Indonesia combining the areas of refrigeration and climate control.



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



@Messeninfo

October 30-November 1

China Fisheries and Seafood Expo 2019, Qingdao, China

Last year this event featured more than 1,500 exhibiting companies from over 50 countries and regions in over 45,000 m² of exhibit space. It was attended by over 33,000 seafood professionals from more than 100 countries.



<http://chinaseafoodexpo.com>



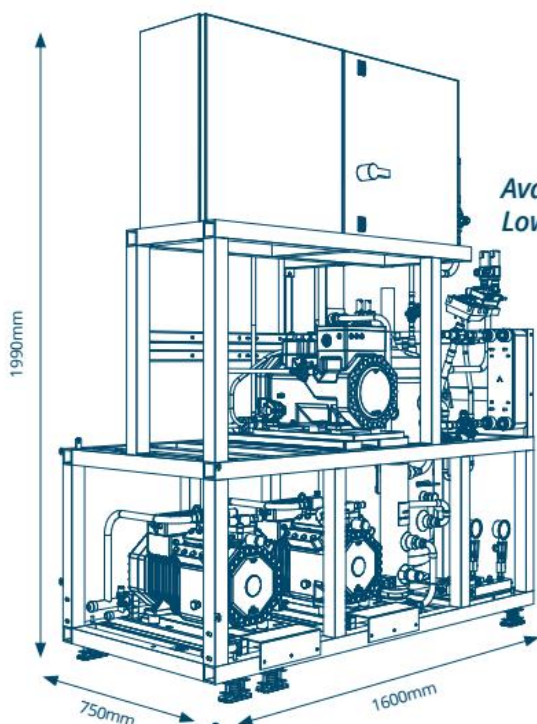
@SeaFareExpo



Bangkok, Thailand

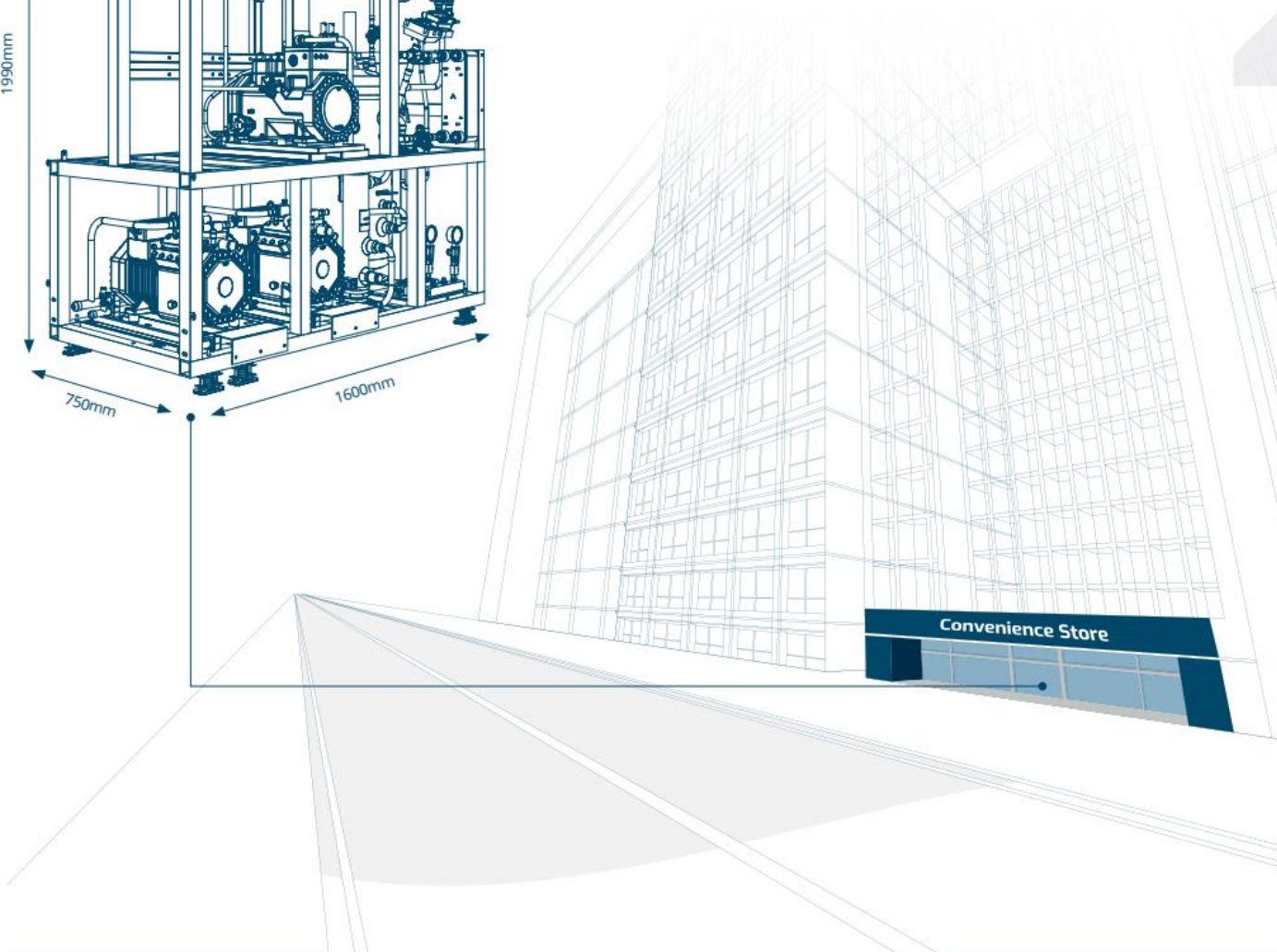
Cold Solutions for Convenience Stores

CO₂ transcritical racks



*Available with
Low Noise Box*

CO₂



NOMINATIONS OPEN FOR ACCELERATE MAGAZINE AWARDS/EUROPE

The awards recognize excellence in advancing natural refrigerant technologies; nominations close on September 16, 2019.

— By Tine Stausholm

The 3rd annual *Accelerate Magazine Awards/Europe* program, which recognizes people and organizations that excel in advancing natural-refrigerant technologies, has launched its nomination process.

Nominations in any of the awards categories are welcomed from end users, manufacturers, academics, contractors, consultants, policymakers, and others working with natural refrigerants in the HVAC&R industry. Self-nominations are accepted.

You can send your nominations in one or more categories to michael.garry@shecco.com; include your name, company, email, and phone number, nominee, award category, and reasons for nomination. Information on last year's winners is available at <https://bit.ly/2GRMx9B>

The awards will be handed out at the 10th annual ATMOsphere Europe conference, taking place in Warsaw, Poland, from October 16-17. Learn more about ATMOsphere Europe at <https://bit.ly/2LX8Qym>

The awards include five categories:

- Best in Sector/Food Retail
- Best in Sector/Industrial
- Best in Sector/Foodservice
- Innovation of the Year
- Person of the Year

Food retail includes any stores that sell food primarily for consumption at home or on the go. Foodservice includes any retail outlets offering prepared food for consumption, primarily at the location, as well as food or beverage companies that supply their own cooling equipment to any retail establishment. Industrial includes cold-storage, food-processing and other operators of large facilities using HVAC&R equipment.

Selection criteria

The Best in Sector nominees are evaluated on their efforts to further the adoption of natural refrigerant technologies from July 2018 to September 2019. The trophies will be awarded to technologies or systems that are part of new builds or remodels.

The judges are basing their decision on the following criteria:

- A reduction in energy consumption.
- A reduction in greenhouse gas emissions.
- Ease of reproduction, and a business case including installation, operation, maintenance and training, and return on investment.
- Commitment to future natural-refrigerant installations.

► Industry leadership.

► Innovation and perseverance.

The Person of the Year award is presented to a single individual who has done the most to advance the adoption of natural refrigerant technologies in HVAC&R applications in Europe between July 2018 and September 2019. Nominations for this category can be applied to individuals from end users, manufacturers, policymaking, academia and research.

The judges assess nominations for Person of the Year based on the following criteria:

- Impact on development and/or implementation of natural refrigerant solutions.
- Leadership within their organization and/or their industry.
- Innovation and perseverance.

Last, but certainly not least, the Innovation of the Year award recognizes companies that have recently developed a novel natural refrigerant-based product with a significant impact on the market, with multiple installations in the field.

A panel consisting of shecco staff and external experts will select the Best in Sector category winners and the Person of the Year. The Innovation of the Year award will be decided by popular voting on selected nominations; after the nomination deadline, an online voting form will be published.

The *Accelerate Magazine Awards/Europe* were previously called the *Accelerate Europe Awards*. *Accelerate Europe* magazine was incorporated into *Accelerate Magazine* in June. ■ TS

Ammonia Gas Detection

Model GG-NH3



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

- ◇ Designed to handle -50°F to +130°F operating temperatures (-45°C to +55°C)
- ◇ Encapsulated circuitry prevents corrosion and withstands high pressure washdowns
- ◇ CTI's ammonia specific electrochemical sensor element eliminates false alarms
 - ◇ Every sensor passes rigorous testing and includes a 2-year warranty
 - ◇ All items are in stock. Fast and easy international shipping
 - ◇ SafeCell technology continuously checks the cell's electrical viability

WEB: ctiengineering.com

EMAIL: sales@ctiengineering.com



Visit the CTI booth at a trade show near you!

IIAR Refrigeration Seminar | Guadalajara, MX | Aug 1-3

IIAR Refrigeration Seminar | Buenos Aires, AR | Aug 8-9

Intl Congress of Refrigeration | Montreal, CA | Aug 26-28

Impact of Cooling on United Nation's 17 Sustainable Development Goals



GOOD HEALTH AND WELL-BEING

Air conditioning offers protection from temperature extremes.



QUALITY EDUCATION

Reducing the risk of malnutrition positively impacts academic performance.



NO POVERTY

Cold chains enhance income for fishermen and farmers.



ZERO HUNGER

Refrigeration enhances food security through extending the shelf life of produce.



CLEAN WATER AND SANITATION

Preventing food spoilage saves substantial amounts of water.



AFFORDABLE AND CLEAN ENERGY

Efficient air conditioning helps compensate for skyrocketing demand for AC.



DECENT WORK AND ECONOMIC GROWTH

Cold chains enhance the efficiency and profitability of agriculture and fishing.



INDUSTRY INNOVATION AND INFRASTRUCTURE

All forms of cooling will require substantial investments in infrastructure and innovation.



REDUCE INEQUALITIES

Clean cold chains reduce poverty by lowering food prices.



SUSTAINABLE CITIES AND COMMUNITIES

Sustainable cooling and design for buildings and transport reduce energy demand.



RESPONSIBLE CONSUMPTION AND PRODUCTION

Food and vaccine loss are reduced through proper access to refrigeration.



CLIMATE ACTION

Cooling uses substantial quantities of energy and causes direct emissions from refrigerant leakage.



LIFE BELOW WATER

Wastage of marine products before reaching market increases pressure on fish stocks.



LIFE ON LAND

Reducing food wastage eases the main driver of deforestation and land degradation.



PEACE AND JUSTICE

Clean cold technologies indirectly help to maintain peace from rising food prices and rural poverty.



PARTNERSHIP FOR GOALS

There is an opportunity to help developing countries leapfrog to clean cold chains.

shecco Base

SOURCE:

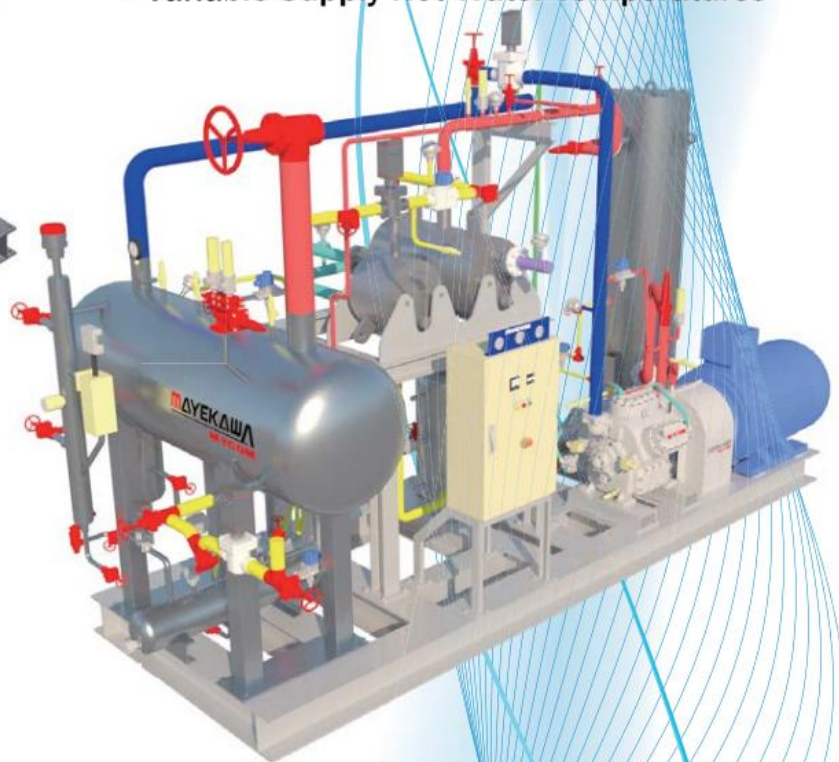
University of Birmingham, U.K.

AMMONIA HEAT PUMP

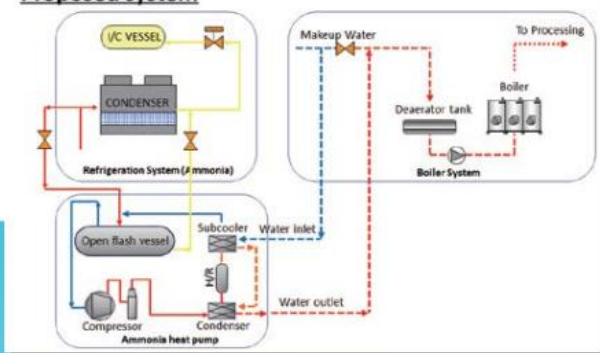


Features of the Ammonia Heat Pump

- Continuous Hot Water Supply
- High Efficiency
- Relatively Easy Installation
- Environmentally Friendly Water Heating
- Variable Supply Hot Water Temperatures



Proposed system



Conclusion

With the use of Ammonia Heat Pumps, we can reduce the usage of natural gas or Heavy oil to further assist in the operation cost down around 3.0 M.THB/year.

Application examples have shown that Ammonia Heat Pumps are effective in reducing CO₂ emissions around 781 t - CO₂/Y.

In the future, Ammonia heat pumps are expected to replace or complement conventional boilers.

Kigali Update

Eighty-One countries (including the European Union) have accepted, ratified or approved the Kigali Amendment to the Montreal Protocol as of August 27, 2019*

The Kigali Amendment to the Montreal Protocol was enacted on October 15, 2016 by 197 countries (parties) 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.

Fifty developed (Non-Article 5) countries start 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 end with an 85% HFC phase down by 2036. Thirty-one have so far accepted, ratified or approved the Amendment.

The 147 developing (Article 5) countries fall into two groups. The majority starts a freeze in 2024 at a baseline of average HFC production/use in 2020-2022; those countries 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) start a freeze in 2028 at a baseline of average HFC production/use in 2024-2026; those countries end with an 85% HFC phase down by 2047. So far 50 Article 5 countries (both groups) have accepted, ratified or approved the Amendment.

Here is a list of the 81 countries that have accepted, ratified or approved the Kigali Amendment as of August 27. The countries that have done so since June 5 include: Cuba, Ethiopia, Cyprus, South Africa, Ghana, Peru, Seychelles and Cook Islands.

* 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
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

Participant	Acceptance(A), Ratification, Approval(AA)
Albania	Jan 18, 2019
Armenia	May 2, 2019 A
Barbados	Apr 19, 2018
Benin	Mar 19, 2018
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-Bissau	Oct 22, 2018
Honduras	Jan 28, 2019
Kiribati	Oct 26, 2018
Lao People's Democratic Republic	Nov 16, 2017 A
Malawi	Nov 21, 2017
Maldives	Nov 13, 2017
Mali	Mar 31, 2017 A
Marshall Islands	May 15, 2017
Mexico	Sep 25, 2018 A
Micronesia (Federated States of)	May 12, 2017
Montenegro	Apr 23, 2019

Participant	Acceptance(A), Ratification, Approval(AA)
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
Seychelles	Aug 20, 2019 A
Senegal	Aug 31, 2018
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



GLOBAL COOLING PRIZE ANNOUNCES CEREMONY FOR FINALISTS

Up to 10 developers of breakthrough cooling technologies will be awarded US \$200,000 each on November 15, in New Delhi, India

— By Tine Stausholm

The Global Cooling Prize, designed to spur the development of climate-friendly room air conditioning (RAC), has announced in an email communication that up to 10 finalists will be revealed at a ceremony in New Delhi, India, on November 15, 2019.

The prize competition aims to develop residential cooling technology that has a climate impact at least five times lower than current standard room air conditioning units.

The 10 finalists came from a submission process that resulted in 445 "Intent to Apply" forms from around the world.

The competition was launched in November 2018 by the Government of India, Mission Innovation and the Rocky Mountain Institute (RMI), and it has Sir Richard Branson as its ambassador. It is administered by RMI, Conservation X Labs, the Alliance for an Energy Efficient Economy (AEEE) and CEPT University.

The awards ceremony "will feature these breakthrough cooling technologies and will have special remarks from global and national leaders on the dais," said Iain Campbell, senior fellow, RMI.

This is a special invitation-only event with limited capacity. Individuals who would like to attend should contact the prize administrators at info@globalcoolingprize.org.

All the shortlisted candidates will be awarded US \$200,000 to support further development of their idea, and the construction of two working prototypes delivered to an Indian test site.

After testing and evaluation of the prototypes, the final winner will be announced in November or December 2020. The winner, or winning team, will receive an additional US \$1 million in prize money.



U.S. AND INDIA LEAD SUBMISSIONS

The 445 candidates are from 56 countries, with the largest number of submissions coming from the United States and India - 140 and 122, respectively. The candidates include individuals, start-ups, university researchers, nonprofits and companies within the air conditioning industry, with the largest groups being individuals (36.4%) and start-ups (27.6%).

The winning AC technology could prevent up to 100 gigatons (GT) of CO₂e emissions by 2050, and put the world on a pathway to mitigate up to 0.5°C of global warming by 2100, said the prize organizers.

According to a report by RMI, "Solving the Global Cooling Challenge," business-as-usual measures are insufficient to overcome the impact of RAC growth and calls for a "5x" solution.

"What we have done is defined the target, and we are asking the world's innovators, whoever you are, to hit that target," said Paul Bunje, co-founder and COO/CSO of Conservation X Labs. "Have five times less climate impact - and you will win. By doing that, we all change the world." ■ TS

The natural evolution

of connected efficiency

CAREL

Visit

natref.carel.com

From convenience up to
hypermarket format:
CAREL solutions for
all types of refrigerants

CO₂
R744

HC
R290

HFO
R448A
R449A

HFO

HC

CO₂



← **Heos** →



← **HFCu** →



← **pRack** →

Connected Efficiency

REPORT RECOMMENDS FOUR FINANCING MODELS FOR EFFICIENT COOLING

NRDC/Climate Finance Advisors paper addresses the absence of an international institution or fund dedicated to the development of efficient HVAC&R

— by Michael Garry

A new report produced by the Natural Resources Defense Council (NRDC) and Climate Finance Advisors describes four models by which the development and implementation of efficient HVAC&R cooling systems could be financed.

The report, supported by the Kigali Cooling Efficiency Program (K-CEP), comes at a time of considerable interest in efficient cooling as part of a strategy to reduce greenhouse gas emissions that includes the phase-down of high GWP refrigerants.

For example, K-CEP is a philanthropic collaborative that works with the Kigali Amendment to the Montreal Protocol to help developing countries transition to energy-efficient, climate-friendly, and affordable cooling solutions.

Another initiative, Global Cooling Prize, will award US \$1 million for the development of residential cooling technology that has a climate impact at least five times lower than current standard room air conditioning units. (See page 24.) Also, the World Bank launched an initiative this year to accelerate the uptake of sustainable cooling solutions.

The NRDC/Climate Finance Advisors report — called “Discussion Paper: Architecture & Financing Models for

Efficient Cooling Alongside the Montreal Protocol,” available at <https://on.nrdc.org/2P9hay3> — recognizes “the proven institutional machinery of the Montreal Protocol” that is working to phase down HFCs via the Kigali Amendment. However, cooling efficiency, it notes, “has no equivalent international institution or fund dedicated to it; it is but one of many issues on the agendas of the multilateral climate funds.”

Support for cooling efficiency has therefore been provided mostly in an “ad hoc, uncoordinated manner, failing in particular to capitalize on the Montreal Protocol’s work phasing out ozone depleting substances (ODSs) from appliances whose energy use is significant,” the report said.

The report reviews the initiatives of the Montreal Protocol and climate finance communities that offer precedents for a cooperative cooling efficiency program. It then describes four generic arrangements, or models, for collaboration among institutions:

- ▶ An energy-efficiency “sidecar” to the Multilateral Fund (MLF) for the Implementation of the Montreal Protocol;
- ▶ A dedicated donor facility housed at a multilateral climate fund or development financial institution such as the Green Climate Fund (GCF), Global

Environmental Facility (GEF), United Nations Environment Programme (UNEP) or World Bank;

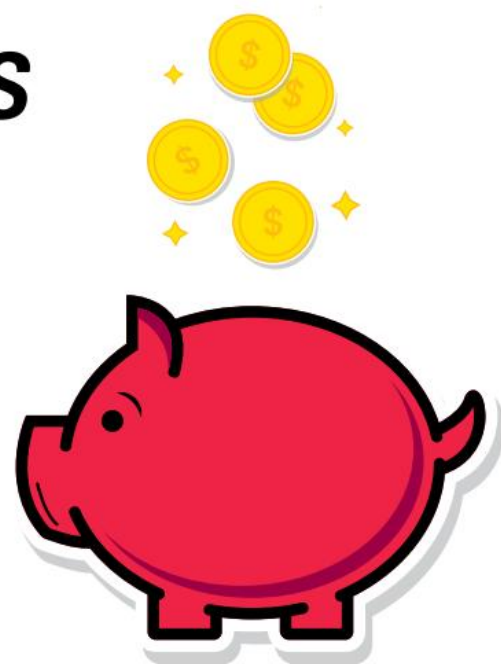
▶ A formal mechanism of inter-institutional coordination between the MLF and other multilateral climate change entities such as the United Nations Framework Convention on Climate Change (UNFCCC), GEF, and/or GCF without funding;

▶ An increase in disparate, ad hoc activities (most closely resembling the status quo).

The report described the strengths and weaknesses of each model.

“One or a combination of these models may be deployed to enhance energy efficiency alongside the work of the Montreal Protocol or, to even greater effect, transform multilateral support for cooling efficiency well beyond the interface of cooling efficiency with the Montreal Protocol,” the report said.

The report offers several next steps to “get an efficient cooling program off the ground”: stakeholders should identify “the challenges to be addressed and solutions available”; funding should be allocated to support development of a plan; and pilot programs should be developed to provide “the evidence base for a major cooling efficiency program.” ■ MG



embraco

Pioneer in Solutions
with Natural Refrigerants

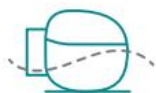


COOL MOMENTS POWERED BY **EMBRACO FULLMOTION** **R-290** VARIABLE SPEED COMPRESSOR

UP TO 40% OF ENERGY
SAVINGS BY SWITCHING TO
EMBRACO R-290 VARIABLE
SPEED COMPRESSOR



HIGH EFFICIENCY
REFRIGERANT



FULL LBP / MBP
OPERATING ENVELOPE



LOWER OPERATING
PRESSURES



EXTREMELY
LOW GWP



LOW REFRIGERANT
CHARGE



DOWNLOAD EMBRACO
TOOLBOX APP



PRODUCT
SELECTOR

EMBRACO.COM

World In Brief

GEA to Equip Chinese Cruise Ships with CO₂

German manufacturer GEA will equip two Chinese cruise ships with transcritical CO₂ refrigeration systems – the first two cruise ships ever built in China, the company says.

In May 2019, GEA signed a contract to supply transcritical CO₂ refrigeration technology with Shanghai Waigaoqiao Shipbuilding (SWS). SWS is building the cruise ships for new Chinese brand CSSC Carnival Cruise Shipping Ltd.

The agreement between GEA and SWS provides for the supply of refrigeration and freezing for all food and beverage on board. The first ship will be delivered in 2023.

Last year, GEA signed a contract with P&O Cruises to supply transcritical CO₂ refrigeration technology. The system has already been installed on board the *Arcadia*, a 2,000-passenger ship, where it provides refrigeration for all the ship's food and beverages.

The use of CO₂ technology is relatively new in the marine business as it is difficult to develop flexible CO₂ cooling systems that can be safely installed in the confined and mobile environments of seagoing vessels, said GEA.

The modular transcritical CO₂ systems GEA is supplying for vessels operate with multiple GEA Bock compressors. Redundancy is built into the system and "it can be tailored to almost any available space on board and is designed to operate safely, robustly and reliably even in difficult weather conditions," GEA said. ■ MG

shecco Launches Low-Charge NH₃ Guide

shecco has published the first of a three-part report, "[World Guide to Low-Charge Ammonia](#)," that provides insights into the fast-growing technology.

The first part of the guide highlights key features of ammonia (NH₃) as a refrigerant and describes the history of its use.

"The use of low-charge ammonia has emerged as one of the key trends in the industrial refrigeration industry in the last few years," said Klara Zolcer Skačanová market development manager for shecco. The report, she added, "aims to identify the underlying trends for low-charge ammonia technology in different parts of the world."

The second part will describe the variety of applications of low-charge NH₃ technology around the world, and outline standards and legislation in the area.

Part three will focus on key trends for low-charge NH₃ technology in different regions, its advantages, drivers and major challenges in today's market.

The initial report addresses the definition of low-charge ammonia. "The term 'low-charge ammonia' is not well defined yet; a clear definition and distinction from traditional ammonia systems is essential to strengthen the position of low-charge systems," said Skačanová. ■ TS

GCCA, OSHA Renew Alliance on NH₃ Safety

Global Cold Chain Alliance (GCCA) renewed an alliance with the Occupational Safety & Health Administration (OSHA), during the GCCA's Cold Chain Policy Forum, held recently in Washington, DC.

The nine-year-old partnership provides GCCA members, and others in the cold chain, with information, guidance, and access to training resources that will help them protect the health and safety of workers, particularly by preventing exposure to hazards related to ammonia refrigeration systems.

GCCA has worked with the OSHA Training Institute to provide web-based training to over 150 OSHA inspectors. The trade group has also supported training for agency personnel in connection with the WFLO Institute, hosting in-person education programs. ■ MG

N.Y. and NASRC to Co-Host Workshop On HFC Regulations

The New York State Department of Environmental Conservation (DEC) and the North American Sustainable Refrigeration Council (NASRC) will co-host a free workshop on September 27 to help supermarket stakeholders prepare for New York's upcoming HFC regulations.

The workshop will also offer stakeholders an opportunity to engage in, and provide input for, the state's regulatory process, according to the NASRC.

Attendees will gain an overview of current low-GWP alternatives to HFCs, recent technology innovations, strategies for energy optimization, and opportunities for financial incentives.

The workshop will take place at DEC's public assembly room on 625 Broadway, Albany, NY 12233, from 8:30 am-4:30 pm. ■ TS

Danfoss Hosts Third Refrigeration Week

Danish HVAC&R component manufacturer Danfoss will host the third annual worldwide [Refrigeration Week](#) on September 16 – 20, 2019. This year's event aims to prepare industry stakeholders to handle the increasing pace of transition to natural refrigerants.

"We want to help professionals everywhere to stay abreast of the latest issues and trends, but more importantly to contribute to the conversation and give their view," said Torben Funder-Kristensen, head of public and industry affairs, Danfoss Cooling.

The event will cover a wide range of topics and include industrial and commercial refrigeration, as well as air conditioning. The packed program is aimed at installers, resellers, wholesalers, operators and OEMs. It

will include webinars, podcasts and local training events.

The webinars will include sessions on:

- ▶ Handling flammable refrigerants,
- ▶ New developments in CO₂ technology,
- ▶ Moving on from R404A and R22,
- ▶ Global refrigerant trends that impact your business,
- ▶ Digital tools to help conversion.

To ensure global coverage, the event will include content in several languages and the webinars will be scheduled to give stakeholders in a wide variety of time zones the opportunity to participate. ■ TS

IOR Seeks Abstracts for Rankine 2020 Conference

The U.K.-based Institute of Refrigeration (IOR) has issued a call for presentation abstracts for the IIR International Rankine 2020 Conference – Advances in Cooling, Heating and Power Generation, to be held July 26-29, 2020 at the University of Glasgow in Scotland.

The deadline for submitting an abstract by September 20. More information on how to submit abstracts can be found at www.rankine2020.com.

This is the first international conference bringing together the disciplines of the Organic Rankine Cycle (ORC) and refrigeration, air conditioning and heat pumps (RACHP). Program themes include cooling and heating refrigeration systems, power generation using organic fluids, and working fluids. ■ MG

EU Seeks Comments for 'Taxonomy' Report

The European Union (EU) is [seeking public comments](#) until September 13 for its "Taxonomy" report, which presents a classification system of environmentally sustainable economic activities.

This system provides practical guidance for policy makers, industry and investors on how best to invest in economic activities that contribute to achieving a climate-neutral economy. It is scheduled to be integrated into an upcoming legislative proposal at the EU level.

The Taxonomy report identifies refrigerants with a GWP under 10 for electric heat pumps with a seasonal coefficient of performance (COP) threshold above 3.33 as one of the climate change mitigation criteria that would substantially improve the environmental performance of industries. ■ PB

Arneg Nordic Acquires 70% Stake in Plug-In Norge

Arneg Nordic has purchased 70% of the shares of Norwegian plug-in cabinet specialist Plug-In Norge AS. With the acquisition, Plug-In Norge becomes a part of Arneg Group.

Per Otto Gjertsen (managing director, Plug-In Norge), Ole Fredrik Eide (product & marketing director), and Vidar Bakken (sales director) together retain the remaining 30% of the Plug-In Norge shares.

Plug-In Norge was founded in 2015. The company, which specializes in medium and low temperature plug-in display cabinets, uses only propane (R290) and isobutane (R600) in its products. It is already a distributor of Arneg Nordic and Oscartielle equipment.

Apart from food and beverage cabinets, Plug-In Norge's product range includes flower and waste coolers. The company also offers servicing and maintenance of equipment.

Founded in 1963, multinational Arneg Group is headquartered in Italy and specializes in commercial refrigeration. The group designs, manufactures and installs more than 20 lines of plug-in R290 display cases for supermarkets. It started using R290 in 2011, and has produced over 8,000 of these units.

Plug-In Norge, located in Tönsberg south of Oslo, has eight employees and had a turnover of 120 million NOK (\$13.34 million US) in 2018. ■ TS

Research for this article
was contributed by Tine
Stausholm, Klara Zolcer
Skacanova and Zita Laumen



While the trifluoroacetic acid produced by R1234yf in the atmosphere is not considered an environmental threat in the foreseeable future, nature's ultimate tolerance to TFA accumulation remains an open question

— By Michael Garry

HFOs

How much is too much?

HFCs, the most omnipresent refrigerants in the world since the 1990s, have a pedigree: They represent the third generation of synthetic halogenated refrigerants used in the HVAC&R industry.

HFCs succeeded the first- and second-generation refrigerants (CFCs and HCFCs, respectively), which were found to degrade the atmospheric ozone layer, and were then targeted for global phase-out under the Montreal Protocol.

But because of HFCs' high GWP values, which make them super-polluting greenhouse gases that contribute significantly to global warming, they have now been targeted for a global phase down under the 2016 Kigali Amendment to the Montreal Protocol.

The demise of these halogenated refrigerants sparked the rise of natural refrigerants as an environmentally benign alternative.

But HFCs are being succeeded by a fourth generation of halogenated refrigerants, known as HFOs (hydrofluoroolefins). Can HFOs serve as a replacement for HFCs, or will they suffer the same regulatory fate as their predecessors?

The most commonly used HFO, R1234yf, has passed muster with government environmental agencies around the

world. However, while having a low GWP (four), and not harmful to the ozone layer, R1234yf has still raised questions with regard to the environment and human safety.

R1234yf has become a popular substitute for R134a in mobile air conditioning (MAC) systems used in cars and trucks. The gas has also been marketed as an aerosol propellant, and can increasingly be found in supermarket refrigeration systems as part of an HFO/HFC blend. Because of the presence of HFCs, these blends still have a relatively high GWP, ranging from about 150 to 1900.

When it escapes into the atmosphere, R1234yf lasts only up to two weeks before breaking down completely into trifluoroacetic acid (TFA), a highly durable and mobile substance. (By comparison, from 7%-20% of R134a, and under 10% of another HFO, R1234ze(E), decompose into TFA.) TFA descends via rainfall as a form of "acid rain" to the earth; there it accumulates in various bodies of water, including rivers, streams, lakes and wetlands, as well as "terminal sinks" like salt lakes, playas and oceans. In water bodies TFA can form trifluoroacetate salts by reacting with minerals such as calcium and sodium; these salts are grouped with TFA in terms of environmental effect.

TFA occurs naturally in oceans but in freshwaters, it is thought to be solely human-made (anthropogenic).

Numerous studies have been done about TFA's potential for environmental harm. The consensus is that, for the foreseeable future, the accumulation of TFA will be too small to pose a threat to the environment and humanity. One manufacturer of R1234yf, Chemours, does not see any uncertainty about the long-term viability of its HFO products; see page 35. (Two other manufacturers, Honeywell and Arkema, did not respond to a request for comment.)

But in sufficient quantities, TFA can be a destructive substance. In pure form, it is harmful when inhaled, and causes severe skin burns; in concentrations as low as that approaching 1 mg/l, it may be toxic to some aquatic life forms.

Given the durability of TFA, and the growing use of R1234yf throughout the world in different applications, will there be a point when enough TFA has accumulated to harm the environment? How long would it take? How much is too much?

NGO Greenpeace International takes the position that there is insufficient knowledge on the tolerable thresholds of TFA accumulation in the environment. "What level of HFO use will result in catastrophic levels of TFA accumulation?" asks Janos Maté, senior policy consultant for Greenpeace. "What is the TFA accumulation tolerance level of nature?"

Source: Empa, Update of
"First observations of the
fourth generation synthetic
halocarbons HFO-1234yf, HFO-
1234ze(E) and HCFO-1233zd(E)."
Measurements taken at
Jungfrauoch, Switzerland



Detection of R1234yf in the Atmosphere Over Europe % of samples in which detected



The uncertainty is magnified by what Maté calls "the sorry track record" of the chemical industry with CFC, HCFC and HFC products, which have caused extensive environmental damage while "the costs of cleaning up have been left to the public purse."

The large-scale uptake of HFOs, he added, "must be prevented until there is a full understanding of peak production levels of HFOs and other TFA-producing substances, and their long-term TFA contribution to the environment."

Another NGO, the Environmental Investigation Agency (EIA), has expressed concern "at the potential impact of TFA degradation, given the predicted widespread use of R1234yf in mobile air conditioning and other sectors."

At the European Union, Philip Owen, head of unit, Directorate-General for Climate Action in the European Commission, described the degradation of R1234yf into TFA as "a concern which requires further research and evaluation" at the 29th Meeting of the Parties to the Montreal Protocol in 2017.

But in a recent communication, he referred to the Montreal Protocol's Environmental Effects Assessment Panel (EEAP), which, he said, reported in 2018 that TFA "is not expected to pose a risk to humans or the environment."

However, he added, the EU "will strive to ensure that TFA continues to be addressed by the Montreal Protocol's EEAP when the terms of reference for the Panel's next report is negotiated in November."

The EU's largest member nation, Germany, has cast a wary eye on R1234yf. From an environmental point of view, "the refrigerant R1234yf is not an overall satisfying solution," said the German Environment Agency (Umweltbundesamt or UBA).

Growing use of HFOs

There is little doubt that the amount of HFOs being used and emitted into the atmosphere is increasing.

The European Environment Agency reported in its "[Fluorinated greenhouse gases 2018](#)" report that the total EU supply of R1234yf (production, reclamation and imports) grew from 826 metric tons in 2014 to 10,493 metric tons in 2017.

According to Germany's UBA, "R1234yf and other new short lived refrigerants like R1233zd(E) and R1234ze are found more often and in increasing concentrations in the ambient air." Moreover, said the UBA, "It was calculated for the EU that about 18,600 tons of TFA will be emitted into the environment per year when the passenger cars alone are fully equipped with R1234yf, not to mention the TFA arising from new refrigerant blends."

Empa, the Swiss Federal Laboratories for Materials Science and Technology, has studied the atmospheric presence of two HFOs and an HCFO in the atmosphere. In June, it published an [update of its 2015 study](#) ("First observations of the fourth generation synthetic halocarbons HFO-1234yf, HFO-1234ze(E) and HCFO-1233zd(E) in the atmosphere"). Measurements were made at two locations, Jungfrauoch in

the Bernese Alps in Western Switzerland, and Dubendorf, the Zurich suburb where Empa is based.

Since the Jungfrauoch and Dubendorf measurements were published in 2015, the two HFOs and the HCFO "have continued to grow in the atmosphere, both in frequency of detectable mole fraction as well as on their intensities/magnitudes," according to the Empa update, written by Martin Vollmer.

While R1234yf at Jungfrauoch was detected in none of 4,150 samples in 2011, when the measurements began, "it was detected in 10% of all samples in 2015, in 30% in 2016, in 45% in 2017, and in 71% of all samples measured in 2018," wrote Vollmer.

A 2015 Chinese study of TFA found a marked rise in TFA in urban landscape waters, tap water and snows in Beijing between 2002 and 2012. The study, "[A 17-fold increase of trifluoroacetic acid in landscape waters of Beijing, China during the last decade](#)," found a rise in TFA concentrations from 23-98ng/l to 345-828ng/l in urban landscape waters, and an "obvious increase" from "not detected" to 155ng/l in tap water. The "remarkable increase" of TFA was attributable to dry and wet deposition. "Our results recommend that measures are needed to control the increase of TFA in China," the study said.

How long would it take for the accumulation of TFA to have an adverse impact? According to the [Scientific Assessment of Ozone Depletion \(SAP\) 2018 report](#), there is "increased confidence" the TFA produced from the degradation of R1234yf and

other refrigerants “will not harm the environment over the next few decades,” However, potential impacts beyond a few decades “could require future evaluation due to the environmental persistence of TFA and uncertainty in future emissions of [R1234yf] and other HFCs that produce TFA upon degradation.”

‘What are we doing?’

That HFOs linger as a concern in the HVAC&R industry was evident at the ATMOsphere America conference in Atlanta, Ga., U.S., in June, during the policy discussion. One of the panelists was Glenn Gallagher, air pollution specialist for the California Air Resources Board, which is pursuing many avenues to meet and go beyond the HFC-reduction requirements of the Kigali Amendment.

One conference attendee asked, “What are we doing about HFOs?”

“Unfortunately, the answer is nothing,” said Gallagher. But, he added, “it’s on our radar.”

Gallagher also referred to [a major study conducted for the Norway Environment Agency](#) that closely considered the TFA question and identified numerous “knowledge gaps” that need to be filled before a definitive statement about TFA’s environmental impact can be made. “It basically said we don’t have enough information to know if it will be harmful or not,” he said.

Conducted for Norway by U.K.-based Risk & Policy Analysts, the 2017 report on the study, called “Study on environmental

and health effects of HFO refrigerants,” tracked the current state of knowledge on HFOs and TFA. It projected levels of HFO emissions through 2100, and assessed how HFO emissions could affect the environment, pointing to many areas of concern as well as noting which areas need to still be investigated.

Information for the Norwegian study was gathered from academic and grey literature as well as consultations with various stakeholders, including a manufacturer of HFO refrigerants, a company involved in the reclamation of HFO refrigerants, academic experts, a nongovernment organization and a refrigeration industry association.

Among the Norwegian study’s contributions was its projection of HFO refrigerant emissions up to the year 2100 for Non-Article 5 (developed) countries and Article 5 (developing) countries. It tracked emissions from the commercial, industrial, transport, stationary AC and mobile AC sectors.

The study used different projection models, including business-as-usual (BAU) and two MIT (mitigation)-5 scenarios (worst and best case), which assume the completion of conversion of key non-Article 5 RAC equipment by 2025 and the commencement of similar conversions in Article 5 countries by the same date. One MIT-5 scenario looks at HFO emissions frozen from 2050 to 2100 and another looks at a phase out after 2050.

For projections up to 2050, the study used the UN’s September 2016 TEAP (Technology and Economic Assessment

Panel) Task Force Report (XXVII/4), which included all low-GWP refrigerants, including natural refrigerants. For projections after 2050, the study focused on R1234yf. (It noted that HFO blends containing R1234yf and HFCs “may not result in different [degradation] products compared to pure HFOs and HFCs, as they will be single molecule reactions in the stratosphere.”) The study acknowledged the “aggressive” nature of its emissions analysis but said that this made its environmental risk assessment “appropriately conservative.”

Combining emissions from Article 5 and Non-Article 5 countries, the study estimated that peak emissions “could exceed 500,000 [metric tons] per year, although this will need closer monitoring as the trends evolve.”

While the study did not link emissions projections to specific environmental impacts, it did note that the “margin of safety (MOS) for human health is reduced in 2100 for the plateau of HFO emissions from 2025.” (The lowest MOS for human health was for maternal and developmental toxicity.)

The 2100 plateau, added the report, “might be particularly concerning as the precipitation is likely to cause a significant increase in levels of TFA not only in the expected final compartment (the aquatic environment) but also those compartments which TFA enters (soils) on its way to entering the final compartment.”

— Emissions from commercial, industrial, transport, stationary A/C and mobile A/C.
— Projected emissions are based on low-GWP consumption levels calculated by UN’s 2016 TEAP (Technology and Economic Assessment Panel) Task Force Report (XXVII/4) through 2050, and then frozen (plateau scenario).
Source: “Study of environmental and health effects of HFO refrigerants,” published in 2017 by the Norwegian Environment Agency.

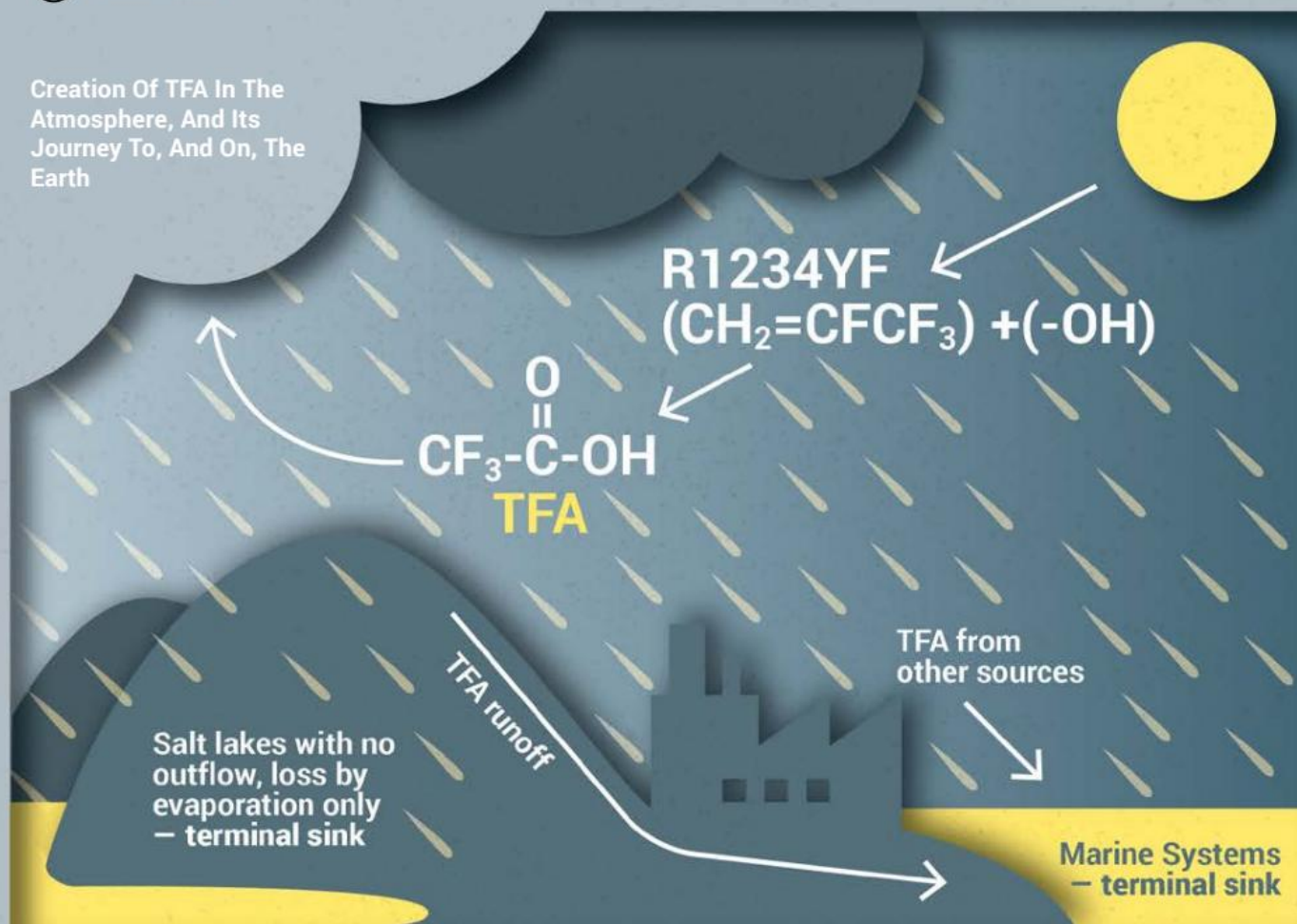
Projected HFO Emissions (metric tons)

	2025	2050	2075	2100
Non-Article 5 Countries	54,923	228,641	232,222	234,585
Article 5 Countries	24,728	860,582	876,971	867,477
TOTAL	79,651	1,089,223	1,109,193	1,102,062

shecco
Base



Creation Of TFA In The Atmosphere, And Its Journey To, And On, The Earth



Source: "Study of environmental and health effects of HFO refrigerants," published in 2017 by the Norwegian Environment Agency.

Toxicity study

The Norwegian study's assessment of TFA found that its projected toxicity risk to organisms and human health "appears to be low." But the study did find one exception – the effect on the most sensitive algae species, *Raphidocelis subcapitata* (freshwater green alga).

In its analysis of the impact of TFA on aquatic biotic communities, the Norwegian study used EUSES (European Union System for the Evaluation of Substances) to do a basic analysis of PEC (predicted environmental concentration) and PNEC (Predicted No Effect Concentration) – the limit of what can be tolerated with no adverse effects – in different regions of the world. The calculations were based on "exotoxicity and environmental concentrations" identified in the scientific literature, said James Hanlon, senior consultant with Risk & Policy Analysts.

The study found the predicted upper environmental [TFA] concentrations in the soils of Malawi and Chile and the surface waters of Germany to be equivalent to 0.0075, 0.0094 and 0.14 mg/l a.e. (acid equivalents), respectively. For the freshwater green alga, these levels would be greater than its most toxic freshwater PNEC of 0.0062 mg/l, using an assessment factor (reflecting data uncertainty) of 100; this, the report said, "would equate to there being an environmental risk." (Data was not available for a soil PNEC.) These calculations "took a precautionary approach and represent that might be called a worst-case scenario," said Hanlon.

Many of the knowledge gaps cited by the Norwegian report involved TFA toxicity data deemed "inadequate or missing, not allowing a thorough assessment of the effects this may have on the wider environment."

As examples, the report pointed to the absence of data on toxicity to organisms found in salt lakes and playas, which are terminal sinks for TFA and where TFA is expected to become concentrated. In addition, no measurements have been reported on the concentrations of TFA in crops for human consumption.

About one third of TFA is moved by rivers, which results in "a considerable amount introduced in terrestrial environments where TFA is susceptible to leaching into the groundwater," the report said. But there have been few studies on TFA concentrations in groundwater. "This needs to be addressed due to potential implications for drinking water," it said.

The study recommends periodic monitoring of TFA concentrations in well-known terminal water bodies such as Mono Lake, Calif., U.S., and Pyramid Lake, Nevada, U.S., and appropriate endorheic (terminal) basins in Europe. These would provide "an early indication

of the rate of TFA accumulation following the large-scale use of HFO-1234yf in MAC."

Generally, more research is needed to fully understand the cycle of TFA in the atmosphere and hydrosphere, as well as other sources of the acid, the report said.

In addition, the report noted that ECHA (European Chemicals Agency) has highlighted the inadequacy and absence of toxicity data in TFA's REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) dossier and have instructed the lead registrant for the substance to address this by 2021. (ECHA declined to identify the lead registrant.) For example, in studies on pre-natal development toxicity in a rat or rabbit, the report said, "ECHA considers that there is not sufficient weight of evidence from several independent sources of information which would allow to assume/conclude that the substance does not have a particular dangerous property, i.e., reproductive toxicity."

Given the persistence of TFA, the risk it presents increases if emissions of R1234yf to the environment increase, the Norwegian report said. With that in mind, it concluded that "phasing out HFOs (and consequently TFA), or emission reduction strategies along with best practice measures that help ensure efficient capturing of HFO/TFA during recycling operations, will help reduce the risk to human and environmental health." In effect, the study deferred to the precautionary principle.

German drinking water

Germany bases its environmental policies in part on the precautionary principle, stating that "environmental policies should not only be reactive damage limitation measures (which may not be entirely possible in many cases) but should also have a preventative nature," according to "A Guide to Environmental Administration in Germany."

While R1234yf is allowed in Germany, UBA is "watching with concern the increased use of the refrigerant R1234yf in car air conditioning systems and stationary refrigeration systems," said Maria Krautzberger, UBA's president, in an interview last year with Frankfurt-based newspaper/online site *Frankfurter Rundschau*.

Krautzberger pointed in particular to the concentration of TFA in drinking water. "TFA cannot be removed [from drinking water] with the usual treatment methods, so further [use] must be avoided at all costs," Krautzberger said.

Elaborating on Krautzberger's comments, the German Federal Government, in a reply to a written question from the parliament, noted that "the treatment techniques commonly used in waterworks, such as ozonation and activated carbon adsorption, are not capable of effectively removing TFA."

"In the light of precautionary environmental protection, the Federal Government therefore considers it to be expedient to reduce the input of persistent substances into the environment, such as TFA and its precursor compounds, as far as possible at source."

The German Federal Government also told the parliament that TFA, originating from "man-made sources" exists "in some cases up to concentrations in the microgram per [liter] range" in spring and surface water, lakes, rivers, and in ground and drinking water. Consequently the UBA set the Health-Related Indicator Value (HRIV) – or in German, Gesundheitlicher Orientierungswert (GOW) – for TFA in drinking water at 3 micrograms (µg)/l.

If the concentration of a substance is above the HRIV, "measures have to be taken to improve the human toxicological evaluation," said the UBA. "In parallel, the responsible authorities explore

Chemours on TFA

In an article last year in *Accelerate America* that addressed the use in ice rinks of Chemours' Opteon-branded HFO blends R449A and R513A, which contain R1234yf, Chemours was asked if the continuing investigation into TFA's potential environmental impact raises uncertainty about the long-term viability of Opteon refrigerants. (See "[Ice Rinks: Which Refrigerant Is Best?](#)" *Accelerate America*, November-December 2018).

Allison Skidd, Chemours' North America marketing manager, fluorochemicals, replied, "We do not see any uncertainty about the long-term viability of our Opteon portfolio. Numerous independent, scientific and peer-reviewed studies have been published on this matter over the past decade, noting that more than 95% of TFA found in oceans is naturally occurring, and TFA generated from current and future use of fluorinated materials will add only fractionally to amounts already present from natural sources such as undersea vents and volcanic activity."

"In addition, she said, '...projected future increased loadings of TFA to playas, land-locked lakes and oceans due to continued use of HCFCs, HFCs, and replacement products are still judged to present negligible risks for aquatic organisms and humans,' according to a article in *Photochemical & Photobiological Sciences*, Issue 1, 2015, called 'Changes in air quality and tropospheric composition due to depletion of stratospheric ozone and interactions with changing climate: implications for human and environmental health.'" (See: <https://rsc.li/2zWcvFw> for article.)

Greenpeace's HFO Recommendations

NGO Greenpeace International calls on national governments to take the following measures with respect to HFOs, according to Janos Maté, its senior policy consultant.

- ▶ Set production quotas on HFOs so that industry is curtailed in its commercial aspirations for these products.
- ▶ Immediately ban the use of HFOs as aerosols.
- ▶ Require that industry commit to paying for all mitigating costs, through a liability contract, should the large-scale production of HFOs in the future result in severe damage to the environment.
- ▶ List HFOs in the Annex of Controlled Substances of the Kigali Amendment to the Montreal Protocol. Including HFOs in the Annex will enable accurate accounting of the volume of HFOs being produced and consumed, and the amount of TFA being released into the environment, and enable reporting and licensing to help prevent the illegal trade of HFCs mislabelled as HFOs.



Janos Maté, Greenpeace.

possibilities of minimizing or preventing the contamination of raw water."

Responding to German concerns about TFA in drinking water, the European Fluorocarbons Technical Committee (EFCTC), said in a statement that R1234yf is currently an "insignificant contributor" to the amounts of TFA found, and that the projected growth in use of R1234yf and resulting emissions of TFA are "expected to have only a small contribution to the quantities of TFA found in German rivers."

While a German ordinance sets drinking-water quality, the federal states are responsible for checking and securing water quality. The German federal state North Rhine-Westphalia (NRW) has set its own goal of staying below the HRIV of 3 µg/l in surface waters that are used for producing drinking water.

NRW found the GOW exceeded at one water supply plant, and mixed its water with that of a non-polluted plant to get below the GOW. (See <https://bit.ly/2z6zGfz>.)

Meanwhile, the German Federal Government is funding a research project that will study HFOs and TFA, with a focus on the refrigeration/air conditioning sector. The study is called "Persistent degradation products of halogenated propellants and refrigerants in the environment: type, environmental concentrations and fate with special consideration of new halogenated substitutes with a low global warming potential."

Results are expected in 2020 – another step toward revealing the ultimate environmental impact of R1234yf and TFA.

■ MG

Daimler's Approach to R1234yf

While R1234yf has been deemed safe to use in mobile air conditioning (MAC) by government authorities in the U.S. and the EU, German automaker Daimler is taking a measured approach to the gas.

Daimler has a long history of questioning R1234yf. In 2012, it announced results of a study showing the potential combustibility of R1234yf in the event of a severe collision. R1234yf is described by the German Environment Agency (Umweltbundesamt or UBA) as flammable and, in the event of fire, forming toxic, highly corrosive hydrofluoric acid (HF). A current ASHRAE study – ASHRAE-1806, “Flammable Refrigerants Post-Ignition Risk Assessment” – is doing a risk assessment of the creation of hydrofluoric acid in the combustion of A2L refrigerants like R1234yf.

But with the EU MAC directive banning R134a taking effect in January 2017, Daimler began using R1234yf in its Mercedes-Benz cars in Europe, with the exception of several models that employ CO₂ as a refrigerant. However, for vehicles with 1234yf systems, “we have implemented a comprehensive safety concept to reduce the risk of fire formation,” said René Olma, global communications, Mercedes-Benz Cars, Stuttgart, Germany.

All current passenger car models with gasoline engines of the Mercedes-Benz, Mercedes-AMG & Mercedes-Maybach brands have been equipped with a so-called “inertization” system. “This reduces the risk of fire in the event of an accident with these vehicles with R1234yf,” said Olma.

In the event of a severe frontal collision, the system ensures that the resultant refrigerant/air mixture is separated from the hot engine components in the engine compartment and that these components “are furthermore cooled in a highly effective manner.”

As an alternative to R1234yf, since 2017, Daimler’s Mercedes-Benz S 400 Coupé has used CO₂ in MAC. In addition, in all variants of the S-Class (Sedan, Coupé & Cabriolet) a CO₂ air conditioning system is employed in the main volume carriers S 560 and S 400 d. Also in the E-Class, the CO₂ air conditioning system is available in some variants as part of the Thermotronic equipment. “In order to reach the necessary quality level, we start with a slow production ramp-up of the new air conditioning systems and will decide on a further case-by-case use,” said Olma.



Walmart Asserts It's Transitioning to Low-GWP Refrigerants

Hundreds of its facilities are near HFC-free, the retailer says, in response to GreenAmerica.org's 'Cool It' campaign

— By Michael Garry



In a reaction to a public campaign urging it to reduce its emissions of HFC refrigerants, Walmart, the U.S.-based global retailing giant, said that many of its stores are close to HFC-free and that it is transitioning to low-GWP refrigerants in new and existing systems.

"In the U.S. we already operate hundreds of facilities (stores and distribution centers) that are near HFC-free and utilize ultra-low GWP refrigerants including carbon dioxide (CO₂) and ammonia (NH₃)," said Micah Ragland, director, sustainability communications, for Bentonville, Ark.-based Walmart. "We continue to use these facilities, along with other laboratory-based tests, to inform the design of our future systems."

Walmart's overall refrigerant strategy calls for moving away from high-GWP refrigerant gases, including HFCs, to refrigerant gases with low- and ultra-low GWP "for new systems as they come commercially viable by 2025," said Ragland, adding that Walmart was "the first retailer to set an approved science-based emissions reduction plan to 2025."

Walmart is also working to reduce refrigerant use and improve efficiency in current systems and install new systems that are "high-efficiency" and "less susceptible to leaking," she said. The company reduced its refrigerant-related direct emissions by 10% between 2016 and 2018, she noted.

Last year Walmart reported operating 11,700 stores in 28 countries. Ragland acknowledged that "much of [Walmart's refrigerants] are HFCs."

Walmart is a member of the Consumer Goods Forum, a global consortium of retailers and packaged goods companies that has pledged since 2015 that its members would take steps to cut their high-GWP emissions (<https://bit.ly/31DCQni>).

Ragland comments came in response to a new HFC-reduction campaign launched by GreenAmerica.org, a nonprofit environmental group founded in 1982. The campaign, called "Cool It!" (<https://bit.ly/2N4WpRu>), initially targets Walmart and urges the retailer to "phase out harmful HFCs, track and repair its refrigerant leaks, and commit to responsible disposal."

"Walmart has known the urgency of this issue for years but has not taken serious steps to put its words into action," said GreenAmerica.org on its website. "We're calling on Walmart to finally develop a plan to cut these harmful super pollutants from its stores."

On its website the group has also set up a petition form so that anyone can email this message to Doug McMillan, Walmart's CEO, and Kathleen McLaughlin, its chief sustainability officer.

Secondary CO₂ systems

Walmart has in the past installed refrigeration systems that use HFCs as the primary refrigerant and CO₂ as a secondary fluid. However, it discontinued using those systems in 2014, according to an industry source. The company did not reply to a request for comment on its discontinuation of those systems.

In a 2013 report called "The Dirty Dozen: How your local supermarket is killing the climate" (<https://bit.ly/33yGKzC>), the U.S. branch of the Environmental Investigation Agency (EIA) said that "Walmart is using a secondary loop refrigeration system that combines either carbon dioxide or glycol and HFCs in more than 125 stores and two Sam's Club stores in the U.S."

One example of a Walmart store with a secondary CO₂ system is a Massachusetts Supercenter converted from a traditional Walmart. The system includes a secondary medium-temperature glycol system and a secondary CO₂ low-temperature system, noted Stan Shumbo, VP at Colchester, Conn.-based Eastern Refrigeration, which installed it. (See, "Gaining Natural Experience," *Accelerate America*, May 2018.)

In its 2018 Global Responsibility Report (<https://bit.ly/2jh9WoV>), Walmart said that its engineers from multiple markets have been "working on bringing distributed packaged refrigeration systems into our stores and clubs. These 'plug and play' units are poised to simplify the business of refrigeration for many of our markets in the coming years.

"This approach to refrigeration design will support quicker installations, reducing store interruptions and are packed with the latest thinking in energy efficient technology and on-board system diagnostics. These systems are designed to use less refrigerant gas, less copper pipe and to be simpler to maintain."

The report did not disclose which refrigerant it would use in these units, though plug-and-play display cabinets using propane (R290) have become more prevalent in Walmart's home U.S. market.

The Global Responsibility Report also noted that Walmart's grocery distribution centers utilize "large ammonia systems" for cooling. In recent years, it added, the company has "worked with our vendors to design a smaller version that could be used in our regional distribution centers." These small ammonia plants are designed "to double the life expectancy of the old plants, use less energy through reduced horsepower and eliminate over 200 pounds of freon."

Asda, Walmart's retail business in the U.K., is testing a system called Mistral, which uses chilled ducted air to cool products held in display cases. According to a 2017 report from the University of Birmingham, U.K. (<https://bit.ly/2Tz715w>), the system's cold refrigerant gas is pumped to a large air handling unit on the roof directly above the aisles; then the cold is transferred to air through a heat exchanger, and the cold air is blown through ducting down to the cabinets below.

In the Global Responsibility Report Walmart said the Mistral system uses less refrigerant gas, offers more energy savings, needs less maintenance and "is also much safer to operate in our stores."

The 2017 University of Birmingham report, "Retail Refrigeration: Making the Transition to Clean Cold," said that Asda had converted a dozen of its stores to Mistral, with one store reporting energy savings of 33%. The stores used R407 refrigerant, though the system could operate with any natural refrigerant, it said. ■ MG

Efficiency Vermont provides funds to Hannaford for CO₂ and R290 equipment and to a food bank for a transcritical system

— by Michael Garry



Ali White, VEIC, at ATMOsphere America 2019

VERMONT UTILITY GIVES INCENTIVES FOR NATREF SYSTEMS

Efficiency Vermont, an efficiency utility under the auspices of the nonprofit Vermont Energy Investment Corp. (VEIC), has begun giving customized financial incentives for natural refrigerant systems implemented in the state, including \$100,000 to the Hannaford Bros. for a new supermarket and \$50,000 to a food bank.

Efficiency Vermont, funded by Vermont utility rate payers, is also planning to launch incentive programs for self-contained cases using hydrocarbon refrigerants and for leak repair. And it is developing a test of CO₂ condensing units — rarely used in the U.S. — in a variety of applications.

The Hannaford store, in South Burlington, Vt., which is expected to open early next year, will employ a transcritical

CO₂/glycol chiller for medium-temperature cases and propane (R290) low-temperature self-contained cases (Husmann's microDS line). Hannaford has been testing these technologies in new stores as a path to using them to retrofit existing stores. (See "[R290: The Future of Retail Refrigeration](#)," *Accelerate America*, January 2019.)

"We were able to calculate energy savings associated with optimizing the [CO₂ system's] adiabatic gas cooler," including lowering compressor head pressure, said Ali White, energy consultant for VEIC, who described Efficiency Vermont's natural refrigerant programs in a presentation in June at the ATMosphere America conference in Atlanta, Ga., U.S. "Between that optimization and the low-temperature system, we were able to give a \$100,000 incentive." The energy savings amounted to 650 MW-hrs and about \$30,000 annually, and a yearly reduction of 2.5 million lbs of CO₂e emissions, compared to an R507 baseline.

“
Now we're focusing
on incentivizing
hydrocarbon
self-contained cases
at the distributor level.

— Ali White, VEIC

Efficiency Vermont is also working with Hannaford on leak monitoring and repairs to reduce fugitive emissions of high-GWP refrigerants, said White. The utility plans to launch a prescriptive (deemed) incentive program for leak repair early in 2020.

At the food bank, which uses a transcritical CO₂ refrigeration system, Efficiency Vermont awarded \$50,000 based on an annual savings of 270 MW-hrs, she said.

Self-contained hydrocarbon cases represent an area of growing interest for Efficiency Vermont, said White. "Now we're focusing on incentivizing hydrocarbon self-contained cases at the distributor level." The utility is targeting a mid-fourth-quarter rollout of a deemed program.

The utility is also studying ways to incentivize existing stores that employ "drop-in" low-GWP refrigerants to replace high-GWP or ozone-depleting refrigerants, White noted. "There are not a lot of new stores in Vermont, so we're metering those conversions this year to see if there's an energy savings."

Interest in CO₂ condensing units

This year, Efficiency Vermont has also been developing plans to test CO₂ condensing units for supermarkets, dairies, cheese makers and breweries, which would be among the first such installations in the U.S. (See "[Vermont to Test CO₂ Condensing Unit](#)," *Accelerate America*, January 2019.)

Efficiency Vermont has recruited a dairy farm and four equipment manufacturers for the program so far. Other manufacturers are welcome to apply, she noted. The dairy farm would use the CO₂ condensing unit to cool its milk bulk tanks as well as employ heat recovery to preheat its clean-in-place water.

The utility plans to have at least one system installed by the first quarter of 2020, said White.

The pilot will measure the energy efficiency of CO₂ condensing units in comparison with that of HFC units in order to justify financial incentives for purchasers of the CO₂ system. Dairies, breweries and stores in Vermont tend to be small, noted White, making remote condensing units a viable refrigeration option. CO₂ condensing units, which also provide ample heat recovery, are "really attractive to us."

CO₂ condensing units, while widely employed in Europe and Japan, are rare in the U.S. ■ MG

New HFC-Reduction Law in Vermont

In May, Vermont's legislature passed legislation limiting the use of HFCs in new equipment — one of the latest examples of a U.S. state incorporating HFC regulations previously used by the U.S. Environmental Protection Agency (EPA). (See "[U.S. Climate Alliance Urges Industry to Support States' HFC Regulatory Efforts](#)," *Accelerate Magazine*, July-August 2019.)

The legislation, S.30, stipulates that products containing certain high-GWP HFCs prohibited by the EPA in SNAP (Significant New Alternatives Policy) Rules 20 and 21 would not be allowed in Vermont in new equipment for specific applications as of specific dates. A 2017 Court of Appeals ruling partially vacated the SNAP rules.

Vermont's governor, Phil Scott, signed the legislation into law in June, and it went into effect July 1.

The law stipulates that, as of January 1, 2021, the high-GWP refrigerants will be prohibited in Vermont for refrigerated food processing and dispensing equipment, remote condensing units, stand-alone units, among other applications. As of January 1, 2023, the refrigerants will be banned for cold-storage warehouses.

In addition, the legislation requires the Vermont Secretary of Natural Resources to file proposed rules by July 1, 2020, "to establish a schedule to phase down the use of hydrofluorocarbons to meet the goal of a 40 percent reduction from the 2013 level of use by 2030."

The HFC-reduction law "is an opportunity for Vermont, but also a burden for end users to make the transition, especially in Vermont where there are a lot of small mom-and-pop grocers," said Ali White, energy consultant for VEIC, in a presentation in June at the ATMosphere America conference in Atlanta, Ga., U.S. "We have an obligation to research natural refrigerant technologies and identify energy savings so we can support customers in the transition."

To Russia with CO₂

The market for transcritical CO₂ systems in Russia is expanding, with both Metro AG and Globus opening new stores in the last few months.

— By Tine Stausholm

Transcritical CO₂ system at Globus store in Moscow



German grocers METRO AG and Globus have both opened new transcritical CO₂ stores in Russia in recent months, pointing toward wider adoption of the technology in this country.

A new hypermarket in the Moscow neighborhood of Salaryevo, which opened in April, is Globus' first such store in Russia, and METRO AG opened its third transcritical store in Solntsevo, also Moscow, in July. Both stores use parallel compressors – and the Solntsevo system employs an ejector – to increase efficiency, and both utilize heat recovery to supply hot water and heating.

"Talking about the large hypermarkets format, we don't see any other alternatives to CO₂ transcritical systems, as one of our top priorities is to increase the efficiency of refrigeration systems," said Vitaly Belozertsev, lead engineer for energy efficiency and refrigeration at Globus.

The Russian refrigeration market tends to follow global trends for energy efficiency and environmental sustainability, a development that is at least partly due to the presence of international food retail chains like METRO and Globus, according to literature from Danish component manufacturer Danfoss, which was involved in both new installations.

Russian end users are looking to their compatriots in the rest of Europe for inspiration, especially when it comes to implementing large refrigeration projects, Danfoss said.

Russia does not currently have any national regulations governing f-gas use, but it is scheduled to ratify the Kigali Amendment in the near future, said Moscow-based Anastasia Isaeva, a marketing manager for Danfoss, in an email to *Accelerate Magazine*. This has prompted several companies in Russia to start working with CO₂ to master the technology and future-proof their systems, she said.

METRO AG CONTINUES COMMITMENT

In 2013, METRO AG initiated its F-Gas Exit Program, aiming to reduce f-gas emissions by 90% by 2030. The progress has been good. As of May 2019, 27% of METRO AG's stores were using natural refrigerants, including 95 with transcritical CO₂.

In Russia, however, METRO didn't jump straight into using transcritical systems. In 2015, the company instead installed its first subcritical CO₂ system.

"We started in some countries the transition from HFC or HCFC with subcritical systems, because either the relevant industry or installer capacities for installation, maintenance and repair of transcritical systems were missing," said Olaf Schulze, director - energy, facility and resource management, METRO AG.

FOOD FOR THOUGHT.



Your fruits, vegetables, meats, dairy are all too precious to risk with any other but Hillphoenix®, the global leader in transcritical CO₂ refrigeration systems. Our installations number nearly 6,000 around the world, over 35 countries in climate zones from the Arctic Circle to below the equator — including over 800 installations in North America. Our extensive portfolio of CO₂ systems insures a perfect fit to every client's exact requirements. And our breadth and depth of experience in sustainable systems far exceeds any other supplier in the industry. Are we exaggerating to make a point? Not even a little bit.

Hillphoenix®
a DOVER company

SYSTEM SPECS

Globus Hypermarket in Salaryevo, Moscow

(System has two refrigeration racks; figures here encompass both)

Store size:
25,000 m² (269,098 ft²)

Medium-temperature capacity:
521 kW (148 TR)

Low-temperature capacity:
155 kW (44 TR)

AC capacity:
258 kW (73.4 TR)

Heat recovery:
745 kW (211.8 TR)

OEM:
KrioFrost, with Danfoss participating in design and testing

Compressors:
Bitzer

Gas coolers:
Guntner

Controllers:
Danfoss (all controllers consolidated into a single monitoring system)

Metro AG store in Solntsevo, Moscow

Store size:
9,100 m² (97,950 ft²)

Medium-temperature capacity:
210 kW (59.7 TR)

Low-temperature capacity:
72 kW (20.5 TR)

Heat recovery:
295 kW (83.9 TR)

Compressors:
Dorin

Controllers:
Danfoss, with special algorithms developed by Land Company



Olaf Schulze, METRO AG

Four years later this situation has changed. "In Russia we have now well-performing installer partners, so that transcritical could be the standard," noted Schulze. "For us in METRO we will only install without exemptions transcritical systems, so far as technically possible."

METRO operates 94 stores in Russia, with 25 subcritical installations as well as three transcritical stores that opened this year (in addition to Solntsevo, one each in Aparinki and Odintsovo). A further five transcritical stores – in St. Petersburg, Lipetzk, Tyumen, Ulyanovsk and Nishni Novgorod, the last two with ejectors – are under construction or refurbishment, all expected to be finished in September.

A FIRST FOR GLOBUS

Globus' new hypermarket in Salaryevo is its 15th in Russia, and the first using transcritical CO₂ booster technology. The German grocer has previous experience with the technology though, having CO₂ systems installed in stores in Germany, Luxembourg and the Czech Republic.

With a total cooling capacity of 1 MW, the new system is also currently the largest transcritical unit in Russia, according to Danfoss, which helped design and test the new system. The system comprises two racks, one of which includes air conditioning.

The installation cost for the new system in Salaryevo was 10%-15% higher than that of a comparable traditional system would have been, said Danfoss. However, the energy savings are expected to be around 25%-30%, and the ROI three-and-a-half years.

In addition to operational savings, the transcritical CO₂ system at this facility has reduced the installed capacity by 15%, said Belozertsev.

Both retailers are positive about the future of CO₂ technology in Russia. "Globus Salaryevo is our first CO₂ project in Russia, but definitely not the last one," said Belozertsev.

"Natural refrigerants are a must for our climate, for our future as a wholesaler, and we will consequently follow this path," said Schulze, adding, "We are sure also the customers will recognize it." ■ TS

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





Coliseum, Rome Italy

NatRefs Highlighted in Italy's First Survey of HFC-Alternative Technologies

Italian contributions to the natural refrigerant industry include Epta's FTE CO₂ system and a strong expertise in R290 plug-in units

— by Tine Stausholm

In response to the Kigali Amendment to the Montreal Protocol, the Italian government has carried out its first national survey on environmentally friendly alternatives to HFCs in a number of industries, with CO₂ and R290 systems cited as major options.

The aim was to promote “made in Italy” technologies to the world, and to help developing nations make the shift

from HCFCs and HFCs to natural refrigerants, thereby complying with the Kigali requirements.

The survey report – [“First National Census on HFC Italian Alternative Technologies”](#) – is the result of a collaboration between the Italian Ministry of Environment, Land and Sea (IMELS) and the Institute for Environmental Protection and Research (ISPRA), together with regional agencies for the protection of the environment.

It spans six sectors - refrigeration, air-conditioning, foams, fixed fire protection systems, aerosols and training. Most of the participating companies (11) are in the refrigeration sector. In the air conditioning and foam sectors, one company each responded; in fire protection, two companies; and in aerosols, none.

Contributions to refrigeration

The survey found that Italy has 17 companies offering technologies using HFC alternatives in the commercial refrigeration sector. The list includes big players in the European market for stand-alone units (Carel, Arneg, Epta, Dorin and LU-VE) and for central systems (Arneg, Carel, Dorin, Epta, LU-VE, DGM, ENEX, EUROKLIMAT, NOVA FRIGOR and SIAD).

The report states that the main Italian contribution to the development of new refrigeration technologies lies within appliance design and the manufacturing of natural refrigerant solutions, including those using hydrocarbons and CO₂. It concludes that this expertise probably stems from the country's long tradition as a machine manufacturer and exporter.

One area singled out is the use of propane (R290) for plug-in units, both for single and multi-circuit solutions. Several Italian companies, including Arneg and Epta, have long-standing expertise, offering solutions with "best-in-class" energy efficiency and low charge.

The report also mentions Epta's Full Transcritical Efficiency (FTE) systems as an example of a patented Italian development that increases the efficiency of transcritical CO₂ systems, and opens up their use in warmer climates. This new option is made possible by decreasing the discharge temperature from FTE medium-temperature compressors by flooding medium-temperature evaporators. The FTE solution "has allowed the use of

the transcritical CO₂ booster at all latitudes of Europe, allowing high energy efficiency at any temperature and use for all store sizes," the report says.

The FTE systems also has installation and maintenance costs that are up to 30% lower than traditional systems, and an energy consumption that is 10% lower, notes the report.

Propane chillers

Italy has a long tradition of using hydrocarbons in small self-contained air conditioning units, with De'Longhi being the first to produce a portable "Pinguino" propane AC unit in 1985. EUROKLIMAT was cited in the air-conditioning sector for its propane water chillers.

Italian legislation on flammable refrigerants in buildings does not address the use of A2Ls, defined as having low flammability. This presents a challenge for the sector when it comes to identifying suitable HFC alternatives in larger air conditioning equipment, says the report. The HVAC sector has requested that international standards of flammability be implemented in Italy to improve this situation.

The report also details how production of air conditioning equipment in Italy doesn't happen on a massive standardized scale. Manufacturers tend to specialize in small-scale production of customized solutions, with the production of heat pumps a driving element in the industry. Generally, the country produces end-user solutions, while buying its compressors abroad. Italian manufacturers of heat pumps and chillers include Carrier, Clivet, Aermec and Euroklimat.

The report also notes that Italian companies' commitment to research and development of new technologies "emerges as an outcome of the survey."

■ TS

“

The FTE solution has allowed the use of the transcritical CO₂ booster at all latitudes of Europe, allowing high energy efficiency at any temperature and use for all store sizes.

”

- ISPRA report

Italian Companies with Natural Refrigerant Technologies for Commercial Refrigeration

- ▶ ARISTON Thermo group
- ▶ Arneg S.P.A
- ▶ Carel
- ▶ Criocabin S.P.A.
- ▶ Dgm
- ▶ Dorin
- ▶ Enex
- ▶ Epta
- ▶ Euroklimat
- ▶ Frascold
- ▶ Lu-Ve
- ▶ New Cold System
- ▶ Nova Frigor
- ▶ Pastor Frigor
- ▶ Siad
- ▶ Tasselli
- ▶ Zanotti



Source: "First National Census on HFC Italian Alternative Technologies," by the Italian Ministry of Environment, Land and Sea (IMELS) and the Institute for Environmental Protection and Research (ISPRA)

EPTA Expands FTE Installations in Greece and the Canary Islands

Transcritical CO₂ systems using the energy-saving technology are now in more than 250 locations globally

— by Tine Stausholm

Italian manufacturer EPTA has installed full transcritical efficiency (FTE) transcritical CO₂ systems – designed to improve efficiency, especially in warm climates – in two new stores, one in Athens, Greece, and one in El Paso on La Palma, one of the Canary Islands.

The Athens store is part of Diamantis Masoutis, the largest supermarket and wholesaler in Northern Greece with 330 stores; the La Palma store is run by SPAR, one of the world's largest supermarket chain with more than 13,100 stores in over 45 countries.

EPTA has now installed FTE transcritical systems at more than 250 locations, 90% of them in Europe, including "the warmest

areas of Europe, like South Italy and Malta, said Francesco Mastrapasqua, EPTA's advocacy & regulatory affairs manager. Other locations include UAE, Tahiti, Australia and Central-South America. Overall, the company has installed more than 1,000 transcritical CO₂ systems globally, he added.

EPTA Iberia installed the first transcritical CO₂ system on the Canary Islands at a supermarket in February 2019. Italian CO₂ rack manufacturer SCM Frigo installed the first transcritical CO₂ system for cold storage on the Canary Islands this year.

"The key motivation for the collaboration [between Diamantis Masoutis and EPTA] include the improved performance of FTE, which exceeds the traditional limits of transcritical technology," according to an announcement published on the website of cabinet manufacturer Costan, which supplied its GranVista and GranBering cabinets for fresh and frozen products to both stores. This is "ideal in any condition, also in the prevailing Mediterranean one like that of Greece."

Both retailers are using other green technologies and SPAR promotes an "increasingly eco-friendly approach" with the opening of the new store in El Paso, EPTA says. Apart from the CO₂ refrigeration system, the El Paso store also includes LED lighting and an electric-car charging station.

The El Paso system, installed in February 2019, has a medium-temperature capacity of 41 kW (11.7 TR) and a 9 kW (2.6 TR) low-temperature capacity. The exact capacity for the Athens store hasn't been published.

Flooding MT evaporators

EPTA's FTE system, a patented system developed as part of the Life C4R project funded by the European Union, was launched at the EuroShop tradeshow in 2017.

According to EPTA, the FTE technology delivers an energy saving of 10% along with 20% lower installation and maintenance costs compared to standard transcritical CO₂ booster racks. Compared to traditional R404a systems, the energy savings are even greater, standing at 25%, the company says.

The system works by flooding medium-temperature evaporators, eliminating superheat and allowing the operating temperature of the cabinets to be increased, the company says. A low-pressure liquid receiver is added to receive any liquid coming out of cabinets. "Eliminating superheat by flooding the evaporators is the key to increasing efficiency in warm climates, Mastrapasqua said at the EuroShop trade show in 2017. ■ TS



The Parthenon, Athens, Greece
©Tzoglia Kappatou/ 123RF.com

Temprite[®]

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

Tecnofreddo Launches Commercial R290 Air-Source Heat Pumps

The PERSEO line, with a COP of 3.5 in cooling mode and 4.0 in heating mode, is viable in colder regions, the company says

— by Tine Stausholm

Italian manufacturer Tecnofreddo has launched a “new generation” line of commercial propane (R290) air-source heat pumps (ASHPs) called PERSEO, part of its ECO³ product series.

“R290 is a promising and cost competitive refrigerant for ASHPs with superior environmental protection credentials,” the company said in a statement. “It has substantial potential for use in such areas as supermarkets, hospitals and public buildings.”

Air-source heat pump technology “has improved in all areas and is these days a viable option even in colder regions,” added Tecnofreddo, which touts “long experience” in R290 refrigeration systems.

One of the first end users to adopt a PERSEO unit is British Johnson Matthey, a manufacturer of exhaust-gas cleaning technology. Coordination for the Johnson Matthey project was carried out by Arriba Technologies, a Tecnofreddo collaborator based in the UK.

The PERSEO line employs a liquid/gas heat exchanger that increases the COP to 3.5 in cooling and 4.0 in heating. Models are capable of delivering 48°C (118.4°F) water in heating mode and 6°C (42.8°F) water in cooling mode. Nominal outputs for heating and cooling are 17 kW (4.8 TR) and 22 kW (6.3 TR), respectively.

The heat pumps are designed with semi-hermetic reciprocating compressors and include a control panel with programmable software. The series is also equipped with a full suite of ATEX-rated leak management and switching equipment to ensure compliance with the latest regulations governing the use of R290 in industrial settings.

The PERSEO line also has accessories like inverter and EC fans integrated as standard. Motor drives and software have been designed for backwards integration with Arriba's lithium-ion battery and DC-to-DC solar-assist technology.

Arriba has long been a proponent of heat pump technology, and is currently pioneering demand-responsive heat pumps fitted with lithium-ion batteries, and heat pumps that produce simultaneous refrigeration.

Tecnofreddo's ECO³ series uses only natural refrigerants and aims to provide a “reduced environmental impact, better energy efficiency and superior performance across all operating conditions,” according to the company.

Tecnofreddo's ECO³ series also includes R290 chillers and low-charge ammonia systems, which are mainly used in industrial refrigeration and process cooling. ■ TS

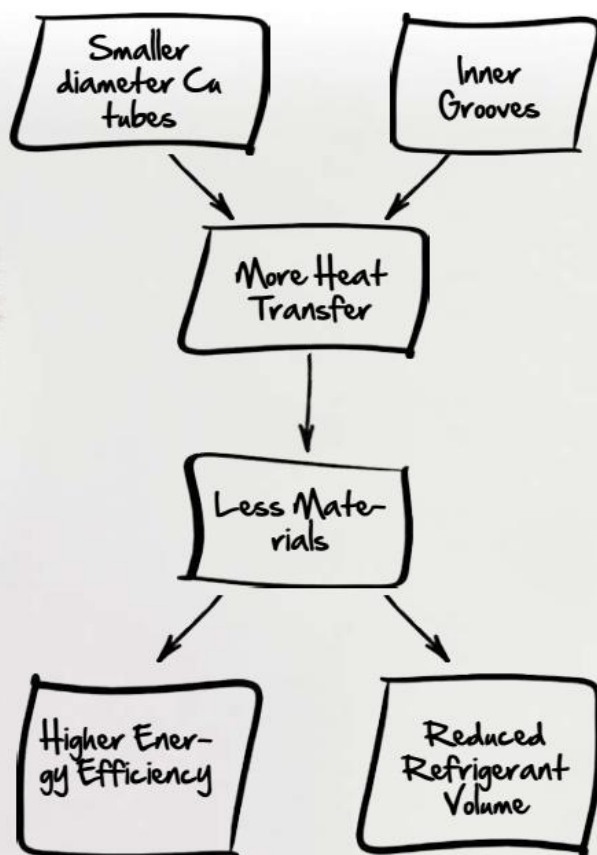
“R290 is a promising and cost competitive refrigerant for [air-source heat pumps] with superior environmental protection credentials.”

— Tecnofreddo

Tecnofreddo R290 air-source heat pump



the microgrooveTM advantage



IT'S A GAME CHANGER

MicroGrooveTM technology is changing the game of air conditioning and refrigeration (ACR) OEM product design.

OEMs are going back to their drawing boards. They are designing ACR products with high energy-efficiency, while minimizing materials usage and reducing refrigerant volume.

The resulting ACR products are smaller and lighter yet can be produced using familiar manufacturing methods.

It's a whole new game!

For more information, or to join a free webinar, visit

www.microgroove.net.



Join us on LinkedIn
via microgroove.net

2019 ATMO Europe Presentation

"Optimisation of transcritical R744 gas coolers with Microgroove smaller diameter copper tubes"



International Copper Association
Copper Alliance



Available from a range of suppliers.
For more information visit:
www.microgroove.net



Bitzer's Schaufler Academy in Rottenburg-Ergenzingen, Germany

Bitzer Expanding CO₂ Training Efforts in Australia and New Zealand

The manufacturer wants to 'push this technology into all market segments'

— by Devin Yoshimoto and Caroline Rham

Shannon Egan, Bitzer Green Point, conducting product training and a factory tour



Bitzer Australia is expanding its CO₂ training from its main Sydney-based center to Melbourne and Brisbane, with plans to also add Adelaide, Perth, Auckland and Christchurch sessions later this year, according to the company.

The manufacturer is doing this through its recently launched Bitzer Green Point after-sales support, training, and maintenance service.

"The latest round of Green Point training has been taken on the road to reach customers who may not have the opportunity to travel to our Sydney-based training center," said Shannon Egan, general manager for Bitzer Green Point.

Egan added that Bitzer Australia aims to "share our knowledge with the industry to push CO₂ technology into all market segments."

For CO₂ technology to be successful long term, he added, it is important that the industry has options for training. "As an OEM we have invested heavily in people and equipment to support the trade."

Bitzer opened its 1,500 m² (16,145 ft²) Schaeffler Academy in the town of Rottenburg-Ergenzingen in 2016, where it offers training on compressors, in addition to courses on working with natural refrigerants such as CO₂, ammonia and hydrocarbons.

Bitzer Australia has been conducting CO₂ training since 2004 when it began manufacturing and supplying subcritical CO₂ systems to the Australian market. To date, it now counts over 300 installations of subcritical CO₂ systems in the country along with 16 transcritical CO₂ racks.

The Bitzer Green Point CO₂ training sessions target tradespeople, project managers, engineers, business owners and consultants. The fee for the training course is \$250 plus tax per person, or a credit equal to this amount from the person's next R744 equipment order with Bitzer Australia.

Content covers introductory information on CO₂ as a refrigerant, component and system design, domestic standards and legislation, as well as an overview of commissioning, service and maintenance tips.

Feedback so far Egan said has been positive. "We have been told the training provides a practical foundation and confidence to begin working with R744 [CO₂] Technology at all technical levels."

In addition to CO₂ training, Bitzer Australia also conducted a one-day NH₃ training course with its staff

"The latest round of Green Point training has been taken on the road to reach customers who may not have the opportunity to travel to our Sydney-based training center."

— Shannon Egan, Bitzer Green Point

and customers in November of last year at the Bitzer Schaeffler Academy in Germany. It covered topics such as ammonia system design in industrial refrigeration, heat recovery, oil use, and case studies.

For more information on Bitzer Green Point CO₂ training, phone Shannon Egan in Australia at 1300 BITZER. ■ DY & CR

MOVING TRANSCRITICAL CO₂ FORWARD IN AUSTRALIA

Bitzer Australia has played a key role in designing and deploying transcritical CO₂ systems in the country's food retail sector. Notably, it has worked closely with Australian food retailer Woolworths on installations in the past few years.

In May 2017, Bitzer Australia was the rack supplier for Woolworth's first transcritical CO₂ store in Colebee, New South Wales (See: [Woolworths' first transcritical CO₂ store: Building NatRef momentum in Australia](#), *Accelerate Australia & NZ*, Winter 2017)

The robust system was designed for ambient temperatures of up to 45°C (113°F). Bitzer Australia worked with the Woolworths internal team to help engage, train, and upskill local talent throughout the entire design, installation, and commissioning process.

Another step forward was taken with Woolworths' first fully integrated HVAC&R transcritical CO₂ system opening in December 2018 in Prestons, New South Wales.

The Bitzer Australia supplier system enabled the retailer to fully integrate the store's HVAC&R needs — virtually eliminating synthetic refrigerants from the supermarket.

Commercial Port to Deploy New Zealand's Largest Hydrocarbon System

Two cold-storage areas will deliver 1 MW of cooling for nearly 3.5 million kg of kiwifruit per year

— By Devin Yoshimoto

New Zealand's largest hydrocarbon-based refrigeration system is scheduled to be up and running at Eastland Port — a commercial shipping port located in Gisborne — by early 2020.

The system will deliver over 1 MW (284.3 TR) of cooling for two cold-storage areas that will handle nearly 3.5 million kg (7.7 million lbs) of kiwifruit per year, according to a statement from New Zealand-based system supplier EcoChill.

EcoChill specializes in installing natural-refrigerant based cooling systems in New Zealand, and is responsible for the design, building, and installation of the Eastland Port system. Site preparation is currently underway and handover is planned for the end of February 2020.

Eastland Ports' decision to use the hydrocarbon-based system, according to EcoChill, was driven by its desire to reduce the environmental impact of its operations and to have a future-proof system.

The cold storage areas will be leased by local fruit packer NZ Fruits, which packs kiwifruit, citrus, mandarins and persimmons for export and domestic markets, according to an article in New Zealand's *Newshub*.

With the new cold storage facility at Eastland Port, NZ Fruits is expected to significantly increase its kiwifruit export capacity as well as reduce the environmental impact of its operations.

More the exception

Eastland Port is more the exception in the New Zealand market. "It is a concern that many New Zealand businesses, particularly those that rely on refrigeration, are not aware of the cost and supply risks that exist with the changes occurring in the refrigeration industry," said Matthew Darby, founder and managing director of EcoChill. "Part of the challenge is the lack of knowledge within the heating and cooling industry itself about using natural refrigerants, particularly carbon dioxide and hydrocarbons."

With New Zealand beginning implementation of its HFC phase-down plans on January 1, 2020, alongside increases in the price of the New Zealand Carbon Unit, operational costs are expected to continue to increase. **DY**



In the near future HFC refrigerants will be replaced by low environmental impact fluids. This scenario has prompted Modine to develop a complete range of CO₂ units for commercial and industrial applications.

ECOTM heat transfer coolers



CO₂ SOLUTIONS

EXPERIENCE

Many years of proven experience with thousands of Modine ECO branded CO₂ gas coolers, unit coolers and heat exchangers introduced in all possible applications

INNOVATION

Modine uses state-of-the-art technologies allowing the installation of its gas coolers in regions with higher temperatures

ENERGY SAVING

CO₂ systems recover an important part of the heat they produce, which can be used for heating buildings

RELIABILITY

Thanks to the type of tubes used in Modine units, the maximum operating pressures that they can withstand are 80 bar for CO₂ unit coolers and 130 bar for CO₂ gas coolers



Get to know the most comprehensive product range in the market

www.modine.com

SMALL GROCERS SEEK FUTURE- PROOF EQUIPMENT AT METCASH EXPO 2019

The exhibition for Australia's independent food retail industry featured CO₂ and R290 systems

— by Devin Yoshimoto

Australia's independent food retailers are looking for direction in how to protect their investments in refrigeration equipment from future regulations, according to companies exhibiting natural refrigerant technology at the 2019 Metcash Supermarket & Convenience Expo.

The event was held July 14-16 at the Gold Coast Convention & Exhibition Centre in Gold Coast, Australia. Metcash is a major Australian wholesaler supporting independently run supermarkets and convenience stores.

"We have had a number of people come see us at the stand looking for direction on refrigerants and how they can future-proof themselves with their current or new stores," said Inderpal Saund, Beijer Ref's APAC business development manager, at the expo.

Saund said that Beijer Ref's main goal at the show was to "educate the IGA owners, consultants, and operators on refrigerant options for the future."

To that end, he provided information on natural refrigerant-based solutions. "It was interesting to see that there are still a lot of misconceptions when it comes to the naturals," said Saund.

R290 and CO₂ systems on offer

Beijer Ref exhibited several natural refrigerant-based systems, including its SCM Frigo line of CUBO2Smart CO₂ condensing units and Embraco's R290-based Plug n' Cool system, a modular unit for self-contained display cases that was only recently made available in Australia.

Embraco's R290 Plug n' Cool system attracted a lot of attention at the show, according to Herlon Eckermann da Silva, Embraco's sales manager for the Asia-Pacific region. "It was the first time Embraco participated in the Metcash Expo and it has definitely reached our expectations," he said.

The Plug n' Cool received attention "especially due to its modularization concept," which applies both to merchandisers and cold rooms, and also "due to the use of natural refrigerant R290," Eckermann da Silva added.

Embraco's Plug n' Cool unit was also on display at Queensland-based contractor Coolphase's booth. The company decided to display exclusively natural refrigerant equipment at the exhibition this year, said Ricky Gatti, Coolphase's general manager.



Gold Coast Convention & Exhibition Centre

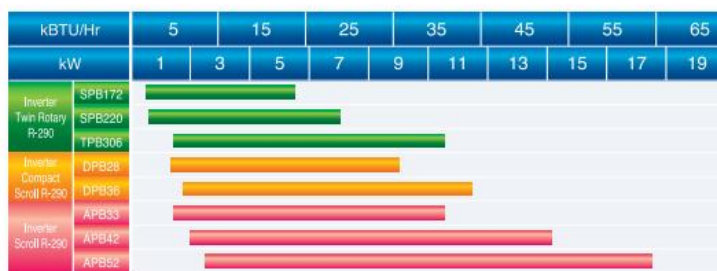
Coolphase showed the Plug n' Cool system connected to a cold room and to R290 cabinets provided by Italian OEM De Rigo Refrigeration.

With the IEC's recently announced increase in its hydrocarbon charge limit standard for self-contained cabinets to 500 g (17.6 oz) from 150 g (5.3 oz), R290 solutions have a chance to gain market share in Australia, Gatti said during the ATMosphere Australia 2019 conference held in Melbourne in May.

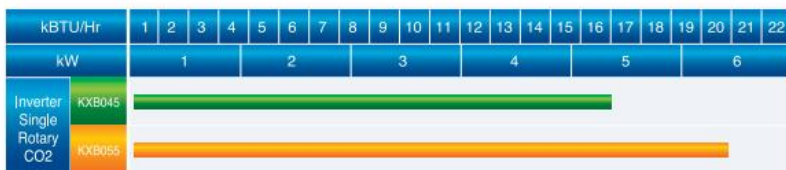
"For us and our little part of the world, [the increased IEC hydrocarbon charge limit] means that the [R290] cases become more affordable," Gatti said. "One of the R290 freezer cabinets that we are bringing in that's on R290 has two circuits. So instead of two, now that potentially will go to one, and then the cost of that would dramatically go down." ■ DY



Alternative refrigerant series of Mitsubishi Electric compressors (R290 and CO₂) - the eco-friendly inverter series ensures saving and comfort by its higher energy efficiency and precise temperature and humidity control. Embracing the combination of technology and philosophy, Mitsubishi Electric, a world-class compressor manufacturer, always offers high-quality products to make the world greener and to make your place more comfortable.



Heat pump Condition : ET = -7°C, CT = 50°C, SH = 5 K, SC = 4 K



Testing Condition : Discharge gas pressure: 10.0MPa, suction gas pressure: 3.9MPa, ambient temperature: 25.0°C, suction gas temperature: 15.0°C, liquid temperature: 22.0°C



SALES OF THE NEWTON ARE SOARING

Mayekawa's sales of the NH₃/CO₂ cooling system since 2008 will exceed 2,000 sets this fiscal year

— By Devin Yoshimoto, Rena Okabe and Tomoro Sato



SUBSIDIES 'A BIG BOOST'

Japanese OEM Mayekawa expects to sell 330 sets of its flagship NewTon NH₃/CO₂ cooling system this fiscal year (April 2019 through March 2020), bringing the total number of sets sold past 2,000 since the system was introduced in 2008. (The number of sets is equal to the number of compressors used; some NewTon units contain more than one compressor.)

This follows Mayekawa's announcement in December 2018 that it had shipped more than 1,840 NewTon sets, 95% in Japan, and 5% overseas.

In a recent interview conducted at the company's main manufacturing facility in Moriya, Japan, Shinichi Yageta, plant vice manager & general manager of Mayekawa's NewTon production department, explained that the company is seeing a growing opportunity for the NewTon in Japan's industrial refrigeration sector as well as in overseas Asian markets.

Natural refrigerant subsidies (provided by Japan's Ministry of the Environment) have provided "a big boost" to sales of the NewTon system, according to Mayekawa.

In 2016 in particular, as the subsidy scheme was ending its first three-year period, the company saw a rush in demand for the NewTon system.

Subsidized installations however, still represent "about one-third of total sales," said Hideyo Asano, who serves as a special advisor to Mayekawa's NewTon production department.

In addition, Asano explained that the company has noticed an increase in the number of business owners who have become aware of f-gas regulations.

1 /





1 / Mayekawa's NewTon production department, from left: Shinichi Yageta, Shiro Hayami, and Hideyo Asano.

2 / NewTon production area at Mayekawa's factory in Moriya, Japan

INNOVATION OF THE YEAR

Mayekawa's NH₃/CO₂ NewTon system won the Innovation of the Year award at this year's ATMOsphere Japan conference, held in Tokyo in February.

"We were so surprised and honored to receive this award. Thank you so much," said Shoji Miyajima, executive director, Mayekawa, who received the award.

"The point is how can we stop global warming. That is our mission, we believe. The refrigerant issue is, of course, important, but more than that, it has to be used to reduce energy consumption, so we would like to continue our effort towards that."

The Innovation of the Year award was chosen by the public in an open vote.

MAYEKAWA'S MORIYA FACTORY

Opened in 1970, Mayekawa's Moriya Factory is the oldest of its three main factories in Japan. Its other two factories are located in the prefectures of Hiroshima and Nagano.

The 220,000-m² (2.37 million-ft²) site houses around 1,000 employees and several factory floors where compressors, food processing robots, and refrigeration packages such as the NewTon system are manufactured.

A video tour of the Moriya facility can be seen at <https://bit.ly/2YTxxu4>.

■ DY, RO & TS

“

The point is how we can stop global warming. That is our mission we believe. The refrigerant issue is of course important, but more than that, it has to be used to reduce energy consumption.

— Shoji Miyajima, executive director, Mayekawa

”

This awareness has contributed to business owners choosing to install the NewTon systems, according to Asano.

OPPORTUNITY IN FOOD PROCESSING

Mayekawa said that 60% of NewTon systems have been installed in cold storage facilities while 30% have been installed at frozen-food-processing facilities.

Over the next few years, Mayekawa sees the Japanese food-processing sector as offering the biggest

opportunity for NewTon sales as several facilities are aging and expected to undergo renovations.

Though overseas sales currently account for only 5% of total NewTon sales, the company expects this to grow in the near future — especially in Korea, Taiwan, and Southeast Asia. The reason is that in these markets Mayekawa uses “basically the same business model for selling the NewTon as we do in Japan,” said Asano.

“We do business with the end user directly [in these markets]. That is very important to install the NewTon.”

Margarine, Beer and Ice Makers Are Adopting CO₂ in Japan

OEM Nihon Netsugen Systems spoke about these transcritical industrial projects at FOOMA Japan 2019

— By Devin Yoshimoto, Rena Okabe, Tomoro Sato

“We are really starting to see a wide range of applications for transcritical CO₂ systems in Japan now.”

— Katsuhiko Harada, Nihon Netsugen Systems

While transcritical CO₂ systems are seeing growing penetration in the cold-storage industry in Japan, other sectors such as beer brewing, margarine production, and ice making are also beginning to adopt CO₂ systems, according to Japanese OEM Nihon Netsugen Systems.

“We are really starting to see a wide range of applications for transcritical CO₂ systems in Japan now,” said Katsuhiko Harada, president of Nihon Netsugen Systems during the FOOMA Japan 2019 exhibition, which was held in Tokyo from July 9-12.

FOOMA Japan (short for the International Food Machinery & Technology Exhibition) is one of Asia's largest exhibitions for food machinery and food processing technologies.

Nihon Netsugen Systems, based in Tokyo, manufactures its own line of transcritical CO₂ refrigeration units named “CO₂ Booster Super Green” systems at its factory in Shiga, Osaka.

This year, the company jointly exhibited its “F-type CO₂ Booster Super Green” freezing system at FOOMA Japan with Japanese OEMs Fukushima Industries Corporation and Takahashi Manufacturing, which make food-processing equipment such as tunnel freezers and blast chillers.

Harada said that he has several ongoing projects with companies such as Asahi Breweries, which makes one of Japan's most well-known lagers, along with margarine production facilities and packaged ice manufacturers.

“In Japan, the rock-ice industry is very important for convenience stores,” said Harada. “If you buy an iced coffee for example, the cup and ice are already prepared. This and other rock-ice products are an important industry and it is here where we have a new CO₂ project.”

“These companies used to use freon or ammonia,” Harada added, “but now they are switching to CO₂.”

Overall, Nihon Netsugen Systems is experiencing steady annual adoption of its CO₂ systems. In February, during ATMOsphere Japan 2019, Harada announced that the company had so far installed over 120 of its CO₂ Booster Super Green systems throughout Japan since production began in December 2017.

Over the next year, the company expects to install 60 more units, Harada said during the FOOMA exhibition.

■ DY, RO & TS



Bangkok Refrigeration Heating Ventilation And Air-condition

Organized by
DITP

Co-Organized by



DITP

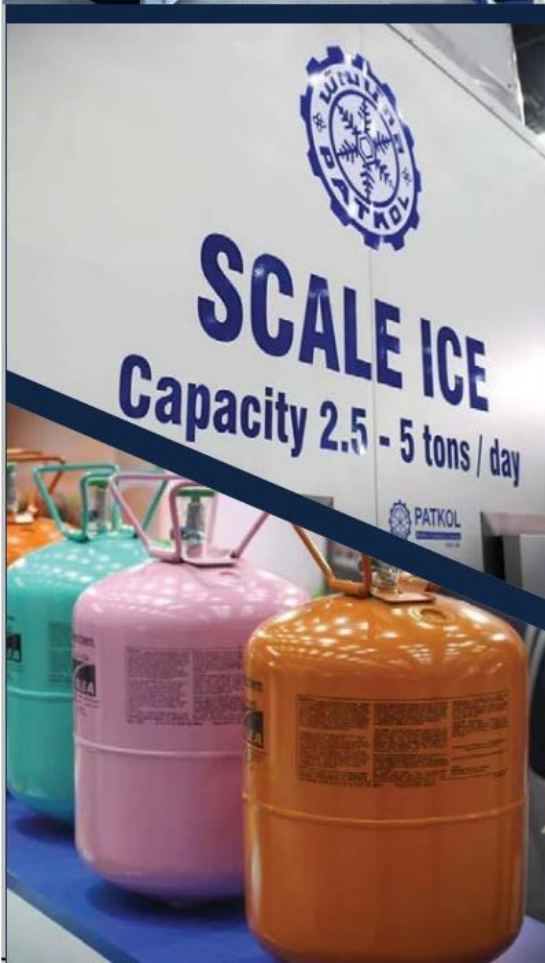
THINK THAILAND

You can download "bkk rhvac"
from app store available
in playstore and ios

The exhibition of refrigeration and HVAC industrial products from many leading companies is coming! This event you will meet many manufacture, trader and experts in the industrial!

Anyone curious about the info of visitors and traders for this event? Here are the details for you!

For you who are ready to this great chance, We are open for registration from today - 24 September 2019. 2 ways to register is as follows; LINE@ : @RHVAC Website : www.bangkok-rhvac.com



ITC's Project Blue Bird About to Take Flight

The Thai OEM has developed a transcritical CO₂ refrigeration system that also does supercritical fluid extraction, a key process in agriculture, food processing and healthcare

— By Devin Yoshimoto

While transcritical CO₂ refrigeration continues to grow in supermarkets, convenience stores and cold storage facilities, some manufacturers are pushing the boundaries on how the technology can be applied, especially in the agriculture, food processing and healthcare sectors.

I.T.C. Group (ITC), an OEM based in Bangkok, Thailand, has recently developed a prototype transcritical CO₂ system that integrates "supercritical CO₂ extraction" — an industrial process using CO₂ as a solvent that is widely considered to be the ideal method for extracting medicinal compounds and consumable oils from raw materials such as lavender, rice bran, peanuts, fruits and even cannabis.

CO₂ becomes a supercritical fluid (a gas-fluid mix) above its critical point, 88°F (31°C) and 1,071 psi (74 bar).

The development effort, which ITC has dubbed "Project Blue Bird," is the first in the region — and possibly the world — to employ transcritical CO₂ refrigeration along with supercritical CO₂ extraction in the food-processing sector.

"Like CO₂ in the refrigeration field, supercritical CO₂ usage in food processing has also gained popularity in the past few years," said Warot Lam, engineer for ITC.

Compounds extracted from biological materials via supercritical CO₂ extraction are considered "purer and more valuable than from other methods," he noted.

Since ITC has always been involved in the food industry and Lam's field of expertise is in food production, "we reckon this system has the potential to merge refrigeration and food processing together."

In particular, Lam added, the system "can create new opportunities in Thailand's markets where herbs and fruits are widely cultivated."

ITC is in final stages of testing its supercritical CO₂ extraction system in preparation for exhibiting the whole Blue Bird project at the upcoming R&HVAC 2019 tradeshow this September.

Rice terrace in Mae-Jam Chiang Mai, Thailand. Supercritical CO₂ extraction is considered the ideal method to extract rice bran oil.

Warot Lam, ITC, and the "Blue Bird" prototype transcritical CO₂ system in January 2019

The system began as an experimental container-sized CO₂ transcritical refrigeration system that included an 8 m³ (283 ft³) cold room, a chilled water system and a heat reclaim system; it was designed to operate in ambient temperatures of around 35-36°C (95-97°F).

Initial tests of the system were conducted in December of last year and positive results encouraged the team at ITC to continue developing it over the following months. The second phase of the project, Lam explained, was to connect the CO₂ transcritical refrigeration system to a CO₂ supercritical fluid extraction system.

FULLY INTEGRATED SOLUTION

The system is designed to obtain supercritical CO₂ fluid at the compressors' discharge lines and employ it for extraction processes "before using it in the typical refrigeration system later on," Lam explained.

The refrigeration side of the system could serve as "a fully integrated, one-stop-shop solution for end users especially in the agricultural sector," he said.

For example, during the postharvest handling stage, hot water from the heat reclaim system can be used for cleaning processing equipment in factories, said Lam. The chilled water system can be utilized for hydrocooling or cleaning produce. After that, the hydrocooled produce can be stored inside a cold storage, waiting to be shipped or further processed.



"It is a perfect solution for agricultural investors who would like to increase the value of their products," Lam said.

Lam said that testing is currently focused on the extraction process for rice bran and peanut oil. However, larger markets in Thailand loom, especially considering recent policy developments in the country.

"Since the government has just legalized cannabis cultivation for medicinal uses, it has become a huge trend in Thailand," said Lam.

Indeed, some reports project Thailand's cannabis market to be worth US \$661 million (21 billion baht) by 2024 and ITC is already fielding requests from this sector today.

"We have received many calls from researchers and hospitals to test our extraction system when it is finished," said Lam.

■ DY

"Like CO₂ in the refrigeration field, supercritical CO₂ usage in food processing has also gained popularity in the past few years."

— Warot Lam, ITC

BLUE BIRDS AND CROCODILES

ITC's innovation in refrigeration doesn't stop with Project Blue Bird. With its penchant for animal references, the company is developing "Project Crocodile."

Project Crocodile is an ice-storage system that will be used for air conditioning at the company's new factory, which covers more than 600 m² (6,458 ft²), explained Warot Lam, engineer for ITC.

ITC is currently in the process of installing this equipment on site.



R290 training in Bangkok, Thailand. Photo: GIZ Thailand

New program aims to educate more than 200 trainers in Thailand by the end of 2020

— by Devin Yoshimoto and Jan Dusek

As Thailand evolves from synthetic refrigerants to natural propane (R290) in air conditioning and refrigeration, an effort is underway to ensure that its trainers know how to safely handle flammable refrigerants so they can inform their peers.

The training program debuted on August 19, at King Mongkut's University of Technology North Bangkok (KMUTNB), with the "Grand Opening of First R Training: Safe Use and Handling of Flammable Refrigerants."

The event – jointly held by KMUTNB, the Electricity Authority of Thailand (EGAT), and GIZ GmbH – marked the official start of a "training of trainers" series on the safe use of R290 in refrigeration and air conditioners in Thailand, including how to charge and vacuum a system.

The program is part of the larger Thailand Refrigeration and Air-Conditioning Nationally Appropriate Mitigation Action (RAC NAMA) initiative which "aims to promote natural refrigerants for energy-efficient and climate-friendly cooling technologies in Thailand," according to a statement released by GIZ Thailand.

More manufacturers in Thailand have switched to green cooling, GIZ Thailand says in an informational video (<https://bit.ly/2Z9sclf>), which explains the importance of switching from synthetic refrigerants to natural refrigerants in air-conditioning in the country. About 1.8 million AC units were sold in Thailand in 2017, up from 900,000 in 2008, according to GIZ Thailand.

Eight locations in Thailand have been selected as training centers for the project, said Tim Mahler, country director of GIZ Thailand and Malaysia. "In total, the project will have organized 13 training courses with more than 200 trainers trained all over Thailand by the end of 2020."

Focus on AC

Training is mainly focused on the safe use of R290 in room air-conditioning applications "as it has less global warming potential [GWP], which helps reduce global warming," said Associate Professor Chatchan Thangjub, who

serves as project leader and head of the Refrigeration and Air Conditioning Engineering Technology department at KMUTNB.

"It also can reduce up to 5%-25% of energy consumption and has an excellent heat transfer property, leading to the development of high-quality air conditioners that are energy efficient and thus help save on electricity bills," he said.

The first training course will see participation from 16 room air conditioning trainers from 16 different Thai provinces. Course content includes theoretical knowledge, operational safety, and "hands-on practice at every step of work, from installation, brazing, operation and leakage testing to labeling, reporting and delivery," according to Thangjub.

The RAC NAMA project is funded by the NAMA Facility on behalf of the German Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the U.K.'s Department for Business, Energy and Industrial Strategy.

"Through the founding of the innovative financing instrument known as the NAMA Facility, the U.K. and Germany have put in place an important initiative that provides both the policies and fiscal measures to support Thailand's transformational change towards low-carbon development," said Margaret Tongue, deputy head of mission at the British Embassy Bangkok. ■ DY & JD

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.

SIGN UP



It's all on Accelerate24.news.

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

Pushing Natural Refrigerants in Southeast Asia

With plans to convert its entire portfolio to hydrocarbons and CO₂ by 2022, OEM Sanden Intercool Group is targeting its home market in Thailand and the region

— By Devin Yoshimoto and Jan Dusek

Thailand-based Sanden Intercool Group, a Thai-Japanese joint venture company and one of the largest global manufacturers of commercial refrigeration equipment, aims to have its entire product range using natural refrigerants, in particular hydrocarbons and CO₂, by 2022.

The goal stems from both environmental concerns and customer demands, particularly for hydrocarbons in Southeast Asia, as well as technical and regulatory advancements.

"Most of our global and regional accounts — meaning beverage, beer, soft drink, dairy and ice cream makers — are actively supporting green refrigeration, either by mandating low-carbon-footprint equipment, or by advising the use of hydrocarbon refrigerants," said Alex Panas, commercial director for Sanden Intercool Group.

Indeed, over the past few years, major multinational brands in these product

categories — many of which are customers of Sanden — have made specific commitments to phasing down the use of HFCs in their equipment.

For example, Dutch-British transnational consumer goods giant Unilever decided to end use of f-gases and adopt hydrocarbons in its freezer cabinets in 1999. Atlanta, Ga.-based Coca-Cola, the world's largest beverage company and investor in plug-in cooling equipment, has aimed since 2008 to make all new cold-drink equipment HFC-free by 2020.

In addition, Dutch multinational brewing giant Heineken is a major user of hydrocarbon equipment, adopting it for all beer fridges since 2013. And Beverage companies Diageo and Group Castel are both investing in green refrigeration for all of their equipment in Africa.

"I think that these are the opinion leaders that will drive further this change in the industry," said Panas.



Production line conversion

Already more than 70% of the company's equipment sales is available with hydrocarbon systems, said Panas, adding that nearly 100% of the company's sales to Europe and Africa have been hydrocarbon equipment in the last few years.

Getting to this point, however, required a significant investment in the development of green refrigerant product configurations as well as in the conversion of the company's production lines to be compatible with them. This change has been supported by German International Cooperation Agency GIZ (Gesellschaft für Internationale Zusammenarbeit) in Thailand. The process began around three years ago and will be completed this August.

"GIZ Thailand is supporting all the phases for the migration to green refrigerant in the country," said Panas. "This includes the necessary investments for the production of hydrocarbon-based equipment through cooperation with manufacturers, as well as regulatory and



Sanden Intercool Group, In a Nutshell

Status: Joint venture between Yammarat Refrigeration Group (Thailand, privately held) and Sanden Corporation (Japan, public, Tokyo Stock Exchange)

Founded: In 1990, with headquarters in Singburi, Thailand

Manufacturing capacity: 500,000 units per year

Manufacturing facilities: Thailand (mega plant), Egypt, Nigeria

Markets: East Asia, Pacific, Africa, Middle East, Europe and North America

Product range: Beverage coolers, ice cream freezers, retail shop coolers and freezers, convenience store and supermarket display cases, professional kitchen and food service equipment, pastry shop showcases

marketing activities required to establish and promote this new equipment to the customer base."

The recent hydrocarbon charge limit increase to 500 g (17.6 oz) from 150 g (5.3 oz) approved by the IEC "will help reduce technological barriers and facilitate wider use of hydrocarbons across more types of commercial and professional refrigeration equipment," he said.

That means that, in addition to small-to-medium beverage coolers and chest and ice-cream freezers, hydrocarbon refrigerants "will be applicable to larger models as well as in retail display cases and kitchen/foodservice refrigeration equipment in the near future," he said.

With that in mind, Sanden Group has devised "a concise three-year plan to develop a complete range of green commercial, professional and retail refrigeration equipment for the beverage, dairy, ice-cream, foodservice and retail store market segments," he added. This is expected to be completed by 2022.

Targeting Southeast Asia

With much of its global market already rapidly adopting hydrocarbons, Panas said that Sanden is now "setting its sights" on growing the utilization of hydrocarbon systems in its home market of Thailand and the rest of Southeast Asia.

"However, apart from offering the right cooling configurations and green refrigeration solutions, there are external factors and outside influences that impact the switch-over to natural refrigerants," he noted.

For example, at the moment there is no clear target for the phase out of CFCs or HFCs in ASEAN (the Association of Southeast Asian Nations), "which creates the lack of strict direction for the industry in this region," he said.

Another obvious factor is service, said Panas. "I think this is the main reason why some of the biggest companies in this region have not yet switched to hydrocarbons."

1 / Sanden Intercool Main
Factory in Thailand

2 / R290 bottle cooler
at Sanden Intercool Office

Photos: Sanden Intercool Group

Despite these challenges however, Panas said that the company is confident in its future vision and decisions, and working towards achieving its green refrigeration deployment goal.

As a message to others considering this transition in Southeast Asia, he remarked, "We can together evolve the industry in the region and facilitate the switchover to green cooling; I urge them to join the effort." ■ DY & JD

Chinese Companies Report Production of Nearly 160,000 Propane Room ACs

Though short of the 220,000-unit pledge made by the industry last year, the number represents progress towards advancing R290 AC adoption in China

— By Devin Yoshimoto and Jan Dusek

As China continues to work towards phasing out the use of HCFCs in its air conditioning sector, production of propane (R290) room air conditioners (RACs) are beginning to gain momentum according to a recent joint statement from Li Xiaoyan, program officer at China's Ministry of Ecology and Environment/Foreign Economic Cooperation Office (MEE/FECO) and Dou Yanwei, in the department of integrated affairs at the China Household Electrical Appliances Association (CHEAA).

Chinese manufacturers confirmed production of 157,920 R290 split-type RACs, as of August 2019, said Li and Dou. Orders were mostly bulk procurement from organizations such as schools or public buildings. There have been no reports of any private purchases.

The R290 ACs are fixed-frequency, 1.5-HP units with energy-efficiency (EE) grade II. (Haier has produced 50,000 units of

grade I EE.) The R290 charge size is around 300 g, following the requirements of China's national safety standard GB4706.32.

"I congratulate the government of China, the industry association, CHEAA, and in particular the eight Chinese industries for their achievements in terms of deployment of R290 split AC's," said Ole Nielsen, chief of the Montreal Protocol division for the United Nations Industrial Development Organization (UNIDO).

"I hope the lessons learned can facilitate further uptake of R290 - both in China and internationally. The transition of residential A/C to low-GWP refrigerant combined with high energy efficiency is a key element in order to meet the climate targets of the Kigali Amendment".

The news follows a public pledge made last year during the "International Workshop on Alternative Technologies to HCFC-22 in Room Air-conditioner

Sector and Air-conditioner Technology Session," held in October in Ningbo, Zhejiang Province in China.

At the event, eight companies — Gree, Midea, Haier, Hisense, Changhong, TCL, Aux and Yair — pledged to produce no less than 220,000 split-type R290 RAC units in the domestic Chinese market by the end of the 2019 "cooling year," which ended on July 31.

Though short of the goal, the initial results represent the first step in a concrete effort by the Chinese RAC industry to increase the production of R290 RAC systems in China.

Midea and Haier are the production leaders so far, according to Li and Dou. Official figures will be announced in October.

Remaining barriers

MEE/FECO has stated that, together with CHEAA, it will continue to review progress until the first 220,000 production target is achieved, and then discuss with manufacturers subsequent targets and next steps.

However, a number of key challenges need to be solved before more rapid progress can be made.

Manufacturing costs for room air conditioners using R290 are still higher than units using R22 and R410A, said



“
Despite the difficulties,
the Chinese room air
conditioning industry
has taken the first step
in the marketization of
R290 ACs.
”

— Li Xiaoyan, MEE/FECO,
and Dou Yanwei, CHEAA

Li and Dou. This is mainly due to safety requirements and the small scale of production.

However, the Chinese government is helping to offset the additional costs for manufacturing ACs using R290, based on the standard incremental operating cost (IOC) determined and funded by the Multilateral Fund (MLF). The IOC standard will be gradually reduced along with the growth of production. No subsidy is provided from government to end users for purchasing R290 ACs in China.

The government also launched a special program recently to support manufacturers in the training of technicians for installation and servicing of R290 ACs.

Another challenge is that the charge limit for R290 in air conditioning is considered too low, limiting the performance of the units.

More time and resources are needed as well to convert the entire supply chain of the industry from nonflammable to flammable refrigerants. This includes storage, installation, servicing, and more.

Finally, MEE/FECO and CHEAA acknowledge that general awareness of the use of flammable refrigerants within the industry needs to improve.

“Despite the difficulties, the Chinese room air conditioning industry has taken the first step in the marketization of R290 ACs, which will help manufacturers and stakeholders accumulate real-time experience with the production, transportation, installation and servicing of R290 ACs,” said Li and Dou.

Chinese air conditioner manufacturers join representatives from the Chinese government and UN Agencies in October 2018.

Production-line conversions

Moreover, in the past few years, there has been significant progress made in manufacturing R290 RACs in the country.

With the support of international organizations such as UNIDO and with funding provided by the MLF, China converted 18 RAC production lines to R290 with a production capacity of 4,500,000 units per year, as well as three RAC compressor production lines with a production capacity of 5,400,000 units per year.

These conversions were completed during the first stage (2013 to 2015) of China's HCFC Phase-out Management Plan (HPMP).

In 2018, another five air conditioner production lines began conversion from R22 to R290. An additional four R290 RAC compressor production lines are under construction, said Li and Dou.

■ DY & JD



NITROGEN ON DOUBLE DUTY IN TRANSPORT REFRIGERATION

1 /

Dearman's transport refrigeration unit uses liquid nitrogen to generate both power and cooling.

— by Tine Stausholm

Using the same principles as an old-fashioned steam engine, a transportation refrigeration unit (TRU) from U.K.-based Dearman Engine Company employs cryogenic liquid nitrogen as an environmentally friendly power alternative to traditional fuels as well as a coolant for the cargo.

"Dearman units have the advantage of having the same flexibility as TRUs powered by a secondary diesel engine, running fully independently of the truck and having a lower infrastructure cost than battery-electric technology," Tony Martyn, chief technology officer for Dearman, told *Accelerate Magazine*.

The system works in two steps. First the extremely cold liquid nitrogen (-210°C to -196°C / -346°F to -320°F) is run through a heat exchanger where it provides two-thirds of the cooling to the temperature-controlled compartments of a trailer. (The other third is provided by a separate vapor-compression system.) Next it is sent at -20°C (-4°F) at 40 bar as a supercritical fluid through the Dearman engine (separate from the engine that drives the vehicle.)

In the Dearman engine the nitrogen mixes with warm water/glycol in direct contact. The nitrogen absorbs the heat from the water/glycol heat exchange liquid and evaporates. When changing from liquid to gas phase, nitrogen expands 710 times, and it is this expansion that is used to drive the piston in the Dearman engine and thus generate the power needed for the cooling systems, eliminating the need for traditional fuels like diesel.

After absorbing heat in the engine, the gaseous nitrogen is dispersed in the atmosphere through an exhaust valve. The heat exchange fluid is reclaimed, reheated via the vapor compression system, and reused.

The Dearman TRU is designed for a very fast temperature pull-down time. "The unit can pull down and recover much faster to set temperatures and have more precise temperature control," said Martyn. In an 18-ton rigid truck, it can cool the trailer from 15°C (59°F) to -21°C (-5.8°F) in less than 30 minutes, the company says.

Depending on the trailer's duty cycle, a single refill of nitrogen can last up to three days, the company says. Refueling can be done by the driver, and the cost of establishing a nitrogen refueling infrastructure is "similar to a diesel refueling infrastructure," according to Martyn.

"At a point of sufficient deployment scale - estimated to be around 20 vehicles per infrastructure - and length, the cost of the infrastructure plus the supply cost of liquid nitrogen is competitive against the cost of white diesel," Martyn added.

The lifetime cost of the Dearman TRU is also similar to that of traditional units. "Our breakthrough in efficiency means our TRU is on track to beat diesel and battery total cost of ownership - including unit cost, maintenance cost, infrastructure cost and fuel/liquid nitrogen cost," Martyn said.

Eliminating the need for traditional fuels to run the cooling system means the Dearman TRU emits no NO_x, CO₂ or particulates, only nitrogen. The CO₂ savings can be up to 30 metric tons per vehicle per year. If the electricity used to manufacture the liquid nitrogen is produced with renewable energy, then up to 96% of lifecycle CO₂ is saved. If the electricity is produced with traditional methods, the CO₂ savings are between 30% and 85%, according to Dearman's website.

End users and a new partner

Dearman was created in 2011 to develop the ideas of British inventor Peter Dearman. Since 2014, Dearman has received funding from the U.K. government's Advanced Propulsion Center for the development, manufacturing and commercialization of the technology.

Unilever and British retailer Marks & Spencer are already using the Dearman TRU. Sainsbury's, another large British retailer, tested it during development.

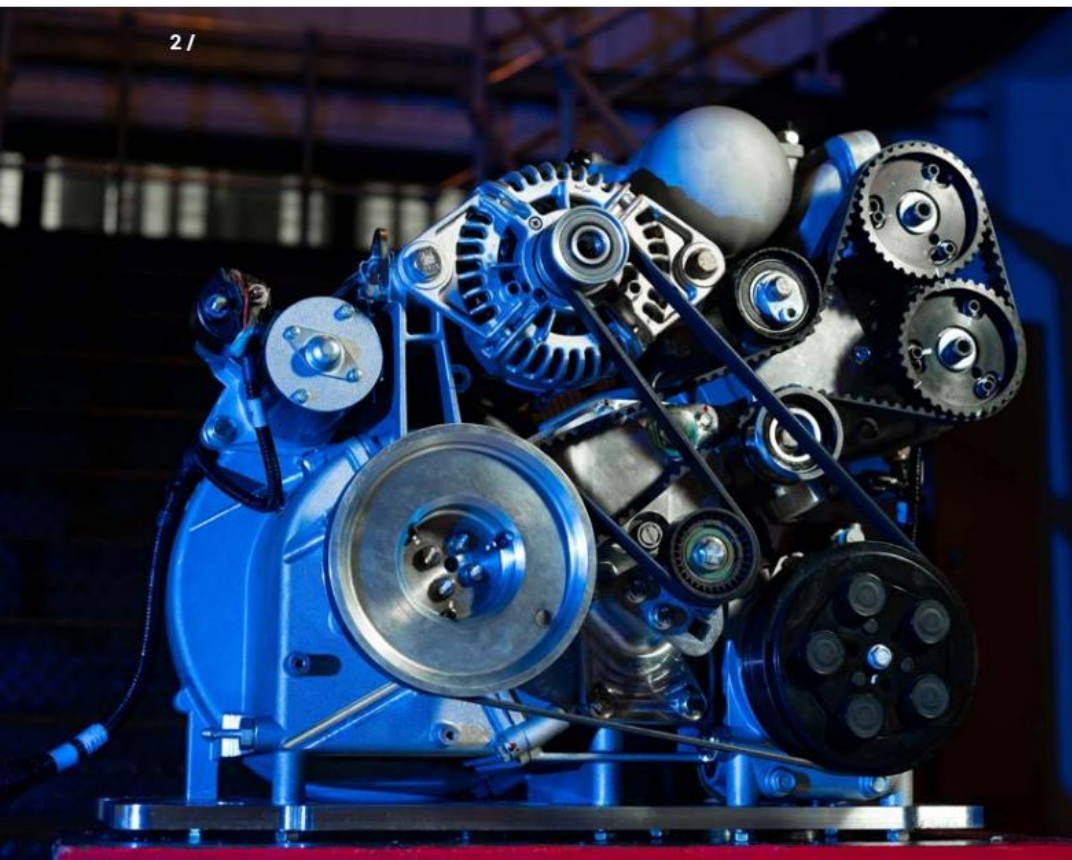
In August 2019, Dutch equipment provider TIP Trailer Services and Dearman announced a partnership that will enable TIP to offer its customers refrigerated trailers equipped with the Dearman TRU, as part of its 70,000-unit strong trailer fleet. TIP had successfully tested the TRU system in the Netherlands and Italy with a multi-brand food retailer.

"TIP sees its customers frequently playing with the question of how to deal with issues such as sustainability and the type of trailers to be used," said Rogier Laan, vice president for TIP Benelux. "We therefore see it as our responsibility to be the best industry partner for these topics, and we support innovative solutions that contribute in making our industry more sustainable."

"TIP's support for clean technology innovation is major step to enable fleet operators to meet the increasing environmental demands upon them from regulators, foods producers and retailers," noted Khaled Simmons Dearman's Chief Commercial Officer

Dearman TRUs can be "installed and retrofitted on trailers and medium to large rigs," said Martyn, adding that "future versions of the Dearman system will be adapted to smaller vehicles such as vans and small rigs."

Other existing applications of Dearman's technology include data centers, mobile pre-cooling for fresh produce, auxiliary power units for bus air conditioning and vehicle range extensions, according to Martyn. ■ TS



1 / Truck equipped with the Dearman transportation refrigeration unit

2 / Dearman engine

TAKING THE MEASURE OF CO₂

Professor Armin Hafner, one of the world's leading CO₂ refrigeration researchers, looks back at the progress made by CO₂ over the past two decades – and the road ahead

— By Michael Garry

Armin Hafner,
NTNU



The modern age of natural refrigerants is said to have begun in the late 1980s when Norwegian Professor Gustav Lorentzen developed the modern transcritical cycle for CO₂.

Following in his footsteps is Armin Hafner, since 2016 a professor in refrigeration at the department of energy and process engineering at NTNU (Norwegian University of Science and Technology), in Trondheim, Norway, where Lorentzen also taught. Prior to that he worked for two decades at SINTEF, a Norwegian research organization.

Hafner has done some of the leading research on CO₂ refrigeration and heat pump technology, investigating every application of CO₂ systems as well as the components that comprise them. *Accelerate Magazine* conducted the following interview with him on the progress CO₂ has made in HVAC&R and its prospects in the global marketplace

// Accelerate Magazine: When did you start working on CO₂ refrigeration?

Armin Hafner: My first practical experience with CO₂ refrigeration technology was during my diploma thesis at FH-Karlsruhe (now the Karlsruhe University of Applied Sciences) in Germany in 1995. I worked with F.Gräßlin to develop a CO₂ laboratory system and build a pilot system under the supervision of Prof. J. Reichelt. An open-type BOCK (now GEA) piston compressor was applied in an air-cooled refrigeration system.

During this period, we studied the research work performed at SINTEF/NTH in Trondheim, Norway. The team in Trondheim had started around 1988 developing CO₂ refrigeration systems for mobile applications (car air conditioning) and hot-water heat pumps in close cooperation with Hydro Aluminum. I applied for an exchange program at NTNU in Trondheim and was accepted to continue my studies within refrigeration in a Master Program. I graduated in 1996 and began my refrigeration research career at SINTEF.

// Accelerate Magazine: How would you describe the progress made by CO₂ refrigeration since you began working on it?

Armin Hafner: Since the early days of the revival of CO₂ refrigeration, spearheaded by the team led by Professor Gustav Lorentzen, there has been some skepticism from industrial players about applying or converting to this natural high-pressure fluid.

In the beginning, before the turn of the millennium, the number of available components was rather limited. Due to the properties of CO₂, the main components of a CO₂ refrigeration system could not be taken from the shelf of low-pressure equipment for HFCs; they had to be adapted both with respect to safety and energy efficiency.

Due to the great effort of various research teams around the globe and public funding, it could be demonstrated that, when adapting the system layout to the properties of CO₂, the CO₂ systems are competitive with current technologies or even more beneficial. As an example, there are more than 5 million CO₂ hot-water heat pumps installed in Japan. CO₂ is an excellent working fluid for hot water production, if a high temperature lift is required and a low water-inlet temperature can be provided. Therefore, nowadays this kind of technology is also introduced to energy systems in high-performance buildings like hotels etc.

Another example is commercial refrigeration. Due to the excellent transport properties of CO₂, energy losses can be significantly reduced in centralized refrigeration systems, which are common in Europe. The shop owners are not very much interested in the type of working fluid that is inside their display cabinets; they care about reliability and cost of ownership. Both are in favor for CO₂ and even the safety of their customers and staff can be secured when applying this nonflammable natural working fluid.

Large efforts with great technical achievements have been made within mobile air conditioning (MAC) applying CO₂ at the beginning of this century. Due to political decisions, personal preferences and lobbying, the number of systems in the market is limited; however, due to the introduction of new electric powertrain concepts a CO₂ revival in this sector is very likely to happen.

// Accelerate Magazine: Do you think that CO₂ transcritical will continue to grow substantially in food retail or will another technology (hydrocarbons, HFO blends) prevent that growth?

Armin Hafner: Since the introduction of the CO₂ refrigeration technology in supermarkets by Costan and Linde nearly 20 years ago, the annual growth rates in Europe have been very high. There is a limit to how many new systems can be produced and implemented every year, due to the production capacity of compressor manufacturers and others. Due to the enforcement of the EU F-Gas Regulation, the demand is even higher than what can be produced, which keeps the cost high and opens the door for alternatives.

Hydrocarbons, utilized as working fluids in self-contained display cabinets, are a solution which should be applied as these are much more energy efficient than comparable HFC units. Hydrocarbon-based systems for small-format stores where the heat is rejected towards a water loop can be another low-cost solution with a natural working fluid.

Outside of Europe, there is a trend to implement CO₂ refrigeration technology in large supermarkets. Most of the global players, which source their refrigeration equipment from global suppliers, do have a strategy to convert to CO₂ in existing or new stores. The challenge is to find skilled contractors able to implement and service this technology. However, the know-how is being transferred and a growth in the number of CO₂ transcritical systems will occur. Shop owners around the globe are business people; if they see a profit in implementing CO₂ technology, they will do it. The environmental benefit will be a side product, which enables leapfrogging from HCFC towards natural working fluids in some parts of the world.

// Accelerate Magazine: Do you see transcritical CO₂ continuing to grow in industrial refrigeration and taking away market share from ammonia systems?

Armin Hafner: Transcritical CO₂ refrigeration and heat pump applications are economically beneficial for industrial players. Due to the new developments of large-capacity compressors by several compressor manufacturers, it is nowadays possible to build industrial systems with a reasonable number of compressors.

Traditionally, ammonia has a strong position within the industrial sector. CO₂ must be seen to be complementary to these units, not as a competitor.

The market growth for refrigeration systems with natural working fluids is high, especially when the end user is informed about the personal and environmental risks related to HFCs of all kinds. Therefore, there is a need for – and growing share of – both ammonia and CO₂ systems.

In cases when refrigeration systems have to be replaced, like inside fishing vessels, CO₂ can offer the advantage of being more compact and being able to increase the cooling capacity without requiring more space for the equipment. At the same time, there are no critical issues related to HSE (Health Safety Environment)

CO₂ will also play an important role in some chiller applications, when both hot water and chilled water are required (hotels, etc.). If flammable working fluids cannot be applied, CO₂ units can represent an efficient and reliable alternative, as demonstrated by enex in Italy.

// Accelerate Magazine: Will transcritical systems that integrate refrigeration, AC and heating take over from refrigeration-only systems in commercial and industrial installations?

Armin Hafner: This will be a natural development, since the end user is very concerned about the total cost of ownership for installations. The shop owners are very much interested in integrated systems, if they own the entire building. A challenge in getting more of these integrated systems into the market is the structure of the companies. If one of them is responsible for the building and its operation, while another one takes care of the requirements for the shop, a common business model must be developed; this would allow them to invest commonly in an integrated unit, instead of independent units with different owners and service providers.

For industrial applications, the ownership situation is often clearer; therefore, most of the CO₂ refrigeration systems can be classified as integrated units within energy processes.

// Accelerate Magazine: CO₂ has made very little headway in mobile air conditioning because of the dominance of R1234y. Do you see that changing, given the environmental concerns and flammability dangers associated with R1234yf?

“
*Shop owners around
 the globe are business
 people; if they see a profit
 in implementing CO₂
 technology, they will do it.*
 ”

Armin Hafner: The new focus of the automotive sector towards powertrains with alternative energy sources to enable these vehicles to drive over long distances must include energy-efficient heating concepts. As most of the new vehicles will not rely on burning fuel in the future, the amount of surplus heat is very limited. The energy management is even more advanced, since different parts need to be cooled or heated to enable a safe and efficient drive.

Taking all these aspects and flammability/toxicity issues into consideration, the number of options for the active heating and cooling of both the passenger compartment and important parts are limited. CO₂ has proven to be the champion, as we will see soon when these new vehicle platforms are introduced by the remaining OEMs.

// Accelerate Magazine: What are CO₂'s prospects in residential air conditioning and heating?

Armin Hafner: The market for residential AC and heating can be mostly covered on a global base with systems applying the natural working fluid R290. Propane is an excellent working fluid available and affordable on a worldwide basis for all people.

In the case of moderate climates, and modern houses where most of the heating demand is represented by hot water heating, CO₂ units can become an option, as the Eco Cute systems have in Japan.

// Accelerate Magazine: Much progress has been made in supporting transcritical CO₂ in warm ambient climates with adiabatic gas coolers, ejectors, parallel compression, subcooling, and thermal storage. Should the “CO₂ equator” issue be considered solved?

Armin Hafner: Yes this is definitely the case. Thanks to a great effort and common research and development there is no CO₂ equator anymore. Nowadays the end user can choose among different energy-efficient solutions adapted to their special requests and needs. The important issue is that the systems are designed for the worst case – i.e. able to perform during the hottest hours of a year for the region where the unit is implemented. However, the efficiency advantage of CO₂ is achieved during the main operating hours and part-load operation.

In addition, when integrating additional functions like AC, hot water, etc. the total cost of ownership is lower for CO₂ systems made in serial production, i.e. large volume orders of standardized units.

// Accelerate Magazine: Overall, where do you see the state of CO₂ refrigeration in five years? What are the biggest hurdles still to be overcome?

Armin Hafner: The state-of-the-art CO₂ refrigeration units by 2025 will be: hot-water heat pumps, commercial refrigeration packs, mobile air conditioning and heat pump units for low/zero emission vehicles, transport refrigeration (truck, trailer and containers), chilling and freezing systems for fishing vessels, integrated chillers providing hot water and cooling, and low-temperature industrial freezing applications for high-quality food.

The biggest hurdles will be: knowledge transfer and practical training on how to adapt and implement CO₂ refrigeration systems in regions where technical skills are less based on organized educational programs; and raising awareness of end users to apply systems with natural working fluids.

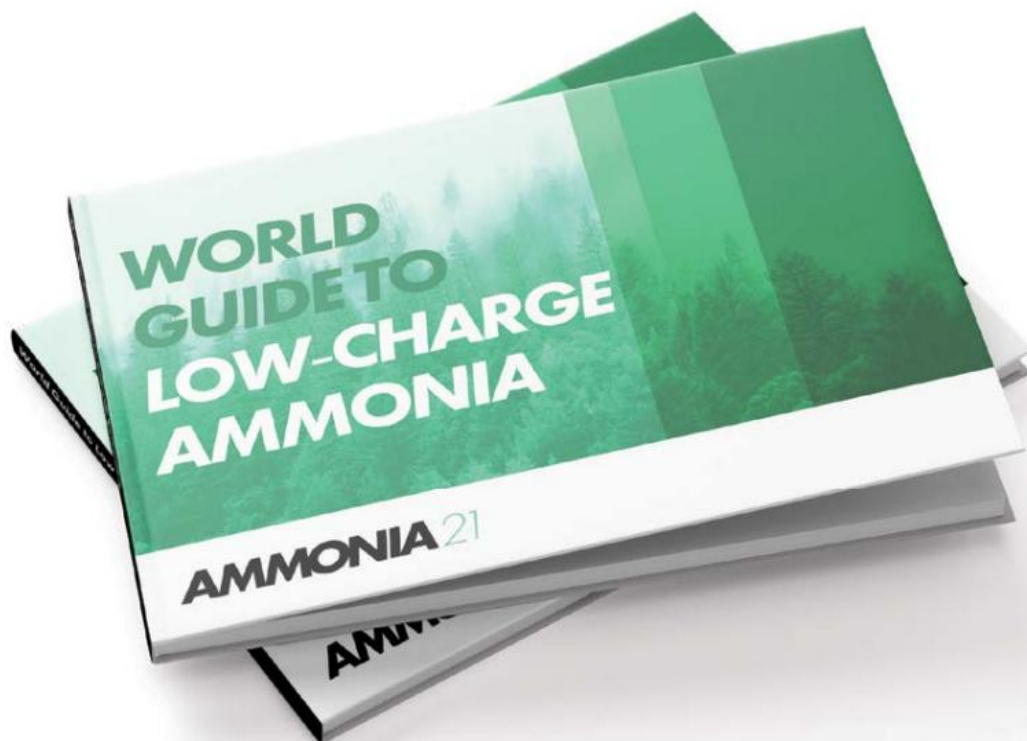
If contractors provide objective safety information – explaining the content of the material data sheet and the consequences/risks – to end users when offering alternative systems, responsible managers will ask for units with natural working fluids.

#GoNatRefs



A21 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!

Join the Supporters!



VAHTERUS



|SSP|KÄLTEPLANER.CH|



info@sheccobase.com

+32 2 230 3700

brought to you by

sheccoBase



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 to our email alert to get all the
NatRef news 24/7 in your hands.

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



Simply attractive. Even the savings. GEA Grasso M.

Redefine the total cost of ownership
of your refrigeration plant.

The GEA Grasso M is simply attractive in every respect – especially in terms of costs. Thanks to advanced engineering design, the GEA Grasso M combines outstanding reliability and easy servicing with high efficiency. This screw compressor unit is used for industrial refrigeration and air conditioning across

many industries such as food and beverage, chemicals, pharmaceuticals, and more – in which it excels in minimal energy, operating and service costs. This means significant reduction in the life cycle costs. Or, as we say: it redefines your total cost of ownership.