

JUNE / JULY 2017

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A M E R I C A

Person of the Year

**Paul Anderson
Target**

CARB's Data Gap

p. 24

**Meeting the
Retrofit Challenge**

p. 30

**Award Winners: Whole
Foods Market, Nestlé,
US Cold Storage and
Hillphoenix**

p. 34



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The Cost of Progress

By Michael Garry



The ATMOsphere America conference, held last month in San Diego, Calif., was a great place to learn about the latest natural refrigerant technologies and installations.

But what made the conference – organized by shecco, the publisher of *Accelerate America* – so compelling was its eagerness to delve into the underlying issues that are driving and, more importantly, impeding the adoption of environmentally friendly natural refrigerant solutions. No punches pulled there.

First of all, the notion that the misguided U.S. withdrawal from the Paris climate accord would set back the progress of natural refrigerants was quickly discarded. For one thing, there's still the Kigali Amendment to the Montreal Protocol, which deals directly with refrigerants. The Senate should approve it, but even if it doesn't, the Environmental Protection Administration and the Department of Energy have already set the stage for continued movement toward low-GWP refrigerants. And California is poised to set even more rigorous standards for refrigerants, which will have a national (and global) impact. (See page 24.)

The bigger issue, as always, was cost, particularly the first cost of equipment. In markets where natural refrigerant solutions are prevalent, like Europe, the initial cost of these systems has reached parity with that of HFC systems. Even in Canada, food retailer Sobeys is seeing cost parity or better with its transcritical systems. The U.S. market, far less mature, is still burdened with a first-cost premium. In low-margin sectors focused on the next quarter like food retail, that can be a deal-breaker.

Speaking at the food retail panel at ATMOsphere America, Harrison Horning of Hannaford Supermarkets acknowledged that the first-cost premium above a standard HFC system for a transcritical system he recently installed in an existing store was in the 10%-20% range. (See page 30.) But costs have come down and he expects that trend to continue. Moreover, when he factors in the heat reclaim derived from the transcritical system, the premium shrinks to near zero. And overall, he is "very confident" in a positive total cost of ownership (TCO)

Of course, when you look at TCO of systems with a lifetime of 20-25 years or more – which includes the energy savings that natural refrigerant systems typically experience vs. HFC systems – the cost argument against naturals pretty much disappears. The TCO becomes even more significant when you consider that HFCs are becoming increasingly regulated, and with a global phase-down, may not be viable in 10 years.

Even with a positive TCO, many end users are impatient to wait for the positive part to kick in; they want a return on the first-cost premium within two or three years. But as Paul Alway of the AB Group noted at ATMOsphere America, "Are we going to close the shop three years after we open it?"

I am of the opinion that the momentum toward naturals is undeniable, and over time cost questions will resolve themselves. Meanwhile, of course, manufacturers will need to keep driving down costs and driving up efficiencies. ■ MG

ACCELERATE

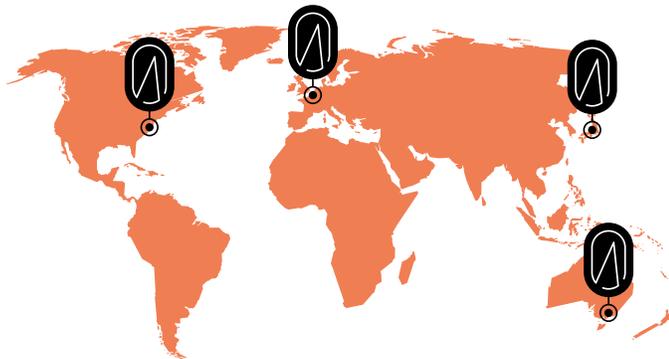
ADVANCING HVAC&R NATURALLY

A M E R I C A

About Accelerate America

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

<http://acceleratena.com>



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Letters to the Editor



Too Much NH₃ Regulation

R1234yf is a permanent F-gas because of its low GWP (global warming potential). But, as Jeff Shapiro, president of International Code Consultants, said in the April 2017 *Accelerate America* (“[IIAR-2 Takes Charge](#)”), it is more flammable than ammonia, a natural refrigerant.

I wrote an email to Dave Rule (president, IIAR) and Lowell Randel (VP, government and legal affairs, GCCA), suggesting that this proves that ammonia regulation in the U.S. is unnecessarily demanding, which should be pointed out to OSHA and the EPA.

Gerard von Dohlen

President, Newark Refrigerated Warehouse
Newark, N.J.

Congrats from a ‘Refrigeration Nerd’

I wanted to take a few moments to say thanks to all who were involved in putting together the ATMosphere America conference in San Diego a few weeks ago.

I had not previously attended this event, so when I was asked to participate in a panel I was unsure of how exactly I might benefit from going. I can honestly state now that I was pleasantly surprised! The conference program was quite diverse, as were the attendees’ fields of expertise, and networking opportunities abounded for me. From regulatory and code concerns to innovative component and system design, there was much to learn throughout the show.

Being heavily involved in the design and operation of industrial refrigeration systems, I have often referred to myself as a “refrigeration nerd.” This conference offered me great opportunity to network with other “nerds,” as well as explore new opportunities with suppliers and engineers from different fields with whom I may not have been able to meet otherwise.

Once again, congratulations to everyone who played a part in making the event such a success. I can’t wait for next year!

Peter A. Lepschat

Engineering Services Manager,
Henningsen Cold Storage Co.
Hillsboro, Ore.

Keeping Up with the Industry

The combination of articles the May 2017 issue – such as “[A Sea Change in Small-Format Refrigeration](#)” by André Patenaude – and the timely “[Natrefs Show](#)” podcast are helping me to keep up on U.S. and global laws. In his article, Mr. Patenaude points out that HFC R404A was phased out in supermarket racks on 1/1/2017 and will be phased out for walk-in coolers/freezers on 1/1/2018 and for >2,200 BTU stand-alone systems on 1/1/2019.

Equipment manufacturers are working feverishly to manage the changes, but moving from a standardized refrigerant like R404A to something else is difficult. Why? Because contractors by nature tend stick with what they know works. Many will stay with R404A as long as they are legally allowed. The end user will suffer when they find their HFC refrigerant has gone way up in price and could be difficult to source.

I would like to see a case study on how contractors, installers and end users manage their leaks. Are they installing permanent leak-detection systems? Do they require special tools to pinpoint leaks for natural gases? How are they managing the back-up refrigerant supply?

In the end, I thank *Accelerate America* for helping me to keep a pulse on the global refrigeration industry without having to jump on a plane or sort through multiple websites and blogs. Movements such as the adoption of naturals took a while to get started, but their time has arrived. In my opinion, the snowball is rolling downhill fast.

Ted Gartland

President, E. Gartland & Associates
Honeoye Falls, N.Y.

LETTERS ARE WELCOMED!

Accelerate America invites readers to submit letters to the editor at michael.garry@shecco.com. They can be about a recent article; anything related to the ATMosphere America 2017 conference; an industry issue that readers would like us to cover in greater detail; or the value of *Accelerate America* and ATMosphere America in educating the industry about natural refrigerants, including what we can do better. Letters can be as short as one sentence, but no more than 250 words; they may be edited for clarity or length.



ATMOsphere

Business Case for Natural Refrigerants

June 5-7, 2017 / San Diego

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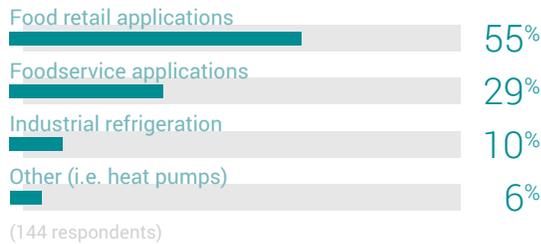
Business Case for
Natural Refrigerants
June 5-7, 2017 / San Diego

Taking Stock

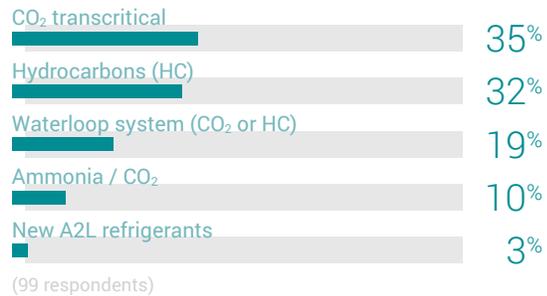
Attendees at ATMOsphere America 2017 opine on the direction – and regulatory drivers – of natural refrigerant uptake in North America

MARKET ADOPTION

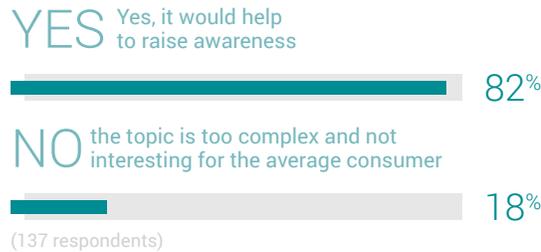
Where do you see the biggest growth potential in North America for natural refrigerants?



Which refrigeration technology holds the biggest potential for new food retail stores over the next 5 years?

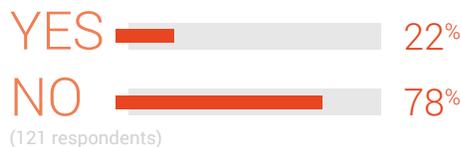


Should end users communicate more openly to consumers about sustainable refrigeration?

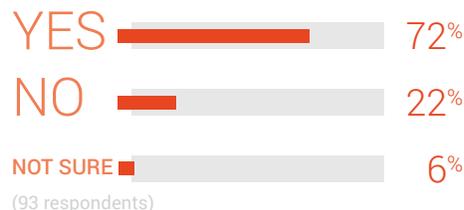


IMPACT OF REGULATIONS AND STANDARDS

Do you expect the market prospects for natural refrigerant solutions in North America to be affected by the U.S. decision to withdraw from the Paris Agreement?



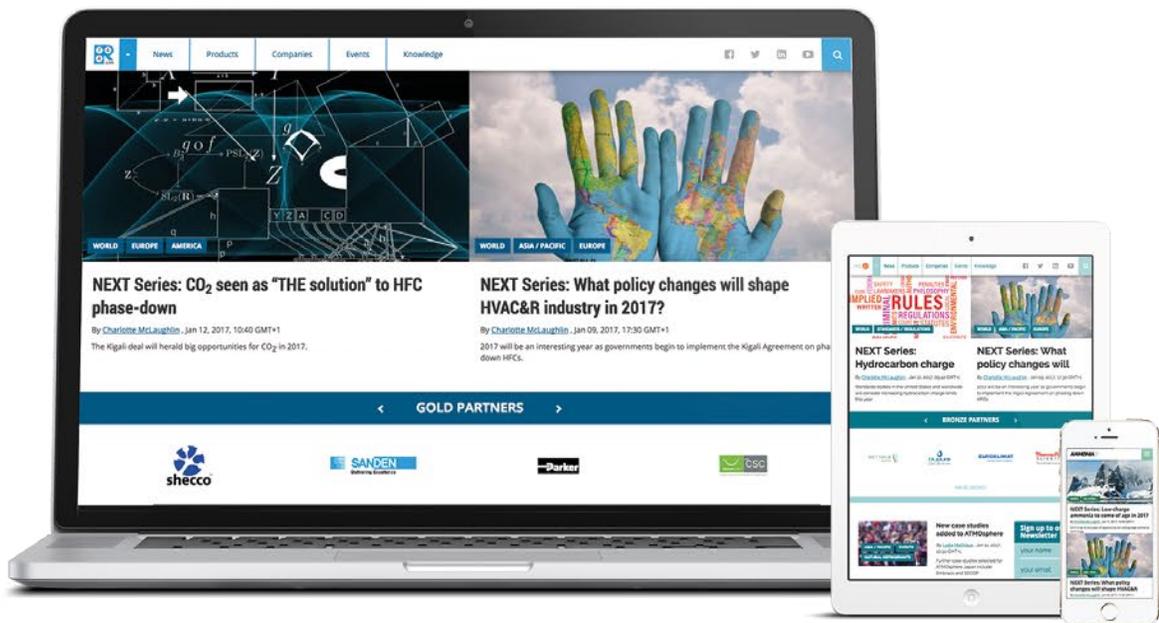
Do you expect the limits for hydrocarbon refrigerant charge to rise over the next year?



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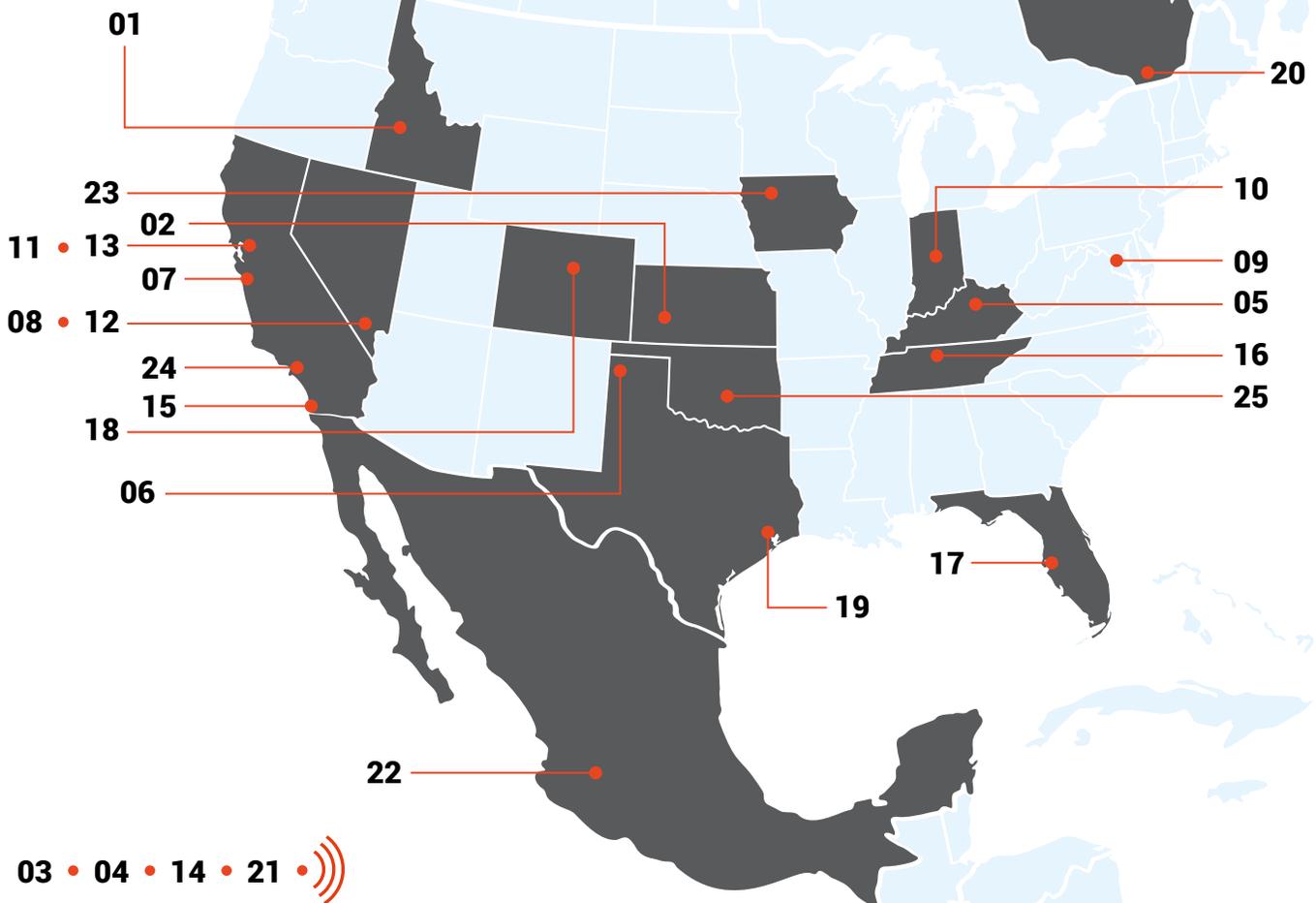
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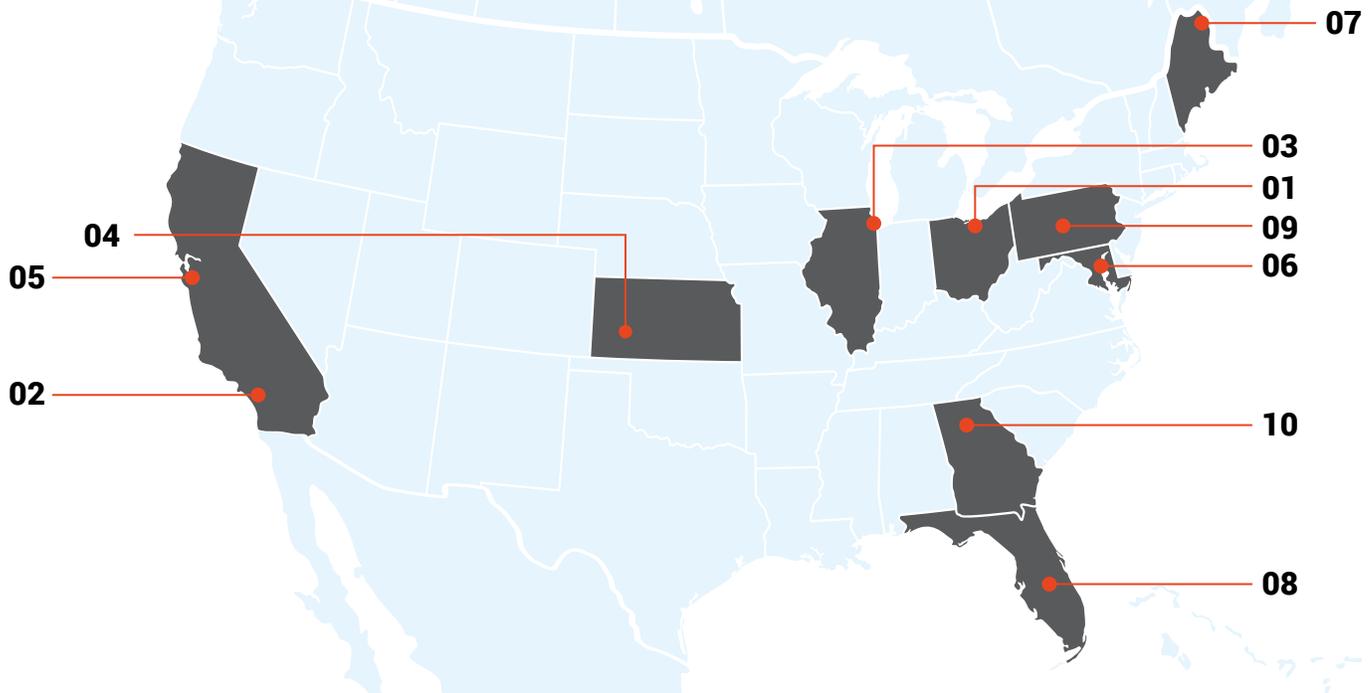
July 2017 / August 2017



- **01** July 17, Boise, Idaho
North American Sustainable Refrigeration Council (NASRC) Natural Refrigerants Seminar and Live Demo
www: <http://bit.ly/2tbQVKY>
- **02** July 17, Garden City, Kans.
Garden City Ammonia Program (GCAP) Ammonia Operator Training
www: <http://www.ammoniatraining.com/111-2/>
- **03** July 18, 2 pm Eastern, Online
"GreenChill Webinar: ASHRAE-Coordinated Research on Alternative Refrigerants"
www: <http://epawebconferencing.acms.com/ashrae>
- **04** July 18, 2 pm Eastern, Online
Food Retail Implications for U.S. Grocery Shopper Trends 2017
www: <http://bit.ly/2rT4WJD>
- **05** July 20-22, Lexington, Ky.
2017 American Association of Meat Processors (AAMP) Convention
www: <http://www.aamp.com/event-calendar/aamp-convention/>
- **06** July 22-23, Dalhart, Tex.
Ammonia Safety & Training Institute (ASTI) 8-Hour Refresher Safety & 24 Hour Technician Training
www: <http://fs4.forms.site.com/ammoniapltdcom/or2/index.html>
- **07** July 28-30, Monterey, Calif.
Produce Marketing Association (PMA) Foodservice Conference & Expo
www: <http://www.pma.com/events/foodservice>
- **08** July 30 - August 2, Las Vegas, Nev.
Independent Retailer Conference
www: [@RetailerConf](http://independentretailerconference.com)
- **09** July 31 - August 2, Washington, D.C.
2017 Global Cold Chain Alliance (GCCA) Assembly of Committees
www: <http://www.gcca.org/events/2017-gcca-assembly-committees/>
- **10** July 31 - August 4, Plainfield, Ind.
Garden City Ammonia Program (GCAP) Boiler Training
www: <http://bit.ly/2tMODzH>
- **11** August 1, Vallejo, Calif.
Bay Area Chemical Safety Day
www: <http://bit.ly/2tLTi4V>
- **12** August 6-9, Las Vegas, Nev.
Retail NOW
www: <https://www.gorspa.org/event/retailnow/>
- **13** August 7-9, San Francisco, Calif.
Building Simulation 2017
www: <http://www.buildingsimulation2017.org/>
- **14** August 8, 2 pm Eastern, Online
GreenChill Webinar: ORNL's Experiences Conducting Life-Cycle, Climate Performance, Tests on Commercial, Refrigeration Systems
www: <http://epawebconferencing.acms.com/life-cycle-climate/>
- **15** August 8-9, San Diego, Calif.
Produce Marketing Association (PMA) Mexico Business Roundtables
www: <https://www.pma.com/Events/Mexico-Roundtables>
- **16** August 9-11, Nashville, Tenn.
Global Sustainability Summit, Food Marketing Institute and Grocery Manufacturers Association
www: <http://www.fmi.org/sustainabilitysummit/About>
- **17** August 15-17, Tampa, Fla.
Energy Exchange 2017
www: <http://www.2017energyexchange.com/>
- **18** August 15-18, Denver, Colo.
2017 American Council for an Energy-Efficient Economy (ACEEE) Summer Study on Energy Efficiency in Industry
www: [@ACEEEdc #SummerStudy17](http://aceee.org/conferences/2017/ssi)
- **19** August 16-17, Houston, Tex.
Build Expo Houston
www: [@BuildExpoUSA](http://buildexpousa.com/Houston2017_Education.html)
- **20** August 16-18, Québec City, Canada
Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI)'s 49th Annual Meeting
www: <http://www.hrai.ca/agm/>
- **21** August 22, 2 pm Eastern, Online
GreenChill Webinar: Overall Costs of Management: Leakage, Usage, and Performance
www: <http://epawebconferencing.acms.com/mgmtcosts/>
- **22** August 25-27, Guadalajara, Mexico
International Institute of Ammonia Refrigeration (IIAR) Natural Refrigeration Seminar XV and Safety Day
www: <http://bit.ly/2s7MHHER>
- **23** August 26, Storm Lake, Iowa
Storm Lake, IA Ammonia Safety Day
www: <http://bit.ly/2tMakji>
- **24** August 27-29, Los Angeles, Calif.
2017 Western Foodservice & Hospitality Expo
www: <http://www.westernfoodexpo.com/>
[@TheFoodShows](#) #TheFoodShows
- **25** August 30-31, Oklahoma City, Okla.
2017 Oklahoma Restaurant Convention & Expo
www: https://www.okrestaurants.com/oklahoma_restaurant_convention.php
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EVENTS GUIDE

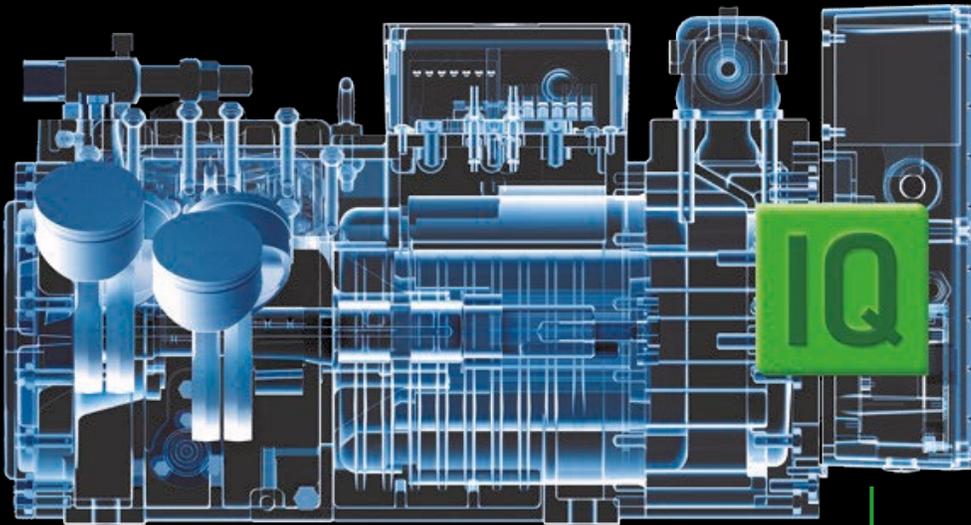
September 2017



- **01** September 12-14, Cleveland, Ohio
Contractor Leadership Live
www: <http://contractorleadershiplive.com/cll17/Public/Enter.aspx>
 @Contractor_LIVE #CLL2017
- **02** September 13-15, Irvine, Calif.
9th International Conference on Energy Efficiency in Domestic Appliances and Lighting – EEDAL'17
www: <http://iet.jrc.ec.europa.eu/energyefficiency/eedal17>
- **03** September 17-20, Chicago, Ill.
Food Marketing Institute (FMI)'s Annual Business Conference
www: <http://bit.ly/2tcLAUm>
- **04** September 18-21, Garden City, Kans.
Garden City Ammonia Program (GCAP) CO₂ Technician Training
www: <http://fs4.formsite.com/ammoniapltdcom/form2/index.html>
- **05** September 19, Santa Clara, Calif.
American Council for an Energy-Efficient Economy (ACEEE) Workshops at VERGE 17
www: <http://aceee.org/conferences/2017/verge>
 @ACEEEdc
- **06** September 20-22, Annapolis, Md.
National Air Filtration Association (NAFA) Conference
www: <http://bit.ly/2t9CvL6>
- **07** September 23, Presque Isle, Maine
Presque Isle Ammonia Safety Day
www: <http://bit.ly/2t9kqNf>
- **08** September 24-27, Orlando, Fla.
Food Marketing Institute (FMI) Energy & Store Development Conference
www: <http://bit.ly/2sd8hmi>
 @FMI_ORG #FMIEnergySD
- **09** September 26-29, Hershey, Pa.
The Refrigerating Engineers and Technicians Association (RETA) Annual Conference (Heavy Equipment Show)
www: <http://reta.com/?page=futureconferences>
- **10** September 27-29, Atlanta, Ga.
World Energy Engineering Congress
www: www.energycongress.com
 #weec

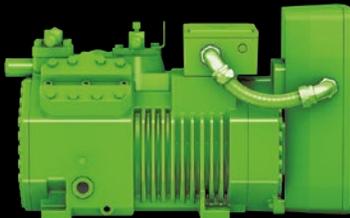


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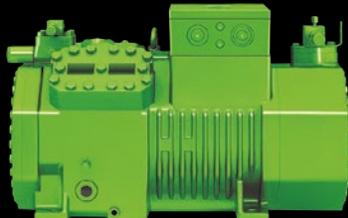


LEADERSHIP IN NATURAL REFRIGERANTS
AMMONIA AND CO₂ COMPRESSORS

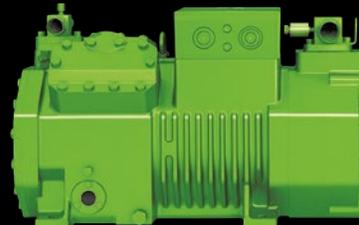
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IN BRIEF

CO₂

SPROUTS EJECTOR CALLED FIRST IN NORTH AMERICA

WOODSTOCK, GA. – A Sprouts Farmers Market that opened recently here is the first store in North America to feature a transcritical CO₂ system with ejector technology, according to Sprouts and transcritical systems manufacturer Hillphoenix. It is estimated that the grocery store will save an average of 10% in energy annually by using Hillphoenix's transcritical CO₂ system with an ejector and parallel compression. The store has also qualified for the U.S. Environmental Protection Agency's GreenChill Platinum certification.

More information at:
<http://bit.ly/2u75PCT>

POLICY

CONGRESS INTRODUCES BILL TO REDUCE HFC EMISSIONS

WASHINGTON, D.C. – U.S. Representatives Scott Peters (a Democrat from California) and Carlos Curbelo (a Republican from Florida) last month introduced the bipartisan Super Pollutant Emissions Reduction, or SUPER Act, into the U.S. Congress to combat short-lived climate pollutants like hydrofluorocarbons (HFCs). The bill came one week after President Donald J. Trump announced U.S. withdrawal from the Paris Agreement. By cutting short-lived climate pollutants, the SUPER Act hopes to avoid up to 0.6°C of warming at mid-century. "Super pollutants are the low-hanging fruit in the fight to slow climate change," Peters said.

More information at:
<http://bit.ly/2tdj40e>

HYDROCARBONS

AHRI PUBLISHES REPORT ON FLAMMABLE REFRIGERANTS

ARLINGTON, Va. – The Air-Conditioning, Heating and Refrigeration Institute (AHRI) on June 13 issued an A2L research report – "Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing of A2L Refrigerants" – as part of its ongoing study of flammable refrigerants. The \$5.2 million research program is designed to test mildly flammable and flammable low-GWP refrigerants in real-world settings. The research "will help us update relevant codes and standards so that appropriate, climate-friendly alternatives can be safely used in the air-conditioning and refrigeration equipment," said Karim Amrane, AHRI's senior vice president, regulatory & research.

More information at:
<http://bit.ly/2rz1S4t>

CO₂

DAIMLER COMMITS TO CO₂ FOR MAC

STUTTGART, Germany – In the wake of the German Federal Motor Transport Authority's recall of 134,000 Daimler cars filled with R134a-based mobile air-conditioning (MAC) systems, Sanden has begun supplying the German manufacturer with CO₂ compressors. According to Sanden, the compressors Daimler will now be using are "the world's first CO₂ compressors for mass-produced passenger cars." Sanden has been developing this product with its Japan- and Germany-based teams since 2014.

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

POLICY

EPA DELAYS SAFETY RULE CHANGES UNTIL 2019

WASHINGTON, D.C. – In a move welcomed by the industrial refrigeration industry, the U.S. Environmental Protection Agency decided last month to delay the effective date of amendments to the EPA's Risk Management Program (RMP) for 20 months, or until February 19, 2019. EPA is now conducting a reconsideration proceeding to review objections raised to the final RMP amendments rule, including concerns about third-party audits of ammonia refrigeration facilities. The 25-year-old RMP as originally constituted imposes safety requirements on U.S. cold storage and food processing facilities using at least 10,000 lbs. of ammonia in refrigeration processes.

More information at:
<http://bit.ly/2rzt3gi>

HYDROCARBONS

EMBRACO R290 COMPRESSOR SAVES 32% IN ENERGY

SAN DIEGO, Calif. – Brazilian manufacturer Embraco's new EMC compressor for propane applications has delivered an efficiency improvement of 32% compared to its R134a rival, according to a case study presented at ATMOSphere America 2017 last month here. In the case study, the R134a compressor in a 7-cu.-ft. worktop freezer was replaced with Embraco's new EMC compressor for R290. The resulting 32% reduction in energy consumption allowed the cabinet to surpass new U.S. Department of Energy (DOE) and ENERGY STAR 4.0 standards.

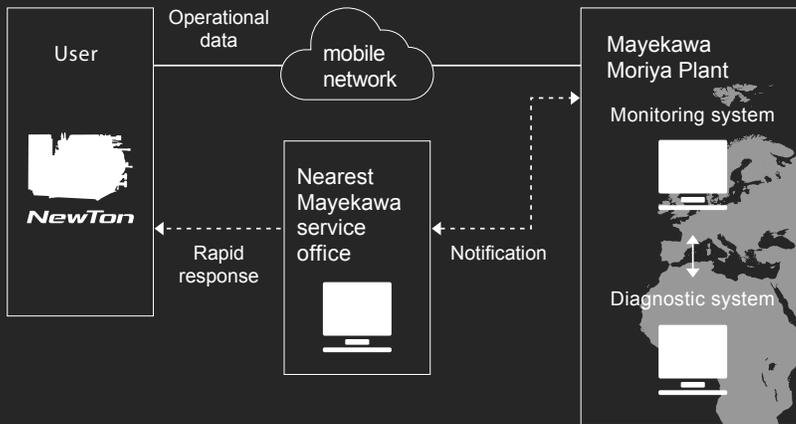
More information at:
<http://bit.ly/2soQld6>

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CO₂: THE NATURAL REFRIGERANT OF CHOICE

Safe, environmentally friendly, economical and reliable, CO₂ has all the characteristics that make it a prime candidate for large-format food retailers seeking an alternative to synthetic gases

By André Patenaude

The large-format food retail market has always been at the leading edge of refrigeration technology. After all, these grocery and supermarket chains must continually deliver the fresh foods that feed much of the global population. Market drivers and regulations in recent years have added sustainable refrigeration to the list of priorities for large-format retailers.

Among the natural refrigerant alternatives able to meet the need for advanced, environmentally friendly centralized systems, CO₂ (R744) leads the pack.

Offering zero ozone depletion potential (ODP) and a global warming potential (GWP) of one, CO₂ is often considered the environmental standard by which all other refrigerants are measured. In a regulatory era when chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs) are being phased out due to their negative environmental impacts, CO₂'s benign environmental profile has led to a broad global uptake in large-format refrigeration applications.

In addition, CO₂ has neither the flammability nor toxicity challenges posed by other natural refrigerant alternatives, providing an additional

comfort level for consumer-facing refrigeration applications. As energy efficiencies and the reliability of CO₂ refrigeration systems rise, system costs are falling to levels typically found in traditional HFC systems. For these reasons, CO₂ has become the natural refrigerant of choice for large-format food retailers.

GLOBAL ADOPTION ON THE RISE

CO₂ refrigeration systems were originally introduced in Europe nearly two decades ago and have since moved into other regions around the globe. Today, CO₂ adoption has migrated from Europe to Japan and North America. ([See map, page 17.](#))

The number of CO₂ stores in the E.U., Norway and Switzerland has tripled in the last three years to 9,000, representing 8% of the overall food retail market share in these regions.

In North America, with more than 410 installations, retailers are still in an experimental "trial" phase to see how CO₂ — and other natural refrigerants for that matter — can be used in their facilities, and across varying climatic zones.

For those U.S. retailers who have begun the transition to CO₂ refrigeration, the benefits are obvious. New Seasons Market, for example, is a Northwestern grocer based in Portland, Ore., whose first CO₂ system delivered on its green promise.

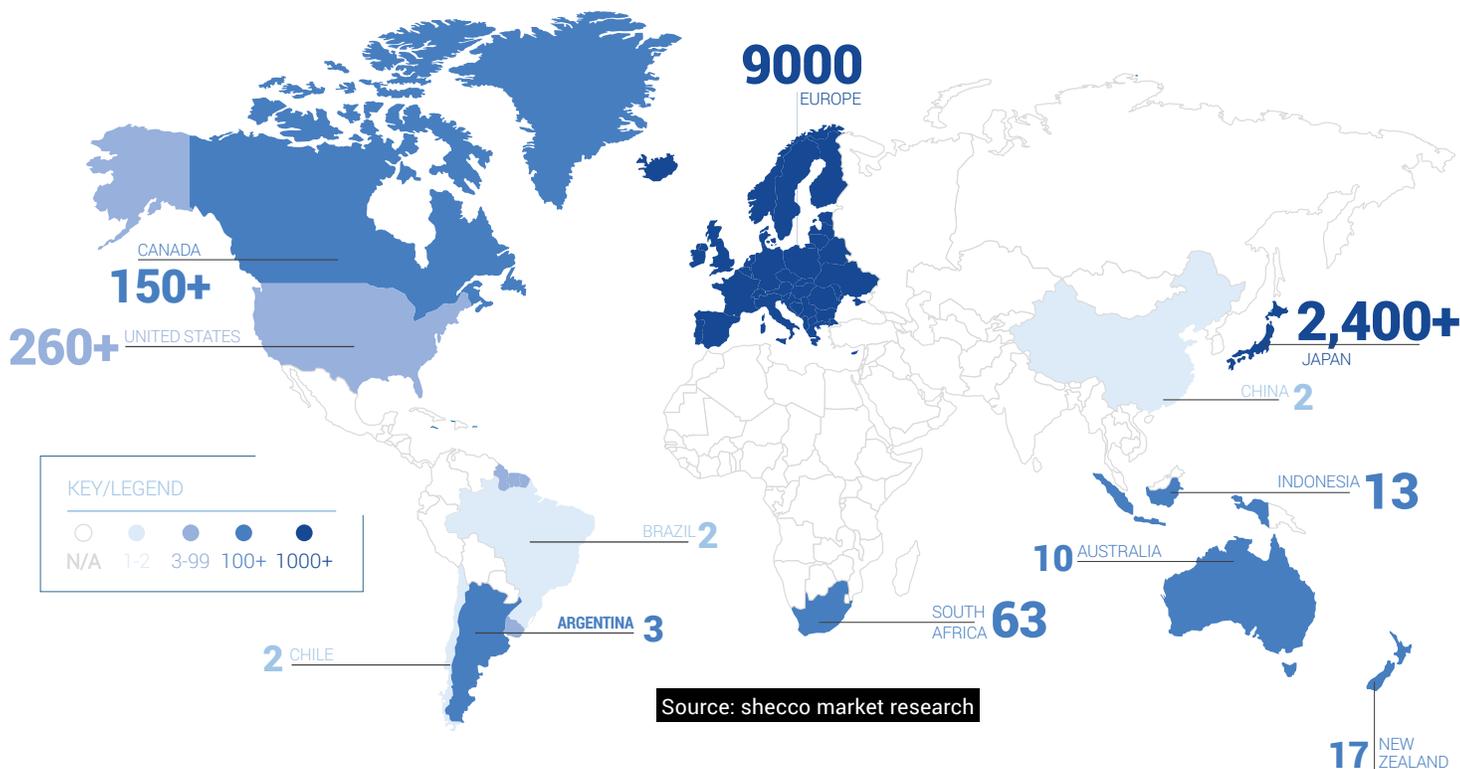
When the retailer opened a new store in a location previously owned by another grocer, it installed a CO₂ transcritical booster system to replace the existing HFC system. The transition earned the store a GreenChill Platinum Certification award for green refrigeration and delivered the following improvements:

- » Up to 30% lower total equivalent warming impacts (TEWI)
- » 95% fewer refrigerant emissions
- » Smaller refrigeration footprint

New Seasons has plans for CO₂ installations in other stores.

HFC PHASE-DOWN DRIVING CHANGES

As older systems age and require upgrading or replacement, many large-format food retailers are making the transition from higher-GWP HFC refrigeration architectures subject to regulations to lower-GWP systems.

CO₂ TRANSCRITICAL STORES (FEBRUARY 2017)

Regulations have emerged from many sources. For example, an Environmental Protection Agency (EPA) ruling in 2015 prohibits the use of R404A and other higher-GWP refrigerants in new supermarket rack systems. Even though the Trump administration brings with it the potential for deregulation, most of the Obama-era commercial refrigeration regulations are still intact.

Meanwhile, global regulatory efforts to phase down HFCs continue, including the recent Kigali Amendment to the Montreal Protocol, the E.U. F-gas regulations and Environment Canada's initiatives.

The trend toward eco-friendly refrigeration is also being driven by the private sector and discussed in corporate boardrooms. As industry organizations like the Consumer Goods Forum advocate the use of energy-efficient and environmentally friendly refrigeration systems, more retailers are now stating formal sustainability objectives.

In Europe, the phase-down of HFCs is already impacting the refrigerant supply chain. With a 37% reduction in F-gas quotas set for 2018, retailers can expect price increases by HFC suppliers and manufacturers to put more pressure on their maintenance budgets. In fact, Europe recently saw the price of R404A increase by 62% in one month. Globally, the industry can also expect HFCs to become scarce and more expensive.

California, led by the California Air Resources Board (CARB), is an example of how the HFC phase-down is being more aggressively pursued. As the sixth-largest global economy in the world, the state has a tremendous amount of global influence.

Through CARB, California has proposed a ban on the sale or distribution of refrigerants with 100-year GWP values of 2,500 or greater. Only refrigerants that are certified reclaimed or recycled would be exempt from the sales ban. CARB has not yet confirmed the exact date of this ban, though it was originally slated for 2020.

OPERATING COSTS AND ARCHITECTURES

The steady increase in global CO₂ refrigeration adoption has led equipment and component manufacturers to not only increase production, but also make continued investments in research and development to refine CO₂ technologies. These economies of scale are helping to lower CO₂ system costs and reduce complexities for end users and service technicians alike.

CO₂ training – both formal and hands-on types – has also greatly improved as the industry becomes much more familiar with CO₂ architectures and performance characteristics. Even refrigeration consultants are becoming well-versed in CO₂ systems and can make more educated recommendations.

Unlike HFC systems, CO₂ system requirements introduce the need for additional electronic components for refrigeration cases, including: a case controller, pressure transducer, temperature sensor and electronic ▶

CO₂ REFRIGERANT CHARACTERISTICS

From a maintenance and operations perspective, it's important to understand CO₂'s unique performance characteristics.

Higher operating pressure

- » Around 1,500 psig (103 barg) on the high-pressure lines (discharge and return lines connected to the gas cooler only)
- » Between 200 and 540 psig (14 and 37 barg) for the low- and medium-temperature suction groups, and the liquid line
- » Robust components, smaller diameter piping, additional pressure relief valves and check valves required

Low critical point: 88°F

- » Well suited for cooler climates
- » Back-up power and refrigeration unit recommended to avoid system pressure increase in the event rack is off
- » Excellent heat reclamation opportunities
- » Smaller equipment footprint due to its thermodynamic characteristics

Emerging warmer climate technologies

To expand CO₂'s applicability in warmer climates (where it faces operational challenges), OEMs and component manufacturers have developed new technologies:

- » Parallel compression
- » Ejectors
- » Adiabatic gas cooling
- » Mechanical sub-cooling

► expansion valve. While these components may contribute to increased system costs, case controllers provide end users with precise temperature controls and ongoing, optimized energy efficiencies.

Food retailers seeking to make the move to CO₂ refrigeration have two primary system types from which to choose: CO₂ transcritical booster and cascade systems. A closer look at each option may help you decide which is a better fit for your operation.

CO₂ transcritical booster is a 100% R744 system, utilizing direct expansion (DX) for low- and medium-temperature suction groups. This system is called transcritical because it is designed to operate at pressures above CO₂'s critical pressure (1,055 psig).

Heat produced from low-temperature case compressors is rejected into the medium-temperature suction group's compressors. Medium-temperature compressors must be sized to handle the total heat of rejection of low-temperature loads, 100% of the medium-temperature load and the flash tank bypass load.

Only one condenser or gas cooler is needed for all low- and medium-temperature cases. The system also requires the use of high-pressure controllers and electronic expansion valves to optimize pressures and refrigerant quality to the cases. (CO₂ pumped technology – where CO₂ is used as a secondary fluid –

is also available in both low- and medium-temperature stages.)

Cascade systems utilize two distinct refrigeration circuits: a CO₂ circuit for the low-temperature suction group, and an HFC-based circuit (such as R134a) for the medium-temperature needs.

It's called cascade because the heat produced from the low-temperature circuit is discharged into the suction stage of the medium-temperature circuit via an intermediate heat exchanger. Medium-temperature compressors send HFC gas to an air-cooled condenser on the roof. Like a standard refrigerant, CO₂ is maintained well below its critical point (subcritical temperature) of 88°F. Electronic expansion valves and case controls are still required in the low-temperature, CO₂-fed cases.

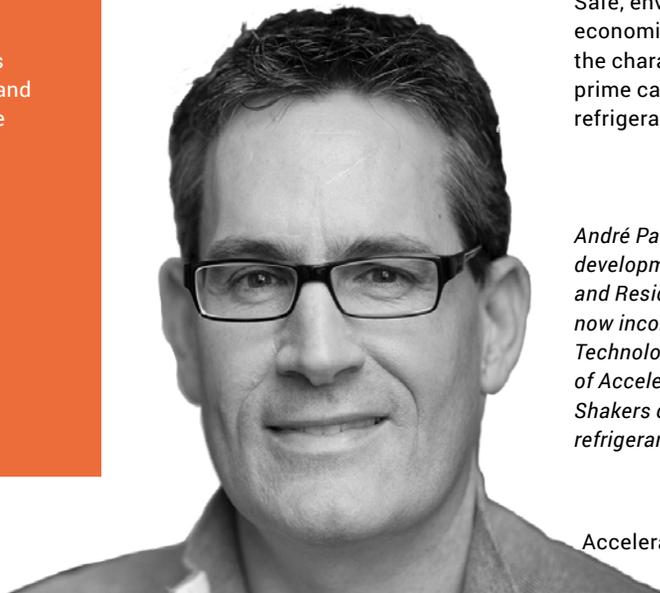
Some retailers have even experimented with using NH₃ (ammonia) as the medium-temperature refrigerant for an all-natural cascade system.

CO₂ LIKELY TO GROW IN THE U.S.

Economies of scale and equipment improvements will continue to drive down first costs and increase CO₂ adoption in North America. While the U.S. is still in the early phases of trials and experimentation, every successful implementation increases the likelihood of more stores making the transition to CO₂.

Safe, environmentally friendly, economical and reliable: CO₂ has all the characteristics that make it a prime candidate for the large-format refrigerant of the future.

André Patenaude is director - CO₂ business development, Emerson Commercial and Residential Solutions (which now incorporates Emerson Climate Technologies). He was selected as one of Accelerate America's 25 Movers & Shakers driving adoption of natural refrigerant technology in North America.





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Deep Thoughts on NatRefs

Surveying the natural refrigerants landscape, Thought Leader panelists at ATMOSphere America see vast potential but seek better retrofit solutions

By Andrew Williams and Michael Garry



On June 1, President Donald Trump announced that the United States would pull out of the landmark, globally accepted Paris Agreement on mitigating climate change.

While there has been much speculation about the impact of this decision, 78% of attendees polled at ATMOSphere America 2017 in San Diego last month said they don't expect the market prospects for natural refrigerant solutions in North America to be affected.

At the seven-person Thought Leaders panel discussion that kicked off the conference, that view was echoed by the panelists. "There's too much momentum [behind natural refrigerants]," said Bryan Beitler, vice president and chief engineer, Source Refrigeration, an Anaheim, Calif.-based contractor with 1,400 technicians. "Folks have already invested significantly."

Scott Martin, director of business development and industry relations at Hillphoenix, said it would be

"shortsighted" for businesses to react adversely to the Paris accord withdrawal. "Ultimately, I don't think it'll have much of an impact on the adoption of natural refrigerants," he said, pointing out that natural refrigerants' strong track record should lead to future growth.

Indeed, the Thought Leader panelists saw many positive signs for natural refrigerant growth in North America. "I believe the train is leaving the station," said Antoine Azar, who after 16 years at the Coca-Cola Company now runs a consulting business called Sustainable Solutions.

Fernando Campos, deputy director for sustainability infrastructure at Walmart Mexico, said that "to improve the sustainability of our operations, we need to take a deep look at natural refrigerants. Over the coming years it will make more and more sense to invest in these technologies. We think there is a business model in place."

Walmart, which operates stores in 28 countries, is weighing options for complying with the global HFC phase-down put in place by the Kigali Amendment to the Montreal Protocol last October. The retail giant currently has 34 outlets in Mexico with self-contained propane (R290) cases, "which will become a bigger number by the end of the year," said Campos. Walmart has also installed CO₂ systems in the U.S., Canada and Africa.

Whole Foods Market is another retailer that is investigating natural refrigerant-based systems. With 465 total stores, Whole Foods now runs 22 using CO₂ in some form in a remote system, with 12 that employ only natural refrigerants, including 10 transcritical operations. More than 50 Whole Foods stores have propane display cases. (Whole Foods is the winner of the Accelerate America Best in Sector/Food Retail Award; [see page 38.](#))

Tristram Coffin, director of sustainability and facilities at Whole Foods Market's Northern California Region, extolled the virtues of natural refrigerant. "These are good refrigerants," he said. "They're efficient, and they work well. That's why we're all sitting in this room today – not because we're worried about regulation, but because we know that natural refrigerants have a positive effect on the environment and on companies' bottom lines."

Gerard von Dohlen, president of Newark Refrigerated Warehouse, is convinced that ammonia, hydrocarbons and CO₂ are the refrigerants of the future. "They are easy to handle and easy to use," he said. "They can take all kinds of abuse, they're tolerant of oil, they run really well, and they're very resilient."

Coffin pointed out that there's a "huge opportunity" to "merge expertise" about natural refrigerant applications in the commercial and industrial sectors "so we can move forward as one rather than in separate sectors."

Praise for propane

Propane got a lot of support at the panel discussion. Coffin argued that R290 in self-contained display cases is already becoming a mainstream refrigerant in food retail today. "[OEMs] True and AHT have dedicated their cases to propane almost exclusively, so [retailers] will be buying natural refrigerant-based systems whether they know it or not," said Coffin.

Self-contained propane cases are particularly suitable, Coffin added, in smaller urban stores and mixed-use buildings "where you can't fit in centralized racks."

"In retail applications, R290 is hard to beat," added von Dohlen.

Chiming in from the audience, Jim Rutz, global platform director, light commercial, for compressor maker Tecumseh Products, declared, "The war is over. R290 has won in the small commercial marketplace. There are a few manufacturers who don't realize it yet, but they're going to get steamrolled." His remarks elicited applause in the room.

However, one challenge facing the use of self-contained propane cases is meeting the requirements of store merchandisers "who care about case depth and width and want to know that they can merchandise their products," noted Coffin.

An often-cited limitation of hydrocarbons is the small charge that is allowed – 150 g for commercial applications (60g for water coolers) and 57 g for domestic uses, per the U.S. Environmental Protection Agency (EPA).

At a global level, the International Electrotechnical Commission (IEC), through its SC61C Sub-Committee Working Group (WG4), is focused on raising the charge limit for flammable (A3) refrigerants by next year. The new maximum charge under consideration for propane is 500 g.

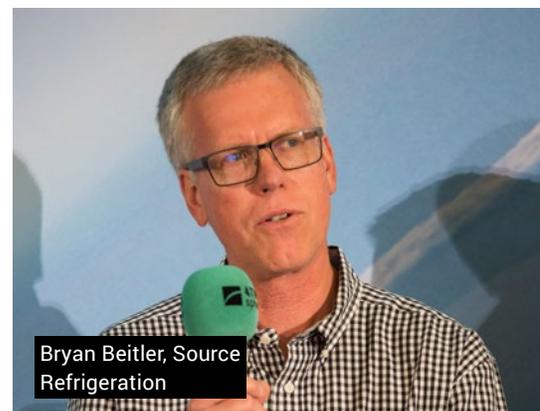
"From a technical perspective, the challenge is always going to be charge limits," said Coffin. "Assuming we can get beyond the charge limit regulations, we'll be in really good shape – R290 self-contained cases will be a winner across the board."

With regard to the flammability of hydrocarbons, Walmart's Campos said that can be dealt with via proper design, operation and maintenance. "When the gasoline car came out, you could have said it's dangerous so let's keep riding horses," he said.

Beitler of Source Refrigeration emphasized the importance of training technicians on propane as well as other natural refrigerant technology. Some manufacturers, such as True Manufacturing, "have a great contractor supply network to



Antoine Azar,
Sustainable Solutions



Bryan Beitler, Source
Refrigeration

take care of their systems," but others "don't have a strategy for repairs."

Source Refrigeration has its own training facilities at three locations where it keeps its technicians up to speed on the latest natural refrigerant technologies. He also works on training with groups like RSES, NASRC and RETA, with whom he is working on a CO₂ certification manual.

What about HVAC?

Coffin expressed the view that "we don't talk enough about naturals in the HVAC space."

Taking up that challenge, Campos noted that because commercial air-conditioning systems are mostly situated on rooftops, flammable hydrocarbon refrigerants could be employed with minimal risk using a secondary refrigerant inside the occupied space.

While some of these AC systems exist in Europe, they are not available in North America. "It's important to get that here," Campos said. "We need a rooftop unit to operate with a natural refrigerant, whether R290, CO₂ or ammonia." ▶

▶ Hillphoenix's Martin observed that with the advent of low-charge-ammonia systems, "ammonia would be great for [commercial] air-conditioning."

Von Dohlen believes ammonia could be used in hotels in large central air-conditioning systems using centrifugal compressors, though others noted the obstacles posed to such applications by local codes and high costs.

Dealing with uncertainty

The panelists did not shy away from delving into other challenges facing natural refrigerant adoption. For example, along with its withdrawal from the Paris accord, the Trump administration has created some uncertainty with its aggressive anti-regulatory posture, they noted.

"How do you build a refrigeration system that copes with the lack of certainty about regulation in the United States in the coming months and years?" asked von Dohlen. "I'm trying to build systems that avoid uncertainty, because I don't know what's going to happen."

Added the humorous von Dohlen: "There's nobody in this room who has a better guess than my cocker spaniel what Trump is going to do next!"

Coffin pointed out that OEMs, end users and engineering groups need to manage to "the most stringent regulations in the marketplace," which could end up being the HFC-reduction rules under consideration in California.

Perhaps the biggest challenge facing the natural refrigerants marketplace is finding a good retrofit solution for existing facilities, since retrofits through drop-ins are not yet possible with naturals, and end-of-life system retrofits can be cost-prohibitive.

Coffin agreed that finding a cost-effective retrofit solution for natural refrigerants is "the Holy Grail." "We'll still be talking about this in 10 years until we come up with a better retrofit solution," he said.

Hillphoenix's Martin warned that HFO refrigerants represent a retrofit option for



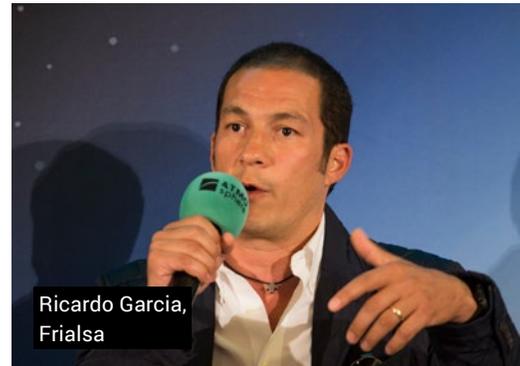
Gerard von Dohlen, Newark Refrigerated Warehouse



Scott Martin, Hillphoenix



Fernando Campos, Walmart Mexico



Ricardo Garcia, Frialsa



Tristam Coffin, Whole Foods Market

end users. "Make no mistake – there will be a play in our lifetimes for HFOs and HFO blends," he said. "For every one of us innovators here, there may be a hundred who would love to have a refrigerant they could drop in to their systems today. The world wants a drop-in, simple solution. It's up to us as contractors, installers, engineers and equipment designers to build low-cost, highly efficient systems."

Azar of Sustainable Solutions urged putting a greater emphasis on total cost of ownership (TCO) in the evaluation of natural refrigerant-based HVAC&R solutions. That includes considering the efficiency and other attributes of these systems.

"We know that natural refrigerants are efficient," said Azar. "We know they work. It's not like 15 years ago. Now, it's about mass production – and going to market."

Ricardo Garcia, director of engineering and projects at Mexican cold storage operator Frialsa, is another firm believer in the TCO argument. Five of the company's 24 cold storage facilities use NH₃/CO₂ systems.

"At first, NH₃/CO₂ systems may be more expensive," he said. "But your return on investment down the line will be better with natural refrigerants. We look at natural refrigerants because they're good for the environment – but they're also good for business."

Coffin thinks more education of retailers and consumers about natural refrigerants could put pressure on retailers to make a change, but he placed a lot of the onus for future progress on manufacturers. "If OEMs continue to invest more in natural refrigerant solutions and bring costs down, then end users are going to adopt them." ■ MG & AW

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CARB Asks for Help

The California Air Resources Board calls on attendees at ATMOsphere America 2017 for input on how to regulate HFC emissions in its Short-Lived Climate Pollutant Reduction Strategy

By Michael Garry and Charlotte McLaughlin

In an effort to gather input from HVAC&R industry stakeholders for its plan to regulate HFC emissions in California, the California Air Resources Board (CARB) held an unusual fact-finding session at ATMOsphere America in San Diego last month.

The interactive session – dubbed an “Open Discussion on HFC Emissions Reductions Strategies” – was hosted by Glenn Gallagher, air pollution specialist for CARB, and Pamela Gupta, manager, greenhouse gas reduction strategy section, CARB. Attendees were asked to electronically answer a series of questions pertaining to California’s HFC reduction plans. (See charts starting on page 26.)

CARB’s HFC reduction effort is part of a broader program called the Short-Lived Climate Pollutant (SLCP) Reduction Strategy, which was adopted in March, and will ultimately lead to regulations designed to cut HFC emissions. “The SLCP strategy is a roadmap of proposals to address HFC emissions,” said Gallagher.

In addition to HFCs, SLCPs include methane and black carbon (soot); these greenhouse gases remain in the atmosphere for much less time than CO₂, but have a global warming potential (GWP) far greater than that of CO₂.

As part of its HFC reduction plan, CARB is promoting the use of low-GWP replacements that are “technically feasible and cost-effective,” said Gupta, including natural refrigerant systems.

CARB’s next steps will be to issue an “official notice of HFC rulemaking” this



summer, followed by workshops and public input in 2017 and 2018, Gallagher said. Board approval on new regulations would take place in 2018-2019.

“CARB will work with all stakeholders to develop common-sense regulations to meet the reduction targets,” Gallagher said. He invited attendees to set up a one-to-one meeting with CARB.

“We really need your feedback,” he told the ATMOsphere America audience.

Added Gupta: “We cannot just take regulations to our board and say ‘approve them.’ We need to show evidence that this works, and what’s the cost.”

Gallagher listed particular “data gaps” that need to be addressed, such as the energy efficiency of low-GWP systems, the added initial cost of low-GWP equipment, code and permitting barriers

for low-GWP refrigeration and air-conditioning, and the feasibility of low-GWP for smaller remote condensing units used in convenience stores. CARB also wants to know whether HFO-HFC blends are the lowest GWP refrigerants that are feasible for air-conditioning (which would justify a 750 GWP maximum).

Ambitious reduction goal

California, which has long set the pace for environmental action nationally, passed California Senate Bill 1383 last year that requires a 40% reduction in annual HFC emissions below 2013 levels by 2030.

To achieve that goal, CARB adopted the SLCP strategy this year with four proposed measures to reduce HFCs: an incentive program for new low-GWP refrigeration (available now only through ▶

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► utility rebates while CARB works on securing cap-and-trade funding); an HFC phase-down that will defer to the global phasedown under the Kigali Amendment to the Montreal Protocol; a prohibition on refrigerants over 150 GWP in new refrigeration equipment and over 750 in new air-conditioning equipment; and a sales ban on refrigerants over 2,500 GWP, to be followed later by a ban on refrigerants over 1,500 GWP (with an exception for recycled or reclaimed refrigerants).

While it expects to defer to the Kigali Amendment, CARB is assessing the impact of the agreement’s global HFC phase-down on reductions of HFCs in California. CARB believes it will need to go beyond the Kigali amendment to achieve its HFC-reduction goal by 2030, said Gallagher. To reach the target [of 40% reductions by 2030] it requires ‘all of the above,’” noted Gallagher.

California does not want to “wait 20 or 30 years to see greenhouse-gas reductions in this sector,” he said. “HFCs have relatively short atmospheric lifetimes, so any little bit we do now will have huge results later on.”

In establishing its GWP benchmarks, CARB has tried to be consistent with other regulatory bodies, like the European Union’s F-Gas Regulation and the U.S. Environmental Protection Agency’s SNAP (Significant New Alternatives Policy) program, Gallagher noted.

The EPA has historically incorporated California’s programs into national regulations, noted Gupta. And because

California has 12 climate zones, what it does “is useful globally also.”

Marc Chasserot, CEO of shecco, observed that in his travels around the world he is often asked about what California is doing in regard to regulations impacting natural refrigerants. “They don’t ask what DC is doing. They see California as the U.S. capital when it comes to regulations in this space.” ■ MG + CM



CARB Questions for ATMOsphere America Attendees

Should California pursue its own HFC reduction measures, in addition to the U.S. EPA SNAP program and the global HFC phase-down?

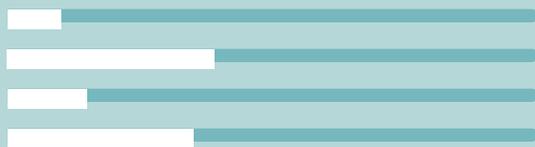
(51 respondents)



65% Yes
29% Yes if it's not too costly
9% Definitely not, defer to U.S. EPA and global HFC phase-down.

California has proposed a ban on refrigerants with a GWP greater than 150 in new equipment. The GWP value of 150 is ...

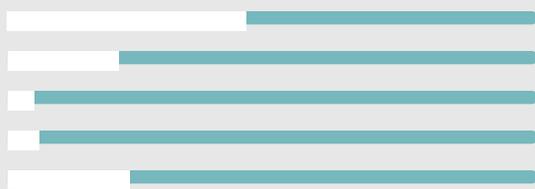
(71 respondents)



10% too low, should be more flexible
39% too high, should be lower
15% it's about right
35% it depends on the type of refrigeration equipment

If a high-GWP refrigerant prohibition is mandated for refrigeration, what year should it start for new equipment?

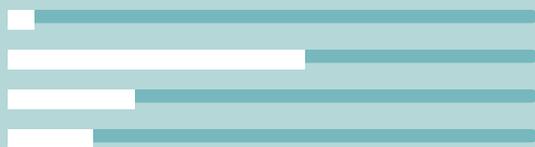
(66 respondents)



45% 2020 or earlier
21% 2021
5% 2022
6% 2023
23% it depends on the equipment

California has proposed a ban on new refrigerants with a GWP greater than 750 in new stationary air-conditioning equipment. The GWP maximum of 750 is ...

(63 respondents)



5% too low
56% too high
24% it's about right
16% it depends on the type of refrigeration equipment

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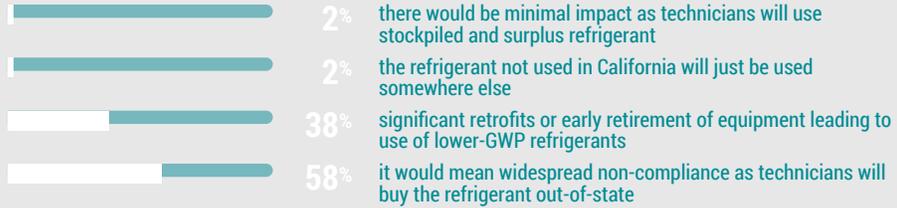
If a high-GWP refrigerant prohibition is mandated for stationary air-conditioning, what year should it start for new equipment?

(60 respondents)



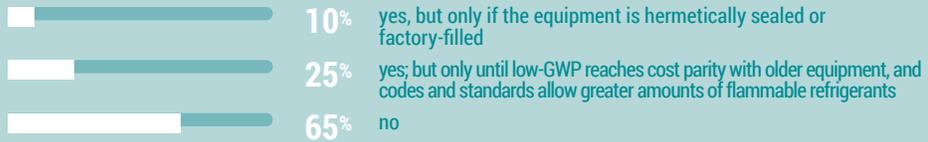
If a California sales restriction is placed on refrigerants with very-high GWPs (more than 2500, followed by more than 1500), what would be the most likely outcome?

(65 respondents)



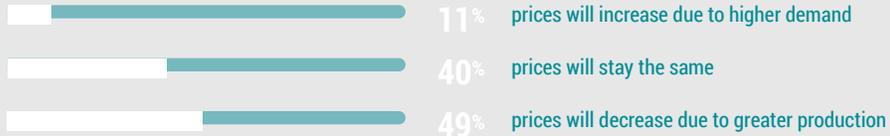
Should new refrigeration equipment containing between one and 50 lbs. (0.45 to 22.7 kg) of refrigerant charge be exempt from the low-GWP requirements?

(68 respondents)



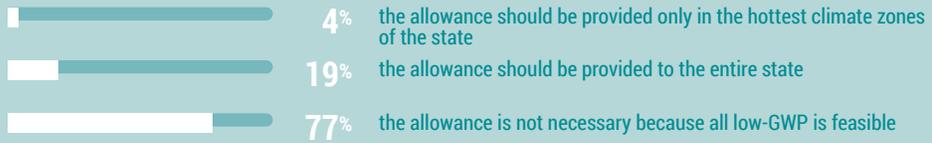
The Kigali Amendment will increase the use of natural refrigerants. What is the most likely impact on natural refrigerant prices?

(63 respondents)



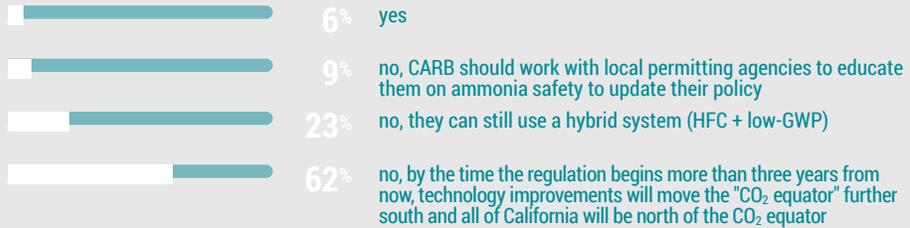
CARB is evaluating allowing a small central charge of HFC or HFO-HFC refrigerant less than 1500 GWP to cool a larger charge of refrigerant/heat transfer fluid, as long as total average weighted GWP of all refrigerant/heat transfer fluid is less than 150 GWP.

(73 respondents)



DOE states that the hottest Climate Zone 2 in California is not ready for transcritical CO₂ with no energy penalty. Should this region of California be exempt from the 150 GWP limit if the local agencies do not allow ammonia?

(53 respondents)



If low-GWP regulations are enacted in California, how far will California's influence reach on the greater adoption of low-GWP refrigeration in the next five to ten years?

(64 respondents)





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Meeting the Retrofit Challenge

At ATMOsphere America, Hannaford and DeCA demonstrate how to replace an aging HFC system in an existing store with a transcritical CO₂ system

By Michael Garry



Food Retail Panel, from left: Pete Savage, AAA Refrigeration; Harrison Horning, Hannaford Supermarkets; John Stuit, DeCA; Tristram Coffin, Whole Foods Market; Paul Anderson, Target; and Paul Alway, AB Group

There are about 410 supermarkets in North America that have installed transcritical CO₂ refrigeration systems – not a lot compared to the 9,000 stores with transcritical systems in Europe, and the more than 2,400 in Japan. Still, it was just four years ago that the first transcritical system was deployed at a Hannaford Supermarkets outlet in Turner, Maine.

In North America, most of those installations have been in new stores. This has given rise to one of the hottest topics in the food retail industry – whether natural refrigerant systems can be

economically installed at existing stores as a replacement for aging HFC systems, thereby expanding the market for naturals well beyond new stores. (Natural refrigerants are not considered acceptable drop-in substitutes for HFCs or R22 in central systems that are not old enough to be retired.)

That question was addressed in detail in the food retail panel discussion at ATMOsphere America 2017 last month in San Diego, Calif., in particular by representatives of Hannaford and the Defense Commissary Agency. Here are their stories.

A SUITABLE RETROFIT CANDIDATE

Last December, Hannaford, which has installed transcritical CO₂ booster systems in two new stores since 2013, began orchestrating its first transcritical retrofit at a 50,000-sq.-ft. supermarket in Raymond, N.H. (which the prior summer had sold a winning \$487 million Powerball lottery ticket).

The 27-year-old store's racks (R507 for low-temperature and R22 for medium temperature), piping, condensers, evaporators and display cases were all "at the end of their useful life," said Harrison Horning, director of energy and facility services for Delhaize America, a subsidiary of the newly formed Dutch company Ahold Delhaize; he focuses on supporting Hannaford's 181 stores in five Northeastern states.

One of the fortunate features of the store from a retrofit perspective was that "there was ample space to put a new system while the old system was running next to it," said Horning. The space came from moving an old emergency generator outside and removing an old air-conditioning rack.

Hannaford would like to find at least one store every year or two that similarly meets the criteria for being retrofit with a transcritical CO₂ system.

On a broader basis, retrofitting existing stores with transcritical systems supports Ahold Delhaize's corporate goals for phasing out R22 and reducing greenhouse gas emissions, which includes lowering the average global warming potential (GWP) of refrigerants. In addition, these projects align with the company's commitment, as a member of the Consumer Goods Forum, to install, where viable, new equipment that utilizes natural refrigerants or other ultra-low-GWP refrigerants.

"That European influence is a significant motivator for us to move forward that may not exist with other U.S. companies," he said.



Harrison Horning,
Hannaford Supermarkets

First with parallel compression

The Raymond store retrofit, which provides 1.8 million BTU/hr. of total heat of rejection, is Hannaford's first transcritical system with parallel compression. It is also the first transcritical system to use hot high-pressure CO₂ gas for direct heat reclaim in a main HVAC unit.

In the store's walk-in freezers and coolers, and in its compressor room, Hannaford has installed CO₂ leak detection, "respecting ASHRAE 15 and 34 requirements," said Horning.

A notable construction challenge in the retrofit was that the transcritical rack needed to be simultaneously hooked up to low-temperature and medium-temperature loads in new cases overnight to allow start-up.

"In a new store, you don't think about that because it happens when nobody is looking," said Horning. "In this case, it happened overnight, because we needed to be open and operational the next morning." But the operation was "planned well and it worked OK." Subsequent cases were phased in over the ensuing weeks.

Hannaford decided not to run some of the store's display cases on CO₂, and those were linked to a separate R407A condensing unit. "So, the store is not 100% CO₂ but it's well over 90%," Horning noted.

Horning offered some caveats about doing a transcritical system retrofit. One was to "make sure that when the equipment leaves the factory, it's ready." In May, the system sprung a refrigerant leak after a fitting cracked. This was because the system was intentional-

ly designed with additional pressure transducers on the high side and thus more threaded connections. "So, pay attention to factory engineering."

He also advised having round-the-clock technical support available. This was true at the Raymond store, which also required skilled welders to work on stainless-steel piping as well as people with controls expertise.

Hannaford does not have any energy data on the retrofit transcritical system yet, but Horning expects its performance to be better than that of the original system, "not because of the CO₂ but just because it's new." He believes the parallel compression will "give us additional savings."

Horning acknowledged that the first-cost premium for the transcritical system above a standard HFC system was in the 10%-20% range. "I truly believe that's coming down every year as we do more projects," he said. Moreover, when the Raymond store factors in heat reclaim, the premium "might have been closer to zero." And he is "very confident" in a positive total cost of ownership.

The Raymond, N.H., store was subsidized by Hannaford's remodeling budget and by "another bucket of money specifically for advanced refrigeration and converting refrigerants," he said.

However, under Hannaford's new parent Ahold-Delhaize, it's getting harder for the chain to secure funding to invest in refrigeration technology, Horning said. "So, we need to find the best solutions and show the business case for a system like this." ►

“The results look promising; it looks like we’re meeting our energy goals.”

John Stuit

► THREE TC RETROFIT STORES

Another food retailer engaged in retrofitting stores with transcritical CO₂ booster systems is the Defense Commissary Agency (DeCA), part of the U.S. Defense Department. DeCA, with 240 stores worldwide, is the “supermarket to the military,” said John Stuit, its chief of design and construction who has been a refrigeration engineer for 31 years.

DeCA has been experimenting with different natural refrigerant systems since 2014, including transcritical CO₂ and ammonia/CO₂ cascade, “to find out what the end game is going to be,” said Stuit. “It’s certainly going to be some kind of natural refrigerant.”

Over the past year, DeCA has retrofitted transcritical CO₂ systems in three existing stores – in Newport, R.I., Mojave, Calif. (Edwards Air Force Base), and Mountain Home, Idaho.

All three installations use adiabatic condensers and parallel compression, both designed to enable transcritical systems to operate efficiently in hot weather.

At one site, which used installers who had not worked on a CO₂ installation before, “they managed to blow the entire charge right into the sales area,” Stuit said. “But it’s working well now.”

Like Hannaford’s Raymond, N.H., store, the three DeCA retrofit stores required significant case loads (from 30% to 50%) for system start-up, said Stuit, adding, “Store operations don’t like giving up display cases [for a start-up]; they want to keep selling groceries.”

Stuit provided preliminary energy results for the transcritical system at the Newport, R.I., store over a six-month period (October 2016-April 2017), when there was 14% less energy



John Stuit, DeCA

consumption compared to the previous HFC system. “The results look promising; it looks like we’re meeting our energy goals,” said Stuit.

However, he said the first-cost premium for the transcritical systems, according to his contractor, “is probably \$200,000 for the typical store.” Depending on energy costs, the ROI for that ranges from five to 10 years for a system that will run for 15-20 years, he added.

DeCA has also installed a transcritical CO₂ booster system at a new store in Spangdahlem, Germany – a cool climate – that opened in May, 2016. Preliminary data shows that the system consumes 23% less energy than a comparable HFC system. The agency plans to deploy a transcritical system in Northern Italy that will be the first to include an ejector, which will help with efficiency in the warmer climate.

Ammonia/CO₂ retrofit

DeCA's other natural refrigerant retrofit project, an ammonia/CO₂ cascade system from Hillphoenix, was installed at DeCA's Lackland Air Force Base commissary in San Antonio, Texas, in November 2014, replacing an aging R404A system; it went fully operational in August 2015. The store remained open during the installation.

The system – one of only four ammonia/CO₂ cascade systems installed in U.S. supermarkets – employs ammonia on the roof to condense CO₂ that is used in low-temperature DX cases and in medium-temperature cases via pumped liquid overfeed.

The rooftop ammonia is housed in nine individual 130,000-BTU refrigeration modules, each containing about eight lbs. of ammonia, combining for less than one lb./TR. A separate fluid cooler is used with water-cooled condensers. The system uses 1,800 lbs. of CO₂.

After initial communication glitches between the ammonia and CO₂ parts of the system were resolved, the ammonia/CO₂ cascade system has been able to “achieve proof of concept – it works,” said Stuit, adding it would be “a viable alternative if commercialized.” The presence of ammonia on the roof has not proved problematic, even though the store is near other stores, schools and housing.

One challenge Stuit cited was overcoming the paucity of service contractors qualified to work with ammonia and CO₂. “The shortage of qualified technicians is very real,” he said.

The cascade system has met DeCA's energy goal for the store as a whole, lowering kBtu/sq. ft./yr. from 160 to 123.4, a 23% reduction. Store engineers expected 8% better efficiency from the system itself over the legacy HFC system, and Stuit believes “we met or exceeded that target.”

But the initial costs of the system, including installation, were 15% greater than those of a standard HFC system, a premium of about \$334,000. Operational savings from energy use and maintenance “will greatly offset these costs, likely resulting in only a small overall cost increase over the estimated 20-year lifetime of the system,” according to a report by the Environmental Protection Agency's SNAP (Significant New Alternatives Policy) program, which noted that the system is not yet at large-scale commercialization when costs would be competitive with traditional systems ■ **MG**

MARKS AND SPENCER OPTS FOR TRANSCRITICAL

Marks and Spencer, a U.K.-based food retailer with more than 600 stores, runs around 36 with transcritical CO₂ refrigeration systems.

Paul Alway, design director, who joined AB Group, a U.K.-based refrigeration design consultancy nine months ago after several years at Marks and Spencer, was one of the people responsible for the chain's adoption of transcritical systems – a 4.5-year process he explained at ATMOSphere America 2017 last month in San Diego, Calif., as part of the food retail panel discussion.

Marks and Spencer also operates 102 stores with CO₂ cascade refrigeration, which was its original CO₂ system. The chain's adoption of CO₂ systems is informed by its corporate goal to be HFC-free by 2030, a policy influenced by the EU F-Gas Regulation – though whether the regulation will be followed is unclear given the U.K.'s decision to leave the EU (Brexit).

Like most food retailers, Marks and Spencer's refrigeration policies are governed by cost, with a desire to get a return on investment for any cost premium within three years. “My response was, ‘Are we going to close the shop three years after we open it?’” he said. “What we eventually found was that by trying to chase that cost parity piece, we ended up value engineering the things to the point where they weren't reliable anymore.”

While at Marks and Spencer, Alway developed a test center for transcritical CO₂ – dubbed “Paul's dungeon” – where “we had so much data that we understood everything about that system.” he said. “The use of data got us to transcritical.”

One of the goals was getting the system to operate more efficiently. “It's still difficult to get it that much better than an HFC [system] at the moment,” he said, taking into account the entire system not just the rack (or pack in the U.K.). However, with greater case efficiency, you start to get an ROI that was palatable – not within two or three years, but within the lifetime of the system.”

His argument: “If we keep getting stuck with what we've always done [three-year paybacks], we're never going to move forward.” Plus, given that HFCs are targeted for phase-down not just by the EU but globally via the Kigali Amendment to the Montreal Protocol, “HFC systems are a flawed benchmark; we haven't got it for the future.”

In any event, seven months ago Marks and Spencer opened its first business-as-usual transcritical store, and, including trial and new stores, now has the system in 36, using racks from Danish OEM Advansor and U.K. contractor Space Engineering Services. While the chain is committed to transcritical for new stores, it is still evaluating what to do about retrofits.

Alway is still involved with the design of the stores and systems. “It's going really, really well,” he said.

Celebrating the Disrupters

In the second annual Accelerate America Awards program, Paul Anderson of Target, Whole Foods Market, Nestlé, United States Cold Storage and Hillphoenix are recognized for advancing the adoption of natural refrigerant-based technologies – and disrupting the HVAC&R industry

By Michael Garry

In a breakfast ceremony at ATMosphere America 2017 in June in San Diego, representatives of four companies and one individual were presented with an Accelerate America Award, a handsome triangular wooden object that celebrates an uncommon contribution to the advancement of natural refrigerants in North America.

This second annual awards program recognized: Paul Anderson, senior director of engineering for Target, as Person of the Year; Hillphoenix, which was given Innovation of the Year for its AdvansorFlex transcritical CO₂ system; and three companies deemed Best in Sector: Whole Foods Market (food retail), Nestlé (foodservice), and United States Cold Storage (industrial).

On the following pages, you will find profiles of the winners explaining why they were selected.

In selecting the Best in Sector awards, we considered metrics like number of installations of natural refrigerant systems, reduction in energy and greenhouse gas emissions, commitment to future installations, and industry leadership.

For the Innovation of the Year award, we looked at companies that developed a particular natural

refrigerant-based product having a significant impact on the market, with multiple installations in the field. And for Person of the Year, we sought someone who has demonstrated clear leadership at his or her company and in the industry in forging new pathways for natural refrigerants in North America – someone who has individually had a palpable impact on the marketplace.

These winners reflect the original mission of *Accelerate America*, which is to cover people, ideas and technologies that are disrupting the HVAC&R industry in North America.





PERSON OF THE YEAR:
PAUL ANDERSON, TARGET

Leading the way

Paul Anderson, senior director of engineering for Minneapolis, Minn.-based Target, has a penchant for taking a leadership role with natural refrigerants.

That started in 2014, when Anderson announced at the ATMOsphere America conference in San Francisco that Target, the iconic U.S. discount retailer operating more than 1,800 stores, would use a hybrid CO₂ cascade system as its prototype refrigeration system in new PFresh outlets.

Target thus became the first U.S. retailer – and the second in North America after Sobeys in Canada – to make a public commitment to running a system in new stores and major remodels based in large part on an environmentally friendly natural refrigerant. (See [“Why Target Opted For CO₂ As its Prototype,” Accelerate America, February 2015](#)).

Since then, Target has installed the cascade system, which uses CO₂ DX as the sole cooling agent for low-temperature cases and R134a DX for medium-temperature cases, in 11 stores scattered across the U.S. Moreover, over the past year, the chain has gone beyond the prototype, installing an all-CO₂ transcritical systems in a store in Marin City, Calif., with plans to install one in a Minneapolis store in August.

Anderson has also taken the lead with another natural refrigerant – propane (R290). In September 2015, he and Keilly Witman (KW Refrigerant Management Strategy) gave a presentation at the Food Marketing Institute’s Energy & Store Development (E&SD) Conference on the potential for hydrocarbons in supermarket display cases. (See [“Hydrocarbons: The Refrigerant of the Future for Supermarkets?” Accelerate America, October 2015](#)).

The following month, representing Target at a White House-hosted meeting in Washington, D.C., he announced that all new stand-alone coolers in its stores with a compressor capacity below 2,200 BTU/hr. would be HFC-free starting in January 2016. That month, he sent a letter to all of Target’s



Paul Anderson, Target

display case suppliers stating that the chain would require propane to be used in those coolers. “Our vendors have done a fantastic job supporting our journey to hydrocarbons,” he said at last month at ATMOsphere America 2017 in San Diego, during the food retail panel discussion ([see page 30](#)).

Last year, at the ATMOsphere America conference in Chicago, Witman said that Target (and by extension Anderson) had spoken to contractors that might be working on propane equipment about the chain’s expectations. “Target said, “Here’s where we’re going; we need you to be able to handle that,” she noted.

Today, nearly half of Target’s more than 1,800 stores have some kind of R290 case in it, from small checkout coolers to medium-sized wellness coolers to full-sized display cases, with plans to

install more. "R290 is a very efficient refrigerant and used in the right application has been very well received in Target stores," Anderson said.

In support of greater adoption of propane refrigeration, Anderson has been participating in industry efforts to increase the permissible charge of hydrocarbons in stand-alone refrigeration above a maximum of 150 g.

For example, last year Target became a co-leader, with the North American Sustainable Refrigeration Council (NASRC), of the Fire Protection Research Foundation's research project aimed at evaluating the fire hazard posed by up to 1,000 g of flammable (ASHRAE Class A3) refrigerants such as propane. In November 2016, Anderson sent out an email seeking sponsors for the program, which was launched in January 2017 and completed last month. He will present the results at the FMI E&SD Conference in September. (Anderson is chairperson of NASRC and sits on the FMI E&SD Conference planning committee.)

For his leadership in advancing adoption of natural refrigerants at Target and the industry at large, Paul Anderson is the recipient of the 2017 Accelerate America Person of the Year Award.

A passion for efficiency

After working at John Deere, Eaton Corp. and Ingersoll Rand, Anderson joined Target in 2007 as an operations manager in facilities management. It was a fortuitous time as Target was just about to launch its PFresh stores, which have expanded fresh food selections. (There are now more than 1,300 PFresh stores.) Since then he has moved up the ranks through a series of managerial and leadership roles across Target's store design and property management departments.

In his personal biography, Anderson describes himself as having "a passion for efficient operation of building systems." That passion informed his investigation of CO₂ cascade systems that led to the adoption of the prototype model, and later his decision to install hundreds of propane display cases.

Target's first three CO₂ cascade systems employed glycol as a secondary fluid for medium-temperature cases, and CO₂ as either a secondary fluid (the first

store) or a DX refrigerant for low-temperature cases. All proved to be inefficient systems compared to Target's former prototype, an R404A DX system.

At ATMosphere America 2017, Anderson reported that the system in the initial store (in North St. Paul, Minn.) manifested a 24% gain in energy consumption, while the one in the second store (in San Clemente, Calif.) consumed 8% more energy. However, in a fourth store in Conyers, Ga., he found that removing glycol in what became the prototype system resulted in a 4% drop in energy usage, which led him to make it the standard system going forward.

In March, Target opened its first transcritical CO₂ store, in Marin City, California, which received the chain's first Platinum certification from the Environmental Protection Agency's GreenChill Partnership. So far Anderson has found that the system runs as consistently as a traditional rack system, though it costs 40% to 50% more.

As expected, the energy efficiency of the transcritical rack erodes in higher ambient temperatures; Target has refrained from adding efficiency-enhancing elements like parallel compression in order to maintain a balanced comparison with a system at a nearby store. "Transcritical might be one of the tools in our toolbox, but we have to be careful where we install that system," he said.

But Target's hydrocarbon cases have proven to offer "phenomenal" energy savings, said Anderson. Using an R134a beverage cooler as a baseline, Target has found an R290 cooler consumes 53% less power (while a CO₂ cooler consumes 25% less).

In order to lower the global warming potential (GWP) of refrigerants in systems for which natural refrigerants are not available, Target has started using HFO blends with GWPs ranging from 650 to 1,300 in certain applications; these include systems in its SuperTarget hypermarket stores, some self-contained cases in small-format urban stores (that are transitioning to R290), and on the high side of the CO₂ cascade prototype.

"[HFO blends] are a great bridge to natural refrigerants," Anderson said. "We've got to select the best tool for an application, and sometimes it's not a natural today. But I'm not saying we won't get there."

BEST IN SECTOR

FOOD RETAIL: WHOLE FOODS MARKET

Silver buckshot



Aaron Daly,
Whole Foods Market

To put it simply, Whole Food Market takes a wide-ranging “silver buckshot” approach to natural refrigerants, as opposed to seeking a “silver bullet” solution that would apply uniformly to all stores, explained Tristram Coffin, director of sustainability & facilities at Whole Food Market’s Northern California Region.

“Hopefully, we’ll find a silver bullet down the road,” he said during the Thought Leaders session at ATMOSPHERE America 2017 in San Diego, Calif., last month. (See [story, page 20](#).) “Until then, we’re evaluating different natural refrigerants to determine what’s best for climate- and building-specific designs.” The San Francisco Bay area has been a particularly active host for Whole Foods’ natural refrigerant pilots, given its multiple climate zones.

Since 2009, the iconic organic/natural foods retailer, founded in Austin, Texas, in 1980 (and recently acquired by Amazon), has investigated virtually every type of commercial refrigeration system using natural refrigerants; these range from pumped CO₂ for secondary low-temperature applications and

various HFC/CO₂ cascade systems, to all-natural CO₂ cascade systems (using ammonia or propane on the high side) and transcritical CO₂ systems.

The chain’s ammonia/CO₂ cascade store is one of only four such implementations in the U.S.; its propane/CO₂ cascade system at a store in Santa Clara, Calif., is the only one of its kind in the U.S. (See [“Whole Foods Pushes the Propane Envelope,” Accelerate America, October 2016](#).)

Whole Foods required special permission from the Environmental Protection Agency’s SNAP (Significant New Alternative Policy) program to install seven rooftop propane chillers at that store; the chain plans to soon ask the SNAP program to allow chillers with an individual charge of up to 45 lbs. of propane to be used in the U.S.

With 467 total stores, Whole Foods now runs 22 using CO₂ in some form in a remote system, with 12 that employ only natural refrigerants, including 10 transcritical operations. (One of the latter, located in Brooklyn, N.Y., is completely HFC-free in all HVAC&R equipment, the only one of its kind in the U.S.) Those installations have earned Whole Foods 10 Platinum certifications from the EPA’s GreenChill Partnership.

All of the chain’s natural refrigerant central-system installations have been in new stores, except for a retrofit at an outlet in Sacramento, Calif., where a low-temperature rack was replaced with a cascade CO₂ system. “We’re looking forward to full-store retrofits,” said Coffin, pointing out that the biggest opportunity to install more natural refrigerant equipment is in existing stores, particularly for systems nearing end-of-life.

On top of that, more than 50 Whole Foods stores employ self-contained display cases incorporating propane (R290) refrigerant, mostly bunker units. “We’re constantly replacing cases, not systems,” said Coffin. “So that could be an easy way to transition to naturals a lot quicker than if we look only at central systems.” Self-contained propane cases could also be a good fit in smaller urban stores.

Each year, natural refrigerants are considered in 15-30 additional stores, said Coffin, who

works with Whole Foods' 11 other operating regions on sustainability initiatives.

For its industry-leading investigation of all manner of natural refrigerant technology, Whole Foods Market is the recipient of the 2017 Accelerate America Best in Sector/Food Retail Award.

Key collaborations

At the food retail panel discussion at ATMOsphere America 2017 ([see page 30](#)), Coffin attributed Whole Foods' ability to explore natural refrigerant systems to the synergistic collaboration it has achieved with rack OEMs, control vendors, engineers of record, commissioning agents and installing/maintenance contractors. "Without those synergies, those projects don't exist," he said.

At the same time, all of Whole Foods' natural refrigerant tests have met its short-term budgetary

requirements. In its longer-term evaluations, Whole Foods likes to look at TEWI (total equivalent warming impact), which encompasses both indirect emissions from electricity use off the grid, and direct refrigerant emissions; because of their low global warming potential (GWP), natural refrigerant solutions typically manifest a superior TEWI.

Whole Foods, Coffin noted, "wants to be on the forefront of sustainability – it's been one of our core values since the inception of the company." But he added that while it's important for Whole Foods to be on the cutting edge, "we don't need to be on the bleeding edge."

At ATMOsphere America, Coffin was critical of certain engineers of record who have been reluctant to share Whole Foods' embrace of natural refrigerant technology. "We're contracting [them] to do this, so either do it or get out of our way," he said. "Let's move on from dinosaurs that are going extinct to folks willing to innovate and make change."

BEST IN SECTOR FOODSERVICE: NESTLÉ

A commitment to hydrocarbons

Nestlé, the Swiss food and beverage manufacturer whose 2,000 brands include such iconic names as Nescafé, Perrier & San Pellegrino water and Häagen-Dazs ice-cream, has made replacing HFCs and other synthetic gases with natural refrigerants an important part of its GHG-reduction strategy. ([See "Nestlé's Natural Refrigerants Journey," *Accelerate America*, May 2017.](#))

Nestlé began the process in 1986 – a year before the Montreal Protocol was signed – with a program to replace ozone-layer-depleting CFCs and HCFCs at its food processing plants with ammonia. While much of its activity with natural refrigerants since then has been focused on its industrial plants,

Nestlé has also made a concerted effort to remove HFCs from its retail and foodservice ice cream freezers.

Nestlé introduced its first hydrocarbon-based ice-cream chest freezer in 2011. Since 2014, all the company's new ice-cream chest freezers in Europe have been HFC-free. This policy was extended worldwide in 2015. Since 2016, all of its new ice-cream chest, upright and island freezers have used hydrocarbons, either propane or isobutane, worldwide.

"We see good efficiency with hydrocarbons compared to HFCs," said Vincent Grass, Nestlé's refrigeration team leader, corporate operations – engineering services,

who is at the company's picturesque headquarters in Vevey, Switzerland. "It's a significant difference."

By 2020, all new proprietary cold beverage dispensers made by Nestlé Professional will use hydrocarbons.

For its aggressive global adoption of hydrocarbon-based ice cream freezers, Nestlé is the recipient of the 2017 Accelerate America Best in Sector/Foodservice Award.

BEST IN SECTOR
INDUSTRIAL: UNITED STATES COLD STORAGE

Pioneering ammonia/ CO₂ cascade

In 2005, conventional wisdom in the industrial refrigeration industry held that combining CO₂ with ammonia in a cascade system was a non-starter. “Equipment manufacturers were making presentations about why you shouldn’t use CO₂,” said Michael Lynch, vice president – engineering for United States Cold Storage.

Yet, based on observations of European installations, US Cold Storage, a division of U.K.-based Swire, decided to move forward with an ammonia/CO₂ cascade refrigeration system at its plant in Bethlehem, Pa. ([See “Shaking Up Industrial Refrigeration,” Accelerate America, April 2015.](#))

The system worked so well that the company has since installed it in 12 addition cold-storage facilities, out of a total of 38 in 13 states. Today, numerous other cold storage and food processing companies in North America employ the ammonia/CO₂ cascade system.

With its ammonia/CO₂ cascade systems, and other ammonia-reduction strategies, US Cold Storage has cut its ammonia inventory company-wide by 27%. “That’s a lot of ammonia,” he said. “Many of our [cascade] systems operate well below 10,000 lbs., even close to 5,000 lbs.”

US Cold Storage has thus led the way toward a new approach to industrial refrigeration that emphasizes lowering the amount of ammonia used in order to improve safety and stay below the 10,000-lb. threshold that triggers greater regulatory scrutiny.

Moreover, the company’s success with CO₂ helped to position it as a viable refrigerant in the industrial world, where ammonia has been the primary natural working fluid for decades. In recent years, the International Institute of Ammonia Refrigeration (IIAR) has increasingly included CO₂ in its conferences and standards activities.

Being one of the first warehousing companies to use an ammonia/CO₂ cascade system is “somewhat of a competitive advantage in the eyes of our customers,” which include large U.S. food manufacturers, said Lynch. “It’s perceived as being forward thinking and at the forefront of innovation.”

For pioneering the use of ammonia/CO₂ cascade systems in cold-storage facilities, US Cold Storage is the recipient of the 2017 Accelerate America Best in Sector/Industrial Award.

Staying off the radar

At the ATMOSphere America 2017 conference last month in San Diego, during the industrial refrigeration panel discussion, Lynch explained why US Cold Storage has adopted low-charge ammonia/CO₂ refrigeration systems.

Staying off the radar of government agencies like the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA) and the Department of Homeland Security (DHS) was a key driver for reducing ammonia charge, he said. Another was creating a safer environment

“It’s perceived as being forward thinking and at the forefront of innovation.”

for employees and customers while reducing insurance premiums.

US Cold Storage also enjoys energy savings by using ammonia/CO₂ cascade systems instead of traditional ammonia systems. According to Lynch, an ammonia CO₂ system consumes 0.4 to 0.8 kWh/cu. ft., compared to 0.7 to 1.1 kWh/cu. ft. for a two-stage economized ammonia system. On average, the cascade system has been found to be 5.8% more efficient.

The reduction in carbon footprint through energy savings “also aligns with our sustainability development activities both internally to our company as well as to our parent Squire in London,” said Lynch.

The main caveats associated with ammonia/cascade systems are keeping moisture out and mitigating the risk of ammonium carbamate contamination in the ammonia/CO₂ cascade condenser with two independent detection systems.

US Cold Storage has installed a different type of low-charge-ammonia system – Colmac Coil’s Advanced DX (ADX) system – in an expansion of its facility in Laredo, Texas. “We’ll probably take a harder look at these systems as we continue to grow,” said Lynch. “They can also provide very low charges, are probably as energy efficient as ammonia/CO₂ cascade systems, and can be cost-competitive in central plant applications.”

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INNOVATION OF THE YEAR:
HILLPHOENIX

A smaller, less costly system

In the mid-1990s, Hillphoenix, the Conyers, Ga.-based manufacturer of commercial refrigeration systems, launched what became its Second Nature line of alternative refrigeration systems. This grew to include CO₂ as a refrigerant, in secondary and cascade DX configurations.

Hillphoenix entered the all-CO₂ transcritical refrigeration category in 2011 with the acquisition of Danish OEM Advansor, a major supplier of transcritical systems to the European marketplace. By 2012, Hillphoenix had begun manufacturing its own Advansor-branded transcritical racks at its Georgia headquarters. The OEM continues to leverage the experience of Advansor, which has nearly 3,000 transcritical installations worldwide.

By mid-2017, Hillphoenix had itself installed close to 300 transcritical racks in North America – out of a total of about 410 – the most of any OEM.

Contributing significantly to that growth is a smaller capacity, less costly (by 20%-30%) version of the original Advansor system called the AdvansorFlex, designed for small-format stores (though it can be used in larger formats as well in multiples). The AdvansorFlex was specifically designed for the North American marketplace to meet stringent UL/cUL requirements and North American safety codes.

Introduced in December 2015, the AdvansorFlex got off to a fast start, with 30-40 installations by mid-2016. Though current numbers are not available, installations of the AdvansorFlex have continued apace over the past year. “The

AdvansorFlex is really popular for us,” said Scott Martin, Hillphoenix’s director of business development and industry relations, at the ATMOsphere America 2017 conference in San Diego last month.

The AdvansorFlex was developed to be a “lower-cost alternative” that smaller-format stores would be able to afford, noted Martin. In addition to small-footprint grocery stores, it is suited for convenience and dollar stores. Whole Foods Market is “looking at [the AdvansorFlex]” for its Whole Foods Market 365 stores, said Tristram Coffin, director of sustainability & facilities for the chain’s Northern California Region.

For developing the AdvansorFlex transcritical CO₂ refrigeration system and then installing it in numerous small-format stores, Hillphoenix is the recipient of the 2017 Accelerate America Innovation of the Year Award.

Flexible installation

The AdvansorFlex’s compact size allows it to be placed in a back room, on a mezzanine, on a rooftop or outside on the ground. Its sound-attenuating panels allow it to be installed near the sales floor. Two units are being considered as a replacement for an HFC system in an existing grocery store.

The AdvansorFlex offers a capacity of up to 125 kBtu/hr. (10.4 TR) for low-temperature (-25°F SST) applications, and up to 425 kBtu/hr. (35.4 TR) for medium-temperature (15°F SST) applications.



Scott Martin, Hillphoenix

Hillphoenix was able to reduce the cost of the AdvansorFlex by redesigning elements like the oil system. “It doesn’t need a full-blown oil system with a separator and reservoir,” said Martin. “The Flex was designed as a more economical solution.”

While its first cost is still above that of an average HFC rack, the AdvansorFlex is designed to reduce installation and maintenance costs. For example, it uses smaller copper piping, less insulation and less expensive refrigerant than an HFC system. Its electrical installation only requires a single point of connection from case controllers, which lowers costs. “All of this has to be rolled into an ROI calculation, and we help people with that,” said Martin.

Like all transcritical systems, the AdvansorFlex’s efficiency depends on its location; it is up to 18% more efficient than an HFC unit in cooler climates, Hillphoenix says, but its efficiency decreases in warmer climates. However, Hillphoenix has installed AdvansorFlex units with efficiency-improving adiabatic gas coolers in southern U.S. locations, said Martin. ■ MG

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Centralized Low-Charge Ammonia Stands Out at GCC Expo

Colmac Coil, Frick, Evapco and M&M Refrigeration make the case for less ammonia at industrial plants with centralized refrigeration systems

By Michael Garry



Low-charge-ammonia packaged systems have become an emerging force in the North American industrial refrigeration industry, with rooftop or outside ground-level units being tested by a slew of cold-storage and food-processing operators.

But centralized systems with traditional engine-room setups are also getting into the low-charge act, which was evident in mid-June at the second annual Global Cold Chain (GCC) Expo, held at Chicago's McCormick Place. The show was launched last year at the same venue as a collaborative effort between the Global Cold Chain Alliance and the United Fresh Produce Association. ([See "Cold Chain Converges in Chicago," *Accelerate America*, July-August 2016.](#))

The following is a look at the centralized low-charge scenarios on offer at the GCC Expo, including Colmac Coil's ammonia DX system, Frick's remote distributed condensing (RDC) units, Evapco's low-recirculation-rate evaporators, and M&M Refrigeration's ammonia/CO₂ cascade systems. ▶

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► **Ammonia DX saves energy and charge**

In a comparison of two low-charge-ammonia DX (direct expansion) systems to a traditional pumped liquid overfeed system in cold-storage facilities, the DX systems used 18% and 38% less electricity as well as far less ammonia, according to a presentation given at the GCC Expo.

“On paper, we calculated that the [ammonia DX systems] would use 1.3% more horsepower per ton than liquid overfeed systems,” said Rick Watters, vice president of refrigeration group, AMS Mechanical Systems, Woodridge, Ill., which was the contractor for the ammonia DX systems. “But the bottom line is that the premium we thought was going to exist to do DX ammonia really doesn’t exist.”

The ammonia DX systems – both ADX systems made by Colmac Coil Manufacturing, Colville, Wash. – were installed at Joliet Cold Storage, Joliet, Ill., in 2014 and Liberty Cold Storage, Bolingbrook, Ill., in 2015.

Watters attributed the difference in energy savings between the two ADX facilities (38% at Joliet, 18% at Liberty) to variances in blast freezing production. Both facilities benefited from VFD fan motors and LED lights.

The construction cost of the ADX system at the Joliet facility was \$100,000 less than that of a liquid overfeed system, which uses a 3-1 ammonia ratio. “That was also the opposite of what was predicted,” said Watters.

In ammonia charge, the Joliet facility uses 8 lbs./TR; Liberty, 11.6 lbs.TR; and liquid overfeed, 72 lbs./TR. The Joliet and Liberty plants both deliver temperatures of -15°F and 20°F, and utilize thermosiphon oil cooling, low-charge condensers and stainless-steel piping. Joliet employs motorized TXVs, Liberty, pulse TXVs. Both use accumulators to capture liquid from the evaporators. “DX is theoretically dry suction back to the compressors but you’ll still want an accumulator to catch liquid coming back that could damage the compressors,” said Watters.

Ammonia DX technology is one of the low-charge scenarios that has emerged in the last few years in response to growing regulatory oversight of industrial facilities with more than 10,000 lbs. of ammonia. “Regulations and risk have driven interest in using ammonia and getting the benefits of it but using less of it,” said Bruce Nelson, president of Colmac Coil, also speaking at the GCC Expo session.

Colmac has installed its ADX system at cold-storage and food processing plants in the U.S. Canada and Australia, said Nelson. In addition to Joliet Cold Storage and Liberty Cold Storage, end users include Shepherd’s Processed Eggs, Spanish Fork, Utah; Preferred Freezer Services, Richmond, Wash., US Cold Storage, Laredo, Tex., and Bidvest Tamworth, Tamworth, Australia.

In the Colmac ADX system, most of the ammonia comes out of the evaporator, explained Nelson. “It’s a 30-50 times charge ►



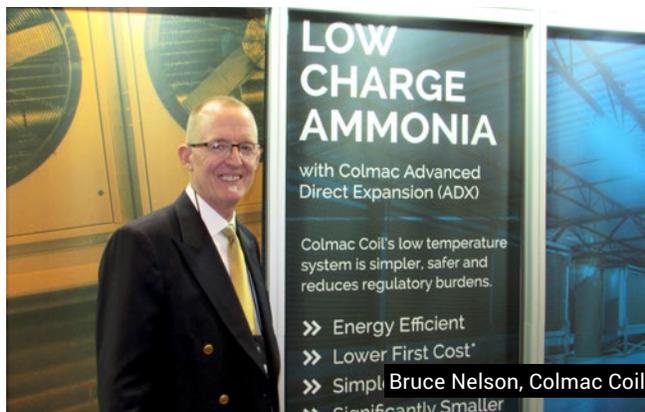
Guntner's hydroBLU adiabetic condenser



Todd Donohoe, M&M Refrigeration



Evapco low-charge-ammonia chiller



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► reduction in the evaporator. That takes out a lot of risk out of the occupied space and gets the overall charge well below 10,000 lbs.” It also reduces risk to the immediate neighborhood; the Joliet facility, for example, is located near residential houses.

Several technological advancements were required to enable the ADX system to reduce ammonia charge, such as “enhancements” inside the evaporator tubes. “We also use better distribution to get the ammonia to the right parts of the heat exchanger,” Nelson said. “That’s the secret sauce.” Colmac also figured out the management and removal of water in pipes and vessels, he added. Both Joliet and Liberty plants use anhydrators to remove water.

A key benefit of the ADX system is its simplicity compared with a traditional ammonia system, noted Watters. “If a [traditional] ammonia system goes down, it takes a while to get back on line,” he said. “[The ADX system] is as simple as a light switch to turn off and on.”

Frick’s RDC units

At the IAR Natural Refrigeration Conference & Heavy Equipment Expo in San Antonio, Texas, last February, Frick Industrial Refrigeration, a division of Johnson Controls, introduced a low-charge ammonia central system that uses “remote distributed condensing” (RDC) units to substantially reduce the amount of ammonia required in industrial applications.

The RDC units, which include a condenser (such as plate-and-frame or adiabatic) and a small liquid supply vessel, are placed near two-three DX evaporators. Apart from the liquid ammonia transfer between the RDC and the evaporators, only ammonia vapor is distributed through the plant. Unlike low-charge ammonia packaged systems, Frick’s design maintains use of a traditional engine room, though it only contains compressors and a control panel.

Frick’s low-charge central system is capable of limiting the ammonia charge in the range of 1.5 to 3 lbs./TR. The capacities for which the system is typically designed vary from 250-1,000 TR. Most of the RDC units are adiabatic condensers, such as Guntner’s hydroBLU system.

“The standard liquid recirculation system has recirculation vessels and high-pressure receivers – all holding a lot of liquid ammonia,” said Steve Heidenreich, regional sales manager, Frick Refrigeration, in an interview at the GCC Expo. “With [the RDC

system], we’ve eliminated those vessels.” The RDC units contain at most 60-70 lbs. of ammonia, he said.

Sensors monitor the ammonia level to make sure a sufficient quantity is fed to the evaporators. “The key to getting the charge down is the controls and managing the ammonia,” said Heidenreich.

The RDC system is suited for retrofits – such as at large ammonia plants in residential areas – or new projects, Heidenreich said, adding that it cost “a little more” than a standard liquid overfeed recirculation system.

Everything is smaller

Evapco continues to promote its low-charge-ammonia Evapcold packaged units and its low-charge evaporators designed for stick-built central systems, with both employing the same underlying technology, said one of its executives.

“Whether in a packaged unit or a stick-built system, we’re using the same low-charge techniques – low recirculation rates and smaller evaporator tubes, line sizes, pumps and vessels – everything is smaller,” said John Kollasch, Evapco’s vice president, industrial refrigeration product application & marketing, in an interview at the GCC Expo in Chicago in mid-June.

The reduction in equipment size as well as costs – while maintaining the same capacity – is making the low-charge approach more popular in central systems, with low-recirculation-rate evaporators being adopted by “a lot of customers,” said Kollasch. “I see people gravitating to lower charge sometimes not for the sake of the low charge but for the smaller systems and lower costs,” especially for plants that would already be under the regulatory threshold of 10,000 lbs.

He is also seeing more interest in low-charge secondary systems, with ammonia restricted to the equipment room and glycol or CO₂ used in the refrigerated space.

Evapco introduced two new evaporators – offering its lowest charge to date – at IAR’s Natural Refrigeration Conference & Heavy Equipment Expo, held in San Antonio, Texas, last February. The new evaporators, the SSTSB series and SSTE B low-profile series, both utilize 3/8-inch-diameter, internally enhanced stainless-steel tubes, which lower the charge compared to 5/8-inch-diameter tube models, using a recirculation rate of 1.2:1. ►

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▶ CO₂ for plant expansions

CO₂ is becoming a growing refrigeration add-on option for cold-storage and food processing operators that are expanding their ammonia-based operations, said an account executive for M&M Refrigeration, a leading supplier of ammonia/CO₂ cascade systems.

The CO₂ in these scenarios is used as the cooling agent, with ammonia serving to condense the CO₂ in what is known as an ammonia/CO₂ cascade system.

Since 2004, M&M, based in Federalsburg, Md., has installed more than 55 ammonia/CO₂ systems in North and Central America and Southeast Asia, said Todd Donohoe, the account executive, in an interview at the GCC Expo

Asked about the growth of the market for ammonia/CO₂ systems, he said M&M cold-storage operators planning to add a frozen room to an existing facility may initially inquire about a standard single-stage or two-stage ammonia system. "We say, 'Have you thought about CO₂, because it can save you money in the long run,'" said Donohoe. "That's where the conversation usually starts."

When installing CO₂ in an expansion, M&M sometimes uses the existing ammonia engine room to condense the CO₂ in a cascade heat exchanger, and sometimes adds additional ammonia equipment. "If there's no room in the existing engine room, we can do a self-supporting skid outside," he said.

In a current expansion scenario at Nardone Bros.' plant in Hanover, Pa., M&M is converting the entire facility to CO₂, using ammonia only in the engine room to condense the CO₂, said Donohoe. "We are repurposing the existing ammonia screw compressors, using different motors, and adding CO₂ reciprocating compressors."

NH₃/CO₂ cascade technology is a compelling option for industrial operators employing blast or spiral freezers because it uses smaller line sizes than ammonia, is easier to install and reduces the ammonia charge – "all the buzzwords," said Donohoe. Moreover, the cascade systems are up to 35% more efficient than a two-stage ammonia system at -58°F saturated suction temperature, he noted ■ **MG**

AMMONIA COMPRESSOR PACK FINDS HOME IN LOW-CHARGE UNITS



Bitzer's ACP

OEMs have reconfigured German compressor maker Bitzer's three-year-old ammonia compressor pack (ACP) to their specifications in low-charge packages, and installed them at "up to a dozen" industrial end users, according to a Bitzer U.S. executive.

"OEMs will buy an ACP from us and tailor it," said the executive, Kurt Bickler, director of OEM and aftermarket sales, Bitzer U.S., in an interview at the GCC Expo.

"Smaller distributed ammonia systems are a very viable concept," Bickler said. "It's a whole new direction."

Bitzer has also been supplying ammonia compressors to OEMs of low-charge packaged units like Azane, Evapco and NXTCOLD.

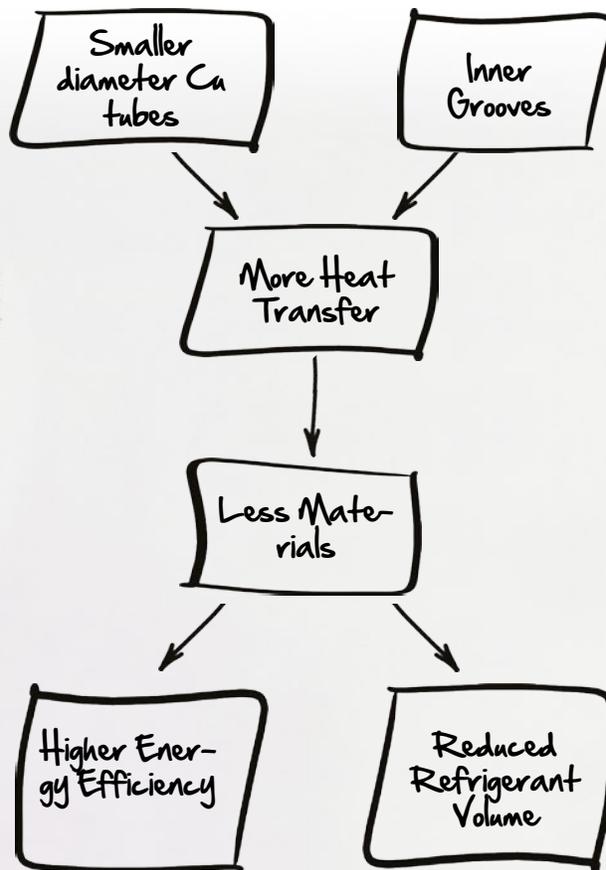
The modular design of the ACP includes two or three compressors in a frame (one with a VFD), as well as oil

management systems and a controller. The ACP, which handles capacities ranging from 142 TR (500 kW) to 1,024 TR (3,600 kW), comes with an optional economizer that enables reduced ammonia charge. ACPs with up to nine compressors can be connected to a single controller.

Bitzer is also marketing CO₂ compressors for transcritical systems in industrial and commercial applications. At the AHR Expo in Las Vegas in February, Bitzer showcased its ECOLINE+ six-cylinder, 50 HP semi-hermetic reciprocating compressor line for transcritical CO₂ systems for the first time in the U.S. The ECOLINE+ compressor line is the next generation of Bitzer's five-model OCTAGON transcritical six-cylinder, 35-50 HP line, which has received UL-approval. The ECOLINE+ units are in the process of getting UL approval.

Both the ECOLINE+ and OCTAGON transcritical six-cylinder, 50-HP compressors can be employed in supermarket and cold-storage applications, reducing the number of compressors needed in a rack.

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Different Approaches to Hydrocarbons

Many OEMs of foodservice equipment are fully committed to propane or isobutane, but at least one is hedging its bets as it assesses market acceptance

By Michael Garry



At the NAFEM (North American Association of Food Equipment Manufacturers) Show in Orlando, Fla., in February, numerous OEMs, led by True Manufacturing, showcased their self-contained hydrocarbon (mostly propane, with some isobutane) refrigeration equipment. (See “OEMs Flock to Hydrocarbons,” *Accelerate America*, March 2017.) Their hydrocarbon units enabled the OEMs to meet the impending Department of Energy 2017 energy requirements, set to take effect March 27.

Three months later, several of those OEMs reconvened at the NRA (National Restaurant Association) Show in Chicago, promoting their propane wares to a wider swath of the foodservice industry. True once again led the way with an expanded line of refrigerated merchandising display cases. (See “True’s New Cases Far Surpass Energy Regs,” *Accelerate America*, May 2017). ▶

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Welbilt R290 refrigerator

“We went through an education process with our customers and put our service techs up to speed.”

► Other NRA exhibitors have followed True with a major commitment to stand-alone propane refrigeration units, though at least one, Traulsen, offers both HFC and hydrocarbon equipment, hedging its bets on North American market acceptance, which is in the early stages. The following reports from the NRA Show describe how these OEMs are proceeding.

No pushback to R290 units

Foodservice equipment manufacturer Welbilt has not seen “any real pushback” from chain restaurants following the conversion of its Delfield upright and under-counter commercial refrigeration units to propane from R404A, according to one of its executives.

“We went through an education process with our customers and put our service techs up to speed,” said Kaye Wisner, vice president and managing director-Delfield. “And we have competitors that have also made this change, so it’s natural for our customers.”

Welbilt, based in New Port Richey, Fla., unveiled its R290 units at the NAFEM show in Orlando, Fla, in February, having completed the conversion of those units late last year. Wisner provided an update at the NRA Show.

She pointed out that Welbilt (formerly Manitowoc Foodservice) has been selling hydrocarbon products in Europe for more than 10 years. In the U.S., Department of Energy (DOE) 2017 efficiency standards and impending Environmental

Protection Agency refrigerant delistings drove the conversion, plus “we had some customers pushing us along this path a couple of years ago,” she added. “So it’s a natural transition for us.”

Welbilt’s propane units are 15% to 17% more efficient than their HFC predecessors and meet the new DOE efficiency requirements, said Sara Sunderman-Kirby, product manager for the Delfield brand, at the NAFEM Show, adding that the cost of both equipment types is comparable.

Wisner said that many of the propane units also meet the new Energy Star 4.0 efficiency standards. Welbilt was named a 2017 Energy Star Partner of the Year - Sustained Excellence Award winner.

Welbilt still sells some R404A products, but is working on converting them to R290 “in most cases,” said Wisner. “It’s a huge game-changer for us, honestly, from our service to development cycle to manufacturing footprint,” she said. “It’s a significant investment for us.”

Beverage-Air: all-in for HCs

Beverage-Air is also committed to selling only propane equipment.

“Just about everything here is R290,” said Peter Kelley, regional sales manager for Beverage-Air, at the NRA Show. Based in Winston-Salem, N.C., Beverage-Air sells equipment to many restaurant chains. ►

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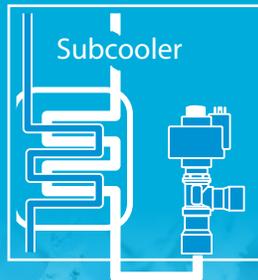
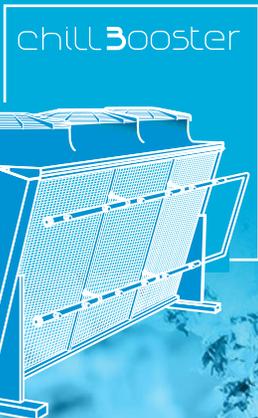
Adiabatic cooling

Parallel compressor

Mechanical subcooling

Modulating Ejectors

DC inverter technology



“ If you're worried about your [carbon] footprint, hydrocarbons are the way to go.”

► The reason for its propane-focused approach is that Beverage-Air did not want to re-engineer its HFC units to meet the Department of Energy's 2017 energy efficiency requirements, only to have to re-engineer them again when HFCs are delisted by the Environmental Protection Agency's SNAP (Significant New Alternatives Policy) program in 2020. With hydrocarbons, “we just did it all at one time,” he said.

Beverage-Air, which has its own UL-certifying labs, says its R290 units can reduce energy consumption from 5% to 25%.

Kelley acknowledged that going from a couple of product categories with hydrocarbon refrigerants to all of its products is “a huge task.” Beverage-Air is still converting a few products, but “the lion's share is done.”

Sandwich prep units did not have to meet any new energy requirements, “but we went to R290 anyway,” he said.

Beverage-Air's restaurant chain customers are satisfied with the change to hydrocarbon refrigeration “as long as it doesn't affect the operation of the unit,” Kelley said.



Traulsen hedges bets

Taking a more cautious approach, Traulsen, based in Fort Worth, Texas, offers the same refrigeration units with either R134a or R290, both of which meet the 2017 DOE efficiency requirements, said Laura Gutkowski, sales development manager, at the NRA Show. “The global restaurant chains are definitely interested in R290, but other chains are mixed, and that's why we're not going to 100% hydrocarbons.”

About 5% of Traulsen's customers currently use R290 equipment, Gutkowski said.

While acknowledging that R290 has a superior heat of absorption, she maintained that Traulsen's R290 units “are not always more energy efficient across the board” compared to its HFC units.

Traulsen plans to offer R134a and R404A “until they are delisted” in 2019 and 2020, she said. At that point, the company intends to make available equipment with HFO blends like R450 and R513 (which have a global warming potential of 601 and 630, respectively). “We know R290 is safe, but there are fire codes where it is difficult to get it accepted,” she said. “So if we can offer a non-flammable option, we'll do that.” School districts, in particular, have pushed back against hydrocarbons.

“We tell them it's safe,” she said, adding, “And if you're worried about your [carbon] footprint, hydrocarbons are the way to go.” ■ MG



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True's Propane Journey

In an interview at ATMOsphere America, True Manufacturing's owner and CEO Steven Trulaske explains how the company became a leader in self-contained propane display cases.

by Michael Garry and Marc chasserot



From left: Marc Chasserot, shecco; Steven Trulaske, True Manufacturing; and Michael Garry, Accelerate America

Last year, Steven Trulaske, owner and chief executive officer of O'Fallon, Mo.-based True Manufacturing, accepted two awards in Chicago; both recognized the company's leadership in developing stand-alone, energy-efficient commercial display cases using propane refrigerant.

The first, presented at the National Restaurant Association (NRA) Show in April 2016, was the Environmental Protection Agency's 2016 Energy Star Emerging Technology Award in the residential/commercial refrigeration category for 42 of True's propane frozen and refrigerated display cases. The second, given at the ATMOsphere America 2016 conference, was the Accelerate America Innovation of the Year award, also for True's propane display cases.

This year, Trulaske, son of True's co-founder Bob Trulaske, was back at ATMOsphere America, held June 5-7 in San Diego, as a participant in the conference's first CEO interview. Fielding questions from Marc Chasserot, CEO of shecco (organizer of the conference and publisher of *Accelerate America*), and Michael Garry, editor of *Accelerate America*, Trulaske described his personal journey at the 72-year-old company, and the decisions that led to True's leadership role in the marketing of propane self-contained display cases. The following are highlights from that interview.

“ *It also comes down to simple fundamentals. What does our customer want?”*

Marc Chasserot: What’s your personal story? How did you end up here?

Steven Trulaske: In my 20’s, the last thing I wanted to do was to get into the refrigeration business, the family business. I was trying to find an entirely different career path. I was really into sports, so after I graduated from DePauw University, I went to Ohio State for a brand-new degree called sports administration. I did an internship for the St. Louis (football) Cardinals (now in Phoenix), and that cured me of the whole sports management idea. I got my MBA at Ohio State and really fell in love with business.

I did go back to True Manufacturing in 1982 but there wasn’t too much for me to do – except to go around the world and push the international business for the company. I began in Europe – I love Germany. But I was trying to sell to Germans something – American refrigeration – that they really had no interest in.

I finally found an opening through the Coca-Cola Company. I built up a relationship, and they said I should go to Coca-Cola in Barcelona, so I did. They were – still are – the outstanding bottler and distributor in Europe. I got this huge order for vertical display coolers and my father couldn’t believe it. From there began the journey of the last 35 years; there are still a lot of opportunities.

MC: What was it that made you decide to go with propane before everyone else? That was a pretty big gamble.

ST: It was really because so many stars were uniquely aligned. First of all, what we’ve done in the last three to five years is so much based upon being a privately owned company. I would imagine it would be very difficult for a publicly owned company to go to the board and say, “Let’s try this, and this is what it’s going to cost, because it’s a big number.” Being privately owned and able to take this long-term view – that’s central to the ability to make a decision like we made with propane.

It also comes down to simple fundamentals. What does our customer want? Coca-Cola wanted to go down the path to CO₂, but we also worked very hard to develop our McDonald’s business in Europe; I’m pretty sure McDonald’s had the first [propane] kitchen in Denmark in [2003]. Propane had been the residential refrigerant in Europe for some years, and had an established track record. So if we were going to do business in Europe, we had to go down this [propane] path. Then we were able to start leveraging our relationships with compressor companies like Danfoss, Secop and Embraco.



Steven Trulaske

Michael Garry: Given your business relationship with Coca-Cola, did you consider CO₂ as a refrigerant?

ST: As we did our analysis between CO₂ and hydrocarbons, we came quickly to the decision that hydrocarbons were the clear winner. More than just the refrigerant and the ability to design refrigeration systems, there were fundamental business things like a lot higher cost to develop [CO₂]. Four to five years ago, we had 100 different choices of hydrocarbon compressors, versus two or three CO₂ compressors. So for us it was so obvious. And the Coca-Cola Company eventually came to an understanding and appreciation of hydrocarbons.

MG: In the U.S., what role did regulations play in driving True’s propane technology?

ST: The regulatory piece crept up on us. We saw in Europe the banning of HFCs. Then [True Engineering Manager] Charlie Hon worked with the EPA’s SNAP program [to gain approval for propane in commercial refrigeration in 2011]. All of a sudden in 2014, we get these new [Department of Energy efficiency] standards for 2017, which for many of our models were absolutely draconian drops. Along the way comes the [EPA] ban of HFCs. We were prepared to go down that path, but at the same time in the United States it came so fast.

Perhaps our situation was more difficult than other manufacturers because we have so many models and so many variations of refrigeration systems that we had to redesign. When this whole journey began about 10 years ago we had 10 to 12 labs. We have 34 today! And we need every one of those to do all of this work. So this has been an enormous investment, but regulations have pushed us hard in the last couple of years. ▶

“ When this whole journey began about 10 years ago we had 10 to 12 labs. We have 34 today!”

► MC: Was the ultimate decision to go with propane a one-off or was it made over a period of years?

ST: I would say fundamentally at True we like to move in evolutionary ways. So I wouldn't say there was one big meeting. We [first] saw the opportunity in Europe. Remember, propane was not approved in the U.S. until 2011, and you still had to reclaim the refrigerant. It was not too sexy in that era. So it was a gradual thing: we'll grow our [propane] business in Europe and we'll learn from it. If we can get the EPA approval, fantastic. But a lot of things had to happen so it wasn't a big moment.

MG: Another key step was in 2014, when the EPA allowed propane venting in commercial refrigeration.

ST: Yes, without that, it would have been a much more difficult transition. There was enough pushback by a number of people relative to the safety of hydrocarbons, so we were very glad when that happened.

MC: Did you get resistance internally to moving to propane?

ST: No, it's been phenomenal. The engineering team loves it; they've designed the best refrigeration systems they've ever designed. And for the new generation coming into the company, they like to be a part of this.

MC: It's not just business; they're also doing the right thing.

ST: Exactly.

MC: Does that help with recruitment?

ST: Yes. It's not just that we're leading this revolution in great refrigeration; as a company, we're concerned with our carbon footprint. But it's not purely an environmental thing. Remember, these refrigerants do save our customers a lot. The difference with two-door freezers is 10 to 12 kilowatts. You add that up across the footprint at Target, and all the units they buy and replace, and you see significant savings. So it's just a big win across the board. ►



From left:
Marc Chasserot and Steven Trulasko

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“ *The engineering team loves it; they've designed the best refrigeration systems they've ever designed.* **”**

► A MAINSTREAM TECHNOLOGY?

MG: With hydrocarbon units becoming so efficient to meet regulations, are these units on their way to becoming mainstream in the U.S.?

ST: I would estimate they are going to be next. I think there are suppliers who are moving some models to hydrocarbons; they are being pushed hard by their customer base, our mutual customer base. But there are other alternatives such as [HFO] blends, which are a lot less of an investment. From a purely financial standpoint, I can appreciate that a company might want to look at the blend option at this juncture.

MG: Did you consider incorporating blends as well?

ST: We studied them, but we are not hearing anything about them from our key compressor suppliers. That really puts a big brake on us in factory investment. We really have to think long-term.

MG: Will the 2017 DOE efficiency requirements be enforced, given the Trump administration's anti-regulatory stance?

ST: We don't believe [enforcement] is going to be a powerful force with the new administration. But at the end of the day, when we made this decision to move to propane, it was not just about the DOE regulations. It was because these were the best refrigeration systems we've ever designed. When you make a decision this fundamental, whether the DOE is funded by the current administration or not is not a critical part of it.

MG: Because administrations come and go.

ST: Administrations come and go.

MG: Do you expect the charge limit for propane in commercial refrigeration to go up from 150 g, and if so what impact will that have?

ST: Yes, but even if that never happens, we're totally ready to do whatever we need to do. We have solutions for the bigger freezers where there are dual systems that are each limited to 150 g. [Raising the charge] would be nice and I assume it would potentially reduce our costs to go to a single system. But I don't look at it as a big deal for us. For the industry as a whole, it's very valuable. [In stores with only propane cases], it would make a huge difference.

MG: It will be interesting to see how self-contained propane cases compete with CO₂ central systems in food stores.

ST: Especially with the societal trend toward moving to urban environments and generally more small-footprint stores. There are all kinds of dynamics that are very positive for self-contained hydrocarbon units.



From left:
Steven Trulasko and Michael Garry

MG: Flammability of hydrocarbons is still an issue for some. What have you done to address this?

ST: When we began this journey, there was a lot of pushback and concern. Fortunately, you had leaders out there like Paul Anderson of Target; when he made his [commitment to propane], that gave it tremendous credibility. To make this kind of journey, we need the Pauls of the world to step up. And we put a lot of effort into educating folks that no one's died or gotten burned [from propane refrigeration].

MC: What advice would you give to other business owners dealing with the confusing world of refrigerants?

ST: You have to do your own testing and take a long-term approach to this transition. You could maybe save money in the short term by going down one path, but given all the things that are occurring, that might not be the best financial decision. You might have to invest today but longer-term you are going to get your payback.

MG: What's next for True?

ST: We still have some work to do. We have existing models with HFCs to convert to propane. [For some models] we didn't keep testing to pass Energy Star 4.0; we will come back and get Energy Star 4.0. There are all kinds of technologies coming that we need to be ready for, and new efficiency standards are coming potentially in 2022, so we always have to think about how to stay ahead ■ **MC & MG**

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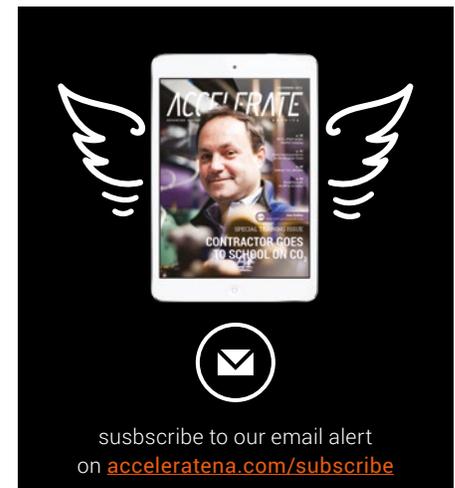
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Publisher	Marc Chasserot marc.chasserot@shecco.com @marcchasserot
Editor	Michael Garry michael.garry@shecco.com @mgarrywriter
VP-Business Development; Technical Editor	Derek Hamilton derek.hamilton@shecco.com
Contributing Writers	Eda Isaksson Charlotte McLaughlin Andrew Williams
Ad Coordinator	Silvia Scaldaferrri
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