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refrigerants

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north america

ATMOsphere America 2013

**Summary Report of
International Conference**

Washington D.C., USA
June 17 - 19, 2013

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ATMOsphere America 2013
**Summary Report of
International Conference**

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ATMOsphere America 2013 was a great success. We had more end users, senior executives from industry and regulators attending and speaking. The fact that we had key decision makers from over 100 North American based organizations is a sign that things are changing. Participants clearly stated that there is a momentum behind natural refrigerants. That the business case for natural refrigerants is growing day by day in North America and that the market penetration across a variety of applications is going to grow very fast over the next 2-5 years.

I firmly believe that when natural refrigerants go global it will be thanks in part to North American leadership.

I'm already looking forward to ATMOsphere America 2014.

Marc Chasserot



MARC CHASSEROT
Chairman ATMOsphere
America 2013
Managing Director shecco

About ATMOsphere America 2013

The North American Conference on Natural Refrigerants was held from June 17-19, 2013 in Washington DC. Under the banner "The Business Case for Natural Refrigerants," the event brought together around 200 industry experts from the HVAC&R (heating, ventilation, air conditioning and refrigeration) sector, including leading retailers, suppliers, engineering and consultancy firms and government representatives. The interactive forum, geared towards making natural refrigerant technology more visible to the global community, gathered presentations from over 40 speakers. It also included many networking opportunities, creating a unique space for fruitful discussions to further spur the uptake of natural refrigerant (CO₂, ammonia, hydrocarbons, air, and water) technologies.

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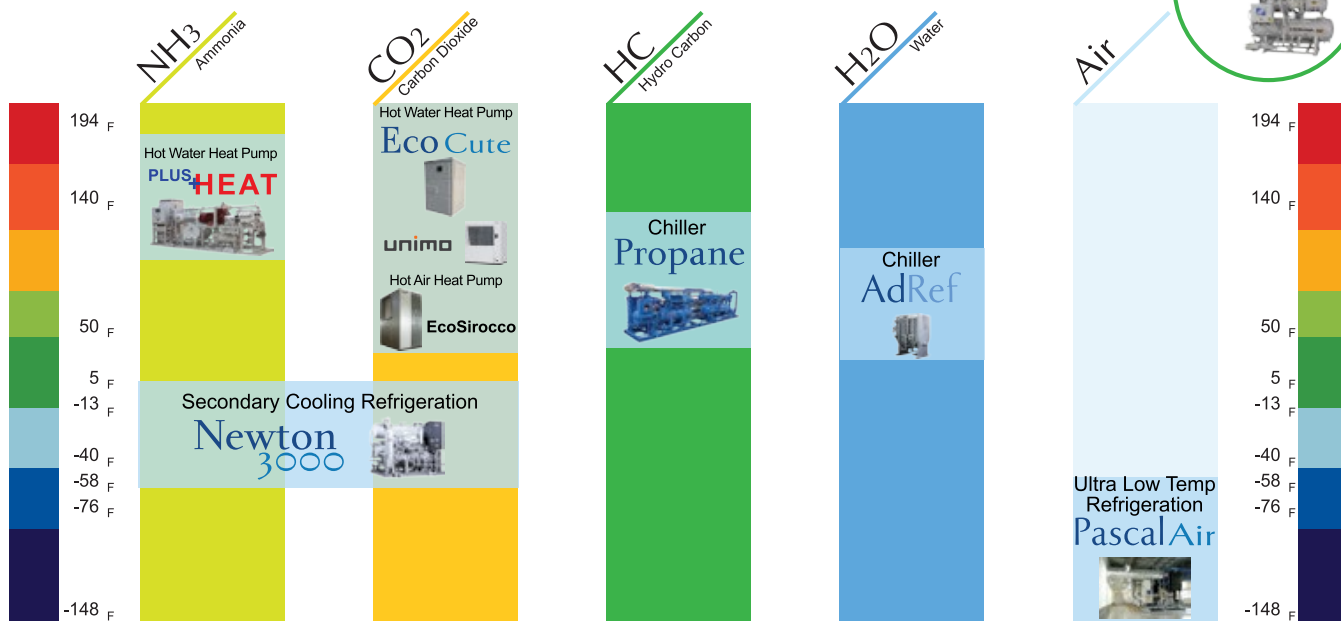
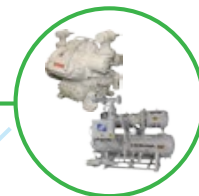
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state of the industry



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State of the industry

With increasing availability, as well as market and regulatory hurdles continuously being cleared for a maturing North American natural refrigerants market, the major push towards the U.S. becoming a world leader in CO₂ (R744) technology could happen within the next 5 years, participants at the ATMOsphere America 2013 conference confirmed. The conference kicked off by presenting market trends and examples of leadership shown by North American corporations in driving the HFC-free technology market forward.



CO₂ works... but North America needs to take more leadership

During the opening presentation by Nina Masson, from shecco, attention was drawn to the current numbers of HFC-free light-commercial applications and CO₂ supermarkets in North America, two of the most likely sectors to experience growth in the coming years. Presenting a global comparison of stores using cascade and transcritical CO₂ refrigeration systems, Masson showed that, following Japan, Canada is now the country with the 2nd highest number of CO₂ transcritical stores outside of Europe. The U.S. is ranked as the 2nd non-European country,

after Australia, in terms of the combined number of cascade and secondary systems. In both areas, Europe seems set to assume market leadership for the years to come; however, Japan, the U.S. and China could catch up quickly. Masson concluded that while current numbers of HFC-free installations in the U.S. and Canada fall short of expectations, especially when compared to the global adoption rate of hydrocarbon technology, North America has the potential to transform the entire industry by showing clear leadership, both on the suppliers side and also through committed end-users driving the issue.

CO₂ supermarkets in the United States of America.¹



1. Masson N., Chasserot M., Topley Lira J., Maratou A., Jia H. (2013) GUIDE 2013: Market Growth for North America. Brussels, shecco publications.
 [ONLINE] Available from: http://www.shecco.com/files/guide_natural_refrigerants_north_america_2013.pdf

CO₂ works... in all climates

Scott Martin from Hillphoenix provided an overview of all available solutions for the North American market currently offered by the company: pump CO₂ secondary systems resulting in more than a 50% reduction in HFC use; cascade CO₂ systems avoiding 60-75% of HFC use; and HFC-free booster systems. Since 2006, Hillphoenix has installed around 100 secondary, 30 cascade, and 20 booster systems in North America. Most of the CO₂-only systems were installed in Canada using Advansor's booster system. Martin confirmed that obtaining UL listing for Advansor's booster systems in late 2012 was a critical step towards spreading their use in the U.S..

Hillphoenix is now working on designing new ways to use the efficiency of booster systems in subcritical operation and to reduce the negative impact of high ambient temperatures on energy efficiency. The use of adiabatic gas coolers will allow for many more subcritical operating hours and could result in annual energy savings of 22% in San Antonio, Texas, according to Hillphoenix's theoretical calculations. In addition, the use of parallel compression of CO₂ flash gas would improve energy savings by up to 15% in warm southern climates. Martin concluded that, while the initial cost of CO₂ booster systems is more expensive than alternatives today, the "Made in USA" trend towards domestic production and economies of scale would quickly drive down costs.

According to Heatcraft, even in the hottest conditions, like in Tampa, Florida, CO₂ transcritical systems are calculated to be only 5% less energy efficient than centralized conventional systems. In the climatic conditions of Edmonton, Québec, Boston and Toledo, they would clearly outperform traditional solutions.

CO₂ works... in supermarkets, distribution centers, ice rinks, and as a retrofit option

Marc-Andé Lesmerises of Carnot Refrigeration, North America's current market leader for CO₂ transcritical supermarket installations, outlined the company's journey from 2007 to the present day, where we can observe the high acceptance rates of R744 solutions among several supermarket chains. Today, there are an estimated 83 CO₂ transcritical systems running in Canada, and the first ones are being installed in the U.S..

In addition to commercial refrigeration, R744 use is starting to penetrate other promising markets such as distribution centers and ice rinks. A provincial scheme to retrofit old ice rinks compared 12 different technology options, concluding that, when taking into account various factors such as direct heat recovery, avoiding the use of a glycol system, compactness, and ease of installation, CO₂ is the best solution. As a result, almost 80% of all ice rinks in Québec will now be retrofitted with CO₂ systems.

Lesmerises stressed the importance of skilled personnel who are able to optimize system operation and drive down costs. He recommended a larger focus on Total Cost of Ownership (TCO) as the best approach to evaluating the real cost over a system's lifetime. The conclusion was that CO₂ systems would not be more expensive than HFC systems when factoring in the heat reclaim option in the initial cost.

CO₂ works... with NH₃ in the retail environment, and in all ambient temperatures

Mayekawa has developed an innovative NH₃/CO₂ solution for the supermarket industry in which the ammonia charge is kept below 250 lbs (113 kg). Installed in the Carpinteria store, the first "all-natural" supermarket in the U.S., the proof of concept has been successful in showing that a low-charge NH₃ system can be com-

petitive with other systems. Efficiency gains range from 13-30%. The system's remarkable ease of operation enabled an assistant store manager to independently launch the system back into operation following an untimely interruption on New Year's Eve.

Masood Ali of Heatcraft argued that, until the remaining CO₂ transcritical efficiency deficit is entirely resolved through new developments, NH₃/CO₂ cascade solutions are perhaps the best option in all ambient temperatures, saving around 30% of energy.

International move towards HFC phase-down will drive the market

Masood Ali also drew attention to the role regulatory initiatives can play in the adoption of HFC-free solutions. Referring to on-going discussions about a significant HFC cut and possible HFC ban in HVAC&R equipment in the European Union, as well as the influence of the HFC levy in Australia, Ali suggested that California could play a vital role in driving the market in the U.S.. The fact that the market for natural refrigerants is maturing can be seen in positive developments such as the availability of appropriate standards, for example the UL approval for CO₂ transcritical (TC) compressors offered by 3 major manufacturers in the last 6 months, and a soon-to-happen update to ASHRAE standard 15 to include CO₂ TC options.

However, although the supplier base for CO₂ commercial refrigeration technology is constantly increasing and system costs are decreasing, a lack of economies of scope and scale still impedes a more rapid market uptake. As a conclusion, Ali argued that a lack of familiarity with the system does not currently allow for all possible cost savings to be capitalized on; therefore, he called on the industry to invest more effort into the education of contractors.

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supermarket end-user panel



KEILLY WITMAN
EOS Climate
Session chair



J'AIME MITCHELL
Whole Foods



MIKE GULDENSTERN
e2s energy efficiency services /
Whole Foods



STEVE HAGEN
Sprouts



HARRISON HORNING
Delhaize America



RICHARD HEATH
Source Refrigeration



ROD PETERSON
Sobeys

End users: food retail

The end user panel chaired by Keilly Witman from EOS Climate, formerly of the Green-Chill Partnership, looked at the North American retail sector's use of natural refrigerants. Speakers representing leading U.S. and Canadian retailers, Whole Foods, Sprouts, Delhaize America, SUPERVALU and Sobeys, presented their experiences with natural refrigerant system installations and the challenges related to these, as well as their plans for the future. Of note were the figures presented by Sobeys, which currently has 45 stores in Canada running on CO₂, with another 20 coming online throughout 2013.



Transcritical CO₂ - a national standard for Sobeys, finally reaches U.S.

Sobeys originally began implementing natural refrigerant projects in 2008. After piloting different systems from secondary loop to cascade, to transcritical and distributed, the Canadian retailer opted for CO₂ transcritical as their preferred system in 2009. In 2012 Sobeys made CO₂ transcritical a national standard, meaning that all new stores would from then on be transcritical CO₂. Today, Sobeys has 45 stores running on R744, with another 20 coming online throughout 2013.

In July 2013, Hannaford, part of the Delhaize Group, will be starting up a CO₂ transcritical system in Maine. The relative proximity of the store to Canadian system suppliers will provide operational support to the retailer. Another CO₂ transcritical system is currently being installed at a new Whole Foods supermarket, its opening date delayed due to the effects of Hurricane Sandy.

Three-year payback for CO₂ transcritical systems

According to Rod Peterson from Sobeys, although CO₂ transcritical technology can be a more expensive initial investment, there are multiple benefits, such as greater cooling capacity and a more efficient heat rejection process to heat the store, thereby reducing gas consumption. The increased complexity of a CO₂ transcritical system also allows for better temper-

ature control. In addition, the added cost of a CO₂ transcritical system, which has been calculated to be around 11% more than a conventional system, is recuperated through the savings on materials used during installation, such as copper piping, and during operation, for example lower refrigerant costs, maintenance costs and electricity costs. Overall, Peterson estimated the payback on a CO₂ transcritical system to be 3 years.

Complete scope of work needed to reduce installation costs; longer start-up times need to be taken into account

With regards to the challenges involved in CO₂ transcritical system installations, J'aime Mitchell of Whole Foods said that costs were higher than expected, which could have been due to either the store's geographical location, New York, or because of uncertain estimates of total costs. Overcoming the higher price of installation requires a complete understanding of the scope of work, a fact emphasized by Richard Heath of Source Refrigeration. He said that for the all-natural Albertson's Carpinteria store, it was a matter of bringing all those involved in the project together in one room to ensure that every aspect of the project was covered and communicated properly.

Another challenge related to CO₂ transcritical systems is that there is a lot more copper slag running through the system, due to the fact that there are not as many strainers compared to conventional sys-

“

Very pleased to see transcritical systems being piloted in the U.S. because that is where the bigger market is. Once these pilots get going and other commitments are made, I think between now and next year we are going to see some huge leaps forward.

Rod Peterson,
Sobeys

“

We are still really excited about natural refrigerants, we are still really excited about the possibilities in the near future.

J'aime Mitchell, Whole
Foods

tems. As a result, the onsite installation team has to clean and flush out the valves to ensure that slag does not get caught in the expansion valves, meaning, start-up can take longer. Rod Peterson of Sobeys estimated that this could add a couple of extra weeks to the start up, which needs to be taken into account in the planning.

For Delhaize America, another point has become evident: the U.S. lacks a “spare parts” network, although certain companies are working on creating a supplier network.

Finding qualified service technicians for CO₂ stores is not an issue

Although the lack of know-how on the side of the service technicians is sometimes used as an argument for not investing in the new technology, Harrison Horning from Delhaize said that not enough credit is given to service technicians, who, he argues, are entirely capable of coping with another type of refrigeration system, including CO₂ systems. While training on CO₂ systems is essential, for example technicians need to understand how to handle high pressures, Horning believes that the vast majority will have no trouble with a CO₂ system.

Rod Peterson from Sobeys echoed this point. He explained that despite initial concerns relating to whether or not Sobeys would be able to find qualified service technicians for their CO₂ transcritical systems in Western Canada, these fears were unfounded. Sobeys has worked with three different installation contractors in Western Canada and has had very good results with all three. According to Peterson, contractors are excited and proud to work on their first transcritical system. Since almost all large supermarkets in Canada are going to have, or already have a CO₂ system, he also believes that there will be some very competitive bids for the installation of the first CO₂ transcritical systems in Ontario.

With regards to CO₂ cascade systems, Whole Foods has found that the CO₂ side of the systems already installed have turned out to be the easiest part to deal with for both the operators and technicians. Mike Guldenstern from e2s energy efficiency services notes that in general technicians are happy to work on the CO₂ systems.

Sharing good practice critical to moving market forward

The importance of sharing best practice and gathering real-life operation data was raised as a key aspect to moving the market forward. For example, through the process of information sharing, Delhaize America was able to discover companies with similar objectives in a similar climatic zone and develop partnerships with contractors who helped them advance on the learning curve. As a result, Delhaize has now installed their first CO₂ transcritical system in the U.S..

Rod Peterson believes that, overall, there is a lot more awareness about transcritical systems, with people becoming educated and excited about the technology. This is true also in Canada, where Sobeys has now begun installing CO₂ transcritical systems outside Québec.

Furthermore, the general public is starting to understand what natural refrigerants are and are starting to embrace them. Whole Foods, which conducts a great deal of market outreach before a store opens, has found that there is a market transformation happening all the way down to the residential level, which was not the case a year or two ago.



Last year we were talking about needing UL certification or approval, and I don't think we are talking about that anymore. So that is now behind us, that is progress.

Harrison Horning,
Delhaize America



We need to engage our team members - when they get excited, they talk and they spread the word.

J'aime Mitchell,
Whole Foods



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regulatory issues and standards



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MICHAEL L. MARSHALL
OSHA

Regulatory issues and standards

The recent agreement between the U.S. and China to work together to phase-down HFCs through the Montreal Protocol framework, gave a fresh impetus to the policy session at ATMOsphere America 2013, in which the latest U.S. policy developments relevant to the natural refrigerant industry were discussed.



While the focus of the discussions during the Regulatory Issues and Standards session was on domestic developments, such as latest policy incentives and standardization requirements, the potential developments at the international level on limiting the use of HFCs and the role this could play in strengthening the regulatory framework for natural refrigerants in the U.S. was also discussed.

Montreal Protocol and CCAC – key to addressing increased HFC use

John Thompson from the U.S. Department of State argued that although enormous progress has been made with regards to phasing-out ozone depleting substances (ODS), the growth of HFCs “is a problem we see in the immediate future”. A good opportunity to address this challenge internationally is through the Montreal Protocol and the Climate and Clean Air Coalition (CCAC), the two initiatives that have been at the center of U.S. efforts to reduce the use and production of HFCs. The CCAC and the Montreal Protocol are seen as complimentary to one another in ensuring progress on reducing HFC use and promoting climate friendly technologies.

The latest proposal to amend the Montreal Protocol, submitted by Canada, Mexico and the U.S., follows a similar approach to that used to phase-out ODS. However, the proposal foresees a phase-down mechanism instead of a phase-out system, explained Thompson. It takes into account that certain applications might need a longer period of time to find suitable alternatives to HFCs. Although President Obama and President Xi have agreed to work together, a lot still remains

to be done, as several countries, including India, Argentina, Brazil and Kuwait, are reluctant to discuss an international agreement to phase-down HFCs.

Update from the U.S. EPA: HC venting prohibition exemption, active SNAP submissions

Cindy Newberg of the U.S. Environmental Protection Agency (U.S. EPA) provided a regulatory update on HCFC phase-out regulations and labeling requirements which, as of 2015, will apply to both domestically produced and imported products containing HCFCs. Specifically, the 2012-2014 HCFC allocation was reduced by 30% compared to the earlier rule, and as of January 2015 the allowed production and import of HCFCs will be at least 45% below the 2010 level, whilst any product manufactured with or containing HCFC will have to be labeled.

Newberg also referred to the proposed exemption to the ‘no venting’ prohibition for hydrocarbons in domestic and retail stand-alone units, for which the U.S. EPA is currently evaluating comments received to the public consultation. The U.S. EPA is also continuously evaluating substitute alternatives under the Significant New Alternatives Policy (SNAP) Pro-



We can, without significant economic disruption, move forward.

John Thompson,
U.S. Department of State

gram and now has 15-20 active submissions under review, including fluorinated and non-fluorinated alternatives as well as new molecules.

DOE's Appliance Standards Program to contribute to annual savings of 260 million tons CO₂ by 2020

An overview of appliance and commercial equipment standards was presented by Lucas Adin from the U.S. Department of Energy (DOE). The Appliance Standards Program establishes mandatory standard energy efficiency levels and test procedures for measuring the energy efficiency of over 60 products covered by the program. DOE estimates that the covered products are responsible for 90% of residential building energy consumption, 60% of commercial building energy consumption, and approximately 29% of industrial energy consumption. Adin explained that the program, which closely collaborates with the EPA ENERGY STAR and the Federal Trade Commission (FTC), is highly effective, with annual carbon dioxide savings expected to reach nearly 260 million tons by 2020.

Concerning the requirements currently being developed, Adin stated that approximately 30 products are undergoing the Standard Rulemakings procedure, while Test Procedure Rulemakings are ongoing for another 30 products. Furthermore, in 2013 the DOE began working on ENERGY STAR test methods for approximately 12 products.

UL standards and OSHA regulations that apply to natural refrigerants

In addition to household refrigerators, UL has developed requirements for the use of flammable refrigerants in commercial refrigerators, vending machines, and room air conditioners. UL is also in the process of finalizing the certification criteria for CO₂ transcritical systems, which are expected to facilitate the widespread adoption of this technology in the North

American market.

In his presentation, Michael Marshall of the U.S. Occupational Safety and Health Administration (OSHA), outlined the safety standards that apply to natural refrigerants, including general industry standards as well as specific standards for the use of ammonia, CO₂ and hydrocarbons. For ammonia, RAGAGEP "Recognized And Generally Accepted Good Engineering Practice" and the National Emphasis Program for Chemical facilities (Chem NEP), launched in 2011, are two of the key Process Safety Management (PSM) standards and inspection systems, in application. To enforce PSM OSHA undertakes both programmed and unprogrammed inspections.

For the installation, operation, maintenance, and modification of systems not covered by a specific PSM standard, such as ammonia refrigeration systems under 10K lbs and CO₂ and hydrocarbon systems, OSHA's General Duty Clause applies.



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supply chain panel



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SAM GLADIS
Emerson Climate Technologies



JIM FLOWERS
Linde



ROB ARTHUR
CTA Architects



LOWELL RANDEL
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MARK LOWRY
RSES

Supply chain panel

For the first time at ATMOsphere, a panel discussion brought together perspectives on natural refrigerant use from various market players, including end users, system suppliers, refrigeration consultants, refrigerant suppliers, and trade and training associations. Discussions among the session's participants, and representatives from The Coca-Cola Company, Emerson Climate Technologies, Linde Canada, CTA Architects and Engineers, GCCA (Global Cold Chain Alliance) and RSES (Refrigeration Service Engineer Society) focused on the regulatory burden on natural refrigerant end users, and on the importance of knowledge sharing and collaborative projects to improve safety and training.



The view from... the industrial refrigeration and heating sector

Contrary to general opinion at last year's ATMOsphere America, Sam Gladis of Emerson Climate Technologies, believes the HVAC&R industry has made significant headway when it comes to natural refrigerants. Furthermore, he states that in order to drive the acceptance of naturals there is a need to educate customers.

Gladis sees a growing recognition of the benefits of natural refrigerants in Europe, which are gradually being adopted in the U.S. as well. Emerson's increasing number of ammonia heat pump installations, a relatively new concept in industrial heating, evidences this raised awareness of the benefits of natural solutions. Since Emerson's first ammonia heat pump installation in a UK chocolate factory 3 years ago, which reduced the amount of coal needed to run the factory by half, Emerson has installed another 17 ammonia systems around the globe, 14 of which are located in Europe.

Overall, the primary drivers for the uptake of natural refrigerants in Europe are seen as environmental pressures "to do the right thing", as well as to decrease energy costs, which are significantly higher than in the U.S.. Gladis notes however, that while the low cost of natural gas in North America does not help the ammonia heat pump market, these systems nonetheless have an acceptable payback of two to three years.

Lowell Randel of GCCA, believes that standards have the most significant impact on natural refrigerant uptake. With regards to ammonia as an industrial refrigerant, there is a high regulatory burden on end users in the U.S.. Consequently, the GCCA works closely with regulatory bodies like OSHA and the EPA to improve the regulatory climate for those using ammonia. In particular, GCCA and OSHA work together through OSHA's formal alliance program to develop assistance materials, and exchange information both on what OSHA does, and on the regulatory impact on industry, thereby ensuring appropriate standards are applied to industrial ammonia refrigeration.

According to Randel, while the regulatory burden can be reduced by using technology such as low charge package systems or cascade systems, which means end users are no longer on the programmed inspection list, the 'General Duty Clause' means end users will remain on OSHA's and EPA's radar.

The view from... the light commercial refrigeration sector

As part of The Coca-Cola Company's commitment to phase-out HFCs, the company is investing heavily in CO₂ refrigeration technology for its 12 million units of point of sale equipment. Although Coca-Cola has hydrocarbon (HC) point of sale equipment in Europe and Japan, according to Antoine Azar CO₂ is considered better suited to the company's varied portfolio of point of sale equipment.



There is no one refrigerant that is the best refrigerant for all applications.

Sam Gladis,
Emerson Climate Technologies

To switch to CO₂, Coca Cola faces some challenges, such as sourcing enough compressors and heat exchangers to cover their purchasing needs. Although the company has an agreement with Sanden to supply compressors, so far these are only produced in China.

However, another light-commercial refrigeration end user, Red Bull, already has over 300,000 hydrocarbon coolers, and has already placed orders for R290 Eco Coolers in the U.S.. Red Bull is hoping that R600a will also soon be approved for point of sale equipment in North America.

Responding to a question regarding the potential to retrofit point of sale equipment, Azar said that this was not possible unless a cassette is used, and since there are not many of these in the U.S. Coke has no retrofit plan. Instead it is focusing on new purchases.

The view from... the refrigerant supplier

Linde, the largest global distributor of refrigerants and the largest manufacturer of CO₂, was one of the first suppliers in America. The company has a significant presence in the LNG market and been involved in large-scale hydrocarbon and CO₂ projects in the U.S., including a pilot cascade R290 system that utilizes 65,000lbs (29,484 kg) of R290.

According to Jim Flowers of Linde Canada, although Linde has been selling CO₂ as a refrigerant since the early 1900s, it remains a niche product representing less than 1% of their global sales for CO₂. The logistics of supplying natural refrigerants are complicated because the volumes are so small, which in turn makes it difficult for a refrigerant supplier to be a leader and drive the natural refrigerant market.

On a positive note, Flowers said that over 80% of CO₂ is captured from waste streams, largely from the manufacturing of ethanol in the U.S.; a positive story in terms of sustainability.

The view from.... a training association

RSES directly trains around 1000 engineers, and through the associations, contractors and wholesalers who use RSES material, they train in total between 8000-10,000 people every year. In the field of natural refrigerants, in addition to their recently launched hydrocarbon training program, RSES is currently collaborating with RETA, whose focus is primarily on ammonia refrigeration, on a joint program to help RETA members better understand smaller ammonia applications in supermarkets.

With regards to the hydrocarbon training program introduced in late 2012, RSES has thus far trained 214 technicians, many referred by True Manufacturing and Hussmann. Mark Lowry of RSES, believes that there is a much larger market potential; however, he made the point that outside the refrigeration sector training and certification is still a largely voluntary process, with an “abysmally low” number of technicians getting training and certified. He says there are very few requirements across the country enforcing technical competence in the HVAC sector.

The view from... an engineering and architectural firm

Robert Arthur of CTA, says he sees a greater acceptance of natural refrigerants in North America and that knowledge sharing is key to natural refrigerant projects. Within the Carpinteria project for the all-natural store, CTA acted as a hub pulling information together. By bringing together information from Mayekawa, Hillphoenix, Danfoss, Carel, and other project partners, into one set of construction documents that the contractors could bid off, CTA helped to ensure that everyone knew what their scope of work was.

Initially CTA gained much of their knowledge from outside the U.S., learning from their European counterparts. To introduce natural refrigerants faster to market, CTA



The plan for next year is that 50% of the purchases would be CO₂... and then the following year we should be at 100%.

Antoine Azar,
The Coca Cola Company



***We find from the re-
frigerant side of the
business the regulatory
market in the U.S. is a
real detriment to selling
hydrocarbon refriger-
ants in the U.S., and
natural refrigerants in
general.***

Jim Flowers,
Linde



***We are definitely still in
the early days. Prior to
the SNAP approval there
was nobody looking for
it [hydrocarbon training].
Now there are some
looking for it, but there
is still clearly a much
larger market potential
as the applications be-
come more widespread.***

Mark Lowry,
RSES

sees their role as bringing knowledge to the market and helping to educate those retailers who lack understanding in how natural refrigerant systems can be safely engineered.

Live Polling highlights a need to reduce regulatory burden

During the supply chain panel, conference participants were invited to take part in live polling, providing instant feedback to the question: what is the most important driver to move the natural refrigerant

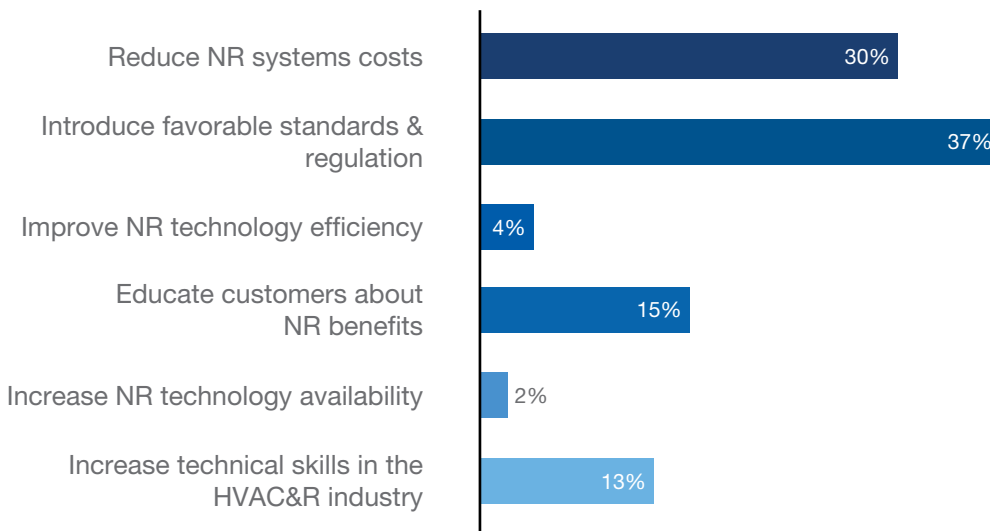
market in North America? Over a third of those who took part believe that introducing favorable standards and regulation is key, followed closely by reducing the cost of natural refrigerant systems.



Bigger retailers have engineering groups and some of them are very knowledgeable, but there are a lot out there that don't have those engineering groups, and as a consultant our role can be to educate them and address some of the misconceptions.

Rob Arthur,
CTA

What is the most important driver to move the Natural Refrigerants (NR) market in North America?





True has remained steadfast in our mission “To provide a wide range of American made commercial refrigeration products, which exceed industry quality standards at competitive prices.”

True consistently strives to improve our products and company. As a privately owned business, True has the unique ability to adjust swiftly and decisively to market trends and employ new strategies for meeting our customers’ needs, while addressing the increasing demands for social responsibility in the manufacturing process.

True, an original Energy Star® Partner for commercial refrigeration is committed to eco-friendly manufacturing and exceeding industry efficiency standards. True was one of the original EPA SNAP submitters for hydrocarbon use in commercial refrigeration and is committed to the use of “Natural Refrigerants,” that exceed customer demands for quality, efficiency and sustainability.

For over 65 years, True has been an industry leader in commercial refrigeration and continues to exceed customer’s expectations because of our high standards in customer service, quality materials, design, availability and performance. True has the unique ability to adjust swiftly and decisively to market trends and employ new strategies for meeting our customers’ needs. . True was one of the original EPA SNAP submitters for hydrocarbon use in commercial refrigeration and is committed to the use of “Natural Refrigerants,” that exceed customer demands for quality, efficiency and sustainability.

industrial end user panel



ERIC SMITH
IIAR
Session chair



MICHAEL CHAPMAN
Tyson Foods Inc.



ERIC JOHNSTON
ConAgra Foods



ROBERT CZARNECKI
Campbell Soup Company



GERARD VON DOHLEN
Port Newark Refrigerated
Warehouse

Industrial end user panel

In a session chaired by Eric M. Smith from the International Institute of Ammonia Refrigeration (IIAR), representatives from some of the leading U.S. brands, including Tyson Foods Inc., Campbell Soup Company, ConAgra Foods and Port Newark Refrigerated Warehouse, shared their experiences with NH_3 . This was the first time such a panel was organized at an ATMOsphere event. In addition to highlighting the benefits of ammonia as an efficient, economical and natural refrigerant, employee safety and training were the focal points of the discussion.



Preparedness is key

Michael Chapman of Tyson Foods Inc., explained that most of Tyson's 100+ facilities employ anhydrous ammonia because it is economical, efficient and natural.

According to Chapman, employee safety is Tyson's number one concern. Costs due to injuries (most of which relate to technicians operating the systems), litigation and workers compensation, as well as penalties from citations for not appropriately managing systems, all affect profitability. Therefore, Chapman emphasized the need to know the systems, to know the emergency responders and to make a plan. There must be a team that is trained to react in the first crucial ten minutes and this team must have someone taking charge – an incident commander. "It's all about crisis management, having someone on the ground who can take responsibility" Chapman said. The quicker the crisis can be addressed and damage minimized, the less business is interrupted and the fewer profits are lost.

Minimizing safety concerns in bakeries

The Campbell Soup Company, which produces famous brands such as Prego, Pepperidge Farm, V8 and Pace, employs ammonia refrigeration in several of its manufacturing facilities including thermal processing, bakeries and vegetable processing facilities. Robert Czarnecki of Campbell Soup Company explained

that while Campbell's thermal and vegetable processing plants predominantly use NH₃, most of its bakeries still use R22 (95%). Despite the lack of experience with NH₃ as a refrigerant at Campbell's bakeries, considerations such as the Montreal Protocol, the need to reduce energy and maintenance costs, and the Consumer Goods Forum pledge to phase in naturals as of 2015, have spurred an R-22 to NH₃/glycol conversion program, which started in 2010. Out of the seven bakeries slated for conversion, so far, 4 bakeries have already been converted, while the remaining 3 facilities will be converted over the next 4 years. There are various advantages to the ammonia system including energy savings, maintenance savings, and the avoidance of potential HFC phase out issues. Moreover, when looking at the Richmond Bakery conversion, the refrigerant charge was reduced from 20,000 lbs to 1,800 lbs (9072 kg to 816 kg).

NH₃ – as safe as any other refrigerant

Eric Johnston of ConAgra Foods Inc., one of the largest food companies in North America, presented the company's experience using ammonia refrigeration. ConAgra Foods produces recognised brands such as Chef Boyardee, Egg Beaters, Healthy Choice, PAM, Slim Jim, Snack Pack, etc.

Of ConAgra's 38 plants with significant refrigeration systems, 27 use anhydrous ammonia as the primary refrigerant. These systems range in size from 1,400

“

[Ammonia] can be managed safely but it requires preparedness, as does using any other refrigerant. Preparedness is a combination of education and maintenance.

Michael Chapman,
Tyson Foods

“

Our history has shown that through the proper handling, operation, and maintaining of our ammonia refrigeration systems, they can be just as safe as any other refrigerant system.

Eric Johnston,
ConAgra Foods Inc.

lbs to 283,000 lbs (635 kg to 128,366 kg) of anhydrous NH₃. For all facilities using NH₃, ConAgra has implemented a comprehensive, performance based, written Process Safety Management (PSM) and Risk Management (RMP) program. No matter the size or operating charge of the system, the company maintains that any facility using ammonia must have a full PSM and RMP program implemented. The Corporate Engineering staff that supports these programs, is responsible for conducting audits/inspections, program training, project reviews, project start-ups, incident investigation/assistance, etc.

Ammonia – the best refrigerant in the industry

Gerard Von Dohlen of Port Newark Refrigerated Warehouse, which has the largest storage of apple juice concentrate in the U.S., argues that ammonia is the best refrigerant in the industry. Unfortunately, in New Jersey, the “freon capital of the world,” the government has all but banned the use of ammonia by requiring a 24 hour-a-day operating engineer to be on hand, which costs approximately \$600,000 per year (€450,550).

According to Von Dohlen, there is no doubt that ammonia is a better choice than R22, which leaks at a rate of about 30% a year. He stated that it is impossible to operate an R22 system economically at \$23/lb (€18/0.5 kg), and that switching to R507 is not a solution. Von Dohlen also believes that AC systems using ammonia chillers in a typical centrifugal chiller are the way forward and can reduce the operating charge from 20,000 lbs to 2,000 lbs (9070 kg to 907 kg).



If you design it right, operate it right and manage it safely, it is a good refrigerant.

Gerard Von Dohlen,
Port Newark Refrigerated
Warehouse

technology case studies



MERLE ROCKE
EcoThermics Corporation
Session chair



MICHAEL ENGLEBRIGHT
CAREL
Session chair



JEFF NEWEL
Hillphoenix



MARC-ANDRÉ LESMERISES
Carnot Refrigeration



DARIN MASSNER
Country Maid



DOUG SCHMIDT
Embraco North America



**VICENTE GUILABERT
HERNANDEZ**
HUAYI Compressor Barcelona, S.L.



SIDNEI OLIVEIRA
Tecumseh Products Company



JAMES HOWER
Danfoss



BENOIT RODIER
Cimco



PRESTON BLAY
Baltimore Aircoil Company



ILANA CEMBER
Baltimore Aircoil Company



DEREK HAMILTON
Star Refrigeration



JOHN HIPCHEN
Exel Consulting Group



BRIAN PORTER
Blissfield Manufacturing
Company



Safer, cheaper and more efficient CO₂ equipment

During the ATMOsphere Conference, a number of system manufacturers presented their latest technologies for CO₂ transcritical refrigeration installations. One of the latest compressors available is a two-stage internally compounded transcritical CO₂ Dorin compressor presented by Brian Porter, from Blissfield Manufacturing. It splits Low Temperature (LT) duty and Medium Temperature (MT) duty into 2 different packs. This allows for a reduction in size of the MT pack.

Also discussed was the development of intuitive and integrated control systems that simplify subsequent maintenance operations and enable service technicians to manage the varying load profiles efficiently. According to Michael Englebright, of CAREL, the company's systems consolidate everything into one system, leading to: reduced capital and installation costs faster maintenance and increased safety.

Jeff Newel of Hillphoenix presented the energy efficiency and advantages of CO₂ secondary and cascade systems. For the former this includes smaller piping, lower pumping power, and an evaporating temperature 2-3°F higher than for an HFC System. For the latter this includes a 30 to 50% lower heat gain than HFC systems, and a saturated suction temperature that is 1-2°F higher than HFC systems, together with smaller piping. Newel also presented the GreenChill gallons of milk financial impact calculator, demonstrat-

ing that a store using a traditional DX system has to sell 43,629 gallons (165,154l) of milk per year to recover the additional refrigerant lost compared to a Hillphoenix second nature CO₂ combined MT secondary and LT refrigeration system.

Maximizing system efficiency through heat recovery

In a project presented by Marc André Lesmerises of Carnot Refrigeration an existing R22 system was retrofitted with a CO₂ system. Thanks to an innovative solution that captures CO₂ gas for water heating purposes without needing a heat exchanger or pumping system, the CO₂ system's efficiency is enhanced. The recovered heat is used to warm the sales area, warehouses, receiving dock, cash register and vestibule. The Carnot Retrofit project demonstrates an average reduction in the supermarket's monthly energy consumption of 10% compared to the original HFC system.

In another example of system efficiency improvements through heat recovery, a commercial/industrial food production installation of a prototype CO₂ transcritical heat pump was described by Merle Rocke of EcoThermics. The CO₂ system is being used to simultaneously provide high temperature hot water and cold water for space air conditioning at a Country Maid commercial bakery. The new heat pump allows Country Maid to achieve cost savings of about \$4,276 (€3,280)/year compared to a conventional system using natural gas and electricity.

Reducing refrigerant charge

Of particular interest in today's industry are low charge, packaged, 'plug and play' ammonia systems, with a refrigerant charge as low as 0.8 lb/TR for water chilling applications and 7 lb/TR for freezer applications. Such low charge ammonia packages can offer lower installation costs, better efficiency and lower operational costs than alternative HFC solutions, as demonstrated by the presentation by Derek Hamilton of Star Refrigeration. The high efficiency ammonia system, with minimal ammonia inventory, uses the latest aluminium heat exchanger technology, developed and built in the U.S., coupled with the proven low-pressure receiver system.

In another technology case study by Danfoss and Cimco, a new state-of-the-art ammonia/CO₂ system, installed at a Canawide Montreal warehouse, also allows for a reduction in refrigerant charge. Proven to be more energy efficient than the alternative Freon design, the system uses medium temperature ammonia as the primary refrigerant to cool a single loop of re-circulated CO₂. The unique solution has contributed to energy, installation cost and maintenance savings, and is scalable for mainstream deployment.

Exponential HC growth expected in 2-3 years

A number of the case studies presented at ATMOsphere also researched the use of R290 in different applications such as bottle coolers, plug-in units, light commercial freezers, and air conditioners, underscoring the efficiency of R290.

For example, the presentation by Sidnei Oliveira, from Tecumseh Products Company, attests to the comparatively higher efficiency of hydrocarbon (HC) beer coolers in comparison to HFC units. Results show 20% higher efficiency for the HC unit and a better pull down time. Douglas Schmidt of Embraco North America presented a case study focused on ways of dealing with current HC charge limits.

According to Schmidt a two-circuit plug-in unit can be used as a solution to comply with the 150g maximum allowable propane charge limit. Vicente Guilabert Hernandez, from Huayi Compressor Barcelona S.L. outlined the complete system energy savings that can be achieved when using R290 as an alternative to R404a, in combination with the use of high efficiency mechanical kits and electrical motors, in a light commercial freezer.

Another case study presented by John Hipchen from Exel Consulting Group, of an R290 air conditioner developed with smaller diameter, 5mm, inner-grooved copper tubes, demonstrated that the refrigerant charge can be greatly decreased compared to air conditioners with 7 mm or 9.52 mm diameter tubes. What is more, the cooling capacity is enhanced by the increased heat transfer coefficient, coupled with optimization of the heat exchanger design.

During a Q&A session conference participants highlighted public perception and insurance factors as barriers that need to be overcome before an exponential growth in hydrocarbons can be expected, which they predict will be in 2-3 years. Industry representatives anticipated that hydrocarbons will then begin to rapidly make inroads in the US, with manufacturing initially in Mexico, which will in turn motivate US manufacturers to follow suit.

Technologies to improve condenser efficiency

A presentation by Baltimore Aircoil's Preston Blay and Ilana Cember investigated the use of water as a medium to more effectively reject heat. It showed that ammonia, water cooled evaporative and hybrid condensers were more efficient than air cooled R407a systems, by up to 44%.

According to BAC, based on their 15 year life-cycle energy consumption analysis, ammonia can achieve significant savings.

“

The benefits of the ammonia system are drawing interest from end users who have traditionally opted for packaged HCFC or HCF equipment.

Derek Hamilton,
Star Refrigeration

“

R290 is the right choice for light commercial refrigeration.

Vicente Guilabert,
Huayi Compressor Barcelona,
S.L.

networking reception guest speakers

Award-winning entrepreneur Amy Larkin, author of “Environmental Debt: The Hidden Costs of a Changing Global Economy” was the keynote speaker at a pre-event reception held on June 17. Ahead of her book’s official launch, Amy Larkin made a guest appearance to share pertinent insights from her book, in which she argues that companies need to start accounting for the ecosystem services they depend on. Only by monetizing environmental impacts in an Environmental Profit and Loss Sheet (P&L) can we avoid being saddled with a huge environmental debt, she argues.

To ensure the true cost of products is not unsustainably subsidized Larkin recommends the following framework for business policy:

- Pollution can no longer be free nor subsidized;
- The long view must guide all business decision making and accounting practices;
- Government must catalyse and vitalize new technology, reward businesses that are moving in the right direction, while penalizing dirty technologies and practices.

One of the architects of a resolution signed by leading retailers to phase-out HFCs from all new equipment starting in 2015, Amy Larkin hopes that her book will inform the debate on energy, business and financial policies, and highlight the need to calculate the real costs of public and private expenditures.



AMY LARKIN



Trey Cown, from Hillphoenix, provided an update on the company's upcoming projects and how they see the natural refrigerant market evolving. Since the last ATMOsphere America conference, Hillphoenix has witnessed many changes in the market for natural refrigerants, such as continuous advancement of the technology, increased adoption, and new customers across various markets.

While last year discussions focused on UL approval for CO₂ transcritical applications and whether the technology was suitable for the US, today discussions have shifted to looking at how to further improve and enhance the technology. For Hillphoenix the biggest change over the last 12 months was getting UL approval for their booster system.

The second major change for the company is that the Advansor technology has been fully transferred to the U.S.. At the same time, Advansor has been working jointly with their US counterparts to develop other technologies such as a single unit booster system, which has been installed in a pharmaceutical company in Indianapolis. Advansor has also developed a product for smaller sized stores.

For Hillphoenix, the industrial market has proven to be very promising for both ammonia/CO₂ systems and CO₂-only systems. Another positive trend is that most of the early adopters are now comfortable with CO₂ technology and have developed store designs that incorporate CO₂.

Cown also sees a concerted effort by several component manufacturers to focus on CO₂ and further enhance the technology in North America.

According to Cown, the driving factors behind investment in natural refrigerants include sustainability initiatives, the increased energy efficiency of the systems, and customers looking for a final solution that will avoid future retrofits.

Over the coming months the focus for Hillphoenix will be on how to reduce the costs of their CO₂ technology, to further drive product acceptance in the North American market, increase training, and increase the efficiency of the booster system.



TREY COWN
Hillphoenix



presentations

Nina Masson, shecco

Natural Refrigerant market trends in North America and beyond

<http://www.atmo.org/media.presentation.php?id=259>

Marc-André Lesmerises, Carnot Refrigeration

R744 refrigerant, ready for today's market

<http://www.atmo.org/media.presentation.php?id=251>

Scott Martin, Hillphoenix

Advances in CO₂ Supermarket Refrigeration in North America

<http://www.atmo.org/media.presentation.php?id=250>

Mark Tomooka, Mayekawa USA

A Manufacturer's Approach to Building and Promoting Natural Refrigerant Systems

<http://www.atmo.org/media.presentation.php?id=252>

Masood Ali, Heatcraft Worldwide Refrigeration

State of the industry

<http://www.atmo.org/media.presentation.php?id=253>

Marc-André Lesmerises, Carnot Refrigeration

Retrofitting an existing R22 refrigeration system with CO₂ in a large supermarket

<http://www.atmo.org/media.presentation.php?id=246>

Merle Rocke, EcoThermics Corporation

Carbon dioxide heat pump field study

<http://www.atmo.org/media.presentation.php?id=247>

Vicente Guilabert, Huayi Compressor Barcelona, S.L.

Low energy consumption when using R290 as alternative to R404a in light commercial refrigeration in America

<http://www.atmo.org/media.presentation.php?id=249>

Sidnei Oliveira, Tecumseh Products Company

Innovative hydrocarbon solutions - bottle cooler application

<http://www.atmo.org/media.presentation.php?id=272>

Douglas Schmidt, Embraco North America

Conquering the barriers of HC technology

<http://www.atmo.org/media.presentation.php?id=248>

Jeff Newel, Hillphoenix

CO₂ Supermarket System - Case Study of a Green Chill Platinum Award-Winning Store

<http://www.atmo.org/media.presentation.php?id=244>

Cindy Newberg, U.S. Environmental Protection Agency (EPA)

Regulatory Updates: alternatives and reducing emissions

<http://www.atmo.org/media.presentation.php?id=255>

John Thompson, U.S. Department of State

Montreal Protocol and CCAC update

<http://www.atmo.org/media.presentation.php?id=254>

Brian Rodgers, Underwriters Laboratories
UL standards - update on natural refrigerants
<http://www.atmo.org/media.presentation.php?id=258>

Michael L. Marshall, U.S. Dept. of Labor – OSHA
OSHA regulations for natural refrigerants
<http://www.atmo.org/media.presentation.php?id=257>

Eric M. Smith, International Institute of Ammonia Refrigeration (IAR)
Industrial Refrigeration and the IAR
<http://www.atmo.org/media.presentation.php?id=260>

Michael A. Chapman, Tyson Foods Inc.
Preparedness is Knowing what to do BEFORE the clock starts ticking
<http://www.atmo.org/media.presentation.php?id=261>

Gerard Von Dohlen, Port Newark Refrigerated Warehouse
No Refrigerant is good - Less is more
<http://www.atmo.org/media.presentation.php?id=264>

Robert Czarnecki, Campbell Soup Company
Campbells and Industrial Refrigeration
<http://www.atmo.org/media.presentation.php?id=263>

Eric Johnston, ConAgra Foods, Inc.
ConAgra Foods
<http://www.atmo.org/media.presentation.php?id=262>

Michael Englebright, Carel
Sustainable CO₂ technology and the role of control systems
<http://www.atmo.org/media.presentation.php?id=268>

Preston P. Blay, Baltimore Aircoil Company
The refrigeration condenser: how the different types affect energy consumption and system performance
<http://www.atmo.org/media.presentation.php?id=267>

Jim Hower, Danfoss
Ammonia/CO₂ system offers mainstream solution
<http://www.atmo.org/media.presentation.php?id=266>

Brian Porter, Blissfield Manufacturing Company
CO₂ double stage trans-critical compressors: making CO₂ equipment reliable, affordable and more efficient
<http://www.atmo.org/media.presentation.php?id=269>

John Hipchen, Exel Consulting Group
Developing low charge R290 room air conditioners using smaller diameter copper tubes
<http://www.atmo.org/media.presentation.php?id=270>

Derek Hamilton, Star Refrigeration
Low charge ammonia condensing units for the U.S. market
<http://www.atmo.org/media.presentation.php?id=265>

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