



natural
refrigerants
solutions
for europe

ATMOsphere Europe 2012

**Summary Report of
International Workshop**

Brussels, Belgium
5-7 November 2012

 **ATMO
sphere**
Solutions for Europe
natural refrigerants

ATMOsphere Europe 2012

**Summary Report of
International Workshop**

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**MARC CHASSEROT**

Chairman ATMOsphere Europe 2012
Managing Director shecco

we have natural refrigerant solutions for europe today...

... and the number of options and companies is constantly growing.

This year ATMOsphere Europe brought together nearly 200 experts from 100 organisations to discuss natural refrigerant solutions for Europe. We had solutions and experiences from top food retailers and consumer brands as well as leading industry suppliers all seeing the 'green growth' opportunity for Europe. We had the 'world exclusive' from the European Commission presenting its latest F-Gas Regulation that will make life harder for HFCs and thereby create new opportunities for natural refrigerant alternatives.

But the key to ATMOsphere Europe was the simple fact that we brought together many of the leading experts that will create the HVAC&R industry of the future. The knowledge sharing, networking and ideas presented are a proof of industry constantly innovating to meet new challenges. Natural refrigerants are a fantastic example of this innovative role of forward thinking industry.

Looking forward to working with leaders to meet our common goal of sustaining our atmosphere.

Marc Chasserot,

About ATMOsphere Europe 2012

The International Workshop on Natural Refrigerants was held on 5-7 November 2012 in Brussels. This year's theme was « Solutions for Europe » to discuss the competitiveness of available natural refrigerant technology, and explore how to best address pending barriers for their faster market uptake. 200 decision makers from 100 organisations represented all major stakeholder groups from the component and systems supply chain, to engineering and consultancy firms, commercial and industrial end-users, research and academia, as well as policy makers. A total of 50 speakers in 9 sessions were part of the ATMOsphere programme.

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market trends



ANDY PEARSON

President of the Institute of Refrigeration (IoR UK)



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TORBEN M. HANSEN

Advansor



JAN BOONE

Mayekawa Europe



MATTI KUIVALAINEN

Carrier

Europe: Leadership through Innovation and Ambition

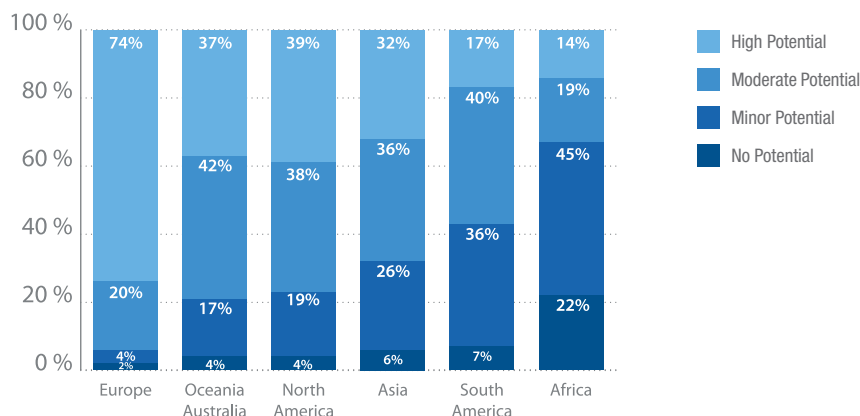
In Europe, natural refrigerants as alternatives to fluorinated gases are constantly gaining ground. Amid a tough global business climate, market prospects for natural refrigerants are overall favourable, a growing number of HVAC&R industry professionals estimates. However, while Europe has already built a solid supplier base for some industry sectors and market dynamics are creating new realities for HFC-free technology without any political intervention, the industry's activity levels have to be readjusted to allow for a more ambitious global leadership in natural refrigerants. Only then Europe will maintain its competitiveness in the field of innovative refrigeration, cooling and heating technology in line with environmental stewardship. ATMOsphere 2012 highlighted which trends will move Europe's HVAC&R markets in the years to come.

“In many if not most sectors there are several suitable low-global warming potential alternatives already available today. Alternatives that are technically feasible, alternatives that are safe, alternatives that are equally or more energy-efficient, and alternatives that are affordable.”

Connie Hedegaard,
European Commissioner
for Climate Action

The presence of natural refrigerant-based technologies is continuously increasing in most of Europe’s refrigeration, heating and cooling sectors. More manufacturers and commercial end-users are turning to HFC-free systems using ammonia, carbon dioxide, hydrocarbons, water or even air. In a 2011 global HVAC&R industry study a striking 74% of European and non-European respondents confirm that the continent has a high immediate market adoption potential for natural working fluids, well ahead of North America, Australia or Asia.

Market adoption of natural refrigerants in Europe



In line with this positive outlook, the ATMOsphere Europe 2012 international workshop brought together “first-movers” to adopt natural working fluids across the whole range of applications as varied as residential, (light-)commercial and industrial refrigeration, chillers, heat pumps and air-conditioners. While some applications like industrial refrigeration have already reached market penetration rates of 90%, other industry sectors are currently working on optimising solutions to capture higher market shares. A majority of participants agreed that strong policy signals in form of phase-out schedules, tax and credit systems, or financial support schemes would significantly accelerate the uptake of such systems.

“The questions for the HVAC&R industry are getting harder and the time to answer them is getting shorter. It is as if the stepping stones are being further apart and the size of them is reducing all the time. Each step that we take becomes more difficult.”

Andy Pearson,
President of the Institute
of Refrigeration UK

The business case for natural refrigerants

Andy Pearson, President of the UK Institute of Refrigeration reminded participants in his keynote speech that some of the largest success stories in the natural refrigerants industry – like the 90% market share of new hydrocarbon domestic refrigerators introduced to the European market or the steadily growing number of CO₂ refrigeration supermarket system - where mostly driven by the fact that their use made good business sense, while also delivering on the environmental benefits at the same time.

This was especially reiterated by several commercial refrigeration system suppliers, highlighting that even in countries without any legislation in place the uptake of CO₂ refrigerant commercial refrigeration would be growing. With more than 1,300 supermarkets confirmed for CO₂-only transcritical systems in 2011¹, and an expected market increase of 20% over the last year², the technology is making inroads into the European market as one of the on-going success stories driven by a combination of corporate sustainability considerations, long-term investment security, and legislative pressure.

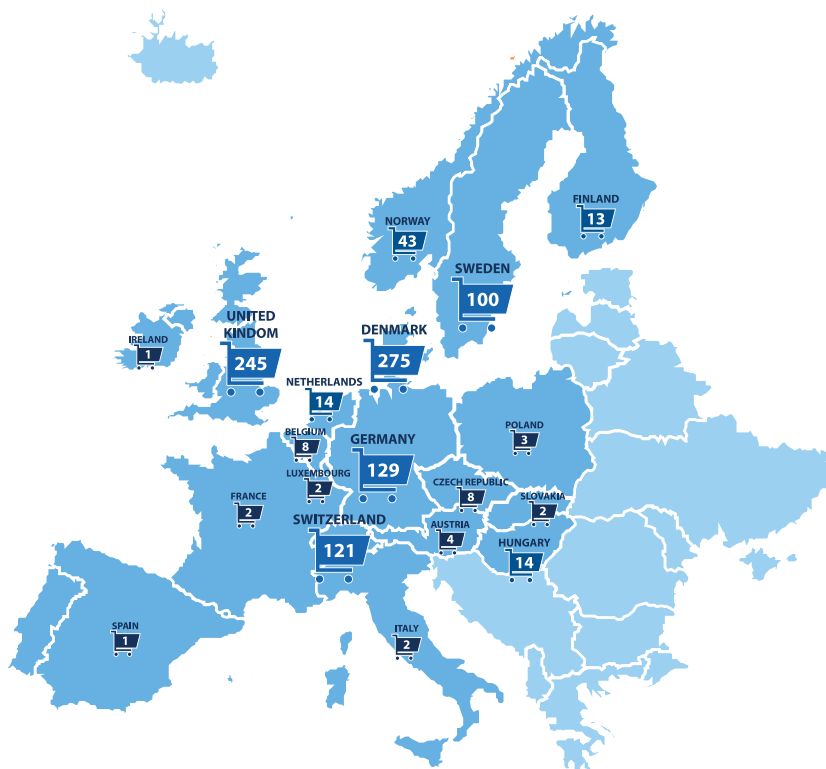
¹ GUIDE to Natural Refrigerants – Market Growth for Europe. shecco, 2011.
² shecco, 2012

By 2020, the market share of natural refrigerant-based systems in the industry could grow to more than 20%, a clear majority of Europe's HVAC&R industry believes. Setting a leadership example with a market penetration of natural refrigerants of close to 100% in supermarket refrigeration, Denmark could show the way to other European regions taking on the challenge to invest in innovative technology solutions and the urgently needed effective training to ensure their safe and efficient operation.

"So yes, we have CO₂ commercial refrigeration solutions for all of Europe. As a supplier we want to send a very clear message: We are ready. We can do this today, so why do we wait until tomorrow?"

Torben Hansen,
Advansor

CO₂ transcritical supermarkets in the European Union 2011



Already today at least 34 food retail chains use natural refrigerants to varying degrees, mostly CO₂ and hydrocarbons, in their refrigeration systems. Although most of these systems are still running in Northern, Western and Central Europe, the active development of new components and optimised systems is pushing the "CO₂ energy efficiency equator" further down to also cover southern Europe, where energy efficiency gains from only using CO₂ refrigerant had been less pronounced. As the cheapest ton of footprint reduction, the replacement of traditional systems with natural refrigerants already today has a strong business case in most of Europe's climate conditions.

"Natural refrigerants are sustainable and commercially viable solutions (...). They are good for our environment and good for our business."

Antoine Azar,
The Coca-Cola Company

Global Stewardship

By the end of 2012, The Coca-Cola Company will have deployed 800,000 of HFC-free cold drink equipment using carbon dioxide and hydrocarbons, whereas Red Bull as of today uses 313,000 units of hydrocarbon beverage coolers. After years of driving the development and commercialisation of now more than 1 million units of hydrocarbon-based light-commercial equipment in every country of operation, Unilever has sent a strong signal that the investment in natural refrigerants is paying off. Energy savings of 10% as compared to conventional HFC ice cream freezers speak for themselves.

Helping fast-track the market uptake by demonstrating clear leadership from large fast-moving consumer goods brands is one of the most effective ways to ensure other, including smaller, corporations can benefit from the established supply chain for natural refrigerant equipment. However, market increase will only be possible if technical expertise is more commonly shared, the extension of national and global training schemes for engineering staff is accelerated, informal networks to exchange knowledge are created, and if suppliers are given a long-term commitment to develop and optimise HFC-free technology.

Keeping Europe's head start

Looking beyond Europe's borders, one can notice that while the head start of deploying natural refrigerant commercial refrigeration systems is pronounced - around an estimated 3000+ supermarket systems using no fluorinated gases, as compared to around 100 in Japan, 60 in the USA, or less than 10 in China – other areas deserve more attention to ensure global competitiveness. At times when the potential production capacity of CO₂ heat pumps is up to 100,000 in China, and Japan has reached a 98% market share of CO₂ heat pumps in the residential hot water heaters segment, Europe has not yet caught up on driving the commercialisation of such models. Today, at least 16 manufacturers produce CO₂-based heat pump systems for a variety of industry sectors and applications in Europe but the market share is at a low estimated 3% in the residential heating sector.

policy and regulations



CONNIE HEDEGAARD

European Commissioner for Climate Action



BENTE TRANHOLM-SCHWARZ

European Commission (DG Clima)



KATJA BECKEN

German Federal Environment Agency



MIKKEL SØRENSEN

Danish Environmental Protection Agency



UGO MIRETTI

European Commission, (DG Enterprise)



BLAISE HORISBERGER

Swiss Federal Office for the Environment



SONJA VAN RENSEN

Journalist



BAS EICKHOUT

Member of the European Parliament



CLARE PERRY

Environmental Investigation Agency



STEPHANE ARDITI

European Environmental Bureau



THOMAS NOWAK

European Heat Pump Association



ANDREA VOIGT

European Partnership for Energy and the Environment



DANIEL COLBOURNE

Refrigerants, Naturally!



BARBARA GSCHREY

Öko-Recherche

"Acting now will put EU industry in a first-mover position and many of you are living proof of this. In this area that will be more and more in the international focus, it gives you an advantage if you are actually among the first-movers."

Connie Hedegaard
European Commissioner for Climate Action

Creating the framework to innovate

The ATMOsphere Europe conference coincided with the launch of the long-awaited proposal to strengthen the existing EU F-Gas Regulation. Participants had the "world exclusive" privilege of the European Commission (EC) presenting the proposal to industry for the first time after publication. The backbone of the proposal is a 79% HFC phase-down target by 2030 in CO₂ eq, supplemented by bans on HFCs with GWP ≥ 150 in new equipment for a few selected sectors.



F-Gas Debate

The presentation of the F-Gas Regulation proposal rounded off statements at the event by the European Commissioner for Climate Action Connie Hedegaard, who noted that early action could benefit the European industry to be in a “first-mover position”. She also noted that “acting now will add momentum to the international scene”.

National initiatives encouraging the transition towards HFC-free technologies

The conference also saw an exclusive preview of Switzerland’s amended national F-Gas policy that was officially announced one day after the closing of the conference. The new strengthened F-Gas policy introduces HFC bans in a series of air-conditioning and refrigeration applications, with a particular focus on larger capacities.

With its new national F-Gas policy, Switzerland sent a strong message of support for HFC bans in those sectors where the industry can optimally cover the cooling heating needs with technologies using natural refrigerants. The country follows the footsteps of other European countries that have introduced HFC bans.

“Some Member States, I know, have already demonstrated that pioneering legislation in this field not only benefits the climate, but clearly also the first movers”, noted European Commissioner for Climate Action Connie Hedegaard.

“To policy makers the lesson [learnt from Denmark] would probably be that you should keep cool. You would be told that alternatives do not exist and that it would be too costly. But I think you should be confident that the alternatives are there or if they aren’t yet, they will most probably be developed [...] You would be surprised how far the industry can go if they get the right signal [...]”

Mikkel Aaman Sørensen,
Danish Environmental Protection Agency

Denmark is a well-known example in that respect, having in place a combination of an HFC tax, a general ban on HFCs in AC&R with exemptions, as well as an initiative supporting the development of alternatives. According to the Danish Environmental Protection Agency, “from our perspective, it can be done to move to natural refrigerants [...] We were told in 2002 that Denmark would become the land of warm beer and melted butter. Luckily we avoided that and we can still have cold beer. [...] “The areas where the alternatives are not yet ready, that’s where we should focus our effort. We should give the signal that we want something to happen there. You would be surprised how far the industry can go if they get the right signal and if they get some clear guidance on what is the time-frame they have to develop alternatives and what would be the goals. [...] [In Denmark,] there was very good cooperation between the industry, between science, between government. In most cases the alternative technologies were in fact superior [...]”.

Besides the European Commission, Switzerland and Denmark, also Germany gave an update on national policies that encourage the transition towards HFC-free HVAC&R technologies. Specifically, Germany announced a new project that runs from October 2012 until June 2014 that will be drawing a “strategy to enhance the use of hydrocarbons as refrigerants”. The project is part of the Germany’s Climate Initiative and will to a large extent focus on standards. Moreover, the German Federal Environment Agency will be analysing the European Commission proposal to strengthen the EU F-Gas Regulation published on 7 November 2012 and evaluate the necessity of additional national measures.

Standards a precondition to wide natural refrigerant uptake

Standards were a recurring theme during the conference’s interactive debates and Q&A sessions. Several conference participants raised the issue of voluntary safety standards being dictated by the interests of companies represented in the standards making process, which requires significant effort and resources. Although voluntary in nature, these standards very often end up in regulatory texts that require conformity with them, while also insurance companies often require that these be respected as part of their insurance coverage conditions.

A policy maker called on the natural refrigerant industry to become more active in the process of standard making, as government representatives do not have the technical knowledge necessary. Several industry players in turn urged the European Commission and government representatives in general to enhance their role in the standards making process and intervene when necessary to widen the scope of standards and allow the use of natural refrigerants. The industry alerted that otherwise there is a risk that regulators’ intention of a proposed regulation to realise climate benefits and accelerate the transition to climate friendly alternatives could be undermined.

Key stakeholders hold “F-Gas Debate” on different policy instruments

Whether or not HFC bans are desirable policy measures was the main focus of the “F-Gas Debate” session of the conference. Key stakeholders, including Member of the European Parliament Mr Bas Eickhout together with representatives from Brussels-based industry associations, NGOs, a group of end-users that have committed to phasing out HFCs, and a research institute formed the debate panel, moderated by journalist Sonja van Renssen.

“Policy makers should be supporting the leaders and the ones who are lagging behind should not be supported. And at certain stage, yes, politicians should tell them ‘sorry you have been lagging behind too long now and it is about time that you are now a bit more pushed to make a change.’”

Bas Eickhout,
Member of the European Parliament

Member of the European Parliament Mr Bas Eickhout kicked off the debate by noting: “We all know that if you look at it product by product and sector by sector, for some of these bans are easily possible. The alternatives are there. The industry who has invested in those alternatives, the climate friendly alternatives, they need to be rewarded. And I think that is the core of what politicians should do when they are discussing the green economy instead of only discussing about vague green rhetorics”.

Overall, the majority of the debate panelists, with the exception of those representing Brussels-based industry associations, were generally in support of the inclusion of HFCs bans in those sectors for which safe, efficient and affordable alternatives are available on the market today or will be in the near future.

NGOs noted that the list of bans proposed by the European Commission should therefore be extended, providing clear signals to industry to start investing now. They remarked that bans are not

a new concept in the area of HVAC&R, nor in the F-Gas Regulation as such and they have always proved to be an efficient tool, while they also reminded that containment & recovery measures have proven more expensive than anticipated.

Bans on HFCs seem to be the best way forward in F-Gas policy making according also to the representative of a group of end-users that have taken the voluntary commitment to phasing out HFCs. The representative felt that although voluntary initiatives by manufacturers and end-users do move the market, there is a need for regulation to further push it in the right direction and create a level playing field.

Association representatives argued that maintaining flexibility and the choice of refrigerant is crucial, and that bans would be too prescriptive, especially in view of the fact that the industry is already innovating and using HFC-free natural refrigerants. In reaction, the Member of the European Parliament agreed that innovation happens even without regulation but reminded that the key question is the pace of innovation and the role of policy in accelerating this.

But the end-user representative, as well as an NGO, a government representative and an industry representative argued that bans are not as inflexible as often presented: they actually apply to new equipment only and do not kick in before a given year in the future, that is set in such a way to give sufficient development time for the industry to achieve high quality, efficiency and safe products. They reminded the audience that a ban sends a signal and sets a clear date for a specific sector, without prescribing which refrigerant and therefore bans are not “draconian”.

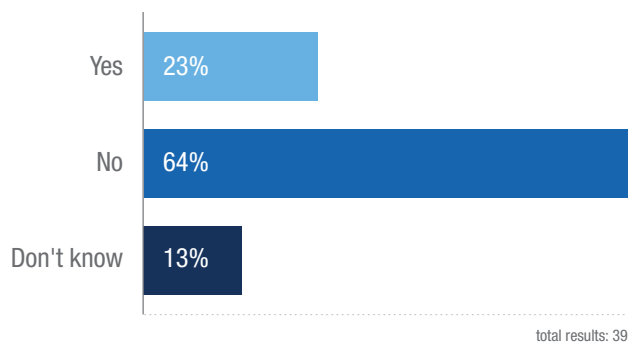
Talking about synergies between different instruments and regulations to achieve f-gas emissions reduction, namely F-Gas and Ecodesign regulations, an NGO noted that there are opportunities to combine these and consider them in such a way that they reinforce each other. He reminded that HFC bans or at least low-GWP refrigerant incentives can also be included in Ecodesign regulations that concern specific product groups that are typically more narrowly defined than sectors.

With the current European Commission F-Gas proposal being more on the “stick” rather than the “carrot” side, several of the panelists expressed the wish for the inclusion of financial support for research & development in natural refrigerants, with the Parliamentarian welcoming innovative “carrot” ideas.

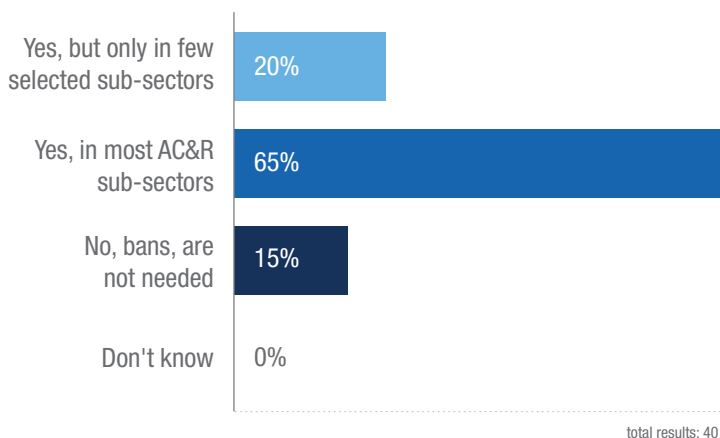
Live Polling shows: Bans are wanted

Conference participants contributed to the debate not just by taking the floor, but also through giving instant audience feedback to live polls showing up on the screens of the conference room. About two thirds of those participating in the polls, thought that the EU f-gas emission reduction target could only be met if bans in new HFC equipment are introduced in several AC&R sub-sectors, and also that a 79% bulk HFC phase-down in CO₂ eq does not give enough clarity and certainty for investment in climate friendly technologies.

Does the overall phase-down target of about 79% CO₂ eq by 2030 provide enough clarity and certainty for investment in climate friendly technology?



The EU aims to reduce f-gas emissions to a level of 35 Mt CO₂ eq in 2030. Do we need HFC bans in new AC&R equipment to attain this goal?



end users: consumer brands



RT. HON JOHN GUMMER

Lord Deben



ANTOINE AZAR

The Coca-Cola Company



RENE VAN GERWEN

Unilever



JUERGEN BRENNEIS

Red Bull



EZRA CLARK

UNEP

Global Consumer Brands to accelerate transition to natural refrigerants

Commercial refrigeration is a large contributor to a corporation's climate footprint, representing 40% of total annual refrigerant emissions, and the figure is expected to represent 47% by 2015³. Enterprises in the sector all have the responsibility to reduce greenhouse gas emissions produced by their coolers, vending machines and other refrigeration equipment with more sustainable solutions. In the end-user session organised by "Refrigerant, Naturally!" this year, a positive message is delivered by cold drink giants Coca-Cola, Unilever and Red Bull: They will increase the use of natural refrigerants to meet their cooling needs in all countries that they operate in.

³ SROC Report : IPCC Special report for UNFCCC and Montreal Protocol



Refrigerants, Naturally! session

"We are confident about our decision of adopting CO₂ in our cold drink equipment (...) We have no doubt about the performance of HFC-free technology."

Antoine Azar,
The Coca-Cola Company

Today, many companies have realised that CO₂ refrigerant technology can help them deliver better value to their business. As a consequence, they are accelerating their steps towards the adoption of CO₂ refrigerant in their equipment. The Coca-Cola Company is phasing out the use of HFCs in all new cold drink equipment by 2015 to mostly replace them with the use of R744. By the end of 2012, The Coca-Cola Company will have placed 800,000 units of HFC-free cooling systems globally, including hydrocarbon and CO₂-based systems.

Potential safety hazards are no longer the main market barrier for hydrocarbon technology in commercial refrigeration today. As key cabinet suppliers have invested significantly in safe production lines for HC equipment, calculated risks for HC cabinet operation are meeting globally acceptable risk levels. Leading cool drink and ice cream manufacturers like Unilever and Red Bull are accelerating the transition to HC.

Unilever regards hydrocarbon as the best-suited option for ice cream cabinets based on their ten years' usage. HC cabinets are at least 10% more energy efficient than HFC equivalents. By 2012, over 1 million HC ice cream cabinets are operating in every single country that Unilever operates in.

Red Bull has started the switch to hydrocarbon coolers for the cooling of beverages. The beverage company aims to realise 100% HC equipment procurement in 2013 except for Japan and the US. Until now, Red Bull has already adopted 313,000 units of HC "ECO Coolers" globally, to combine the use of hydrocarbons (R290 and R600a). The systems represent 35% of Red Bull's entire fleet of cooling equipment. ECO Coolers consume up to 45% less energy than previous generations of cooling equipment. Based on favorable CO₂ emissions data, Red Bull's ordering guidelines guarantee that wherever feasible, from a legal and technical point of view, only ECO Coolers will be installed in the future.

end users: food retail



ROBERT ARTHUR

bolyn ltd. formerly
Marks & Spencer



JOHN SKELTON

Sainsbury's Supermarkets Limited



KNUT LUTNÆS

COOP Norway



EMMA COLES

Royal Ahold Group



PHILIPPE H. HEYMANS

Delhaize Europe



GEORG WEINHOFFER

COOP Switzerland



JEAN-MICHEL FLEURY

Carrefour

Refrigeration: high priority on retailers' environmental agendas

The second End User Session chaired by Robert Arthur, former Head of refrigeration at Marks & Spencer, focused on food retail with speakers from a number of leading European retailers including Delhaize Europe, Royal Ahold Group, COOP Switzerland, COOP Norway and Sainsbury's, who presented their views, state of play and future plans as well as challenges related to natural refrigerant systems in their stores. Carrefour, retailer operating over 15.000 stores worldwide, also took the floor during the conference, to highlight some of the latest developments and obstacles in converting to natural fluids in commercial refrigeration.



food retail

Refrigeration has on average a 30-40% share on the overall carbon footprint of retail stores. Reducing its impact has therefore been given a high priority within food retailers' corporate social responsibility agendas. "What matters for us as a retailer, is the whole footprint. We look at the indirect, direct emissions, we also even look at the emissions connected to the production of the refrigerant substances – what we call the life-cycle production of our system," underlined Emma Coles of Royal Ahold.

In addition to efforts to minimise the leakage of HFC-based systems, retailers have taken steps to move to refrigerants with low global warming potential (GWP). To this end, many have voiced their confidence in CO₂ as a preferred option not only because of its environmental properties, but also due to the improved energy efficiency performance that further reduces the energy bill for end-users. The adoption of hydrocarbons in retail stores has not been so widespread mainly because of misconceptions regarding its safety, legislative limitations in many European countries, and the complexity of national standards and regulations. Another natural refrigerant, ammonia, is commonly used in warehouses across Europe.

"At Sainsbury's we are committed to naturals, we continue along that journey, for us it's business as usual."

John Skelton,
Sainsbury's

CO₂ transcritical becomes business as usual

Several retailers, including COOP Switzerland, COOP Norway, Sainsbury's and partially Royal Ahold have already established CO₂-based refrigeration as a standard in a number of European countries. In Scandinavia and Switzerland, this trend has been largely motivated by legislation that regulates the use of HFCs, while the UK-based Sainsbury's is looking to be future-proofed against such measures.

"We managed to do enough testing to establish CO₂ as our standard refrigerant in new and refurbished stores, which has led to today's situation of 40+ stores with transcritical CO₂ systems," pointed out Knut Lutnaes of COOP Norway. Within the recently initiated energy programme 2012-2017, the retailer will seek to improve the integration of CO₂ transcritical systems with ventilation and heating as well as to optimise the energy use in stores with less heat recovery.

With the aim of becoming CO₂-neutral by 2023, COOP Switzerland has similarly taken the decision in 2010 to install only CO₂ systems in all new stores and refurbishments in the country. Looking

ahead, the retailer will also look to further increase the efficiency of stores with parallel compression and additional adsorption system. With over 800 supermarkets in Switzerland, the country's biggest retailer operates more than 160 CO₂ transcritical stores and plans to become HFC-free across the business by 2025.

Sainsbury's had adopted a target of reducing the absolute emissions from operation by 30%, which is a 60% saving compared to 2005 benchmark.

"CO₂ transcritical will still be our standard and what we are experiencing now is that investment costs in CO₂ systems are lower than in conventional equipment."

Knut Lutnæs,
COOP Norway

Switching to CO₂ makes economic sense from lifetime perspective

Cost-effectiveness of natural refrigeration systems plays an important role when taking the decision to make the switch from high GWP refrigerants. According to COOP Switzerland and COOP Norway, the investment costs of refrigeration plants using CO₂ are lower than the cost of plants with HFCs in their respective countries of origin either because of legislation that promotes climate-friendly refrigeration technologies or as a result of economies of scale that decreases the cost of piping and equipment for a CO₂ plant.

While the stores of Royal Ahold in Scandinavia already use CO₂ as a standard, the retailer is currently running pilot projects in 3 supermarkets in the Netherlands to evaluate the performance. If the project proves to be successful in terms of energy efficiency and lifecycle costs, Royal Ahold will roll out CO₂ refrigeration in new stores across the country.

"We see this as a journey. We have a goal to go to natural refrigerants, that's where we want to go."

Emma Coles,
Royal Ahold Group

Training and collaboration with suppliers

One of the messages that resonated the most with the speakers from the retail industry was the lack of awareness and training in natural refrigeration technology in Europe, which becomes ever more important with the increasing number of CO₂-based installations. Urging for an action on natural refrigeration training, John Skelton of Sainsbury's noted: "We've invested money into that, but we are only scratching the surface. I think it needs a bigger movement within the industry... CO₂ is just another fluid, it is just another refrigerant, it should be relatively straight forward".

As the rollout of CO₂ transcritical systems speeds up in Europe, the pressure on suppliers and service providers to maintain those systems over their lifetime increases. Close collaboration with the supply base is therefore key to overcoming this challenge. "Retailers will not progress without manufacturers and vice versa to make simple and reliable new technologies available, affordable and financially sustainable," said Jean-Michel Fleury of Carrefour.

"If you calculate our regular investment cycle, we are going to be HFC-free in commercial refrigeration by 2025."

Georg Weinhofer,
COOP Switzerland

Raising awareness and sharing good practice

Given that the core business of retailers lies in selling food and not in developing cooling equipment, the experience with different refrigeration systems should be easy to share with other retailers who are looking to invest in such technologies. The lack of case studies and real-life data from pilot schemes was raised as one of the major issues. In addition, it was stressed that retailers also have a responsibility to be more transparent about the technology they use and the experience they have towards the technology suppliers, which would facilitate and drive innovation to address outstanding challenges.

technology case studies



DAVE PEARSON

Star Refrigeration



JAN BOONE

Mayekawa Europe



ALEXANDER COHR PACHAI

Johnson Controls



GEORGES KHOURY

SANDEN Manufacturing Europe



J. MICHAEL GRIFFIN

Carrier Transicold



BART W. EZENDAM

Thermo King



TORBEN M. HANSEN

Advansor



TORBEN FUNDER-KRISTENSEN

Danfoss



DIEGO MALIMPENSA

CAREL Industries



JONAS SCHÖNENBERGER

Frigo-Consulting



SERGIO GIROTTO

enEX



SAMER SAWALHA

Royal Institute of Technology (KTH)



JAN HINRICHS

Ixetic



CHRISTIAN SCHMÄLZLE

Obrist Engineering



MARION GEISS

GIZ Proklima

New opportunities in commercial refrigeration, transport and heat pump sectors

Increased attention at ATMOsphere Europe 2012 was paid to CO₂ systems improvement and components development for increased efficiency in countries with higher average ambient temperature - key to change the out-dated paradigm that CO₂ systems cannot be efficiently used in southern regions. Several suppliers presented their solutions ranging from new component development to optimisation of system configuration. Moreover, developments in the transportation and heat pump sectors indicate new opportunities for natural refrigerants. The message across all of the presenting suppliers is clear: HFC-free solutions are ready for the whole Europe.



technology case studies

The industry is now clearly moving beyond the first generation systems that have superior performance over all HFC systems in Northern climate and second generation CO₂ systems with parallel compression, which are 5-10% more efficient in the mid-Europe region. The suppliers' present challenge is to address the performance in Southern Europe.

A number of system manufacturers presented their technical solutions to increasing transcritical CO₂ system efficiencies for commercial refrigeration in warmer climates. Different technology paths are explored by industry to achieve attractive energy performance across the whole of Europe. The third generation of CO₂ systems is currently evaluated with respect to efficiency, safety, reliability, environmental impact and modularity. Performance comparisons between various CO₂ system configurations - including the use of expanders, economisers, ejectors or mechanical sub-coolers - indicate that there will be more than one solution depending on the application requirements. The most promising and straightforward solution is the cascade CO₂ system with mechanical sub-cooler which offers the greatest potential for efficiency gains in southern climates. Hydrocarbons, or water in adsorption chillers, as refrigerants can be used for sub-cooling of the CO₂ systems to preserve the all-natural character of the refrigeration system.

The number of innovative commercially available technical solutions to increase the efficiency of CO₂ systems continues to grow. Overfed evaporators contribute to 10-12% energy savings in all climatic conditions due to lower compression work, at increased reliability and reduced total cost. Combined with a flash vapour recompression and an ejector the energy savings in southern climate amount to up to 22%. The system innovations for southern Europe climate are available today.

Prototype level innovation for high ambient temperatures

A bright future for CO₂ commercial refrigeration in southern climate is also indicated by the results of several prototype stage innovations. As an example, efficiency improvement of 5-15% is made possible for the CO₂ system with an expansion-compression unit at ambient temperatures of +28°C. A simple and cost-effective solution for warmer climates are CO₂ booster with evaporative cooling that lead to 5% higher efficiency than an HFC system.

A remarkable example of the technological progress being made in Europe on the component level is represented by a prototype R744 piston compressor. The presented 100kW_{el} CO₂ compressor for commercial refrigeration and large capacity heat pumps combines a high efficient compact permanent magnet motor and improved valve system for high speed with up to 10% efficiency gains.

Transportation

The natural refrigerant R744 is also a viable alternative to F-gas based refrigeration in two other parts of the cold chain: transport refrigeration as well as mobile air-conditioning. Two presentations at the ATMOsphere conference introduced sea trial results of a CO₂ transcritical system and a new open cycle truck refrigeration system.

Refrigerated reefer containers for the transport of perishable and frozen cargo are based on new CO₂ technology with optimised efficiency for different modes of operation. The system consists of purpose built multi-stage compressor, gas cooler heat exchanger, two speed gas cooler fan, flash tank, variable speed drive and advance controls. The CO₂ transcritical system has been successfully tested during more than 23,000 operating hours, resulting in an average energy use equal to R134a.

A new technology trend in the transport refrigeration sector is the open cycle CO₂ refrigeration. Liquid CO₂ obtained as a by-product from industrial production is stored in a tank mounted to a truck and when released cools air through an evaporator coil located in a refrigerated space.

Another presentation introducing a heat pump system using CO₂ for thermal management in battery electric vehicles and for passenger air-conditioning brought a lively discussion among participants in the market innovation session. The electric driven CO₂ compressor with a gas cooler in the heating/cooling unit with a heating power of 3.2kW at -7°C ambient temperature had a COP of about 3.0. With the recent development in the mobile air conditioning (MAC) sector pointing to a renewed interest in natural refrigerants, it is likely that CO₂ MAC systems will be in the spotlight at next year's ATMOsphere event.

CO₂ heat pumps ready for space heating

CO₂ heat pumps have been successfully used for domestic water heating (DWH) mainly in Japan. Today, already 16 manufacturers offer R744 heat pumps for varying applications also in Europe. This year brought a new development of this environmentally friendly technology: a high temperature CO₂ air/water heat pump with a new cascade and control is targeting space heating applications. The heat pump supplies hot water of up to 80°C, the temperature required by heating systems in older buildings. The patented technology - the new cascade - is based on the upper stage recovery of the excess heat in the first stage through an intermediate heat exchanger. A maximum heating capacity of 8.6kW with a COP of 2.6 makes it an attractive alternative to fuel and gas boilers. According to laboratory tests, in combined mode (space heating & DHW), R744 would be more efficient than HFC.

more information

presentations

Andy Pearson, President of the Institute of Refrigeration (IoR UK),

Innovation in Refrigeration,

www.atmo.org/media.presentation.php?id=180

Bente Tranholm-Schwarz, European Commission (DG Clima),

New EU F-Gas regulation – Coming Soon,

<http://www.atmo.org/media.presentation.php?id=164>

Katja Becken, German Federal Environment Agency,

Options to reduce F-Gas emissions (SRAC),

www.atmo.org/media.presentation.php?id=165

Mikkel Sørensen, Danish Environmental Protection Agency,

Lessons learned from phasing out HFCs in Denmark,

www.atmo.org/media.presentation.php?id=167

Ugo Miretti, European Commission (DG Enterprise),

Ecodesign Directive & Energy Labelling Directive state of play,

www.atmo.org/media.presentation.php?id=169

Blaise Horisberger, Swiss Federal Office for the Environment,

First achievements and strengthening of the Swiss F-Gas regulation,

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Jan Boone, Mayekawa,

Natural Refrigerants in different industrial heat pump plants in Norway,

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Alexander Cohr Pachai, Johnson Controls,

Refrigeration and air-conditioning in warm Mediterranean climates,

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Georges Khoury, Sanden,

Development of a high temperature CO₂ heat pump for space heating,

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J. Michael Griffin, Carrier Transicold,

Efficient sustainable container reefer applications using CO₂,

www.atmo.org/media.presentation.php?id=176

Bart Ezendam, Thermo King,

Transport refrigeration system using CO₂,

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Jan Hinrichs, Ixetic,

CO₂ compressors for mobile air conditioning and light commercial refrigeration,

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Christian Schmälzle, Obrist,

100 kW CO₂ Compressor for commercial refrigeration,

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Marion Geiss, GIZ Proklima,

Demonstrating technology cooperation worldwide: Examples of green cooling in air-conditioning and refrigeration,

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Nina Masson, shecco,

Natural Refrigerant market trends in Europe,

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Lothar Serwas, Carrier,

Market trends & developments for CO₂ in commercial refrigeration in Europe,

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Torben Hansen, Advansor,

Market Overview: Commercial / retail refrigeration,

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Philippe H. Heymans, Delhaize Europe,

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Emma Coles, Royal Ahold Group,

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Georg Weinhofer, Coop Switzerland,

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Knut Lutnæs, COOP Norway,

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John Skelton, Sainsburys Supermarkets Limited,

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Antoine Azar, The Coca-Cola Company,

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Rene van Gerwen, Unilever,

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Juergen Brenneis, Red Bull GmbH,

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Torben Funder-Kristensen, Danfoss,

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Diego Malimpensa, Carel,

Sustainability of CO₂ technology and the role of control systems,

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Jonas Schönenberger, Frigo Consulting,

Efficiency analysis and comparison of innovative CO₂ refrigeration systems,

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Sergio Giroto, enEx,

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Samer Sawalha, Royal Institute of Sweden (KTH),

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