

Mainstreaming Natural Refrigerants

GLOBAL SHIFT TO
COST-EFFECTIVE AND
ENERGY-EFFICIENT
TECHNOLOGIES

Gambian technicians
upgrade their skills on
natural refrigerants

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Time to phase in natural refrigerants



By Nina Masson



The world is on the verge of agreeing a global legally binding deal to put an end to climate-damaging gases commonly used in heating, refrigeration and cooling equipment. It is therefore an appropriate moment to recognise the significant positive effect that natural refrigerants have already had on industry sectors – and indeed entire world regions. Widely used in industrial refrigeration, domestic refrigerators, or light-commercial equipment, HFC-free substances have long been a market-ready solution to never-ending iterations of ozone-depleting or high global warming refrigerants. Now natural refrigerants are ready to step up to the plate once again.

Together, natural refrigerants such as ammonia, hydrocarbons, carbon dioxide, water and air are not just alternatives but true mainstream solutions, provided that their use is embraced wholeheartedly by the international community and the appropriate resources are set free to ensure their efficient use in applications for which they provide the highest climate and economic benefits.

Expertise on handling these natural substances efficiently and safely is growing rapidly, thanks to initiatives like those in Australia (p. 36), Iraq (p. 42), the Gambia (p. 19) and Thailand (p. 40).

Numerous case studies demonstrate that HFC-free technologies not only bring climate

benefits, but are also becoming even more economically viable in a growing number of applications, including hydrocarbons in industrial refrigeration (p. 17), CO₂ and ammonia in commercial refrigeration (p. 35), ammonia in vaccine coolers (p. 39), water in air-conditioning (p. 27), and many others.

This edition of the Natural Voice magazine – with stories from Vietnam, the Gambia, Mexico, Jordan, India, South Africa, China, Australia, Thailand, Iraq, Tanzania and Saudi Arabia – once again demonstrates that natural refrigerants have become a global phenomenon and are well on the way to becoming mainstream under a new climate agreement. ■

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About The Natural Voice

The Natural Voice is a global call for action supported by industry and other parties that points to the environmental, economic and social potential of natural refrigerants in heating, cooling & refrigeration.
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Avoiding the mistakes of the past

by Sidi Menad Si Ahmed

NEGOTIATIONS ON AN HFC AMENDMENT ARE ENTERING A CRUCIAL TIME, SINCE MANY ISSUES OF PROFOUND DIVERGENCE WERE ALREADY SOLVED AT THE JULY MEETINGS IN VIENNA.

Now it seems that we are closer to an agreement than ever. A deal could be struck at the 28th Meeting of the Parties in Kigali.

However, voices were raised to review some important rules in the functioning of the Montreal Protocol bodies – in particular the Executive Committee (EXCOM) of the Multilateral Fund and the Technical and Economic Assessment Panel (TEAP) – in order to ensure full transparency and more significantly a more effective decision-making process.

Indeed, many interested Parties sounded a warning note by recalling the many hurdles the previous amendment on HCFCs had to overcome. They hinted at reviewing certain procedures in applying the decisions of the Parties. The main concern is related to the functioning of the Executive Committee, which until now has been operating with a certain degree of flexibility, giving its members a powerful tool to interpret decisions of the Parties.

Let's consider a few of the rules established by the Executive Committee that have never been decided by the Parties. A few significant examples could be illustrated concerning the eligibility criteria, which I have always seen as a set of tools that try as much as possible to limit the scope of funding projects in Article 5 countries.

The cut-off date for eligible enterprises in Article 5 countries stipulates that any enterprise established after September 2007 is not eligible for funding to phase out HCFCs. While the rationale was

that countries should take measures to prohibit establishment of HCFC-based enterprises as of the cut-off date, it goes against the very spirit of the grace period given to developing countries. Moreover, a few years can elapse between ratification of the amendment and the adoption of appropriate measures. This meant that many countries could not avoid phasing in controlled substances after the cut-off dates and now a number of enterprises find themselves in a difficult situation whereby they are not eligible for funding. In addition, from a legal angle countries should not have any obligations before the ratification of the Montreal Protocol and its amendments.

Another example is the cost-effectiveness threshold, which is based on "historical figures of conversion costs approved for the last three years of the operation of the Fund". On one hand, the rationale for such a rule could be understood as a way to standardise costs and thereby avoid inflation from one project to another. On the other hand, the cost-effectiveness values should have been more strongly based on historical costs of projects approved for the three previous years. Moreover, from an economic point of view, costs should be subject to a serious review taking into account market forces.

Operating costs were meant to compensate for any additional costs incurred by enterprises when switching from a controlled substance. This was one of the prominent decisions, since the spirit was to pay for all incremental costs. However, in less than three years, the agreement on four-year operating

costs was reduced to a mere six months period in the refrigeration sector and one year in the foam sector.

It is quite obvious that prominent members of the EXCOM, and mainly the donor countries that dominate the EXCOM, are inspiring such decisions.

It is rather sad that Article 5 countries are often not fully prepared to debate issues before the EXCOM. One could of course say that it is up to the representatives to organise themselves in such a way that they can fully play their role at the EXCOM. Nevertheless one would have also hoped that since the ultimate objective is to protect the ozone layer, national interests should be set aside. In fact, Parties should encourage Article 5 representatives to be more pro-active.

The relative success of the Protocol and particularly the Multilateral Fund is unfortunately overshadowed by the presence of different lobbies promoting solutions that are meant to keep a certain monopoly in supplying chemicals. It is therefore no surprise that so-called 'transitional substances' like HCFCs, despite the fact that they too have ozone-depleting potential, replaced CFCs. In 2007 amendments were adopted to phase out HCFCs when they never should have been introduced in the first place – because natural refrigerants were largely available.

In all of these examples the role of TEAP should have been more forthcoming in ensuring no interference from industry interests. Unfortunately one cannot say that TEAP is safe from outside pressure.

Today TEAP should at least recommend a strong decision to leapfrog HCFCs to very low-GWP substances such as natural refrigerants. This will greatly help Article 5 countries to get out the loop of second or third conversions, which are damaging to their economies. Parties have the duty to ensure the full independence of TEAP.

HCFC Phase-Out Management Plans need to be reviewed accordingly to guarantee long-term and sustainable solutions. This, in my view, is much more urgent than an agreement on an HFC phase-down, since it will already avoid significant amounts of HFCs being phased in. ■

Sidi Menad Si Ahmed is Chief International Advisor at shecco, formerly Director of the Montreal Protocol branch at the United Nations Industrial Development Organisation (UNIDO).

Events Planner America



OCTOBER

1	GreenChill Webinar: Ongoing Efforts to Evaluate Alternative Refrigerants	18 Oct	online	http://epawebconferencing.acms.com/evaluatingrefrigerants/
2	2016 Behavior, Energy & Climate Change Conference	20 - 22 Oct	Baltimore, MD	http://aceee.org/conferences/2016/becc

NOVEMBER

3	GreenChill Webinar: Transcritical CO ₂ Operations in Warm Ambient Conditions	1 Nov	online	http://epawebconferencing.acms.com/warmtranscriticalco2/
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DECEMBER

4	2016 HARDI Annual Conference	3 - 6 Dec	Colorado Springs, CO	http://hardinet.org/hardi-annual-conference/
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Events Planner

Europe & Africa



OCTOBER

1	28 th Meeting of the Parties to the Montreal Protocol	10 - 14 Oct	Kigali, Rwanda	http://climate-l.iisd.org/events/28th-meeting-of-the-parties-to-the-montreal-protocol/
2	2016 Euroheat & Power District Energy Days	11 - 12 Oct	Brussels, Belgium	https://www.euroheat.org/events/16ehpautumn/
3	Chillventa 2016	11 - 13 Oct	Nuremberg, Germany	https://www.chillventa.de/en
4	International Congress on Energy and the Environment 2016	26 - 28 Oct	Opatija, Croatia	http://www.hsse.hr/cms/index.php/ENERGY_AND_THE_ENV_2016
5	The Sustainable Retail Forum	27 - 28 Oct	Paris, France	http://www.tcgfsrs.com/

NOVEMBER

6	Future Food Tech: Innovation & Investment from Farm to Fork	3 - 4 Nov	London, UK	http://www.foodtechlondon.com/
7	22 nd session of the Conference of the Parties (COP 22) to the UNFCCC	7 - 18 Nov	Marrakech, Morocco	http://www.cop22-morocco.com/
8	Supply Chain Summit 2016	9 - Nov	London, UK	http://www.igd.com/Events/Supply-Chain-Summit-2016/

Events Planner Asia



OCTOBER

1	Climate Abu Dhabi 2016	3 - 5 Oct	Abu Dhabi, United Arab Emirates	http://climatexpo.ae/about.html
2	India Cold Chain Show (ICCS 2016)	17 - 19 Oct	Mumbai, India	http://indiacoldchainshow.com/
3	2 nd District Cooling Arabia	18 - 19 Oct	Riyadh, Saudi Arabia	https://fleming.events/en/events/landing-page/energy/district-cooling-arabia

NOVEMBER

4	8 th Annual Middle East District Cooling Summit	1-2 Nov	Doha, Qatar	https://fleming.events/events/landing-page/energy/middle-east-district-cooling-summit
5	The GCC HVAC Summit 2016	2 - 3 Nov	Dubai, United Arab Emirates	http://www.thehvacsummit.com/
6	CHINASHOP 2016	3 - 5 Nov	Suzhou, China	http://en.chinashop.cc/
7	HVACR Southeast Asia 2016	23 - 25 Nov	Jakarta, Indonesia	http://www.hvacr.merebo.com/

DECEMBER

9	Myanmar International Ventilation, Air Conditioning and Refrigeration Show (MIVAR'16)	1 - 3 Dec	Shin Saw Pu RdYangon, Myanmar (Burma)	http://mivarexpo.com/
10	SIAL Middle East	5 - 7 Dec	Abu Dhabi, United Arab Emirates	http://sialme.com/

Prioritising natural refrigerants

By Chandra Bhushan

AT AN OCTOBER GATHERING IN KIGALI, RWANDA, THE WORLD IS EXPECTED TO AMEND THE MONTREAL PROTOCOL TO PHASE DOWN HYDROFLUOROCARBONS (HFCs). FOR DEVELOPING COUNTRIES, IT IS IMPORTANT TO HAVE A ROADMAP FOR AN EFFECTIVE AND COST-EFFICIENT TRANSITION AWAY FROM HFCs.

We believe that such a roadmap should prioritise the safe use of natural refrigerants. These are non-proprietary, low global warming potential (GWP) refrigerants that face no uncertainty with respect to emerging environmental regulations. They avoid the chemical treadmill of the fluorinated gases. Additionally, these refrigerants offer higher energy efficiency than their fluorinated counterparts – resulting in further reductions in greenhouse gas (GHG) emissions.

A recent study conducted by the Centre for Science and Environment (CSE) estimates that 77% of India's cooling capacity can be converted to naturals by using currently available technologies, which include hydrocarbon, ammonia and CO₂-based refrigeration and air-conditioning (RAC) systems. This potential will be similar or higher (as India's emissions have a larger than average contribution from the mobile air-conditioning sector, where no natural alternatives are currently available) for most other developing countries. Reaching this potential will require enabling regulations, clear and enabling safety standards, and market incentives for first movers.

A transition to naturals will mostly benefit the domestic air-conditioning sector. In India, sales of domestic air-conditioning systems are slated to increase six-fold by 2030 and account for more than 30% of total RAC sector cooling capacity. Similar patterns are expected in other Article 5 countries. The most suitable natural alternative in the domestic air-conditioning sector is R290 (propane), which is low GWP and has high energy efficiency. The large-scale use of R290, however, has been curtailed due to dated and restrictive safety standards. These were designed decades ago (not taking into account advances in safety features) and grossly exaggerated concerns related to the flammable nature of R290 and other hydrocarbon-based refrigerants.

Currently there are efforts to update international safety standards and make them more accommodating for the use of R290 in domestic air-conditioning systems. However, considering the large commercial interests of the fluorinated gas industry, these efforts are not likely to reach fruition in the near future. We in India have therefore decided to start a process to develop domestic safety standards for the use of natural refrigerants in the RAC

sector. CSE is working with the Bureau of Indian Standards (BIS) to update ISO 5149 (the most prominent international standard for the use of flammable refrigerants), so that it adequately reflects current technological safety solutions and tests. These efforts have led to the establishment of a panel to review the feasibility of changes to ISO 5149 suggested by CSE. The comments of this panel will be on the agenda of the next meeting of the RAC committee of BIS.

In addition to their low GWP, natural refrigerants like R290 offer much higher energy efficiency than HFCs. Another study by CSE showed that a doubling of energy efficiency in the domestic air-conditioning sector alone will lead to an emissions reduction of 100 million tons of CO₂ equivalent by 2030. The use of natural refrigerants in India will improve energy efficiency, reduce GHG emissions and increase energy security.

Chandra Bhushan is deputy director of the Centre for Science and Environment, New Delhi.



Projects showcase naturals in emerging economies at Gustav Lorentzen

GLOBAL EFFORTS TO SECURE A HISTORIC AGREEMENT TO PHASE DOWN HFC CONSUMPTION UNDER THE MONTREAL PROTOCOL ARE CREATING OPPORTUNITIES FOR NATURAL REFRIGERANTS TO THRIVE. MEANWHILE A PLETHORA OF PROJECTS ARE DEMONSTRATING TECHNOLOGICAL SOLUTIONS TO DELIVER THIS POTENTIAL IN EMERGING ECONOMIES WORLDWIDE.

By Andrew Williams

Ahead of the event, 155 experts reviewed 203 abstracts before selecting 147 papers penned by 317 co-authors to be presented in Edinburgh.

Overcoming technical barriers to wider uptake of natural refrigerants is particularly crucial in developing countries, whose infrastructure may not be ready to support greater rollout of unfamiliar HVAC&R systems.

To address this, the Multilateral Fund for the Implementation of the Montreal Protocol was established in 1991. The fund's main objective is to assist developing country parties to the Montreal Protocol whose annual per capita consumption and production of ozone-depleting substances (ODS) is less than 0.3kg in complying with the Protocol's control measures.

At present, 147 of the 196 Parties to the Montreal Protocol qualify for assistance from the Fund. They are referred to as Article 5 countries.

Despite this funding, many barriers to the adoption of natural refrigerants in Article 5 countries remain. These include a lack of trained installers or technicians, and concerns related to the complexity or safety of natural refrigerant-based systems resulting from lack of awareness or familiarity with the technology.







Psychological and practical barriers to natural uptake

"The barriers to greater uptake of natural refrigerants in developing countries are psychological as well as practical," Daniel Colbourne, a member of the UNEP Refrigeration Technical Options Committee (RTOC) for the Montreal Protocol, told a workshop held during the Gustav Lorentzen conference.

To highlight the problem, Colbourne warned that customers interested in switching their rooftop-condensing unit from R22 to CO₂ or R290 (propane) often find their efforts thwarted by a lack of technical capacity among local installers or technicians, or the absence of standards allowing hydrocarbons in this application.

Another problem is that some companies – particularly in Southeast Asia – are marketing hydrocarbons as drop-ins. "Technicians are dropping refrigerants into existing systems without understanding what they're doing. This is to the detriment of everyone," said Colbourne. This practice is particularly damaging to companies that have invested time and resources in doing things properly, he added.

Colbourne cited legislative and standardisation bodies, national ozone units, trade associations and technical institutes among the entities with the biggest role to play in helping to overcome barriers to wider uptake of natural refrigerants.

Organisations like GIZ Proklima are already playing such a role. Philipp Münzinger, its project manager for environment and climate change, told the Edinburgh audience how the 'Green Chillers' project is supporting Indonesia in creating framework conditions to support energy efficiency and environmental improvements in the industrial and commercial refrigeration and air-conditioning sectors.

Among the barriers to wider uptake of natural refrigerants in Indonesia, Münzinger cited low electricity prices (resulting in inefficient system design), a lack of qualified installation and service technicians, misuse of locally produced R290 (which can cause accidents or damage systems if dropped into existing HFC-based equipment), and discrepancies between perceived risk and actual risk among potential users of hydrocarbon systems.

In Ghana, meanwhile, GIZ Proklima is facilitating the installation of 30 propane-based, 30 kW split-system air-conditioners at the Ghanaian Environmental Protection Agency. It is also training technicians and local trainers in the safe use of hydrocarbon systems.

In Münzinger's view, a lack of locally available technology, inappropriate servicing infrastructure, and limited local awareness of energy efficiency – not to mention poor understanding of the properties of different refrigerants – are holding up market penetration of hydrocarbon air-conditioners in Ghana.

Opportunities for R290 in Colombia

Over in South America, Colombia is working hard to encourage wider use of natural refrigerants in its flower industry – which requires refrigeration systems in cold stores, used for post-harvest processing and exports.

Angelica Antolinez from the Colombian national ozone unit told the Edinburgh audience that the country's flower industry requires 31.1 million kW of cooling capacity for cold storage. Currently, 99% of these facilities use R22 and the remaining 1% uses R134a. "There is a huge opportunity here to convert to R290," Antolinez said.

The national ozone unit is currently running a demonstration project to convert a flower storage

facility from R22 to R290. Other natural refrigerant projects in Colombia include district cooling in La Alpujorra, Medellin, and the promotion of district cooling in five major Colombian cities.

Obstacles to adopting R290 in the South American country include a lack of national experts (both to design and implement projects, and to conduct risk assessments), a lack of trained technicians, and a lack of locally available components.

Colombia also suffers from a lack of technical standards governing hydrocarbon safety, a lack of public funding for projects, the failure of end users to trust service technicians, and a lack of adequate legal and procedural structures governing the installation and use of natural refrigerant-based systems, Antolinez lamented.

Regulatory change to boost naturals

Earlier this summer, representatives of close to 200 countries met in Vienna to discuss amending the Montreal Protocol to address growing emissions of HFCs in developed and developing countries. Confidence was high that the nations will adopt a deal on phasing down HFCs globally at the next Meeting of the Parties to the Montreal Protocol in Kigali, Rwanda in October.

"It looks like 2016 will be the year for locking down an international agreement to phase down HFCs," said Alexander von Bismarck of the Environmental Investigation Agency, who expressed hope that a global deal would be in place by the end of 2016.

Adopting an agreement would just be the first step, however. "So much depends on the implementation of the phase-down and the speed at which replacements for HFCs penetrate the market," Von Bismarck warned.



With the prospects for an HFC phase-down deal in Kigali looking good, it is imperative for natural refrigerants to step in as market-ready alternatives. "The replacement of HFCs is a huge business opportunity," said Carole Bond of Carbon Data Resources, a UK-based environmental consultancy.

"We need to understand the inherent connections between our industry and the world outside," said Bond. Only by interacting with one another can stakeholders deliver the dramatic change required to transition away from HFCs, she argued.

Bond urged industry, end users and academics to collaborate on innovative solutions to deliver UNFCCC climate targets agreed at COP21 in Paris in December 2015. The Paris Agreement set out a global action plan for putting the world on track to avoid dangerous climate change by limiting global warming to well below 2°C.

Getting off 'the chemical treadmill'

Natural refrigerants will play a key role in delivering the Paris goals but raising awareness will be crucial to ensuring that they fulfill their potential, according to Bond. "We need to communicate the benefits of natural refrigerants much more effectively to the world at large – including governments, industry, end users and NGOs," she said.

Bond singled out natural refrigerants' lack of patentability, however, as a barrier to their wider uptake. "They are perceived to have less value," she said. To address this, she called for greater recognition of natural working fluids' potential to deliver COP21 objectives.

Von Bismarck agrees. "We need to increase the piece of the pie that goes to natrefs, which aren't patent-protected," he said. "We have a chance now

to leapfrog HFCs and get off this chemical treadmill," the EIA representative argued.

Efforts by large emitters will play a crucial role in the success of any phase-down deal. It is a good sign, therefore, that experts attending Gustav Lorentzen were optimistic that China's HCFC phase-out plan will trigger wider uptake of natural refrigerants across the Asian powerhouse.

Under the Montreal Protocol, China has agreed to completely eliminate the production and consumption of HCFCs by 2030. "China is now on the road to phasing out HCFCs," said Professor Guangming Chen of the Ningbo Institute of Technology at Zhejiang University.

As the world's biggest producer and consumer of refrigerants, China's efforts to reduce HCFC consumption will have a major global impact. "38% of world refrigerant demand comes from China. 65% of the world's total refrigerant production capacity is in China too," said Chen.

"We are increasing our use of natural refrigerants. China is under pressure to phase out HCFC refrigerants," said Chen. "By 2020, the average GWP of refrigerants used in the industrial and commercial sectors will be 300," he argued. The professor admitted, however, that China's status as the world's biggest producer and consumer of refrigerants poses "great challenges" in charting a more sustainable course.

Overcoming standards barrier

Some conference participants expressed hope that China's HCFC phase-out may trigger wider use of natural refrigerants in room air-conditioning, heat pumps, and commercial and industrial refrigeration applications. For natural refrigerants to thrive,

however, they called on China to revise national standards regulating the extent to which they can be used in specific refrigeration and air-conditioning applications.

"The main barrier to uptake of R290 for room air-conditioners in China is national standards. Companies stand ready to promote R290 for room air-conditioning once new standards have been adopted," said Professor Chen.

Indeed, as technological innovation continues apace, the pressure is on regulatory authorities worldwide to update standards that allow these new products to enter the market.

"All the major players in China are ready and waiting. I'm counting on 2017 to be the breakthrough year in terms of sales," said Ole Reinholdt Nielsen of the United Nations International Development Organisation (UNIDO). For this to happen, China must put an end to restrictive standards governing the use of hydrocarbons, he argued.

UNIDO runs similar projects that help to covert HFC-based air-conditioner production lines to propane in Algeria, Bahrain and Pakistan, among other countries.

The mood among delegates streaming out of the conference centre into the summer night, however, was buoyant. The future for natural refrigerants would appear to be equally bright. ■



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Vietnam on the road to HFC-free solutions

AS VIETNAM CELEBRATED INTERNATIONAL OZONE PROTECTION DAY, IT PRESENTED PROPANE INDUSTRIAL REFRIGERATION PILOT PROJECTS AS A SUCCESS FOR COMBINING OZONE LAYER PROTECTION WITH CLIMATE BENEFITS.

By Nina Masson

Vietnam celebrated the International Day for the Preservation of the Ozone Layer (held on 16 September) with two workshops in Hanoi and Ho Chi Minh City on 13 and 15 September, respectively. Bringing together ministry representatives, cold store operators, educational bodies and international experts, the events presented final results from a two-year project initiated by the United Nations Industrial Development Organisation (UNIDO) and supported by the Global Environment Facility (GEF). The project installed 25 propane (R290) units in nine cold stores for the fish processing industry.

45 million kWh energy reduction potential

The R290 conversion project delivered average power reductions of 30% in the cold stores involved. With cost savings of around US\$18,000 per year, operators also improved work safety and comfort, as well as product quality and operational reliability compared to R22 equipment. End users have already expressed their intent to continue using the R290 units – provided by Italian manufacturer Zanotti – in future installations.

Those savings, however, are just the tip of the iceberg. Vietnam's current cold store volume is about 3.5 million m³, out of which 40% runs on R22. Assuming that 30% of R22 cold stores with a surface area of 50-1,000 m² are converted to hydrocarbons, and the rest to ammonia and HFCs, UNIDO's national expert for Vietnam estimates that the annual energy reductions will be about 45 million kWh.

To reach this, the volume of R290 adoption needs to be 150 times that of the current pilot projects. The Vietnamese government is therefore contacting 500 operators of fish processing facilities to assess their suitability to receive a preferential loan from



the Vietnam Environment Protection Fund. It is also looking into creating pilot projects for hydrocarbon use in larger industrial equipment, and into CO₂/NH₃ industrial refrigeration systems to complement the range of HFC-free solutions.

Overcoming barriers, one step at a time

The project team encountered various challenges, among them the non-availability of propane refrigerant in the country. Hence, for the first pilot installations, cylinders with R290 had to be imported to Vietnam. This problem has since been solved, with one domestic wholesaler making the substance available.

Other items, identified in the policy gap analysis carried out by private sector partner shecco, are proactively addressed. Technical standards for safe handling of hydrocarbons, CO₂ and ammonia are to be developed in line with international standards. A nationwide

training programme is also envisaged to familiarise technicians with the use of f-gas-free substances.

Saving the climate and ozone layer in one go

Riccardo Savigliano, industrial development officer at UNIDO, called on Vietnam to continue initiatives like the R290 pilot project, whereby R22 is directly replaced by natural refrigerants:

"The Montreal Protocol, celebrating its 29th anniversary, is grown up and has delivered on its promise to reduce ozone depleting substances. It is time for it to get married to the climate protection scheme, to fully take advantage of the climate benefits of phasing out high-GWP substances," he said on the occasion of the International Day for the Preservation of the Ozone Layer in Ho Chi Minh City. ■

Water-based eChiller delivers year-round cooling...naturally

GERMAN COMPANY EFFICIENT ENERGY GMBH IS BREAKING NEW GROUND BY DEVELOPING A COOLING SOLUTION THAT HARNESSES WATER (R718) AS A REFRIGERANT – SAVING 80% ELECTRICITY COSTS COMPARED TO HFC TECHNOLOGY. ITS ENVIRONMENTALLY FRIENDLY DESIGN MAKES IT FUTURE-PROOF FOR ANY FUTURE LEGISLATIVE CHANGES.

By Charlotte McLaughlin

Water is the most natural of refrigerants. It is readily available, odourless, colourless, non-toxic and non-flammable. It also has zero ozone-depleting potential (ODP) and zero global warming potential (GWP). Nonetheless, is not yet widely used in HVAC&R applications.

Munich-based CEO Jürgen Süß is leading the charge towards water with his centrifugal eChiller that promises 80% efficiency gains compared to HFC systems.

Its coefficient of performance (COP) is four times higher than an R410A system, offering electricity savings of 50,000 kWh, electricity cost reductions of €7,000 and emissions reduction of 31 tonnes CO₂e, as demonstrated over the course of the year 2015 in a data centre application: namely the server cooling racks.

Warm ambient – a question of design

Water chillers usually use absorption technology. But the eChiller uses a centrifugal system instead. "Using water as a refrigerant isn't a new idea. What's new is the way that we do it," Süß explains.

His system uses a turbo motor to evaporate and condense the water in a vacuum to provide cooling and reject waste efficiently.

Providing cooling all year round, the system could be adapted for different conditions. "You could use it for high temperature heat

pumps or for warm climates, which is always an advantage when it comes to places like Dubai," he says.

Easy to install, the eChiller is a self-contained system, meaning installers just have to hook it up. Some of the most common application areas of the eChiller are air conditioning, process cooling and data centre cooling.

A 'future-proof' solution

Efficient Energy GmbH hopes to prove by the third quarter of 2017 that the chiller is commercially and technically viable. At the moment the cost of the product is relatively high, as a result of the R&D that went into the product. But the actual cost of materials is very low. Süß also thinks the technology could be introduced to developing countries; it is just a question of "mass-producing and marketing the product right" in order to drive down costs.

"We just need help to educate people that this is a solution that it is reliable, and that it works. Water is not dangerous, no problems with pressure. The lawyers in the US are not a problem for us," he says.

"The entire refrigeration system was built on CFCs, then HCFCs, then HFCs, and now HFOs, so for me it is just a continuation of the same thing. We have environmentally friendly solutions that have efficiency gains on top – it would be crazy for society not to shift to them," he argues. ■



Gambian technicians upgrade their skills on natural refrigerants

A FIVE-DAY TRAINING WORKSHOP OF REFRIGERATION TRAINERS IN THE GAMBIA, HELD ON 28 JUNE-2 JULY, FOCUSED ON TECHNOLOGIES USING NATURAL REFRIGERANTS CO₂ AND HYDROCARBONS. THE PROJECT AIMS TO HELP THE GAMBIA LEAPFROG HIGH-GWP REFRIGERANTS AND SHIFT TO NATURAL REFRIGERANTS IN THE FISHERIES SECTOR AND OTHER APPLICATIONS.

By Klara Skacanova



Gambian refrigeration technicians receive natural refrigerants training

Funded by the Global Environment Facility (GEF) and supported by the United Nations Industrial Development Organisation (UNIDO), the Gambian government, the Gambian Technology Training Institute (GTTI), Centro Studi Galileo and shecco, the innovative project combines awareness-raising and training activities, technology transfer, and a legislative element to help the country transition to low-GWP refrigerants.

During the inaugural workshop held in Banjul, the Gambia in May 2015, Ndey Sireng Bakurin, executive director of the National Environment Agency of the Gambia, made it clear that the Gambia wishes to leapfrog the use of further fluorinated gases when she said that:

"You will agree with me that today one of the world's most daunting challenges is climate change-related predicaments, hence the need to control emissions of greenhouse gases and some refrigerants like hydrofluorocarbons used mainly in our air conditioning systems like those at the fish processing factories, which contribute significantly to the warming of the Earth."

The chance to use natural refrigerant-based technology to help replace R22 in the Gambia's struggling fisheries sector is seen as a golden opportunity. The fish processing sector is currently experiencing problems due to high energy costs, out-dated refrigeration equipment with components that are impossible to replace either

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Practical demonstration during training session

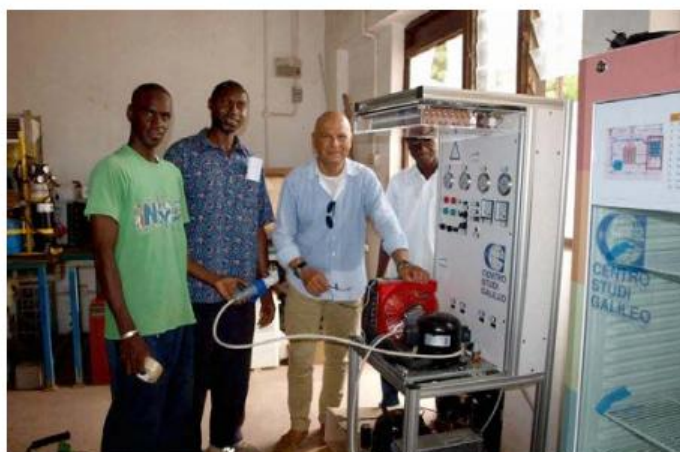
because spare parts are no longer available or they are too expensive to buy as they must be imported.

Comprehensive course helps alleviate knowledge gap

At the June workshop, twenty technicians from private and public institutions were selected to undergo a training course, conducted by Gianfranco Cattabriga, a trainer from Centro Studi Galileo. The objective was to familiarise technicians with safety requirements and equipment related to the use of natural refrigerants, hydrocarbons and CO₂, so that they can transfer this knowledge to their peers and end users in the Gambia.

"I consider this sort of activity extremely important and useful for the environment," says Cattabriga. He is convinced that skilled refrigeration engineers improve the reliability and energy efficiency of the equipment and prolong its lifetime. This essentially translates into financial savings and better quality of life and health. Such efforts require financial resources, but Cattabriga believes these are "investments rather than costs".

Over the five-day period, technicians received comprehensive theoretical and practical training, which helped to enhance their awareness of available technologies that could replace traditional fluorinated refrigerants. Combined with other activities under the project framework, the training should ultimately create an enabling environment for the use of natural refrigerants in the Gambia.



The training included a detailed explanation of the chemical and physical properties of natural refrigerant fluids, such as CO₂ (R744) and hydrocarbons. These were compared with other traditional refrigerants currently used in the Gambia (CFCs, HCFCs and HFCs) in terms of performance and their impact on the ozone layer and global warming. The sessions focusing on hydrocarbons were divided into three parts, while two were devoted to training on CO₂. The participants had the opportunity to learn about and debate the key industrial, commercial and domestic applications in which these refrigerants are used.

Technicians had the opportunity to undergo practical training, where they got hands-on experience with using the tools and equipment required to use natural refrigerants.

The equipment necessary for the training were delivered by Centro Studi Galileo and comprised of a cooling room charged with CO₂ refrigerant of a cascade type and two cooling rooms charged with hydrocarbon refrigerant isobutane. Other tools included CO₂ and hydrocarbon leak detectors, pressure gauges, a vacuum pump and a weighing scale.

The range of high-quality tools and instruments were provided as a complete set, with a view to equipping GTTI's main and regional campus.

Enhancing management of training centres

Following the five-day course on natural refrigerant technologies, one day was devoted to improving the management of training centres, which targeted operators, managers and administrators of professional training facilities. Besides the management aspects related to operational and organisational activities, the session provided insights into how a new training course should be designed effectively.

The participants concluded that thorough consideration should be given to the recognition of training needs and evaluation of participants' level of knowledge. To ensure that the training process is effective, the operators should ensure access to relevant tools and equipment and provide information and study material.

A strong policy climate is as important as the climate

Many factors must clearly be aligned to allow for the successful proliferation of natural refrigerant-based equipment. shecco, in collaboration with the Gambian government, conducted a policy gap analysis to identify the key policy measures that should be implemented.

The analysis intends to identify priority areas where legislative action and more effective safety and technology standards hold the most promise to accelerate more environmentally friendly industrial refrigeration and air conditioning solutions, including the use of hydrocarbon refrigerants and carbon dioxide cascade solutions.

Some of the options that shecco put forward that could have an immediate and longer-term impact on the uptake of natural refrigerants include taxation of fluorinated gases, incentives and investment grant schemes for energy-efficiency measures, and effective safety standards.

Funding available to assist the Gambia's transition

To assist the Gambia with its transition to natreps such as hydrocarbons, the Global Environment Facility (GEF) Secretariat has provided a grant of US\$495,000 (€446,000). Co-financing from various partners totals US\$2.4 million (€2.16 million). This financial support is to help the Gambia facilitate the adoption of climate-friendly and energy-efficient equipment to help modernise their fisheries sector and other susceptible sectors such as the air conditioning sector. The money is also meant to help with policy measures, technology transfer and awareness raising-related activities.

The project is particularly innovative as, for the first time, it is bringing together the funding mechanisms of the Montreal Protocol on substances that deplete the ozone layer and the GEF, meaning that the environmental benefits of phasing out ozone-depleting substances have become eligible for a wider spectrum of financial support. ■





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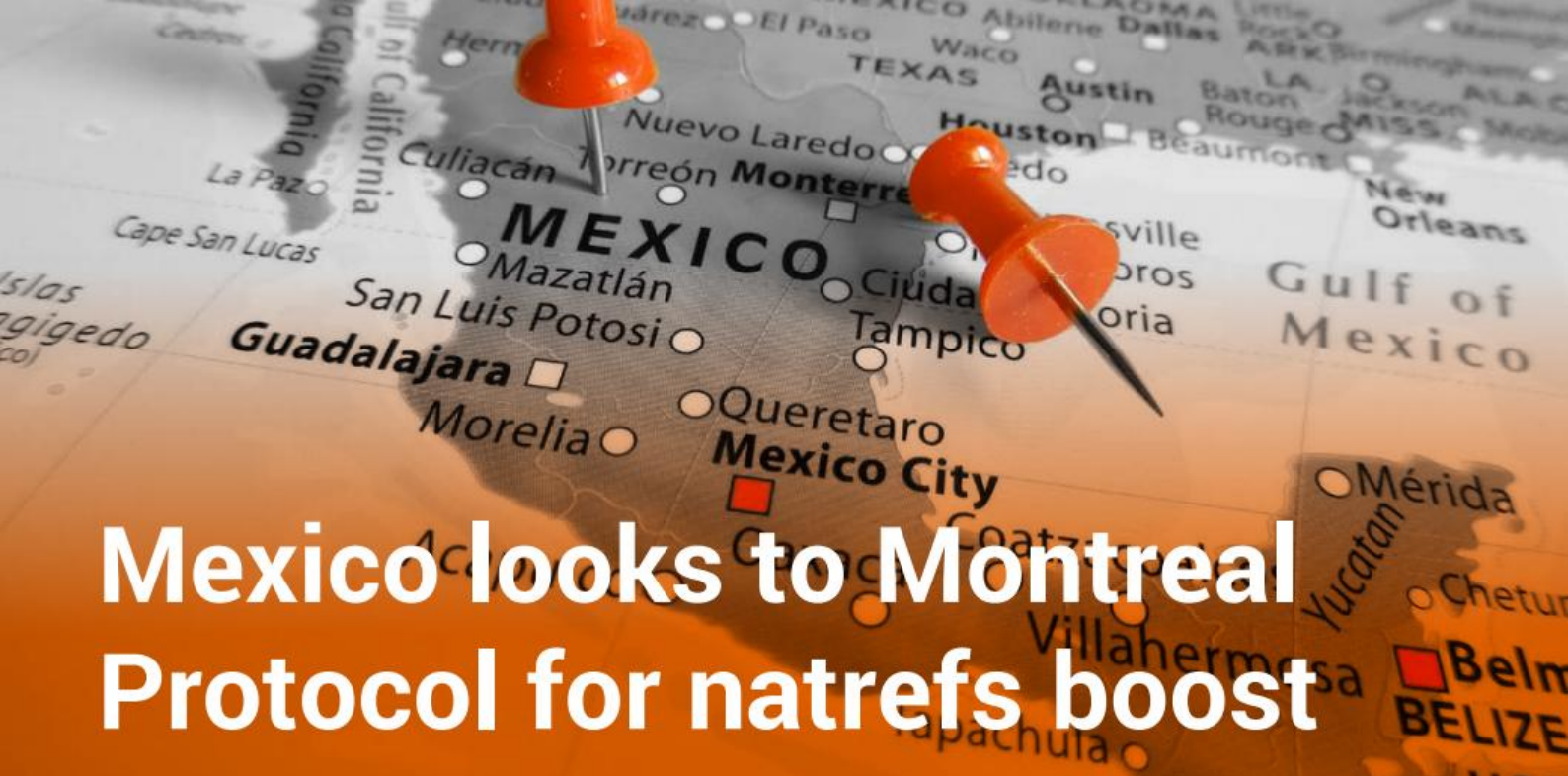
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Mexico looks to Montreal Protocol for natrefs boost

MEXICO HAS RECEIVED FUNDING FROM THE MULTILATERAL FUND OF THE MONTREAL PROTOCOL TO SHIFT AWAY FROM OZONE-DEPLETING CFCs AND HCFCs. IT IS NOW SEEKING AN AGREEMENT WITHIN THE FRAMEWORK OF THE PROTOCOL THAT WOULD PHASE DOWN HFC USAGE AS WELL.

By Lauren Clark and Klara Skacanova

Agustín Sánchez Guevera, national coordinator of Mexico's Ozone Protection Unit – which oversees the implementation of national regulatory frameworks for ozone-depleting substances – notes that, “to control HFC emissions, the best is to phase down consumption and production as we do (with CFCs and HCFCs) in the Montreal Protocol”.

Mexico is currently implementing an HCFC Phase-out Management Plan (HPMP) that will eliminate HCFCs by 2030 in three stages. The first phase focused on the foam sector, domestic and commercial refrigeration, the servicing sector and the aerosol sector. The goal was a phase-out of 30% of HCFCs.

The second phase will focus on the remaining companies of the aerosol, domestic refrigeration, and servicing sectors. It will also focus on customs training and developing hydrocarbon-based technology as the standard for refrigeration. The goal is a phase-out of 67.5% of HCFCs.

The third stage will centre on the polyurethane and polystyrene foam sectors and the servicing sector. The goal is a complete phase-out of HCFCs by 2030.

To reach these phase-out goals and to reduce overall greenhouse gas emissions by 30% in 2020 and by 50% in 2050 compared to 2000 levels, Mexico passed the Climate Change General Law in 2012. Sánchez Guevera explains that these goals “could be reached if an international regime like the Montreal Protocol is established for the technology and for financial support to developing countries”.

North American leader in natural refrigerants for light commercial refrigeration

In North America, Mexico is the clear leader in the use of natural refrigerants in light commercial refrigeration. Mexico has adopted more than 180,000 HFC-free light commercial refrigeration units so far, compared to around 100,000 in the United States and Canada combined, according to a 2015 market study. This includes bottle coolers, vending machines and ice cream freezers as well as display cabinets, most of which rely on hydrocarbons.

Mexico's particular success with hydrocarbons can be attributed to the favourable legislative environment, which is driving the introduction of such equipment as a replacement for HCFC-based technology.

Training of technicians

In Mexico, and many other countries, the main barrier to the adoption of natural refrigerants is the lack of trained service personnel. “If manufacturing companies don't have servicing in the market, they can't put their products in the market. So they are waiting until we have well-trained technicians in the service sector,” Sánchez Guevera points out.

During the second stage of the HCFC phase-out, Mexico will receive assistance from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to tackle the training issue. The aim is to open the first training centre in Mexico City to train technicians on ozone and climate-friendly technologies, especially hydrocarbons. The project will also include the development of certification programmes for refrigeration technicians and the introduction of air-conditioning units using propane. ■

Definition of 'low-GWP' – lost in translation

THERE IS AN URGENT NEED TO TRANSITION AWAY FROM REFRIGERANTS WITH HIGH GLOBAL WARMING POTENTIAL (GWP). YET CONFUSION REIGNS AS TO WHAT IS MEANT BY THE TERM 'LOW-GWP', WITH MANY DIFFERENT INTERPRETATIONS ACTING AS A DISTRACTION FROM TRULY CLIMATE-FRIENDLY NATURAL REFRIGERANTS.

By Klara Skacanova



The Paris Agreement that was reached among 197 countries at the 21st Conference of the Parties (COP21) to the UNFCCC aims to keep the global temperature rise below two degrees Celsius, while pursuing efforts to limit it to 1.5°C (compared to pre-industrial levels). The reduction of HFCs globally can contribute to avoiding 0.5°C warming by 2100, representing a significant contribution to global mitigation efforts.

Governments, organisations, companies and other entities emphasise the need to move towards substances with low global warming potential (GWP). Yet there is no clear definition of what 'low-GWP' stands for exactly. Industry and technology end users are perplexed about the future technology choices, particularly after having already been

forced to take steps to eliminate several generations of chemical substances (CFCs, HCFCs and now HFCs).

The adoption of natural refrigerants that have zero or negligible impact on the climate should play a key role. Nonetheless, natural refrigerants, while being clearly distinct from synthetic refrigerants, are usually labelled as 'low-GWP' and put in the same basket as these other chemical substances (many of which have properties that have not been fully studied and even have a relatively high GWP). A clear definition of natural refrigerants as climate-friendly, future-proof, energy-efficient and safe replacements of HCFCs and HFCs is needed to bring some clarity to companies that need to make urgent technology choices in view of the forthcoming global HFC phase-down.

Thresholds for 'low-GWP' range widely

The adoption of the EU Directive on mobile air conditioning probably marked the establishment of the first GWP limit for HFCs in legislative form. The Directive prohibits the use of HFCs with a GWP of over 150 as of 2017 in all new cars in the EU. This has set a precedent for setting a definition for 'low-GWP'. Nevertheless, with the adoption of the EU F-Gas Regulation, the EU itself has moved away from this threshold when it added another 'low-GWP' limit of 750 for small air conditioning equipment.

The Technical and Economic Assessment Panel (TEAP), established as an advisory body to the Montreal Protocol Parties, in its Progress Report has made effort to categorise global warming potential (GWP) levels. However, it did not make clear recommendations on how these should be used for decisions by the Parties. The Task Force has classified GWPs in seven categories ranging from "ultra-low" with GWP < 30, "very low" with GWP < 100, through to "low", "moderate", "high", and "ultra-high". It concluded that these GWP definitions would evolve as technology advances. In addition, TEAP has identified more than 80 substances as candidates to replace HCFCs and high-GWP HFCs – some of which have rather high GWP. With the lack of GWP thresholds, this adds to the overall confusion in the market as well as among policymakers.

Refrigerant manufacturers often market their new HFC blends as 'low-GWP' or 'lower-GWP' alternatives, while their GWPs range greatly, often reaching values higher than 600 or even 1,200.

Besides the wide-ranging definitions of GWP limits, unsaturated HFCs are sometimes referred to as 'non-Freon' refrigerants, just one of the errors that create misunderstanding.

Should GWP be the only parameter?

Their global warming potential (GWP) is usually measured over a period of 100 years with reference to CO₂. Nevertheless, considering the relatively short lifetime of HFCs in the atmosphere, a shorter horizon, such as 20 years, would much better reflect the effects of these gases on the climate. For instance, R134a, an HFC currently accounting for over half of f-gases used in refrigeration, air-conditioning and heating, has an atmospheric lifetime of ~14-16 years. Its GWP over 100 years is 1,430, while the GWP over 20 years, which is much closer to its actual existence in the atmosphere, is 3,830.

The excessive focus on global warming potential is distracting attention from other effects of refrigerants that are currently being recommended as replacements for high-GWP HFCs. Just like the climate impact of HFCs was not seen an issue worthy of attention under the Montreal Protocol back in 2007, when the Parties adopted an amendment to phase out HCFCs, governments seem to be ignoring effects of the new generation of unsaturated HFCs on the toxicity levels of ecosystems, arguing that there is insufficient scientific evidence to prove any negative long-term effects.

There is also a debate about adding energy efficiency as another parameter when considering HFC replacements. Energy efficiency is particularly important in developing countries, where the need to pay attention to energy bills is often greater. Industry end users will also want to avoid adopting technologies that are more energy intensive. ■

Embraco Shares Research, Insights & Predictions on Light Commercial Refrigeration in the U.S.



In recent years, the refrigeration industry has been discussing and evaluating the environmental impact of the increased concentration of gases in the atmosphere and the greenhouse effect, as well as new laws and regulations for energy efficiency and use of refrigerant gases.

Embraco has been conducting research for many years and believes that the use of natural refrigerants is the future for refrigeration. Embraco has been applying natural refrigerants, such as R290 and R600a, and found that these alternative solutions reduce the negative effects on the ozone layer and improve equipment's energy efficiency rating. One of Embraco's goals is to offer the best refrigeration solutions for customers and educate the market about the importance of adopting alternatives to HFCs gases for the planet's future.

The use of natural refrigerants is also aligned to the North American standards and regulations. A recent Environmental Protection Agency (EPA) ruling is considering a ban of high global warming potential (GWP) refrigerants, such as R134a and R404A, in the next few years in several categories of commercial applications. Additionally, the California Air Resources Board announced that much stronger measures, very similar to the recent EU F-gas regulation, will be published in the next few months.

As a result, the chemical industry is beginning to offer a number of alternative synthetic refrigerants and additional options are coming, which is why Embraco performed a number of studies to assess their potential to replace high GWP refrigerants presently in use.

To provide an overview of the present testing state for R134a and R404A alternatives, Embraco developed a position paper. The position paper focuses on the reliability and performance of the alternative options and how they relate to the safety legislation evolution.

The position paper is based solely on research and testing activities performed by Embraco labs and supported by Embraco's experts, and aims to assess the transitory solutions towards low GWP refrigerants and provide an overview of the main outcomes for customers and stakeholders. Embraco is committed to continuing its research in natural refrigerants and providing solutions for refrigeration equipment that improve energy efficiency with low GWP.

To read the position paper, view global regulations and learn more about why Embraco believes natural refrigerants are the future, visit

naturalrefrigerants.info

embraco



Climate-friendly solar cooling in Jordan

By Christine Noel



TWO NEW SOLAR COOLING SYSTEMS HAVE BEEN COMMISSIONED FOR INSTALLATION AT THE IRBID CHAMBER OF COMMERCE AND THE ROYAL CULTURE CENTRE IN AMMAN, JORDAN. THE SYSTEMS USE SOLAR ENERGY IN COMBINATION WITH ABSORPTION COOLING UTILISING WATER AS A REFRIGERANT.

In Jordan, the demand for air-conditioning is increasing drastically. Until recently, the cooling technologies available in Jordan were less efficient, used climate or ozone-damaging refrigerants, and leaked heavily. In fact, Jordan's commercial sector, for instance, counts emissions of about 600,000 tons of CO₂ equivalent per year.

Due to hot weather, demand for air-conditioning and cooling systems is very high in Jordan. The climate conditions are particularly favourable for using solar energy to power the cooling process. Jordan does not possess any major resources like oil or gas, and energy prices heavily depend on the level of political stability in the region as a whole. As a result, solutions that are sustainable, reduce energy dependency and are climate-friendly are very much sought after in Jordan.

In view of increasing efforts to adopt more sustainable solutions for the cooling sector, the German Federal Ministry for the

Environment, Nature Conservation, Building and Nuclear Safety (BMUB) chose Jordan as a recipient of funding from the International Climate Initiative (IKI) for the project Industrial and Commercial Solar Cooling. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Technische Universität (TU) Berlin support the project in collaboration with the Jordan Environmental Ministry.

Back in 2015, two solar-powered cooling systems were installed at the German Jordanian University near Amman and at Petra Guest House. Their successful operation serves as a basis for the two new installations. As the first pilot project of its type in Jordan, its evaluation is crucial for the future of sustainable air-conditioning in similar hot climate regions.

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Absorption chiller
'Bumblebee'



Technology based on solar energy and natural refrigerants

The project aims to achieve a climate-neutral cooling process by using energy from solar heat. Inside the absorption system, the natural refrigerant water is used in combination with lithium bromide. The technology is similar to the heat pump principle. With solar energy, heat is transferred from low to intermediate temperature levels. Thereby, the low temperature level is cooled down to a greater extent, which generates the necessary cold for the application.

Solar heat collector fields were already in place at some of the project sites. In winter, the solar thermal heat is used for the heating systems, allowing for combined use and delivering financial benefits.

The Jordanian Ministry of Energy and Mineral Resources stipulates that 10% of the energy in Jordan must come from renewables by 2020, as opposed to below 1% in 2007. As a result, several solar collector fields have been installed in the country. As for refrigerants, a phase-out of HCFCs will be underway until the end of 2016. By using natural refrigerants, the project is thus a pioneer in Jordan.

A multi-level approach

One of the project's main goals is to actively transfer knowledge and technology during each project cycle.

GIZ and the Jordanian Environment Ministry are responsible for project implementation at practical level. While Millennium Energy Industries is the knowledge partner responsible for solar systems, more knowledge was required on how solar energy systems could be integrated in the cooling sector. The planning and implementation phases are therefore being carried out in close cooperation with TU Berlin, which is providing intensive technical workshops to the other project partners.

Marion Geiss, GIZ consultant for the project Industrial and Commercial Solar Cooling, is highly satisfied with the knowledge transfer on all levels: "A technical committee in which all the major universities and engineering faculties are represented is an integral part of the project's design. This ensures replication via the universities' curricula, thus mainstreaming solar cooling as an alternative technology."

Environmental and economic benefits

The project was implemented with the aim of reducing both direct and indirect GHG emissions of f-gases by installing solar cooling systems with natural refrigerants. By relying on solar energy and improving energy efficiency in general, the new technologies are set to reduce energy costs and ensure financial sustainability overall.

During its first summer of operation, the cooling system in the university was very stable, despite one of the pre-existing solar collector fields not working at optimal efficiency.

In the Petra Guest House, the first weeks of operations saw high electrical efficiency of up to 25 (25 units of cold produced per unit of electricity). However, temperatures were only 30°C during that period and, therefore, efficiency would be expected to drop as the temperature increases. Overall, the project partners were satisfied with the results so far.

This success is triggering the implementation of more projects in the future, starting with the two new systems commissioned at the Irbid Chamber of Commerce and the Royal Culture Centre in Amman. ■

Opportunities for natrefs in Indian fast-food industry



MULTINATIONAL FAST-FOOD BRANDS HAVE A MAJOR ROLE TO PLAY IN REDUCING INDIA'S RELIANCE ON HFCs. A NEW REPORT BY THE EIA RECOMMENDS THAT THEY COMMIT TO INSTALLING ONLY HFC-FREE EQUIPMENT IN NEW STORES AS OF 2019.

The Environmental Investigation Agency (EIA) recently released a report entitled 'Transitioning HFCs in India: The Opportunity for Climate Friendly Cooling in the Fast Food Industry', which looks at the potential of phasing out HFCs in this sector in India.

The Indian fast food market is expected to double in size from 2013 to 2016 and grow from \$15 billion to over \$50 billion over the next five years. The report highlights the need for fast-food companies in India to leapfrog HFCs and transition directly to natural refrigerants, as a means of reducing their growing climate impact, reducing energy consumption and improving the cost-effectiveness of the systems they run.

Fast-food restaurants generally contain multiple types of refrigerator, freezer, icemaker and soda machine. Additionally, their products are often stored in cold storage warehouses and transported in refrigerated trucks. To

combat increased HFC emissions, the Indian fast-food industry can invest in low-GWP cooling solutions to help accelerate market uptake of these technologies

Fast-food industry to have major impact on overall HFC reductions

Energy consumption due to refrigeration equipment normally accounts for 9-12% of a restaurant's total energy use. The EIA was able to garner the current GHG emissions and projected growth of seven multinational companies by studying their current HFC emissions footprint, projected growth, and commitments and actions to mitigate GHG emissions. The findings indicate that eight fast food chains in India could add close to 970,000 tonnes of CO₂ equivalent in HFC emissions by 2020. The impact from their refrigeration would equate to the annual emissions of about 205,000 cars.

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The projected emissions could be avoided entirely if these companies were to invest in transitioning to low-GWP technology and if they ensure proper disposal of their existing equipment by recycling or destroying the HFC refrigerants or any HFC-containing foam. The report stresses that investment in climate-friendly technologies in the fast-food industry will have a positive impact on the overall phase-down of HFC use, because it will help develop the necessary infrastructure of manufacturers, component suppliers, and service technicians. This will help build economies of scale for these new technologies, which in turn will help India meet its international responsibilities under the Montreal Protocol to reduce GHG emissions and increase energy efficiency.

While some international fast-food companies have made an effort to invest in low-GWP technologies in other countries, it is unclear how quickly they will transition to low-GWP refrigerants in their Indian operations.

Industry and academia see natrefs as ultimate solution in India

While Europe has seen significant market penetration of hydrocarbon refrigerants, with over two million commercial units installed over the last 20 years, the Indian market has yet to take advantage of this momentum.

A 2012 survey conducted by the Indian Institute of Technology, Kharagpur showed that awareness of low-GWP refrigerants is high throughout India. Respondents comprising 35% industry representatives and 65% academia were in agreement: the country needs to switch from HCFCs and HFCs to natural refrigerants. Additionally, 72% of respondents agreed that India should leapfrog the use of HFCs.

Benefits of natural refrigerants for Indian companies

As barriers to market entry are overcome, many Indian businesses are reaping the rewards of HFC-free cooling equipment. The cost savings that companies experience using natural refrigerants will help finance additional conversions to low-GWP equipment over time and help free up more resources for product development.

Hydrocarbon systems have been proven to work efficiently in high ambient temperatures, thus making them an excellent choice for the hotter regions of India. This is illustrated in a case study that compares energy use in a vertical freezer using HFC-404A and one using natural refrigerant R290 (propane). The propane unit showed 38% less energy consumption and a saving of \$1,260 over five years. Transitioning to hydrocarbon refrigeration systems will allow fast-food businesses to increase their return on investment while also reducing energy use and GHG emissions.

The EIA notes that while refrigeration efficiency is important for a business's bottom line, it also helps to decrease GHG emissions from electricity use. This investment in energy-efficient equipment helps companies to meet efficiency goals, reduce operating costs, and decrease the climate impact of their operations.

Additionally, while there is energy-efficient and low-GWP equipment in nearly all sectors, there is a huge business opportunity to produce the next generation of refrigeration and air conditioning equipment based on constantly evolving technology. Indian businesses could take advantage of this market development by directly transitioning to these new technologies while skipping HFC use.

Companies making progress outside of India

The EIA studied the commitments and actions of several multinational companies – including Burger King, Domino's Pizza, Dunkin' Donuts, McDonald's, Starbucks, Subway and Yum! Brands – with regards to transitioning to low-GWP equipment.

Some of these appear to be more focused on reducing energy consumption and emissions than others. Overall, the activities related to reduction of HFCs seem to be centred in Europe, while similar strategies are currently lacking in India.

Dunkin' Donuts publically releases information on its annual direct and indirect GHG emissions and is currently working to establish its 2020 and 2025 energy and GHG

ONLY EIGHT FAST FOOD CHAINS IN INDIA ADD NEARLY 970,000 MT CO₂E IN HFC EMISSIONS - THIS TRANSLATES TO ANNUAL EMISSIONS OF ABOUT 205,000 CARS



emission reduction targets. McDonald's has also made great strides. In 2003 it opened the world's first 100% HFC-free restaurant in Denmark and is operating several more in Denmark and Germany. Additionally it has installed more than 9,000 HFC-free pieces of equipment in Europe. With the growing awareness concerning HFCs in India, this could be a great opportunity for the company. In 2014 it reaffirmed its climate commitment by stating: "We will also continue to work with our equipment suppliers to develop and implement HFC-free refrigerant solutions."

Starbucks has plans to transition more than 150,000 units to natural refrigeration equipment. Subway uses hydrocarbon-based refrigerants in back-counter chillers in the UK and Ireland, which could be transitioned to its Indian operations.

Fast-food industry should avoid HFCs as of 2019 in India

The EIA acknowledges that while the companies that were studied made references to sustainability commitments to reduce GHG emissions, few specifically referred to low-GWP technologies and none mentioned investing in low-GWP refrigeration technologies in India.

Among its recommendations, the EIA stresses the need for fast-food companies operating in India to commit to installing more HFC-free equipment and not installing new HFC equipment in new stores past 2019. Additionally, companies should provide a date by which HFCs will be completely phased out in refrigeration equipment throughout the supply chain.

The government would also play a key role in facilitating the transition to HFC-free equipment through the introduction of enabling regulatory measures, such as a ban on the use of HFCs with a GWP over 1,000 in new food and beverage refrigeration equipment as of 2018. In addition, the government should support the industry by focusing its efforts on strengthening the capabilities of the servicing sector to handle equipment that uses HFC-free refrigerants, the EIA suggests. ■

CRS driving change in Africa

HAVING ESTABLISHED THE FIRST CO₂ TRANSCRITICAL REFRIGERATION SYSTEMS IN AFRICA, COMMERCIAL REFRIGERATION SERVICES (CRS), IS CONTINUING TO DRIVE THE PUSH TOWARDS NATURAL REFRIGERANTS LIKE CO₂ FROM ITS NEW BASE IN JOHANNESBURG, SOUTH AFRICA.

By Charlotte McLaughlin and James Ranson

Wynand Groenewald, CRS' head of engineering, has been busy highlighting the potential for CO₂ refrigeration in Africa. CRS currently has 53 CO₂ transcritical and three subcritical supermarket installations (that do not use HFCs) in South Africa to its name, a figure that is expected to rise.

Speaking to the Natural Voice, Groenewald said: "The trend will definitely evolve to the favour of CO₂. As the number of CO₂ installations grows, more results and case studies can be produced to show the benefits and feasibility of these systems to other end users."

They have also begun working with CO₂ heat pumps since 2015, which save 65%-75% energy compared to other electric heating units. Groenewald said the company already has eight heat pumps on tender. "Our prediction is to have 30-50 of these operational soon," he says.

'Huge impact of R22 ban'

Since 2015, it has been illegal to use HCFCs, including R22, in refrigeration, heat pump and air-conditioning systems in South Africa. Groenewald said the regulations were playing a significant role in accelerating the adoption of natural refrigerant technology and educating end users to make responsible business choices.

"It [the HCFC ban in South Africa] has definitely had a huge impact," he comments. "The industry is talking a lot more about taking up natural refrigerants."

"In the end it is more about convincing, or rather educating, the end user about phase-out regulations and where the future of refrigeration is heading. Often, end users do not know what is going on in the refrigeration industry and focus only on cost," he adds.



Wynand Groenewald
CRS' head of engineering

Huge potential in Africa

Groenewald sees population and economic growth in Africa as a potential driver for change.

"There is an opportunity to ensure that all developments start with natural refrigerants, and thus avoiding retrofitting these supermarkets in the future," he says.

"There is a massive opportunity for small-scale natural solutions such as split air conditioning-type units and domestic fridges. The growth in use of the appliances is impressive."

"Key barriers are regulations, cost (funding) and know-how," he explains. The government in South Africa does not have a plan to push manufacturers and installers towards natural refrigerants.

A potential way of changing this is, "if government should allow for funding to use natural refrigerants or taxation on non-natural refrigerants, the cost implications will ensure that developers prefer the use of naturals above other alternatives," he says.

The global HFC phase-down is already playing a role in influencing decisions to adopt natural refrigerant solutions in South Africa.

"We realise that although we as a country do not necessarily have strong legislation on refrigerants, we do rely on imports of goods; and if we ignore legislation in progress worldwide, that we will be left behind in the near future," he explains.

Africa's first CO₂ training facility

Central to CRS's distribution – and Africa's acceptance of natural refrigerant technology – is the company's new CO₂ training facility in Johannesburg, which has been fully operational since the beginning of this year. Featuring a transcritical booster system compatible with ejector technology and parallel compression, it has attracted the interest of HVAC&R professionals from Ghana, Ivory Coast and other African countries.

With its new training facility, Groenewald said CRS is seeking to raise awareness of natural refrigerants and improve contractor confidence in CO₂ technology throughout Africa.

CO₂ training facility
in Johannesburg



"We believe that one of the most crucial role players with expanding CO₂ is education," he says. "We want to use the facility to be a more reachable destination for African citizens, where they can learn and do practical work on an operating CO₂ system."

CRS is also dedicated to helping overcome barriers that are making it difficult to use natural refrigerants in the rest of Africa. "We are already pursuing feasible options within Africa for CO₂ refrigeration technology and hope to expand the use of naturals into Africa within the next few months," Groenewald says.

"Let's be part of the solution not the problem"

CO₂ is already becoming a more widespread technology in South Africa. "It has been proven over and over again that natural refrigerants are energy-efficient, and with the latest technologies they are energy-efficient within the majority of environments," he argues.



Asked what his message was for policy makers at the Montreal talks he said, "the technology is available and has been proven, there has never been a better time to react than now [...]. The legislation should come into play as soon as possible".

Part of his motivation and the motivation of CRS, "is to be part of the solution to global-warming and not be part of the problem," he says. ■

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China becoming more invested in natural refrigerants

A RECENT WORKSHOP HELD IN BEIJING CENTRED ON THE NATURAL REFRIGERANT TECHNOLOGIES THAT ARE BEGINNING TO BE INTRODUCED TO THE CHINESE COMMERCIAL AND INDUSTRIAL REFRIGERATION MARKETS.

By Lauren Clark

The International Workshop on Green Cold Chain Technologies, held on 9-10 September and attended by over 120 delegates, discussed the need to decrease HCFC use by using alternatives such as natural refrigerants.

During his opening remarks Xiao Xuezhi, deputy director-general of the Foreign Economic Cooperation Office (FECO) in the Ministry of Environmental Protection, detailed how China had met its 10% HCFC phase-out reduction target in 2015, ahead of schedule. He noted that to keep on progressing, it would be necessary to combine regulatory measures with incentives to reduce the use of HCFCs.

Patrick Haverman of the United Nations Development Programme (UNDP) highlighted the introduction of ammonia and CO₂ technology for cold storage and freezing applications as one of the milestones that had helped the country reduce its reliance on HCFCs in the sector of industrial and commercial refrigeration.

Potential for CO₂/ammonia growing in cold stores

While foreign multinational companies have mostly introduced natural refrigerant technologies to China, Chinese firm the Yantai Moon Group – represented at the workshop by Chief Engineer Jiang Shaoming – is pushing for natural refrigerant systems to be used in industrial refrigeration. In May 2011, the UNDP, the UN Multilateral Fund and the Ministry of Environmental Protection listed the Yantai Moon Group's ammonia/CO₂



cascade refrigeration technology as a suitable substitute for R22-based equipment.

The project was successfully accepted in June 2013. Since then, the Yantai Moon Group has signed 84 NH₃/CO₂ projects in China, with 40 of these completed and 20 still under construction. The group has been working to make CO₂ the first choice in refrigerant options to reduce ammonia charge in industrial refrigeration applications, while increasing energy efficiency.

Commercial refrigeration also eyeing use of natural refrigerants

The commercial refrigeration sector has also seen important developments in China. Anhui Hongfu, a local food retail chain, detailed their plan to introduce a first R134a/CO₂ system to replace the current R22 system in a 4,000 m² store. While international retailers such as Tesco and Metro have introduced more than 30 hybrid

CO₂ stores in China already, Anhui Hongfu is one of two local retailers to have gained first-hand experience with the technology.

The new system should be completed in December. It will reduce energy consumption by 23% and total equivalent warming impact (TEWI) by 22%. Hongfu hopes the project will encourage others to implement similar technology.

Carrefour is looking to implement its first transcritical CO₂ system in China next year. According to Harry Chen, Carrefour China's national engineering director, the retail giant is looking for a possible location to install the system. However, he notes that many challenges must still be overcome before implementation is possible. These include pressure design requirements and standards. Carrefour wants to use a simple system, manufactured in Europe and shipped to China for installation. ■

State-of-the-art TAFE equipping 'generation next'



Box Hill senior lecturer Len Raines

THE NEED TO RAISE TRAINING STANDARDS BY ARMING FUTURE PROFESSIONALS WITH NATURAL REFRIGERANT KNOW-HOW IS CENTRAL TO BOX HILL'S WORLD-CLASS EDUCATION CENTRE.

By James Ranson

The future of Australia's HVAC&R industry, expected to rely strongly on natural refrigerants, will require the next generation of technicians to be equipped with the skills to take up the baton.

At the Technical and Further Education (TAFE) Institute in Box Hill, Melbourne, senior educator Len Raines is well aware of the skills shortage facing the ageing industry and the integral role that training students on future technology will play.

Box Hill's state-of-the-art Refrigeration and Climate Control Centre of Excellence (RCCC) has been in operation for 18 months and includes an integrated technology hub (ITH) with 37 mobile workstations called PODs (Professional Organisational Development). The PODs are supplied by various suppliers and give the school flexibility and the capability to train students in hydrocarbons and CO₂ refrigerants.

The multi-million dollar facility, constructed to fit the Green Building Council of Australia's five-star standard, is the first of its kind in Australia and provides collaborative and innovative learning spaces not just for air conditioning and refrigeration students, but also for the mechanical, plumbing and electrical technology industries.

BRIDGING THE KNOWLEDGE GAP

Completed in late 2014, the college is a fine example of collaboration between the education sector, government and industry to help address a lack of quality training incorporating future technology at vocational level.

Raines admits, "the knowledge of most of the students coming in on natural refrigerant technology [is] not great". But he insists that courses like the Certificate III in Refrigeration and Air Conditioning and CO₂ and hydrocarbon modules are helping address the knowledge gap.

Key to the centre's commissioning was a connection made through the Air Conditioning and Mechanical Contractors Association (AMCA), who helped fund the project.

"AMCA came to Box Hill's management and expressed their ideas that they wanted a better product coming out of the colleges," Raines explained. "They felt the level wasn't up to the right standard and they made it clear that they wanted to put something back into the training to obtain this level."



The Heatcraft CO₂ POD

THE BOX HILL MODEL

One of the premier vocational and higher education providers in Victoria, along with RMIT University and colleges in rural hubs Bendigo and Wangaratta, the Box Hill Institute offers:

- » Certificate III in Refrigeration and Air Conditioning (3 years – 1060 hours)
- » Certificate III in Engineering – Mechanical Trade (specialising in refrigeration and air conditioning) (3 years – 980 hours)
- » Certificate III in Appliance Service (3 years – 1060 hours)

The facility boasts over 300 students and enables them to get real-world experience with natural refrigerants within the safety of the institute. The state government subsidises all apprentices, with students needing an employer to enter the trade.

Each course requires apprentices to complete three full years of training at Box Hill, as well as a fourth while on the job

with their employer, to become a fully qualified technician. Depending on the employer, an apprentice's fourth year of study can be curtailed if they are deemed fully competent on the job.

In the third year of the RAC and the engineering courses, students can take electives and occupational hazard and safety (OH&S) training in CO₂, ammonia and hydrocarbon refrigerants, while the Appliance Service certificate offers hydrocarbon competency only.

Raines said providing a course for students on hydrocarbon refrigerants required a slightly different approach, with occupational health and safety requirements as part of the programme. "I feel when I deliver the

hydrocarbon course I have to take the fear factor out a little bit, once you do that the students are fine." facility

Additional courses in natural refrigerants and subjects like business management are on offer to students wanting to obtain a Certificate Level IV. Raines says this is viewed favourably by leading end users and manufacturers in the industry.

A further 'master class' on natural refrigerants allows teachers and selected students to take personal development lessons for free. Apprentices and other industry professionals can make use of these as well.

RESISTANCE TO CHANGE

As a self-confessed 'oldie' Raines said only the industry could decide what legacy it will leave for the next generation of technicians. Some people are resistant to change but in the face of growing demand for natural refrigerants, he knows the industry had to adapt.

More recently, Raines has worked with natural refrigerants CO₂ and ammonia, collaborating on training projects with City Facilities Management and Coles, who have installed a hydrocarbon water loop system in their Coburg North store.

Coles have sent their qualified tradespeople to the RCCC to gain hydrocarbon competency. "They don't get a certificate but they are up-skilled."

Commissioned recently in May, Heatcraft supplied the equipment for a new CO₂ POD while HyChill fitted the hydrocarbon POD. ■

Powerful in subcritical and transcritical CO₂ applications

Designed for transcritical CO₂ pressures
LP 100 bar / HP 150 bar

Highest COP / EER
Compared to competitors

ASERCOM certified performance data



Low oil carry over

Optimized drive gear

Motors for variable speed control
frequency band 20–70 Hz (4- & 6-cylinder)

Oil pump
Optimal oil circulation
Oil pressure control (optional)
Therefore up to 20 Hz operating possible



GEA offers a variety of compressors for commercial and industrial cooling or heat pump applications for use with CO₂ as a refrigerant. What these compressors have in common is that they are optimised for use with CO₂ not only with regard to pressures but also in many other ways. Relevant features include a reliable design (to meet the challenges of CO₂ operation), very smooth running thanks to low levels of vibration and pulsation, quiet operation and incredibly low oil carry-over. The design engineers have also made provision for good thermal separation in the compressor, to the benefit of high efficiency.

The HX34 CO₂ T (4 cylinders) and HGX46 CO₂ T (6 cylinders) series of transcritical CO₂ compressors are capable of efficiency

performance data that is unrivalled by any other comparable product on the market, boasting the highest EER/COP values in the wide application limits. This efficiency is verified by certification of the performance data at several displacement stages by ASERCOM1. Available in various frame sizes, the transcritical CO₂ series cover a wide range of swept volumes from 6.2 to 38.2 m³/h (at 50 Hz) and are designed for operating pressures up to 130 bar.

The portfolio includes the HGX12e CO₂ (2 cylinders), HGX22e CO₂ (2 cylinders), HGX34e CO₂ (4 cylinders) and HG4 CO₂ (4 cylinders) series for subcritical CO₂ applications, catering a range of swept volumes from 1.6 to 48.2 m³/h (at 50 Hz).

The whole range is applicable for variable speed drive. With subcritical CO₂ compressors supporting an adjustment range from 25 or 30 to 70 Hz and transcritical CO₂ compressors (4 and 6 cylinders) supporting 20 to 70 Hz, they are able to cover a very wide performance range, giving rise to refrigeration capacity that is flexible enough to adapt to prevailing requirements.

Backpack ammonia-water vaccine chiller could save lives

A PORTABLE COOLING SYSTEM FOR TEMPERATURE-SENSITIVE VACCINES WON 22-YEAR-OLD DESIGNER WILLIAM BROADWAY THE UK JAMES DYSON AWARD ON 8 SEPTEMBER.

By Charlotte McLaughlin



The Isobar lightweight backpack unit cooler uses ammonia-water absorption refrigeration technology to keep vaccines cool for up to six days.

Broadway, a final-year student at Loughborough University, designed the backpack to be recharged on the go in just over an hour. This could make it an effective transportation system in rural areas where health services and electricity access are lacking.

Current vaccine programmes often fail to meet international standards for temperature-safe vaccine distribution. The NGO path.org found that many countries do not comply with safe vaccine transportation practices outlined by the World Health Organisation (WHO), causing vaccines to lose their potency.

Broadway had the opportunity to experience the challenges faced by medical staff in getting life-saving vaccines during a seven-week trip to Cambodia, China, Hong Kong and Vietnam, which he undertook before embarking on his university course.

Traditional vaccine coolers often freeze vaccines, "which is becoming a huge problem in third world delivery," says Broadway.

The Isobar is specifically designed to maintain stable temperatures of between 2°C (35°F) and 8°C (46.4°F) for an entire journey.

How it works

"It has two chambers and they have two sets of chemicals [ammonia and water] in the bottom. When you heat it, the chemicals separate and when you want the cooling effect, you flip the device over. When those two chemicals recombine, they give a really strong cooling effect," he explains.

The device is simple to use and can be worn as a backpack, making it easy to take to remote locations. It was inspired by an invention by Albert Einstein in the 1920s. Einstein's concept was originally intended to provide electricity-free refrigeration, which required only a heat source to drive a chemical process.

Broadway believes his system's potential is huge, not just for vaccines, but also for "organ and blood donation" and stem cell research.

Broadway says he will use the £2,000 cash prize that he received from the UK James Dyson Award to further develop prototypes and apply for patents.

"It gives me the confidence to pursue it with my whole heart in the knowledge that I can actually make this device and that it could have a great impact for the benefit of thousands of people," he told the Guardian.

His design will now be entered into the international leg of the James Dyson Award – the winner of which will be announced in October. The winner of that prize will receive £30,000 to fund further development. ■

Support for natural refrigerant technologies in Thailand

A NEW PROJECT JOINTLY SUPPORTED BY GERMANY AND THE UK THROUGH THE NAMA FACILITY WILL PROMOTE THE INTRODUCTION OF CLIMATE-FRIENDLY AND ENERGY-EFFICIENT TECHNOLOGIES USING NATURAL REFRIGERANTS IN THAILAND ACROSS A NUMBER OF APPLICATIONS. IT WILL TACKLE SUPPLY-SIDE ISSUES WITH INCENTIVES, AND ADDRESS DEMAND WITH AWARENESS-RAISING AND TRAINING SUPPORT OVER A PERIOD OF FIVE YEARS.

By Christine Noel

The project Thailand Refrigeration and Air Conditioning Nationally Appropriate Mitigation Action (RAC NAMA Thailand), launched in April 2016, received a grant of 560 million baht (approximately US\$16 million) and will be implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH until March 2021.

In Thailand, GIZ estimates that the refrigeration and air-conditioning sector is responsible for 50% of overall electricity consumption. In a business-as-usual scenario, energy demand for cooling is expected to triple by 2030.

A twofold impact

Energy suppliers in Thailand find it very challenging to satisfy this high electricity demand from the cooling sector, especially during periods of peak demand. In addition, direct emissions of the cooling sector in terms of refrigerant leakages have considerably contributed to Thailand's greenhouse gas (GHG) emissions. This is especially due to the usage of refrigerants with high global warming potential (GWP) in today's technologies.

In fact, cooling technologies in Thailand vary in terms of energy efficiency and climate-friendliness. While refrigeration technologies in the Asian country have already started to use low-GWP refrigerants and even natural refrigerants, this is not the case for the air-conditioning sector yet.

Peter Prügel,
Germany's ambassador to Thailand,
officially kicks off the project



The RAC NAMA Thailand project aims to both improve energy efficiency in the cooling sector and to increase uptake of climate-friendly technologies. "The project targets the use of natural refrigerants [and] depending on the sub-sector, e.g. air conditioning or commercial refrigeration, natural refrigerants such as hydrocarbons, CO₂ or ammonia will be promoted," says Tim Mahler, project director of the RAC NAMA Thailand.



Germany's ambassador to Thailand, Peter Prügel, said, "Thailand is an important industry hub in the cooling sector for both national and international companies. To be competitive, companies need to be able to adjust to the changing requirements – among others triggered by international agreements."

Tackling demand and supply side

The goal of project will be addressed both from the supply and the demand side. To increase demand for more climate-friendly technologies in the cooling sector, the project will develop labels and other incentives for end users of these technologies, such as retailers or hotels. The plan is to also implement a financial incentive scheme for sectors where low-GWP technologies already exist in the country, so that end users increasingly turn towards these alternatives. Furthermore, best practices of Energy Performance Standards will be showcased to this interest group. Concrete demonstration projects using natural refrigerants should be launched from 2018 onwards.

On the supply side, the aim is to strengthen the competitiveness of the Thai RAC sector. One significant barrier to the adoption of natural refrigerants is that the whole industry needs to be prepared from a technical point of view. For instance, some natural refrigerants have certain characteristics that need to be dealt with more carefully in order to ensure proper handling and safety. The project team is helping the Thai government to adopt new safety standards and develop guidelines with practical measures for RAC manufacturing and installation companies. These codes of practice will be aligned to international standards. In addition, supply partners will receive training for their staff within the scope of the project.

The project will also directly support companies financially when developing and adopting these new technologies. "The project intends to work with producers in the

air-conditioning, commercial refrigerator and chiller sector and will provide technical support. It will also support the manufacturers in covering the additional costs," says Mahler. The number of industry project partners will depend on demand, but the target is to involve at least one company from each sector.

As such, the RAC NAMA project promises to play an important role with regard to Thailand's overall climate goals. In fact, the large size of the RAC market and its major impact on GHG emissions is one of the key factors to be addressed when striving to achieve the country's reduction targets. In addition, it attracts international climate funding to Thailand.

The recently launched project is currently in its early stages. Before the implementation of concrete projects can begin, detailed analysis of the RAC industry needs to be conducted. ■

Short takes

By Lauren Clark & Charlotte McLaughlin

IRAQI EXPERTS RECEIVE HYDROCARBON TRAINING

By Lauren Clark

A group of Iraqi HVAC&R experts gathered in Casale Monferrato, Italy from 29 August-2 September 2016 to receive specialised training on alternative refrigerants for commercial refrigeration and the safe use of hydrocarbons in domestic and commercial refrigeration.

The purpose of the training was to ensure that Iraq has an established group of experts and trainers to promote and support the introduction of hydrocarbon and low-GWP refrigerants in the domestic and commercial refrigeration sector.

The participants will be responsible for running a local training programme in order to elevate the skills and capacity of local engineers and technicians in Iraq.

The training, funded by the Multilateral Fund of the Montreal Protocol and managed by the UN Environment Programme (UNEP) OzonAction, is part of Iraq's national strategy for phasing out ozone-depleting substances. The training was held in cooperation with the Association of Italian Refrigeration Technicians (ATF) and was hosted by the Centro Studi Galileo.

Through practical and theoretical training and field visits, the Iraqi experts acquired the necessary knowledge to train local engineers and technicians. This will hopefully allow Iraq to make significant progress in phasing out HCFCs and reduce its dependency on high-GWP and ODS refrigerants with available alternatives.

UNEP will continue to support Iraq through the next stages of its phase-out plan by ensuring that relevant stakeholders from the refrigeration and air conditioning industry receive the necessary training and capacity building. ■

GLOBAL REFRIGERATED WAREHOUSE CAPACITY INCREASES

By Lauren Clark

An August 2016 survey found that global refrigerated warehouse capacity grew to 600 million cubic metres between 2014 and 2016. Growth was mostly from emerging markets such as China.

The survey – from the Global Cold Chain Alliance, an industry group representing temperature-controlled logistics companies – reveals significant market change for newly industrialised countries.

Richard Tracy, the alliance's vice-president of international programmes, says, "what really causes the growth of the cold chain in developing and emerging markets is the growth of disposable income".

Tracy believes this can potentially present opportunities for the natural refrigerants market in developing countries if they can scale up.

"A lot of capacity in developing and emerging markets are growing with smaller-sized buildings and are thus not at the scale to use ammonia quite yet. There is a basic size that needs to be reached in order to make business sense to invest in the ammonia system over a less expensive system for the size needed," Tracy explains.

He states: "As low-charge systems become more and more mainstream, as emerging markets grow capacity, the change that needs to occur to natural refrigerants will happen. It is only a matter of time."

New technologies are also driving a further increase in natural refrigerants. He argues that, "there has been a good deal of exploration into CO₂ and into low charge ammonia systems".

Globally the market grew by 8.6% from 2014 to 2016, also from 2012 to 2014 cold chain capacity increased by 20%.

It was not as high as expected due to a decrease in cold chain capacity in many European markets. ■

TANZANIAN GOLD MINE OPTS FOR AMMONIA CHILLERS

By Charlotte McLaughlin

A gold mine south of Lake Victoria in Bulyanhulu, Tanzania has decided to install two ammonia-water chillers made by multinational refrigeration and engineering company Johnson Controls.

These chillers, produced by Johnson Controls and installed by BBE Projects - which provides turnkey ventilation, refrigeration and cooling technology – will supply water to a surface bulk air cooler (BAC) that will then cool workers.

Chillers service ventilation system

The chillers that supply cold air from the surface at temperature of 8 °C to the second ventilation shaft 1000 meters below the ground where rock temperatures can reach 50 °C were installed by BBE.

"The chillers are a repeat order for the mine. This project is Phase II of a cooling solution specified by consulting engineering firm Hatch in 2010. The first phase saw the implementation of an identical plant system for BAC on Bulyanhulu's main ventilation shaft" said Russell Hattingh, operations manager at Johnson Controls.

"Each shaft requires two BAC cells, and each BAC cell uses two chillers running in a lead-lag configuration. The pair of lead-lag ammonia water chillers supplied in 2010, and again now, complete the first cell of each of the two-cell BACs," Hattingh added.

Working in tough conditions

Richard Gundersen, director of BBE, which was responsible for the design, procurement and commissioning of the cooling system, said: "Key design requirements for the chillers were reliability, consistent performance in a harsh environment and climate, cost containment in terms of power consumption, and ease of maintenance."

The ammonia-water chillers met all the technical and design requirements that are required by BBE for these types of systems – BBE installed them for phase one and two – and hope to also implement them in the third stage of their building plan.

"Phase III of this solution will see another pair of chillers installed to increase cooling capacity by another 7 Megawatts of Refrigeration (MW_r)," said Gundersen.

Hattingh concluded: "The chillers that Johnson Controls supplied were able to meet the technical challenges. It is a solution that BBE and Bulyanhulu have used before, that has proven itself and can be trusted to perform in a remote, difficult-to-access location." ■

CASE STUDY: AL-SHAHINI COLD STORE, RIYADH, SAUDI ARABIA

By Lauren Clark

At the eurammon Symposium 2016, a case study was presented about a large cold store in Riyadh, Saudi Arabia. Entitled 'Efficient deep freezing under extreme conditions', the study showed that sustainable, environmentally friendly and economically efficient refrigeration was a necessity for this large store. Ammonia (R717) was therefore chosen as the refrigerant.

Among the challenges facing the project was the extremely high ambient temperature in Riyadh (up to +50°C), and the need for a constant temperature distribution as well as no air 'hot spots'. Another requirement was for all system components to be located outside the cooling room in order to ensure safety.

To meet these requirements and others, the project used Güntner THERMOSTORE technology with ammonia. This system is the optimal solution for deep-freeze stores and is very energy efficient. It can be positioned inside or outside the cooling room.

The THERMOSTORE system was ideal not only for its efficiency and safety, but also its practicality. It is extremely easy for technicians to service or clean the insulated chiller units. There are large service flaps on each chamber and the fans can slide out of the machine on rails for servicing. Additionally, the important parameters are displayed on a touch-screen control panel and ammonia leak detectors monitor each unit. ■



Natural Refrigerants, including hydrocarbons, ammonia, carbon dioxide, water and air have negligible global warming potential, and no ozone depletion potential. Natural Refrigerants are already the predominant option or can readily replace fluorinated gases in many sectors today. We call upon National Governments to acknowledge their potential to address direct emissions globally.

Natural Refrigerants have been known for decades as low-cost substances offering a technically viable and efficient solution for refrigeration, heating and cooling applications. They can be used safely applying industry best practice. We call upon National Governments to remove inappropriate obstacles, including national and international trade barriers and revise safety standards, codes and legislation that restrict their use without merit.

The Manufacturers and Users of refrigeration, heating and cooling equipment are convinced that Natural Refrigerants offer unexploited potential for developed and developing countries. We call upon National Governments to provide financial and non-financial support for the research and promotion of Natural Refrigerants and equipment based on these substances, as well as to facilitate a technology transfer from developed to developing countries, to fully exploit their ecological, economic, and social potential.

Effective action on fluorinated gases is a 'low hanging fruit'. We call upon National Governments to agree on an ambitious schedule for the reduction of hydrofluorocarbons in developed and developing countries under the Montreal Protocol without further delay. The signatories of this Statement stand ready to support Natural Refrigerants as a future-proof solution, and call upon National Governments to do the same.

Join 109 signatories at

www.thenaturalvoice.org

Contact us at

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