

SEPTEMBER 2018

ACCELERATE

ADVANCING HVAC&R NATURALLY

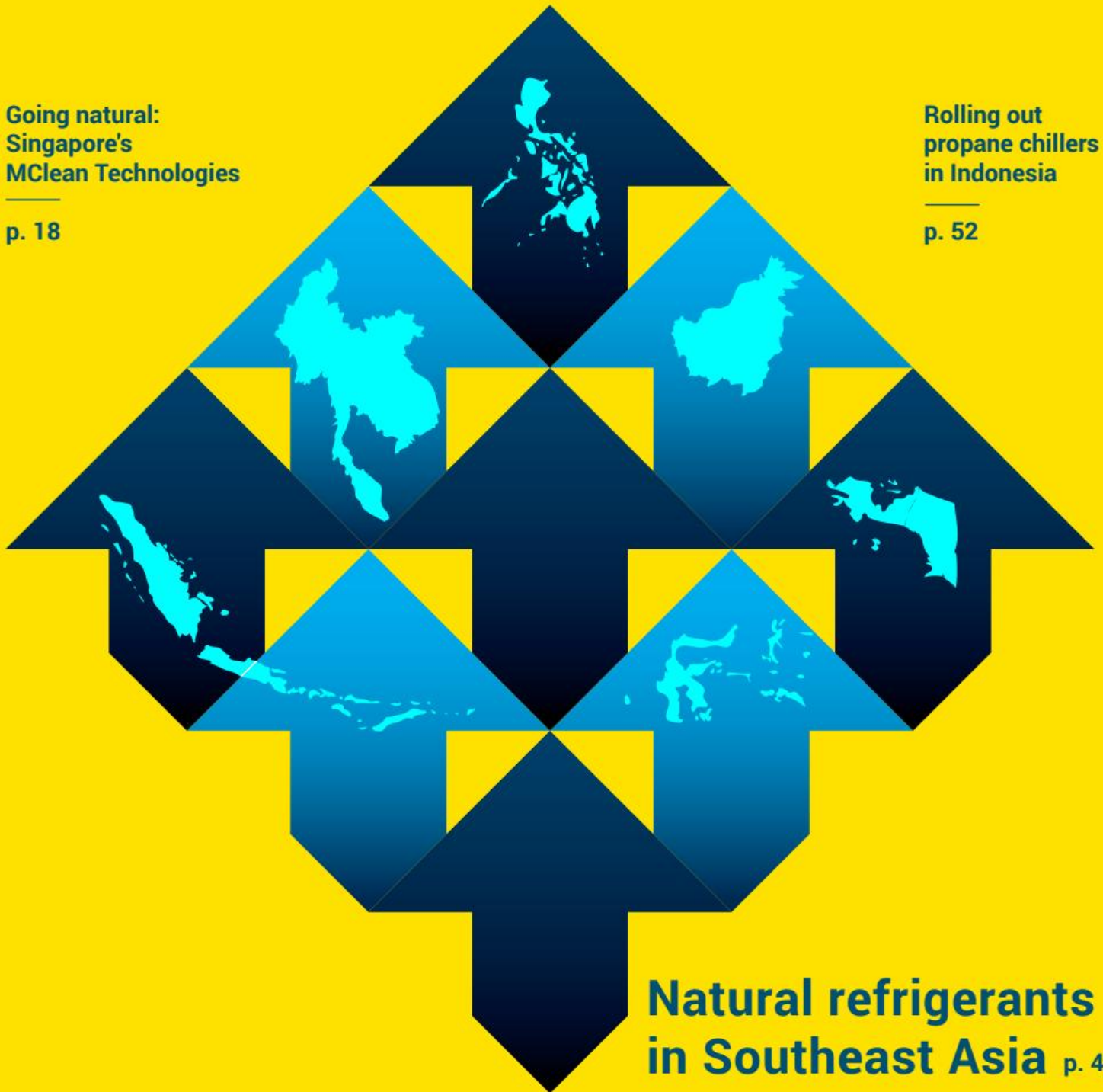
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Singapore's
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propane chillers
in Indonesia

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in Southeast Asia p. 48

On the rise



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A RISING TIDE

We are often told that nothing is happening for natural refrigerants in Southeast Asia. Yet the more we dig, the more we find.

As an organisation, shecco has been actively following developments with natural refrigerants in Southeast Asia for many years. But only recently have we begun to see a particular uptick in this activity. And it seems we have only scratched the surface.

Despite the region facing its own unique challenges, including a need for more government support, trained technicians, and high costs, we are seeing at first hand the momentum that is building on the ground – and with a population of more than 650 million people, what is happening in this region today has big implications for the global market for natural refrigerant technology in the future.

That is why right now is a crucial period for all industry stakeholders to come together and align themselves to take advantage of the coming opportunities.

With this first issue of *Accelerate Asia*, we intend to highlight the best examples of end users making the business case for natural refrigerants in Southeast Asia and around the world today, as well as to identify the biggest barriers holding progress back.

Accelerate Asia will be published and launched alongside ATMOSphere Asia 2018, to be held in Singapore on 4 September, where we aim to serve as the platform connecting the global industry with the local market and advancing the discussion among end users, policymakers, and technology suppliers.

Southeast Asia now has the opportunity to leapfrog HFCs and pre-empt the phase-down targets set by the Kigali Amendment. Our hope is that by bringing the industry together and shining a light on those demonstrating the business case for natural refrigerants today, the foundations will be set for Southeast Asia to take full advantage of the opportunities ahead.

Please enjoy our first issue and, as always, we welcome your comments – please contact me at jan.dusek@shecco.com.



Jan Dusek
Publisher





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SEIZING THE OPPORTUNITY

With the Kigali Amendment to the Montreal Protocol requiring governments worldwide to put in place HFC phasedown strategies, the time is ripe for the economies of Southeast Asia to begin their own transitions away from damaging refrigerants.

Southeast Asia has a population of some 650 million people and an established manufacturing base. Demand for and production of HVAC&R technology is growing fast throughout the region. The transition away from HFCs brings with it exciting opportunities for natural refrigerants. Our special feature looks at the views of technology manufacturers and suppliers on this evolving market ([p. 48](#)).

This year's ATMOSphere Asia conference on natural refrigerants, to be held in Singapore on 4 September, provides another opportunity to discover the market prospects for natural refrigerants in Southeast Asia. The event will bring together end users, policymakers, technology manufacturers and suppliers to discuss the latest market trends. Check out our preview and programme on [page 30](#).

Thailand's Charoen Pokphand Foods, one of the world's largest food processing companies, is among

the local end users adopting natural refrigerants in Southeast Asia, installing some of the country's first CO₂ heat pumps ([p. 14](#)). Singapore-based MClean Technologies, meanwhile, is trialling one of the city-state's first CO₂ heat pumps ([p. 18](#)).

Internationally, a number of leading consumer brands serve as impressive examples of what natural refrigerants can achieve. Heineken is committed to hydrocarbons for all its new fridges and draught beer equipment ([p. 22](#)), while a succession of inspirational leaders at Nestlé have helped bring natural refrigerants to new parts of the world ([p. 26](#)).

German multinational retailer METRO AG is installing CO₂ transcritical systems in some of its Chinese stores ([p. 40](#)), while Switzerland's Migros is pioneering propane-based water-loop systems in certain store locations ([p. 34](#)). A new hotel in Belgium, meanwhile, is arguably the country's most sustainable – largely thanks to a propane-based heat pump ([p. 36](#)).

Policy and standards can play a major role in helping to bring natural refrigerant technologies to market around the world, but can often also pose unnecessary barriers in a fast-changing HVAC&R sector. Another of this issue's special features looks at the policy inspiration that Southeast Asian countries can draw from various



Andrew Williams
Editor

other jurisdictions around the world, whose HFC phase-down journeys have already begun ([p. 42](#)).

International cooperation between Germany's GIZ, the Indonesian government and local manufacturers, meanwhile, is helping Indonesia to adopt propane chillers ([p. 52](#)).

On the industrial side, features on Scantec Refrigeration Technologies and its innovation with low-charge ammonia ([p. 58](#)), and Thailand-based I.T.C. Group turning to CO₂ to complement its ammonia offering ([p. 60](#)) complete this first edition of *Accelerate Asia*.

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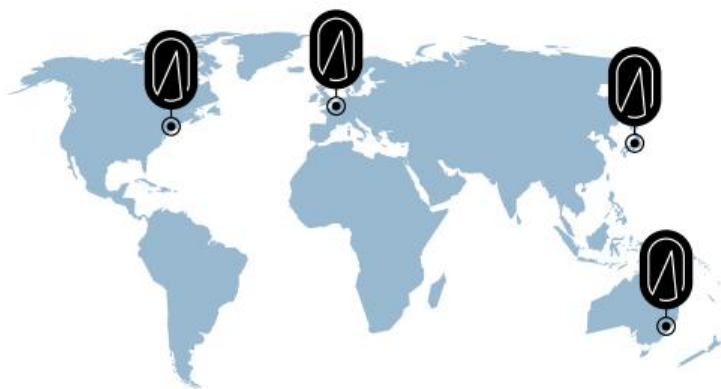
Brought to you by shecco, the worldwide experts in natural refrigerant news, *Accelerate Asia* is the first news magazine written for and about the most progressive business leaders working with natural refrigerant solutions in all HVAC&R sectors in Asia.

The *Accelerate* family of magazines includes editions in Europe, America, Asia, China, Japan, and Australia & New Zealand.

Printed copies are available to pick up at leading HVAC&R tradeshow and are posted to key end users and industry professionals.

<http://accelerate.shecco.com>

Accelerate publisher shecco's network spans the globe with offices in Brussels, Tokyo, New York and Sydney.



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AUG—



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SIVAR'18 Expo, Colombo, Sri Lanka

The event seeks to bolster Sri Lanka's HVAC sector and economy by showcasing technologies and through new business partnerships and enterprises.



www.sivarexpo.com

04.09

ATMOsphere Asia 2018, Singapore

The event, organised by *Accelerate* publisher shecco, brings together industry, end users and policymakers to discuss natural refrigerant trends in Southeast Asia.



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26-28.09

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31.10 - 02.11

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16-18.11

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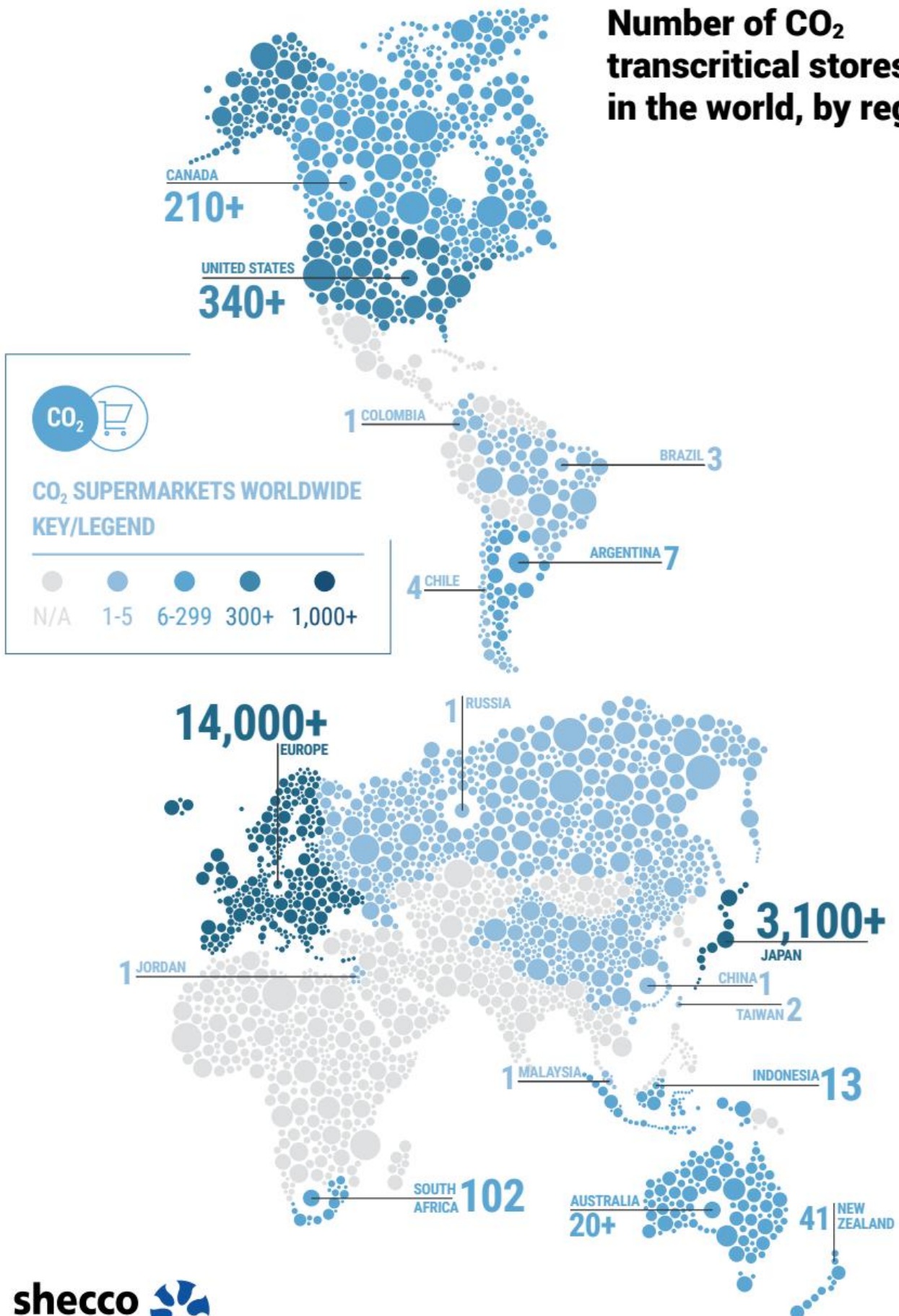
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Looking to the future with CO₂ heat pumps

Thanarak Kosalwitr, CP Foods

Thailand-based Charoen Pokphand Foods is one of the largest food processing companies in the world. By installing CO₂ heat pumps at one of its facilities, it is demonstrating how natural refrigerant systems can help Southeast Asian companies to mitigate greenhouse gas emissions while sustaining growth in today's fast-paced economy.

– By Devin Yoshimoto & Jan Dusek

C

haroen Pokphand Foods (CP Foods), a subsidiary of Thailand's largest conglomerate, Charoen Pokphand Group (CP Group), is one of the largest food processing, distribution and retail companies in the world.

At the heart of the company's business operation is the processing of livestock such as shrimp, chicken or pork and the production of ready-made meals. Though headquartered in Bangkok, CP Foods focuses on growing its business overseas, operating food manufacturing and processing facilities in Southeast Asia, China and India, and also exporting to Europe and most recently the United States.

As one of Southeast Asia's largest businesses, CP Foods understands its leadership role when it comes to environmentally sustainable business growth and development.

According to the company's 2017 Sustainability Report, CP Foods aims to reduce energy consumption by 15% and greenhouse gas (GHG) emissions by 15% per production unit by 2020 (compared to the base year 2015).

Thanarak Kosalwitr, CP Foods' vice-president of corporate engineering, is leading the charge on this initiative internally.

Kosalwitr told *Accelerate Asia* about installing the company's first CO₂ heat pumps as well as his motivation for pursuing natural refrigerant technology.

REPLACING FUEL BOILERS WITH CO₂ HEAT PUMPS

In late 2017 and early 2018, Kosalwitr oversaw the installation and commissioning of some of the first CO₂ heat pumps in Thailand.

A total of eight EcoCute UNIMO water-sourced CO₂ heat pumps, supplied by Japanese manufacturer Mayekawa, were installed at CP Foods' poultry food processing plant in Nakhon Ratchasima (also known as Korat) province in Thailand.

The UNIMO heat pumps were installed to replace a large portion of the plant's hot water supply needs, which were traditionally provided by fuel oil boilers.

Initial projections estimate energy cost savings of 38% and a CO₂ emissions reduction of 63%.

CHAROEN POKPHAND FOODS (CP FOODS) AT A GLANCE

Sales revenue in 2017:

501,507 million Baht (~15 billion USD)

Core business: Integrated agro-industrial and food (livestock and aquaculture such as swine, broiler, duck, shrimp and fish).

2020 energy consumption and emissions reduction targets:

1. Reduce energy consumption per production unit by 15% compared to the base year 2015.

2017 performance: Reduced energy consumption per production unit by 11.6% compared to the base year 2015.

2. Reduce GHG emissions per production unit by 15% compared to the base year 2015.

2017 performance: Reduced GHG emissions per production unit by 6.97% compared to the base year 2015.

Mayekawa's UNIMO water-to-water heat pump.

SYSTEM DETAILS:

Unit name: EcoCute 'UNIMO W/W' CO₂ heat pump

Number of installed units: 8

Heating capacity: 100 kW

Hot water supply: 60°C or 90°C (22°C cold water)

COP: 8 (with integrated heating and cooling)

Dimensions (mm):
W 1,140 × L 1,293 × H 1,919



Kosalwitr notes that actual performance data is still being collected as factory staff undergo a learning curve of fully integrating the CO₂ heat pumps into the factory's food processing and manufacturing processes.

"We have had some challenges, and the system's operation has changed a bit as we expanded the capacity and are using the hot water in different ways," says Kosalwitr.

There is no issue with the system, Kosalwitr says, so the focus now is on training and educating staff on optimising the system's implementation and use as well as the process of data collection and analysis.

"We will have the real figures at the end of this year," he says.

One benefit, however, has already been realised. The installation of the CO₂ heat pumps has significantly reduced the risk to which CP Foods is exposed with respect to oil prices.

"It fluctuates," says Kosalwitr. "When the price of crude oil increases, we have a problem."

This first installation received funding assistance from the Joint Crediting Mechanism (JCM) subsidy scheme – an agreement signed between the Thai and Japanese governments to help introduce new low-carbon technology.

This, in combination with reducing exposure to oil price fluctuations, has greatly reduced the project's payback period. Kosalwitr is now confident enough to begin planning the next CO₂ heat pump installation.

"Oil prices, in fact, have recently been increasing," says Kosalwitr.

"So with the subsidies, we might achieve a four-and-a-half to five-year payback period. This has made me confident enough to go ahead with our next CO₂ heat pump project, which might also be in Korat near the one we just installed."

ABOUT THE JOINT CREDITING MECHANISM (JCM)

Initiated by the government of Japan in 2011, the Joint Crediting Mechanism (JCM) is a bilateral project-based cooperation framework that aims to assist both Japan and developing countries in reducing their greenhouse gas emissions.

Essentially, the scheme aims to support the diffusion of advanced low-carbon technology (including natural refrigerant-based technology) from Japan to developing countries, with both countries being credited for the reduction achieved by each project.

Thailand and Japan have agreed to cooperate via the JCM programme, signing an agreement on 19 November 2015.

To date, 17 countries have signed agreements with Japan including Thailand, Indonesia, Vietnam and most recently, the Philippines, among others.

For more on the JCM, visit <https://www.jcm.go.jp>.

A PARADIGM SHIFT

For Kosalwitr, the drive to keep up with industry and technology changes stems from his personal passion for learning about new things.

"For me, anything new, I'm interested in," says Kosalwitr.

"And then trying to learn about something new is one of my passions as well."

This personal passion, however, also serves a very important purpose for both himself and his team at CP Foods.

"We have to survive as a business, and if you stay still, you'll become a kind of dinosaur," says Kosalwitr.

He explains that the need to change, adapt and innovate, especially with new technology, is key to the survival of the business.

"If I'm not innovative enough to adapt we won't survive – simple," says Kosalwitr.

He actively encourages his team to track the latest trends or news about the business and technology.

Anticipating the change coming in HVAC&R technology worldwide is something Kosalwitr is following closely as it is a key part of CP Foods' business operations. As an example, in addition to CO₂ heat pumps, Kosalwitr mentions that he is looking into learning more about the recent trend of CO₂ transcritical systems being used in the food processing and cold storage sectors.

Implementing these small steps needed in his business today in order to be ready for the future is all part of Kosalwitr's mindset towards leadership and surviving in today's market.

"Change is not enough," he says.

"For me, I use another term. I say we have to go forward with a paradigm shift. Change is horizontal. A shift is horizontal and vertical. If you go higher you will survive." ■ DY & JD

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***MCLEAN
TECHNOLOGIES
GROWS
BUSINESS BY
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MClean Chairman Jason Yeo

Singapore-based MClean Technologies has installed and tested one of the country's first CO₂ heat pumps. Given the heat pump's potential to reduce energy costs by up to 70%, the company is now planning to roll them out in all its facilities. *Accelerate Asia* reports.

– By Devin Yoshimoto & Jan Dusek

The government of Singapore has been taking increasingly proactive steps towards reducing the country's greenhouse gas emissions – implementing a carbon tax and stating its intention to financially support energy-efficiency initiatives beginning in 2019.

Singapore's target, under the Paris Agreement, is to reduce emissions intensity by 36% below 2005 levels by 2030.

With respect to the HVAC&R sector, Singapore has yet to ratify the Kigali Amendment to the Montreal Protocol, which aims to prevent a 0.5°C rise in temperature by 2100 through a worldwide phasedown of global warming-causing hydrofluorocarbons, or refrigerants known as HFCs.

Some companies are already preparing for the new business opportunities being created by this shift towards energy-efficient and environmentally friendly technologies, especially in the HVAC&R sector.

One of these companies is Singapore-based MClean Technologies Pte. Ltd. (MClean).

The company, whose main business is providing precision cleaning services for the semiconductor, hard disk drive and medical device industries, has recently installed and trial-tested a CO₂ heat pump at one of its facilities.

The CO₂-based heat pump supplies hot water for the company's business operations and is expected to save up to 70% on the firm's energy costs as it rolls out the technology to all its facilities, replacing older traditional electric resistance hot water heating systems company-wide.

MClean is led by Chairman Jason Yeo. Yeo, who is himself a trained engineer, tells *Accelerate Asia* about his experience testing the technology and his vision for how harnessing natural refrigerants could contribute not only to his business's bottom line but also to the sustainable development of Southeast Asia's entire industry as well.

“According to our calculations, we can save almost 70% [on energy costs].”

– Jason Yeo, Chairman, MClean

TESTING ONE OF THE FIRST CO₂ HEAT PUMPS IN SINGAPORE

Early this year, Yeo decided to move forward with a trial test for the CO₂ heat pump at MClean's facility in Singapore. The company installed one 'ECOSTAR CO₂ Solution' heat pump provided by another Singapore-based company, Energeia Technologies.

Hot water is vital for MClean's precision cleaning process. The company uses ultra-clean distilled water that must be heated to 60°C to clean trays and components.

Until the trial, the company had always used electric resistance water heating.

The CO₂ heat pump trial testing period lasted several months, while Yeo and his team benchmarked basic energy consumption data. When the data was collected and analysed, the results not only confirmed but exceeded Yeo's expectations.

As per data collected in May, the 'ECOSTAR CO₂ Solution' heat pump supplied close to 800 litres of hot water per hour at 60°C at a daily average COP value of 4.2.

In other words, for every 6.3 kW of energy used, the heat pump was supplying around 27 kW of heating capacity. Inlet water temperature averaged around 27-34°C, while ambient temperatures averaged around 30-32°C.

This data was representative of the results seen in previous months of the trial-testing period, according to Energeia Technologies.

Yeo then compared these results to its internal company data on the energy efficiency of its conventional electric resistance water heaters.

"According to our calculations, we can save almost 70% [on energy costs]," says Yeo.

"We would have been happy even with 30%. But we know that we can save much more. Even with external factors like the environment, we will easily save more than 50%."

Once the testing was completed, Yeo says the decision to implement the new technology at MClean on a large scale was a no brainer.

"Basically, once I saw our potential cost savings, we decided to move forward," says Yeo.

"It is very much about the cost savings."

Asked when he estimates the installations will provide a return on investment, Yeo replies, "less than three years. It is very much worth doing for us".

Yeo says that the wheels are already in motion to begin installing the ECOSTAR system in both its planned new facilities as well as replacements for electric resistance systems in its existing facilities.

"We now have the operational data of the system, so we are going step-by-step to get them in," says Yeo.

END USER, TECHNOLOGY SUPPLIER, GOVERNMENT ALIGNMENT

Asked if he sees this technology being implemented in Singapore on a wider scale, Yeo replies, "for sure, Singapore is the right place for implementing all these innovative technologies".

"It's not only myself. There's a group of us working on environmental issues and looking for ways to improve the situation."

However, Yeo recognises the significant challenges facing industry in any country trying to change.

"It's not easy," he says.

"Innovation is a change. It's a change of systems and a change of concepts."

In Singapore, Yeo explains that there must be alignment between the government, technology providers, and end users before innovation can take place on a wider scale.

"Here, the government is obviously the key organisation that is pushing [for environmentally friendly technology]," Yeo explains.

"But in order to drive this forward, [end users] still need to get back to

the bottom line. How can we actually implement this [technology] in a way that benefits our 'P and L' (profit and loss) statement?"

"Then it also depends on how the technology suppliers can present to the end users. End users might not always understand the technology. So, it will take a bit of time. Implementation depends very much on the alignment of technology suppliers, policymakers, and end users."

"End users will only come to use the technology when those three parties are already aligned," Yeo says.

MClean, for its part, contributes to moving this conversation forward in Singapore by sharing its experiences, expectations and reasons for choosing to be the first to move forward with this technology.

"With every new technology," Yeo says, "the challenge is always the installation of the first unit".

"But I believe, once our first unit is installed, we can then look forward to the next hundred units. I'm very happy to share our experience with this new technology with everyone – that it's not only good for us, but for the environment as well." ■ DY & JD

Energeia's ECOSTAR CO₂ Solution Water-Source System.



System specifications

- **Company name:**
Energeia Technologies Pte. Ltd.
- **Unit name:** ECOSTAR CO₂ Solution Water-Source System
- **Unit model:** EN-10GW
- **Hot water supply:** 55-90°C
- **Horsepower:** 10 HP
- **Heating capacity (kW):** 28
- **Nominal input (kW):** 6.8
- **COP:** 4.1 (manufacturer spec)



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Cheers to a greener world!

Convinced of the role that natural refrigerants can play in reducing its carbon footprint, Dutch multinational brewing giant Heineken is adopting hydrocarbons for all its new beer fridges worldwide. *Accelerate Europe* reports from the company's global headquarters in Amsterdam.

– By Andrew Williams



Hans Donker (l) and Graeme Houghton (r),
HEINEKEN Global Procurement

Founded by Gerard Adriaan Heineken in 1864, today Heineken is the second-largest brewer in the world by revenue. It owns more than 165 breweries in over 70 countries and its beers are available in 192 nations.

The firm – whose brands include Heineken, Amstel, Strongbow, Red Stripe and Bulmers – is proud of its long history at the forefront of innovation.

Today, a team of modern-day pioneers are proud to be following in the footsteps of their innovative predecessors. In 2010, Heineken International CEO Jean-François van Boxmeer gave his team the target of reducing the energy consumption of beer fridges. Thus began Heineken's hydrocarbon journey.

Accelerate Europe was at Heineken's Amsterdam headquarters next to the former brewery to meet two of the people responsible for making this vision a reality – Graeme Houghton, Global Category Leader – Commercial Equipment & Servicing, HEINEKEN Global Procurement and his colleague Hans Donker, Global Category Buyer – Fridges & Draught Beer Equipment.

"I got the briefing, 'you need to buy green fridges'. That's what we said, so I asked, 'what's a green fridge?' It took them a few months to say, 'best in class'. That wasn't very specific," recalls Donker.

"So we thought about it ourselves, and we said, 'a green fridge is a fridge that has a hydrocarbon refrigerant, LED illumination, and a smart thermostat (energy management system)'," he says.

Once the decision had been taken to opt for hydrocarbons, things moved quickly.

"In that first year, we saved 30% on energy consumption," he says.

“We’ve got to the point where the green way – with hydrocarbons – is an accepted part of the Heineken way of life. And it’s reflected in our logo!”

– Graeme Houghton, Heineken

PROUD TO BE GREEN

Targeting 50% lower emissions from fridges by 2020, Heineken provides ‘green’ fridges whenever a fridge needs replacing and tests fridges against the Heineken Energy Efficiency Index (HEEI).

The brewer defines green fridges according to the following four principles: the use of hydrocarbon refrigerant, LED illumination, an energy management system, and energy efficient fans.

“We discovered hydrocarbons as part of our ‘Brewing a Better World’ programme. We adopted them for two reasons – one, because they help to deliver the energy efficiency that we want; and two, because of their significantly lower GWP compared to the existing refrigerants we used in our fridges,” Houghton says.

“So that was the pairing of it. We work with a number of cooling partners. We use an independent cooling advisory group, which helps us with the technology side of things, plus our cooling partners – the fridge manufacturers,” Houghton says.

To facilitate the optimal serving of Heineken and the other brands, whether in cans, bottles or draught, the company itself provides the infrastructure. “In the majority of cases, we own the fridges and draught beer equipment. We place it with our customers to help them serve the perfect Heineken,” Houghton says.

In 2017, almost 100% of the 137,818 new fridges Heineken bought had one or more (and in many cases all four) green features. CO₂ emissions per fridge were 48% less than in 2010 (2016: 46%). Since the beginning of 2018, 100% of the fridges Heineken is purchasing are ‘green’.

“Because of the lifecycle of fridges, which we expect to be around about eight years, we anticipated that in order to reach our target in 2020, we needed to start immediately,” Houghton says.

The company started to use fridges based on hydrocarbons in 2010. “We expect that by 2020, the majority if not all of our fridge population will be green, with natural refrigerants,” Houghton says.

“It’s a lifecycle thing. The policy is ‘all new fridges,’” he explains.

In Australia and New Zealand, the company buys 100 new fridges per year. In Southeast Asia, the figure is 6,000,

while the brewing giant buys 600 new fridges annually in Japan. Their typical lifespan is seven to eight years, meaning that Heineken currently has a total of around 50,000 hydrocarbon-based fridges in the region.

Adopting natural refrigerants is helping Heineken to improve the energy efficiency of its fridge portfolio. “When we started, we made enquiries with our fridge suppliers, asking them how many energy savings introducing hydrocarbon refrigerant, LED illumination, and a smart thermostat (energy management system) would deliver,” Donker says.

“They said, ‘if you do hydrocarbons, you’ll get 7% more efficient fridges; if you do LED, you’ll save 15%; and the energy management system gives another 15%’. That’s how it was described to us,” he explains.

The David XL green, Heineken’s propane-based draught beer dispenser.



“We adopted hydrocarbons for two reasons – one, because they help to deliver the energy efficiency that we want; and two, because of their significantly lower GWP.”

– Graeme Houghton, Heineken



FROM AMSTERDAM TO THE WORLD

With operations in so many countries, Heineken is mindful of the large contribution that adopting greener cooling practices can make to reducing its overall climate impact.

“Cooling is a significant part of our CO₂ footprint. We’ve got over a million fridges out there in the field. We’re reducing their energy consumption by half,” says Donker.

“We buy roughly 140,000 fridges a year,” says Houghton. “All the fridges we buy are hydrocarbons. We’re on a journey. It’s about changing our entire fleet.”

“The average lifetime of our fridges is about eight years, and we’re currently about eight years in. So if you do the maths – allowing for a bit of a dropout rate, it’s probably fair to say that we have about a million fridges in the market with natural refrigerants,” he estimates.

Heineken’s decision to use proprietary technology is an integral part of its wider strategy for reducing its carbon footprint. The company works with different fridge suppliers around the world.

The Blade – Heineken’s latest draught beer dispense innovation – has a keg volume of eight litres and is capable of chilling beer to 2°C, delivering beer at 3°C in the glass. It uses isobutane (R600a) as the refrigerant. “It’s already live in selected markets and will go further,” Houghton says.

The propane-based David XL Green draught system, meanwhile, stores and chills 20-litre kegs in a fridge directly below the counter so the beer does not have to travel far to the tapping point. Over 12,000 of the systems have been installed in 25 markets across Europe, Africa & the Middle East, Asia and the Americas.

David XL Green (double tap of beer) is the line extension of David Green (single tap of beer), the world’s first ‘green’ draught beer system.

“It’s about deploying the right equipment in the right outlet, and applying the right technologies to make sure you’re as efficient as possible,” Houghton explains. “It’s a holistic approach.” ■ AW

All Heineken’s new beer fridges use hydrocarbons.

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NESTLÉ'S PIONEERING VISION

Swiss multinational Nestlé began replacing its CFC and HCFC systems with natural refrigerants in 1986. Today, its commitment to adopting natural refrigerants for HVAC&R applications wherever possible is helping to bring the technology to new parts of the world. *Accelerate Europe* reports from Nestlé's hometown of Vevey.

— By Andrew Williams



Vincent Grass, Nestlé

From industrial refrigeration systems with NH₃/CO₂ at key production sites in Switzerland to ammonia-cooled data centres and the worldwide deployment of hydrocarbon-based display cabinets, the commitment of Nestlé to natural refrigerants is consistent and firm.

With snow-capped mountains casting their reflections in the water, visitors to Nestlé's lakeside headquarters in the Swiss town of Vevey cannot fail to be inspired by the magnificent surroundings.

Vincent Grass is a man with a vision as far-reaching as the lofty Alpine summits that tower above him on his daily commute to Vevey alongside Lake Geneva from his home in Evian, in nearby France. As refrigeration team leader in the 'corporate operations – engineering services' department at Nestlé, the Frenchman is responsible for turning the Swiss multinational's ambition to expand its use of natural refrigerants into a reality.

"We are expanding the use of natural refrigerants across the company," Grass says.

By 2020, Nestlé is aiming to reduce greenhouse gas (GHG) emissions per tonne of product in every product category to achieve an overall reduction of 35% in its manufacturing operations (versus 2010). Also by 2020, the company is aiming to reduce GHG emissions in its distribution operations by 10% (versus 2014).

Natural refrigerants have long played a central role in delivering this. Since 1992, Nestlé has invested CHF 299 million (USD 300 million) in replacing HFC systems with natural refrigerant-based alternatives for industrial refrigeration. It installed 47 new industrial refrigeration systems based on natural refrigerants in 2016 alone.

Reducing industrial refrigeration footprint

The majority of Nestlé's refrigerant consumption by charge is attributable to industrial applications.

About 90% of Nestlé's refrigerant charge – and potential risk in terms of direct refrigerant emissions – is in manufacturing. Commercial applications account for the remaining 10%.

"We're focusing on industrial because that's where we can make the biggest impact. It's where we have the biggest risk of leakage and the highest electricity consumption," says Grass.

"For most big plants, ammonia is the most efficient option. In combination with CO₂, you can address safety issues and still deliver low temperatures. By adding CO₂, you need more components but the compressors are smaller, so you're reducing your footprint too," he argues.

Nestlé is already using natural refrigerants for over 90% of its industrial refrigeration needs worldwide. In the Europe,



Nestlé's hometown of Vevey.

Photography by Anna Salhofer

Middle East and North Africa (EMENA) region, 91% of its industrial refrigeration is provided by natural refrigerants. In the Americas – Nestlé's biggest market is the USA – the figure is 95%. "In Asia, Oceania and the rest of Africa, we're at 84%," Grass says.

He says it is hard to predict when the firm will achieve 100% natural refrigerants for industrial use. The official target is simply to expand their use in industrial refrigeration by 2020.

"The thing is, we have many different applications in our factories, on different scales and at different temperatures. We also have different geographies, with different climates. The cooling demand is different," Grass explains.

"We strive to hit 100%, but we can't say when we'll be there. Achieving the last 10% is very difficult," he admits.

Factors slowing down progress include lack of available technology in some countries, restrictive charge limits in some jurisdictions, and transitioning away from existing HFC systems on recently acquired sites.

"We need to look at it product-by-product and application-by-application. You have the environment, the climate, the surroundings to consider," Grass explains.

Peter Jaggy is head of engineering at Nestlé. He stresses the need to ensure that staff in headquarters and throughout

the 119 countries in which Nestlé operates are on the same page. "On the fringes, there is a lot of activity which we don't necessarily see from here in headquarters. This is why it's not so easy to get from 90% to 100%," he says.

The renaissance of CO₂

Nestlé's natural refrigerants journey begins in 1986 – three years ahead of the entry into force of the Montreal Protocol on Substances that Deplete the Ozone Layer in 1989 – when the company began to replace CFCs and HCFCs with ammonia. "At that time, we focused our efforts on our biggest plants, deciding to move from CFCs directly to ammonia. Later, we extended our use of natural refrigerants to the replacement of HFCs in smaller systems," Grass says.

In 2000, Nestlé turned to natural refrigerant CO₂ for the first time. At a factory in Beauvais, France, it replaced 15 tons of CFC R13 installed in the 1970s with an ammonia-CO₂ cascade system in which the CO₂ circulates without compression. "This was a renaissance of CO₂. It had been used at the turn of the century, but for over 50 years it had not been used at all," Grass says.

In 2001, Nestlé opened the world's first large NH₃/CO₂ cascade system to use compressed CO₂, built in cooperation with Star Refrigeration. It replaced an R22 system at Nestlé's coffee factory in Hayes, UK.

"The valves for CO₂ did not exist at that time. HERL was a valve manufacturer in Germany back then, and they developed the valves for us," says Grass.

What is driving Nestlé's phaseout of HFCs? "In many of the countries in which we operate, there is no regulatory deadline to change. But the day the units don't match capacity any more, we need to switch to another refrigeration solution," Grass says.

Nestlé's long experience with natural refrigerants makes them the obvious choice. "My predecessor's predecessor, Holm Gebhardt, was Nestlé's chief refrigeration engineer and did a lot of work on natural refrigerants," he says.

Gebhardt helped to convince not just Nestlé but the wider world that natural refrigerants are viable alternatives to f-gases. He was one of the founders of natural refrigerants advocacy group Eurammon in 1996.

In 2000, Gebhardt co-founded the now-defunct Carbon Dioxide Interest Group – bringing together manufacturers and end users – which blazed a trail by raising awareness of CO₂ technology's potential.

"This is why Nestlé is already above 90% natural refrigerants in industrial. We started this journey a long time ago. We've always been convinced that natural refrigerants are the right way to go," Grass says.

Brewing up a Nescafé

Nestlé's industrial processes require negative temperatures, sometimes as low as -50°C, for certain applications. Nescafé coffee, for example, is freeze-dried, with the water removed by sublimation. The company also requires freezers for its ice cream and frozen food brands.

New milestones have steadily been reached. In 2005, Nestlé commissioned its first chillers using hydrocarbons as the refrigerant (R290), in a confectionery factory converted to natural refrigerants in York, UK. "We couldn't hook everything up to the same system, so this is where we started to use hydrocarbon chillers – using water or glycol for the end uses," Grass says.

In 2006, Nestlé installed the world's first CO₂ ice cream freezer, in its factory in Bangchan, Thailand. "When you manufacture ice cream in a factory, you use a freezer in which you start to freeze the mixture. In 2006, this equipment did not exist for CO₂. We worked with suppliers to develop the first one," Grass says.





1 / Main entrance to one of the ammonia engine rooms, with chilled water piping connected to a water-side economiser. Nestlé data centre, Bussigny, Switzerland.

2 / Ammonia engine room with fixed and variable-speed driven screw compressors. Two compressors are driven by permanent magnet synchronous motors. Nescafé Factory (Orbe).

3 / CO₂ engine room with HPC 108S reciprocating compressors from Sabroe (JCI) operating at -54°C. Nescafé Factory (Orbe).

4 / Low-charge ammonia chiller (Chillpac product from Sabroe). Nestlé data centre, Bussigny, Switzerland.

All Nestlé's new ice-cream freezers now use hydrocarbons, either propane or isobutane. "We see good efficiency with hydrocarbons compared to HFCs. It's a significant difference," says Grass.

Nestlé first used a hydrocarbon-based ice-cream chest freezer in 2011. Since 2014, all the company's new ice-cream chest freezers in Europe have been HFC-free. This policy was extended worldwide in 2015. Since 2016, all its new ice-cream chest, upright and island freezers have used natural refrigerants worldwide.

Competing with HFCs

Asked whether Nestlé has the internal expertise to make the switch to natural refrigerants, Grass says: "We have to use suppliers. We work with the key industry players around the world". Jaggy goes further: "We depend 100% on them for the execution."

Assessing the performance of Nestlé's enormous asset base helps the company's suppliers improve their systems. "Worldwide, we have over a thousand ammonia compressors running at any one time. Thanks to this asset base, we see the issues," says Grass.

"In developed countries, the availability of service technicians is quite good, though it depends where you go. Elsewhere in the world, training can be a big issue. In a number of developing countries, if you want to install an ammonia chiller, then finding technicians and operators who already have experience of ammonia is a challenge. You'll have to train them," he says.

"Alone, we can't do much to change this. We pushed manufacturers to open service centres in remote areas, because we told them that we're not ready to pay for overseas assistance every time," Grass admits.

"For component manufacturers, offering training is potentially a big opportunity for their business model. There is a huge shortage of training facilities," he argues.

Another obstacle to wider use of natural refrigerant-based technologies is the cost gap with HFCs. "Non-natural systems often tend to be cheaper to acquire. This is one of the biggest challenges today. We have to continuously fight the battle of convincing our people that it still makes sense to do this, even if it would be cheaper to do something else," says Jaggy.

"We've seen some reduction. When we installed the ammonia heat pump in the Nest [Nestlé's discovery centre in Vevey], I was surprised because it was the first time that I had seen an ammonia system at the same price as an HFC system. It's more efficient and it is cost-competitive, so there was nothing else to say!"

"The efforts we're making save us a lot of money too. Yes, the initial investment may be more, for example after budgeting for safety considerations. But an industrial ammonia plant usually lasts for 30-40 years. When we opt for ammonia, we know there won't be any deadlines to phase out or replace it later," Jaggy says. ■ AW



ATMO
sphere

Business Case for
Natural Refrigerants

04/09/2018 – Singapore

**ATMOSPHERE ASIA GEARS
UP FOR THE LION CITY**



The 5th annual ATMOsphere Asia conference on natural refrigerant-based HVAC&R solutions for Asia will arrive in Singapore on 4 September, the day before comfort cooling exhibition Mostra Convegno Expocomport (MCE) Asia kicks off in the same city (5-7 September).

– By Eda Isaksson

With natural refrigerants poised to play a greater role in the global HVAC&R landscape following regulatory changes at global and national level (not least thanks to international agreements such as the Kigali Amendment to the Montreal Protocol), Southeast Asia – a warm-climate region with over 650 million inhabitants, whose growing middle class is fuelling increased demand for air conditioning – looks set to play a pivotal role in determining whether or not the world will meet its climate goals.

Singapore plays host to this year's ATMOsphere Asia, the Southeast Asian edition of the global ATMOsphere conference series organised by *Accelerate* publisher shecco to help bring climate-friendly HVAC&R solutions to market. The city-state is known for being international, technology-savvy and environmentally friendly – some of the same values embodied by ATMOsphere events.

Against this backdrop, the conference will serve as a platform to bring together local and international stakeholders with its comprehensive programme of sessions on policy and regulations, and market and technology trends. The programme features an end user panel, case study presentations and several networking opportunities.

Discussions will revolve around bringing sustainable and business-savvy natural refrigerant-based

HVAC&R solutions to market in Southeast Asia, addressing the opportunities and challenges faced by the sector, efficiency in warm climates, policy updates from Southeast Asia, and the latest natural refrigerant-based technology updates.

Among the event highlights is a diverse end user panel representing several different sectors, with interventions from Kiat Ananda Cold Storage (Indonesia's largest cold store operator); MClean Technologies (a Singaporean precision cleaning and surface treatment service provider); Phapros (an Indonesian pharmaceutical company) and hotel firms Fairmont Singapore & Swissôtel the Stamford and Hilton. These end users will present the HVAC&R needs of their businesses and their future plans. In acknowledgement of the crucial role they play in growing the natural refrigerant sector, end users are welcome to attend the conference free of charge.

Other key presenters include Stefan Jensen of Scantec (an expert on low-charge ammonia solutions), Inderpal Saund of Beijer Ref (an expert on CO₂ refrigeration) and Philipp Munzinger from GIZ Proklima (an international expert on hydrocarbon air conditioners). Bitul Zulhasni from the Indonesian government and Amy Charlene Wong from the Malaysian government will present their countries' activities to phase out HCFCs and reduce the use of HFCs, and discuss opportunities to leapfrog to natural refrigerants. ■ EI



ATMO sphere

Business Case for Natural Refrigerants

04/09/2018 – Singapore

PROGRAMME

TUESDAY 4 SEPTEMBER

09:00 / Welcome & Introduction

09:20 / Policy Session

Latest policy updates from Southeast Asia.

*Ministry of Environment and Forestry of Indonesia
Department of Environment of Malaysia
GIZ Proklima
National University of Singapore
sheccoBase*

10:30 / Networking Break

11:00 / NatRef Solutions for Asia

A strategic discussion about market and technology trends.

*Scantec
Sphere Solutions
Beijer Ref
Embraco
Godrej
sheccoBase*

12:30 / Networking Lunch

sponsored by Sphere Solutions

14:00 / Future of the Industry End User Panel

End users sharing their experiences and future plans with natural refrigerants.

*Kiat Ananda Cold Storage
MClean Technologies
Phapros
Fairmont Singapore & Swissôtel The Stamford
Hilton*

15:30 / Networking Break

16:00 / Technology Case Studies

*Scantec
Sphere Solutions
TEKO
Emerson
Embraco
ASHRAE Thailand / ITC
GIZ Proklima*

17:45 / Conclusion

18:00 / Networking Dinner Reception

Programme subject to change.

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MIGROS PIONEERING WATER-LOOP TECHNOLOGY

Migros has been installing propane-based water-loop systems as an alternative to CO₂ transcritical refrigeration in its smaller stores. *Accelerate Europe* reports from the Swiss retailer's pilot propane water-loop store in Zürich, Switzerland.

— By Andrew Williams

RIGHT

R290 water-loop store, Zürich, Switzerland.

Founded in 1925, Migros is Switzerland's largest retail company, its largest supermarket chain and its largest employer. Structured as a cooperative with over two million members, every adult living in Switzerland can become a member, receive one share for free, and vote in the general assembly.

The 'Generation M' programme governs Migros' sustainability objectives across five areas – consumption, environment, employees, society and health. For supermarket refrigeration, CO₂ transcritical has been the retailer's standard system choice since 2010.

Proud of its history at the forefront of innovation, Migros is also keen to trial new technologies as it searches for the most effective means of meeting its sustainability targets, says Urs Berger, who heads the Energy and Building Technology department at Migros Engineering Solutions (MES). This is what drove some Migros cooperatives to begin installing water-loop HVAC&R systems in supermarkets.

Water-loop systems represent an alternative method for businesses such as supermarkets to supply their refrigeration needs in a more flexible, decentralised manner.

Migros currently boasts 25 supermarkets fitted with water-loop systems based on natural refrigerant propane (R290). *Accelerate Europe* reports from Migros' pilot propane water-loop store in Zürich, Switzerland – where the system was installed in May 2016 – to find out what's driving interest in this technology.

Rather than cooling the whole supermarket from a centralised refrigeration plant, each wall-mounted display case runs off its own propane system.

The exhaust heat is carried away by a water loop.

"There are three hydrocarbon circuits within each cabinet. The new edition contains only one circuit per cabinet. The water-loop rejects the heat to a nearby logistics centre, where it provides hot water for the central heating system," Andreas Moser, who works on energy efficiency and climate protection in Berger's team, told *Accelerate Europe*.

For Migros, the business case for choosing a water-loop system is at its most compelling if the store is small enough, if there is limited space on site for a machine room, and if there is demand for hot water elsewhere on the premises.

"Part of the motivation for installing these R290-based water-loop systems is if you don't have space on site for a machinery room," says André Deppeler of *Cooperative Migros Zürich*, who is responsible for the system seen by *Accelerate Europe* in the Zürich store.

"They also make sense if you connect them to another water system, or if there is demand for hot water nearby," Deppeler says.

Reliability is another significant advantage of this configuration. "If something goes wrong, then it's only one cabinet that will fail, rather than the whole system. That's an advantage," argues Moser.

A competitive option for small stores

He believes water-loop systems are best suited to smaller stores.

"This system is very good for convenience stores and petrol stations," Moser says. "We've also got experience of using it in bigger shops, but there, we're asking ourselves if it's the right solution" given the competition posed by CO₂ transcritical condensing unit and rack systems, he admits.

Asked whether water-loop has the potential to become a serious rival to CO₂ transcritical, his colleague Berger replies: "Yes, in the niche market of small convenience stores up to a maximum surface area of around 500 m², and in train stations and petrol stations."

"Water-loop systems are interesting if you don't have space for machinery to produce the refrigeration centrally," says Berger. "It depends on the location in which you want to install the system."

Lithuanian firm Freor LT provides the 'Jupiter Green' cabinets in Migros' water-loop stores. The system also offers a heat pump box, which is an ideal solution for standalone shops in Switzerland's climate.



MES works with the HAVO Group, which supplies Freor products to the Swiss market. In addition to the cabinets, HAVO provides the piping, the controls, and the cooler outside – everything that is required for a complete system. "We seek one installer who is responsible for the lot," Berger says. "We prefer to have the whole installation in one pair of hands."

An attractive option for Asia-Pacific climates

He concedes that in Switzerland's climate, the efficiency of the R290-based water-loop systems does not always compare favourably with CO₂ transcritical solutions.

"If you're designing CO₂ transcritical systems for the outside ambient temperatures of Switzerland, then you're designing for up to 34°C," Berger says. Given that the average annual temperature in Switzerland is 9.5°C,

"you're only operating in that particular scenario for a few hours per year" – meaning that CO₂ transcritical remains the more efficient system, he admits.

The longer a CO₂ system must operate in high ambient temperatures, however, the more attractive a water-loop system becomes as an alternative option. In the warmer climates of Asia and Australia, therefore, the water-loop solution becomes more competitive.

As for Migros, the retailer will continue to install water-loop systems where there is a business case to do so.

"At Migros, most of our future expansion will be in small convenience stores, and in railway stations, and such like. We're looking for good, natural refrigerant-based solutions," Moser says. "This is one of them."

■ AW



The Corbie Ring Hotel, Lommel, Belgium.

Photography by: Charlotte Georis

A sustainable Belgian hotel, thanks to hydrocarbons

The Corbie Ring Hotel in Lommel, which officially opened its doors in February 2018, opted for the TripleAqua – a complete heating and cooling system that also stores energy – thanks to its efficiency and environmental credentials.

– By Charlotte McLaughlin

The Belgian town of Lommel – a jewel of the Flanders region – is rich in the quartz sand that forms the basis of the high-quality glass for which the area is famous. It is also home to the largest solar park in Belgium, which produces energy for over 24,000 households in the region.

The town now has another claim to fame – the Corbie Ring Hotel, arguably the most sustainable hotel in Belgium. During construction of the hotel, which is now partially open, the owner opted to install the TripleAqua: an energy-efficient heat pump employing natural refrigerant propane (R290), a hydrocarbon, with a global warming potential (GWP) of three.

“This is the most sustainable hotel in Belgium thanks to the TripleAqua,” Bart Beerten, owner of HVAC contractor Willems-Diels – which installed the unit at the Lommel hotel – told *Accelerate Europe*.

1 / Bart Beerten, Willems-Diels (l) and Filip Van Hulle, ECR Belgium (r).

2 / The hotel's breakfast area.

3 / Hotel owner Jan-Baptist Koch and ECR Belgium's Filip Van Hulle converse alongside the TripleAqua.

Jan-Baptist Koch, the hotel's owner, nods in agreement. "We asked [Beerten] to look for a good technique to put savings in our pockets, of course, [and one which] is environmentally sound."

The hotel has 27 hotel rooms and 20 business flats, with a small reception area and a breakfast area. It generally caters for business guests.

The TripleAqua, an invention of *Accelerate Europe's* 'Person of the Year' for 2017 Menno Van der Hoff (head of R&D and HVAC manager at Uniechemie, a division of Swedish HVAC&R distributor Beijer Ref), is an outdoor 113 kW unit. It has been placed on the roof of the hotel.

The unit provides the hotel's entire space heating and cooling throughout the year. It is connected to 54 internal HVAC units and a floor heating circuit, allowing guests and staff to adjust the temperature in individual rooms and common spaces according to their needs.

Van der Hoff explains, "this the perfect place to install it, as hotels have different customers with very different needs. One may wish to heat, another may want to cool".

"This is the first TripleAqua in Europe in a hotel," he says. "I am convinced that this application will take hold."

Many ideas, one solution

In choosing the right heating and cooling system for the hotel, HVAC engineer Beerten – who has run the Willems-Diels business with his wife since taking it over from his father-in-law over 20 years ago – went through several options.

He knew he needed an environmentally sound, cost-effective and long-lasting solution.

"The market is getting to more environmentally friendly [solutions]. People expect long-lasting and ecological" products and places to stay, Koch told *Accelerate Europe*.

Most hotels install a boiler and a separate VRF split air-conditioning (AC) system that traditionally uses high-GWP HFCs. The heat in the other Corbie hotel in Lommel, with solar panels on the roof, is produced by solar energy. Beerten installed that hotel's HFC-based VRF AC system only later, as air conditioning was not as popular in 2005 when the hotel first opened.

1 /



2 /



3 /



1 / Guests can regulate the temperature in their rooms.

2 / Hotel owner Jan-Baptist Koch.

"With VRF you need multiple copper piping and leak detectors in every room," Beerten explains. "[With the TripleAqua] water just goes through, also in the underfloor heating" – a simpler design for the installer, he argues.

"I also explained [to the owner of the hotel] that f-gases will be more expensive in the future," he adds. "Prices of R410A are increasing."

He first met Van der Hoff at an HVAC&R show where the latter was exhibiting the TripleAqua. He approached Filip Van Hulle, sales manager at ECR Belgium (part of the Beijer Ref Group) – who is responsible for TripleAqua sales in Belgium – to discuss various sustainable HVAC&R options.

Van Hulle proposed the TripleAqua, to produce all the building's space heating and cooling in combination with a condensing water heater to produce hot water, as an extremely energy-efficient solution. The other option was to install a separate heat pump to provide hot water to serve the hotel's entire demand, including the showers.

Beerten also looked at integrating solar energy into the hotel's energy picture. In the end he decided on the TripleAqua together with a separate condensing water heater for hot water production, with no solar panels because the heat pump takes up too much space on the roof. The solar park and wind turbines close to the town serve the hotel's energy needs.

According to Beerten's calculations, the current setup was the best option, as space heating and cooling is generally responsible for the majority of a building's energy consumption. It also had the highest payback for the end user and was the most environmentally friendly solution, Beerten argues.

For Koch, trust played a key role in following Beerten's recommendations. "I looked over it and said [to Beerten], if you say this is the best option, I will go for it," he said.

The return on investing in the TripleAqua will be four years, according to Van Hulle. Beerten has made a theoretical calculation comparing it to his work in the other Corbie hotel, where he installed a different heating and cooling system. "It's [around] 50% more efficient," he told *Accelerate Europe*.

Beerten also praises the uniqueness of the system. "We can take heat from the south [which has glass windows that warm up the reception area] and [redistribute] it to the north side," which does not get as much sun during the colder winter months.

"We [also supplied] the hotel [with a balanced] ventilation system," Beerten says. In a balanced ventilation system, a network of ducts throughout the building supplies air to vents in each room without the different airflows crossing each other, and recovers air through a heat exchanger.

"This allows us to recover warm air during the winter and cool air during the summer," Beerten says. Also, "during the winter the water is stored to be used later for heating," he notes.

An important aspect of the system is its low-temperature lift. Most heating systems use radiator pipes at temperatures of up to 70°C, according to Beerten, but rooms can be heated efficiently with under-floor water pipes at lower temperatures.

The TripleAqua generally heats and cools the three water pipes to return ambient temperatures ranging from 28-36°C and 12-16°C.

Another installation?

Koch is also expanding the family business: "We [may start building] a new hotel in the summer." The TripleAqua could also be installed there. Koch has been pleased with it so far and plans to add a page on the system's environmentally friendly credentials to the hotel guide that he is writing.

"We will convince them to install the TripleAqua [again]," Beerten says. "We think it's the best solution for a hotel."

■ CM



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BLUE-SKY THINKING:

Chinese retail's first transcritical CO₂ system

The installation of China's first transcritical CO₂ system in the retail sector, in a METRO wholesale store in Beijing, is just the first step in a journey that will see the German multinational fit transcritical systems in all its new Chinese stores by 2025.

— By Devin Yoshimoto, Jan Dusek & Yingwei Tao

One week before the grand opening of METRO China's new Beijing Lishuiqiao wholesale store in January, *Accelerate China* could not help but notice the clear blue skies and fresh, crisp air.

Despite Beijing's international reputation as a city with high levels of pollution, the situation is now changing. The Chinese government is continuing its aggressive push to curb pollution and put the country on a more environmentally sustainable footing.

Industry leadership is crucially important in this regard. By installing the Chinese retail sector's first transcritical CO₂ refrigeration system, METRO China hopes to demonstrate the potential of natural refrigerant-based HVAC&R systems to benefit both businesses and the environment.

Accelerate China toured the store with key members of the METRO China team – led by Head of Facility Management Alan Lin – alongside the main installation contractor, Shanghai Fute Refrigeration & Electrical Engineering Co., Ltd. (FUTE), to learn more.

A major milestone

METRO China's parent company, Germany-based METRO AG, is a world-leading international wholesale and food retail company whose F-Gas Exit Program has been in place since 2013. The firm aims to phase out f-gases in all METRO stores worldwide by 2030, replacing them with natural refrigerant systems where it is technically and economically feasible to do so.

For the METRO China team, this first installation of a transcritical CO₂ system represents a key milestone as they continue with their f-gas phasedown.

Thus far, the company has been installing subcritical CO₂ systems instead of f-gas-based systems. It is now beginning to transition towards using transcritical CO₂ technology as well.

2020: 'The end of R22'

"2020 will be the end of R22 for us," says Alan Lin, METRO China's head of facility management, who oversees the installations.

Lin explains that R22 installations are already banned in new stores and that they will be completely replaced by CO₂-based systems in 2020. "We have just finalised the designs for our cascade systems, at the end of last year," he says.

"So this year we are continuing to go step by step towards preparing for our 2020 target with our first transcritical CO₂ system," says Lin.

"It is planned that starting in 2025, all our new stores in China will be equipped with transcritical CO₂."

Preparing for transcritical

Preparations for METRO China's first transcritical CO₂ system began around two years ago, when the team started an intensive internal research and discussion process.

METRO China worked closely with colleagues at METRO headquarters in Düsseldorf, Germany to discuss and address the most important issues: the first of which was China's high ambient temperatures.

"In China, most urban areas have different temperature ranges," says Lin. "Yet during summer, 80% of the cities will reach over 35°C."



Alan Lin, METRO China

To find out whether transcritical CO₂ technology would be viable in China's climate, Lin and his team flew to Europe last year to inspect at first hand the latest transcritical CO₂ systems already in operation.

"We learned some real cases, like in Spain, where temperatures in some cities reach over 40°C," says Lin.

"When we saw that the transcritical CO₂ systems were functioning there, we thought to ourselves, 'OK, we can go this way', and got the confidence to move forward."

A second issue the team faced was the lack of local maintenance service providers in China. "This was the biggest challenge," admits Lin.

"For system components like the compressors and condensers, it would be OK to have them imported. But we thought the cabinets were the most important things."

Lin was fearful of something going wrong with the refrigerated cabinets on the sales floor. Only once the METRO China team had found the cabinets, the component suppliers, and the maintenance staff to service them within the local Chinese market did they decide to move forward.

Chinese retail's first transcritical CO₂ system

For this pilot transcritical CO₂ project in Beijing Lishuiqiao, METRO China decided to use the simplest version of the technology currently available on the market: a transcritical CO₂ booster system.

"For the first store, we are taking the safe way," says Lin. "We'd like to find out how suitable it is for China's environment and how it can be improved."

The system itself consists of two separate transcritical booster racks, provided by Italy-based CO₂ system manufacturer SCM Frigo.

With a total cooling capacity of 334 kW, the centralised system supplies the cooling requirements for the entire store, including its fresh sales areas, freezer room, cold room, and prep room.

Commissioning was completed in December 2017, and the store celebrated its grand opening on 17 January 2018.

Key to the success of the first six months of operation, Lin explains, is training the in-store technicians and store-operation team.

"Together with SCM Frigo and FUTE, we created a training programme for our store, which will consist of two parts," says Lin.

"The first is a deep introduction to the system, for our staff, covering the basic processes needed for daily maintenance and checking," he explains.

"Second will be an on-going training programme that will be held consistently for the next two years to help control the system and train, not only our store technicians, but technicians from other stores as well." ■ DY, JD & YT

Shaping the natural refrigerant future

Policies, standards and codes are an important driver for uptake of natural refrigerants, but can often pose unnecessary barriers in a fast-moving HVAC&R industry.

— By Klára Zolcer Skačanová

With the adoption of the Paris Agreement in 2015 and the Kigali Amendment to the Montreal Protocol a year later, governments around the world are intensifying their efforts to reduce the impact of refrigerants on the climate and environment.

The Paris Agreement reached among the countries of the world at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) aims to keep the global temperature rise below 2°C, while pursuing efforts to limit it to 1.5°C (compared to pre-industrial levels) by the end of the century.

In October 2016, the world's nations adopted the Kigali Amendment to the Montreal Protocol, a historic accord committing economies worldwide to significantly reducing the consumption and production of HFCs. The Kigali Amendment will help avoid an estimated 0.5°C of warming by 2100, making a significant contribution to reaching the overall target.

By end of July 2018, over 40 countries had ratified the Kigali Amendment, with more expected to do so before its entry into force on 1 January 2019.

Improving energy efficiency while phasing down HFCs will be crucially important for the successful implementation of the Kigali Amendment. This topic was at the top of the agenda for the Parties to the Montreal Protocol at their last meeting, held in Vienna, Austria on 11-14 July.

Prior to the formal meeting, a two-day workshop was organised dedicated to this topic. Whilst discussions primarily focused on the importance of system optimisation and maintaining existing systems to improve energy efficiency, some participants pointed out that the focus should be on HFC alternatives such as natural refrigerants and their potential to reduce energy consumption.

The Kigali HFC phasedown schedule

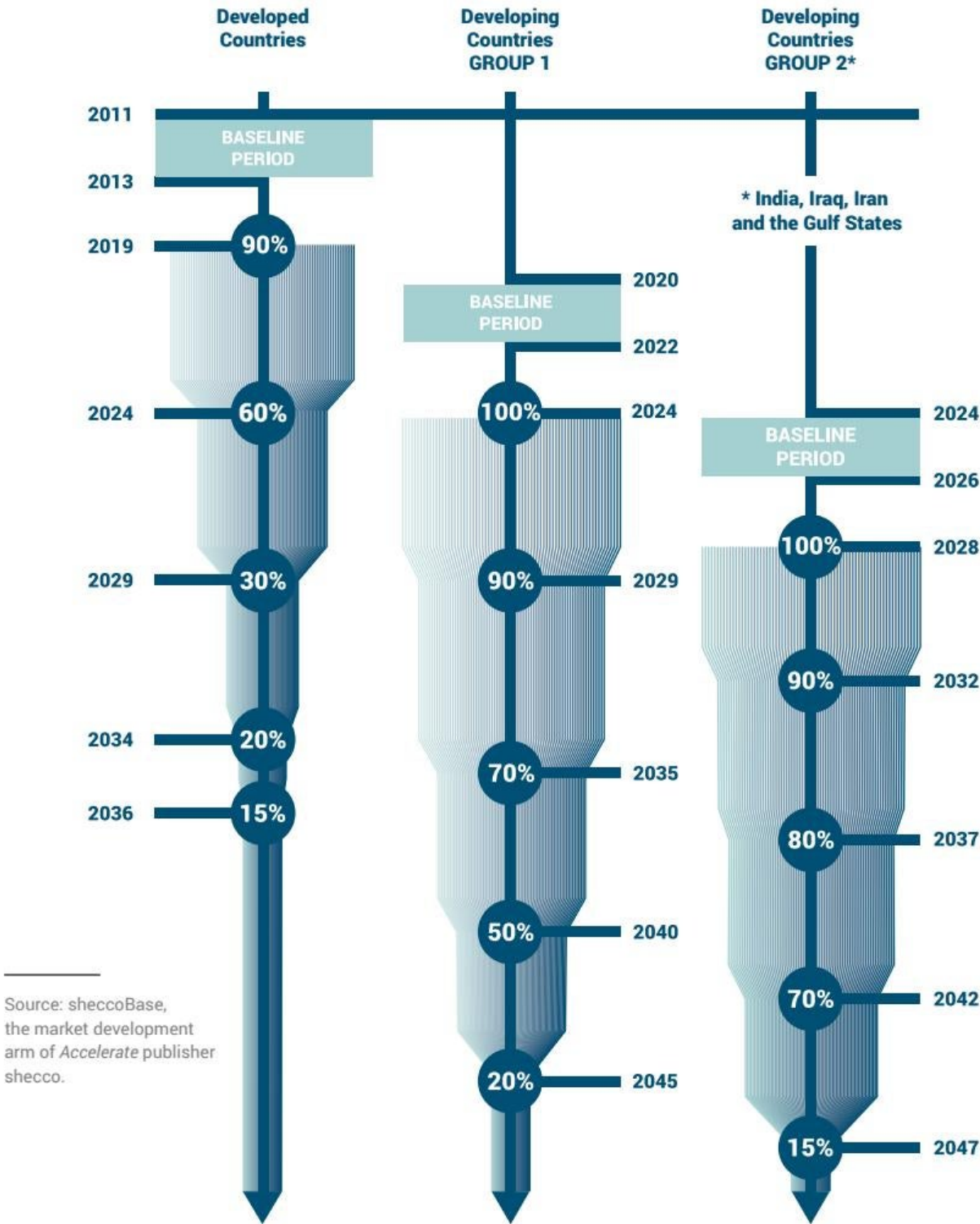
HFC phasedown under Kigali Amendment

Kigali sees developed countries take the lead on phasing down HFCs, starting with a 10% reduction in 2019 and delivering an 85% cut in 2036 (compared to the 2011-2013 baseline).

The amendment splits developing countries into two groups. The first one – which includes China, and Southeast

Asian and African nations – will freeze consumption of HFCs by 2024, with their first reduction steps starting in 2029 (compared to the 2020-2022 baseline).

A second group including India, Iran, Iraq, Pakistan and the Gulf countries will meet a later deadline, freezing their use of these gases in 2028 and reducing consumption from 2032 (compared to a 2024-2026 baseline).



To ensure implementation of the international agreement, governments are actively putting in place legislation that will give the HVAC&R industry the guidance they need to make sound investment choices.

EU: A model for global phasedown

The European Union adopted its new F-Gas Regulation back in 2014. The EU HFC phasedown measured in CO₂ equivalent (CO₂e), which is the cornerstone of this legislation, actually served as a model in designing the global HFC phasedown under the Montreal Protocol.

The EU F-Gas Regulation is currently the world's most ambitious piece of legislation regulating HFCs, impacting industry in 28 EU countries and beyond. It will limit emissions of fluorinated gases by two-thirds by 2030 (in CO₂e). The first big cut in HFC quotas (allocated to gas producers) in 2018 is triggering a huge price increase in commonly-used HFCs. While EU HFC prices grew five-fold in 2017, they are expected to spike 20 times by the end of 2018 as supplies contract sharply.

For example, the price of R134a – one of the most commonly used HFCs – increased from less than €2 per tonne (t) of CO₂e in 2014 to €16,40/t CO₂e at the beginning of 2018 (OEM purchase price), according to *Öko-Recherche*, a research institute monitoring HFC price development on behalf of the European Commission.

Besides the EU-wide HFC phasedown, the F-Gas Regulation also introduced a number of complementary measures, including sector-specific bans on high-GWP HFCs, containment and recovery measures, and minimum training requirements. These are supporting the HFC phasedown, helping the industry to transition away from HFCs and reduce the use of high-global-warming-potential (GWP) refrigerants.

California aspiring to lead

California is another region where legislators are working to introduce strict limits on HFC use, which are expected to outstrip the ambition of the EU F-Gas Regulation. In March 2017, the California Air Resources Board (CARB) approved the Short-Lived Climate Pollutant (SLCP) Reduction Strategy, which aims to reduce HFC emissions by 25% below business-as-usual levels by 2030 and by 40% by 2030. To deliver on this commitment, legislators are considering a combination of measures similar to those in the EU F-Gas Regulation.

Besides the phasedown and a sales ban on very high-GWP refrigerants, CARB considers sector-specific bans on HFCs in new equipment to be an effective measure for transitioning towards long-term alternatives such as natural refrigerants. "A prohibition or ban on the use of high-GWP HFCs in new equipment would result in certainty of reductions in applications where alternatives are readily available, and immediate HFC reductions that the global phasedown would not achieve until many years later," reads the SLCP Reduction Strategy report.

In parallel to the work of CARB, State Senator Ricardo Lara has introduced

the California Cooling Act, a bill that foresees establishing incentives for businesses and residents to replace HFCs with low-GWP alternatives. The bill would empower CARB to move forward with additional regulations to reduce emissions of HFCs.

"California has a global responsibility to address issues of [climate] change," said Lara at this year's ATMOSphere America conference – organised by *Accelerate* publisher shecco – in Long Beach, California (12-14 June). "We believe in science and scientists here in California, and allow them into the conversation," he added.

The work of California legislators becomes even more important in the context of current uncertainty at federal level, following a court case which ruled that the US Environmental Protection Agency's Significant New Alternatives Policy (SNAP) programme cannot require companies to replace HFCs designated for HVAC&R equipment or other applications with low-GWP substances under the existing programme; these substances include natural refrigerants and HFOs.

California's progressive environmental legislation, therefore, could eventually be adopted nationally for the entire US.

Japan's subsidy programme for natural refrigerant equipment, 2014-2018



Natural refrigerant subsidies in Japan

Imposing restrictions on the use of fluorinated gases is one way that policies can drive the reduction of refrigerant emissions. Some countries, such as Japan, have opted to also use financial subsidies to motivate end users to switch to long-term alternatives. Since 2014, Japan has implemented a subsidy programme for natural refrigerant-based equipment, which has been a major driver of its market growth. The scope of the subsidy has changed since 2014.

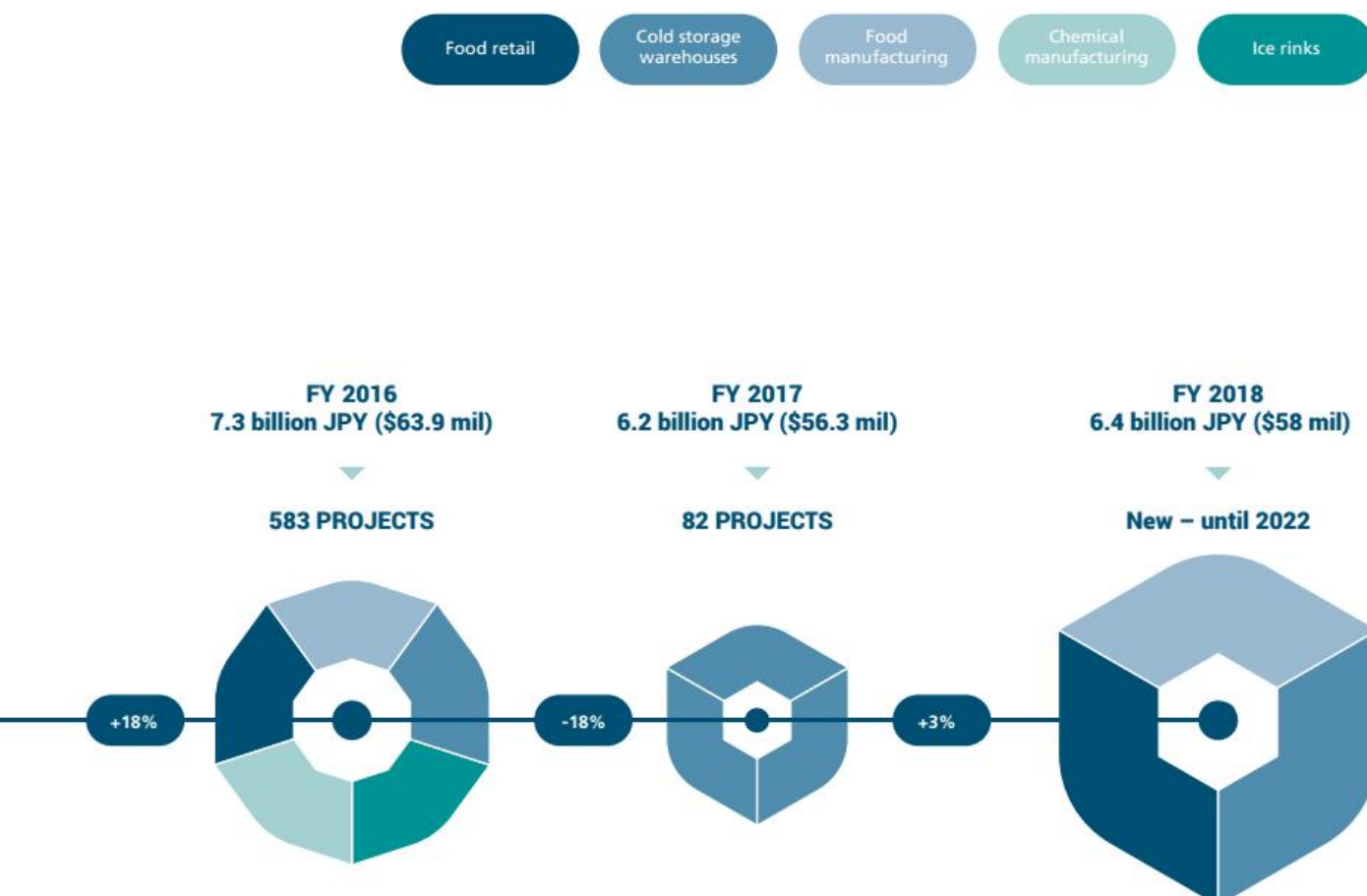
In 2017, the Ministry of the Environment (MOE) confirmed the subsidy programme's budget would be increased to €47 million (\$58 million) for the fiscal year 2018. The renewed subsidy scheme is a five-year project, beginning in financial year (FY) 2018 and ending in FY 2022. The targeted sectors are now food retail, food manufacturing and cold stores.

"Because of Kigali, we decided to expand the sectors and budgeted amount for the market to accelerate the uptake of natural refrigerant technology," said Yasuhiro Baba, director of the office of fluorocarbons control policy in the Japanese Ministry of the Environment.

The subsidy scheme has been key to driving uptake of natural refrigerant technologies.

In commercial refrigeration, for example, the subsidy has helped to drive the introduction of CO₂-based technology. With just 200 stores utilising such equipment in 2004, there are now more than 3,100 stores in Japan that use CO₂. According to retailers, this would have not been possible without the help of the subsidy scheme that helps to bring down the initial cost of equipment to parity with traditional HFC-based systems.

Source: sheccoBase



The Japanese Ministry of Environment conducted a survey gathering end users' feedback and results from the installation of natural refrigerant-based HVAC&R systems.

"By replacing their systems with natural refrigerant systems, on top of a complete elimination of direct CO₂ emissions, convenience stores realised a 15% reduction in indirect CO₂ emissions through energy efficiency," said Sho Nakamura of Japan's Ministry of the Environment at ATMOsphere Japan, held in Tokyo on 13 February 2018.

"Supermarkets realised a 20% reduction in CO₂ emissions through energy efficiency."

"For cold storage operators and food manufacturers, similar results were seen. By installing natural refrigerant systems, end users in these sectors saw a 48-55% reduction of indirect CO₂ emissions through energy efficiency. That's what the survey showed."

Review of safety standards key for hydrocarbons

Amid growing legislative pressure on cooling gases with high global warming potential around the world, the market for flammable refrigerants such as hydrocarbons is poised to grow.

Hydrocarbons such as propane and isobutane offer several advantages due to their low climate impact and extraordinary energy performance. Nevertheless their use has been limited as a result of arbitrary restrictions anchored in industry standards. Historically, standard-making was primarily focused on chemical refrigerants, and the specific requirements for natural flammable refrigerants were not prioritised. This was due to a lack of knowledge at the time of drafting the standards, exacerbated by the commercial interests of chemical refrigerant manufacturers.

The main barrier stemming from industry standards relates to the maximum allowed quantity of flammable refrigerant in refrigeration, heat pump and air-conditioning equipment. The cooling capacity of natural flammable refrigerants is dependent on refrigerant quantity, which is often strictly limited by industry standards.

A number of assumptions in the current version of international standards are not based on scientific measurements. For example, IEC 60335-2-40 for residential air conditioners and heat pumps assumes a constant leak rate, a leak of the entire charge in four minutes, and that occupied spaces are gas-tight, none of which is based on real conditions. In addition, current standards do not take into account various available risk mitigation measures, such as improved system tightness, systems with integral airflow, housing design, and others. These would allow for higher refrigerant charge limits while maintaining at least the same level of safety.

Several international and regional standards are now undergoing revisions to enable the use of higher charges of flammable refrigerant. This is critical to the success of the Kigali Amendment to the Montreal Protocol.

The revision of charge limits for hydrocarbons in commercial refrigeration (IEC 60335-2-89 standard) is underway. The draft standard proposes to increase the charge limit of propane to 500g from the current 150g. The revised standard would unlock the opportunities for hydrocarbons globally, making energy-efficient technology accessible to end users at a lower cost while maintaining the same level of safety.

In July 2018, the draft standard cleared another hurdle when it passed the national committees' vote, setting the stage for a potential final vote by the end of 2018.

The review of other international standards with respect to hydrocarbons is progressing slowly. Regarding IEC 60335-2-40 for residential air-conditioning and heat pump equipment, for example, a proposal to address the charge size of A3 refrigerants and to introduce mitigation measures is currently at committee draft stage and a revised standard is expected in the 2019-2022 timeframe.

Discussions are also underway on several issues concerning A3 refrigerants within group standard ISO 5149 (e.g. improved charge limit for hydrocarbons below ground). However, there is currently no clear timeline for publication of that revised standard. ■ KS

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Seizing the opportunity: **Natural refrigerants** in Southeast Asia

Opportunities for natural refrigerants are abundant in Southeast Asia's growing industrial and manufacturing sectors as the transition away from damaging refrigerants picks up pace. Yet a lack of government direction, training opportunities and high initial costs, suppliers say, are limiting the potential of natural refrigerant technology in the region.

— By Devin Yoshimoto

The Southeast Asian (SEA) market for natural refrigerants is shaping up to be an important future market in all HVAC&R sectors. With a population of over 650 million people and an established manufacturing base, demand for and production of HVAC&R technology continues to grow at a fast pace.

International suppliers are also paying close attention. The opportunity for natural refrigerant technology has never been bigger as governments begin to focus on solutions to support growth while reducing the environmental impact of HVAC&R.

However, obstacles such as high initial costs and a lack of trained technicians will continue to be prohibitive in the region without the cooperation of governments, end users and technology suppliers. Though natural refrigerant training and certification programmes are already underway in places such as Indonesia (see [‘Rolling out propane chillers in Indonesia’](#), page 52), suppliers say more needs to be done.

Accelerate Asia spoke to some of the leading technology suppliers active in Southeast Asia to get their perspective on the opportunities and challenges in the market.

A GROWING MARKET

Manufacturers see an opportunity for Southeast Asia to serve as a manufacturing base for natural-refrigerant HVAC&R systems to be built and exported competitively to other regions.

Embraco, which manufactures hydrocarbon-based compressors and components for light commercial applications, has been active in Southeast Asia for the past eight years.

Meihua Liu, an Embraco marketing representative, explains that the company is now working with a Thai customer to develop and export products that use propane (R290) as the refrigerant.

"Southeast Asia is a huge market that has great potential as a production base for export due to its low costs and fast development," says Liu.

"Based on that, there is a big opportunity for Southeast Asia to push natural refrigerant technology development for export."

Traditionally, ammonia has been the dominant refrigerant used in the industrial sector (cold storage, logistics, food processing and food manufacturing, etc.). At ATMOsphere Asia 2017, held in Bangkok last year, Pattra Chotchuangchutthaval, senior sales engineer at Patkol, said, "in Thailand today, ammonia seems to be the very best solution, especially

in large industrial systems," adding that there was considerable interest in modern low-charge ammonia systems.

Today, a number of suppliers have identified the industrial sector as the biggest opportunity for natural refrigerants as the region's industrial base continues to grow at a fast pace.

"I think Southeast Asian countries will continue to see growth in general for most of the food processing and cold chain logistics sector," Peng Kiang Chia of Johnson Controls Industrial Refrigeration Singapore told *Accelerate Asia*.

Johnson Controls provides turnkey solutions, primarily for ammonia, and sees the natural refrigerant's advantages in this sector, "primarily due to the energy efficiency of using [it] versus Freon, especially in the low-temperature range of application".

Mayekawa, meanwhile, has a number of installations in the region using NH₃/CO₂ secondary systems and CO₂ heat pumps for food processing and cold storage facilities (see [‘Looking to the future with CO₂ heat pumps’](#), page 14).

"Large-scale cold storage and cold rooms are expanding fast in Southeast Asia," echoes Lieny Jang, director of marketing (Asia) for Emerson.

"Therefore, it will be the biggest opportunity for growth over the next few years."

"Food processing plants expanding to ready-to-eat foods requiring freezing and storing is a strong opportunity," says Danfoss' Prurdy Wong, who is responsible for marketing communications in the Asia-Pacific region.

"Thailand will continue to be the leader as they have the cold chain structure, agricultural base, and a developed food technology sector."

Solutions that increase efficiency and reduce ammonia inventories are seen as promising options for this region, such as low-charge ammonia systems, NH₃/CO₂ cascade and CO₂ transcritical.

"With the Asia-Pacific region, CO₂ transcritical systems supplied to date have been for food retail applications," says Inderpal Saund, business development manager APAC for Beijer Ref.

"However we are exploring other cold chain applications too. Within Southeast Asia there is awareness of natural refrigerants but mainly from an ammonia aspect. As far as CO₂ is concerned, things are still very new. We see that CO₂ will be an upcoming trend on plants where ammonia may not be a viable choice," Saund says.

Beijer Ref has recently seen an increased focus on natural refrigerants worldwide and is slowly beginning to build up its capacity in the Asia-Pacific region, with manufacturing bases in both China and Australia.

On the commercial side, Southeast Asia is still a nascent market with just a few pilot projects for natural refrigerant systems. However, leading commercial system suppliers, such as AHT, CAREL and Epta, are keen to bring their experience and technology to OEMs and end users in the region.

"We strongly believe there is a market for natural refrigerants in Southeast Asia," says LS Lee, technical director for Epta Asia.

"To support the change of refrigerants in the market, Epta is expanding rapidly across Southeast Asia. We're constantly investing in local staff by sending them to Europe for training at Epta's CO₂ training centre in Bradford, UK. We're able to leverage on group strength, knowhow and local installation experience to be ready when retailers take that step with natural refrigerants," Lee said.

Looking forward, companies like Emerson see opportunities in both the industrial and commercial sectors.

"Our current focus is on large-scale cold storage with ammonia and engaging CO₂ opportunities in the commercial or retail industry," says Jang.

"We are currently engaging a supermarket replacement project in Thailand with CO₂."

GOVERNMENT AND INDUSTRY SUPPORT REQUIRED

Key to furthering the adoption of natural refrigerants in Southeast Asia, suppliers argue, is active government support and clear legislation signalling the intended future direction of the market.

Liu of Embraco explains that lack of government support for industry education has been a limiting factor for natural refrigerants.

"Those kind of initiatives," says Liu, "could be conducted by local associations and involve OEM suppliers and specifiers that are already moving in this direction, so that they can expose their applications as references".

She adds that there should be some direction on "the commitment to define regulations and the phase-out and phase-in [of certain technologies] over a certain number of years".

Emerson has been active in the industrial refrigeration sector in the Southeast Asian market for several decades. However, it has also seen challenges with the lack of government and industry support in the region.

"Most Southeast Asian countries are developing fast, but there is still a lack of government and industry support for natural refrigerants, such as regulation and planning," says Jang.



"Overall, the cold chain [sector] is growing fast and there will be many opportunities, but natural refrigerant growth is highly dependent on government direction and industry support."

Wong of Danfoss agrees: "Government legislation will drive business towards adoption of new technologies."

"Today within Southeast Asia there are no clear guidelines for moving towards lower GWP refrigerants," says Saund of Beijer Ref, "and I think industry knowledge regarding this topic is still quite low".

In addition to government support, training of technicians is required to sustain growth.

"The install base is still small and there is no local capability in Southeast Asia," says Emerson's Jang. "Technician training efforts will be needed for natural refrigerants to succeed."

Several suppliers identified the need to overcome high initial costs as another barrier.

"Natural refrigerant systems' initial cost is still high compared to existing Freon systems," says Jang. "Government support for natural refrigerants will encourage the market transition."

Panasonic, which supplies CO₂ condensing units for small to medium-format retail applications, has long been present in the Southeast Asian market.



Yasuyuki Tsuchiya, director general manager for Panasonic Eco Solutions Commercial Equipment Systems, argues that "subsidy support and more proactive promotion for protections against global warming" are steps local governments can take to address this issue.

NATURAL REFRIGERANTS ARE THE FUTURE

The Kigali Amendment to the Montreal Protocol is a major driving force for the adoption of natural refrigerant technology worldwide, and it is only just beginning to affect the market in Southeast Asia.

"The biggest opportunity is already in place, since the use of natural refrigerants is on the agenda worldwide," says Embraco's Liu.

"All countries have to act, once the Kigali Amendment to phase down high-GWP refrigerants is enforced," she says.

Industrial refrigeration supplier Scantec, based in Australia, is one of the world's leading suppliers of low-charge ammonia technology.

Scantec Managing Director Stefan Jensen sees natural refrigerants as the only viable future option for the industry.

"Eventually natural refrigerants will dominate in all mainstream RACHP applications – HFOs and HFCs will be dedicated to niche applications," Jensen predicts.

"Evidence of the environmental, energy performance and safety impacts of HFOs and other derivatives thereof will be steadily mounting and ultimately jeopardise the market share of these working fluids," he says.

Natural refrigerants, then, look well placed to seize a greater share of the market. ■ DY



Rolling out propane chillers in Indonesia



With the support of the German Ministry of Environment (BMU), the Indonesian government and local manufacturers, Indonesia is beginning to roll out propane chillers in the commercial and industrial sectors, setting the stage for more natural refrigerant uptake in the country.

— By Devin Yoshimoto & Jan Dusek

ABOVE

Barokah Sri Utami, also known as Emmy, president director of PT Phapros, where two propane chillers have significantly reduced energy use.

In 2012, Indonesia began to phase out the use of hydrochlorofluorocarbons (HCFCs) under its HCFC Phase-Out Management Plan, which aimed to reduce 80.4 ozone-depleting potential (ODP) tonnes of national HCFC consumption by 2018.

R22, at the time, was a widely used refrigerant in the commercial and residential air conditioning sectors. Though the use of R22 has significantly dropped since it was banned in 2015, it has largely been replaced by hydrofluorocarbons (HFCs) such as R134a, which are themselves now scheduled to be phased down under the Kigali Amendment to the Montreal Protocol.

One company, however, saw an opportunity to grow its business by looking into the development and manufacture of propane-based (R290) systems as an alternative to HFCs.

AICOOL Air Conditioning and Chiller (AICOOL), which operates under PT Ilthabi Mandiri Teknik, is a local, family-owned business that has been making refrigeration and air-conditioning systems for close to fifty years.

Today, the company operates three factories with around 600 employees. It primarily does business in the Indonesian market.

In 2012, as Indonesia began to phase out HCFCs, AICOOL Managing Director Iwan Chandra saw an opportunity to develop and expand its manufacturing capabilities into propane-based (R290) refrigeration and air-conditioning systems.

"Looking at all the alternatives, I realised that there were many, many choices available," Chandra told *Accelerate Asia*.

"Soon, however, we realised that R290 was a very good alternative."

The gas, as a refrigerant, Chandra says, "was already available locally in Indonesia for a very long time".

Indonesia remains one of the world's largest producers of natural gas. State-owned energy company Pertamina has been supplying propane since 2005 – actively encouraging its use in the Indonesian market.

AICOOL soon became the first manufacturer in Indonesia to produce R290 chillers for commercial and industrial refrigeration and air-conditioning applications, training its own staff in house.

It wasn't until a couple of years later, however, that AICOOL began to ramp up production of the chillers.



Herlin Herlianika and Indira Darmoyono (GIZ Green Chiller consultants) with the commissioned R290 chiller.

Green chiller project in Indonesia

In 2014, BMU – the German Federal Ministry of Environment, Nature Conservation and Nuclear Safety – commissioned the Green Chillers NAMA (Nationally Appropriate Mitigation Action) project in Indonesia.

The project's goal was to actively facilitate the development of Indonesia's market for green cooling technologies through pilot projects, training, certification, and creating standards.

Over the next few years, AICOOL, in close co-operation with Indonesia's Ministry of Energy and GIZ, began to manufacture more R290 chillers for the purpose of performance testing and analysis as well as training.

These chillers were installed at the University of Indonesia, as well as the Bandung and Bali State Polytechnics' vocational schools, for the purpose of training and performance testing.

In addition, the Indonesian National Standardisation Agency worked at the same time to publish new and updated refrigerant safety and energy efficiency standards to pave the way for further development of the R290 chillers.

To date, AICOOL counts a total of ten R290 chillers installed in the Indonesian market. Chandra expects this total to hit 100 units next year.

NatRefs, a simple action

At the beginning of 2018, as an official Green Chillers NAMA pilot project, large Indonesian pharmaceutical company PT Phapros installed and commissioned two AICOOL R290 chillers, replacing two existing R134a units, at its production facility in Semarang, Central Java.

The two chillers each have a cooling capacity of 231.9 kW and each use around 30 kg of propane.

The chillers are used to cool various rooms for drug production, storage and breeding of bacteria in PT Phapros' production building.

According to the company, the old R134a chillers used 545,387 kWh of electricity per year, costing the company around IDR 600 million (~US \$41,655) per year in energy costs. The new R290 chillers are expected to use only 151,078 kWh per year, resulting in around IDR 160 million (~\$11,107) per year in energy costs.

Though the old R134a chillers were very old systems, with capacities that were significantly larger than needed, the reduction still translates to a cost saving of around IDR 440 million (~\$26,300) per year. The company estimates the payback period to be around 2.5 years and its annual greenhouse gas emissions to be reduced by 356 tCO₂ per year.

Barokah Sri Utami, president director of PT Phapros, highlights the role that natural refrigerant systems play in demonstrating the company's commitment to its own, as well as Indonesia's, sustainability goals.

"PT Phapros' vision and mission is to become the leading pharmaceutical company with a strong commitment to social responsibility for our environment," says Barokah Sri Utami.

The company considers the installation of natural-refrigerant systems to play a central role in a number of programmes the company is pursuing to achieve its sustainability goals.

"These programmes span simple actions, from using energy efficiently and cultivating mangrove plants to investing in the two green chiller units for our production plant," she says.

Barokah Sri Utami recognises the importance of aligning PT Phapros' sustainability strategy with what is currently happening globally.

About Green Chillers NAMA

NAMA, which stands for Nationally Appropriate Mitigation Action, is a term used to refer to any action or initiative a country undertakes to reduce its greenhouse gas (GHG) emissions.

The Green Chillers NAMA project is one of these initiatives, undertaken by Indonesia and Germany to help reduce GHG emissions in its industrial and commercial refrigeration and air-conditioning sectors.

According to GIZ, "energy consumption from commercial and industrial refrigeration and air-conditioning systems in Indonesia can be reduced by 15-30% through the implementation of modern technologies. Moreover, direct emissions coming from leakage of refrigerants account for approximately two to three million tons of CO₂ equivalent per year." (Source: 'Development of a NAMA for Energy-Efficient Cooling Systems and Cold Supply in Indonesian Industry and Commerce', GIZ, 2015, <https://www.giz.de/expertise/downloads/giz2015-en-indonesia-greenchillers-nama.pdf>).

The goal of the project is to assist Indonesia in establishing incentives, introducing pilot projects, and building technical capacity for the adoption of green cooling technologies in this sector.

Key details and milestones:

- ▶ The Green Chiller NAMA Project is jointly implemented by Indonesia's EBTKE (Directorate General of New Renewable Energy and Energy Conservation) at the Ministry of Energy and Mineral Resources (MEMR) and by GIZ (*Deutsche Gesellschaft für Internationale Zusammenarbeit*) on behalf of the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU).
- ▶ Project term: 2014-2018.
- ▶ April 2016: PT Pertamina, a supplier of R290 under the brand name MUSIcool (MC-22), and PT Ilthabi Mandiri Teknik, a manufacturer of R290 refrigeration and air-conditioning systems, sign a Memorandum of Cooperation with the Directorate-General of New, Renewable Energy and Energy Conservation (DG NREEC), under Indonesia's Ministry of Energy and Mineral Resources, together with GIZ to provide technical assistance.
- ▶ July 2016: Indonesian representatives from Bandung State Polytechnic (Polban), Bali State Polytechnic (PNB), and the National Professional Certification Authority (BNSP) travel to Germany for hands-on, practical training with hydrocarbons. Memorandum of Understanding signed between GIZ, DG NREEC, Polban and PNB to establish capacity development programme for hydrocarbon handling in Indonesia.
- ▶ April 2017: R290 chiller installed at the University of Indonesia. Performance analysis, training and capacity building conducted.
- ▶ May 2017: R290 chillers installed at Polytechnic Bali and Polytechnic Bandung. Both established as 'Hydrocarbon Centers of Excellence' facilitating training for technicians, engineers and operators.
- ▶ July 2017: 20 trainers certified for R290 training by the Indonesian National Professional Certification Authority (BNSP) at the Polytechnic Bali and Bandung 'Hydrocarbon Centers of Excellence'. 100 technicians planned for certification from September 2017 onwards.
- ▶ Jan. 2018: Indonesian pharmaceutical company PT Phapros installs two R290 chillers at its production facility in Semarang Central Java as a pilot project.
- ▶ May 2018: The Indonesian National Standardisation Agency publishes two new and one updated Indonesian National Standards for refrigerant safety and performance, opening the door for further uptake of R290 in Indonesia.



From left to right: Philipp Schukat, GIZ Indonesia; Sunandar, Coordinating Ministry for Economic Affairs, Indonesia; Kai Berndt, Green Chillers NAMA Project, GIZ Indonesia; Barokah Sri Utami, PT Phapros; Herlin Herlianika, HEAT; Rida Mulyana, Ministry of Energy and Mineral Resources, Indonesia

“The technology is there, the people are there, the institutions are there, the standards are revised... so I think this is a good opportunity for everybody.”

— Iwan Chandra, AICOOL

7 business benefits of NatRef use in Indonesia

PT Phapros' business sees a number of benefits, both financial and non-financial, in using R290 green chillers in Indonesia.

In a statement to *Accelerate Asia*, PT Phapros identified them as:

1. The use of natural refrigerants, in this case propane, has the lowest global warming potential and lowest risk of depleting the ozone layer. The use of propane is a mitigation and adaptation action for climate change and global warming.

2. Participating in climate change mitigation fulfils our moral obligation and our commitment to business ethics by preserving our Earth.

3. By using a lower amount of electricity compared to non-green chillers, we are contributing to energy conservation.

4. Not only do we appreciate locally sourced products, but we are also reducing our carbon footprint, as the green chillers have a high level of locally sourced content.

(*Accelerate Asia* note: Known as TKDN in Indonesia, government regulations require a certain percentage of product components or human capital to be sourced locally).

5. The expertise used in developing and implementing these green chillers has increased the exposure and cooperation of professional workers and experts from other institutions and countries, which is relevant to reduce global warming.

6. It increases our corporate reputation.

7. It supports our corporate sustainability goals.

▶ "Natural refrigerants have low global warming potential compared to synthetic refrigerants, so they are effective for reducing the risk of climate change and global warming that disturbs the Earth's balance," she says.

"PT Phapros' environmental strategy is in line with Indonesian and global initiatives to mitigate and adapt to global warming and climate change," she adds.

Scaling local technician training

Among the challenges still facing AICOOL, Chandra highlights the need to scale up training and certification of technicians to work with R290 technology in Indonesia.

"Until now, the design, testing, installation and after-sales service of the units has all been done by our internal group," says Chandra.

"That's been a challenge. So the question now is, 'how do we bring this to the right scale for the industry?' Right now, I need a lot of support

from the contractors and from other companies."

"In the meantime, we are working very closely with the two polytechnics that are introducing this technology. Currently we have about 30-40 technicians who have R290 certification," he says.

Asked how the company deals with the issue of flammability, Chandra says the use of propane is quite safe as long as proper training and safety precautions are in place.

"We haven't seen yet any serious accidents due to flammability," says Chandra.

"We use gas detectors and put the units outside and away from any possible sources of sparks. We also use clearly visible flammability signage, and enclose the area so that it is only accessible by trained and certified people."

Though AICOOL works closely with its overseas suppliers to import key components, Chandra stresses that it is important to assemble and



Placing of R290 chillers at the pharmaceutical company PHAPROS.

manufacture the completed chiller units locally.

"Sharing from my own experience in manufacturing R290 systems, it is very good technology for local industries because you need local support," says Chandra.

"You cannot import these big units with R290. You need a local manufacturer, you need a local installer and you need local after-sales support. But the technology is very good, easy to handle, and cheap compared to other high-pressure or secondary-loop systems."

Indonesian government promotes NatRefs

The Green Chiller NAMA project term concludes in 2018. However, Chandra is confident the stage has been set for local manufacturers in Indonesia to take advantage of the opportunity to use natural refrigerant systems on a bigger scale in the industry going forward.

"With the Green Chiller programme's successful pilot projects, I think we

are now all convinced that we have the technology in Indonesia," he says.

"Of course, now they are only pilot projects on a small scale but we are very confident that this will grow more and more as others in our industry begin to follow."

The Indonesian government, for its part, sees local use and production of R290 chillers as an effective means of achieving its sustainability targets while growing its economy at the same time.

"We support the installation of hydrocarbon chillers," says Rida Mulyana, director-general of Indonesia's Directorate-General of New, Renewable Energy and Energy Conservation.

"This technology is more energy efficient with very low-GWP refrigerants and can be locally produced," says Mulyana, referring to local providers AICOOL and Pertamina as examples.

"The programme also gives Indonesia an opportunity to enhance its capacity for developing and adopting clean

technology by using domestic resources, which is very much in line with Indonesia's economic policies on enhancing local content," he says.

Showing the government's commitment to supporting the adoption of natural refrigerants in general, Mulyana says, "we fully support the implementation of energy-efficient and climate-friendly technology in Indonesia".

"Thus, we hope hydrocarbon or other natural refrigerant-based technology will be widely used as an alternative to synthetic refrigerants," he adds.

"We also encourage local manufacturers to start investing in climate-friendly technology, specifically hydrocarbon technology," Mulyana says.

AICOOL's Chandra remains hopeful. "The technology is there, the people are there, the institutions are there, and the standards are revised. Also, the market is big enough and we can do everything locally without importing everything," he says.

"So, I think this is a good opportunity for everybody." ■ DY & JD



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PUSHING THE LOW-CHARGE ENVELOPE

Low-charge ammonia systems are becoming increasingly competitive with HFC-based systems and traditional ammonia systems as design improves and more players enter the market around the world. Scantec Refrigeration Technologies recently installed its largest low-charge ammonia system to date, showing just how adaptable and efficient these systems can be. *Accelerate Asia* reports.

— By Devin Yoshimoto

The use of low-charge ammonia systems is continuing to gain popularity around the world. Their energy efficiency and inherent safety benefits are driving this trend.

System manufacturers around the world are also continuing to iterate and improve on low-charge ammonia systems in applications ranging from refrigerated warehouses to air conditioning and even supermarkets.

This, in turn, is driving competition and decreasing costs, making them increasingly viable options for business owners looking to move away from HFCs, increase employee safety, minimise governmental regulation, and save on energy costs.

One of the pioneers of low-charge ammonia technology in Australia is Scantec Refrigeration Technologies, which has been developing and installing low-charge ammonia systems since the early 1990s – refining design, improving efficiency, and reducing ammonia charges the whole way.

Among the company's latest low-charge ammonia installations is

its largest system to date, showing just how competitive and adaptable this type of system is becoming in comparison to traditional ammonia and HFC-based systems.

Accelerate Asia spoke to Scantec's managing director, Stefan Jensen, to get the details.

ACHIEVING ENERGY EFFICIENCY AND SAFETY WITH LOW-CHARGE AMMONIA

In February of this year, Scantec successfully commissioned its largest low-charge ammonia system in Australia.

The system was done for a newly-built cold storage facility in Brisbane and its total NH_3 inventory is 750 kg, providing cooling for a total refrigerated volume of 114,000 m^3 .

Several types of low-charge ammonia system exist in the market today. Scantec's new system is a centralised system, referring to the fact that it runs off of a central plant rather than being a pre-packaged or decentralised system consisting of several separate units.

For a centralised system of this size, Jensen explains, it is remarkable how energy efficient it is, especially compared to a comparable HCFC-based system that the company worked on a decade prior.

"A little over a decade ago, Scantec was awarded a contract for the conversion of a large refrigerated warehouse in Sydney from R22 to NH_3 ," says Jensen.

The metric commonly used for measuring energy efficiency is SEC or specific energy consumption. For this previous project, annual SEC prior to the conversion was 100 $\text{kWh}/\text{m}^3\text{a}$.

Accelerate Asia has confirmed with Scantec actual SEC values that have been measured for the system's running period from February to April 2018.

"We're currently seeing a yearly SEC value of 17.9 $\text{kWh}/\text{m}^3\text{a}$," says Jensen.

"This value includes the facility's use of blast freezing, which typically doubles the refrigeration capacity required on the low temperature side."

Jensen notes that, "it is important to understand that all other things being equal, SEC values reduce with increasing refrigerated volume".

"This means SEC values are not directly comparable without also referencing refrigerated volume in each particular case."

The 100 $\text{kWh}/\text{m}^3\text{a}$ value does, however, put into perspective the amount of energy savings that can be realised when converting Freon-based systems to low-charge ammonia systems.

The value of installing the low-charge ammonia, therefore, was clear to the end user for this project, whose main goals were achieving high energy efficiency and reducing the NH_3 inventory.

"Not only is the overall NH_3 inventory low (750 kg), but the operating NH_3 inventories of the individual freezer evaporators are also exceptionally low," Jensen remarks.

Inherent in the design of the low-charge ammonia system is reduced risk to ammonia exposure in the event of a leak.

"The largest freezer room (approximately 50,000 m^3) is fitted with six evaporators with a unit capacity of approximately 80 kW," Jensen explains.

"Each evaporator has an operating NH_3 inventory of 0.7 kg at the design point. Release of the operating NH_3 inventory from one evaporator is therefore unlikely to cause an NH_3 concentration greater than 25 ppm."

DEFINING LOW-CHARGE AMMONIA

Currently, there is no standard definition of what exactly constitutes a low-charge ammonia system.

Some argue that this is hindering the development of the technology as well as the awareness of such systems' benefits among end users, but Jensen suggests that the technology can be defined in three main ways.

"There are three fundamental types of low-charge NH_3 system," Jensen explains.

"Packages for chilling of liquid (down to 0.03 kg NH_3 /kW), unitary equipment (down to 0.018 kg NH_3 /kW), and central plants (0.3-1.2 kg NH_3 /kW or 4-5 times less than liquid overfeed)".

Jensen acknowledges, however, that there is currently "no clear definition of what low-charge NH_3 is by using the absolute charge metric in kg of NH_3 or the specific inventory in kg NH_3 /kW".

As low-charge ammonia technology matures and manufacturing costs continue to go down, one thing is certain: an increasing number of end users in Australia and New Zealand – and around the world – will have more options for moving away from HFCs.

■ DY & CR

1 /



2 /

1 / One of six evaporators in freezer room.

2 / Engine room with four SABROE SMC 116L reciprocating compressors in dual-stage compression configuration.

Photography by: Marty Pouwelse Photography



Apichit Lumlertpongpana, Managing Director, I.T.C. Group

I.T.C. Group is a leading manufacturer and supplier of refrigeration systems to the industrial sector in Thailand. Until recently, the company has focused mainly on the use of ammonia, but now it is also developing innovative CO₂ systems – for which the company sees significant potential in Southeast Asia.

— By Devin Yoshimoto

Established in 1982, Thailand-based I.T.C. Group has long been developing and manufacturing ammonia-based refrigeration systems for the country's freezing and cold storage industry.

Led by Managing Director Apichit Lumlertpongpana, the company looks to the future to guide its R&D. It is now looking into using CO₂ technology to help its customers reduce the amount of ammonia charge in their facilities, or even to replace ammonia altogether: with transcritical CO₂.

Accelerate Asia spoke to Lumlertpongpana about the I.T.C. Group's most recent efforts in this area and the potential for natural refrigerant technology in the region.

// Accelerate Asia: Can you please provide some background on the main types of

refrigeration system and refrigerant I.T.C. has been working with over the past 10-15 years? Who have been your main customers?

Lumlertpongpana: I.T.C. Group is one of the leaders in turnkey design and contracting in Thailand's refrigeration industry. With our installations, 98% use ammonia as the refrigerant. The largest installation in one plant used 46 sets of ammonia screw compressor packages.

This plant won first place in the 2008 ASHRAE Technology Awards. Our main customers are mostly in poultry and seafood processing, and fruit and vegetable facilities.

To date, only two of our installed plants used CO₂. The first CO₂ installation was at our I.T.C. office, which used a cascade R507/CO₂ brine system for a thermal ice storage application in 2015.

The other was a cascade NH₃/CO₂ pump recirculation system for a cold storage facility. Ammonia is continuing to grow and I.T.C. will also drive the CO₂ market to grow more.

// Accelerate Asia: What is I.T.C.'s current focus? Do you have any recent or current projects you are working on that use natural refrigerants?

Lumlertpongpana: I.T.C. is focusing on transcritical CO₂ systems. We have started to build a demonstration on a self-contained containerised unit with a small cold room container. Another trial will be at our factory's air-conditioned office area with CO₂ transcritical thermal ice storage with an adiabatic evaporative gas cooler.

// Accelerate Asia: Can you please tell us about the Cooling Batt project? What are the system's specifications and how does it work?

Lumlertpongpana: The Cooling Batt was our first trial to use CO₂ at our own facility and to learn how CO₂ behaved. We also let our design engineers, technicians, and factory staff be hands-on with this R507/CO₂ cascade system by using thermal ice storage and melting it to become chilled water during the peak period, so that we can gain maximum benefit from the low tariff rate of electricity costs and peak-demand charges. The public is welcome to visit our facility.

The system was installed in 2014 and the results have been excellent, already paying us back.

// Accelerate Asia: What do you see as the main challenges moving forward?

Lumlertpongpana: The main challenges for I.T.C. and Thailand as a whole are the problems of labourers' lack of technical skills and the younger generation preferring to do office work.

The Federation of Thai Industries (F.T.I.), of which I am one of the committee members, has agreed to drive a technical college to teach HVAC&R as a subject in long-term courses and to teach for 3-5 years in RAC as a subject for both vocational schools and technician colleges.

// Accelerate Asia: Transcritical CO₂ systems are growing quickly in industrial refrigeration. Do you see potential for more CO₂ or ammonia-based systems to be applied in Thailand or Southeast Asia as well? Have you considered this technology for your customers?

Lumlertpongpana: I also follow transcritical CO₂ closely. Currently, we are starting to do our own R&D and learn from lessons in-house before we go out to drive things in the market.

The opportunity for CO₂ refrigerant is very high. Big barriers, however, are cities' high building architecture and the government, which does not want to take a risk with using ammonia in congested areas in cities.

// Accelerate Asia: How about the potential for NH₃/CO₂ cascade systems in industrial refrigeration in Thailand?

Lumlertpongpana: We have launched one installation and are monitoring it very closely. Once we're fully 100% confident, we will convince the market to try this ammonia charge-limiting solution through a CO₂ cascade system.

If our CO₂ transcritical trial system is a success, we will implement it in the market next year. I.T.C. aims to continue living up to our slogan of 'frontrunner in refrigeration systems' in both Thailand and the ASEAN countries. ■ DY



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