

ATMOsphere Asia 2015

INTERNATIONAL WORKSHOP
SUMMARY REPORT

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MARC CHASSEROT

CHAIRMAN, ATMOSPHERE ASIA 2015
MANAGING DIRECTOR, SHECCO

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ATMOsphere Asia 2015

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NATURAL REFRIGERANTS ON PATH TO WIDESPREAD ADOPTION

ATMOsphere Asia 2015 welcomed 160 government and industry experts, end users, and market leaders for two days to share insights on the inevitable dawn for natural refrigerants. The quality of attendees and presentations was outstanding, and the key message clear: 'natural refrigerants are here to stay'.

We learned about the latest innovations and the government subsidies and policies playing a key role in driving the market to a more dynamic position. The key experts from Japan's government sector attended - from the Ministry of Economy, Trade and Industry, and the Ministry of Foreign Affairs, to the Ministry of the Environment. In 2015, around JPY 6.2 billion in subsidies will be available for natural refrigerants, more than ever before.

Last year CO₂ stole the limelight, but now hydrocarbons are keen to join the party. As interest in hydrocarbons for commercial refrigeration grows, legislation and policy will inevitably adapt, but this will require a change in perception.

Meanwhile, we're no longer talking about when CO₂ will take off in commercial refrigeration; it's happening. More and more inventive companies are utilising subsidies as end users look to CO₂ solutions for their CVS and larger format retail stores in increasing numbers.

Government subsidies are also creating huge opportunities for ammonia in industrial refrigeration, while Japan continues to lead the world in its quest for water-based solutions, not just domestically but globally.

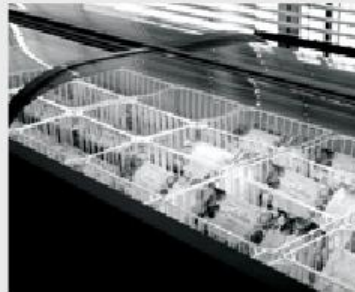
Natural refrigerants are no longer emerging; they're here to stay. There is a strong sense 2015 will provide the industry with its watershed moment - shecco Japan and ATMOsphere will be back in 2016 to share the progress we've made once again.



For its second year ATMOsphere Asia returned to Tokyo, where the prestigious Shin-Marui Conference Square welcomed over 160 participants, aiming to support the adoption of natural refrigerant technology in Asia and beyond. Titled, "Natural Refrigerants – Solutions for Asia", the event provided a platform for 33 international presentations covering policy, market trends, the newest technology and innovation across all five natural refrigerants: CO₂, ammonia, hydrocarbons, water and air. Manufacturers, end users, policy makers and academics discussed advancements in natural refrigerant-based technology and exchanged insights on the best way to develop solutions adapted to current domestic and international legislative measures, for commercial and industrial refrigeration, heating and air conditioning. With JPY 6.2 billion (€46.5 million) in subsidies for natural refrigerants in 2015 and green procurement policies set for the Tokyo 2020 Olympics, a dynamic market environment has been created for business leaders to continue driving the transition towards low GWP (global warming potential) refrigerants around the globe.

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CHAPTER 1

POLICY DEVELOPMENTS



SIDI MENAD SI AHMED,
SHECCO (FORMER UNIDO)



KAZUHIRO TAKAHASHI
MINISTRY OF FOREIGN AFFAIRS, (MOFA) JAPAN



MASAFUMI OKI
MINISTRY OF ECONOMY, TRADE AND INDUSTRY (METI)



MOTOYUKI KUMAKURA
MINISTRY OF ENVIRONMENT (MOE)



SATOSHI NARISAWA
TOKYO METROPOLITAN GOVERNMENT (TMG)



TETSUJI OKADA,
JAPAN REFRIGERATION & AIR CONDITIONING
INDUSTRY ASSOCIATION (JRAIA)

Across two policy sessions at ATMOSphere Asia 2015, industry leaders and ministers focussed on already-adopted Japanese and international legislation as well as further regulatory changes to take effect in the coming months. The legislative landscape in Japan continues to change with the government set to enforce a revised F-gas law in April, aimed at targeting sectors with the highest levels of emissions. An environmental labelling scheme to promote natural refrigerant alternatives and increased budgetary measures in the form of grants will encourage end users to invest in natural technology. Subsidy schemes to convert thousands of existing HCFC systems, Japan's action to help promote low-GWP technology in developing countries, and the Tokyo 2020 Olympics exemplifying the country's use of natural refrigerant technology, were also discussed.

REVISED F-GAS LAWS TO TAKE EFFECT IN APRIL

Upcoming measures aimed at addressing the rapidly increasing f-gas emissions in Japan were the subject of presentations from Masafumi Oki from the Ministry of Economy, Trade and Industry (METI) and Motoyuki Kumakura of Japan's Ministry of Environment (MOE). Oki explained Japan's revised F-gas law, which will take effect in April 2015, setting different global warming potential (GWP) targets for sectors with the highest levels of emissions.

To promote alternatives using natural refrigerants in these sectors, METI is also devising a coherent labelling scheme. The scheme, expected to be finalised as early as September, will enable companies to better understand the environmental impact of refrigerants.

GOVERNMENT GRANTS TO HELP END USERS ADOPT NATURAL REFRIGERANT TECHNOLOGY TO INCREASE BY 24% IN 2015

Aside from a stricter F-gas law to discourage the use of hydrofluorocarbons (HFCs), Kumakura, from the Ministry of the Environment, also stressed the importance of continued financial support to encourage end users to invest in natural refrigerant technology. In an important step to continue to close the cost gap between conventional technology and energy efficient natural refrigerant systems, Kumakura outlined the increased budget of JPY 6.2 billion (€46.5 million) in 2015, compared to JPY 5 billion (€36 million) in 2014. The subsidy scheme for 2015, which will now include support for the food manufacturing sector, once approved, will accept applications in April 2015.

Mayekawa's Executive Director, Kuniaki Kawamura, canvassed the MOE's subsidies to support natural refrigeration systems in his presentation, highlighting how they can help in developing natural food processing and freezing applications. Already, thirty refrigeration plants are under construction thanks to MOE funding, and in 2015 around \$60 million (€53 million) is expected to be granted in order to propel the natural refrigeration market forward in Japan..

METI also has a subsidy scheme aimed at accelerating the introduction of natural refrigerants in Japan. With an allocated budget of JPY 280 million (€2.1 million) for 2015, the scheme is designed to support R&D activities for the development of high efficiency, HFC-free air conditioning systems, freezing and refrigeration equipment.

Natural refrigerants are part of the policy setup that Japan is trying to set in the next few years," said Oki.

Other activities aimed at the natural refrigerant market include an MOE project to further improve the energy efficiency of natural refrigerant showcases through the installation of doors and covers. Interested end users can apply to participate in the project by 9 March, or in a second round that will be organised 1 April – 11 May 2015. Also, MOE aims to increase awareness of the benefits of natural refrigerants among the general public and industry through the website, brochures and a short movie.

“

HFCs are rapidly increasing & there will be twice as many emissions by 2020 & given this environment we need to promote climate friendly equipment.

”

MOTOYUKI KUMAKURA

JAPANESE MINISTRY OF THE ENVIRONMENT (MOE)

“

There are still about 10,000 HCFC refrigeration plants in Japan – the replacement to natural refrigerants, ammonia, CO₂ or air cycle, is needed. We expect continuous government support, but we have to make more effort to reduce CO₂ emissions and improve the equipment.

”

KUNIAKI KAWAMURA

MAYEKAWA



TOKYO GOVERNMENT PROVIDES DIRECTION FOR NATIONAL F-GAS POLICY

Satoshi Narisawa, Director, Environmental Protection Section, Environmental Improvement Division - Bureau of Environment, at the Tokyo Metropolitan Government (TMG), explained that activities aimed at addressing f-gas emissions had already been initiated by TMG at a regional level in 2001. Perhaps it is no surprise then that Tokyo has the largest market for natural refrigerants in Japan.

Narisawa's presentation discussed TMG's subsidy programme for energy efficient showcases using natural refrigerants. Through this programme, which was initiated in 2014, small and medium sized businesses receive subsidies that cover one-third of the equipment cost. Applications will be accepted until the end of February 2015 and the annual budget is JPY 200 million (€1.48 million). In addition to this, TMG is supporting the government's labelling scheme (through the subsidy).

Overall it is expected that these activities will better promote alternative natural technologies and accelerate their uptake.

JAPAN HELPING DEVELOPING NATIONS TO PROMOTE LOW-GWP TECHNOLOGY

Kazuhiro Takahashi, Director, Global Environment Division at Japan's Ministry of Foreign Affairs (MOFA) emphasised the Japanese Government's efforts to help developing countries phase out of ozone depleting substances through bilateral cooperation, especially in Southeast Asia.

While international discussions on the proposed HFC amendment have shown some progress in the last two years, Takahashi pointed out that these are expected to intensify in the coming months, starting with the extraordinary Open Ended Working Group (OEWG) meeting of the Parties to the Montreal Protocol and the HFC management workshop in April.

For Takahashi, it is essential to provide the right signals to industry and the market in order to develop and commercialise the alternatives.

MINISTRY OF ENVIRONMENT'S JOINT CREDITING MECHANISM ENABLING LOW-CARBON INSTALLATIONS IN INDONESIA

MOE's Joint Crediting Mechanism (JCM) facilitates the diffusion of low carbon technologies, products, systems and services, supporting the development of developing countries. Through the JCM project for the cold chain industry, Mayekawa's NewTon 3000 package, which uses mainly ammonia as the refrigerant and CO₂ as the secondary refrigerant (brine), is now being installed in Indonesia, with plans to expand into Vietnam, India and Thailand. The NewTon 3000 refrigeration package can achieve up to a 34% energy reduction compared to existing R22 existing systems. There are 500 units currently running in cold storages and ice arenas in Japan.

Convenience store operator Lawson has also benefited from the JCM, successfully installing CO₂ at its stores in Indonesia.

“

We are making sure that it will be easier for consumers to use and understand environmentally friendly equipment – therefore we are promoting the labelling of equipment saying it is environmentally friendly.

”

SATOSHI NARISAWA

TOKYO METROPOLITAN GOVERNMENT (TMG)

“

Natural refrigerants have an important role to play in tackling global environmental challenges.

The industry and the market have played a key role in developing alternative technologies. They need to address the sector where alternatives are already available.

”

KAZUHIRO TAKAHASHI

THE JAPANESE MINISTRY OF FOREIGN AFFAIRS (MOFA)

Panasonic



Refrigeration Should Not Worsen Global Warming.

Reducing the adverse effect of chlorofluorocarbons used in refrigerators that operate 24/365 is an important issue for supermarkets and convenience stores. Panasonic's CO₂ Refrigeration system developed with original technologies is the first^{*1} business-use refrigeration equipment to use a natural refrigerant (CO₂), which has a zero ozone depletion potential and a greenhouse effect that is approximately 1/4,000^{**2} of that of conventional refrigerants. Since this refrigerant's environmental performance translates to a 58%^{†3} CO₂-equivalent reduction per year, the number of stores using our system is increasing. Furthermore, Panasonic has launched a remote monitoring/control service using cloud technology to facilitate the management of energy consumption. Panasonic takes active approaches from various angles in an effort to help mitigate global warming.



Ozone Depletion Potential:
0

Global Warming Potential:
Approx **1/4000**

CO₂ Emission Reduction Effect:
Approx **58%**

Panasonic CO₂ Refrigeration System Pressure adjust control type

*1: In the category of refrigeration system for frozen showcases for supermarkets, as of May 25 2010.
*2: As compared to that of R404A refrigerant. *3: Test condition Sales area: 3200m² Condensing unit: output 90kW, R404A refrigerant, inverter multi-unit model. Refrigerant leakage rate: 10% (From METI.
*Re-examination of losses and air-conditioner operational emission: March 7th 2009)

Panasonic Eco Solutions Commercial Equipment Systems Co., Ltd.

1-1-2, Oshiage, Sumida-ku, Tokyo 131-0045, Japan

Akagi Plant in SANDEN FOREST

Why the focus on
CO₂
as a refrigerant ?



CO2 COMPRESSOR

A natural refrigerant that has the least impact on the environment.

A safe and secure refrigerant.

**HARMONY
with
NATURE.**

That is our answer.



SANDEN
Delivering Excellence

TOKYO OLYMPICS 2020: AN OPPORTUNITY TO SHOWCASE JAPAN'S NATURAL REFRIGERANT LEADERSHIP

In view of the forthcoming Olympic and Paralympic Games in Tokyo in 2020, Japan aims to promote eco-friendly, sustainable technology and establish Tokyo as an environmental city, said Tsugumasa Horita Senior Policy Coordinator of the Policy Planning Division at the Ministry of Environment (MOE). The National Government is working in close cooperation with the Tokyo Metropolitan Government to ensure that Japan will showcase its leadership in reducing greenhouse gas emissions and promote sustainable, cutting-edge technology. A large number of facilities need to be renovated or newly constructed in line with sustainability and low-carbon targets, providing opportunities for natural refrigerant air conditioning and refrigeration equipment.





CHAPTER 2

MARKET TRENDS



NINA MASSON
SHECCO



TETSURO HOMMA
PANASONIC



JUNYA ICHIKAWA
SANDEN



KUNIAKI KAWAMURA
MAYEKAWA

The market trends sessions at ATMOsphere Asia 2015 highlighted changes in the market landscape for key Japanese system manufacturers, suppliers and end users, who discussed the latest market developments for natural refrigerant technologies in Japan and worldwide. Striving to become a world leader in CO₂ refrigeration, presentations from Mayekawa, Panasonic, and Sanden confirmed Japan's shift towards CO₂ - the world's preferred low-GWP refrigerant. But like the CO₂ market, where cost remains the major barrier, hydrocarbons are gaining momentum in Japan and beyond but face challenges with a lack of components and system training.

GLOBAL SHIFT FOR CO₂ FROM NICHE APPLICATION TO PREFERRED LOW-GWP REFRIGERANT

Nina Masson, Deputy Managing Director of shecco, focused her Market Trends presentation on the uptake of CO₂ refrigeration systems in Europe, North America and Asia.

As in Japan, in Europe, the news is encouraging, with industry anticipating 6,000 transcritical systems to be installed by 2015 and 64,000 systems by 2025. Based on data presented by shecco, Oliver Javerschek, Project Manager, Bitzer, estimated that the total number of CO₂ transcritical installations worldwide is currently 3,100, with 2,020 subcritical installations. Bitzer alone has sold more than 40,000 CO₂ compressors, mainly in commercial refrigeration, and the data indicates the market will experience rapid exponential growth in the next decade.

“

In the next five years there will be a big shift towards CO₂ in China, with the highest potential areas in industrial refrigeration, light commercial and commercial applications.

NINA MASSON
SHECCO

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Ch.2

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JAPANESE RETAILERS & MANUFACTURERS AIMING TO LEAD THE WORLD IN CO₂ REFRIGERATION

In Japan, convenience store operator Lawson and system manufacturer Panasonic are making big strides with their adoption of CO₂ solutions. In his presentation, Lawson's director Shinichirou Uto talked about the Japanese convenience store's plans to install CO₂ in all new outlets and reduce energy consumption by 20% across all stores compared with 2010 FY (Fiscal Year). Lawson, which operates 12,000 stores, adopted CO₂ refrigeration as its standard technology for all new stores, in 2014.

Lawson has stated its desire to become 'the world's number one natural refrigerant retailer', and is rapidly approaching the international benchmark set by Denmark, of 712 CO₂ stores. The retailer currently has 461 CO₂ stores in operation but expects to increase that figure to 570 by the end of February 2015. Lawson operates in almost every region throughout Japan, from Hokkaido to Okinawa, with the exception of Fukui and Kochi.

Fellow convenience store chain SAVE ON is set to break ground and open Japan's first 'all-natural-refrigerant' store. Part of the Besia group in Japan, SAVE ON operates 605 stores, with the new 'all green' store to feature Panasonic CO₂ showcases and condensing units as well as AHT's R290 cabinets.

Meanwhile, Panasonic reiterated its plans to improve its CO₂ system solutions and target more stores throughout Japan. Panasonic's CO₂ retail store system, which was aided by support from MOE and METI, shows the company's unified effort to introduce CO₂ systems. Tetsuro Homma, Executive Officer at Panasonic, expected demand for the company's CO₂ systems to continue to grow and estimated that by March 2015, there would be 763 of Panasonic's CO₂ refrigerated stores in Japan.

Panasonic is placing a lot of focus on improving the company's CO₂ product line-up. Their next generation showcases of condensing units are 34% smaller and 20% lighter than R404A models, and will play a part in the manufacturer's philosophy to help promote the 2020 Olympic Games. "We'd like to play a key role in the Olympic Games 2020 in establishing Tokyo as a sustainable, advanced city and creating a new society with natural refrigerant products, including CO₂ cooling systems," Homma said.

NORTH AMERICA: SOBEYS LEADING THE WAY WITH CO₂ TRANSCRITICAL SYSTEMS IN CANADA

Leading Canadian food retailer Sobeys continues to raise the bar in North America, with 72 CO₂ transcritical stores now in operation, of which 44 are GreenChill Platinum Certified by the U.S. EPA (Environmental Protection Agency). Sobeys, who first trialled CO₂ transcritical refrigeration technology in 2009, made CO₂ its standard refrigeration technology for all new stores and major retrofits, in 2011. In addition, the food retailer plans to open up a further 15 to 20 stores every year.

Sobeys' Manager of Energy Management, Ian Crookston, explained how Sobeys uses a centralised CO₂ booster system, which features heat reclaim, to provide domestic hot water and winter heating.

“Market trends indicate that the timing is right to centre developments within retail refrigeration around natural refrigerants and improve within these refrigerants instead of waiting for the next generation in line. We have passed now the point of no return, and for food retail now it makes sense to focus on CO₂. The industry is ready and retailers are keen on adapting it

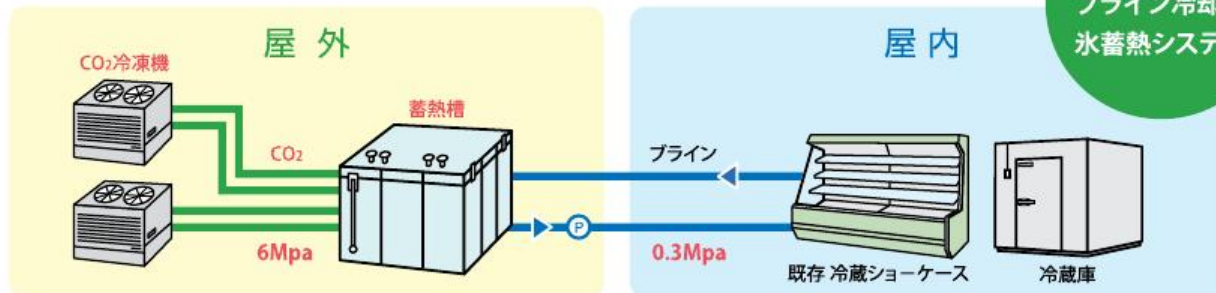
ANDERS JUUL
DANFOSS

ノンフロン ウルトラエコ・アイスシステム

高温・中温 ショーケース用

熱源にCO₂冷凍機、二次冷媒にブライン(不凍液)を使用したブライン氷蓄熱システム

ノンフロン
ブライン冷却式
氷蓄熱システム



特徴

- ① 冷蔵システムの冷媒にブラインを使用、圧力の高いCO₂配管を屋外に設置、万が一の異常漏洩時でも施設内では発生しない。
- ② 蓄熱システムと、夜間における冷凍機の高効率運転により、冷凍機を小さく選定でき、冷凍機コスト増を抑える事が可能。
- ③ 蓄熱システムによる経済性効果によりライフサイクルコストを低減し、投資回収が可能。
- ④ 熱源の冷凍機を複数設置するのでバックアップ機能を発揮。
- ⑤ 既存ショーケースを一部改造してブライン化、転用が可能。
- ⑥ 本システム導入には補助金の活用が可能。

<http://www.yamato-se.co.jp>



株式会社 ヤマト

Main business

- Design and installation for air-conditioning and refrigeration facilities
- Development and operation of thermal storage system

10+

years of extensive
experience in
natural refrigerants

Engineering a greener tomorrow

Your expert in natural refrigerants

Danfoss offers complete solutions for natural refrigerants incl. CO₂. If you partner up with us you get an experienced and reliable partner which will allow you to save money and protect the environment.

www.danfoss.com/NaturallyCool

ENGINEERING
TOMORROW

Danfoss

SPREADING JAPANESE INSIGHTS THROUGHOUT SOUTH EAST ASIA & CHINA

Japanese companies are continuing their expansion into neighbouring regions, with manufacturers Mayekawa, Panasonic, and retailer Lawson all active in Indonesia. Mayekawa are promoting best practice in neighbouring countries with their Joint Crediting Mechanism (JCM) project for the cold chain industry in Indonesia, where they are trying to establish their NewTon model as a replacement for out-going R22 models.

Meanwhile, Panasonic confirmed it will operate in 13 CO₂ transcritical stores in South East Asia.

Junya Ichikawa, GM and Division Head, ES Business Division Sanden Corp demonstrated his company's CO₂ capability and the global potential to adopt CO₂ technology through Sanden's various applications, including vending machines, showcases, cooling modules for industry, domestic hot water and space heaters, and automotive systems. Ichikawa also confirmed Sanden's one-millionth CO₂ system sale and predicted another one million in 2015.

In China, international food retail chains and consumer brands are driving the shift towards natural refrigerants with CO₂ transcritical systems and heat pumps showing market growth. China presently has eight supermarkets using CO₂, with one of them using a CO₂ transcritical system, while there are already over 160 commercial CO₂ heat pumps in the market. In regards to light commercial refrigeration, China has at least 12,000 CO₂ bottle coolers.

INDUSTRIAL REFRIGERATION & HEAT-PUMP MARKET MEETING REGULATORY MEASURES

Although the commercial refrigeration sector was in focus at ATMOsphere Asia 2015, industrial refrigeration remained a hot topic with huge opportunities to transition to natural refrigerants before the HCFC phase out in 2020. In Japan, more than 500 NewTon CO₂/NH₃ installations have been completed in cold storage, ice arena and freezer applications, but there are still approximately 10,000 industrial refrigeration plants utilising the R22 refrigerant in Japan.

End users switching their industrial refrigeration systems using R22 to CO₂/ammonia systems is an expanding market worldwide, with government support available to complete 30 CO₂/NH₃ installations. It is expected that with an increased budget for the next round of incentives, there will be increased activity. In New Zealand, there are more than 600 Mayekawa industrial compressors operational; three CO₂/NH₃ cascade systems and two ammonia hot water heat pumps.

“

We have started activity to expand our system globally, especially Europe, the United States and other parts of Asia.

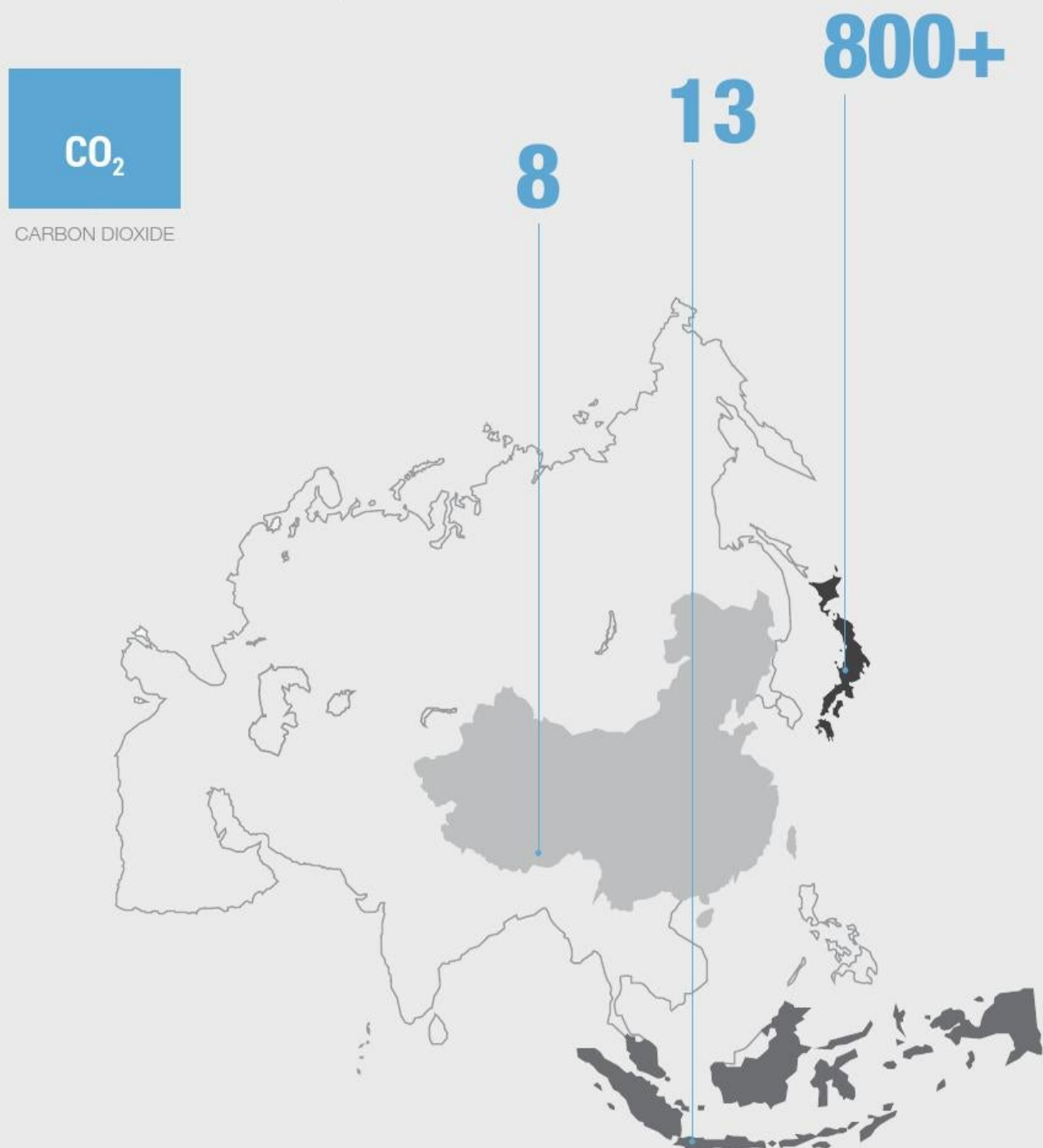
”

YUKIO YAMAGUCHI

SANDEN



DATA PRESENTED AT ATMOSPHERE ASIA 2015 ON CO₂ COMMERCIAL
REFRIGERATION APPLICATIONS IN CHINA, JAPAN AND INDONESIA *



*The figures are based on data presented at ATMosphere Asia 2015
only and do not necessarily represent total market data

HYDROCARBONS IN COMMERCIAL & DOMESTIC REFRIGERATION

In addition to CO₂, hydrocarbons are also experiencing rapid uptake in a number of regions with Red Bull and leading Japanese HVAC&R product supplier REI-TECH providing their insights at ATMosphere Asia 2015.

Global Purchasing Manager at Red Bull, Jürgen Brenneis, began his presentation by discussing 'Refrigerants, Naturally!', a joint initiative by PepsiCo, Unilever, The Coca Cola Company, and Red Bull to replace HFCs with natural refrigerants in beverage coolers and vending machines.

Thanks to the UNEP and Greenpeace supported initiative:

- 3.5 million HFC-free plug-in units have been installed
- Saving 1.2 million tonnes of CO₂ emissions
- Red Bull has a presence in 166 countries with a global cooler fleet of 1 million
- 500,000 units use hydrocarbon R600a

Red Bull, a major proponent of hydrocarbons in commercial refrigeration, believes there is still considerable work to be done to bring R290 and R600a components faster to the Japanese market. Japan remains the region in which Red Bull has not yet been able to make a market impact. The company's environmentally friendly ECO Coolers use around 45% less energy than traditional coolers but a shortage of components, and a lack of service partners and training, are stalling Red Bull's progress.

According to Brenneis, Red Bull has 10,000 cooler units in Japan and a market share growing by 25-30% every year, but due to the negative reputation in Japan for hydrocarbons as refrigerants, none of them use hydrocarbons.

While Red Bull has struggled to find market share in Japan, leading Japanese distributor REI-TECH presented the company's aim to have all of its showcases using hydrocarbons by 2020. Through his case study presentation, REI-TECH's Kazuhiro Tatewaki explained the benefits of the AHT R290 showcases the company began selling in 2013, including reduced energy consumption, operating costs and reduced waste compared to conventional systems. REI-TECH plans to employ two new models using the same refrigerant with global unit sales rising from 3,364 to 5,021 between 2013 and 2014.

shecco's Nina Masson presented research findings ahead of the first GUIDE China publication, which revealed the following:

- 325,000 hydrocarbon ice cream freezers installed in China
- 380,000 stand-alone hydrocarbon cabinets installed in China
- 29% of respondents plan to use hydrocarbons in the next five years
- The greatest market potential for hydrocarbons exists in the domestic refrigeration market

“

We would like to fulfill our HC policy in Japan but we are struggling to find and get components for R600a

”

JÜRGEN BRENNEIS

RED BULL

DATA PRESENTED AT ATMOSPHERE ASIA 2015 ON LIGHT COMMERCIAL
APPLICATIONS IN CHINA AND JAPAN *



CHINA

325,000

HC ICE CREAM FREEZERS

380,000

HC STAND ALONE CABINETS

12,000

CO₂ BOTTLE COOLERS



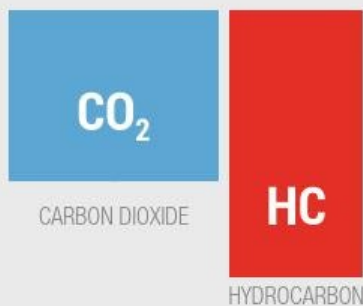
JAPAN

50+

HC FREEZER STORES
(30 SAVE ON STORES)

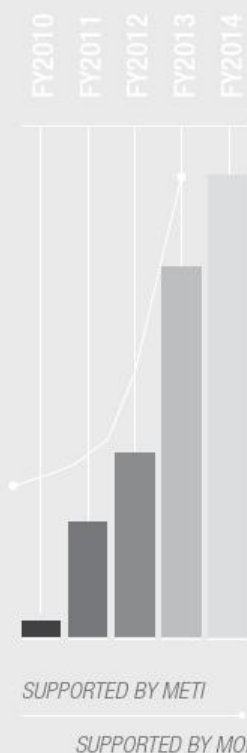
85,000

CO₂ PEAK SHIFT VENDING
MACHINES (OUT OF A TOTAL
OF 350,000 CO₂ AND HC
VENDING MACHINES)



*The figures are based on data presented at ATMosphere Asia 2015 only and do not necessarily represent total market data





BY MAR 2014

190

SHOPS

BY MAR 2015

763

SHOPS

RAPID PENETRATION OF PANASONIC NATURAL REFRIGERANT PRODUCTS IN JAPAN

CHALLENGES FACING COMMERCIAL & INDUSTRIAL CO₂ MARKET IN JAPAN

In addition to the barriers facing the uptake of hydrocarbons in Japan, the expanding CO₂ market faces similar challenges, from high costs to a lack of training. Convenience store operator Lawson has shown the benefit of training in the installation and maintenance of CO₂ refrigeration technology with 900 of its technicians trained to cater for 461 CO₂ stores.

Remote monitoring data also plays a leading role in Lawson's successful maintenance program, which it could not have conducted without the cooperation of the system manufacturers, according to director Shinichirou Uto.

"It has been a long road and we have overcome many challenges. The biggest problem was the lack of training, so we had to provide training to Lawson's refrigeration technicians, for which we received the cooperation of the system manufactures," Uto said.

In their presentations Panasonic's General Manager Hidekazu Tachibana and Sanden's General Manager, Development Department, CO₂ Refrigeration Yukio Yamaguchi stressed the same sentiments, while Tesco's Bob Hurley said cost remained the major issue preventing the company from adopting its CO₂ convenience store technology. In a video presentation, Hurley bemoaned the fact that Tesco felt the need to utilise HFC blend R407f as an alternative in its convenience store applications.

“

We face the challenge of high cost of new systems, and without government support it would be difficult for us to install this many systems.

”

SHINICHIROU UTO

LAWSON

“

Capacity building for CO₂ refrigeration is vital – from now on we need to strengthen the support system for capacity building for the maintenance operators installing and repairing CO₂ technologies.

”

MASAFUMI OKIJAPANESE MINISTRY OF ECONOMY,
TRADE AND INDUSTRY (METI)



FEINSTE MEHLSPREIS
Zwetschken
KNÖDEL

FEINSTE MEHLSPREIS
Zwetschken
KNÖDEL

FEINSTE MEHLSPREIS
Zwetschken

FEINSTE MEHLSPREIS
Zwetschken

CHAPTER 3

CO₂ COMMERCIAL REFRIGERATION INNOVATIONS



ANDERS JUUL

DANFOSS



ABEL GANANAKUMAR

EMERSON CLIMATE TECHNOLOGIES



KATSUNORI SHIBATA

SHIBATA WELDING CONSTRUCTION CO.
& CAREL JAPAN CO.



OLIVER JAVERSCHKE

BITZER



HIDEKAZU TACHIBANA

PANASONIC



YUKIO YAMAGUCHI

SANDEN

ATMOsphere Asia 2015 provided the platform for system manufacturers and component suppliers to present their CO₂ systems and technologies designed to increase the energy efficiency of CO₂. Panasonic and Sanden presented their innovative CO₂ refrigeration units, while Carel, Bitzer and Danfoss investigated the benefits of mechanical subcooling, parallel compression and ejectors. While these latter technologies are playing a key role in improving CO₂ systems in warm ambient climates, heat reclaim remains a key energy saver in more northerly climates.

SMALLER, LIGHTER, MORE AFFORDABLE CO₂ SYSTEMS FOR THE JAPANESE MARKET

In the commercial refrigeration sphere, manufacturers Panasonic and Sanden presented their latest innovations, including improved CO₂ refrigeration systems, enhanced pressure adjust controls and a micro channel gas cooler.

In his presentation, Panasonic's General Manager Hidekazu Tachibana, discussed the company's two-stage and split system compression solutions. The two-stage compression solution reduces pressure differential, thereby reducing leakage, and also reduces the cost and weight of the casing. While improving efficiency, it reduces vibration, noise, and temperature of the sliding components by cooling the discharge gas in the intercooler.

Tachibana explained that Panasonic's CO₂ split system, whereby the refrigerant is partially branched off from the gas cooler and decompressed to intermediate pressure in a split expansion device, increases the overall cooling capacity of the unit. To achieve this, a split heat exchanger cools the refrigerant in the main circuit because the refrigerant discharged by the outdoor unit is cooled to a lower temperature.

In addition to these compression solutions, Panasonic showcased its 'pressure adjust control' CO₂ refrigeration system, with four models to be released in 2015. In addition, a new 2HP (horse power) model will be made available in May. The solution addresses the common problem of variance in output pressure to the showcase (usually (5-9MPa) by automatically controlling the transfer pressure from the condensing unit at about 6MPa, in all seasons. Benefits of the pressure adjust control system include:

- Up to a 35% reduction in CO₂ unit size
- Up to a 23% reduction in weight
- One fan rather than two to reduce noise

Sanden's Yukio Yamaguchi, General Manager within the Department of CO₂ Refrigeration, presented the company's unique CO₂ system with three compressors and an all-aluminium micro channel gas cooler, which compared to a fin and tube gas cooler features:

- 15% increase in capacity
- 75% smaller size
- 58% lighter
- 60% less expensive

Among its line of new CO₂ innovations, Sanden has developed 6HP and 2HP CO₂ transcritical units, CO₂ plug-in showcases and a CO₂ open-front drink cooler. In addition, its outdoor CO₂ units are unique in that the three-compressor cascade system is able to reduce the refrigerant charge, and, in the event of a lone compressor failure, maintain the overall system temperature. According to Yamaguchi, these CO₂ cascade system has the capacity to improve COP by 1.5 times compared with a standard system.

“

We developed a micro-channel heat exchanger because the costs of CO₂ refrigeration systems are very high so we had to reduce the cost of devices, not only the compressor but also the heat exchanger.

”

YUKIO YAMAGUCHI

SANDEN

CO₂ ENERGY SAVINGS COMPARED TO CONVENTIONAL SYSTEMS

In their presentations at ATMOsphere Asia 2015, Lawson, Panasonic and Sanden all reported energy savings from conversions to CO₂ systems. In the commercial refrigeration market, convenience store operator Lawson has introduced two CO₂ systems in all new outlets and as a result saved 27% per store. With regards to their newer generation CVS (convenience store), installations have proven to save on average 21%, compared to R404A models.

The results of six installations of Panasonic's new pressure adjust control CO₂ system proved to be on average 12.9-18.2% more efficient than conventional models in the Kyushu region, and 17.4-32.2% more efficient in the Kansai region. Test results from Sanden revealed a 23% energy saving ratio for their CO₂ system, and 11% in higher ambient temperatures of 40°C.

CHANGING THE LANDSCAPE FOR CO₂: PARALLEL COMPRESSION, MECHANICAL SUBCOOLING & EJECTORS

Bitzer's Oliver Javerschek presented an empirical study on a parallel compression unit in three different climates – Tokyo, Beijing and New Delhi - and found it can significantly increase COP in warmer climates. Using a CO₂ booster system with parallel compression (PC), flash gas bypass (FGB) and no heat reclaim, Bitzer's study used the smallest available compressor for the parallel compression, the 2MTE-7K.

In summary, Javerschek concluded that parallel compression shifts the "CO₂ equator", and that it is possible to increase the COP by 14% to a maximum of 6, in high ambient temperatures. Conversely, in lower ambient temperatures (below 12.5°C), the COP gradually decreases because the system has to be switched from parallel compression to flash gas bypass. Javerschek asserted that parallel compression is more efficient than a flash gas bypass system because the temperature lift is taken in with a high density and high pressure level, which means a smaller displacement is required to compress the flash gas.

CAREL Japan tested two systems in three different climates - Munich, Venice and Palermo – to compare CO₂ system efficiencies at higher outside temperatures. CAREL Japan's President Katsunori Shibata revealed that the CO₂ booster system with parallel compression reduced power consumption by 4%, 7% and 10% respectively, compared to a booster with flash gas bypass. Shibata also found that unlike the CO₂ booster system with flash gas bypass, the CO₂ system with parallel compression had almost the same power capacity compared to a hybrid

CO₂/R134a system, and could significantly increase the efficiency of CO₂ transcritical refrigeration.

Meanwhile, ejectors present a fresh opportunity for further innovation in the CO₂ market. Supplier Danfoss is currently focusing on testing two different types of ejectors: variable ejectors - controlled electronically - and fixed ejectors, to identify their potential to increase system efficiencies in warmer climates. Initial testing has revealed energy performance improvements of around 20%, compared to traditional R404A plants.

Another more conventional technology used to enhance the efficiency of CO₂ transcritical systems is mechanical subcooling. Canadian retailer Sobeys is conducting a benchmarking exercise between two of its stores, in Milton and Stratford, Ontario to measure energy savings. The data collection is underway with the first results to be presented at ATMOsphere America 2015, in Atlanta, in June. Both stores have similar low and medium temperature capacities however; one store will use the mechanical subcooling technology to indicate the energy savings available.

Emerson Climate Technologies' Director-Refrigeration Marketing (Asia) Abel Gnanakumar presented on the company's iPro controller, which enhances flash tank stability, and evaporator expansion valve control (EXV), which has two control points to maintain a more steady case temperature and pressure.

HEAT RECLAIM A KEY ENERGY SAVER FOR CO₂ SYSTEMS IN COLDER CLIMATES

While several presentations canvassed innovations designed to improve CO₂ system efficiencies in high ambient temperatures, the importance of heat reclaim technology in colder climates was also highlighted by several speakers at ATMOsphere Asia 2015.

In the northern hemisphere, Danfoss provided components for a KIWI CO₂ transcritical store in Norway, with integrated heat reclaim technology. The 1300m² pilot store, which has a transcritical CO₂ booster system, has achieved 40% energy savings thanks to the heat reclaim optimisation.

In Canada, Sobeys uses a booster system with heat reclaim as its standard refrigeration technology, while in the UK, Tesco's Robert Hurley confirmed the company had found CO₂ systems with heat reclaim to be cost effective and therefore sustainable over the long term.



CHAPTER 4

CO₂ HEAT PUMPS & PEAK SHIFT TECHNOLOGIES



HIRONARI FUJIKI
MITSUBISHI HEAVY INDUSTRIES



SADAO NISHIMURA
YAMATO CO



YOSHINARI OKUYAMA
COCA COLA'S TOKYO RESEARCH &
DEVELOPMENT COMPANY LIMITED

In colder climates, CO₂ heat pumps are beginning to make an impression with Mitsubishi Heavy Industries presenting its Q-Ton heat pump, which it hopes to distribute in South Korea and beyond in the coming years. With a large portion of Japan's existing refrigeration systems still using HCFCs, Yamato's Ultra-Eco-Ice CO₂ thermal storage system is specifically designed to retrofit existing display cases and address regulations under the Montreal Protocol, which must be complied with by 2020. The Coca Cola Company continues to add thousands of award-winning CO₂ vending machines to its fleet with its peak shift technology able to chill drinks for up to 16 hours without running a compressor.

Mitsubishi Heavy Industries launched its Q-Ton CO₂ transcritical heat pump for commercial applications in late 2011 with the aim of reaching the system's hot water capacity in temperatures below 7°C - where similar models had failed in the past. Hironaki Fujiki Engineering Manager for the Heat Pump Solution Sales Section of Air Conditioning and Refrigeration Division of Mitsubishi Heavy Industries presented the results of the company's extensive field tests on the Q-Ton under temperatures as low as -20°C - in Iwate, Hokkaido and Toyama.

Initially, Mitsubishi was having difficulties reaching the Q-Ton's ability to supply 90°C hot water in temperatures below 7°C, but after extensive testing in the most severe conditions, was eventually able to achieve:

- In temperatures as low as -20°C the supply of 90°C was assured
- 61% reduction in running costs
- 29% reduction in CO₂ emissions
- Suitable for ambient temperatures as low as -7°C
- Highest COP of 4.3 in the industry

The Q-Ton has been installed in a number of applications throughout Japan, including a nursing home in Fukushima, a school in Shizuoka, hot springs, saunas and other industrial applications, with future plans to expand supply throughout Asia.

Yamato's Managing Executive Officer Sadao Nishimura presented the company's Ultra-Eco-Ice (UEI) system, which incorporates CO₂ refrigeration and a brine-ice thermal storage system.

The innovative UEI system is now installed in 13 different facilities, and enables end users to upgrade their HFC systems rather than replace the entire case. Yamato's solution stores cold energy during night time, converting it for refrigeration and air conditioning inside the store and display cases. The integrated brine system will help address over 50% of existing facilities in Japan still using HCFCs, which must be phased out by 2020.

COCA COLA INCREASING DISTRIBUTION OF PEAK SHIFT CO₂ VENDING MACHINE IN JAPAN

Yoshinari Okuyama, Director, Sales Marketing Equipment and Process Research at the Coca-Cola Tokyo Research & Development Co. Ltd., confirmed the company's distribution figures of their award-winning vending machine increased by nearly 300% in 2014 - to 83,000 units from 28,000 in 2013. The vending machine is capable of drastically reducing power consumption during peak hours and keeping drinks cold for a maximum of 16 hours without running a compressor.

“

We have many future plans, especially in South Korea; where there are several cold areas and this is where the Q-Ton (shines), such as hot springs, spas, dormitories and industrial applications.

”

HIRONAKI FUJIKI

MITSUBISHI HEAVY INDUSTRIES



Coca-Cola
Refreshing & Uplifting

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Refreshing & Uplifting

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CHAPTER 5

AMMONIA REFRIGERATION

& HEAT PUMPS FOR

INDUSTRIAL APPLICATIONS



YUJI NAKAJIMA
KOBAYA BAKING



MARTIN MILLOW
MAYEKAWA AUSTRALIA PTY LTD

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here industrial refrigeration applications are concerned, end users converting their R22 systems to ammonia/CO₂, is an expanding market globally. Thanks to ammonia's high efficiency and low cost, industrial facilities are turning to the natural refrigerant in increasing numbers. At ATMOsphere Asia 2015, Mayekawa presented on ammonia heat pumps and their use in meat processing plants in New Zealand. The Kobeya Baking Company disclosed its four main energy reduction initiatives that have led to significant annual energy savings at its Kanto production facility.

CO₂/NH₃ INDUSTRIAL REFRIGERATION CASE STUDY

In his presentation, Kobeya Baking's General Manager of Frozen Dough Plants Yuji Nakajima, explained the measures the company has taken to reduce energy consumption using a CO₂/NH₃ system at its 7,034m² frozen dough production facility in Kanto, Japan. Replacing an R22 system with Mayekawa's NewTon F600 90kW, Kobeya was able to achieve 38% in annual power savings; an energy reduction of approximately 45% in the summer, and 25% in the winter. To achieve this, Kobeya made three other major alterations to its system integration:

- The plant replaced a low-speed compressor with an inverter-driven air compressor, achieving a 27% reduction in power consumption, operating one set at 15 kW rather than two sets at 11 kW.
- Kobeya replaced a central steam boiler running on gas with two electric heaters (using only night-time electricity), to store thermal energy. The adjustment led to savings of 75% in energy costs and eliminated the need to produce hot water 24 hours a day.
- In light of the rise in summer temperatures in Japan (5°C in August/September from when the factory opened in 1996), the plant installed a roof with heat cutoff coating to prevent heat from penetrating through the roof. The system has decreased the indoor temperature by 3°C, which is equivalent to reducing the cooling load by 25,000 kW per year.

Kobeya Baking Company plans to replace other existing R22 systems with CO₂/ammonia solutions in order to reach a company-wide goal of 30% power consumption reduction.



AMMONIA HEAT PUMP CASE STUDY

New Zealand Regional Manager at Mayekawa Australia Pty Ltd., Martin Millow, presented a case study on ammonia heat pumps using rejected heat for hot water generation in two meat processing plants. In New Zealand, where industrial refrigeration is key for most industries, particularly the dairy industry, which accounts for 7% of the country's GDP, finding solutions to utilise heat rejection through condensers, is vital.

The two meat processing plants presented require a high volume of hot water for C.I.P functions, sterilisation and wash down, and with a water temperature requirement of 65°C, they presented ideal applications for the ammonia technology. Millow explained that depending on the heat source temperature for the condensing temperature of the refrigeration system, the COP can be increased from approximately 6.5 at 25°C, to a COP exceeding 8. In light of the energy savings, the payback period for the system was less than 3 years, making it a very attractive investment for end users.

"If we consider the amount of heat rejected through condensers of industrial refrigeration systems globally, it's a massive amount of energy being exported into the air – we need to start recovering some of this heat and using it," Millow said. "Energy cost and demand is constantly increasing and natural resources are not going to be everlasting. Climate change is a key focus for us."

“

In the future we believe that ammonia heat pumps will complement or replace conventional boilers because of their high efficiencies when providing hot water by utilising refrigeration rejected heat. They not only reduce CO₂ emissions, but they also offer a lower operational cost when compared to the traditional boiler applications.”

”

MARTIN MILLOW
MAYEKAWA AUSTRALIA

MAYEKAWA
MYCOM

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CHAPTER 6

AIR & WATER AS REFRIGERANTS



DONG GUY KIM

SEA SKY GLOBAL



NOBUYA ISHITSUKA

MAYEKAWA MFG.CO. LTD



HAYATO SAKAMOTO

KAWASAKI HEAVY INDUSTRIES LTD.



JONGSOO JEONG

WASEDA UNIVERSITY



KENICHI NISHIKAWA

DENSO CORP.

W

hile less prevalent than CO₂, hydrocarbons and ammonia, air and water complete the 'natural five' refrigerants as the ultimate environmentally friendly, low risk solutions. With zero ozone depleting (ODP) and global warming potential (GWP), Mayekawa and Sea Sky Global outlined the benefits of using air as the working fluid in ultra low temperature storage with the Pascal Air system. ATMosphere Asia 2015 also confirmed water's bright future in the industrial refrigeration sector, with Kawasaki Heavy Industries' R718 turbo chiller and Denso's new micro-fin technology, designed to improve heat transfer and reduce size for adsorption heat pumps, showing their flexibility.

AIR FOR ULTRA-LOW TEMPERATURE STORAGE FACILITIES

In his presentation, Mayekawa's Engineer Nobuya Ishitsuka presented the company's adoption of air as a refrigerant, most notably the 54 Pascal Air system installations it has now completed. Ishitsuka stated that due to its non-flammable and compact nature, ultra-low temperature warehouses represented the greatest area of demand for the Pascal Air, but that rapid food freezing and the chemical process cooling industry were also presenting market opportunities.

The Pascal Air is highly flexible with a wide range of temperature control, even as low as -120°C . The system uses an open cycle, meaning there would be no damage or threat to safety in the event of a leak. In addition, the system is a suitable replacement for ultra-low temperature R23 cascade refrigeration systems, as well as for liquid nitrogen refrigeration. Using an integrated turbo compressor expander, wherein the compressor and expander are connected in the same shaft with a motor in between, the system is able to save 25% energy in comparison with a conventional system, because there is no defrost required. In the future, Mayekawa intends to expand the technology to other application areas such as vacuum freeze drying, semiconductor manufacturing, and low temperature milling.

Sea Sky Global's state-of-the-art tuna processing plant, located in Busan, South Korea, has installed three Mayekawa Pascal Air units to keep the company's 2,500 tonnes of raw tuna and processed products fresh. In his presentation, Dong Gyu Kim, Marketing Manager Sea Sky Global promoted the major benefits of the Pascal Air, namely the 40% reduction in energy costs achieved at the tuna plant. Kim also explained that there is no need to defrost, so there is little variation in temperature, and no need to hire a safety manager, reducing labour costs.

“ When I saw the Pascal Air for the first time, my gut feeling said, ‘This is it.’ ”

DONG GYU KIM
SEA SKY GLOBAL

MAJOR DEVELOPMENTS IN R718 TECHNOLOGY RISE TO THE SURFACE

While air is gaining ground, water is an increasingly established climate-friendly alternative to HFC heavy applications like air conditioning. As Hayato Sakamoto, Assistant Manager, Blower Engineering Section - Aero - Dynamic Machinery Department Kawasaki Heavy Industries, emphasised, the company's newly developed turbo chiller for air conditioning applications has proven to reduce CO₂ emissions by 30%, without compromising cooling capacity. With a capacity of 352 kW, the system's compressor is driven by a high speed inverted motor, which functions without oil. Kawasaki has successfully operated a turbo chiller at their offices since 2013 and is looking to introduce the product in larger applications.

Denso presented the evolution of its adsorption heat pump for industrial refrigeration that now includes micro-fin technology to improve energy efficiency. Denso's Manager, Climate, Cooling and Heating Engineering Division Kenichi Nishikawa explained the enhancements to the adsorption heat pump, including a 75% reduction in energy costs compared to a water-cooled chiller. In addition, the device does not use a compressor and can provide cool temperatures from

low-temperature waste heat below 100°C. Denso uses a zeolite/copper sintered adsorbent.

Hindering the device's broader application is its size and cost, but the micro-fin equipment, which is 25% smaller than traditional adsorbents, is still in development. Denso aims to develop a compact solution for consumer use but the system must be downsized, and the adsorption rate elevated, in order for the heat transfer to improve. Given that the micro-fin improves the overall adsorption rate of the system, thinning the fins would enhance the heat pump's performance, but this is difficult to obtain via mechanical processes.

Jongsoo Jeong, Visiting Associate Professor from the University of Waseda in Japan, presented a sustainable solar air conditioning system that has been supported by the Ministry of Environment in Japan. Introduced at the University of Indonesia in 2014, the system reduces fuel gas consumption by 32%, uses water as a refrigerant and has a cooling capacity of 281kW.

The system is powered by evacuated glass tube solar energy collectors, which supply 75-90°C hot water to the absorption chiller.

RECEPTION AT THE BELGIAN EMBASSY IN TOKYO

On the evening of the first day, ATMOsphere Asia participants were regaled with a “taste of Belgium” during a dinner reception at the Belgian Embassy in Tokyo. In his opening speech, Christophe de Bassompierre, the Deputy Head of Mission and currently the Chargé d'affaires in the absence of the Ambassador, praised shecco's specialised knowledge and capacity to bring stakeholders together. Tetsuro Homma, Senior Vice President of Panasonic Appliances warmly encouraged participants to take advantage of the unique networking opportunities afforded by ATMOsphere Asia, to create new business connections with both Asian and international companies present at the event.

“Innovation is crucial for the future of our society and our businesses. The market for natural refrigerants is moving in Japan, thanks to government support, in particular a subsidy for the introduction of natural refrigerants, and thanks to innovation from suppliers from Japanese Industry. The market is also growing for international companies. With the Olympics fast approaching, the eyes of the world will be on Tokyo, and this will be a golden opportunity to showcase Japan's natural refrigerant technology to the world,” said His Excellency Christophe de Bassompierre.





GLOSSARY

CVS

— CONVENIENCE STORE

CO₂

— CARBON DIOXIDE

COP

— COEFFICIENT OF PERFORMANCE

EU

— EUROPEAN UNION

FGB

— FLASH GAS BYPASS

HC

— HYDROCARBONS

GWP

— GLOBAL WARMING POTENTIAL

HCFC

— HYDROCHLOROFLUOROCARBON

HFC

— HYDROFLUOROCARBONS

HP

— HORSE POWER

HVAC&R

— HEATING, VENTILATION, AIR CONDITIONING & REFRIGERATION

JRAIA

— JAPAN REFRIGERATION & AIR CONDITIONING INDUSTRY ASSOCIATION

KWH

— KILOWATT HOUR

NH₃

— AMMONIA

METI

— MINISTRY OF ECONOMY, TRADE AND INDUSTRY

MOFA

— MINISTRY OF FOREIGN AFFAIRS

MOE

— MINISTRY OF THE ENVIRONMENT

NR

— NATURAL REFRIGERANTS

ODP

— OZONE DEPLETION POTENTIAL

PC

— PARALLEL COMPRESSION

R290

— R-NUMBERING IDENTIFICATION FOR PROPANE

R600A

— R-NUMBERING IDENTIFICATION FOR ISOBUTANE

R744

— R-NUMBERING IDENTIFICATION FOR CARBON DIOXIDE

R717

— R-NUMBERING IDENTIFICATION FOR AMMONIA

R&D

— RESEARCH & DEVELOPMENT

TC

— TRANSCRITICAL

TMG

— TOKYO METROPOLITAN GOVERNMENT

UEI

— ULTRA ECO ICE

UK

— UNITED KINGDOM

U.S.

— UNITED STATES

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MARC CHASSEROT — SHECCO

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JUNYA (JOE) ICHIKAWA — SANDEN

IN PARTNERSHIP WITH NATURE

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NINA MASSON — SHECCO

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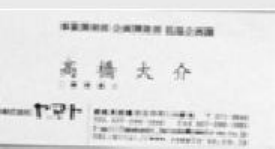
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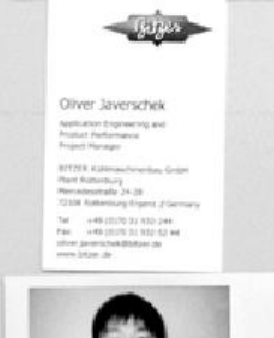
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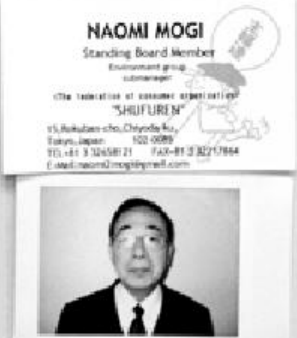
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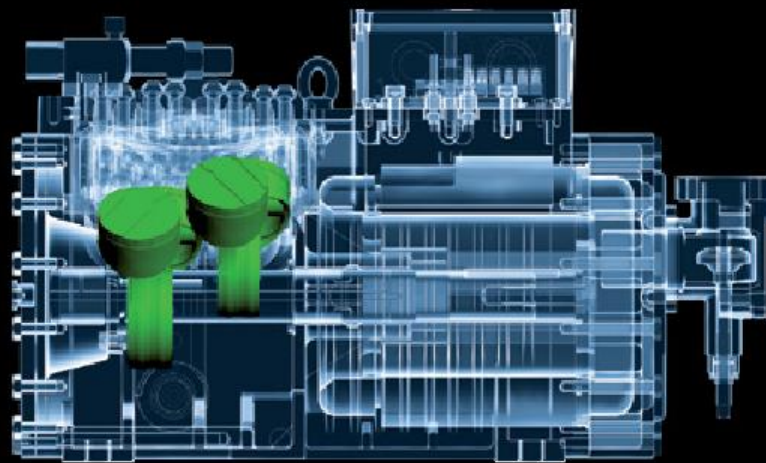


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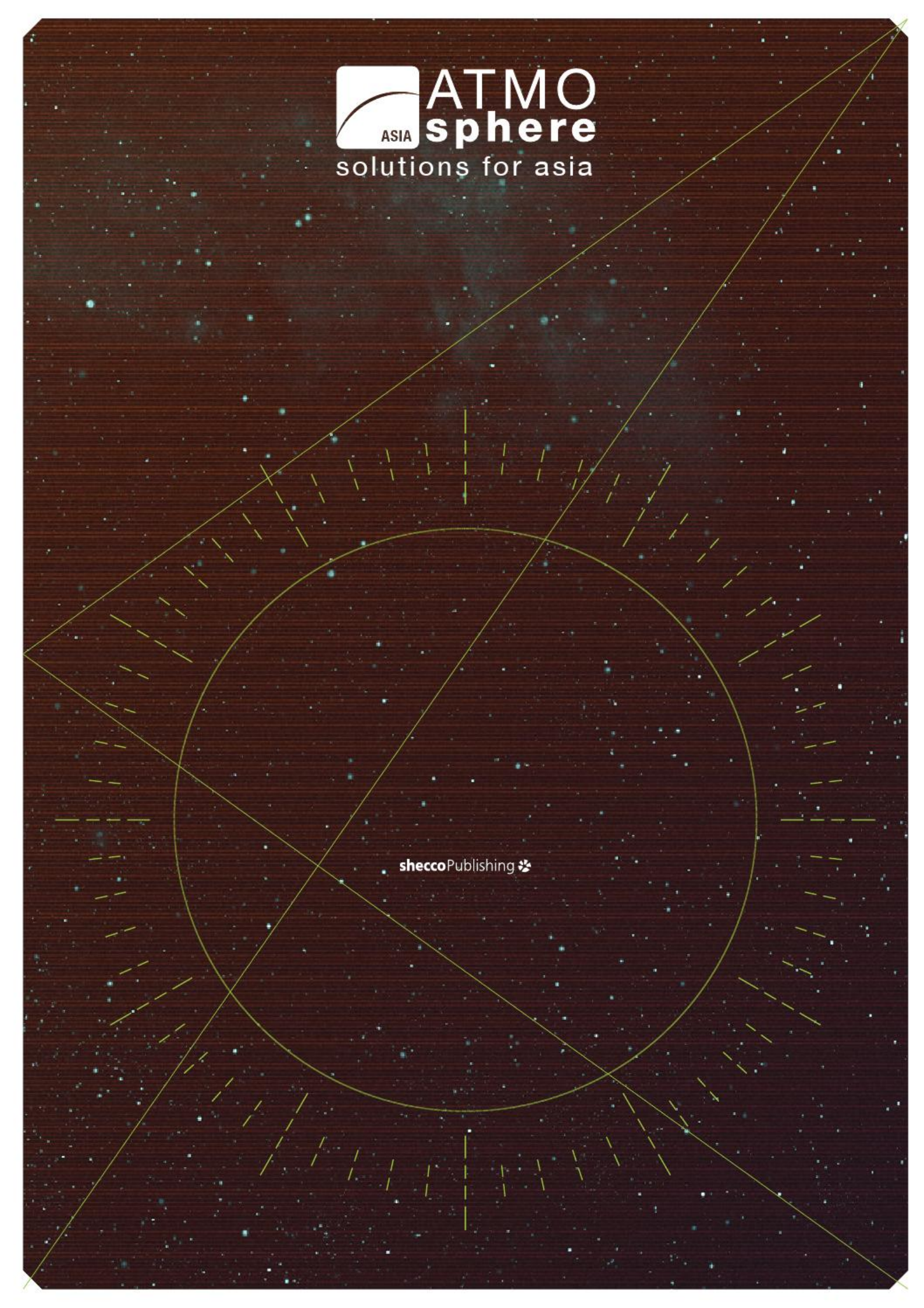


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