

Natural Refrigerants: Global market trends

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Sydney
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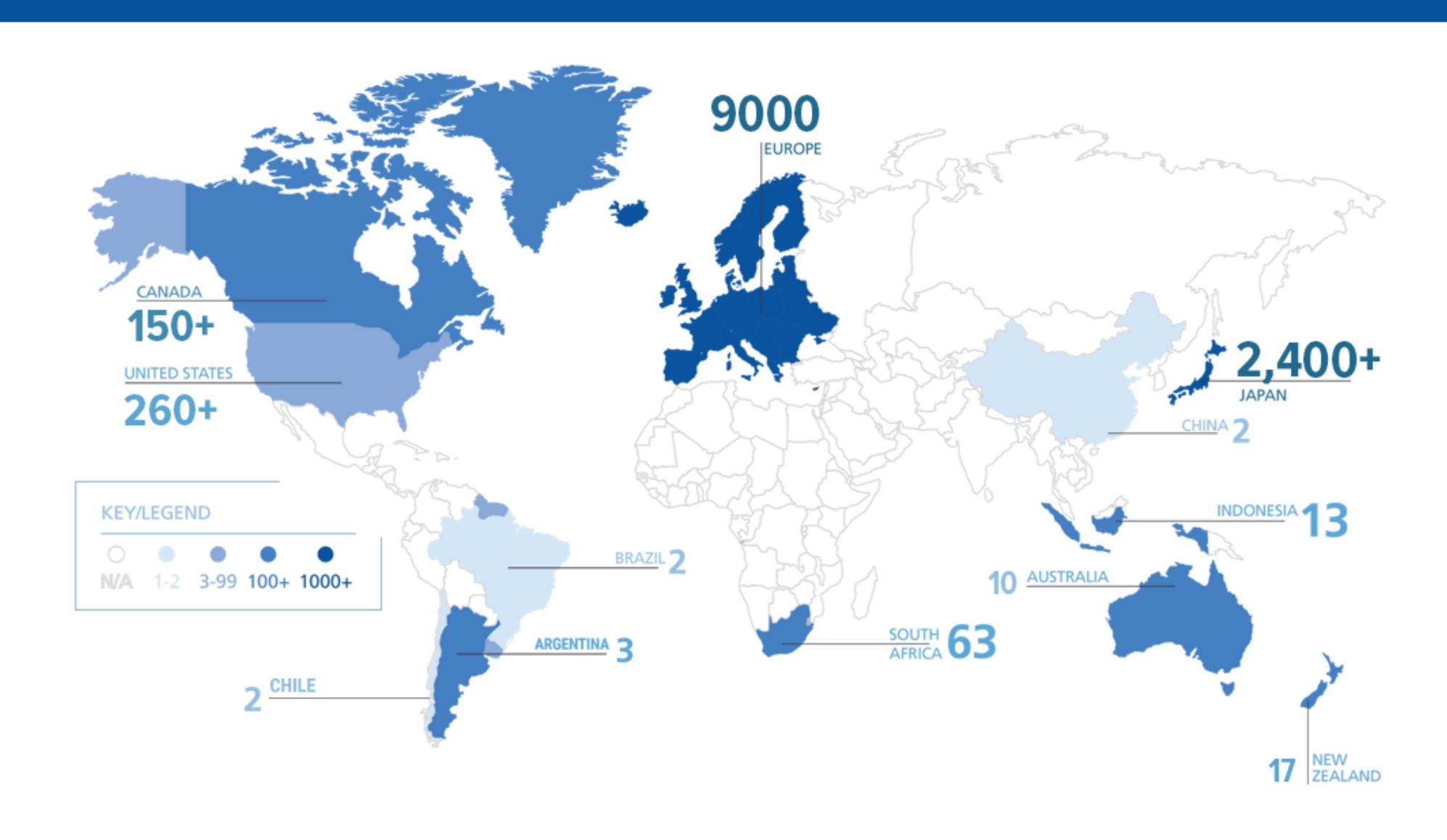
Business Development Manager APAC, shecco

COMMERCIAL REFRIGERATION



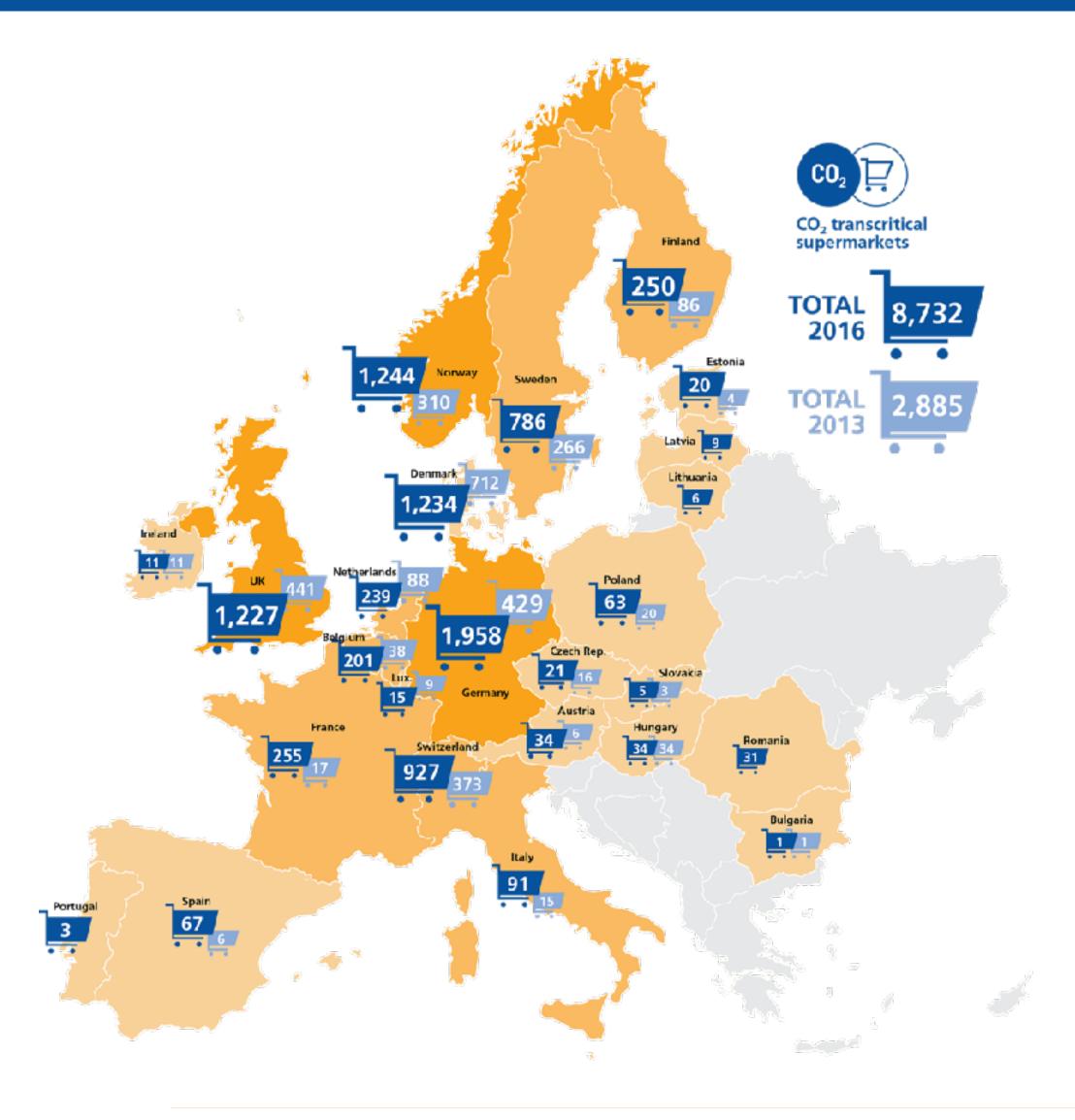
CO₂ TC STORES GROWING GLOBALLY (FEB 2017)





CO₂ TC STORES IN EUROPE (MID 2016)

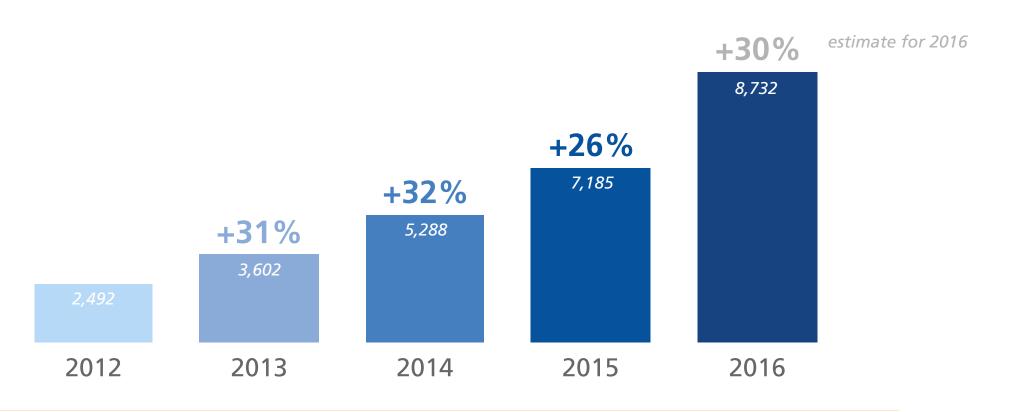




Number of CO₂ stores in the EU, Norway, Switzerland has **tripled** in the last 3 years = **8% of the overall market share** in the food retail market

Despite earlier claims that there are no viable solutions for warmer climates, the number of new installations is growing steeply in Southern Europe

Growth of CO₂-based stores



CO2 SUBCRITICAL MARKET IN CHINA (FEB 2017 UPDATE)



- Currently 32 subcritical CO₂
 supermarkets in China (HFC/CO₂ cascades) south east region
- Majority operated by Metro China, first ever installed by Tesco
- 5 contractors able to handle CO₂ installations
- Market opening up to CO₂ TC discussion about subsidy for retailers from
 the Gov



CHINA: LIST OF RECOMMENDED SUBSTITUTES FOR R22



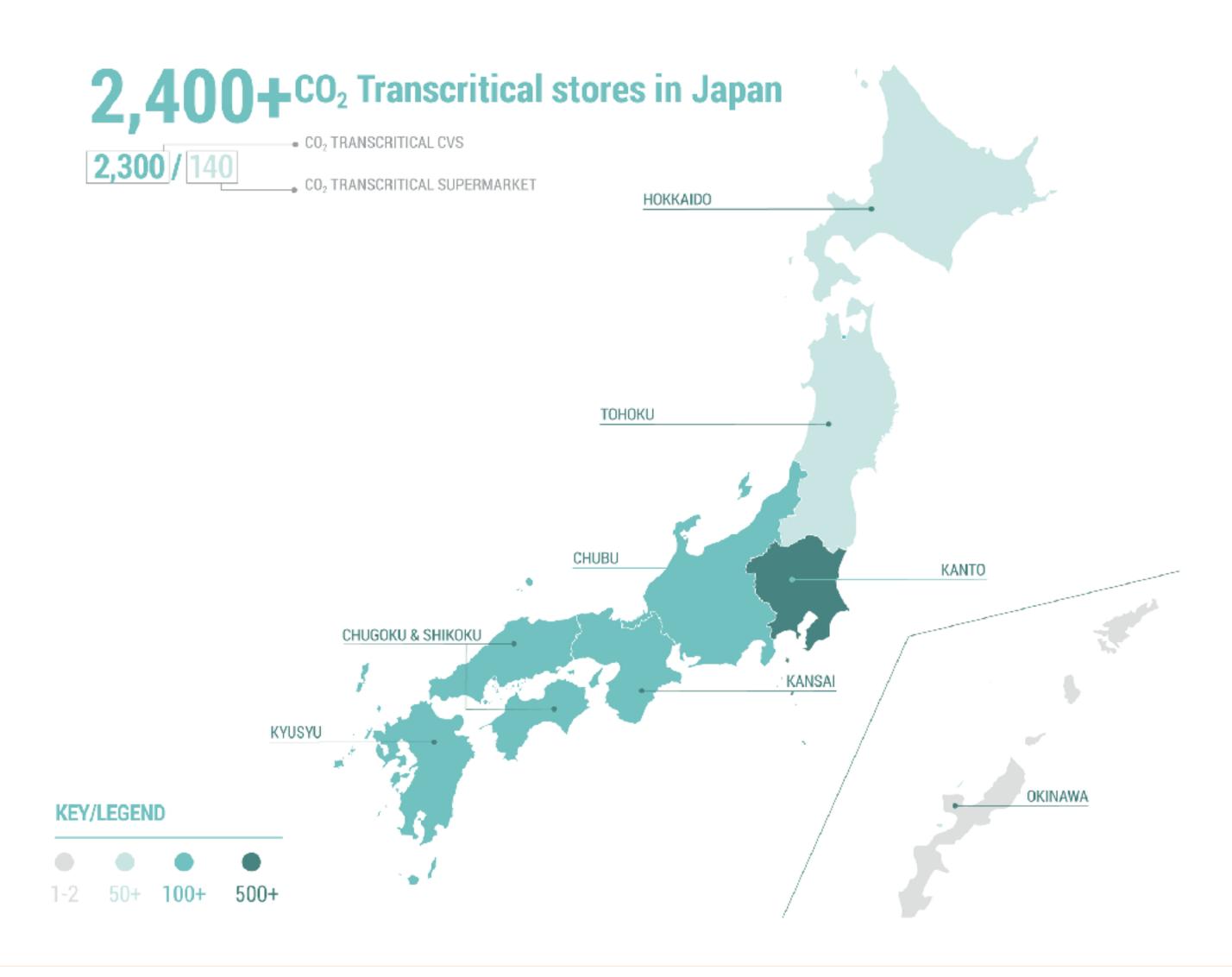
Natural Refrigerants recommended by MEP/FECO China in majority of targeted HVAC&R segments

- R290 Room air conditioner, Heat pump water heater, Stand-alone refrigeration system
- **R600a** Stand-alone refrigeration system
- CO₂ Domestic heat pump water heaters, industrial or commercial heat pump water heaters, Industrial or commercial refrigeration system (refrigerant or secondary refrigerant)
- NH₃ Cold storage, condensing unit, industrial refrigeration system



CO₂ TC STORES IN JAPAN (FEB 2017)





HYDROCARBONS GROWTH - AHT



Plug-in Units in Supermarkets with R290: A reality today

Market estimate by early 2017:

1,500,000+ units worldwide

Figures reported by AHT (market leader) by 2017:

- over 300,000+ units manufactured per year





KEY TREND: CO₂ BECOMING MAINSTREAM IN RETAIL



Strong investment of large food retail groups = CO_2 Transcritical systems becoming the norm in Europe, N. America, Japan.

Efficiency and reliability are increasing, and prices are going down.

Case Study: Aldi Süd reaches 1000th installation:

- Strategic decision in 2010: Exclusive focus on natural refrigerants
- Now: Over 54% of all Aldi Süd's stores globally are running on CO₂

Source:

r744.com/articles/7423/aldi sud proud to install 1 000th co2 system



CASE STUDY WITH HYDROCARBONS - COLRUYT



Belgian retailer **Colruyt** targeting **100% hydrocarbons for refrigeration**. Exclusive use of hydrocarbons as of 2017

Based on:

- Medium capacity chiller (2,5kg of R290 charge) + secondary glycol loop
- Standalone chest freezers (R600a)

Reported:

- High energy savings
- Reduced leakage rate to approx 5%

Source: hydrocarbons21.com

(http://hydrocarbons21.com/articles/7438/





CASE STUDY WITH HYDROCARBONS - WHOLE FOODS



Whole Foods pushes the propane envelope

The organic/natural food retailer Whole Foods Market, which has installed small-charge propane cases in many stores, is the first in the U.S. to test a centralised propane/CO₂ cascade system

Source: Accelerate America

(http://acceleratena.com/sites/action/AA1610/read/s_main)





KEY TREND: CO₂ RACK SYSTEM











10+ suppliers providing CO₂ solutions - highly competitive market

KEY TREND: CONDENSING UNITS / SMALLER SYSTEMS











Europe traditionally working with large capacity CO2 racks

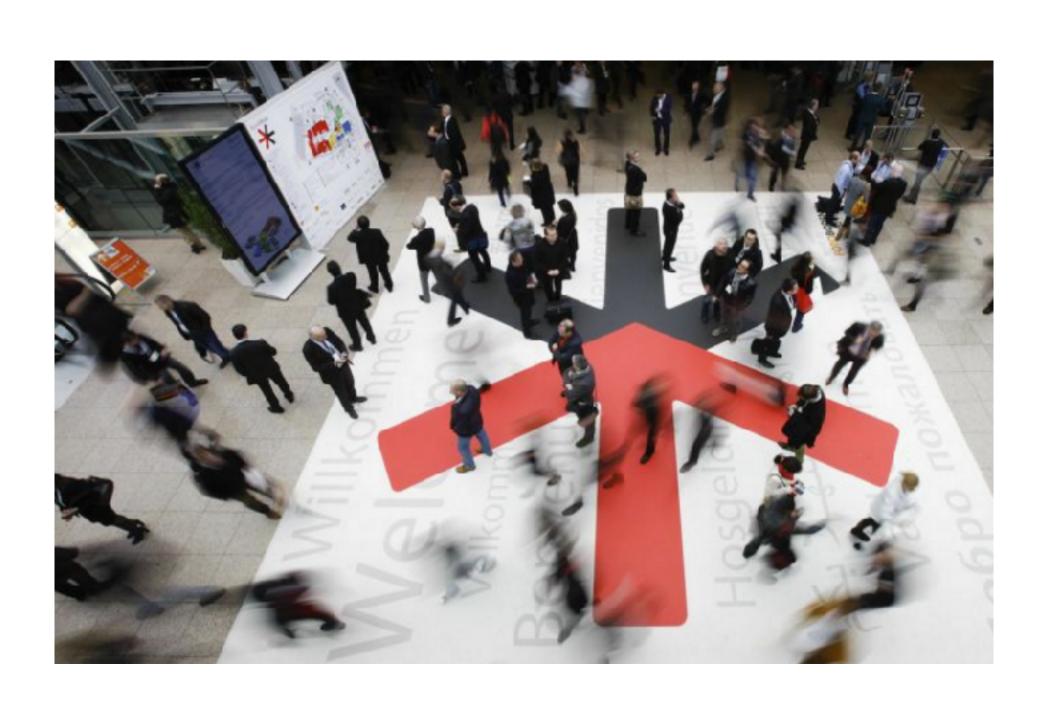
Recently several manufacturers introduced small systems

Competition increasing: more efficiency, lower prices

EUROSHOP 2017 - KEY TRENDS & INSIGHTS



- On-the-spot survey to 33 companies, including major players of the sector
- Ejectors, parallel compression and waterloop systems identified to be the main technology trends,
- Approximately 15-20% increase in production of natural refrigerant systems expected for the period 2017-2018
- R290 dominating plug-ins, showing the greatest potential
- Even higher growth expected by 2020 and beyond, with a few companies claiming that they will be ready to have their entire production moving to only natural refrigerants
- Regulation and mainly customer demand are the reasons for the expectations, especially for Europe



EUROSHOP 2017 - KEY TRENDS & INSIGHTS







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COMPANIES GOING TOWARDS HC - TRUE MANUFACTURING



- True Manufacturing (Global)
 - Committed to move entire manufacturing to 100% HC (R290) by 2019
 - Heavy investments in R&D over the last five years
 - Currently 2/3 through the transition from R134a and R404A to R290
 - Partly motivated by regulation (F-GAS, US DOE, US SNAP)
 - HC systems cheaper to run and more cost effective than HFC counterparts (25+% more efficient)
 - 327 HC base models that meet DOE's 2017 standards
 - T-23-HC single door commercial refrigerator consumes 1.27kWh daily (DOE's limit: 2.27kWh daily) => 31.76\$ energy costs saved over a year (at 10cents/kWh)



INDUSTRIAL REFRIGERATION



LOW CHARGE AMMONIA - STRONG UPCOMING TREND



Low-charge Ammonia systems are becoming a strong trend for industrial refrigeration, traditionally dominated by HFCs/ large Ammonia installations with big refrigerant charge

Key drivers:

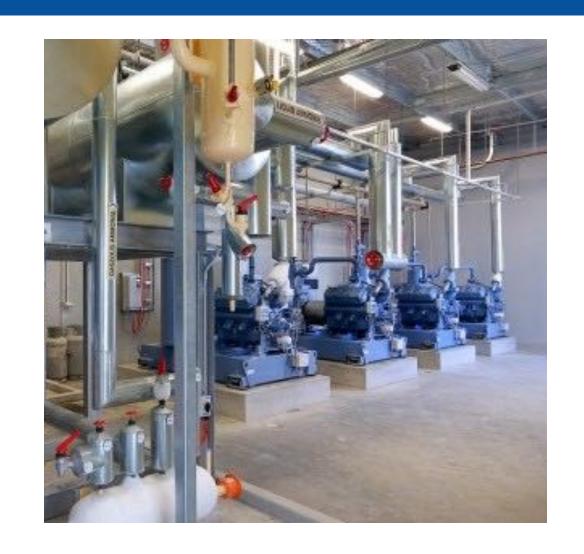
- increased safety- lower risk
- higher efficiency
- easier servicing (more compact units)
- return on investment for the end user

KEY TREND: INDUSTRIAL APPLICATIONS WITH CO₂ & NH₃















INDUSTRIAL REFRIGERATION WITH CO2 & NH3 IN CHINA



 Estimated 100+ refrigeration projects in industrial sector with CO₂ & NH₃



INDUSTRIAL REFRIGERATION WITH CO2 & NH3 IN JAPAN



the market is changing, from a strong reliance on R22 to a renewed uptake of (lower charge) NH₃ systems

Estimated **450+ installations** use secondary NH₃-CO₂ systems

BUT: the use of CO₂ transcritical systems still faces restrictions through the High Pressure Gas Safety Act



CO2 IN INDUSTRIAL APPLICATIONS - CASE STUDY



World's biggest CO₂ industrial plant

(vegetable processing plant in the Netherlands by Advansor for Staay Food group):

- 3,36 Megawatt (MW) total cooling capacity
- 7 transcritical CO₂ racks
- 45 Bock compressors (28 medium temp., 14 parallel, 3 frost)
- 600 kW of heat recovery, providing "free" heating for the office facilities
- Installation in 2016, in operation since early 2017
- Lower capital, installation & maintenance costs.

Source:

http://www.r744.com/articles/7124/advansor to deliver world s biggest co sub 2 sub system so far



Evaporating capacity of system

- 0,53 MW at -7 °C,
- 1,87 MW at -5°C,
- 0,78 MW at 0°C and
- 0,03MW at -28°C.
- 0,15 MW of cooling for AC purpose.

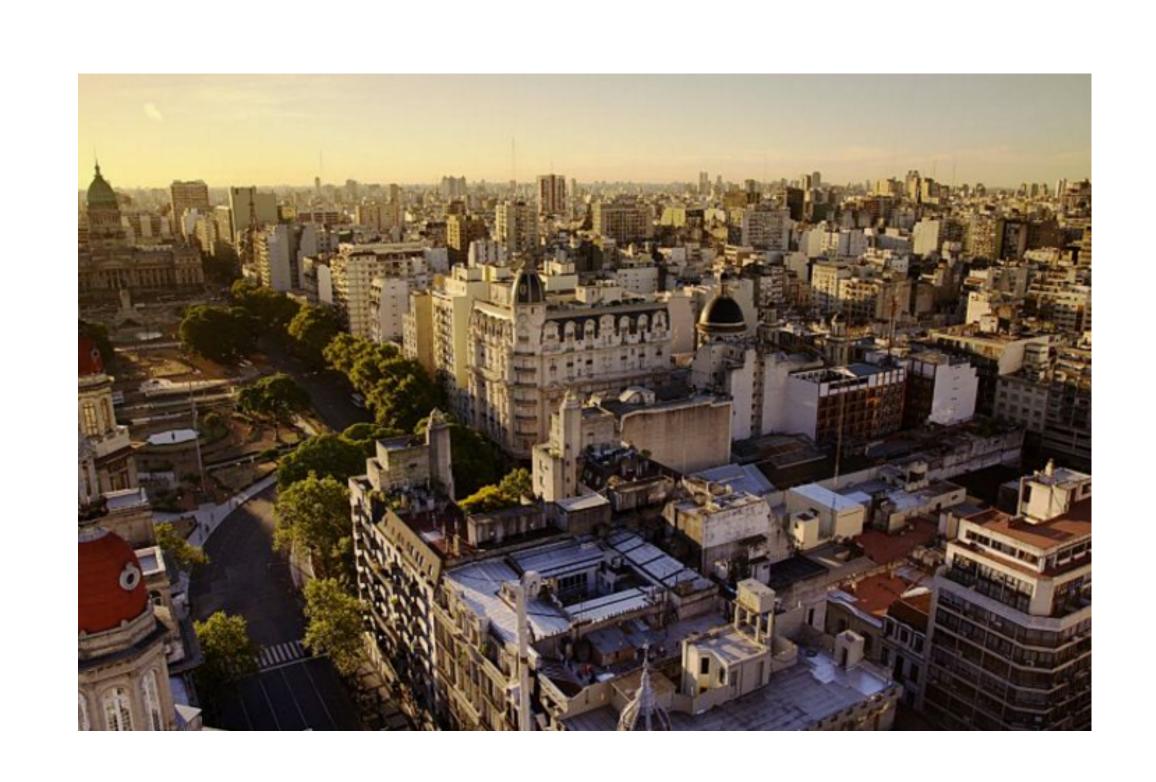
FIRST NH₃/CO₂ SYSTEM IN ARGENTINA



System installed at a **Carrefour** distribution centre in Buenos Aires.

First of its kind in Argentina, and second in Latin America

- Ammonia CO₂ brine system
- Installation began in 2016, running since 19 Jan 2017
- Biggest in the region: 14,000 m²
- High cooling and freezing efficiency; low pressure system with a high coefficient of heat transfer
- Lower cost of installation
- Another installation planned for a 3,000 m² Arca Continental ice cream facility in Mexico



AUS: LOW CHARGE AMMONIA DX AND CO2 IN INDUSTRIAL







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AIR CONDITIONING



R290 AIR-CONDITIONING, IS IT COMING?





R290 AIR-CONDITIONING, IS IT COMING?













INDIA - GODREJ APPLIANCES



Godrej Appliances

- Replaced CFC, HFC and HCFC as early as 2002
- Efficient and green ACs using R290; first in the world
- India's first ACs with 7-star performance
- 300,000+ units sold since launch
- Earliest brand to opt for voluntary energy labelling of its refrigerators



JAPAN - RESEARCH - LOW-GWP HIGH EFFICIENCY AC



- Japanese Government (METI) & New Energy Development Organisation (NEDO)
 - 4 companies participating in the research projects to develop technologies for high energy efficiency low-GWP based small and mid-size air-conditioning systems
 - DENSO development of CO₂ (R744) AC system with high efficiency ejector
 - MITSUBISHI ELECTRIC development of HC based room air-conditioning system

高効率低GWP冷媒を使用した中小型空調機器技術の開発

三菱電機株式会社	自然冷媒を適用したルームエアコンの研究
株式会社デンソー	高効率エジェクタを使用したCO2冷媒空調システムの開発

HC&NH BASED HEAT PUMPS & WATER CHILLERS



- HC based water chillers introduced by several companies targeting commercial air-conditioning and process cooling applications
- RSA Cooling water chiller for outdoor installations, and are available with cooling capacity from 3,0 to 15,0 kW
- HC water chillers in Australia, reliable performance at 45C days this summer



R718 WATER CHILLER







The world's first water-refrigerant turbo chiller

Kawasaki Heavy Industries (RH) is ready to launch the world's first commercially available water-refrigerant contrifugal chiller for use in air-conditioning applications. Accelerate Japan reports.

By/Devin Ynshimoto & Jan Busek

Servetimes complex solutions come from simple question
As global memeritum continues to snowball towards
finding alternative referential to HPCs, some
companies are retaining their entire approach by asking very

Heyers Sakarooto is assistant manager in the Machinery Division of Eavenaki Heavy Industries (CIII). When he and his team own the global market start to shift towards using more environmentally firendly refrigurants, they asked themselves the cuestion:

"It there an ultimate refrigorant that does not heat the planet, deplets the paper layer, or present the right of combession entoxicity?"

"The snover is yet - water."

After several years of development and testing, QH is now maky tomarket the world's first commercially available water-elrige as

Accelerate Nothalia B HZ / Autuma 2017

contributed chiller for use in air-conditioning applications.

"For the air-conditioning industry, systems using water at a refrigerant have been an etamal thems. Although there were other manufacturers who worked on development, never could inner a feasible product, hecause their salutions were account since larger than existing systems with the same refrigeration pagacity' says Takahiro Hara, serior manager in the Aerodynamic Machinery Department, Machinery Division.

KHI, however has never been the type of company to snywwy from engineering challenges — especially if the work leads to breakthroughs that have the potential to change the world.

Development of the water-refrigerar turbo chiller

Kawanati Mawy Industries hashad a long history of salving trobrical challenges by leveraging knowledge sorver different trobrical fields

ROII does this through what it calls matrix management — a corporate menufecturing philosophy which encourages histoaches to intersally share issues with experts in other fields to look for the best technical solutions, taken their having departments working incepeedonify from one another.

One of the most stoom examples of this is the release of Kilwasab's new hima HGHUHC recording. The motorycole has been able to achieve the company's highest performance

Artimo 2017 / Arcelerate Australia & NZ

benchmarks to date. This was schieved by incorporating industrial technology - nom KHTs work with gas sublines in the motocopolic research and development process.

Why is this so important? Secause this gas tertime traveledge was the same source of insposition that ed to correctning the challenges of working with water as a refrigerant. Rayato Salameto told Accelerate Japan have kild one carrie those challenges.

Two-stage compression, high speed motor

Using water as a refrigerant presents two main challenges. First, thouse of water requires the achievement of a significantly higher-pressure ratio let when the condenser and the evaporates, compared with standard FF-C chillens.

"Indiae HFCs, which exist in the facts of gas under normal atmospheria conditions, water is a liquid, and its pressure needs to be reduced in when to change physics from liquid to quis." Switch described:

Second, Decause water contribute to a single-principle conditions, it has a mach larger volume than HFC gases. This reason that, in addition to increasing the performance of the compresses, the size would also have to increase.

Joing water as a refrigerant," Sakamoto says, "multiplies the olimetric flow rate 100-fold reconsistating the use of a large

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www.R744.com

www.ammonia21.com

shecco Publications, incl. GUIDEs

http://publications.shecco.com

Accelerate Magazines:

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