



ATMO sphere

Business Case for Natural Refrigerants

04/09/2018 – Singapore



**Latest updates on market &
technologies globally**

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COMMERCIAL REFRIGERATION



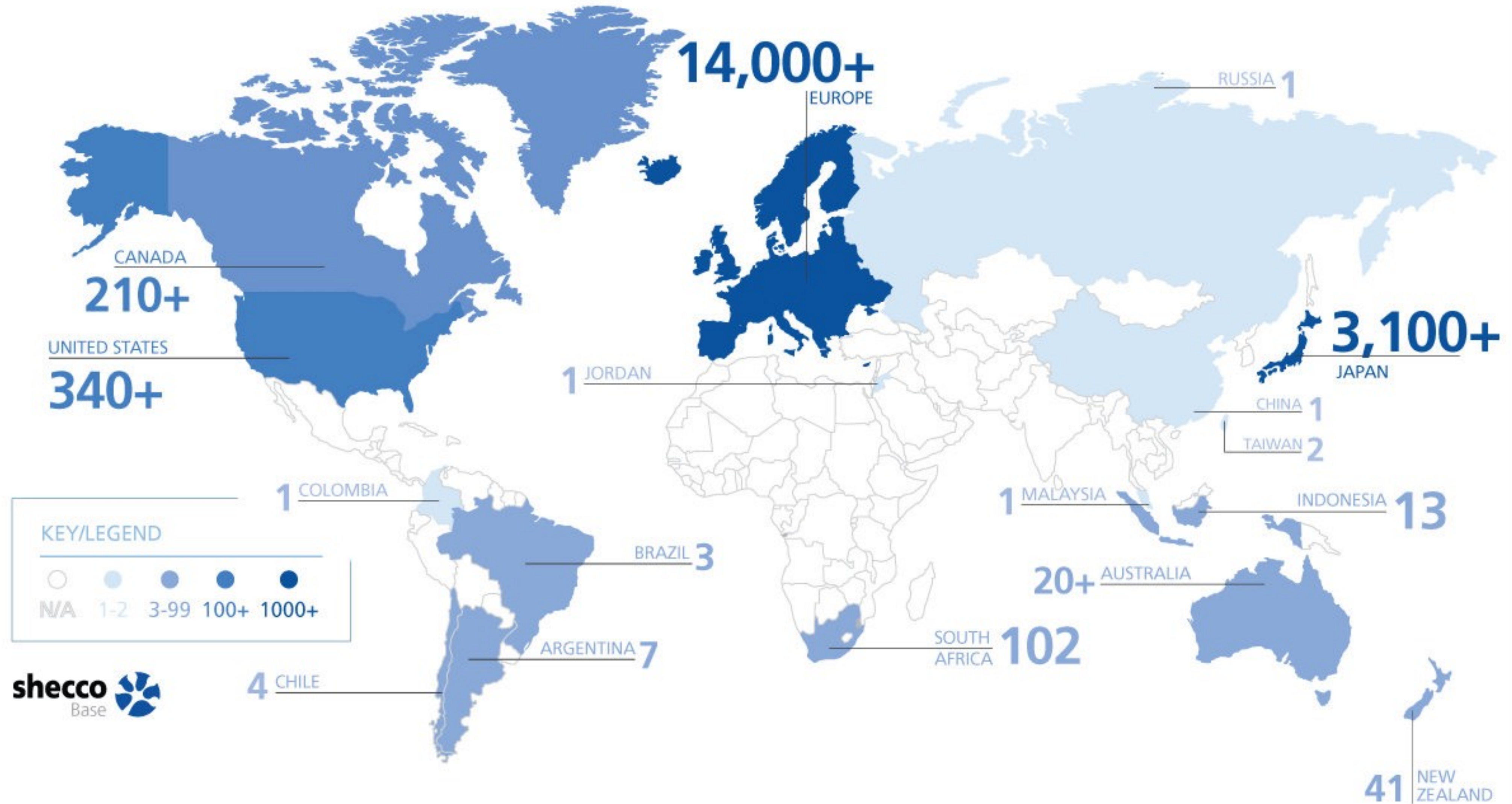


7.25 million units using natural refrigerants (HC & CO₂) collectively installed

=> 43.5 million tonnes of avoided CO₂ (equivalent emissions of more than 8.86 million passenger cars over one year)



Increasing number of consumer brands choosing HCs for their point of sale equipment - often targeting global procurement 100%

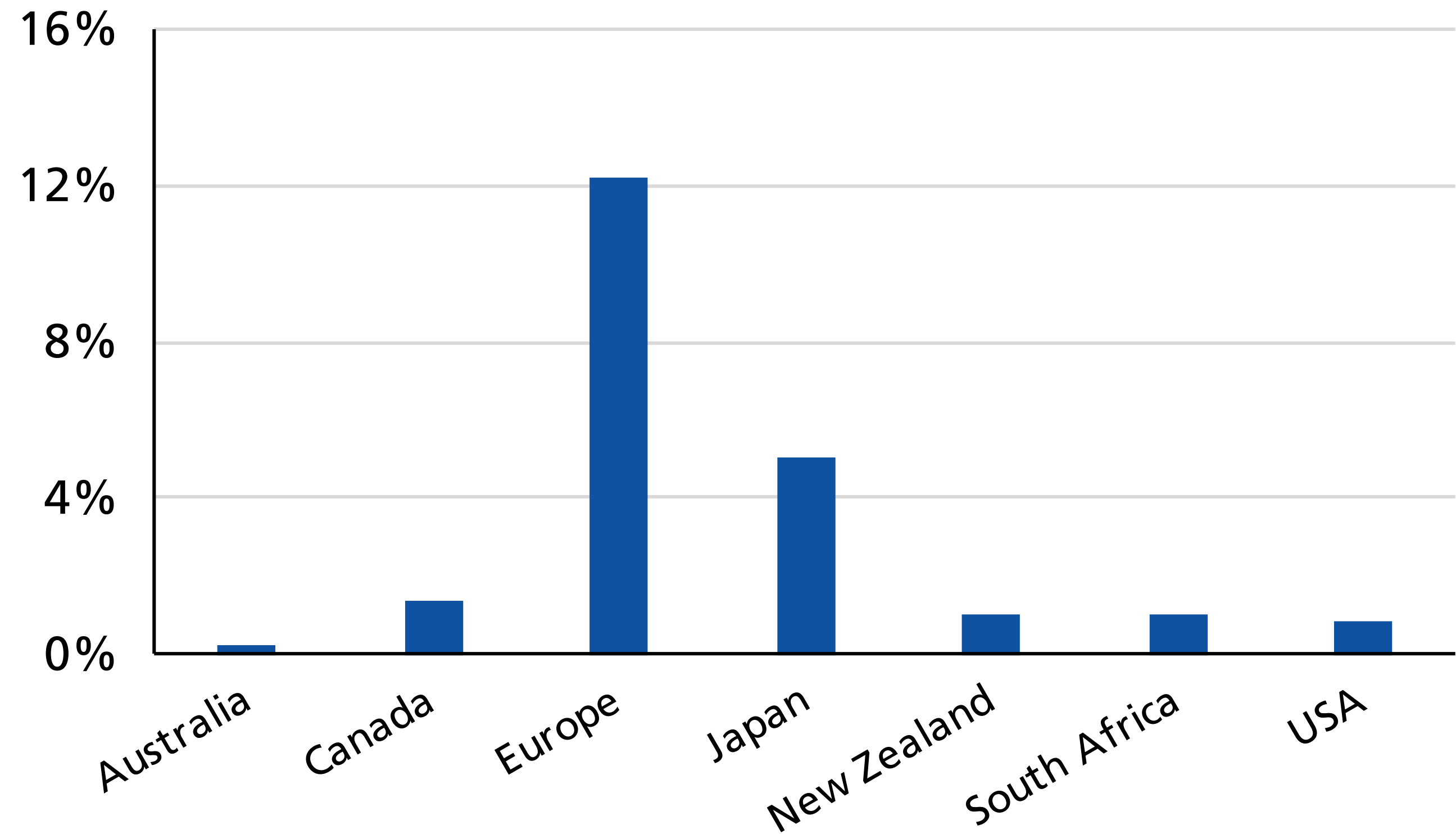


GLOBAL SHARE OF CO₂ TC STORES

The market transition is still in its early stages.

CO₂ TC stores account for more than 10% only in Europe (excluding small stores).

Less than 10% of total stores in other major markets.



Europe: EU + Switzerland, Norway - food retail stores bigger than 400m²
 Japan: Supermarkets & convenience stores combined

Global market estimate (August 2018)

= **2.5 million units**

In early 2017 there were about 1.5 million units

Increase of **HC charge limits** in industry standards is key for the future uptake of hydrocarbons



Innovative waterloop solutions are gaining ground in different parts of the world. There are an **estimated 1,500 stores globally**.

According to manufacturers, waterloop solutions have:

- lower installation costs and time compared to integrated CO₂ systems
- lower energy consumption and a competitive advantage in warm climates
- lower service and maintenance costs
- no need for refrigeration engineers/high-skilled workers
- lower total cost of ownership



Main challenge to overcome: R290 charge limits

Thousands of HC plug-ins

First HC waterloop systems in SEA

Japan - 3,100 CO₂ stores as of 2017

China - First two CO₂ stores at METRO and CSF Market

Malaysia - First CO₂ system installed by Jaya Grocer

Indonesia - 13 Alfamidi CO₂ stores



Jordan - Al-Salam supermarket opens **first CO₂ transcritical store** in Jordan

India - Indian Institute of Technology tests **first transcritical CO₂ system** in India

Russia - METRO opens **two CO₂ transcritical stores** in Russia



INDUSTRIAL REFRIGERATION

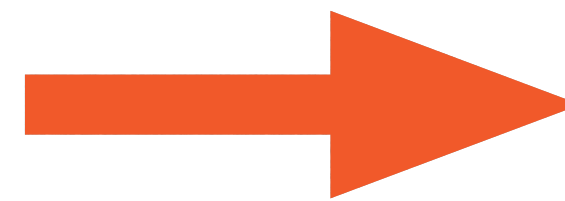
02



market traditionally dominated by **ammonia** and HFCs

NR cutting edge technologies becoming strong trend and competing:

- **ammonia low charge**
- **NH₃/CO₂ cascade & secondary**
- **CO₂ transcritical**
- **HC & air based systems**



Key drivers:

increased safety - lower risk

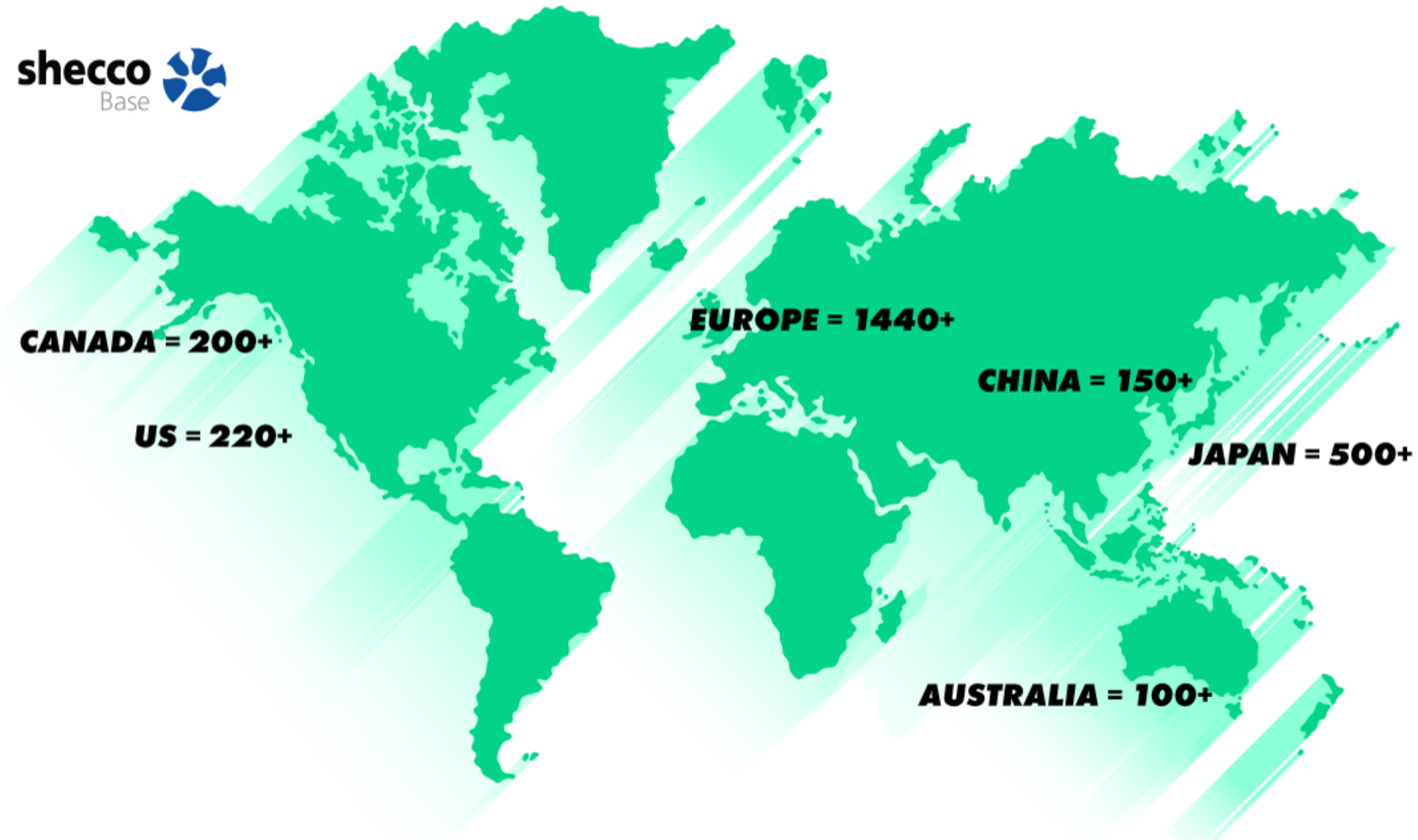
higher efficiency

easier servicing

return on investment for the end user

growing competition - prices pushed down, technology becoming more available

Low charge ammonia installations around the world



*data collection is ongoing as part of a project World Guide to Low-Charge Ammonia

Thailand: 10+ installations using low charge cascade ammonia/CO₂

Philippines: Allforward Warehousing Inc. installs NH₃/CO₂ cascade system in General Santos

Indonesia: Kiat Ananda Cold Storage, largest cold storage operator in Indonesia, installs NH₃/CO₂ system

Vietnam, Malaysia,...



HEAT PUMPS & HVAC

03

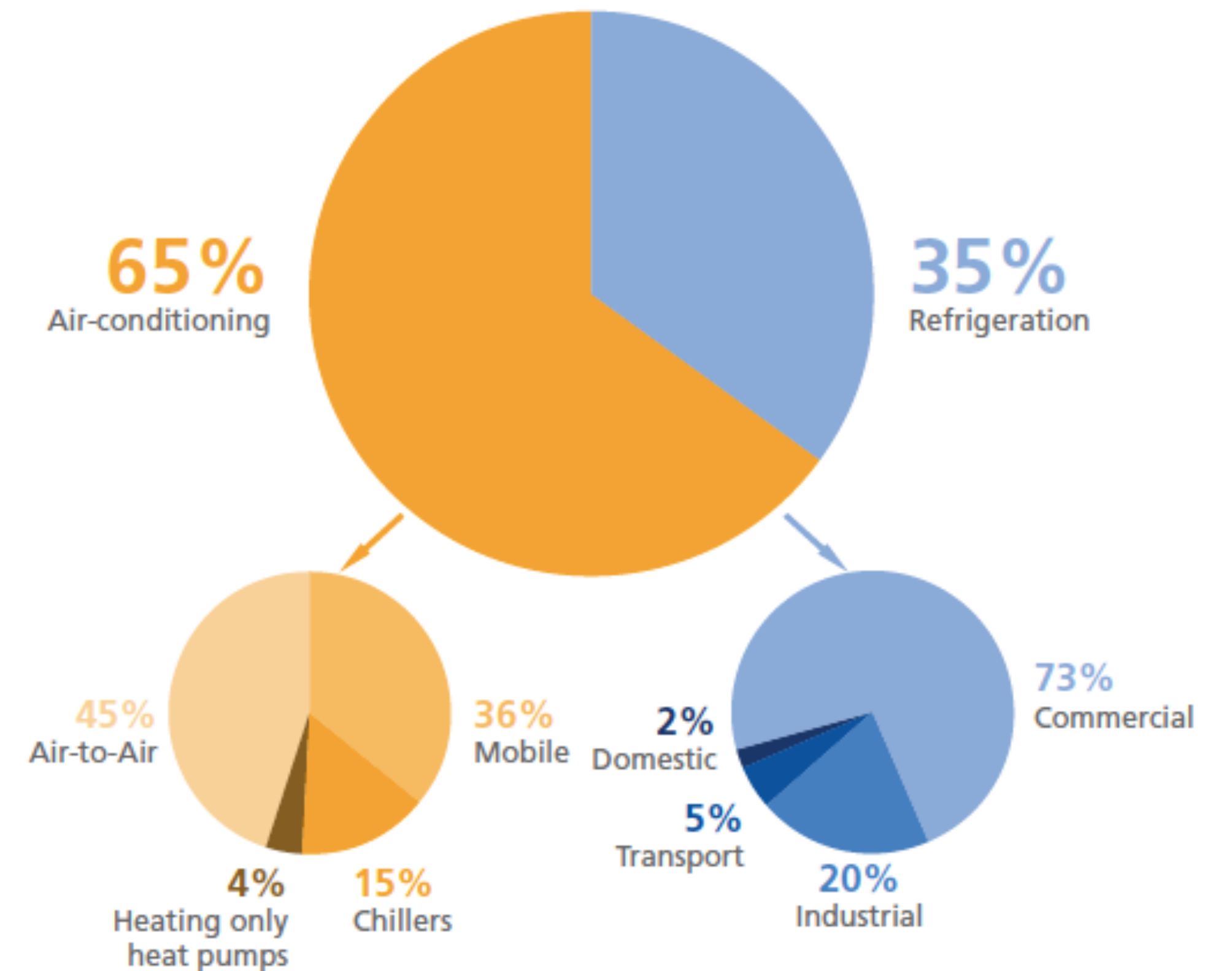


Globally, the **need for air conditioning is set to increase** which means rising temperatures and a growing middle class.

Today, less than 1/3 of households own an AC. By 2050, this could grow to 2/3.

Energy efficient ACs could save as much as USD 2.9 trillion in investment, fuel and operating costs.

UNEP: 65% of HFC use comes from AC (in CO₂e)



TODAY, the hotel industry accounts for **1% of global emissions** - as demand grows this is set to increase.

Cooling often represents more than 50% of energy consumption in hotels in tropical regions

Adoption of **energy efficient natural refrigerant-based technologies** for AC, heating and refrigeration demands could substantially lower the energy consumption.



Supply of split and window RAC units comes **predominantly from Asia**

India: Split AC represents 80% of total AC units sold in India

- Currently **600,000+** R290 units installed in the market
- Major leader: Godrej Appliances

China: Market share of 85%, 100+ million AC units / year

- 20 RAC production lines converted to R290 - **potential to make 6 million R290 RAC units per year**
- But only < 10,000 R290 units installed
- Major players: Midea, Gree, Haier, TCL,...

= active policy support, update of safety regulations, and stronger industry commitment are needed to unlock full R290 RAC market potential

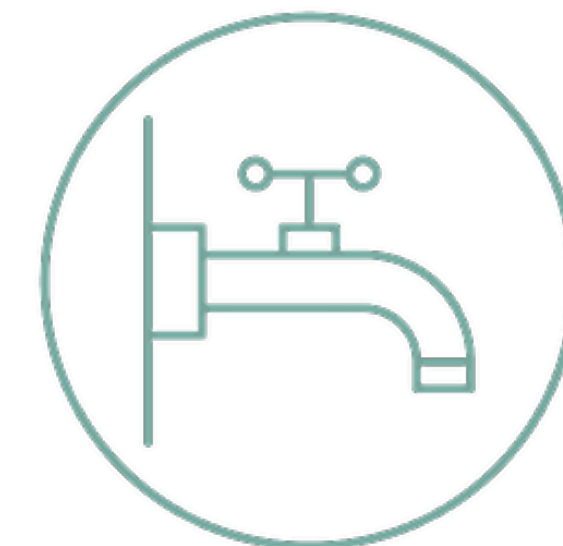


- **HC-based residential heat pumps**

- Europe: at least 15 manufacturers, but production volumes are small (thousands of units in the market)

- **CO₂ heat pump water heaters**

- Japan: 98% of all new heat pump water heaters
 - more than **6 million “Eco Cute” CO₂ HPs** installed
- Other regions accelerating adoption: China, Australia, ...
- Adoption in Europe, North America starting



Growing interest in CO₂ heat pumps targeting **commercial hot water supply, air-conditioning applications**

Globally estimated **15,000 commercial CO₂** (majority in Japan & China)



Thailand - CP Foods food processing CO₂ heat pump

Singapore - MClean Technologies CO₂ heat pump
precision cleaning

Source: Accelerate Asia



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

Charoen 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).

Accelerate Asia // September 2018

Growing interest in HC based water chillers targeting **commercial air-conditioning** and **process cooling applications**.

Growing number of manufacturers: SRS Frigadon, JCI, Euroklimat, GEA, CTA, Cool-Therm, Geoclima, Bundgaard, RSA Cooling, Roccheggani, Aicool (Indonesia)



Indonesia - PT Phapros installed and commissioned **two propane (R290) chillers** at its production facility in Semarang, Central Java.

Source: Accelerate Asia

52 // Market

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.

TRANSPORT & MOBILE AIR CONDITIONING

04



Maersk Line testing **100** refrigerated shipping containers fitted with Carrier Transicold's NaturaLINE CO₂ refrigeration system

MSC Mediterranean Shipping announced it will lease **2,000** containers using Carrier Transicold's NaturaLINE CO₂ refrigeration system

Source: r744.com



Some major automotive manufacturers are turning towards **CO₂ for mobile air conditioning systems.**

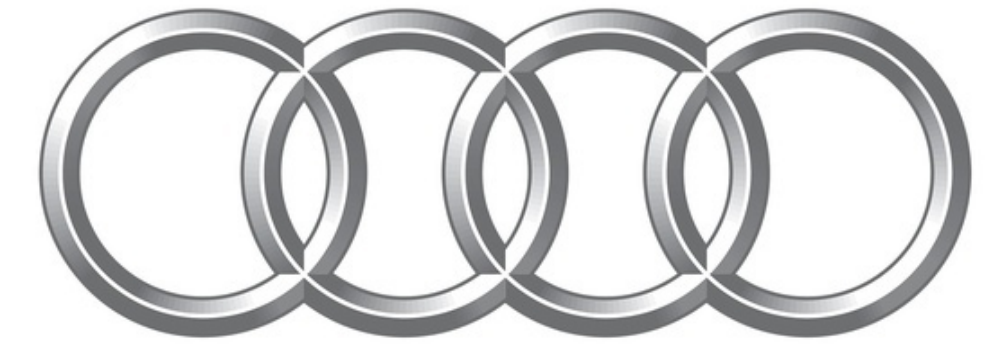
Estimated number of CO₂ MAC units in the market: **12,000 -15,000**

CO₂ also holds potential for electric vehicles.

DAIMLER



Volkswagen



Audi



CONCLUDING REMARKS

- Innovative natural refrigerant solutions penetrating **all HVAC&R sectors**
- **Competition** driving down costs and increasing technology availability
- Opportunity to **leapfrog HFCs** and achieve Kigali Amendment phase-down targets
- Opportunity to position yourself as key technology provider (technology, training,..)



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Thank you for listening.

