



# Natural refrigerants - latest trends in Europe & the world



DEPARTEMENT  
LEEFMILIEU,  
NATUUR &  
ENERGIE

**Brussels, 7 July 2016**

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market accelerator for  
climate-friendly  
technologies

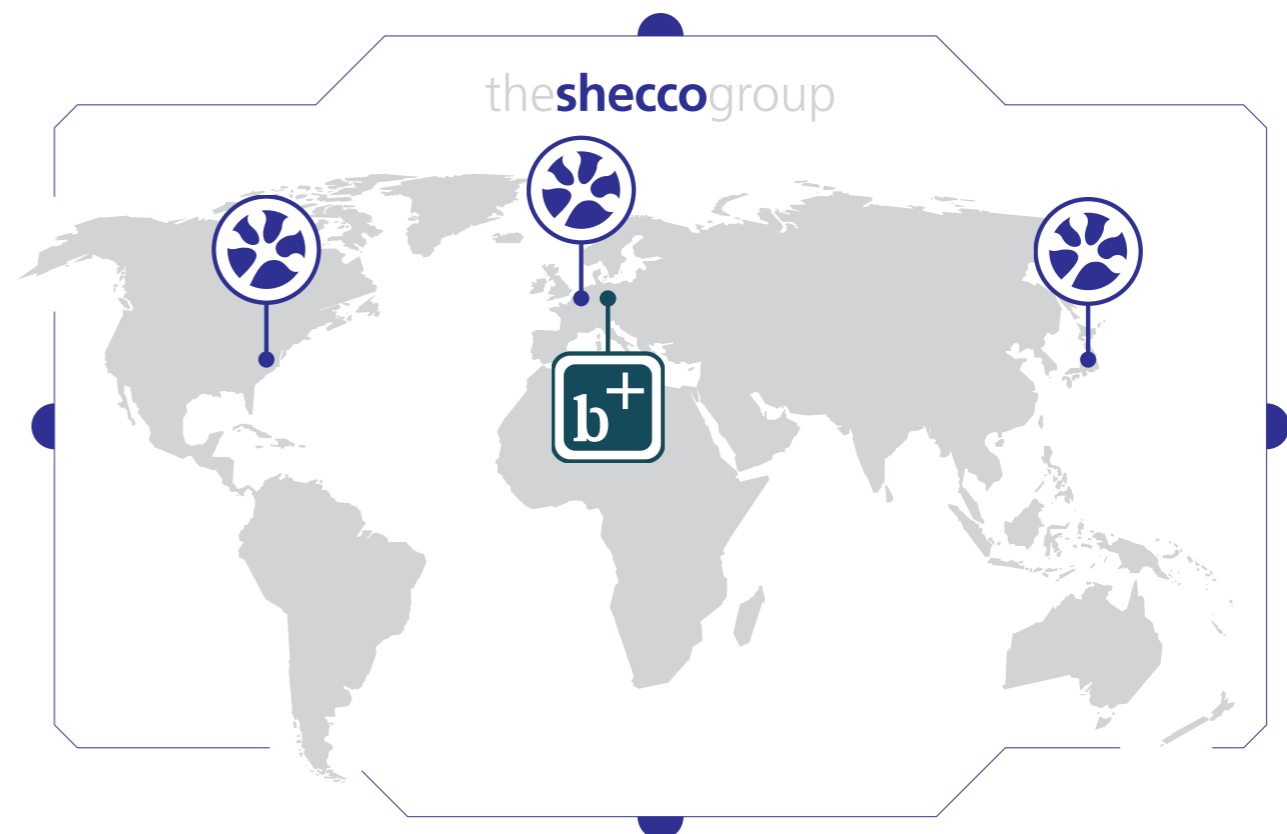
offices: brussels, new  
york, tokyo, berlin

focus is on the HVAC&R  
industry & natural  
refrigerants

CO<sub>2</sub>, NH<sub>3</sub>, HC, H<sub>2</sub>O, Air

150+ clients

reach 50,000+ individuals  
through our  
communication network





**Regulatory** Affairs

**Market** Research & Consulting



## **Trends for natural refrigerants in:**

**01** Commercial refrigeration

**02** Light commercial refrigeration

**03** Industrial refrigeration

**04** Heat pumps

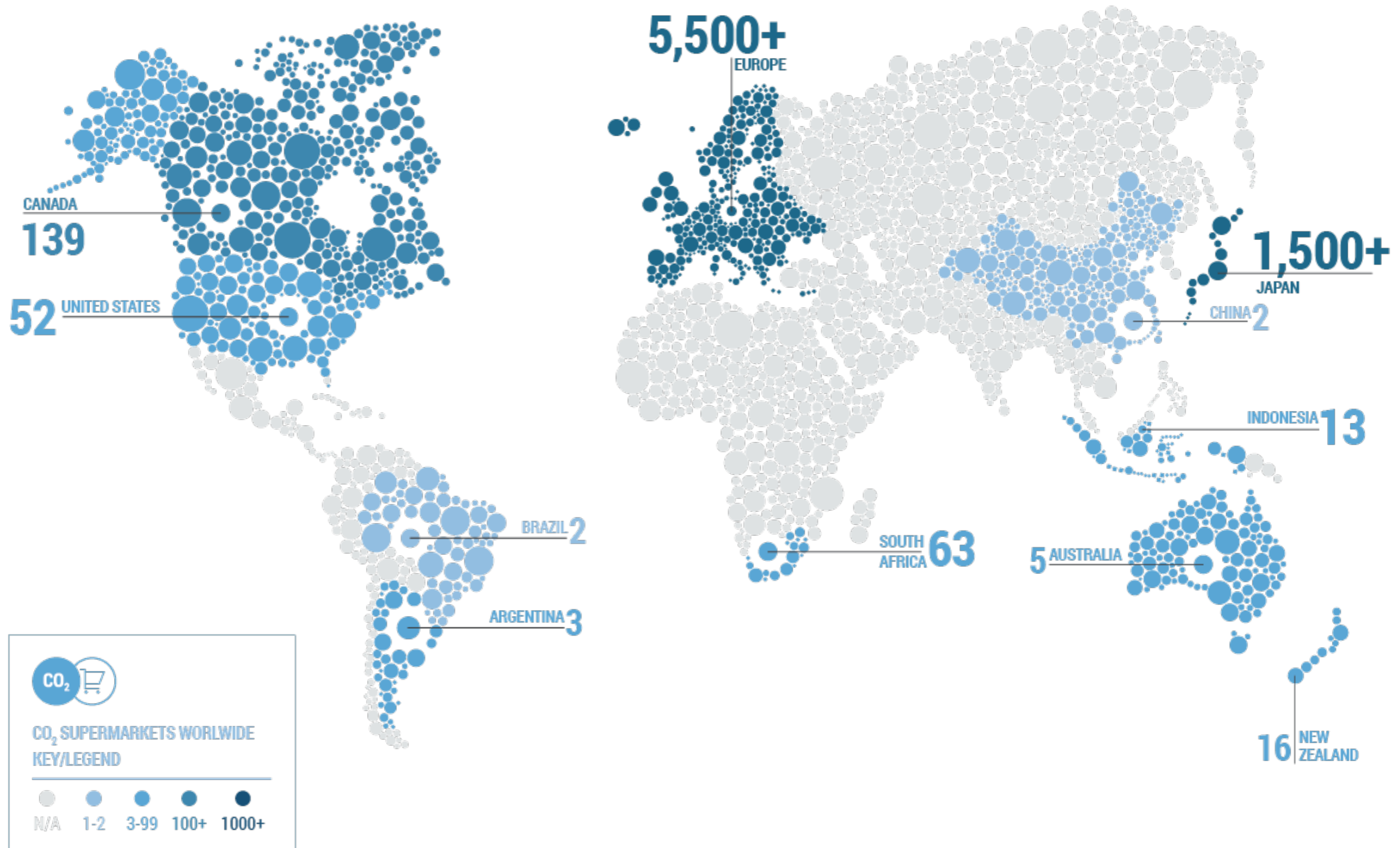
**05** Room air conditioning

# COMMERCIAL REFRIGERATION

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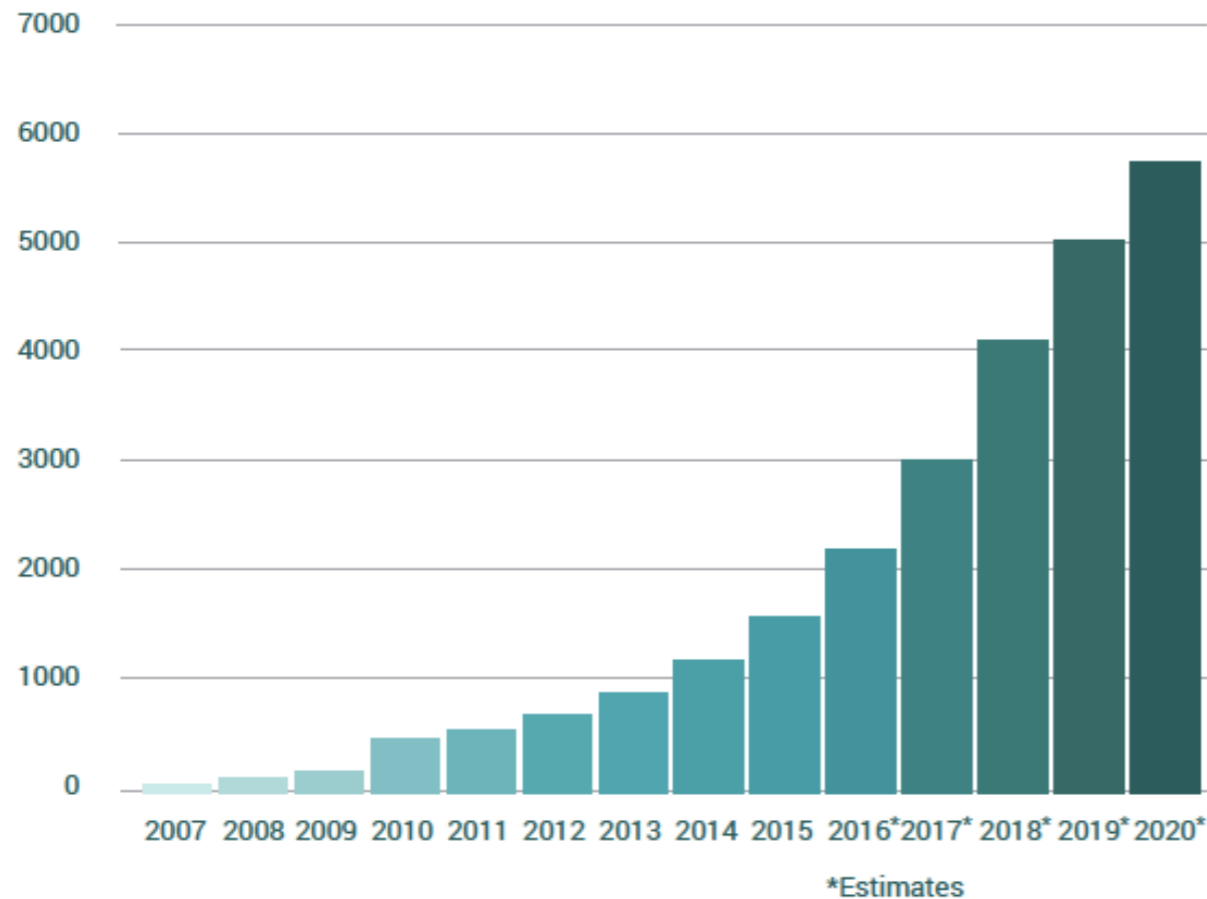
# CO2 TRANSCRITICAL STORES IN EUROPE & THE WORLD





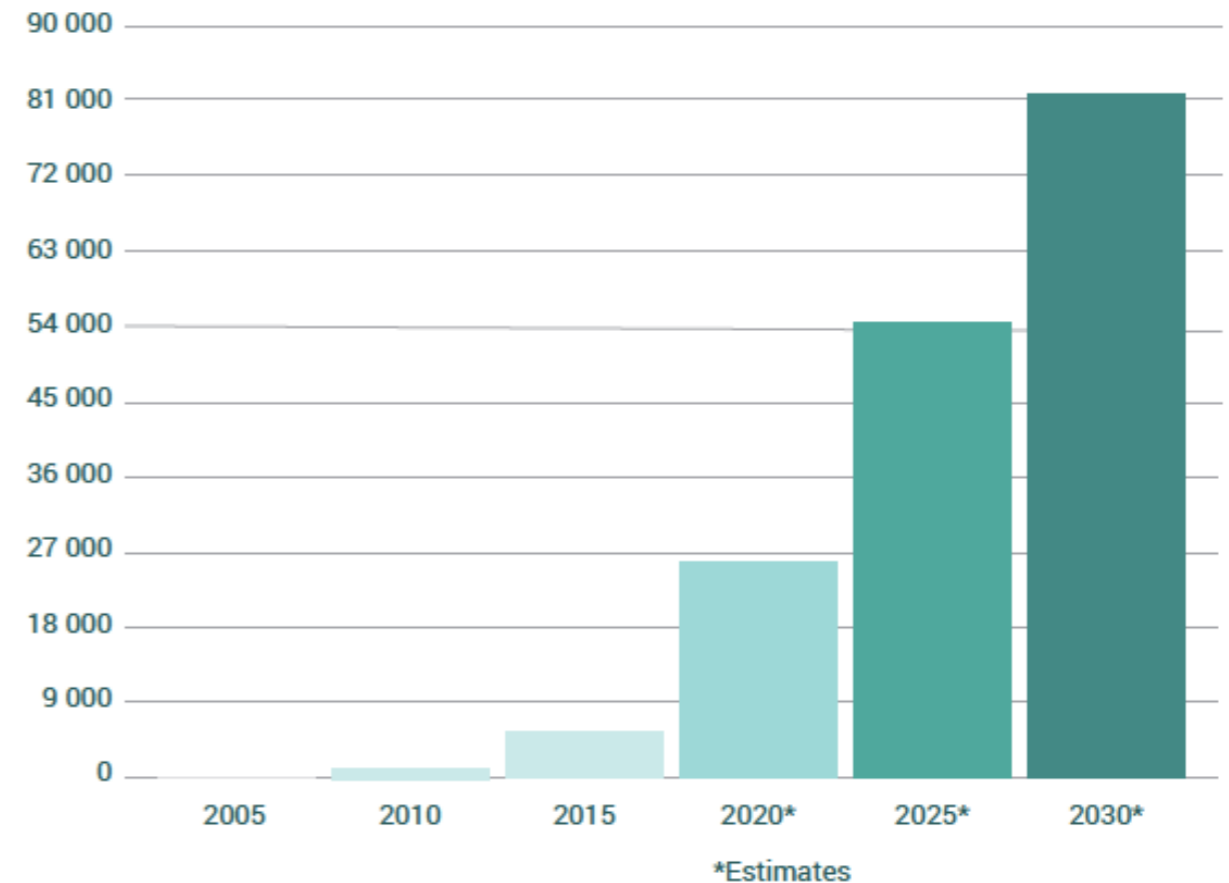
## new

### CO<sub>2</sub> stores in EUROPE 2007 - 2020



## total

### CO<sub>2</sub> stores in EUROPE 2005 - 2030

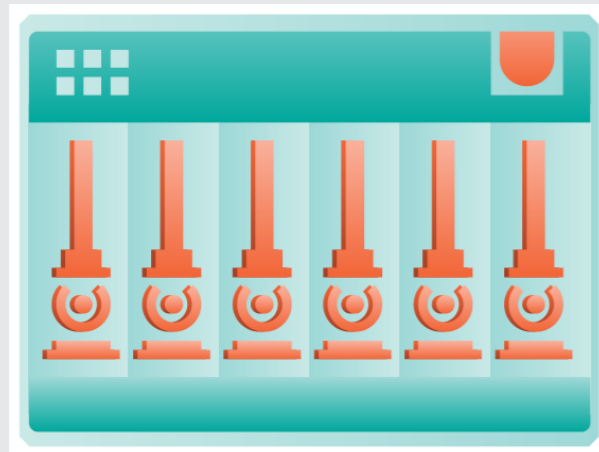


the world's largest market for CO<sub>2</sub> TC supermarkets with growth rates of 25-35% in the last few years

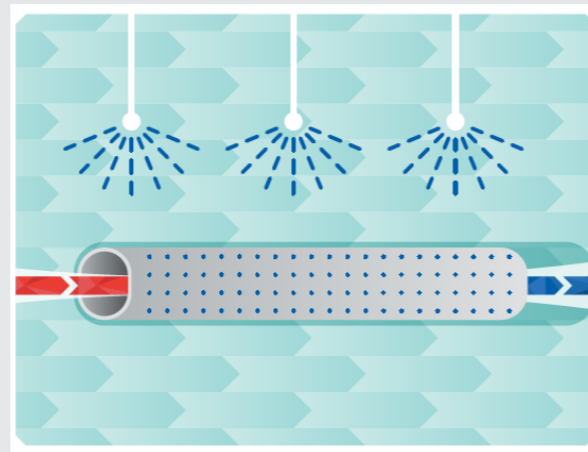
the F-Gas Regulation will further push the market - expected peak in adoption around 2018-2020

total number of CO<sub>2</sub> stores could reach 81,000+ by 2030 (assumes it will also enter small store formats)

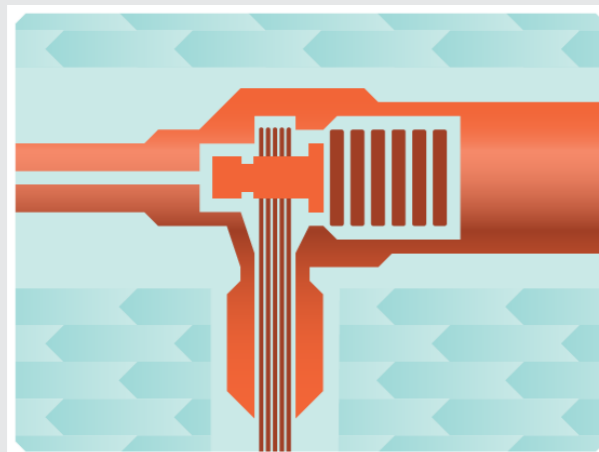
# TREND 1: CO<sub>2</sub> SYSTEMS MOVE SOUTH



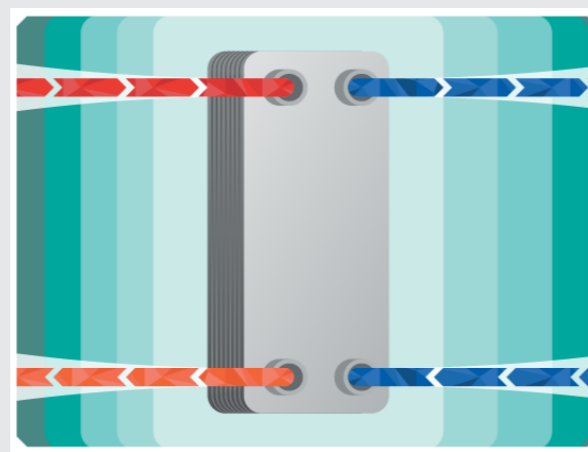
PARALLEL COMPRESSION



ADIABATIC COOLING



EJECTOR



SUBCOOLERS

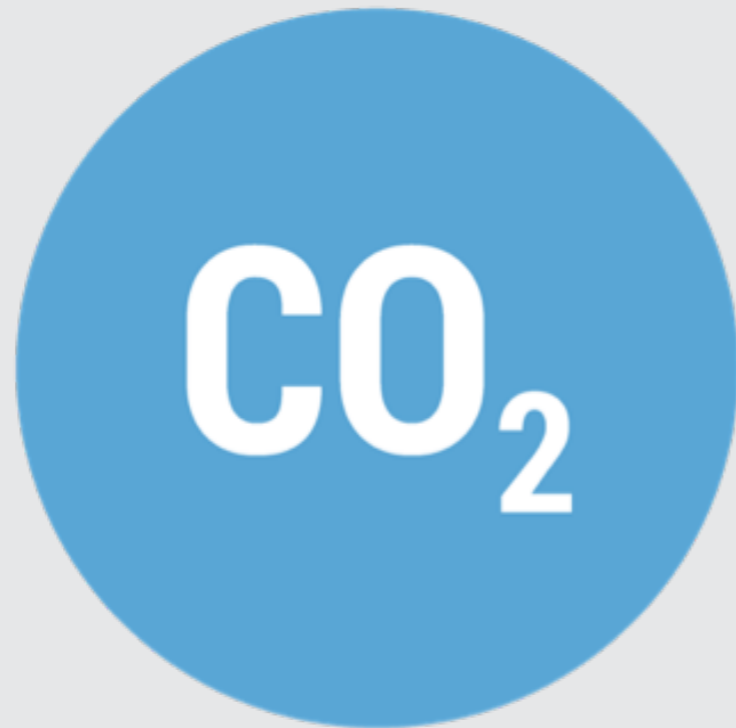
several technology approaches exist to remove any energy penalty CO<sub>2</sub>-based systems could have in warmer climates

peak savings of 15-25% or annual savings of 6-15% can be achieved

the next step: make these systems widely available and more cost-competitive



# TREND 2: CO<sub>2</sub> REFRIGERATION SYSTEMS FOR SMALLER STORES + STANDARDISED SYSTEMS



move towards more compact, easy-to-install and service friendly design

simplification on CO<sub>2</sub> booster systems

condensing units for smaller stores

bringing further down the first cost for CO<sub>2</sub> systems, making them more competitive against HFCs

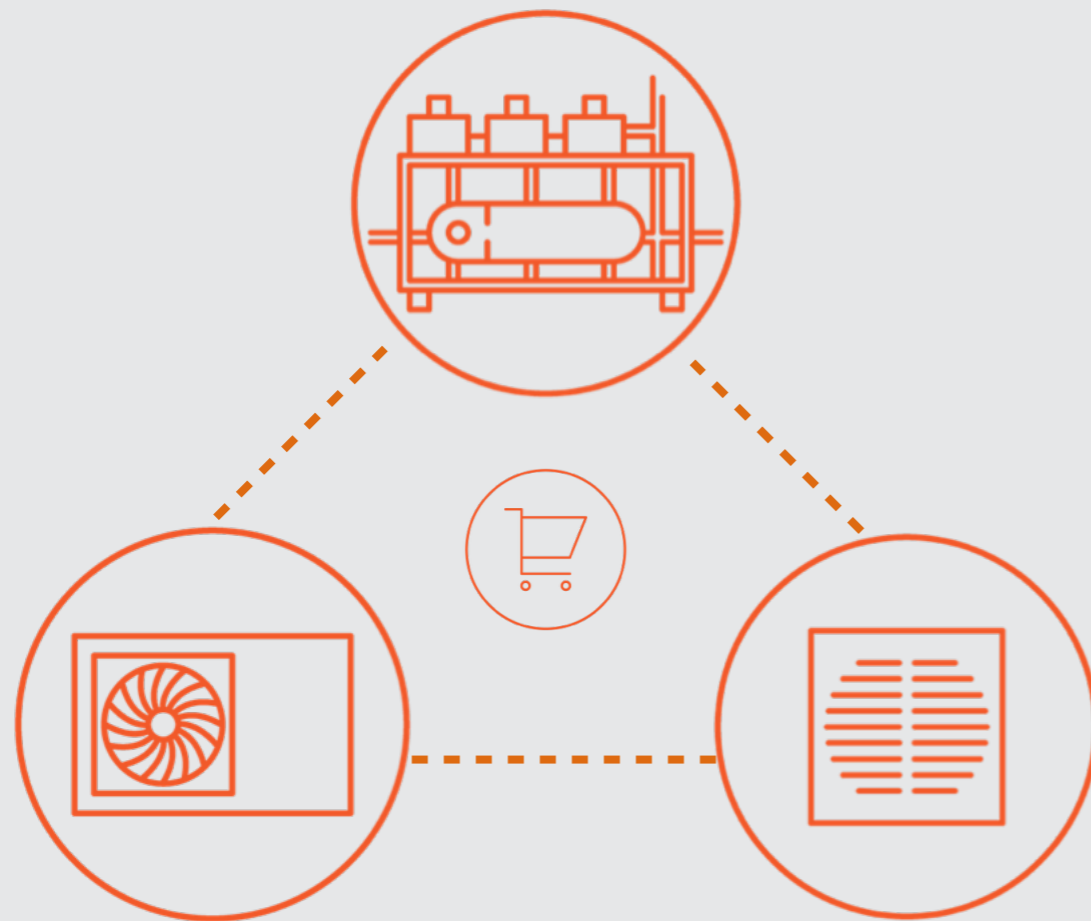


self-contained water loop  
HC-based refrigeration  
systems are a clear trend

used with leading retailers  
in Germany and the UK

90% reduced refrigerant  
charge at better capacity  
than R404A and a fast  
break-even to recover  
higher first costs

# TREND 4: INTEGRATION OF REFRIGERATION WITH HVAC



a trend goes towards thinking about supermarkets in a more holistic way:

integrated system solutions for refrigeration, A/C and heating have appeared on the market

use of waste heat, coupling of heat pumps

# TREND 5: DISSIPATING BOUNDARIES BETWEEN REFRIGERATION TECHNOLOGIES



the limits between “light-commercial” and “commercial” refrigeration become vague with HC-based systems pushing into larger store formats, and CO<sub>2</sub>-based systems into smaller formats

the distinction between “commercial” and “industrial” is less clear, since NH<sub>3</sub>/CO<sub>2</sub> systems push into the food retail sector

= internal competition between different NR systems has increased

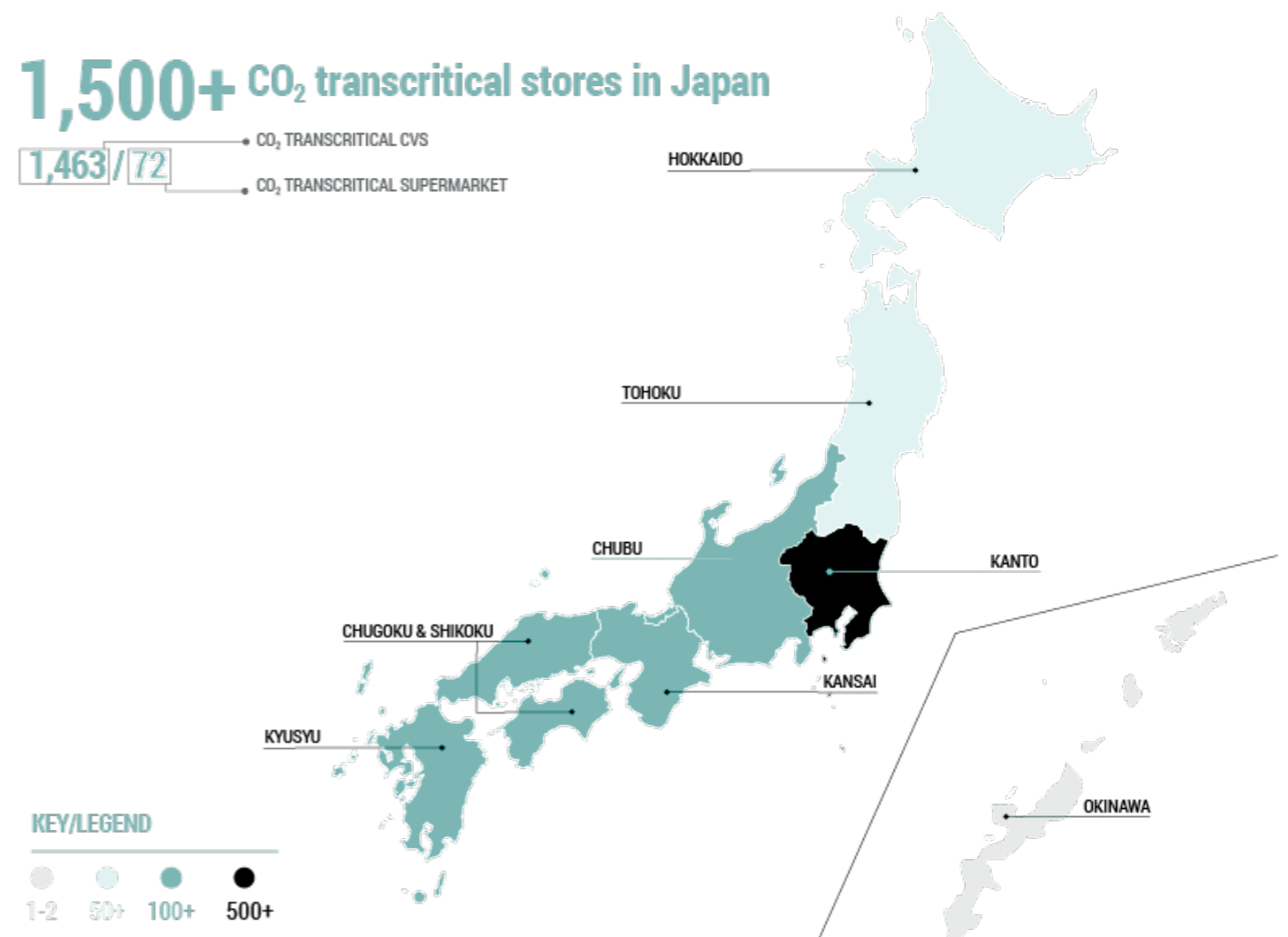


from 190 CO<sub>2</sub> stores to 1,500+ in just 2 years - a major success story putting Japan at the forefront of global CO<sub>2</sub> adoption!

out of that **1,463 are small CVS** which use less than 10 kW

**NEXT:** export of Japanese CO<sub>2</sub> technology to SE Asia and other regions, incl. Australia and Europe

**BUT:** only **72 supermarkets** have **CO<sub>2</sub> TC** refrigeration - one reason: the High Pressure Gas Safety Act slows down their use in larger systems



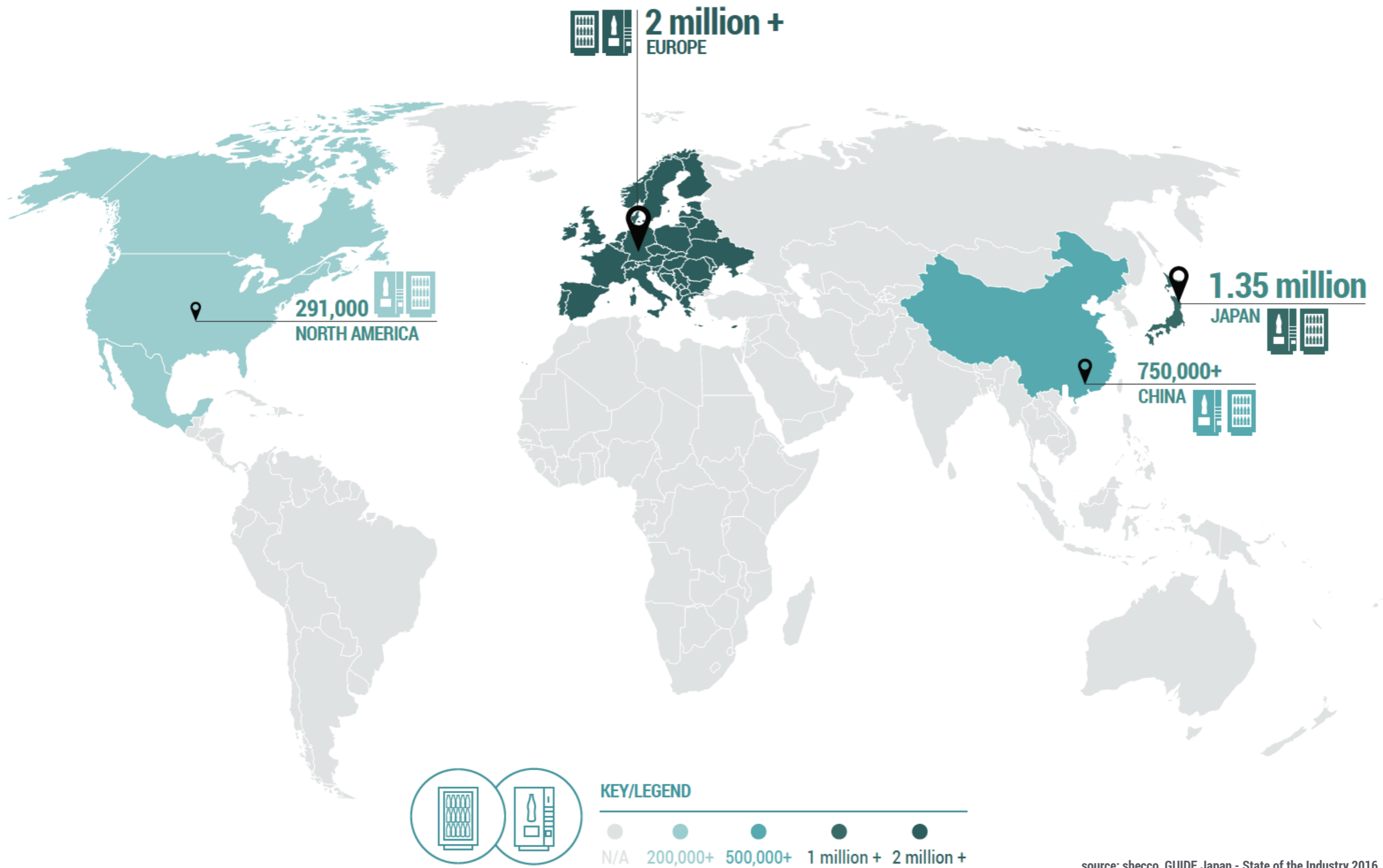
source: shecco, GUIDE Japan - State of the Industry 2016

# LIGHT COMMERCIAL REFRIGERATION

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# LIGHT-COMMERCIAL REFRIGERATION AROUND THE WORLD



source: shecco, GUIDE Japan - State of the Industry 2016

# LIGHT-COMMERCIAL REFRIGERATION IN CHINA



**400,000**

HC stand alone cabinets



**322,000**

HC ice cream freezers



**2,500**

HC bottle coolers  
& vending machines



**25,000**

CO<sub>2</sub> bottle coolers  
& vending machines



at least 750,000 HFC-free units are placed in China today - global brands fast-track the use

85% of the Chinese industry expects an increase in NR use for that sector by 2020

the outlook for HC is rated slightly more positively than for CO<sub>2</sub>

source: GUIDE to Natural Refrigerants in China - State of the Industry 2015, status: May 2015



# LIGHT-COMMERCIAL REFRIGERATION IN JAPAN

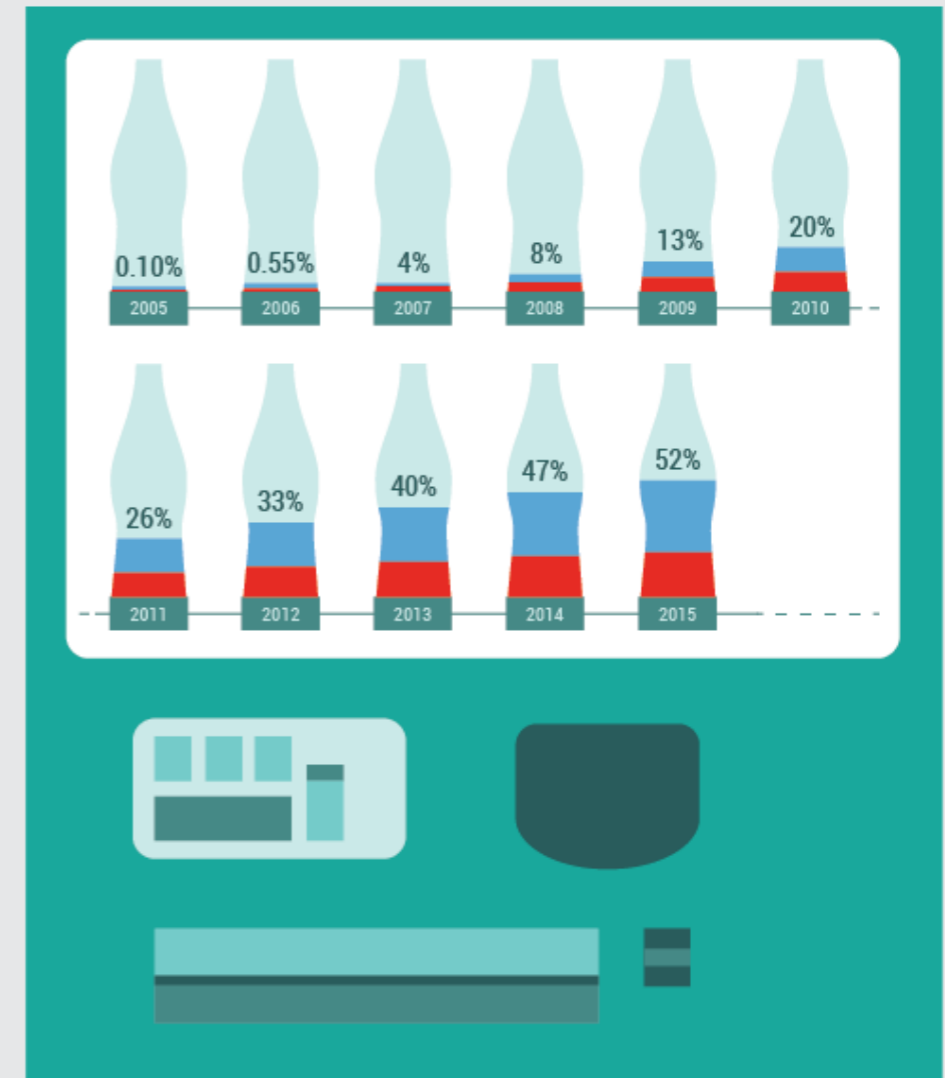


**1.35 million** beverage vending machines in Japan use either hydrocarbons or CO<sub>2</sub> - world's highest number per capita

natural refrigerants make up over **50% of the market**

from 0.1% to 52% market share in just 10 years ! = a clear Japanese success story

**BUT:** Japan has not made similar progress in NR use for small plug-in units - a major trend in other world regions (especially for HC)



■ hydrocarbons      ■ carbon dioxide

source: shecco, GUIDE Japan - State of the Industry 2016

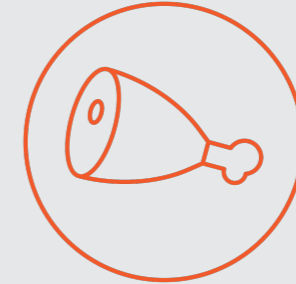
# INDUSTRIAL REFRIGERATION

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- **NH<sub>3</sub>/CO<sub>2</sub>, low-charge NH<sub>3</sub>, CO<sub>2</sub> TC** gaining popularity
- **triple benefit** - enhanced safety + higher efficiency + lower regulatory burden
- **packaged solutions** = simplified installation & maintenance
- **development on-going** to fit different temperature ranges, applications, locations / space requirements etc.
- **lifetime costs** already competitive today





the market is changing, from a strong reliance on R22 to a renewed uptake of (lower charge) NH<sub>3</sub> systems

**300+ installations** use secondary NH<sub>3</sub>-CO<sub>2</sub> systems

**NEXT:** export of the technology to other regions

**BUT:** the use of CO<sub>2</sub> transcritical systems still faces restrictions through the High Pressure Gas Safety Act



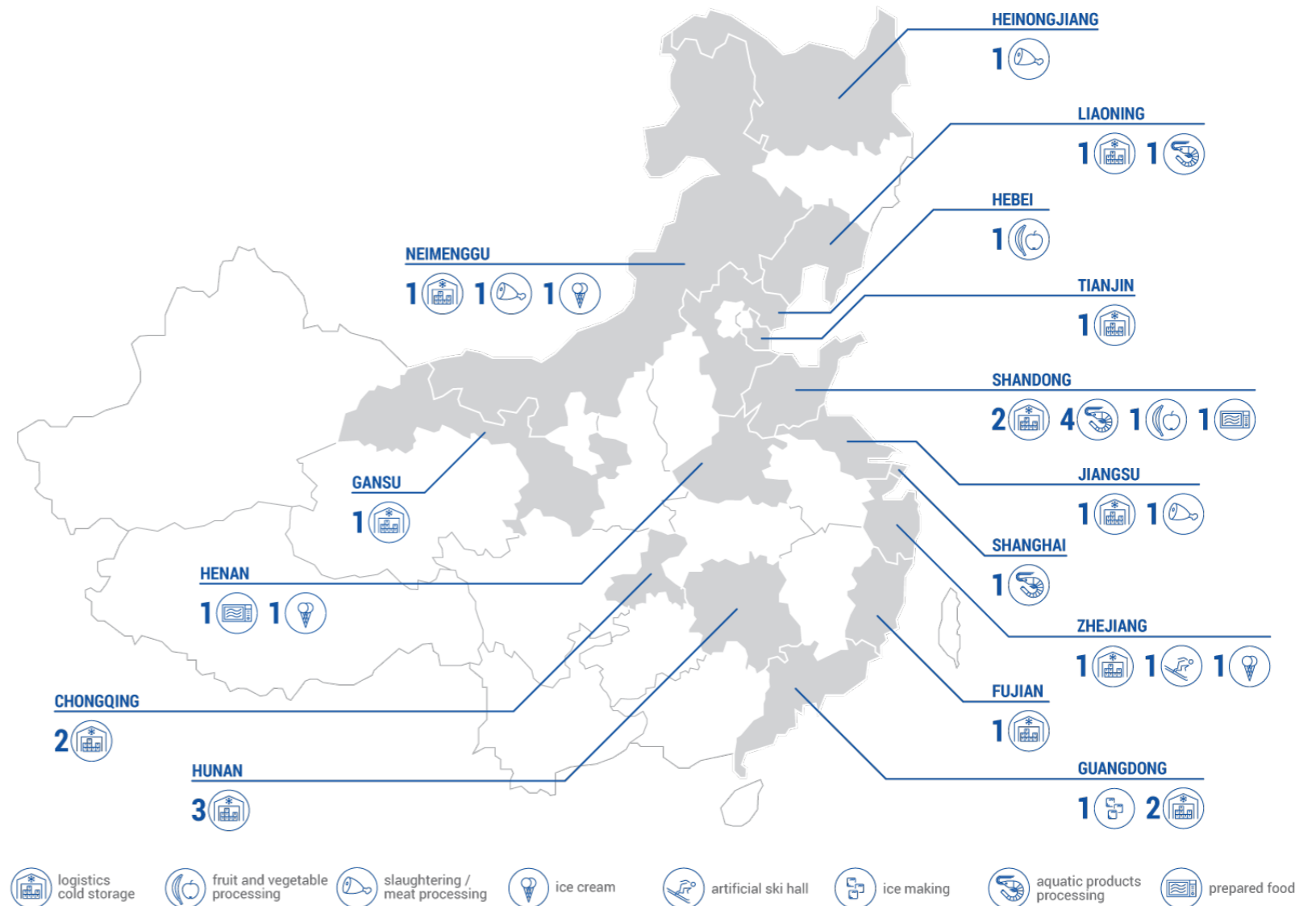
source: shecco, GUIDE Japan - State of the Industry 2016



more than **30,000 end-users** use NH<sub>3</sub> systems

by 2017, China will most likely surpass the capacity of the US cold chain, currently at 115 million m<sup>3</sup> of space

by end-2015, **34 CO<sub>2</sub> cascade / secondary projects** were installed in China's industrial refrigeration sector



source: shecco, status: May 2015

# HEAT PUMPS

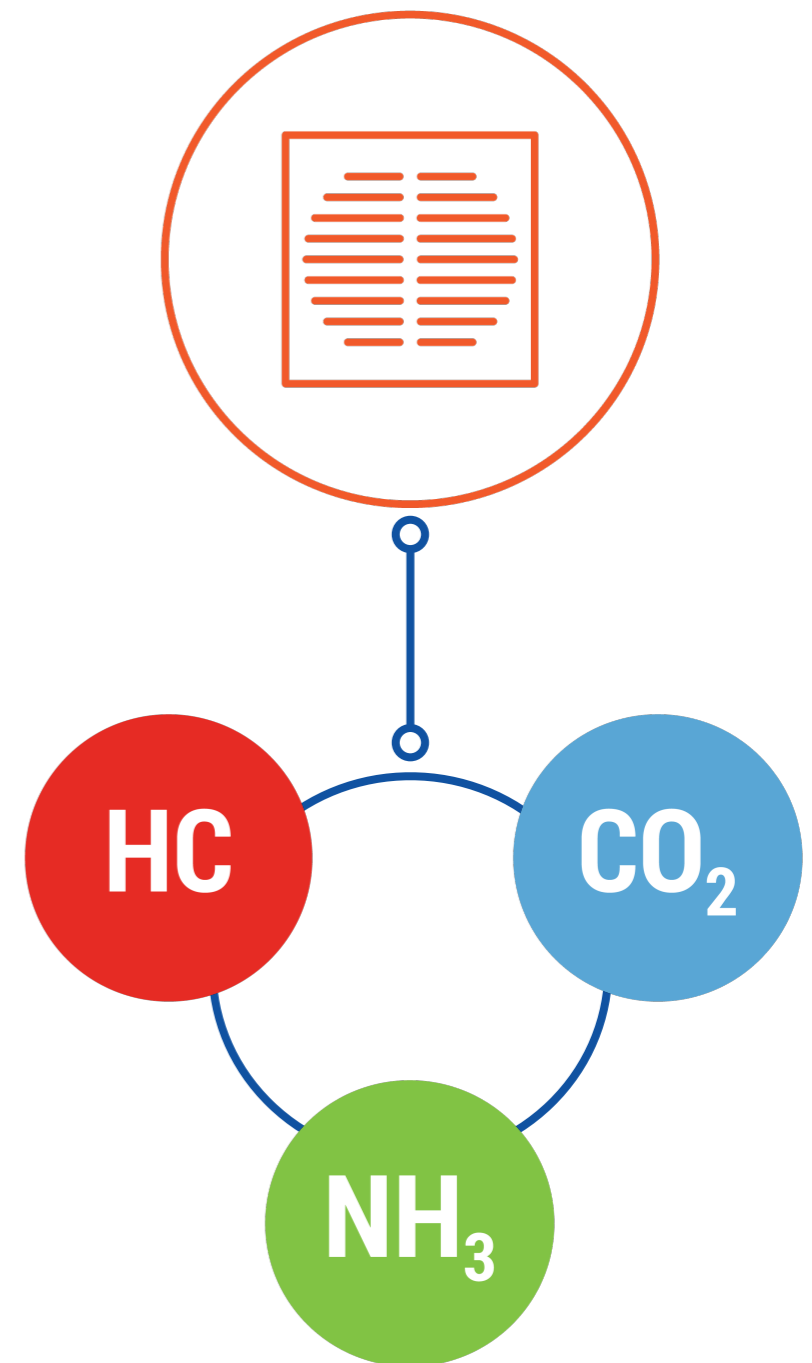
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04





- Until 2004, **more than 50% of residential heat pumps were using R290** - with the Pressure Equipment Directive HC heat pumps disappeared from the market
- Today, at least **12 European companies offer HC-based heat pumps** and minimum **4 are looking at introducing HC heat pumps in 2018-2020**
- The use of **CO<sub>2</sub>** is growing especially in hot water heat pumps - increasing importance of water heating on overall energy use (low energy / passive houses) = opportunity for CO<sub>2</sub>
- **Ammonia** is popular in large heat pump installations
- **Drivers**: legislation (EU F-Gas Regulation, EPBD), environmental impact & energy efficiency
- **Barriers**: HC charge limits & safety concerns related to flammability, lack of demand, lack of trained technicians, lack of clear policy signals



# RESIDENTIAL CO<sub>2</sub> HEAT PUMPS

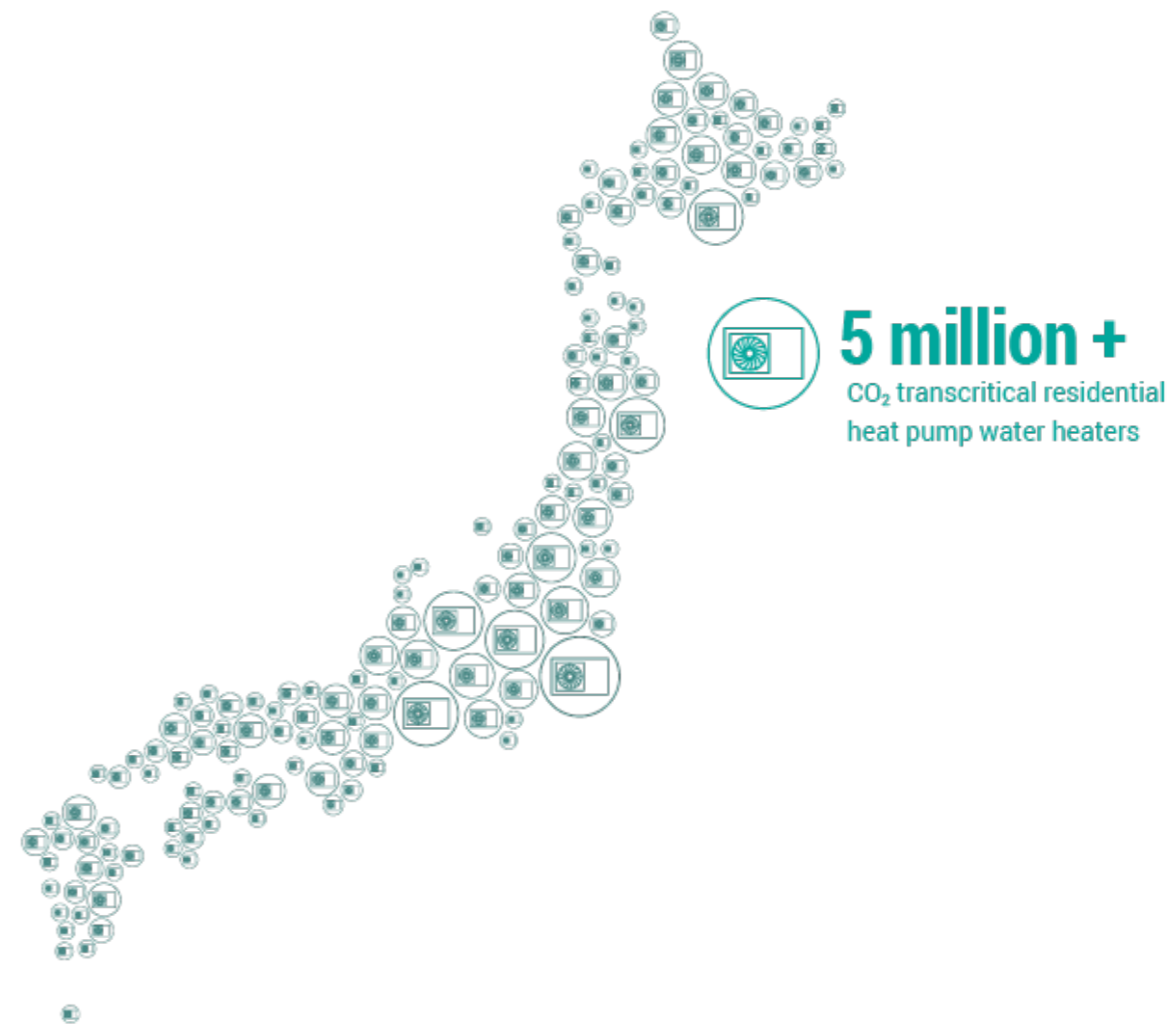


Eco Cute (CO<sub>2</sub> heat pump) has been a run-away success, with strong government support

**98% of all new residential HP water heaters**

**400-500k new units per year - 5 million+ in total**

10 million expected by 2020



source: shecco, GUIDE Japan - State of the Industry 2016



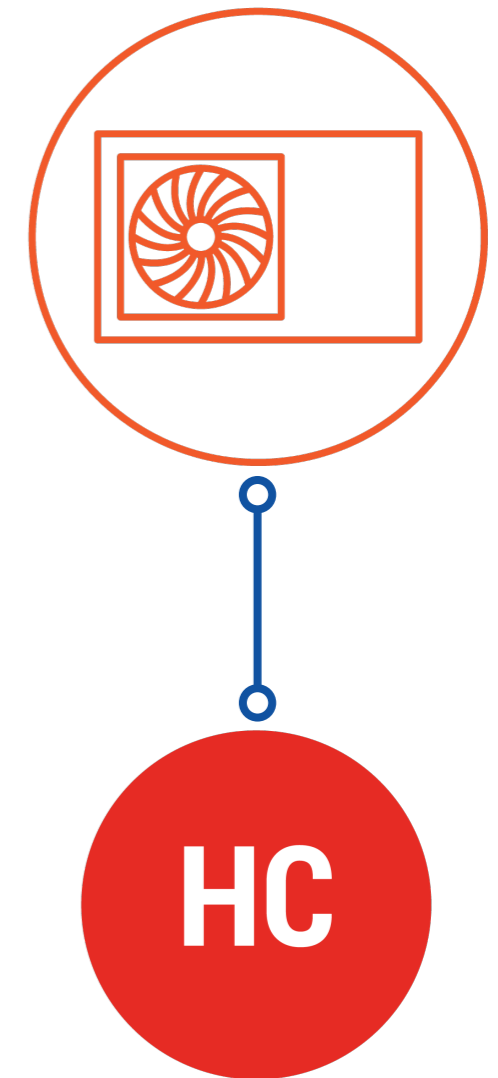
# ROOM AIR CONDITIONING

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- Supply of room AC comes from Asia, mainly **China & Japan** = the availability of NR equipment depends their technology choice besides other factors
- **China** manufactures **85% of global room AC** - **R290 has been chosen as the alternative** and conversion of 20 RAC production lines and 4 compressor lines is currently underway = by 2017 production capacity should be **4.5 million units**
- There is a growing market for room AC in Europe, but the **use of hydrocarbons is only found in portable units**
- **Drivers:** ban on high GWP refrigerants for portable units, energy efficiency, environmental benefits
- **Barriers:** lack of market demand, lack of ambitious legislation, initial cost per unit, HC charge limits, mindset of installers & training



# GUIDES TO NATURAL REFRIGERANTS



China 2015

China Business Directory 2015



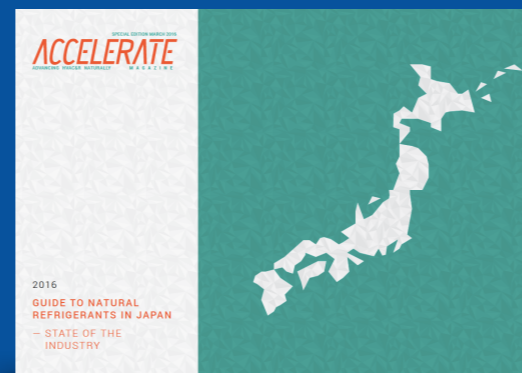
Europe 2014



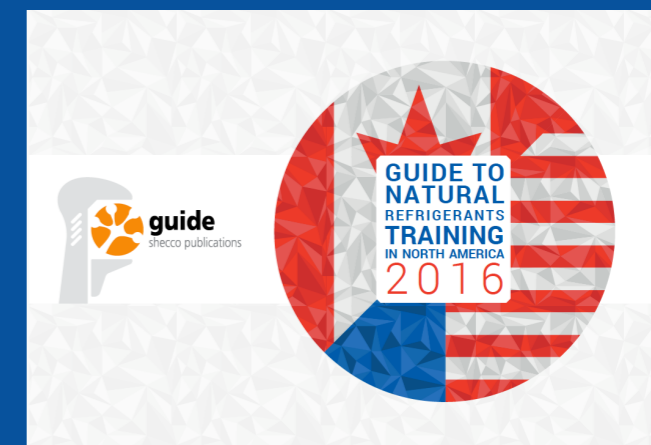
Upcoming: NR Training in Europe



North America 2015



Japan 2016



Upcoming: NR Training in North America



## **Industry Platforms:**

[www.hydrocarbons21.com](http://www.hydrocarbons21.com)

[www.R744.com](http://www.R744.com)

[www.ammonia21.com](http://www.ammonia21.com)

[www.R718.com](http://www.R718.com)

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