

natural refrigerants in a global context

an overview of market and policy trends outside europe



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shecco

natural refrigerants world trends



north america: CO₂ and HCs gain momentum
in the food retail & food service sector



china: an emerging market for NR solutions
across all applications



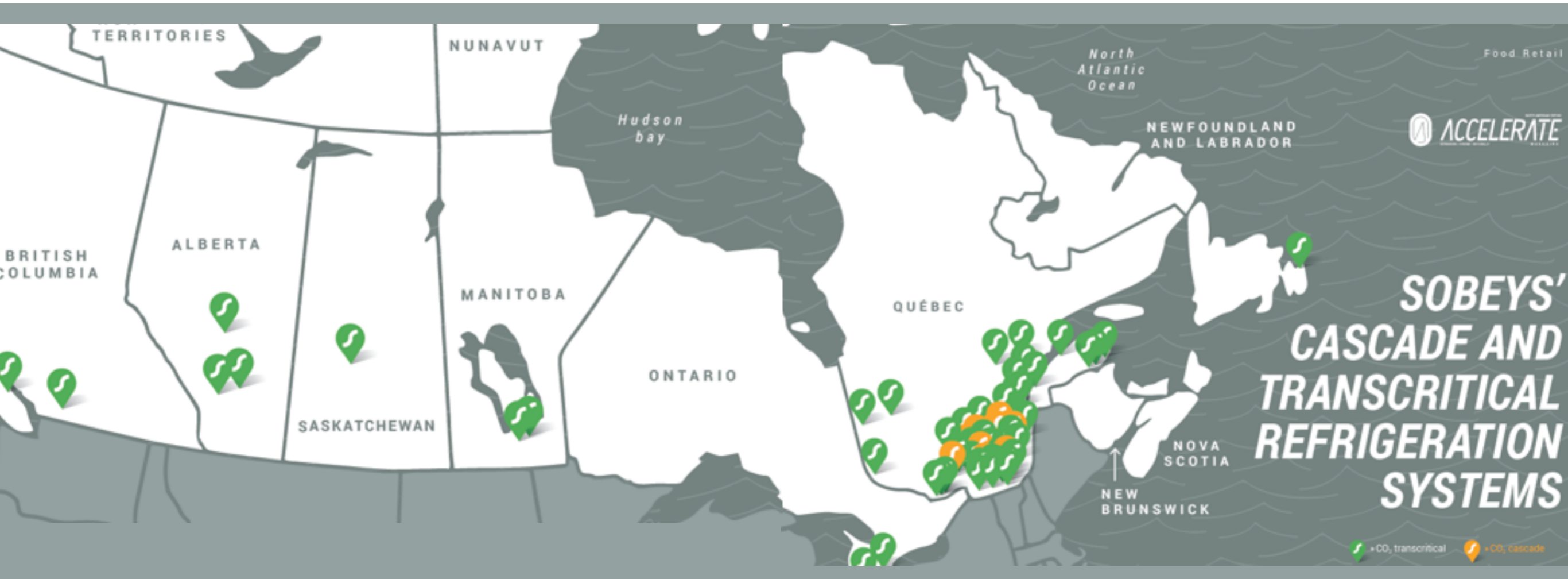
japan: home to the world leaders in CO₂ for
heat pumps & food stores + HC use emerging



natural refrigerants world trends for food retail

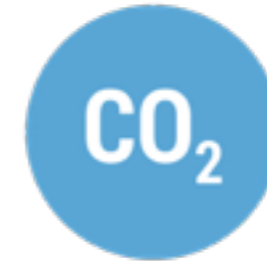
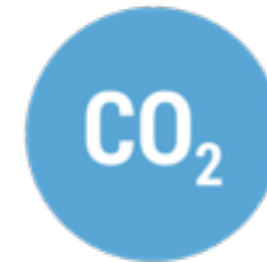


north america's leading food retailer CO₂ TC

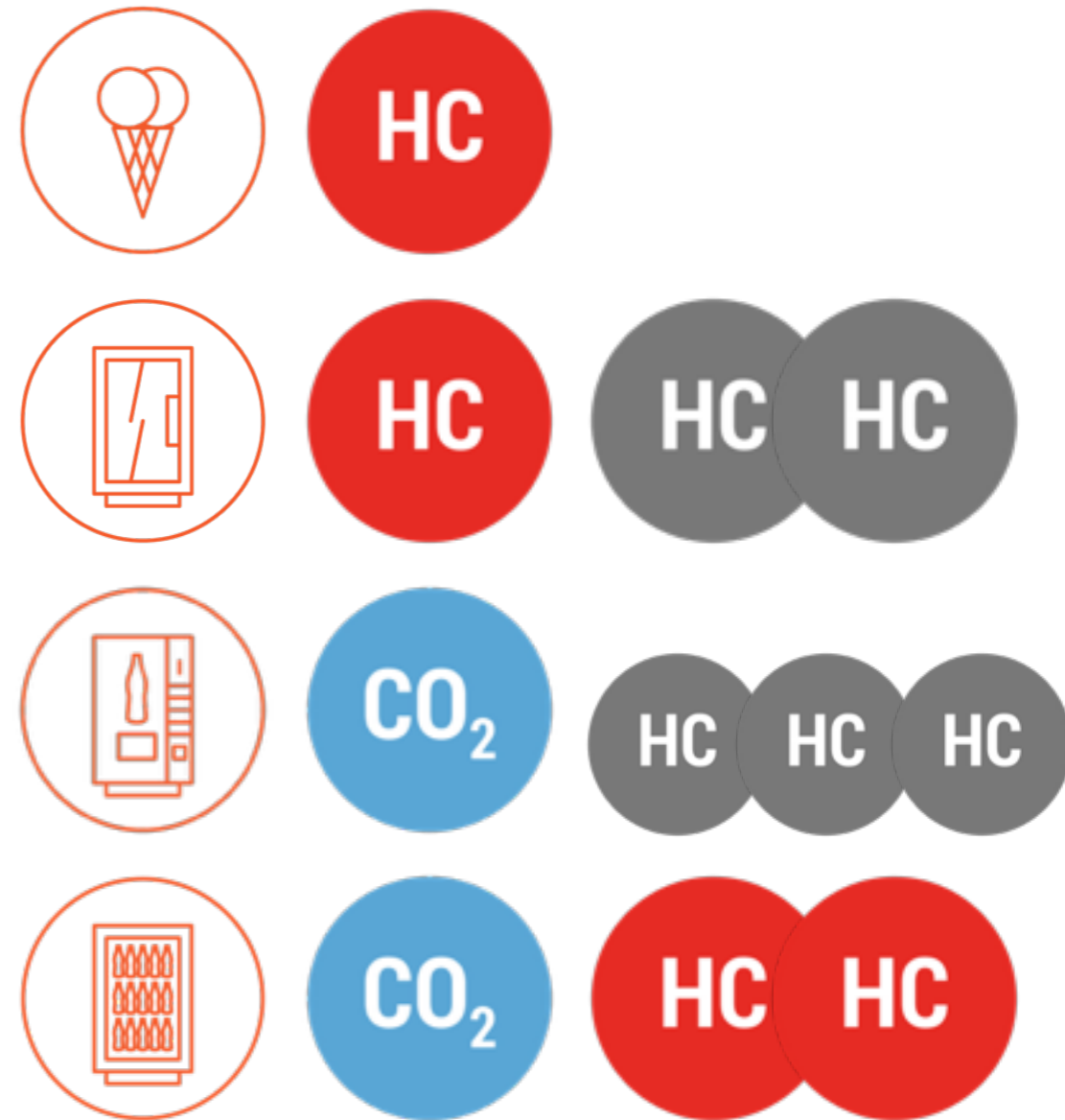


- Sobeys has 72 stores using CO₂ transcritical systems + 15-20 stores opening every year with CO₂ = the North American leader of transcritical installations
- in total there are more than 118 transcritical stores in North America (est. Feb 2015)

north america: growing appetite for NR in the food service industry **current**



north america: growing
appetite for NR in the
food service industry
future



north america vs the world: growing appetite for NR in the food service industry



HFC-Free Placements by Coca-Cola Operating Group*

NORTH AMERICA
12,354

EUROPE
402,994

EURASIA AND AFRICA
280,815

LATIN AMERICA
28,863

PACIFIC
364,579

*As of June 2014

HFC-FREE UNITS WORLDWIDE
1.4 MILLION

north america vs the world: growing appetite for NR in the food service industry

- Red Bull: 100% HC procurement plan for its Eco-Coolers
- Unilever's Ben & Jerry's had 4,588 propane freezers by end-2013 in the US (1.5 million worldwide)
- PepsiCo have committed to purchasing only HFC-free coolers, vending machines and fountain dispensers by 2020 in the US



north america vs europe: growing appetite for NR in the food service industry



McDonald's Propane Refrigeration Equipment Deployed in Europe, 2010-2013



MEAT FREEZERS

3,811



ICE MACHINES

688



FROZEN FRY DISPENSERS

2,802



BLENDED ICE MACHINES

1,614



JUICE DISPENSERS

503



BEVERAGE SYSTEM CHILLERS

9

usa: policy trends



- in Feb 2015, **HC were approved for use in 6 AC&R applications** under the US EPA SNAP program (subject to use conditions):
 - stand- alone commercial refrigerators and freezers (R600a, R441A); vending machines (R600a, R290 and R441A); residential and light-commercial AC and heat pumps (R290, R441A); very low temperature & heat transfer (R170); household refrigeration (R290)
- 2016 (target year): US EPA **SNAP de-listing of certain high GWP HFCs** (incl. R134a) in certain sectors
- 2017: **DOE energy efficiency standards**
 - upright glass door freezers must achieve 57% less energy use than 2010 standard; horizontal solid door ice cream freezers: 53% less energy use; bottle coolers: 48% less energy use

north america: policy trends



usa:

- 2018: DOE energy efficiency standards
- updated regulation for automatic commercial ice makers
- US government partnered up with several private companies to announce a **voluntary industry agreement** towards reducing HFC emissions
- **California**: considering HFC phase down, low-GWP requirements, high-GWP fee, proposal is expected later in 2015

canada:

- intention to align with the USA on **limiting the use of HFCs**, incl. prohibition on use of high GWP HFCs (R134a) in commercial refrigeration

china: an emerging market for NR solutions
across all applications



GUIDE China 2015

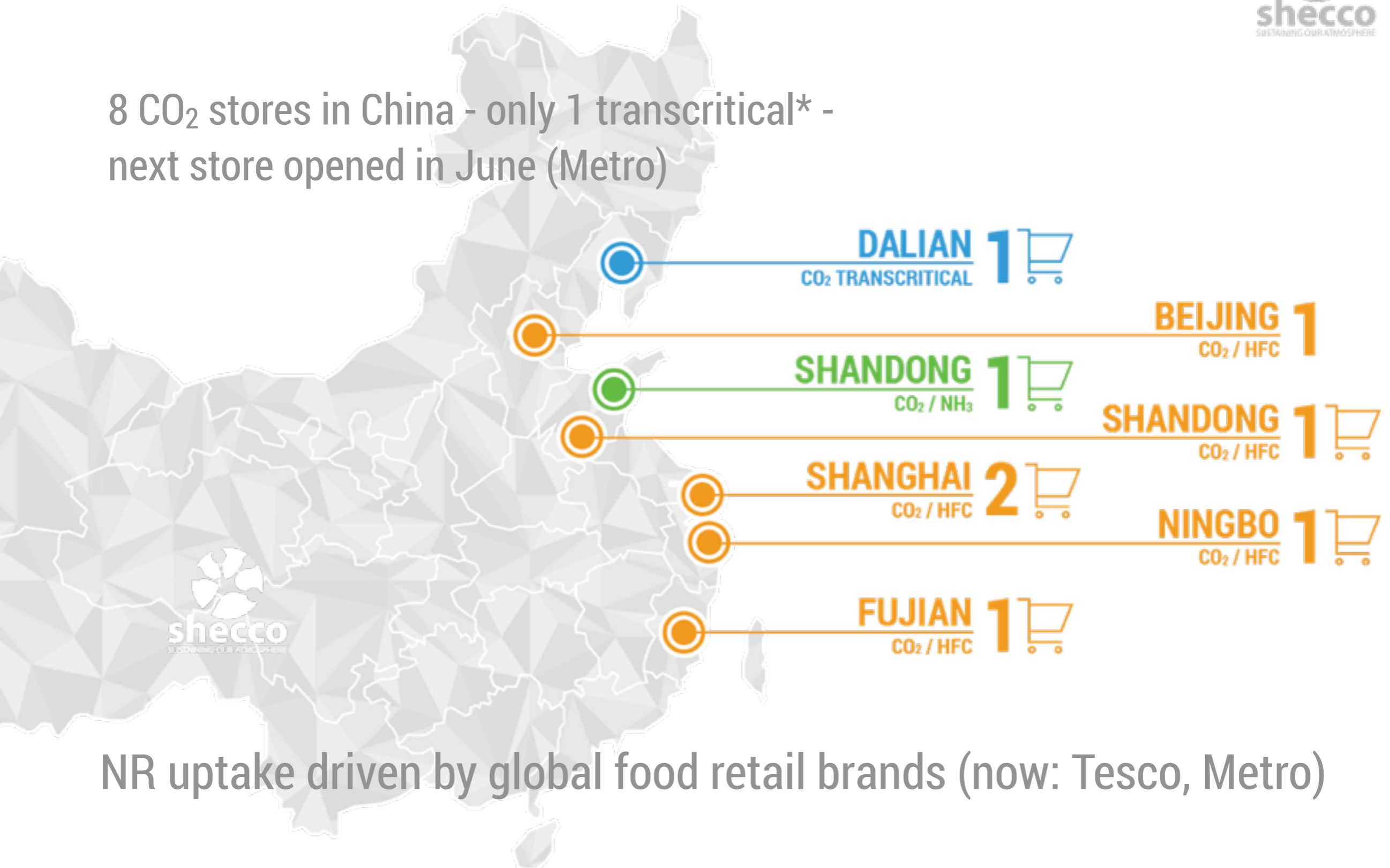


- in cooperation with Chinese Association of Refrigeration
- survey launched in Chinese and English = largest survey about NR so far
- overview of NR technology, market & policy trends

china: supermarkets



8 CO₂ stores in China - only 1 transcritical* -
next store opened in June (Metro)



NR uptake driven by global food retail brands (now: Tesco, Metro)

* source: shecco, status: Feb 2015

china: light-commercial applications



400,000

HC stand-alone cabinets



25,000

CO₂ bottle coolers & vending machines



2,500

HC bottle coolers & vending machines



320,000

HC ice cream freezers

china: heat pumps



CO₂

160
CO₂ commercial
heat pumps*

* data, combined from 7 suppliers

source: shecco, status: Feb 2015

china: industrial refrigeration



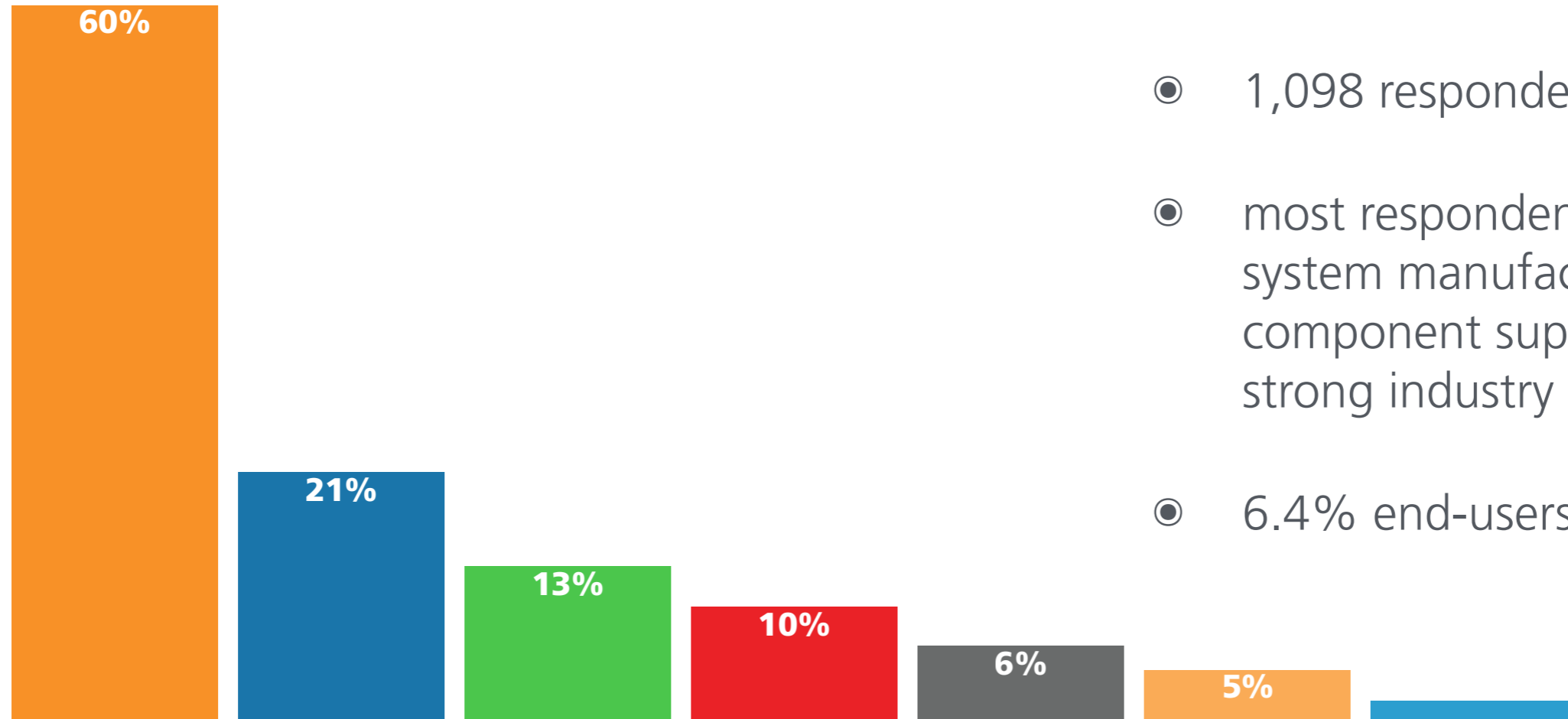
30

NH_3/CO_2 projects*

* includes both cascade and secondary systems

source: shecco, status: Feb 2015

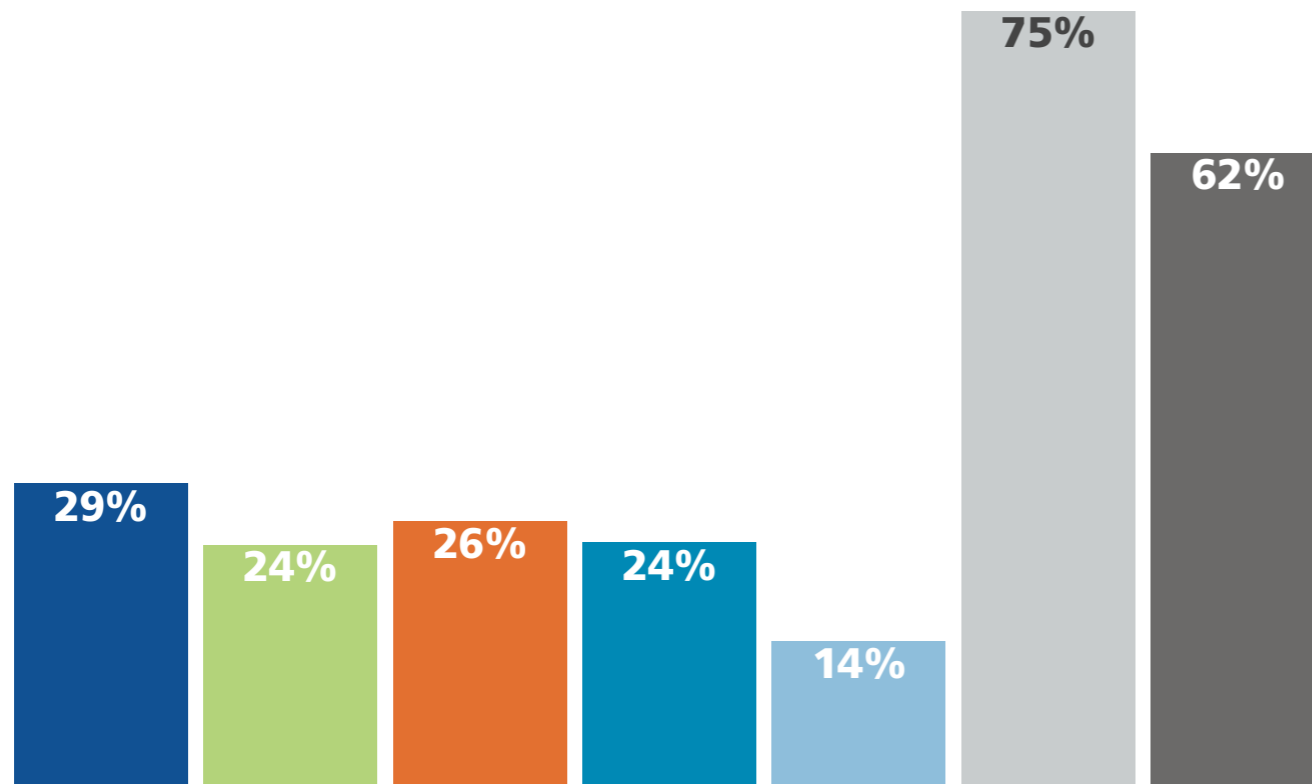
china: survey participants



- 1,098 respondents
- most respondents represent system manufacturers and component suppliers = strong industry perspective
- 6.4% end-users represented

System Manufacturer Component / Refrigerant Supplier Engineering / Contractor
Training / Research End-User Association
Consultancy / Marketing

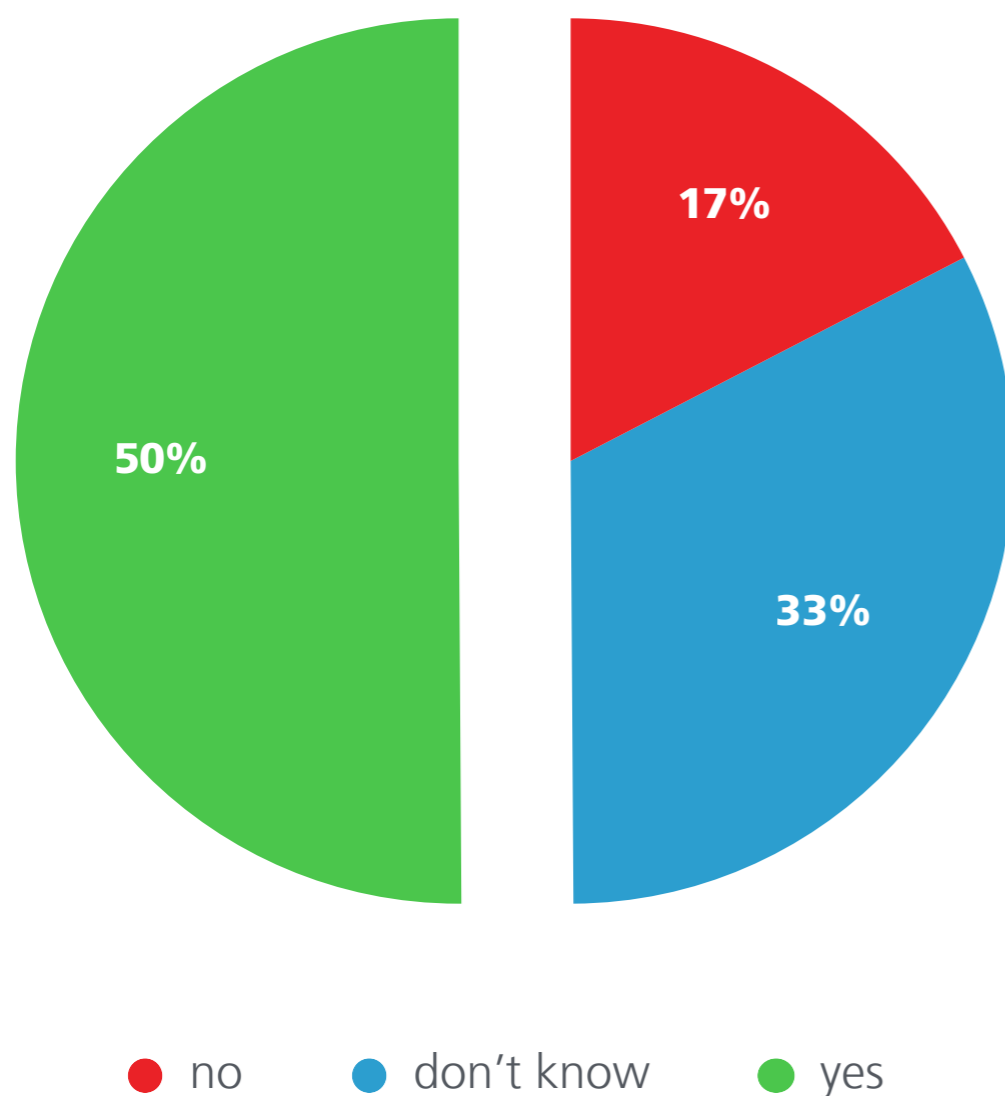
china: use of natural refrigerants vs f-gases



■ Carbon dioxide ■ Ammonia ■ Hydrocarbons ■ Water ■ Air ■ HFCs ■ HCFCs

- today, a clear 3/4 majority still uses HFCs; more than 60% still even use HCFCs
- among NR, carbon dioxide is currently the most popular choice (close to 30% use it), followed by hydrocarbons

china: future plan to use NR solutions

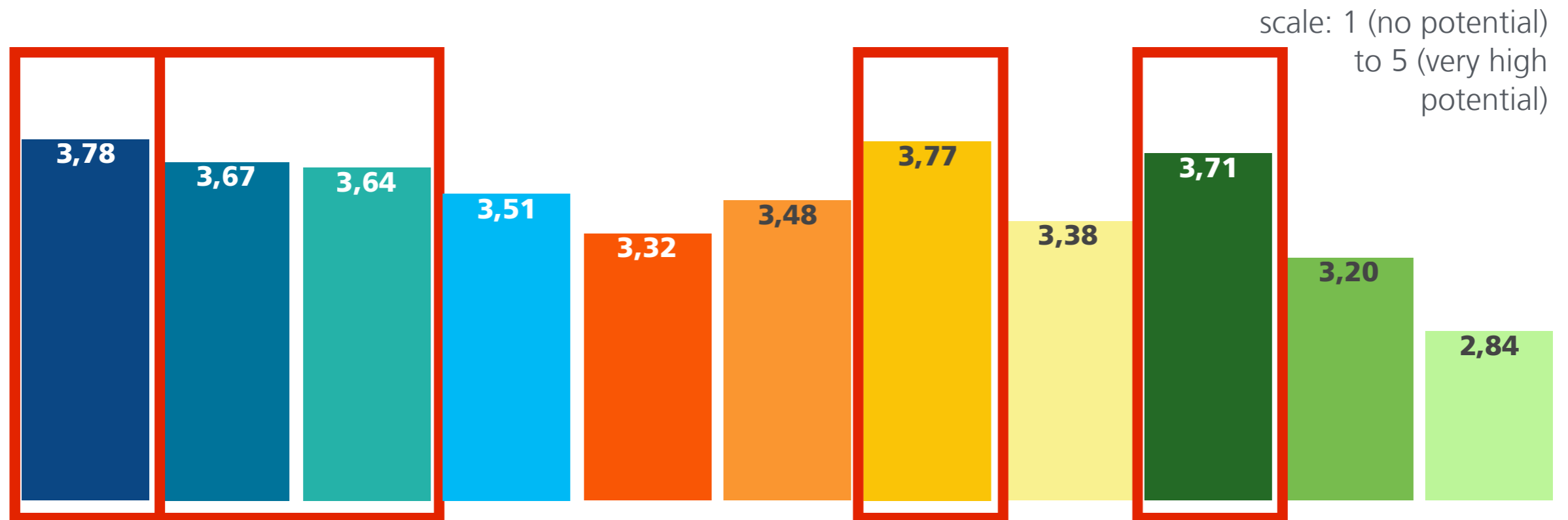


- half of all respondents (50.1 %) say that they will provide products or services with natural refrigerants in the future
- another 32% is not sure yet = large untapped potential for more communication about NR technology and its business case
- only 17% have currently no plan to provide NR products or services
- in 2020, there will be a big shift towards CO₂ when 34% want to start using it; another 26% plan to use hydrocarbons in five years from now

NR potential in china 2020, by application



- highest potential for CO₂ in commercial refrigeration, HCs in domestic refrigeration and ammonia in industrial refrigeration
- overall, CO₂ has the highest potential across refrigeration + also in smaller HP



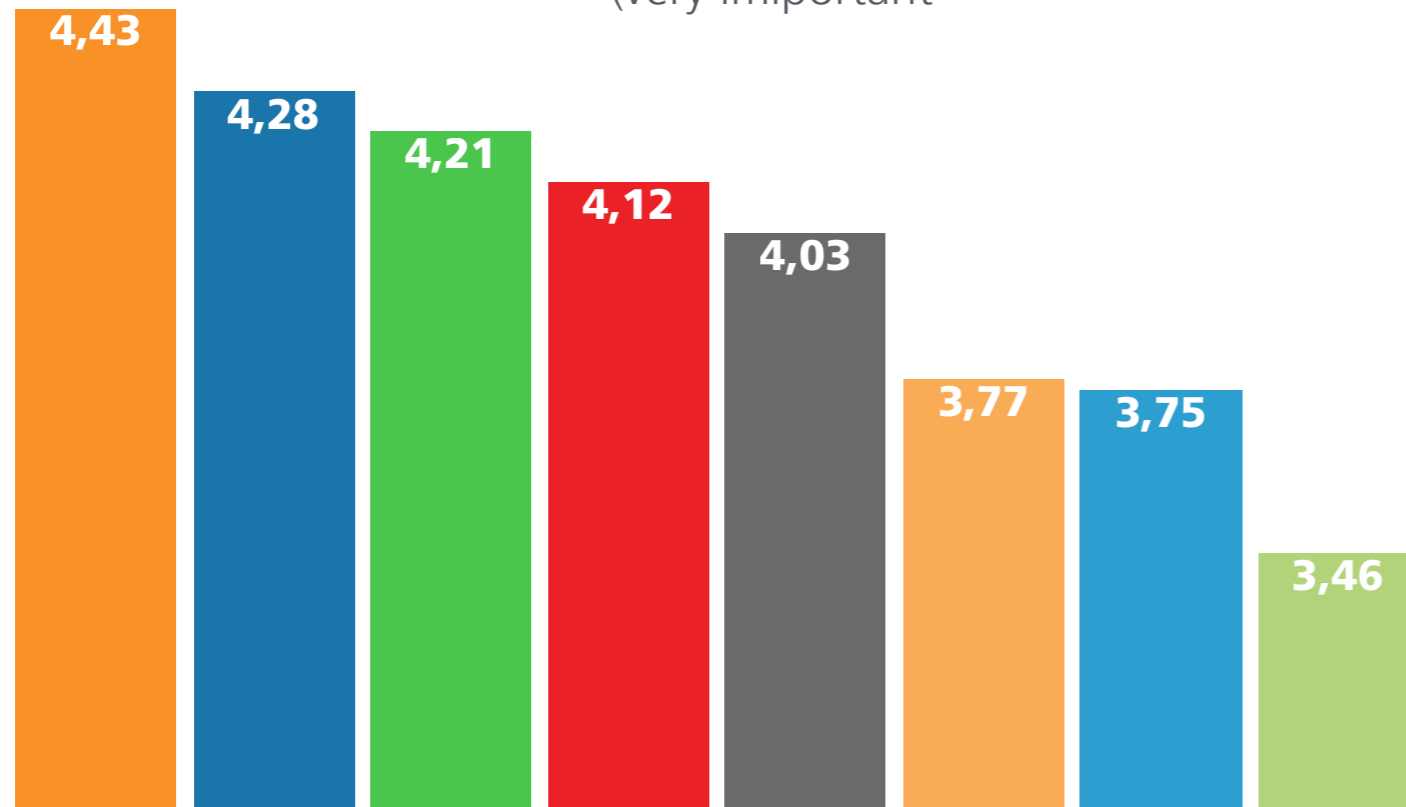
■ CO₂ Refrigeration industrial
■ CO₂ Heating residential / commercial
■ HC Refrigeration commercial
■ HC Refrigeration domestic
■ Ammonia Refrigeration industrial
■ Ammonia District heating

■ CO₂ Refrigeration commercial
■ CO₂ Refrigeration light-commercial
■ HC Refrigeration light-commercial
■ HC Air-conditioning residential
■ Ammonia Refrigeration commercial

drivers for NR industry in china



scale: 1 (not important) to 5
(very important)



- National regulation restricting HFC use
- Global agreement on HFC phase-down
- Review or introduction of standards to enable NR use
- Financial incentives for manufacturers / end users
- Higher availability of components for NR systems
- Higher awareness of NR technology, knowledge sharing
- Higher availability of training & safety programs for HVAC&R industry
- Voluntary industry / end user commitment to phase out HFCs / HCFCs

- government policy will be key in NR market growth: restricting HFC use is the most important driver = "very important"
- a global agreement on HFC phase-down, better standards for NR, financial incentives = "important"
- no strong belief in voluntary action by HVAC&R industry or end-users

china: policy trends



- new **Environmental Protection Law** for 2015, revised version after 25 years = stricter monitoring and enforcement system
- national **government strategy for natural refrigerants** (HCFC phase-out plan) in RAC - mostly for HC
- expected for 2015: a new **government strategy on CO₂ and NH₃ in the cold storage industry**
- new **Energy Efficiency Label** (Jan 2015); applied to air-source heat pump water heaters
- **Top Runner label** (Jan 2015) for domestic appliances incl. room A/C; 2) high energy consumption industries and 3) public buildings



japan: home to the world leaders in CO₂ for
heat pumps & food stores + HC use emerging



GUIDE Japan 2015 / ATMOSphere Asia



- Special Edition of the upcoming "Accelerate Japan" magazine
- expected launch: Sep 2015

japan: CO₂ heat pumps



10 million expected by 2020

**400-500k units
per year**

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



**4.7 million
CO₂ heat pumps**

Eco Cute has been a run-away success,
with strong government support

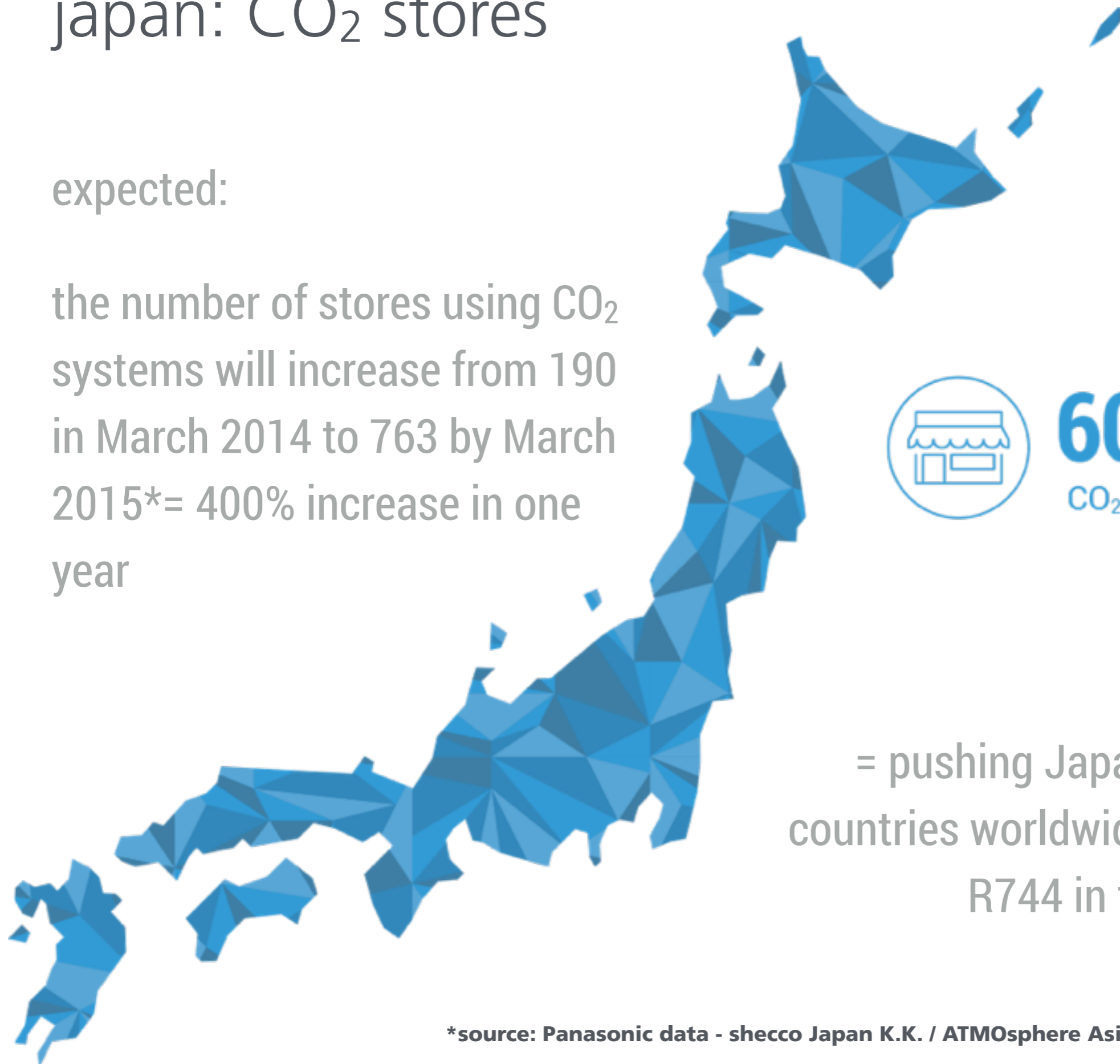
***source: shecco Japan K.K. status: February 2015**

japan: CO₂ stores



expected:

the number of stores using CO₂ systems will increase from 190 in March 2014 to 763 by March 2015* = 400% increase in one year



600+

CO₂ transcritical stores

= pushing Japan into the top 4 countries worldwide for the use of R744 in food retail (est.)

*source: Panasonic data - shecco Japan K.K. / ATMOSphere Asia 2015, status: February 2015

japan: food retailers using CO₂



expected:

the number of food retailers using CO₂ systems will increase from 14+ to 25+ brands by march 2015



*source: Panasonic data - shecco Japan K.K. / ATMOSphere Asia 2015, status: February 2015

japan: Lawson - the world's leading food retailer using CO₂ ?



- **570 CO₂ transcritical CVS stores** by end-Feb 2015 - out of 12,000 stores across the country
- **R744 now standard technology** for all new stores; even applied in sub-tropical climates
- **training of 900 technicians** on CO₂ was done by the system supplier
- maintenance activities across all R744 stores have decreased from 250 / month in April 2012 to now below 10 / month despite the rapidly increasing number of such stores



japan: 1st all natural store / SAVE ON



- SAVE ON (total of 605 stores across Japan) will open the **first “all-natural” store in Japan, using CO₂ transcritical technology for wall side cases + R290 cabinets**
- as of January 2015, SAVE ON had introduced R290 flat showcases to 30 stores
- existing case study in Maebashi-Rikimaru store:
 - HC unit (572 liters) vs. HFC unit (320 liters): **HC unit achieved -77% energy consumption / -70.4% electricity cost as compared to HFC unit**
 - initially **higher costs were compensated by the installation of 2 instead of 1 food display units** in the same space (HC unit smaller with higher storage capacity)



japan policy trends



- ◎ **Industrial Voluntary Action Plans:** 14 Japanese organisations implement new measures incl. to support the conversion from F-gases to natural refrigerants
- ◎ **F-Gas Law:** in force in April 2015; targets the entire life cycle of F-gases, from production to destruction
- ◎ **reduced F-gas leakage** from commercial equipment: periodical checks, maintenance, reporting etc.; proper refill and recovery; obligation of destruction
- ◎ the act also includes the **promotion of low-GWP / non F-gases alternatives for designated products**

japan policy trends



Designated products	Present refrigerant (GWP)	Target value (GWP)	Target year
room air conditioning	R410a (2090) R32 (675)	750	2018
commercial air conditioning (offices & stores)	R410a (2090)	750	2020
condensing units and refrigeration unit (for separate type showcases etc.)	R404a (3920) R410a (2090) R407c (1774) CO ₂ (1)	1500	2025
cold storage warehouse (above 50,000 m ²)	R404a (3920) NH ₃ (single digit)	100	2019
mobile air conditioning	R134a (1430)	150	2023

japan policy trends: label



- **label** by Ministry of Enterprise and Industry (METI) to be introduced on the product catalogue / packaging of designated products
- rating based on GWP value - if below the target value = A; **S = Natural Refrigerants**



japan policy trends: finance scheme



- **support for R&D for F-gas free technologies:** for A/C systems (small, large) and refrigeration systems, incl. for food retail and industrial applications
- **support for energy-saving equipment** using natural refrigerants: 1/2 (cold storage) or 1/3 (food retail) of introduction cost = target: market penetration through mass production
 - in 2014: 21 companies in food retail were supported
 - in 2014: 34 companies in cold storage sector were supported

shecco - useful links



Industry Platforms:

<http://www.hydrocarbons21.com>

<http://www.R744.com>

<http://www.ammonia21.com>

<http://www.R718.com>

ATMOsphere conferences, side-events & network meetings:

<http://www.ATMO.org>

shecco Publications, incl. GUIDEs

<http://publications.shecco.com>

Accelerate Magazine

<http://accelerate.shecco.com>

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