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SUSTAINING OUR ATMOSPHERE

Updates on the latest natural refrigerant technology and market trends

Tokyo, 27 November 2014

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Montreal Protocol: progress towards global HFC phase down

November 2014 - 26th Meeting of the Parties held in Paris, France

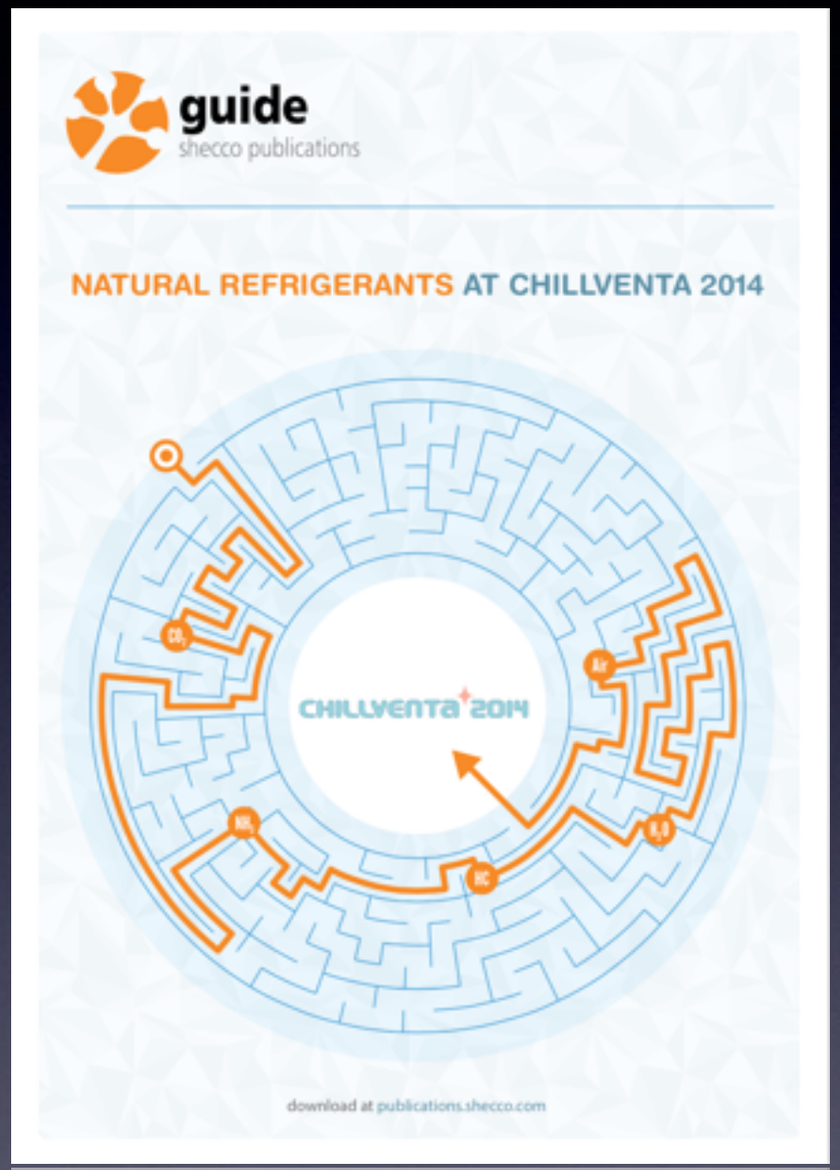
- For the 6th consecutive year **amendment proposals** for HFC phase down were submitted (North America, Micronesia)
- **Informal discussions** on management of HFCs, but no formal debate was formed (opposition of Gulf countries, Pakistan)
- **India** changes its stance, drops strong opposition
- **China** is open-minded about dealing with HFCs under Montreal Protocol
- **Replenishment of the Multilateral Fund** for 2015-2017 fixed at $507.5 million (higher than last replenishments)

Montreal Protocol: global HFC phase down possible in 2015/2016

- Decision to hold a **3-day extraordinary meeting** and **2-day workshop on HFCs** in April 2015
- EU Climate Commissioner, Miguel Arias Cañete: **EU** plans to submit a **formal HFC phase down amendment** proposal in 2015
- More information on **ODS alternatives** required, especially for high ambient conditions (commercially available, technically proven,...)

GUIDE to natural refrigerants at Chillventa

- **First ever GUIDE to natural refrigerants at Chillventa**
- **30 Partners**
- **Products, Directory, Halls, Events** showcasing natural refrigerants.



Guide available on

www.publications.shecco.com

Chillventa trends

- **Chillventa set a new record** as the world's largest showcase for natural refrigerant products:
  - European cooling industry is planning to move quickly to lower GWPs
  - Revised F-Gas Regulation is already having an impact

- **Chillventa market trends:**
  - Transition has been made from "development phase" to "optimisation phase"
  - 2006: only a few prototypes existed for natural refrigerant valves and exchangers
  - 2014: approximately **13% of exhibitors** showcased a natural refrigerant products or service
  - In general exhibitors at Chillventa 2014 reported a dramatic increase in demand for NR compressors

Chillventa technology trends

- **Todays NR compressors** are much more efficient, compact and lightweight
  - Parallel compression and external sub coolers mean now possible to find CO2 system for any geographical area in Europe
  - Hydrocarbons a standard technology in plug-and-play commercial refrigeration

- **Record breaking** number of new NR products launched at Chillventa 2014:
  - for hydrocarbons: new R290 and R600a compressors from Danfoss, Cubigel, embraco and Tecumseh and HC charging machine from Galileo TP
  - for CO2: new CO2 booster systems from enEx with ejector liquid overfeeding; Saginomiya, Carly, Deka premiered a range of CO2 components
  - for ammonia: new compressors for ammonia from Bitzer and wet-dry condenser from Evapco
  - for water: first ever industrial, mass-producible chiller launched by Efficient Energy

Chillventa Congressing: heat pumps

- In Europe heat pumps have a 15% market share of heating market - French market is driving major growth

- In the US heat pumps have experienced a 15% increase and captured an 18% market share

- In China ground source heat pumps supported by Government - China has become leading market for heat pump technology

north america: accelerating market for natural refrigerants

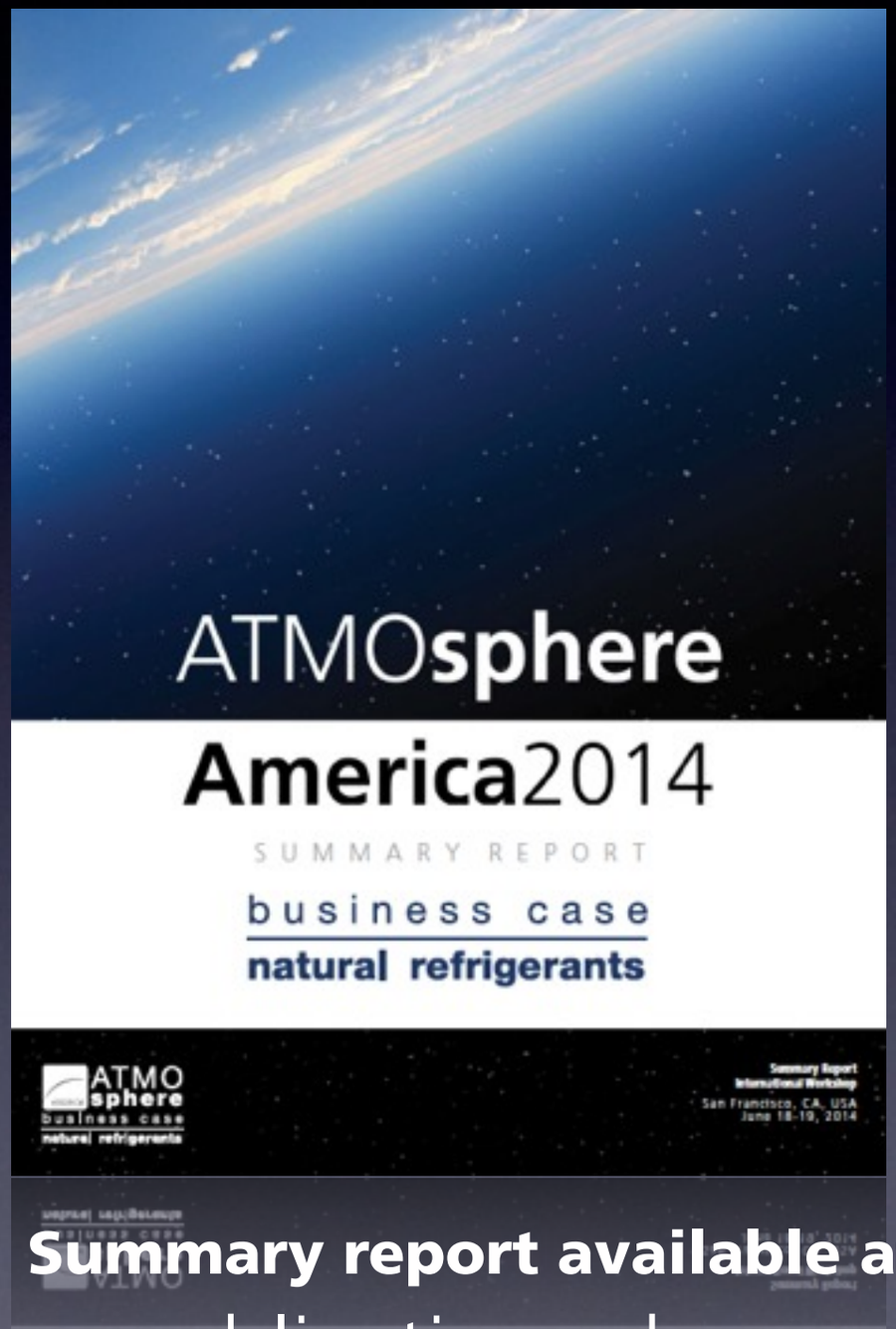
- North American market shows **increased interest in natural refrigerants**
- **Policy action on HFCs** at federal and state level (California considering low-GWP requirements, HFC phase-down...)
- **68 CO_2 only stores** in North America and at least **27 more** planned in 2014, including in warmer regions (e.g. Georgia)
- North American companies starting to invest in European market

  - 250 experts
  - 60 presentations
  - 13 HVAC&R sectors

ATMOsphere America 2014 - 18-19 June, San Francisco

north america: accelerating market for natural refrigerants

- **Target** officially announces shift to CO_2 hybrid systems
- **Sobeys** to have 64 CO_2 TC stores by end of 2014, investment cost decreased by 17% since 2011
- **Red Bull** placed order on 12,650 isobutane coolers in the US since EPA approved R600a in July 2013; 457,000 HC coolers globally
- **The Coca-Cola Company** placed 12,354 CO_2 cabinets in North America; 1.1 mil HFC-free equipment (CO_2 and HC) globally, representing around 80% of the purchase volume



Summary report available at

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US EPA proposals to open up opportunities for natural refrigerants

June 2014: Proposal to allow use of **4 HC in 6 AC&R** applications (subject to use conditions)

AC&R application	**Refrigerants proposed to be <u>allowed</u>**
Retail food refrigeration (stand-alone)	isobutane (R600a) R441A
Vending machines	isobutane (R600a) propane (R290) R441A
Residential & light commercial AC and heat pumps	propane (R290) R441A R32
Very low temp refrigeration & heat transfer	ethane (R170)
Household refrigeration	propane (R290)

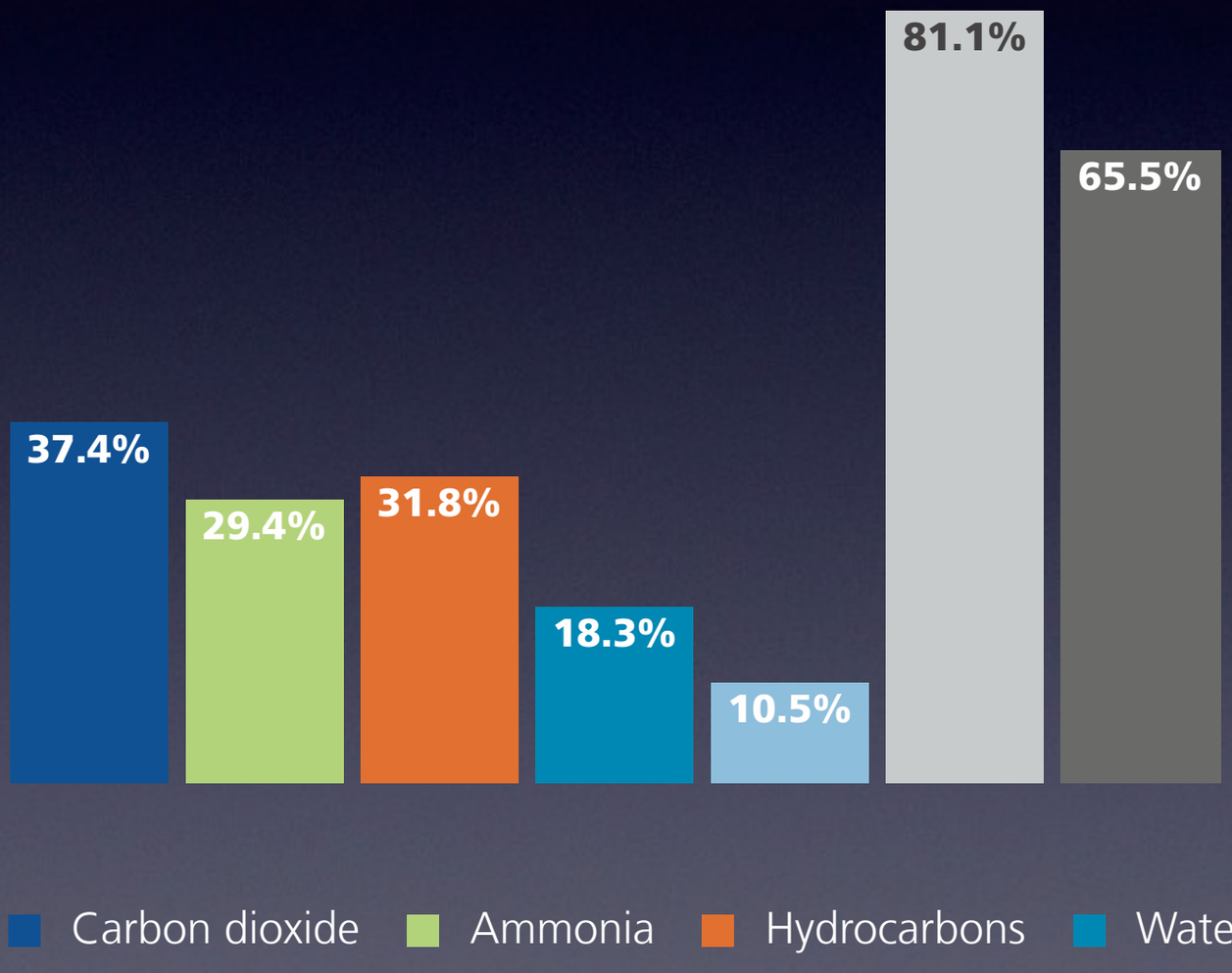
US EPA proposals to open up opportunities for natural refrigerants

July 2014: Proposal to list as **unacceptable certain high GWP refrigerants**

AC&R application	**Refrigerants proposed to be <u>unacceptable</u>**	**Propose date**
Mobile AC	R134a	2021
New retail food refrigeration (stand-alone) & vending machines	R134a, R404A, R407A, R407C, R507A, other blends	2016
Retrofit retail food refrigeration (stand-alone) & vending machines	R404A and R507A	2016
Retrofit & New supermarket refrigeration (direct and indirect systems)	R227ea, R407B, R421B, R422A, R422C, R422D, R428A, and R434A	2016

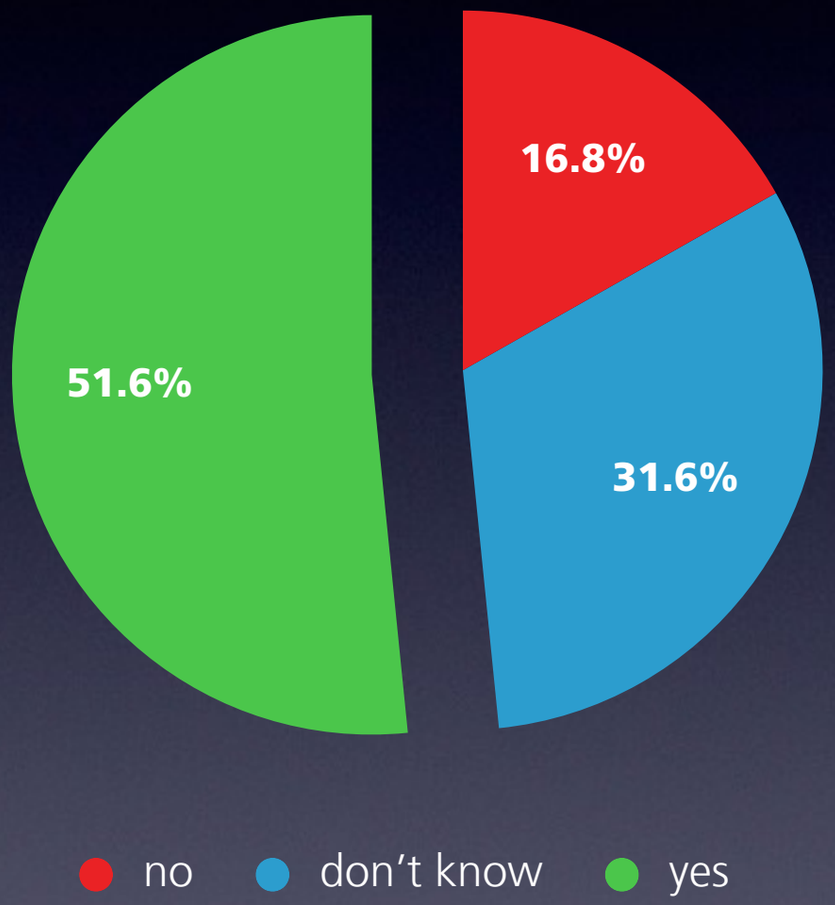
GUIDE China 2015: first dedicated NR industry survey

use of natural refrigerants vs f-gases



- today, a clear 80% majority still uses HFCs; 65% still even use HCFCs
- among NR, carbon dioxide is currently the most popular choice (37% use it)

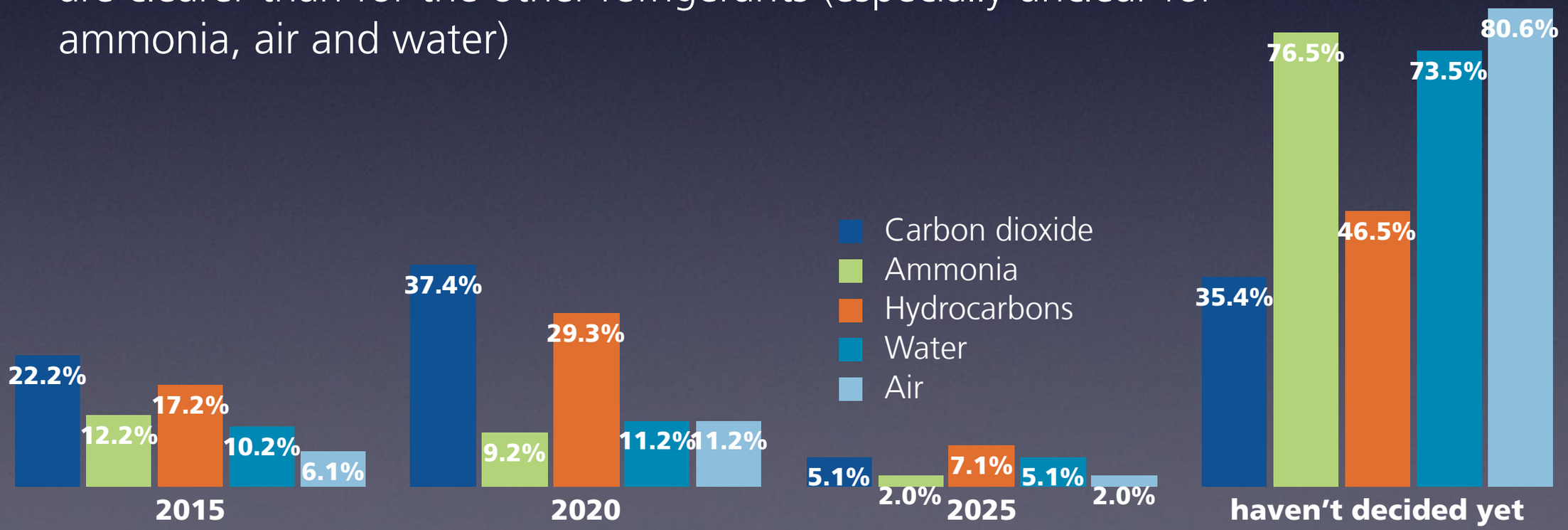
future plan to use products / services with NR



- already a high 51% says that they will provide products or services with natural refrigerants in the future
- another 31% is not sure yet = large untapped potential for more communication about NR technology and its business case
- 16% have currently no plan to provide NR products or services

future plan to use products / services with NR

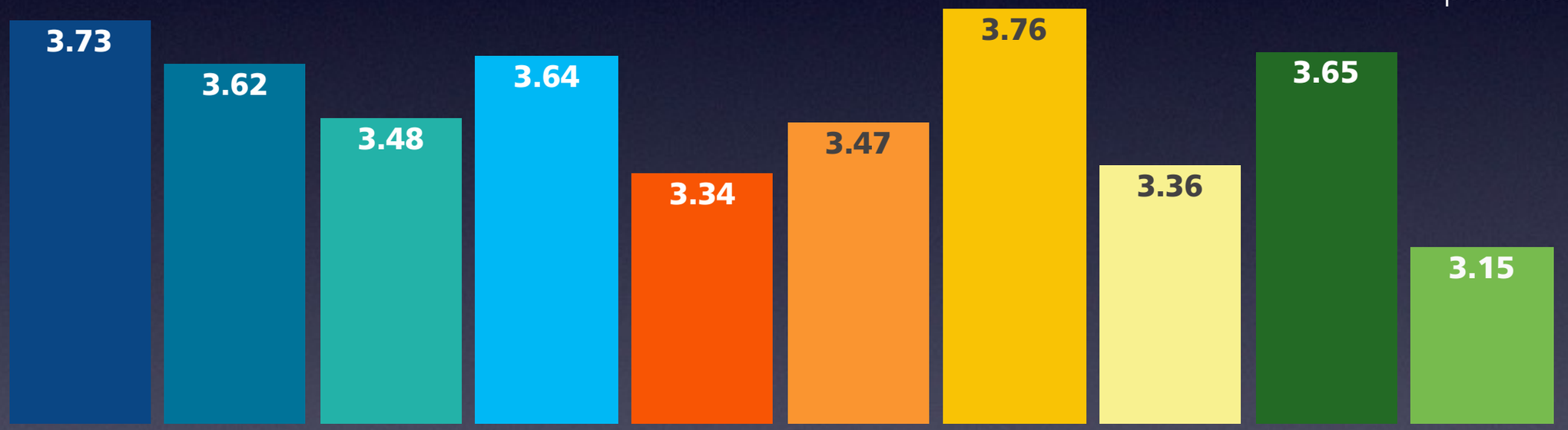
- in 2015, new products / services with all five NR are expected to be offered in China, but mostly CO_2 and hydrocarbons
- in 2020, there will be a big shift towards CO_2 when 37% want to start using it; another 29% plan to use hydrocarbons in five years from now; increased use of water and air is also expected
- most respondents, however, are really undecided about which NR they will use when - prospects for CO_2 and hydrocarbons are clearer than for the other refrigerants (especially unclear for ammonia, air and water)



NR potential in China 2020, by application

- respondents see highest potential for HCs in domestic refrigeration, CO_2 and ammonia in industrial refrigeration, and for CO_2 in heating and commercial refrigeration

scale: 1 (no potential) to 5 (very high potential)



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