Natural Refrigerants -
Global Market Development

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Across the whole range of heating, cooling and refrigeration needs the “Natural Five” can cover all applications.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Ammonia, NH₃, R717</th>
<th>Carbon dioxide, CO₂, R744</th>
<th>Hydrocarbons, HCs, R290, R600a etc.</th>
<th>Water, H₂O, R718</th>
<th>Air, R728</th>
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<td>90°C</td>
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</table>
... in the food retail chain

- factories, warehouses
- supermarkets
- fast-food restaurants
... in buildings

- air-conditioning, refrigerators, freezers, heat pumps, district heating
- hospitals, offices, public buildings, data centres, airports etc.
... in transport

- transport refrigeration, passenger car and bus air-conditioning, fishing vessels and reefers refrigeration
... in special applications

- deep mining, ski slopes & ice rinks
- industrial & chemical plants
- research labs freezing & cooling
... globally (more applications)

- electric vehicle / train air-conditioning
- vaccine coolers, water fountains
- portable air-conditioners
- hot water heating & dryers
market: HFC-free in the world

- 400 million HC fridges
- 1.2 million HC ice cream freezers (Unilever)
- 313,000 HFC-free bottle coolers (Red Bull)
- approx. 950,000 HFC-free vending machines (Coca-Cola + Pepsi)
- 20 million cars with HC air-conditioning

The potential for HC chillers alone was estimated at 4 billion USD.
GUIDEs on North America & Europe

- 1st reports on the market trends for natural refrigerants in the European Union; and in Canada, Mexico and the USA
- Market trends for natural refrigerants & forecasts (industry survey)
- View of End-users (retailers, consumer brands)
- Case studies, Company directory, ... and more

free download at:

http://guide.shecco.com
What are the strengths of NR as compared to conventional refrigerants in NORTH AMERICA?

- Direct & indirect environmental benefits most important
- Efficiency, performance & ROI
- Safety is not considered to be an issue (anymore)

Average values of 356 respondents: all above 2 is superior than conventional refrigerants.
“What are the strengths of NR in EUROPE?”

- direct & indirect environmental benefits most important
- operation costs, technology reliability clear advantages
- supply & availability not considered an issue in Europe anymore

511 respondents
strengths of NR: North America & Europe

- Environment: 3.07
- Refrigerant Costs: 3.01
- Efficiency, Performance: 2.80
- Image, Competitive Advantage: 2.70
- Return on Investment: 2.56
- Compliance with Legislation: 2.46
- Reliability of Technology: 2.41
- Safety: 2.32

Supplementary Data:

- Supply: 27%
- Environment: 24%
- Markets: 35%
- Operation Costs: 5%
- Legislation: 19%
- Technology: 34%
- Refrigerant Costs: 47%
HFC-free light commercial systems (2013)

- remember: total HFC-free light commercial units globally: minimum 2.5 million units (bottle coolers, ice cream freezers, vending machines)
- in North America: around 4,000 units (HC restriction only lifted a short while ago in the USA)
- driven by large consumer goods brands:
2 stores with transcritical CO₂ systems planned for 2013

75 stores with CO₂ cascade & secondary systems in 2012; already 25 new ones planned for 2013

TOTAL minimum = 100+ CO₂ stores by end-2013 - trend towards cascade systems

status: February 2013
CO₂ refrigerant supermarkets: canada

37 stores with transcritical CO₂ systems in 2012; 24 new ones already planned for 2013

13 stores with CO₂ cascade & secondary systems in 2012

TOTAL minimum = 75+ CO₂ stores by end-2013 + clear trend towards transcritical systems

status: February 2013
verified: 1,331 transcritical CO\textsubscript{2} stores by mid-2011 for Europe
transcritical CO$_2$ supermarkets 2012

**verified:** 1,331 transcritical CO$_2$ stores by mid-2011 for Europe

**estimated:** 1600+ CO$_2$ supermarkets by end-2012
natural refrigerants supermarkets

verified: 1,331 transcritical CO$_2$ stores by mid-2011 for Europe

estimated: 1600+ CO$_2$ supermarkets by end-2012

estimated: 3000+ supermarkets using CO$_2$, ammonia and/or hydrocarbons refrigeration
market potential for Europe

a minimum of 34 food retailers use natural refrigerants
market potential for Europe

... with the potential of introducing the technology EU-wide
natural refrigerant supermarkets 2013
NR future use by current “non-NR” industry

- Europe: 55% say they will use them in the future
- North America: 40% say yes
- Asia: 75% say yes
CO₂ heat pumps in the world

**EUROPE**
- 16 Manufacturers
- max 3% market share for residential heat pumps

**CHINA**
- 100,000 units production capacity / year

**JAPAN**
- 20 Eco-Cute Manufacturers
- 3.5 million CO₂ HP
- 98% market share for residential heat pump water heaters
- 500,000 units production / year
NH₃ industrial refrigeration

- **EUROPE**: 90% market share
- **INDIA**: 95% market share
- **USA**: 95% market share
- **CHINA**: 95% market share

- 600-800 cold stores above 10,000 tonnes
main messages

- The market for some NR applications is already well-established and growing, like for Ammonia in industrial refrigeration or Hydrocarbons in domestic refrigeration.
- The market for some NR applications is well on track to become a success story, like CO\textsubscript{2} in supermarket refrigeration, Hydrocarbons in light-commercial applications, and CO\textsubscript{2} in heat pumps.
- The market for some NR applications promises high market and energy efficiency potential, like Hydrocarbons in domestic air-conditioning.
- China could use the opportunity to establish itself as a driving force for NR solutions globally, in all areas.
GUIDEs: published

GUIDE Europe
Feb 2012

GUIDE North America
March 2013

GUIDE: Examples of NH₃/CO₂ Secondary Systems for Cold Store Operators
March 2013

http://guide.shecco.com
GUIDEs: upcoming

FREE GUIDEs 2013:

- Europe 2nd edition
- Japan
- China
GUIDE China

- 1st dedicated report on the market trends for natural refrigerants in China
- expected launch: Q4 2013
- jointly published by CRA and shecco

**highlights:**
- Market analysis: quantitative surveys and interviews with high-level decision makers
- Policy: China’s policy and national projects under the HPMP, and their impact on the use of natural refrigerants
- Case studies: best practice examples
- Market trends: forecasts per application
Case Study booklet - A5 / EITs

Content:

- case studies for natural refrigerants from shecco’s industry platforms
- www.R744.com
- www.ammonia21.com
- www.hydrocarbons21.com
shecco - useful links

Industry Platforms:
- http://www.ammonia21.com
- http://www.R718.com

GUIDEs:
- http://guide.shecco.com

ATMOsphere Asia 2013 workshop & Europe Report 2012:
- http://www.ATMO.org

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