Policy and market trends regarding natural refrigerants

Refrigeration 2017 Conference
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GLOBAL POLICY TRENDS
KIGALI AMENDMENT TO THE MONTREAL PROTOCOL

Changing the HVAC&R Industry globally?
Kigali Amendment: the most practical step towards mitigating climate change.

- Clear message: HFCs on their way out globally
- Global phase down will span the next 30 years
- Phase-down affecting 18 substances - average GWP of 2500
- Multilateral Fund to come up with guidelines for Finance
- If fully implemented, it could stop global warming by 0.5 degrees
- Exemptions for high-ambient temperature countries still remain on the table
Entry into force: By 1 January 2019 latest (following ratification by 20 parties to the Montreal Protocol)

Priorities: standards (initiated by China), access to finance, exemptions

Next Key Meetings

- 11-14 July 2017: Workshop on standards for low GWP alternatives to HFCs (Bangkok, Thailand)

- 20-24 November: 29th Meeting of the Parties of the Montreal Protocol (Montreal, Canada)
Entered into force in 2015

Introduced a number of measures to limit f-gas emissions

Aims to reduce HFC emissions by 79% by 2030 (compared to 2009-2012)

= the average GWP of HFCs will have to fall from today’s 2,000 to about 400 by 2030 across all sectors
## EU F-GAS REGULATION: HFC BANS

<table>
<thead>
<tr>
<th>Sector</th>
<th>GWP limit</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic refrigeration</td>
<td>150</td>
<td>2015</td>
</tr>
<tr>
<td>Stationary refrigeration (except &lt; -50°C)</td>
<td>2500</td>
<td>2020</td>
</tr>
<tr>
<td>Hermetically sealed commercial refrigeration</td>
<td>150</td>
<td>2022</td>
</tr>
<tr>
<td>Centralized commercial refrigeration (≥40kW), except in the primary refrigerant circuit of cascade systems where f-gases with a GWP&lt;1500 may be used</td>
<td>150</td>
<td>2022</td>
</tr>
<tr>
<td>Movable room AC</td>
<td>150</td>
<td>2020</td>
</tr>
<tr>
<td>Single split AC (&lt; 3kg of f-gases)</td>
<td>750</td>
<td>2025</td>
</tr>
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Report reveals early effects of the EU F-Gas Regulation

Looks at the impacts on the European businesses (qualitative & quantitative analysis)

Evaluates the effects on other legislative frameworks, incl. Montreal Protocol
F-Gas Report survey: Over 650 companies work with natural refrigerants (HFC alternatives) in the EU, Norway, Switzerland and Iceland

Southern European countries are increasingly investing in this technology

First-movers were able to benefit from their competitive advantage across the EU and beyond
Recent survey in Europe:

Out of a total of 160,000 technicians in Europe, 8,000 - 10,000 received training on natural refrigerants in 2015

Close to 200 companies in Europe offer training related to natural refrigerants

4 in 5 industry experts expect the number of people trained in HFC alternatives will grow in the next 1-2 years
Next Steps

Review process of the Regulation kicked off end 2016

Review may result in extended list of HFC bans in other applications

European Commission currently considering options. In November 2016 it published reports on:

- standards
- training
US: UNCERTAINTY AT FEDERAL LEVEL

New US Administration under Trump: what it means for the Industry?

- Head of EPA (Scott Pruitt): leading advocate against action on climate change
- Head of DOE (Rick Perry): ties to oil sector, climate sceptic

Open questions / risks

- Ratification of Paris Agreement?
- Ratification of Kigali Amendment?
- Role of EPA in enforcement of legislation?
- Investment in renewables, climate change programmes?
- Future of Clean Air Act?
California seizing the opportunity to lead with most progressive measures:

- Regulating HFC emissions since 2011
- Prohibition on sale of new refrigerants with high GWP (>2500) as of 2020:
  - High GWP refrigerant prohibitions in new stationary systems: GWP > 150 in refrigeration (as of 2021)
  - Financial incentives (tbc): to motivate early adopters of low GWP refrigeration in commercial refrigeration
The California Air Resources Board (CARB) approved the Short-lived Climate Pollutant Reduction Plan on 23 March 2017.

Plan to curb harmful super pollutants brings California closer to achieving its goal of reducing greenhouse gas emissions by 40% by 2030.

Methane, HFCs and black carbon under the remit of the SLCP Strategy

Aim to reduce HFCs 25% below business-as-usual emissions by 2020

Opportunities to increase uptake of natural refrigerant-based HVAC&R solutions
Standard IEC 60335-2-89 currently recommends charge limit of Hydrocarbons at 150 grams.

International Electrotechnical Commission (IEC) working group on household and similar electrical appliances currently reviewing safety standards.

Agreement on recommended limit expected by 2018: raising the limits to 500 grams likely.

26 Working Group members (including Germany, NZ, Japan, US).

Changes at IEC level will require reviews of national standards in turn.

Potentially opening up further opportunities to hydrocarbons globally.
JAPAN: SUBSIDIES INCREASING… BUT CHANGING FOCUS

For FY2017, subsidy of 6.3 billion JPY only for Industrial refrigeration (cold storage, warehouses).

FY2018 and onwards?
Natural Refrigerants CO2, NH3 and HCs recommended by MEP/FECO China in majority of targeted HVAC&R segments
MARKET TRENDS
COMMERCIAL REFRIGERATION
02
CO₂ TC STORES GROWING GLOBALLY (FEB 2017)
Number of CO₂ stores in the EU, Norway, Switzerland has tripled in the last 3 years = 8% of the overall market share in the food retail market

Despite earlier claims that there are no viable solutions for warmer climates, the number of new installations is growing steeply in Southern Europe

Growth of CO₂-based stores
2,400+ CO₂ Transcritical stores in Japan

CO₂ TRANSCRITICAL CVS
CO₂ TRANSCRITICAL SUPERMARKET

HOKKAIDO
TOHOKU
CHUBU
CHUGOKU & SHIKOKU
KANTO
KANSAI
KYUSYU

KEY/LEGEND

1-2  50+  100+  500+

www.shecco.com
• Currently 32 subcritical CO₂ supermarkets in China (HFC/CO₂ cascades) - south east region

• Majority operated by Metro China, first ever installed by Tesco

• 5 contractors able to handle CO₂ installations

• Market opening up to natural refrigerants. Potential identified in:
  • CO₂ in commercial and industrial; HPs
  • low charge NH₃ in industrial refrigeration
  • but also…R290 in RAC
Plug-in units in supermarkets with R290: A reality today

Market estimate by early 2017:
1,000,000+ units worldwide

Figures reported by AHT (market leader) by 2016:
- over 700,000 units in Europe alone
- 3500+ in Thailand

Source: Atmosphere Europe 2016
On-the-spot survey to 33 companies, including major players of the sector

Ejectors, parallel compression and waterloop systems identified to be the main technology trends,

Approximately 15-20% increase in production of natural refrigerant systems expected for the period 2017-2018

R290 dominating plug-ins, showing the greatest potential

Even higher growth expected by 2020 and beyond, with a few companies claiming that they will be ready to have their entire production moving to only natural refrigerants

Regulation and mainly customer demand are the reasons for the expectations, especially for Europe
KEY TREND: CO₂ RACK SYSTEM

10+ suppliers providing CO₂ solutions - highly competitive market
Europe traditionally working with large capacity CO$_2$ racks

Recently several manufacturers introduced small systems

Competition increasing: more efficiency, lower prices
Growing line up of small size NH$_3$/CO$_2$ systems - potential to serve supermarkets?
The cost of equipment is becoming comparable to systems using HFCs.

In sectors where HFC alternatives are growing in availability, prices are falling - in commercial refrigeration same as HFC technology or 5-10% higher.

Each year, reported higher energy efficiency, lower prices as technology reaches mass production.

source: Advansor, ATMOsphere Europe 2016
Strong investment of large food retail groups = \( \text{CO}_2 \) Transcritical systems becoming the norm in Europe, N. America, Japan.

Efficiency and reliability are increasing, and prices are going down.

Case Study: Aldi Süd reaches 1000th installation:

- Strategic decision in 2010: Exclusive focus on natural refrigerants

- Now: Over 54% of all Aldi Süd’s stores globally are running on \( \text{CO}_2 \)

Source:

r744.com/articles/7423/aldi_sud_proud_to_install_1_000th_co2_system
As HFCs are being phased down globally, the competition among natural refrigerant solutions is increasing…but they can also coexist successfully.

Case Study:

NH3/ CO2 Supermarket retailer in the US saving 30% on energy bills

http://r744.com/articles/7329/nh3_co2_system_continues_to_save_energy_at_piggly_wiggly_store
Belgian retailer Colruyt targeting 100% hydrocarbons for refrigeration. Exclusive use of hydrocarbons as of 2017

Based on:
- Medium capacity chiller (2.5kg of R290 charge) + secondary glycol loop
- Standalone chest freezers (R600a)

Reported:
- High energy savings
- Reduced leakage rate to approx 5%

Source: Accelerate Europe

(https://issuu.com/shecco/docs/ae1609/34?utm_source=shecco+natural+refrigerants&utm_campaign=5dfd40d6b5-AE1606&utm_medium=email&utm_term=0_9db972ca57-5dfd40d6b5-)
Low-charge Ammonia systems are becoming a strong trend for industrial refrigeration, traditionally dominated by HFCs/large Ammonia installations with big refrigerant charge.

Key drivers:

- Increased safety - lower risk
- Higher efficiency
- Easier servicing (more compact units)
- Return on investment for the end user
the market is changing, from a strong reliance on R22 to a renewed uptake of (lower charge) NH₃ systems

Estimated 400+ installations use secondary NH₃-CO₂ systems

NEXT: export of the technology to other regions

BUT: the use of CO₂ transcritical systems still faces restrictions through the High Pressure Gas Safety Act
As the know-how on CO₂ Transcritical systems increases, CO₂ is now becoming an option for higher cooling capacity needs, traditionally dominated by Ammonia and HFCs.

Key drivers:

- increased reliability and performance of CO₂ systems

- growing competition in the segment pushing prices down and technology becoming more available

- excellent safety record

- return on investment for the end user
KEY TREND: INDUSTRIAL APPLICATIONS WITH CO$_2$ & NH$_3$
Western Gateway: #1 Cold storage facility in Norther Utah, US. In operation since 100 years

New low-charge Ammonia system:

- Two compact, packaged low charge Ammonia systems for new plant (nearly 3000m², storage at -23 degrees)

- Total Ammonia charge: 16% of usual charge (260kg instead of 1500kg)

- 20% yearly energy savings = 30 000$ annual savings in bills

- No need for central refrigeration room

Source: ATMOsphere America 2016
http://www.atmo.org/presentations/files/57646e4f813ba1466199631KJ7fc.pdf
World’s biggest CO₂ industrial plant (vegetable processing plant in the Netherlands by Advansor for Staay Food group):

- 3,36 Megawatt (MW) total cooling capacity
- 7 transcritical CO₂ racks
- 45 high capacity compressors
- 600 kW of heat recovery, providing “free” heating for the office facilities
- Installation in 2016, in operation since early 2017

Source:

http://www.r744.com/articles/7124/advansor_to_deliver_world_s_biggest_co_sub_2_sub_system_so_far
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