



Market Trends on future-friendly ACs and heat pumps

Monday, 08 July 2024, 1 pm
Montreal, Room 7-AB

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Agenda

Welcome Remarks	Sebastian Schnatz German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)
Policy and market trends in China	Shang Shuwen Foreign Environment Cooperation Center in the Chinese Ministry of Ecology and Environment (FECO)
Market trends on natural and flammable refrigerants in the European AC and heat pump industry	Marc Chasserot ATMOsphere
Questions & Answers	All participants
Conclusion and Closing Remarks	Bernhard Siegele GIZ Proklima



Welcome Remarks


Sebastian Schnatz, German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)



Policy and market trends in China

Shang Shuwen

Deputy Director, Division of Montreal Protocol, FECO, China

A stylized globe with a grid pattern is centered in the background. It is surrounded by several thick, light green, swirling lines that create a sense of motion and energy. The globe is rendered in a light blue color.

The ACs Heat Pump Solutions for Future

Foreign Environmental Cooperation Center, Ministry of Ecology and Environment, China



Overview



Kigali Amendment in China



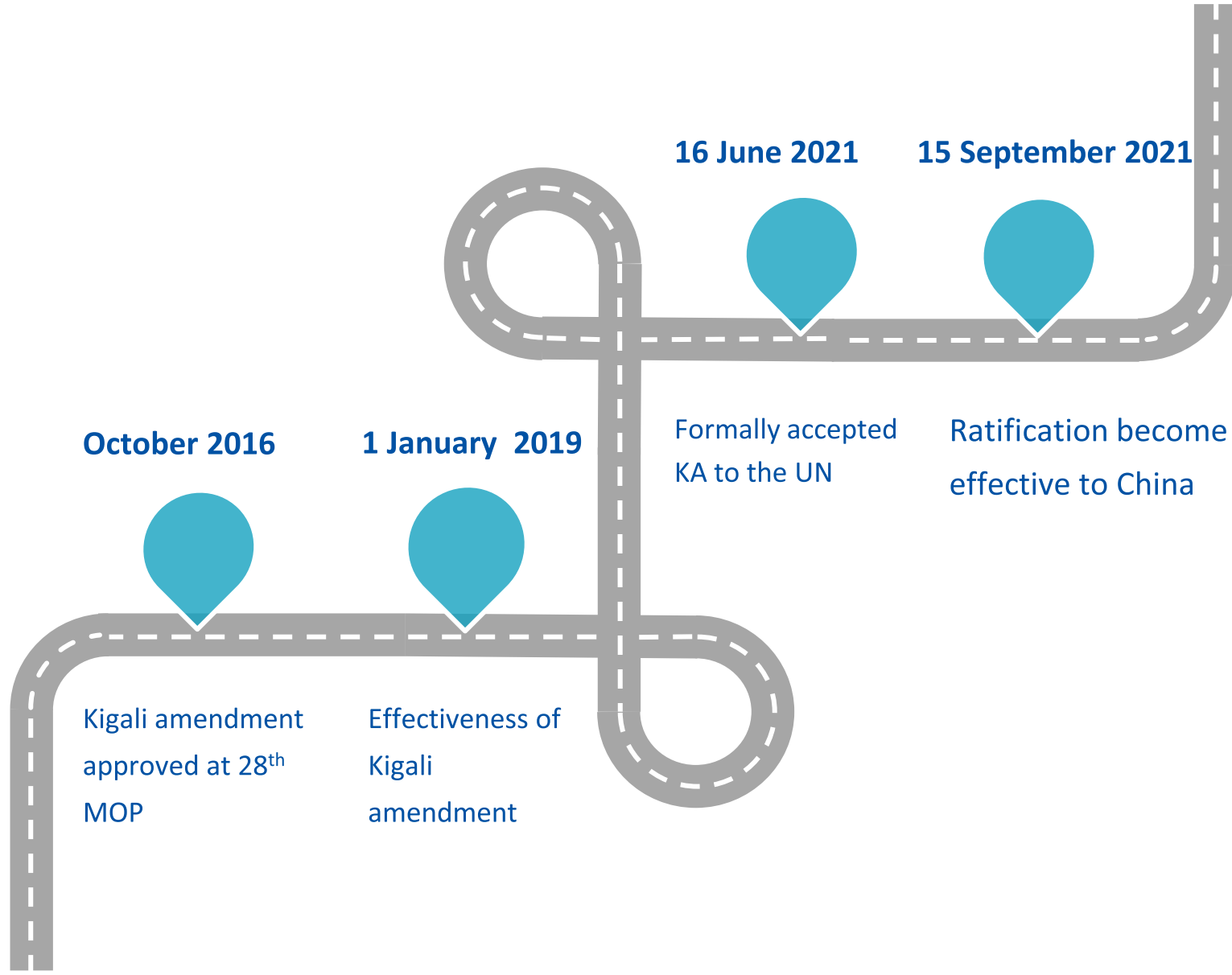
The Selection of Alternatives in the Refrigeration Sectors



R290 in the Room Air Conditioning Sector



Kigali Amendment in China





Policies on Kigali Amendment Implementation

1

Revised *Regulations on ODS management* issued, HFCs were listed in the controlled substances.

National program on phase-down of HFCs is being prepared and is planned to be released by the end of this year.

3

Notice on Control of the First Batch of HFCs Production and Construction Projects prohibits new construction and expansion of facilities that produce HFC-32, HFC-134a, HFC-125, HFC-143a, HFC-245fa as refrigerants, blowing agents and other controlled uses.

Recommended List of Alternatives to Ozone-Depleting Substances issued.

2

5

Notice on Controlling of by-product HFC-23
By-product HFC-23 should be destroyed and disposed to the extent practicable using MOP-approved destruction technologies.

From 1 November 2021, the import and export of HFCs has been subject to license management.

6

4

7

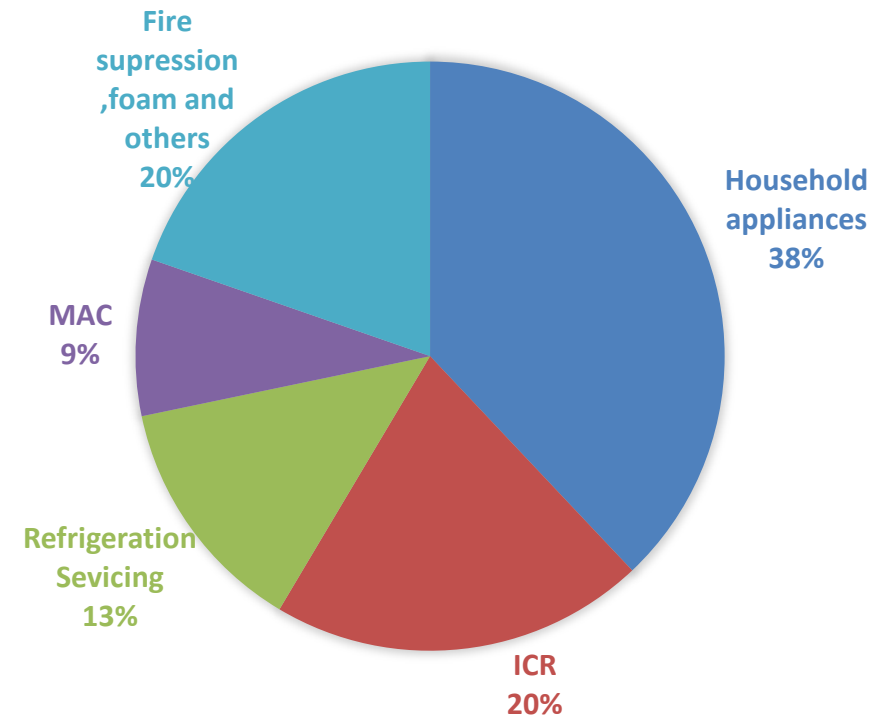
HFCs production quota for 2024 implemented, quota for 2025 in preparation.



Selection of Alternatives in the Refrigeration Sectors in China






- ✓ China is the world's largest manufacturer of refrigeration and air conditioning equipment, and the use of HFCs has maintained a rapid growth trend in recent years.
- ✓ HFCs are widely used, involving automotive air conditioning, household air conditioner, industrial and commercial refrigeration, refrigeration servicing, fire suppression, foam and aerosol sectors;
- ✓ HFCs are mainly used as refrigerants, and the use of HFCs in the automotive air conditioning, air conditioner, industrial and commercial refrigeration and refrigeration servicing sector accounts for about 81% of the total domestic HFCs used (calculated by carbon dioxide equivalent).

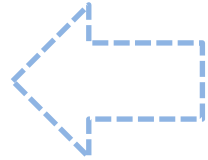
CO2 EQUIVALENT





Selection of Alternatives in the Refrigeration Sectors in China

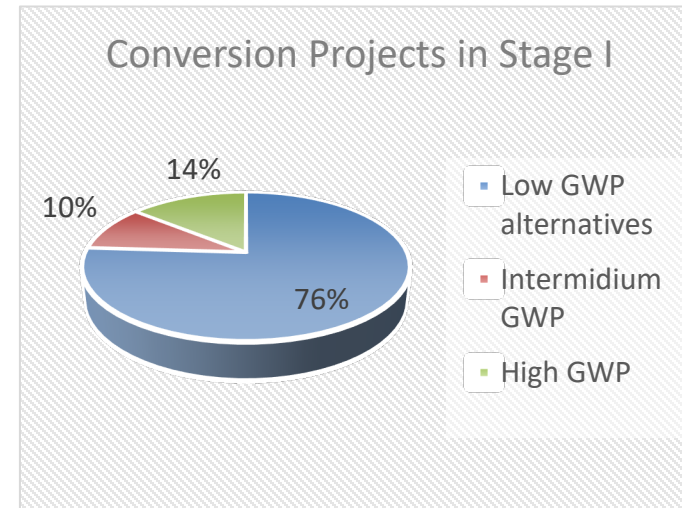
-  Capital cost and operation cost
-  Safety and reliability
-  Availability of the technology
-  Environmental impact
-  Energy efficiency



In the implementation of HCFCs phase out programs, the refrigeration industries in China are looking for long-term and sustainable solutions.

In stage I HCFCs phase-out management plans: about 76% production lines were converted to low-GWP alternatives.

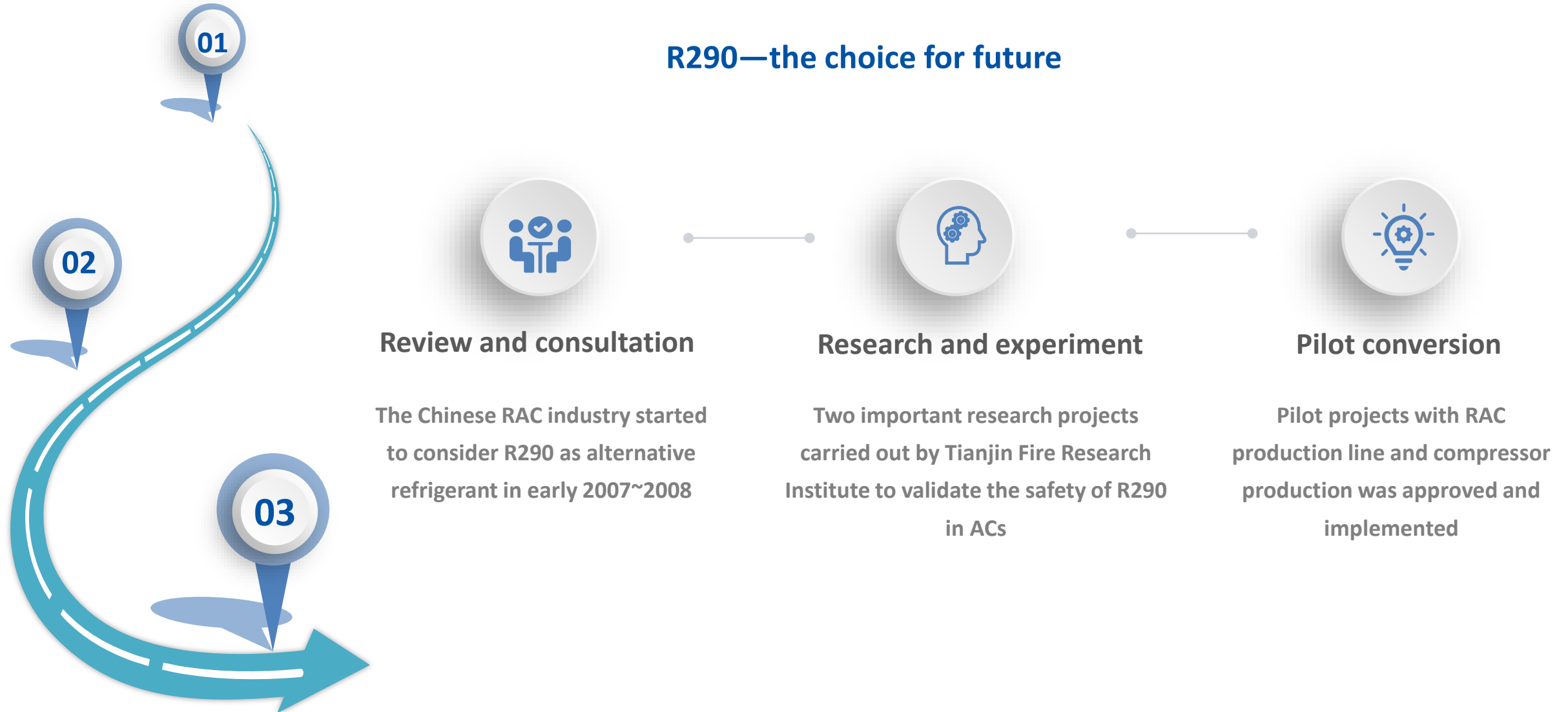
In stage II HCFCs Phase-Out Management Programs: Only low GWP alternatives are supported by the sector plans.





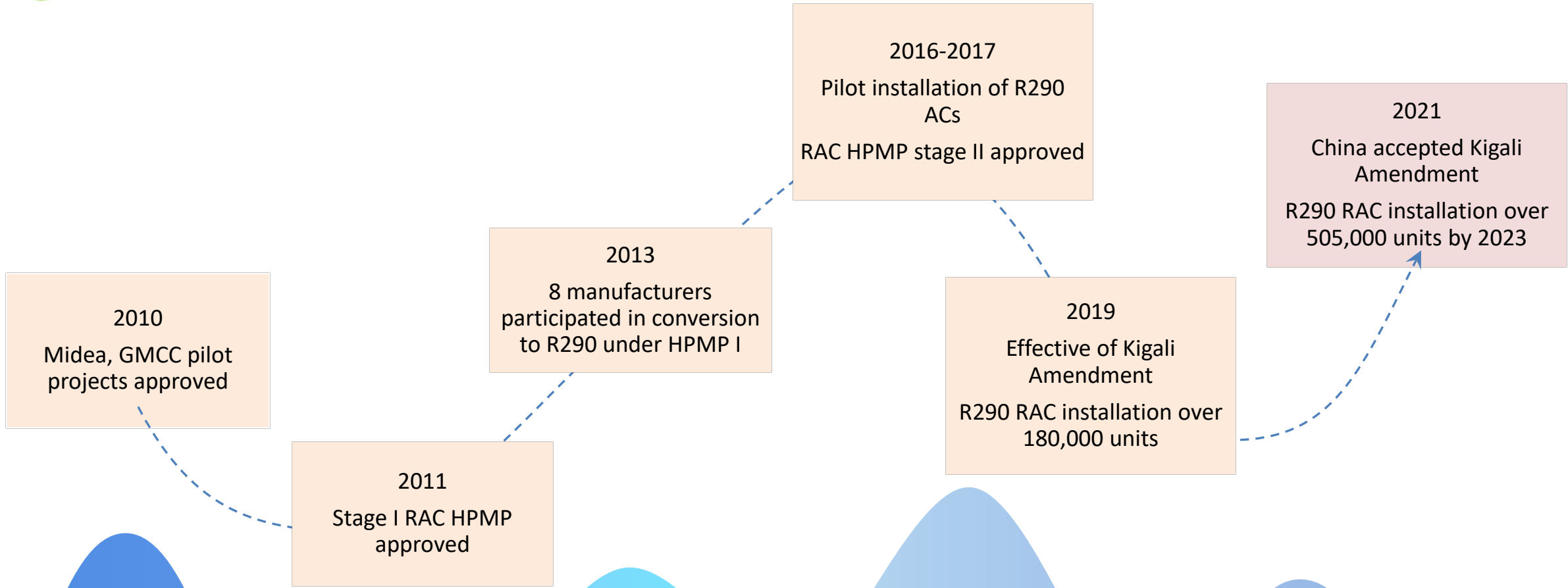
R290 in the Room Air Conditioner Sector

R290—the choice for future





R290 in the Room Air Conditioner Sector





R290 in the Room Air Conditioner Sector

◆ Conversion of production lines

A total of 34 Room Air Conditioner production lines were converted from HCFC-22 to R290 supported by the RAC HPMP

7 Compressor production lines converted to R290



XIAOMI 13 ULTRA

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R290 in the Room Air Conditioner Sector

- ◆ Technology development-to inspire and encourage research activities at enterprise level

HPMP Stage I

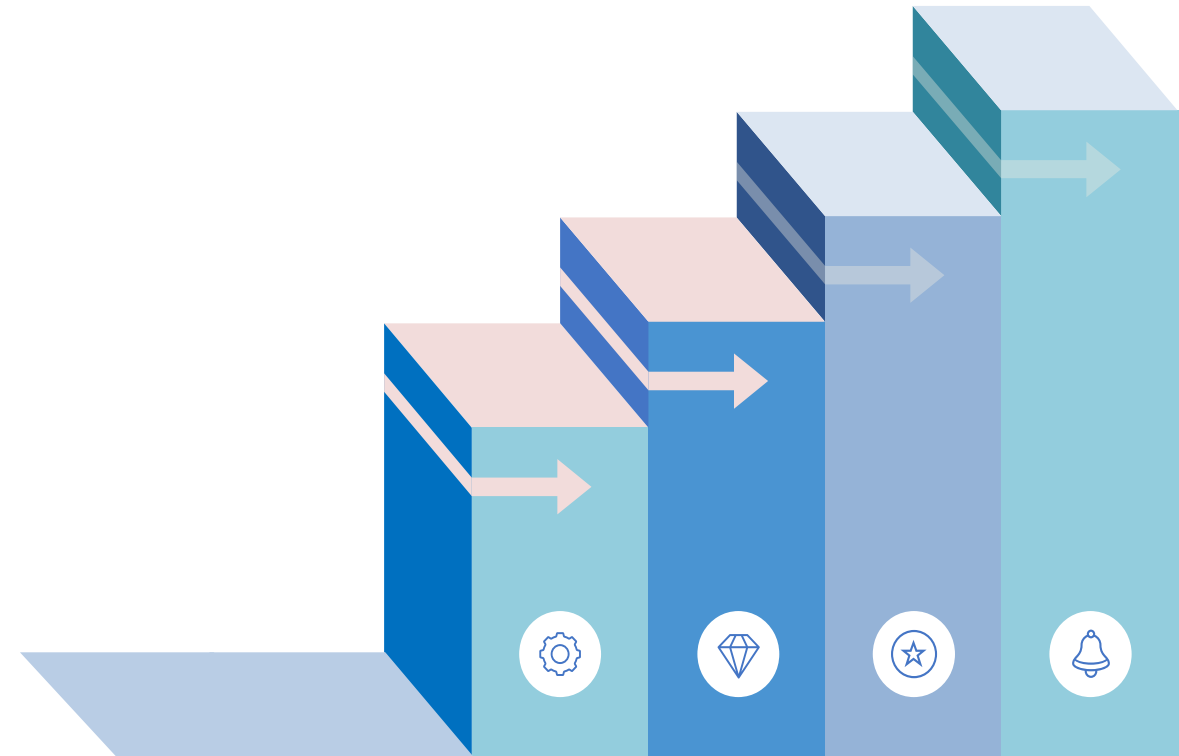
In stage I, technical research is carried out to address the safety and reliability of the alternatives, product performance and key components for the conversion.

HPMP Stage II

In stage II, in-depth research on R290 technology focusing on compressors, lubricating oil, R290 AC performance and reliability, and improvement of energy efficiency.

2024~2026

Research and development will focus on heat pump water heaters.





Natural refrigerants in the Room Air Conditioner Sector

◆ Establishment of standards to ensure effective implementation

Safety standard

In May 2013, *GB 4706.32-2012 Household and similar electrical appliances - Safety-Particular requirements for heat pumps, air-conditioners and dehumidifiers* was implemented, allowing room air conditioners to use flammable refrigerants.

The standard is updated to be equivalent to the IEC60335-2-40 7.0



Standard for manufacturing

In April 2017, *Safety Technical Specifications for the Production of Room Air Conditioners for Household and Similar Uses Using Flammable Refrigerants* was implemented.

Servicing standards

In January 2015, *Technical Requirements for the Installation, Servicing and Transportation of Room Air Conditioners Using Flammable Refrigerants* was implemented.

In April 2017, *Special Requirements for the Transportation of Room Air Conditioner Products Using Flammable Refrigerants* was implemented.

As the industry has more experiences, these standards are under review and revision.

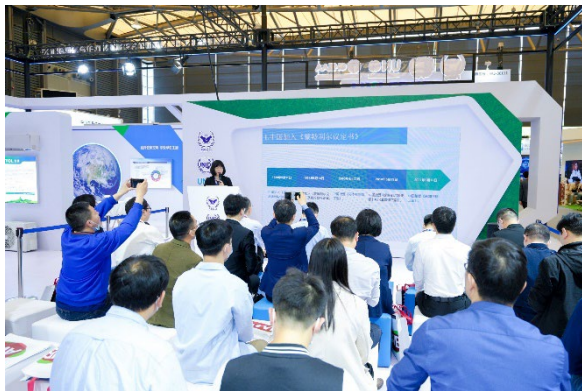


R290 in the Room Air Conditioner Sector

Awareness and publicity



Air conditioner low-carbon refrigeration technology exhibition and technology roadshow
28 April 2023, Shanghai AWE





R290 in the Room Air Conditioner Sector

◆ Promotion of R290 technology in ACs



Investment cost of R290 AC manufacturing lines were reduced

Over the past ten years, the supply chain of equipment for R290 AC production lines, such as explosion-proof transformation of assembly line, safety system, and refrigerant charging machine is becoming relatively complete, which has brought down the overall invest cost for R290 AC facilities. The R290 AC technology becomes more replicable in China and elsewhere.

To make R290 ACs more competitive to R32 ACs, the manufacturers in China have invested in reducing cost for key components for R290 ACs, such as compressors and heat exchangers. It has made easy for countries with assembly lines to establish R290 facilities and produce locally.

Key components for R290 ACs are getting cheaper





R290 in the Room Air Conditioner Sector

- ◆ China will continue to promote the application of R290 alternative technology in room air conditioners and heat pumps



Promote market acceptance of R290 ACs

Strengthen international cooperation on R290 technology application and product sales

Continue to support technology research and development

Strengthen policy making and raise of public awareness



Concluding Comments

- ✓ The Chinese room air conditioner sector has dedicated more than a decade of effort and substantial investments to adopt R290 refrigerant, and we strongly believe that it is the correct and worthwhile decision.
- ✓ By using R290 refrigerant, the direct emission from ACs are significantly reduced, focusing on energy efficiency, effective energy management and promoting responsible user behavior, we can reduce indirect emissions and enhance the overall sustainability of AC systems.
- ✓ China's progress in adopting R290 refrigerant has been driven by the support of the Multilateral Fund and international agencies, as well as bilateral government collaborations. In light of this, China is strongly committed to enhancing cooperation with other countries and international agencies to further advance R290 adoption. This effort aims to promote the widespread use of R290 and contribute to the achievement of global sustainability goals in the air conditioning sector.



**Thank you for your
attention.**



Market trends on natural and flammable refrigerants in the European AC and heat pump industry

Marc Chasserot - CEO ATMOSphere



Accelerating Clean Cooling & Heating

www.atmosphere.cool



Market Trends & Drivers for Natural Refrigerant based solutions

Marc Chasserot, CEO @ ATMOsphere

www.atmosphere.cool

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ATMOsphere is a global, independent market accelerator on a mission to clean up cooling and heating. Since 2006.



A global industry label recognizing the best in class for natural refrigerants



Curated natural refrigerant products and services with news



Defining the future of cooling via exclusive in-person networking & best-practice

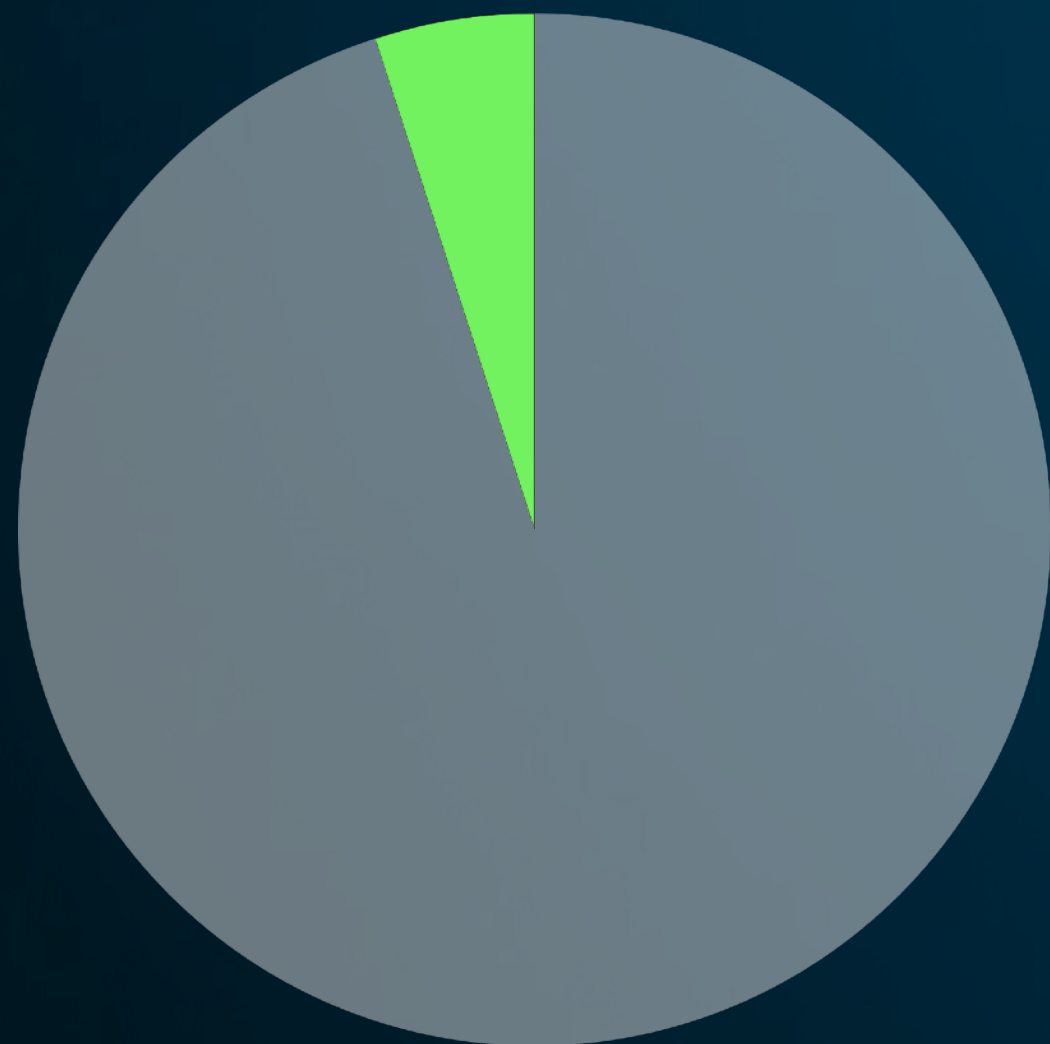


Understand the latest market trends, technologies and players

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Clean Cooling Opportunity

5%



CO₂

Hydrocarbons

Ammonia

Water

Air

Dirty Cooling Reality

95%



HFOs

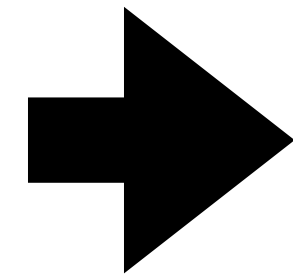
HFCs

HCFEs

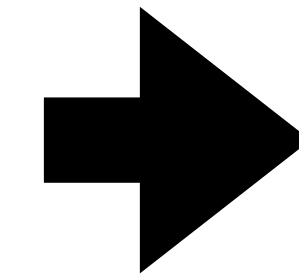
CFCs

Terrible Track Record ... and it's getting worse

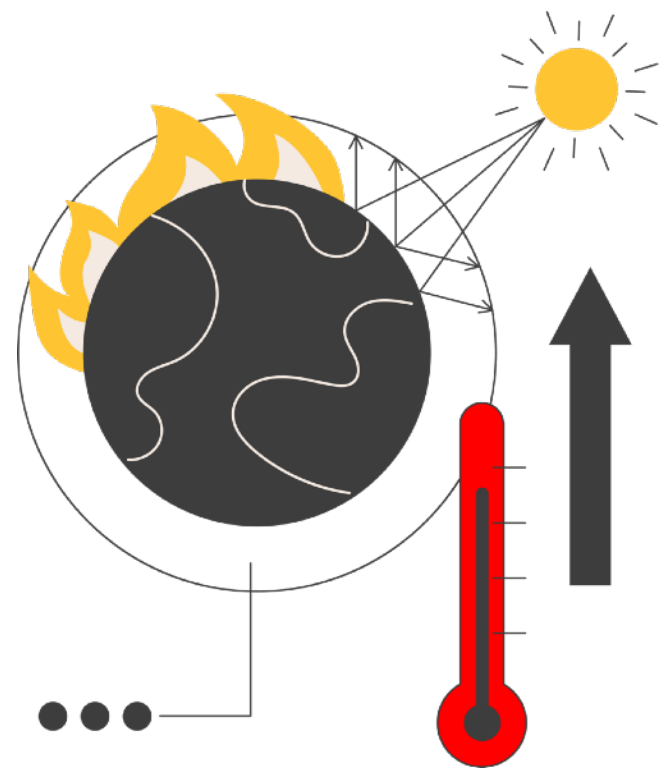
CFCs



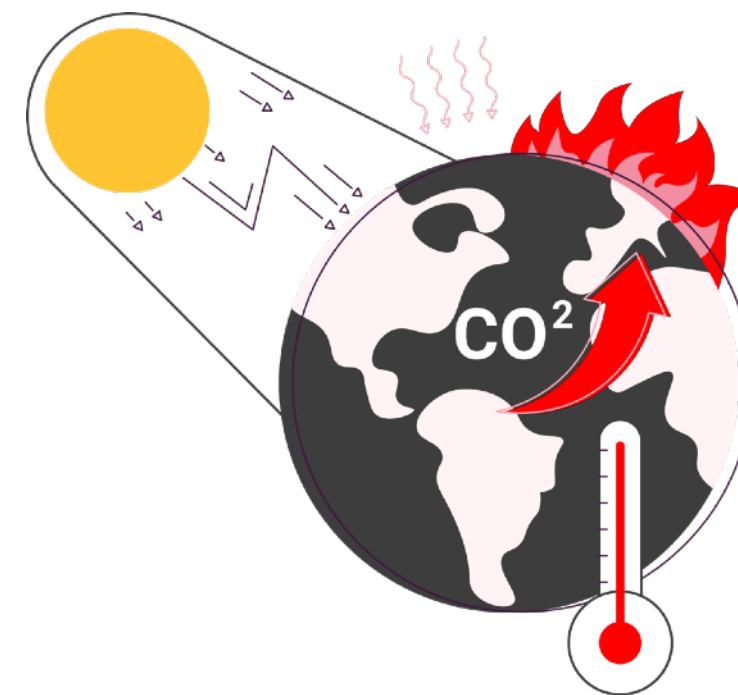
HCFCs / HFCs



HFOs



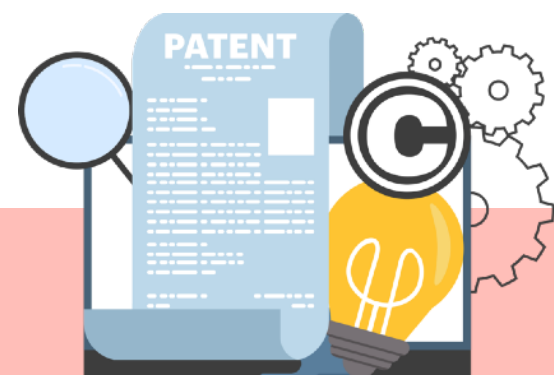
Ozone Hole



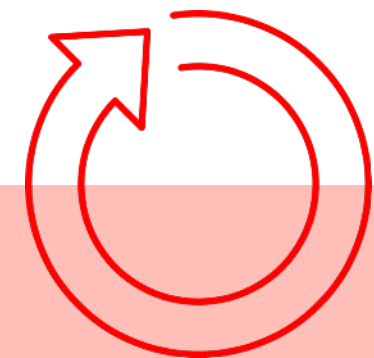
Accelerated global warming



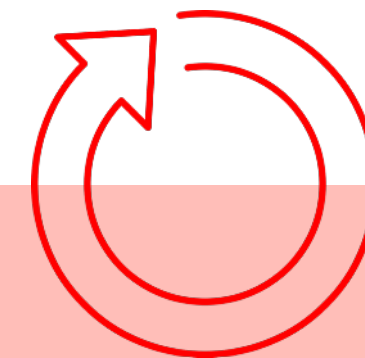
PFAs contamination



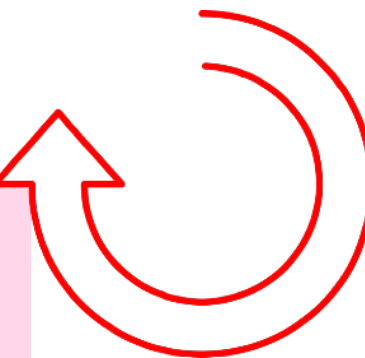
20 Years



20 Years

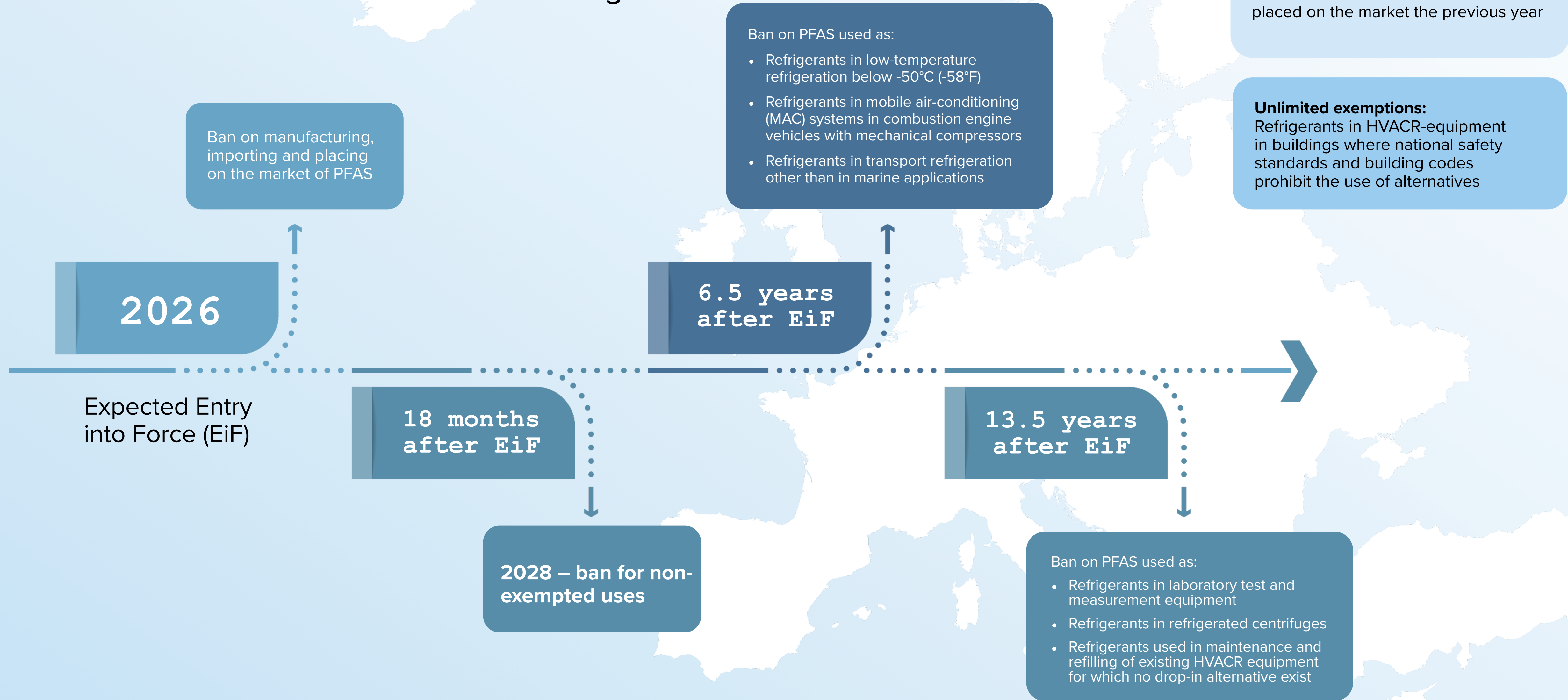


15 Years



EU PFAS Restriction Proposal

– Measures on PFAS in HVAC as refrigerants



HFOs linked to Reproductive Toxicity

HFO decomposition NOT only about impact on Environment BUT now directly linked to Personal Human Health.

June 2024 - German Federal Office of Chemicals has submitted a 'separate' proposal to ECHA linking 'reproductive toxicity' to TFA which is a major decomposition product of HFO 1234yf and other f-gases

One of the first efforts by a country to associate exposure to small quantities of TFA with harmful human health effects.

Changing TFA's current classification to Acute Toxicity (toxic if inhaled) AND changing Hazard Classes to PMT (persistent, mobile and toxic) and vPvM (very persistent, very mobile).

NATURAL Refrigerants
NEWS & MARKETPLACE

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Image by bdyzewski from Pixabay

German Chemicals Office Submits Proposal to EU Linking TFA to Reproductive Toxicity

TFA, an atmospheric by-product of HFO-1234yf and other f-gases, is considered by scientists to be a PFAS that persists in the environment.

Michael Garry July 1, 2024 Europe, Refrigerants

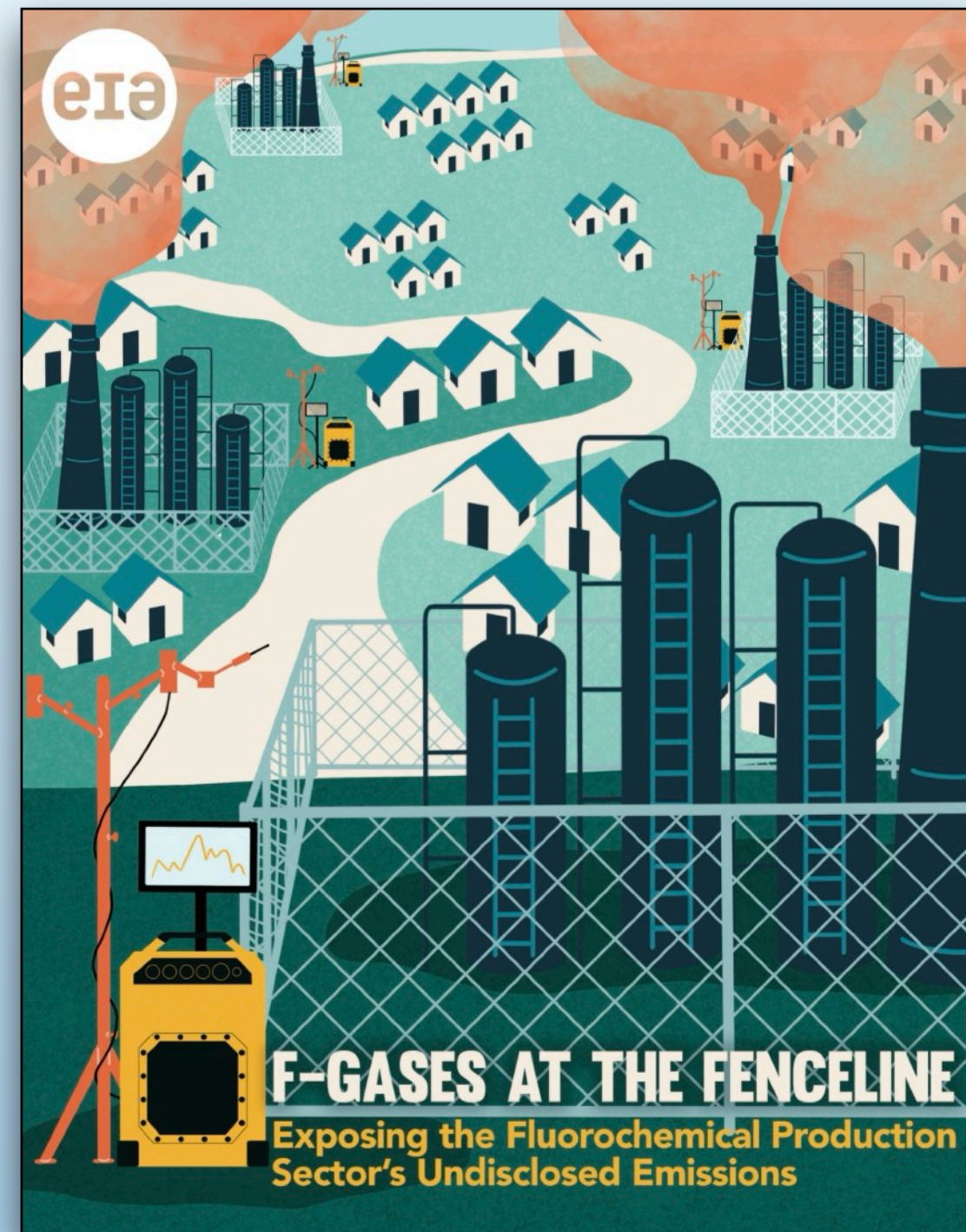
The German Federal Office for Chemicals (Bundesstelle für Chemikalien or BfC) has submitted to the European Chemical Agency (ECHA), in separate dossiers, its proposal linking reproductive toxicity to trifluoroacetic acid (TFA) and its inorganic salts; TFA is an atmospheric by-product of HFO-1234yf and other f-gases.

BfC is a division of Germany's Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin or BAuA). ECHA is responsible for the safe use of chemicals in the EU.

This is one of the first efforts by a country to associate exposure to small quantities of TFA (concentrations of at least 0.1% to 0.3%) with harmful human health effects. One of the main sources of TFA in the environment is the oxidation of HFO-1234yf and other f-gases in the atmosphere, with TFA absorbed in rainfall. TFA is also formed from the breakdown of pesticides and other anthropogenic sources.

While it is an ultrashort-chain, two-carbon substance, TFA falls under the **scientifically accepted** "one fully fluorinated carbon" definition of PFAS (per- and polyfluorinated substances) established by the OECD (Organisation for Economic Co-operation and Development). As such, it acts as a "forever chemical" that persists for a very long time in the environment. Longer chain PFAS with a similar chemical architecture (known as perfluoroalkyl carboxylic acids), such as eight-carbon PFOA, have been tied to harmful health impacts, including reproductive toxicity, ulcerative colitis and cancer.

HFOs are not « low GWP »



Dirty Production



“Low GWP”

Study Links HFOs to Formation of Super Greenhouse Gas HFC-23

Atmospheric HFO degradation products TFA and TFE, the study says, have pathways to generating HFC-23, which has a GWP of 14,600.

Michael Garry April 19, 2024

North America, Policy, Uncategorized



A new study points to a link between the long-term fate of HFO degradation products in the atmosphere and the formation of HFC-23, a potent global warming gas with a 100-year GWP of 14,600 (IPCC, AR6).

The study – “On the Chemical Pathways Influencing the Effective Global Warming Potential of Commercial Hydrofluoroolefin Gases” – was published April 4 in the journal *ChemSusChem*. Its author is Gabriel Salierno, a Green Chemist at the [Toxics Use Reduction Institute](#) at the University of Massachusetts/Lowell.

Dirty Decomposition

A magician in a tuxedo and white gloves is performing a magic trick. He holds a glowing blue wand in his right hand and gestures with his left hand towards a glowing blue hat. The scene is lit with blue light, creating a magical atmosphere.

Just like a magic trick

A close-up, front-facing view of an astronaut in a white space suit, floating in space. The astronaut's helmet is visible, and the Earth is seen in the background, partially obscured by the suit. The scene is dimly lit, with the primary light source being the Earth, which appears as a large, bright, blue and white sphere. The astronaut's suit is detailed with various equipment, including a circular hatch on the chest and a rectangular device on the left side. The background is a dark, starry space.

Houston, we have a problem...

A small globe is centered in the image. The top half of the globe shows a dense city with various skyscrapers and buildings. The bottom half of the globe shows a lush green forest with a winding river. The globe is set against a teal background with a larger, fainter globe behind it.

But we also got solutions

Plenty of alternatives

	CO ₂ /R744	NH ₃ / R717	HC	H ₂ O/R718	Air/R729
Domestic applications					
Commercial refrigeration					
Industrial refrigeration and heat pump systems					
Water and space heat pumps					
Chillers					
Vehicle air conditioning					



90% New Stores in Europe today are with CO2 or Propane

Figure 7: Transcritical CO₂ Installations in Europe

(as of December 2023)

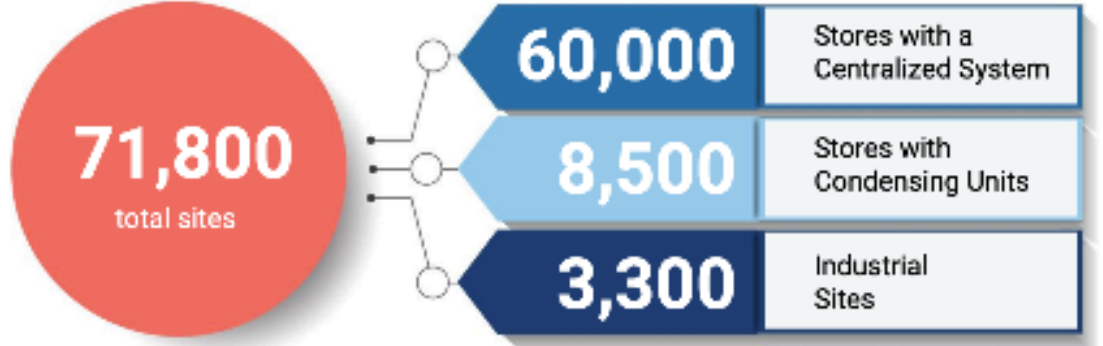
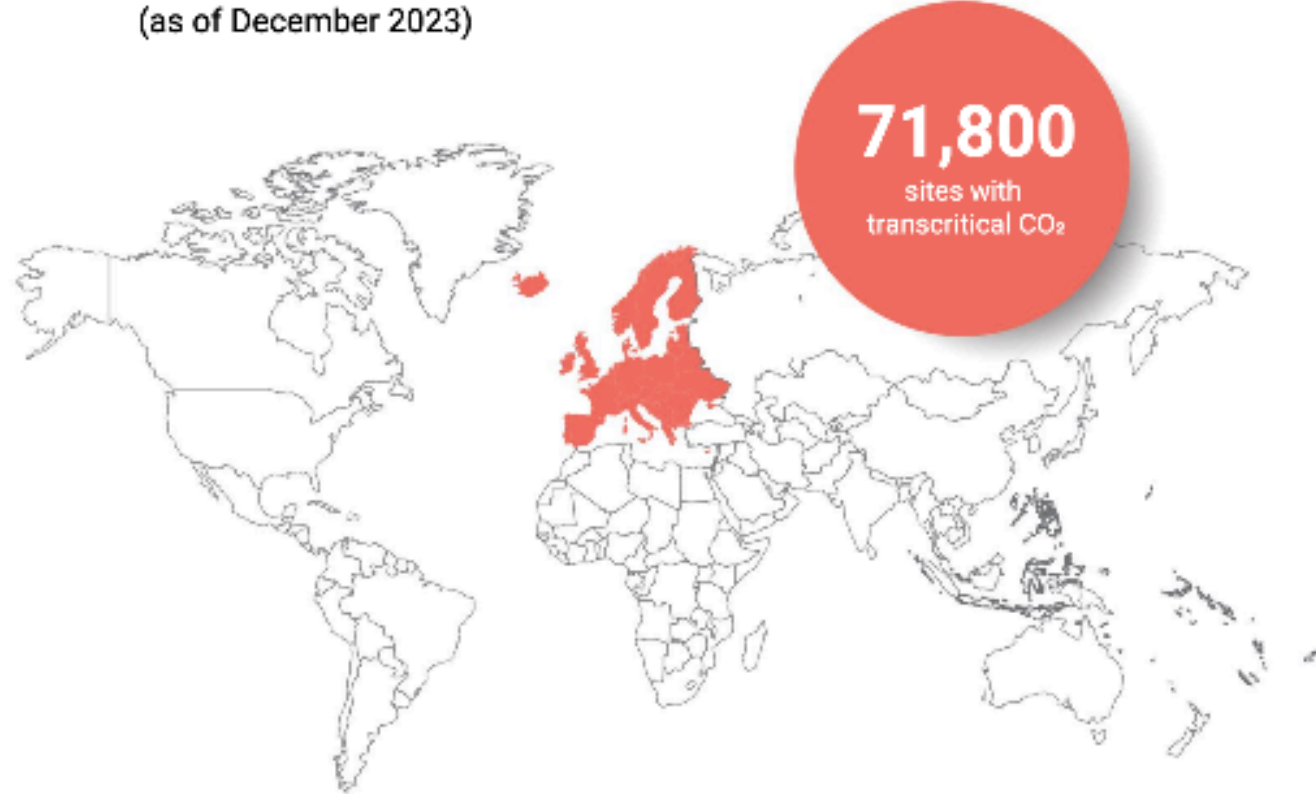
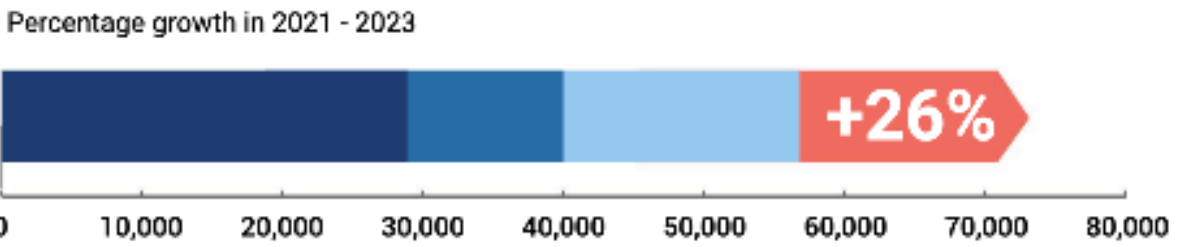
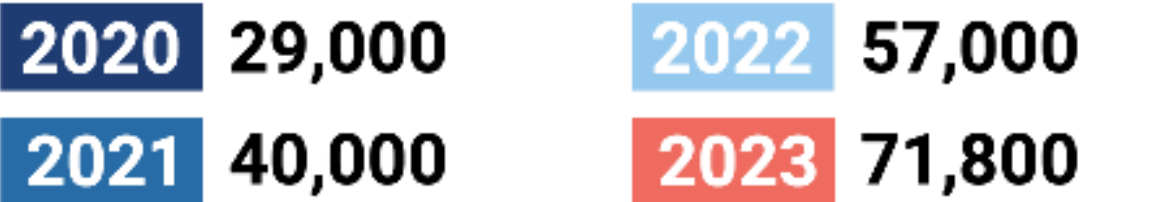


Figure 8: Transcritical CO₂ Commercial Refrigeration Market Penetration in Europe



Figure 9: Transcritical CO₂ Installation Growth in Europe

(stores and industrial facilities)



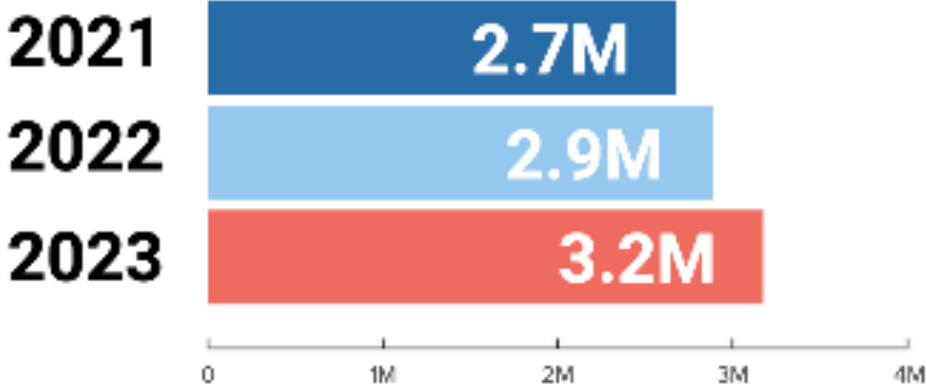
90% New Stores in Europe today are with CO2 or Propane

Figure 11: Self-Contained Hydrocarbon Cabinets Installed in Europe

(as of December 2023)



Figure 12: Self-Contained Hydrocarbon Cabinets, Historical Installation Growth in Europe



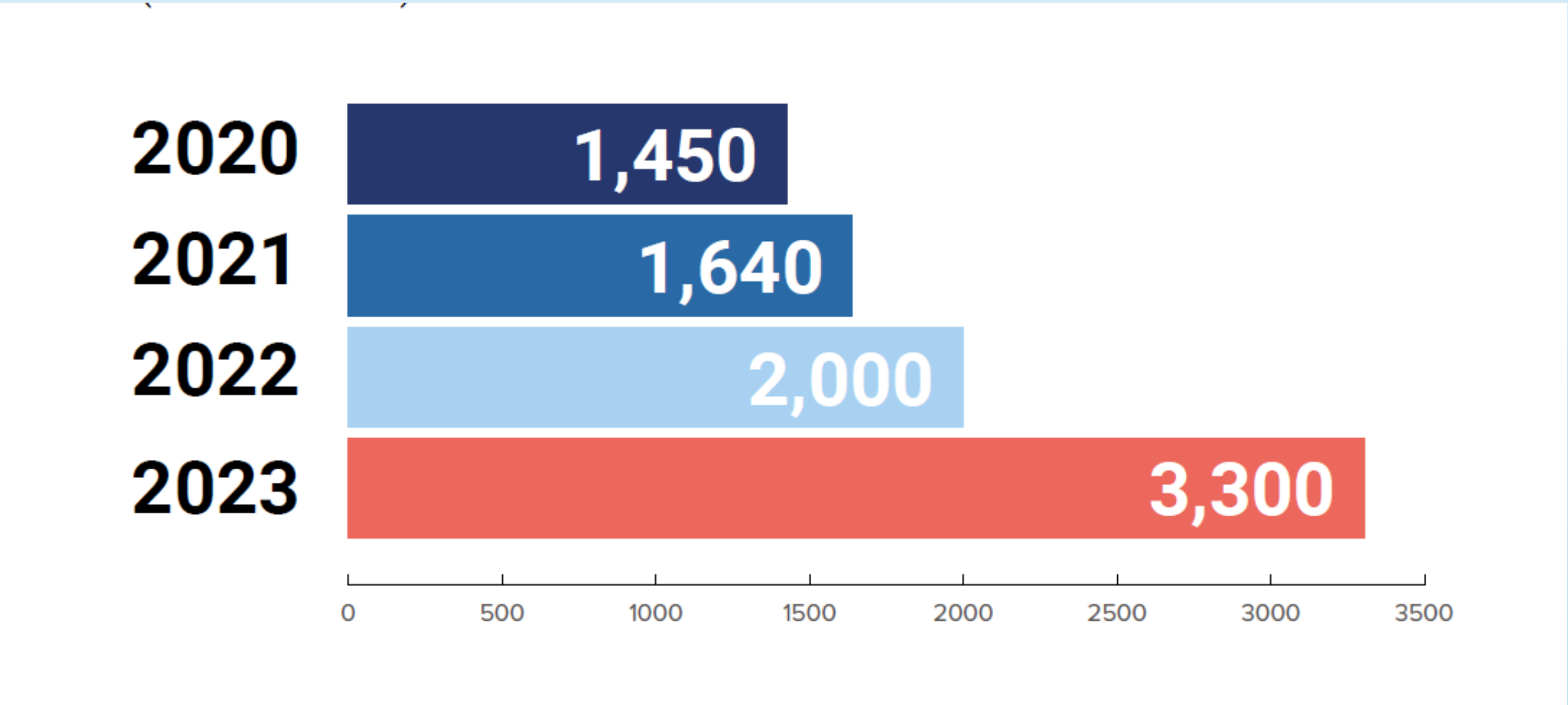
The screenshot shows a news article on the "NATURAL Refrigerants NEWS & MARKETPLACE" website. The article title is "An E.Leclerc in France Is Helping Novum Make the Claim That Its R290 Cabinets Are 'the Only Viable Alternative to CO₂ Systems'". The author is Michael Hines, dated May 17, 2024. The article text includes: "The Ville-la-Grand Leclerc serves as the Irish OEM's real-world showroom for its LEAP lineup of propane chest freezers and cabinets." and "To shoppers at the bustling E.Leclerc hypermarket in the small French town of Ville-la-Grand, located on the Swiss border near Geneva, April 11 was just another spring day. However, for the leadership team at Irish commercial refrigerator manufacturer Novum, which was walking through the frozen and refrigerated food sections, the day was anything but ordinary." Below the article is a "Newsletter" sign-up box with the text "Sign up to our newsletter" and "Get the latest products, news and analysis about natural refrigerants, cooling and heating solutions."

The cover of the "ATMO Report 2023 Edition" is displayed. The title is "Natural Refrigerants: State of the Industry". The subtitle is "Refrigeration in Europe, North America and Japan, Plus Heat Pumps in Europe". The cover features a globe with location pins, a circular chart, and a bar chart.

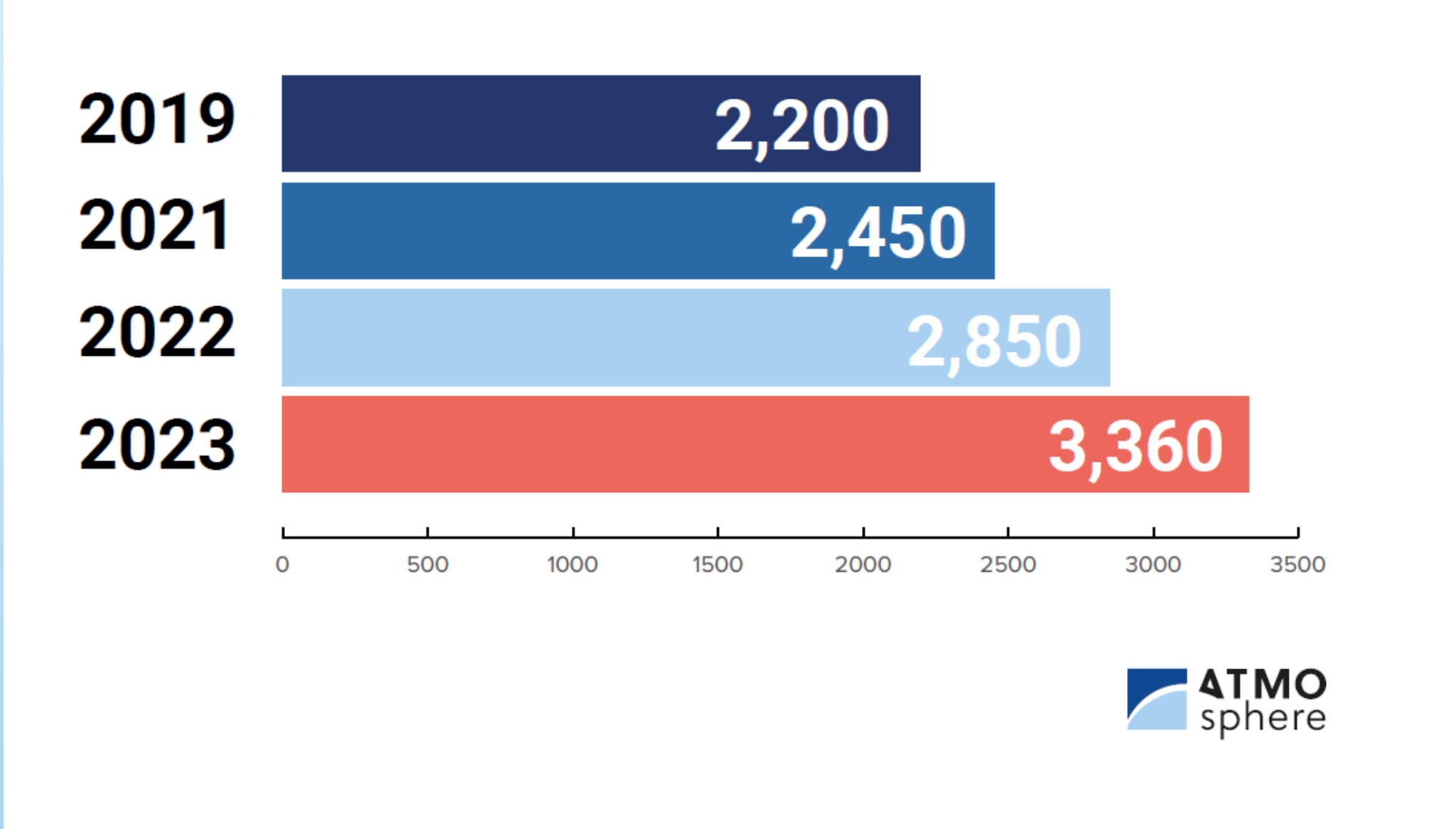


CO₂ and ammonia in industrial sites

Growth of transcritical CO₂ installations in Europe



Growth of low ammonia-charge installations in Europe



EU F-gas 2024/573

-> new placing on the market provisions (bans) - Split ACs and Heat Pumps

Application	GWP	Date
Split air-to-water systems of a rated capacity up to and including 12 kW	f-gases above 150 GWP	1 January 2027
Split air-to-air systems of a rated capacity up to and including 12 kW	f-gases above 150 GWP	1 January 2029
Split systems of a rated capacity up to and including 12 kW	f-gases	1 January 2035
Split systems of a rated capacity of more than 12 kW	f-gases above 750 GWP	1 January 2029
Split systems of a rated capacity of more than 12 kW	f-gases above 150 GWP	1 January 2033

Safety standards provisions and exclusions for particular applications are included in the Regulation.

For a more complete overview check Annex IV of the legal text: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202400573

EU F-gas 2024/573

-> Placing on the market prohibitions referred to in Article 11(1) - chillers

Application		Date
Chillers that contain, or whose functioning relies upon	HFCs with GWP of 2 500 or more except equipment intended for application designed to cool products to temperatures below – 50 °C	1 January 2020
	fluorinated greenhouse gases with a GWP of 150 GWP or more for chillers up to and including a rated capacity of 12 kW, except if required to meet safety requirements at the site of operation;	1 January 2027
	fluorinated greenhouse gases for chillers up to and including a rated capacity of 12 kW, except if required to meet safety requirements at the site of operation;	1 January 2032
	fluorinated greenhouse gases with a GWP of 750 for chillers above 12 kW, except if required to meet safety requirements at the site of operation	1 January 2027

Safety standards provisions and exclusions for particular applications are included in the Regulation.

For a more complete overview check Annex IV of the legal text: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202400573

Residential Heatpumps @ ISH 2023



ACOND - CZECHIA
acond.cz



ARGO - ITALY
argoclima.com



AIT/NOVELAN - GERMANY
novelan.com/de
alpha-innotec.com/de



DE DIETRICH - FRANCE
dedietrich-heating.com



DOMUSA - SPAIN
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HELIO THERM - AUSTRIA
www.heliotherm.com



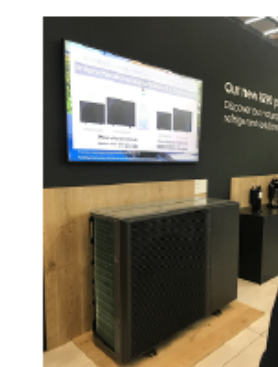
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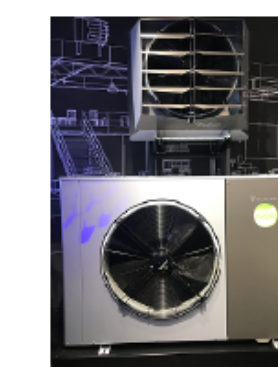
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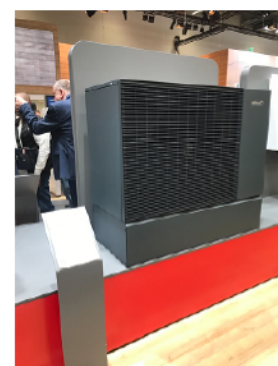
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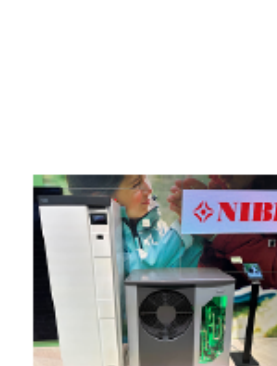
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NIBE - SWEDEN
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nobel.bg



THERMOPLUS - GERMANY
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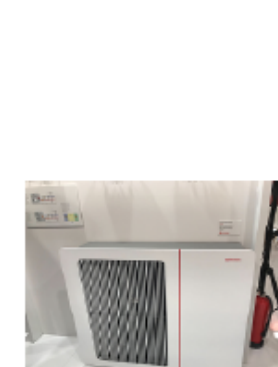
CTC - SWEDEN
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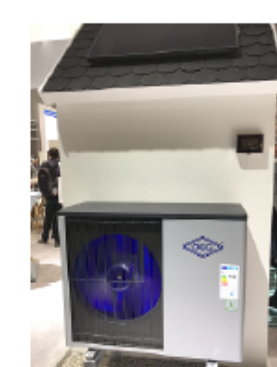
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galmet.com.pl



GIACOMINI - ITALY
it.giacomini.com



GLEN DIMPLEX
dimplex.de



OEG - GERMANY
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PANASONIC
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QUANTUM - SWEDEN
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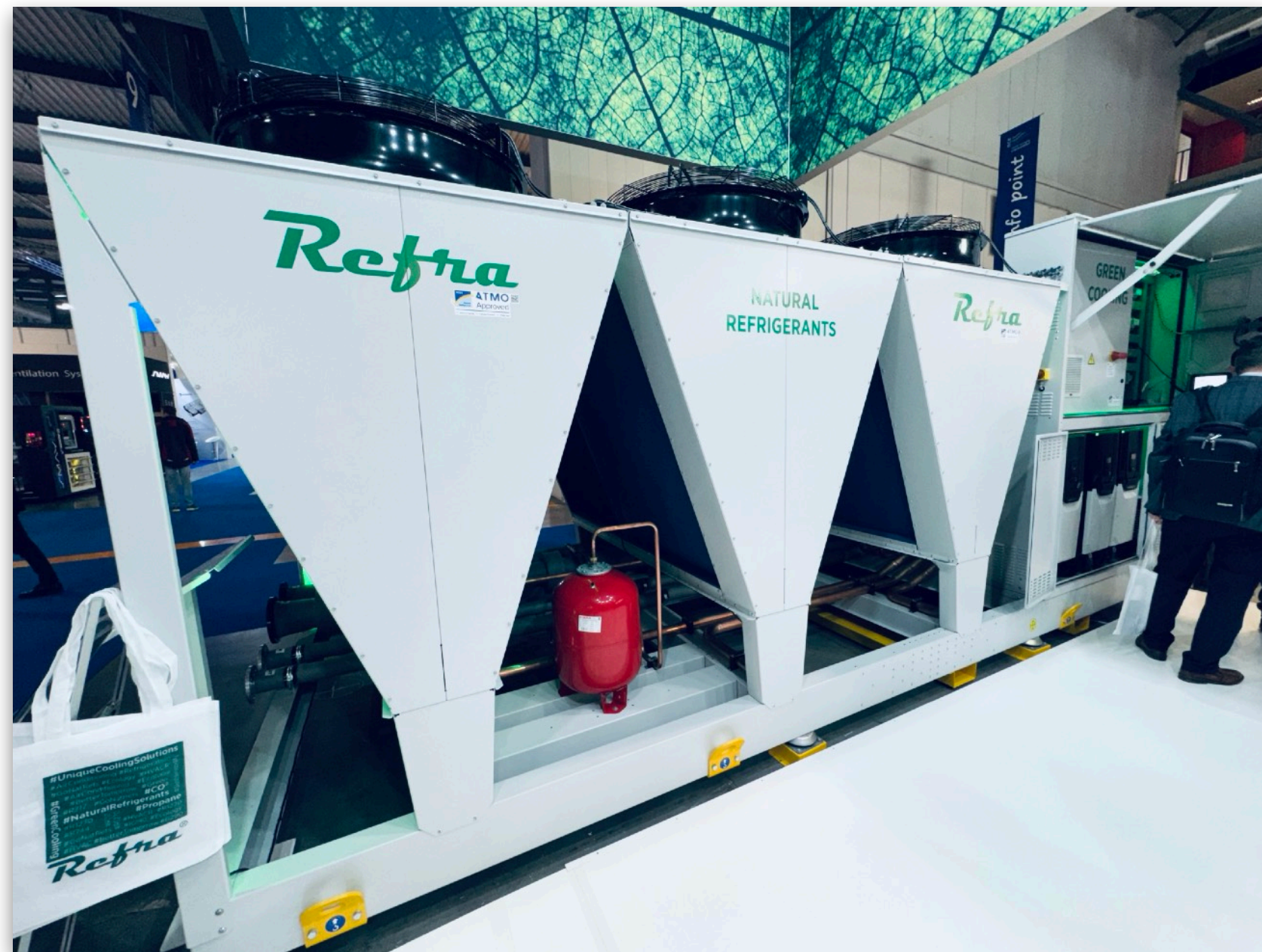
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Commercial Propane Heatpumps

@ MCE 2024



Marc Chasserot · You
Founder & CEO @ ATMosphere #CleanCooling #CleanHeating with #NaturalRefrigerants. Helping HVAC&R companies worldwide to clean u...
1w · Edited · 🌐

Will #mce2024 go down in the history books as the 'Propane takeover of commercial heatpumps' ?

I spent two days in #milan with [Sabrina Munao](#) and talked with a lot of people. I started in the morning of day 1 taking pictures of every single new #R290 Heatpump i could see. I basically got overwhelmed very quickly and stopped. It was nuts. Literally EVERYBODY had at least one R290 heatpump on display at their booth.

Insight 1) this mega switch happened because of the #EUFGas bans coming. Two years ago it was only talk and all the traditional players were saying 'we're not ready' 'we need more time' 'jobs will be destroyed if we move too fast' etc

Insight 2) is this for 'real or for show' ? Real means that the incumbents will proactively sell these solutions to their customers over high gwp R32 and pfas blend R454B alternatives. My suspicion is NO. They just want to have it in their portfolio to not be caught out by the competition. And will still push the #synthetics until the last day before they are banned. Unless an #enduser insists on R290 of course.

Insight 3) the propane innovators / the ones that did not wait for #MCE24 to #gonatrefs are happy. Because they know that they are ahead and will push for more and more innovations to optimize R290 whilst the others have divided loyalties.

Insight 4) so where does this leave #R744 heatpumps. I counted 2 players. There are more. We talk to them. But it's a pretty safe bet to assume that #heatpumps will be 80% Propane / 20% R744 going forward just like we have 80% CO2 in #refrigeration / 20% Propane today.

End users will have choice at different price points to meet their needs. #naturalefrigerants will take over heatpumps just like they did in refrigeration in Europe. 🍌🍌

See you at #Chillventa2024 :-)

ATMosphere #cleancooling Michael Hines Jan Dusek

Jan Dusek and 104 others
6 comments · 4 reposts

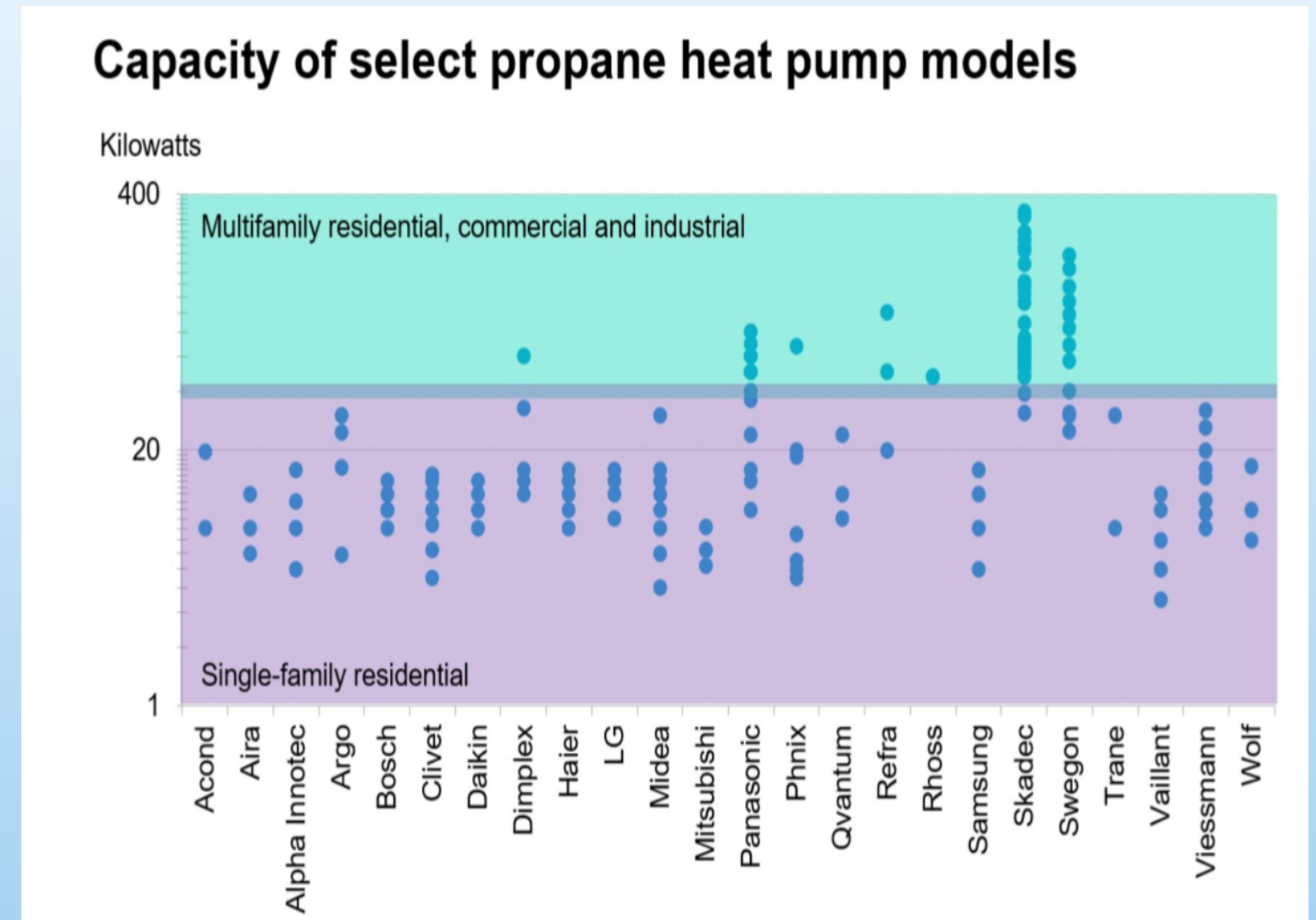
Propane heat pumps for residential and commercial

European market has high sales of propane heat pumps.

US adoption is hindered by safety regulation codes.

Some key figures:

- ✓ 80+ propane Heat pumps models announced since beginning of 2023
- ✓ 225,000 propane heat pumps sold in Europe in 2022



Source: Bloomberg NEF, Note: Y-axis is in logarithmic scale

Hydrocarbon chillers

Based on production numbers from leading OEMs, ATMOSphere estimates there were 5,000 industrial sites with hydrocarbon-based (propane, iso-butane, propylene) chillers in Europe as of December 2023.

Leading chillers manufacturer in Europe include:

- ✓ Secon (Germany)
- ✓ Intarcon (Spain)
- ✓ Euroklimat (Italy)
- ✓ MTA (Italy)
- ✓ Refra (Lithuania)
- ✓ many others



Next segment to switch ? Split AC



Haier single split system
(Chillventa 2022)



Clivet single split system



Midea single split system

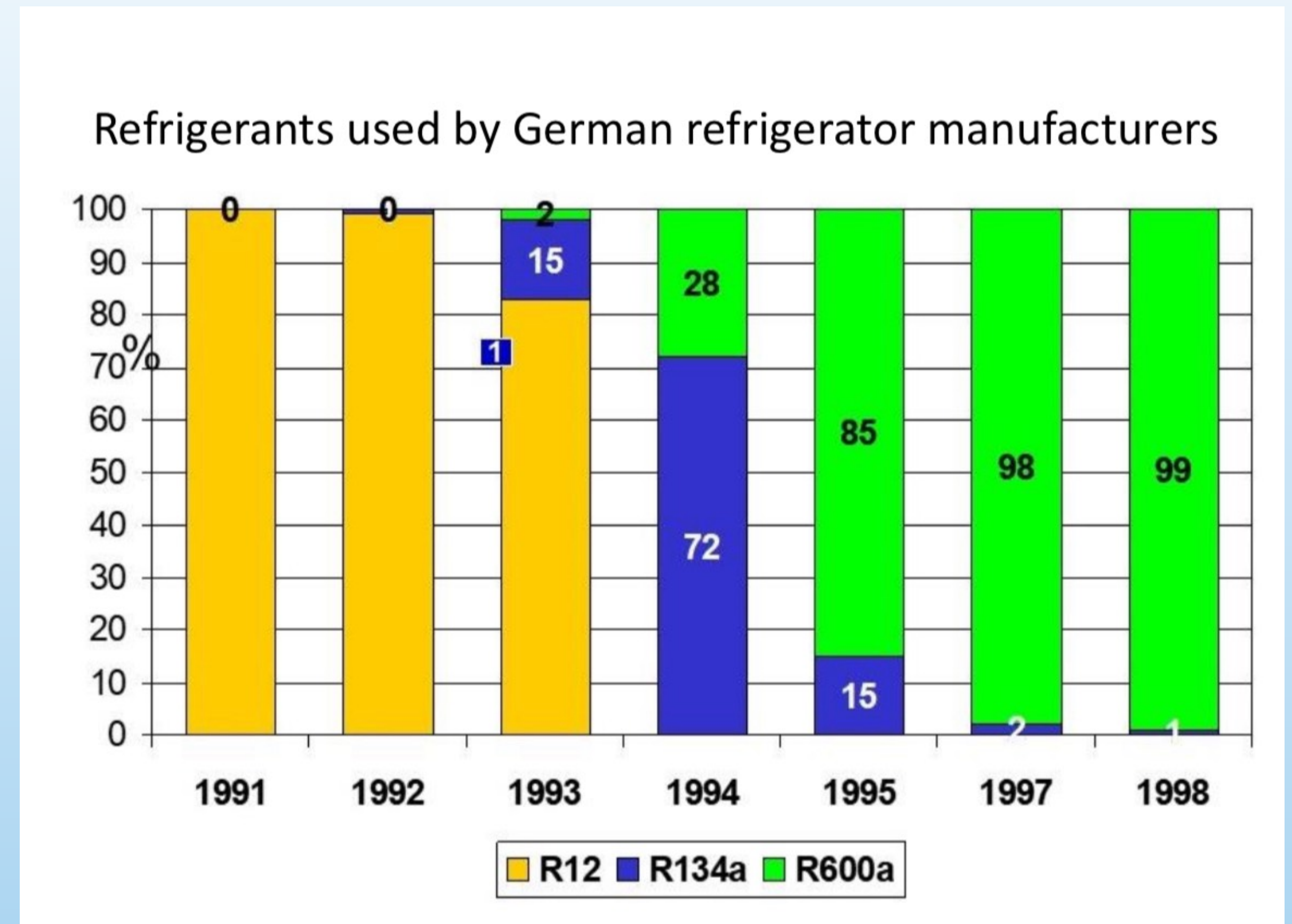


Godrej single split system

More Asian manufacturers coming to market with split AC R290 units before FGas Ban

Transitions will be fast

After domestic and commercial refrigeration, expectation is other segments to switch within 5 years, starting with Heatpumps and Chillers and finishing with split AC.



Prof Michael Kauffeld



Thank you for listening.

Find out more on

www.atmosphere.cool



Questions & Answers

All Speakers



Conclusion and Closing Remarks

Bernhard Siegele, Programme Manager, GIZ Proklima



THANK YOU


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