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ONLINE

23-24/06/2020

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Natural Refrigerants in HVAC: Pathway to a Sustainable Future

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Growing market,
Growing problem

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The HVAC&R market today…

- "Current cooling technologies and practices are a substantial and growing contributor to climate change" – because of direct AND indirect emissions
- **Estimated 4.8bn** new units of cooling equipment will be sold globally between 2019 and 2030
- Annual sales will hit **460m units** by 2030 (336m in 2018)
- 62% of cooling demand from residential sector

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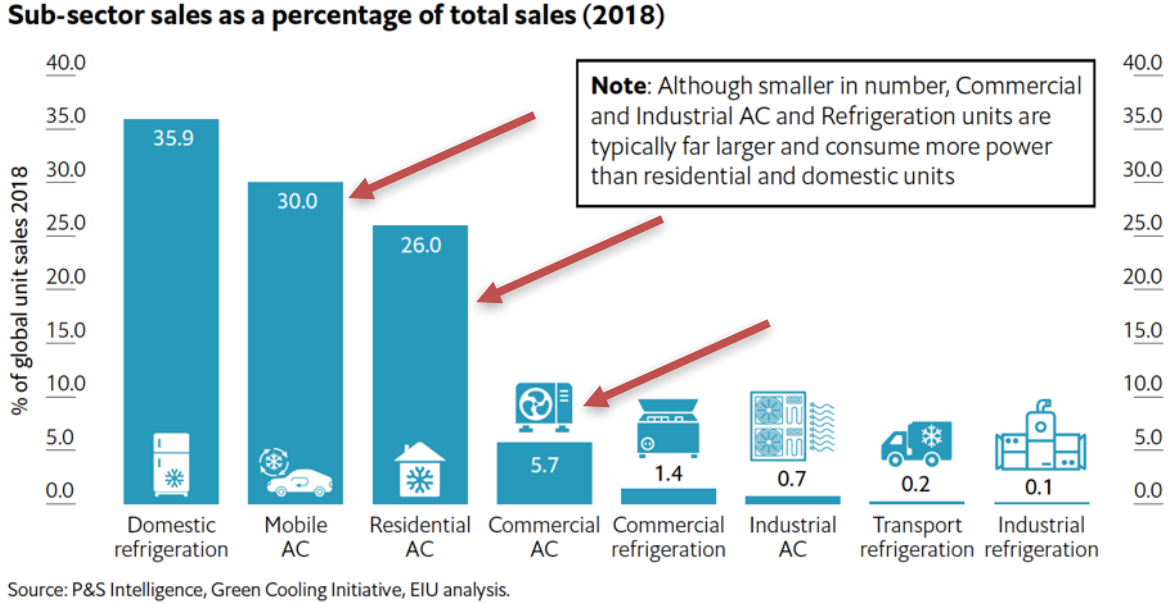
HVAC's share over Refrigeration



AC accounts for more than 62% of cooling market

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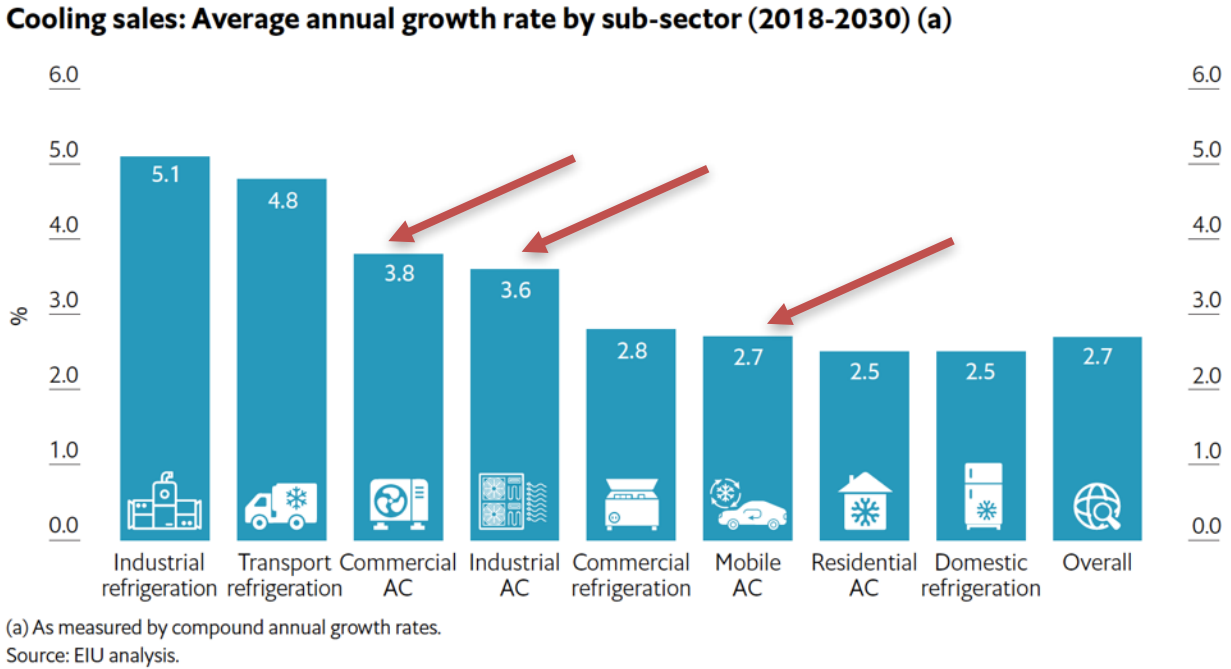
Future growth of HVAC



(a) As measured by compound annual growth rates.
Source: EIU analysis.

Rapid growth expected for commercial and industrial HVAC

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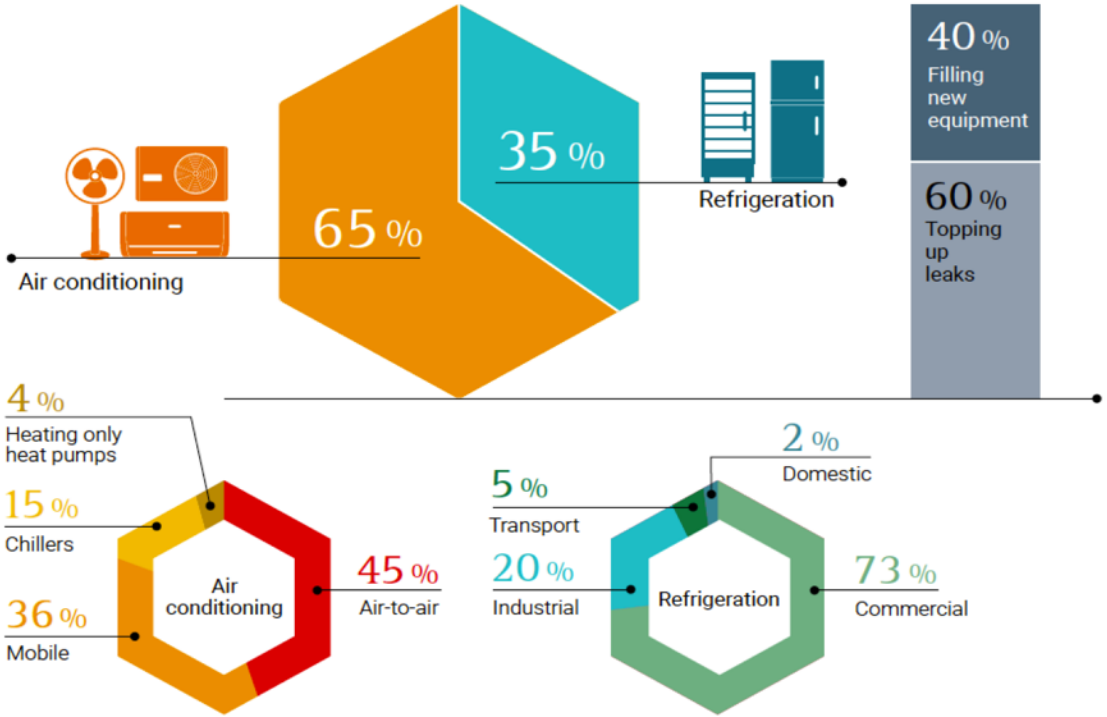
HVAC's HFC share



UNEP2020: AC accounts for 65% of the HFC market

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What can we do?

"If the world is to scale up access to cooling without exacerbating current levels of emissions, policymakers, companies and individuals must ***transition*** *to more* ***efficient climate-friendly*** *models."*

1. Reduce the need for cooling

2. Shift to climate-friendly tech with lower emissions

3. Improve efficiency of cooling

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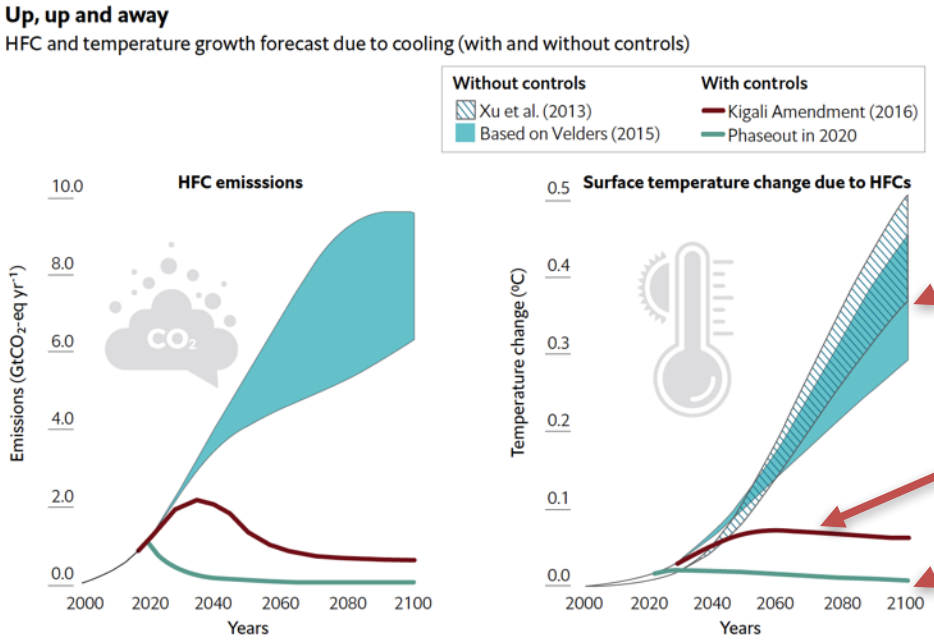
Why do refrigerants matter?



Business as usual

With Kigali Amendment

With phase downs

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Refrigerants: What's the alternative?

Low-GWP HFCs such as R32?
- GWP over 20 years: 2,330

HFOs such as R1234yf?
- TFAs could cause acid rain

Natural refrigerants?
- Only long-term, future-proof solution

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Residential/ domestic solutions

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HCs for room air conditioning (R290)

China:

- 18x RAC production lines converted to R290;
- Production capacity: 4.5 million units/year
- CHEAA expects 300,000 units sold by Aug 2020

India:

- Godrej sold 650,000+ R290 split type RAC systems (Sep 2019)

Suitable replacement for unsustainable split units

Other:

- **Egypt**: 8x production lines converted
- Pakistan converted an R22 production line

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Residential HVAC: portable

- Europe has been moving towards **R290 in portable AC**
- EU F-Gas Regulation bans the use of HFCs with GWP > 150 in portable AC as of 2020
- At least 8 manufacturers
- Estimated number of HC-based portable AC units in Europe: **200,000+**
- **All new products expected to use R290 within 2 years**

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Residential: Hydrocarbons blend

- **Australia:** Terry Hills
- **Old system:** R22 splits
- **New system**: HC ducted packaged units
- **Refrigerant blend**: 35% propane, >60% propylene, <5% isobutane, <1% butane
- **Energy savings**: estimated 65% savings
- **Refrigerant charge:** 50% less refrigerant than before

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Residential: NO refrigerants?

- **Saudi Arabia:** Mina Valley tent city
- **New system**: 50,000x evaporative coolers
- **Energy savings**: 35%
- **Maintenance costs:** 80% less than ducted reverse cycle AC
- **GHG emissions:** 80% less

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Commercial and industrial solutions

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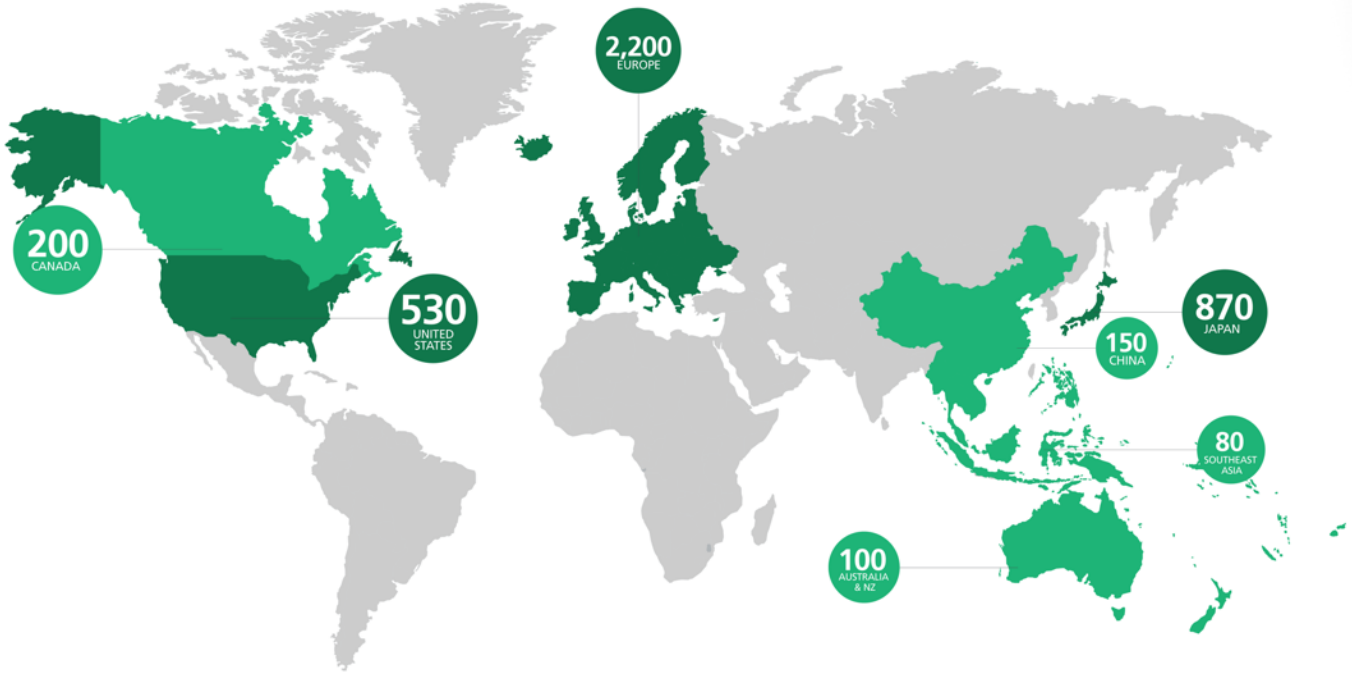
Low-charge ammonia – a growing trend



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Commercial: LC ammonia chiller

- **Australia:** Logan City Council Admin Centre
- **Old system**: 2x R22 chillers
- **New system**: 2x low-charge ammonia chillers
- **COP improvement**: from 2.52 to 3.83
- **Annual CO_2e reduction**: 680 tons
- **Annual cost saving**: $140,000

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TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

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Commercial HVAC: R290 splits

- **Ghana:** Various commercial buildings
- **Old systems**: R22 splits
- **New systems**: R290 ductless single-split AC
- **Energy savings**: 700kWh/year/unit
- **GHG emissions**: 42% lower

COOLING CAPACITY	5.3 kW (18,000 BTU/h) Fixed speed		
Compared models	R-410A Baseline AC[1]	R-22 Baseline AC[2]	MIDEA All Easy
Refrigerant Type	R-410A	R-22	R-290
GWP	1,923	1,810	3
Initial refrigerant charge (kg)	1.0	1.0	0.38
EER (W/W)	3.0	2.8	3.5
Electricity consumption kWh/year	3,392	3,634	2,907
Total GHG emissions (tCO_2eq)[3]	28.3	29.2	17

Table 1: Comparison between split units with different refrigerants.

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Commercial: R718 (water) chiller

- **Germany:** Combitherm Facilities commercial offices
- **New system**: R718 chiller with solar power
- **Energy savings**: 40% over HFC solution
- **Solar**: AC system only uses 30% of solar generated
- **CO_2e emissions**: 0
- Maintenance costs offset by energy supplied into grid

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Data center: R744

- **Canada:** Telus data center
- **Old system**: R22 DX units
- **New system**: R744 AC units
- **Energy savings**: 60% reduction
- **Payback period**: 2 years

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Industrial HVAC: R290 chiller

- **Indonesia:** PT Phapros Pharma factory
- **Old system**: R22 chillers
- **New systems**: R290 chillers
- **COP improvement**: 1.45 to 4.3
- **Electricity consumption**: 54% reduction
- **CO_2e emissions**: mitigates 560 tons/year

Type of System	R-290 Chillers	Old Chillers (R-22)
Cooling Capacity, Manufacture Specifications [kW]	231.9	643
Measured Cooling Capacity [kW]	239.5	175
Refrigerant Type (GWP value)	R290 (GWP=3)	R22 (GWP=1810)
Refrigerant charge [kg]	23	141.4
Measured COP [W/W]	4.30	1.45
Operation time period	Since 2018	1992 – 2017

Table 1: Comparison between the R-290 chillers and the old R-22 chiller.

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Developments to watch

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Mega trends in HVAC&R

1. Moving towards natural refrigerants
- Getting rid of harmful synthetics

2. Servitization
- Pay-per-use model

3. Digitalization
- Smarter systems

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CaaS

Cooling as a Service

- Scaling up clean and efficient cooling technologies
- Pay-per-service model: only pay for cooling used
- Solves issue of costly upfront payment/ CAPEX
- Solves issue of quality of technicians/ maintenance
- **E-Summit:** 1 December

www.caas-initiative.org

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Residential HVAC: RMI Cooling Prize

- Seeking super-efficient, climate-friendly, affordable residential AC
- Majority of 8 finalists chosen use natrefs

1. Godrej-Boyce: **R290**
2. S&S Design Startup Solution: **R290**
3. Transeara: transitioning to **R290** for prototype
4. Kraton Corporation: **water**
5. M2 Thermal Solutions: **water**

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life front

Removing barriers for hydrocarbons

- 3-year project concluded 14 June 2020
- Improve standards and product design for safe use
- Conducted field study on leak hole size and type per application and set up public databases
- Conducted quantitative risk assessment and developed prototypes with enhanced product safety features for 5 different types of equipment

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Funded by the EU LIFE Programme

http://lifefront.eu

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Guiding small & organic independent food retailers

- European Project to encourage the adoption of more energy-efficiency RACHP units
- Includes single-split air conditioners for space cooling
- Currently: Often rely on extended maintenance / second-hand equipment with less sustainable refrigerants
- Challenge: Use distributors as intermediaries / no tailored cooling systems matching their needs

Refrigerants, Naturally! for LIFE

refnat4life.eu

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Global NatRef textbook to raise the bar for training

- Partnered with German publisher VDE Verlag
- English version: *Natural Refrigerant – Applications and Practical Experience*
- 340-page practical handbook for the HVAC&R industry, covering all natrefs – written by top experts
- Planned publishing date of English version: Sep/Oct 2020

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In search of the best products

- Working with EIA on the “Pathway to Zero” Report Product Annex to be presented at COP26
- Products using natural refrigerants or no refrigerants
- Best-in-class list
- Companies can submit suitable products
- Watch this space!

F-Gas what next? Get involved

Currently conducting a survey

Aim: To inform policy makers

Assessing the current EU F-Gas Regulation:

- What worked?
- What didn't?

Looking at the next EU F-Gas Regulation update:

- What should be included?
- What does progressive industry want?

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What can YOU do?

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- **OEMs:** invest in R&D and develop new technology
- **Professional team:** upskill your team and pitch natural solutions to end users
- **End users:** do your homework, insist on a climate neutral HVAC&R solution, not just the lowest CAPEX
- **Government:** drive change with policy
- **Academia:** research and training to make cooling sustainable and accessible to all

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Thank you for listening!