



Making Buildings Green and Safe: Safety Standards for ACs

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Introduction and context

Numerous challenges, hurdles and barriers when selecting and adopting alternative refrigerants

Safety standards are one significant factor

- In some countries/regions, legally obligated
- In many others, only voluntary status



Regardless, they are perceived by many stakeholders as the “go/stop” determinant



Standards development process enables dominant enterprises to introduce their preferred rules

(Active participation costs €lots!)

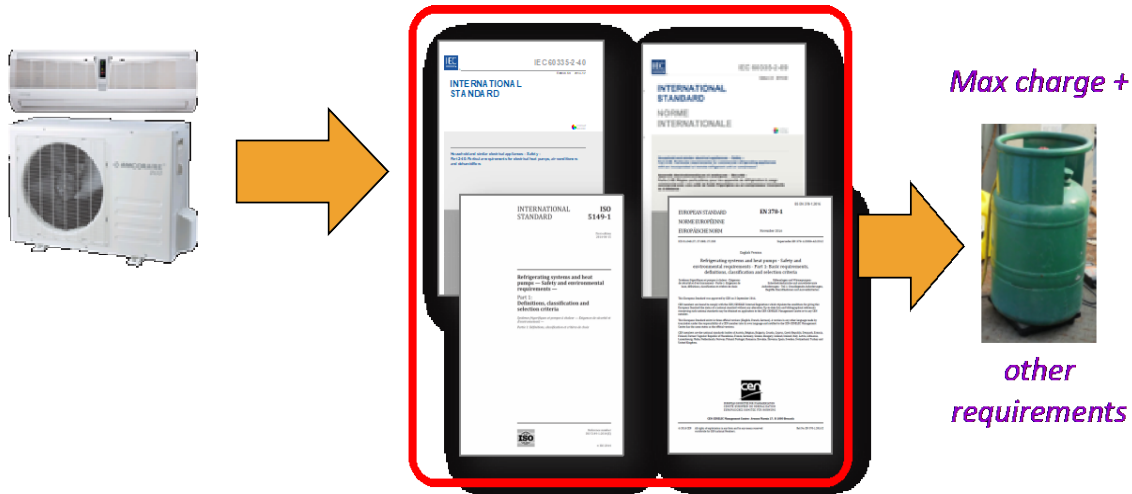
Only stakeholders with a strong interest are consistently active



Technical requirements

Topics addressed by safety standards

- Moving parts
- Electricity
- Vibration
- Asphyxiation
- Short- and long-term toxicity
- Sharp edges
- Pressure
- Combustibility
- **Flammability – fire and explosion**
- Hot surfaces
- Very cold
- Impacts
- Etc.



Endless discussions on the refrigerant flammability

Comes up everywhere, in all sorts of contexts

Charge limits:

How much refrigerant can be used

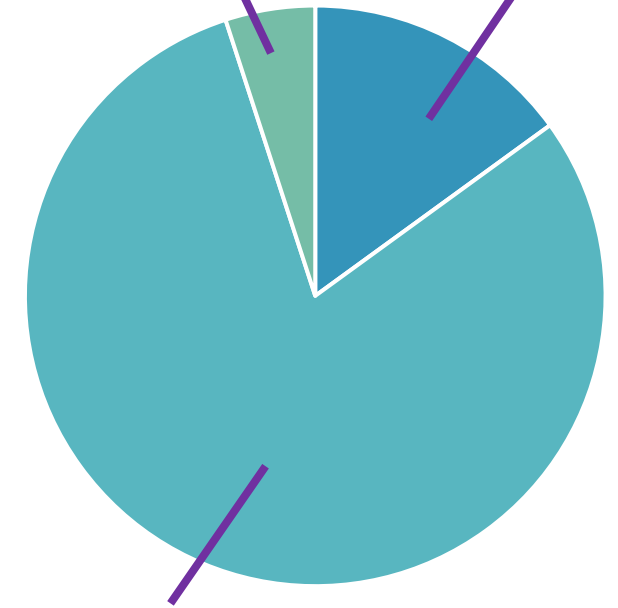
- Per system (~1 kg), and
- Per m³ of room space

For R290, it is the determining factor!



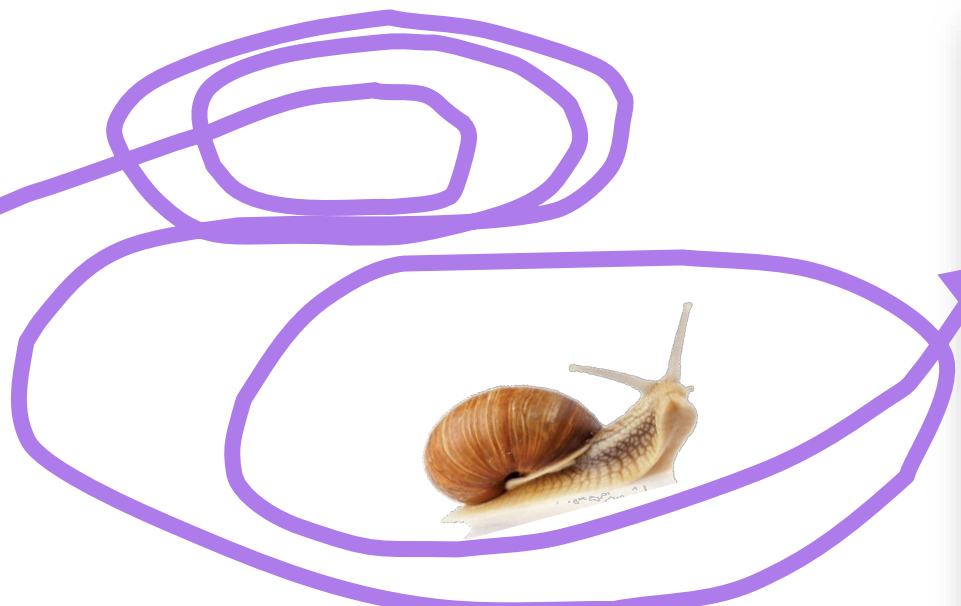
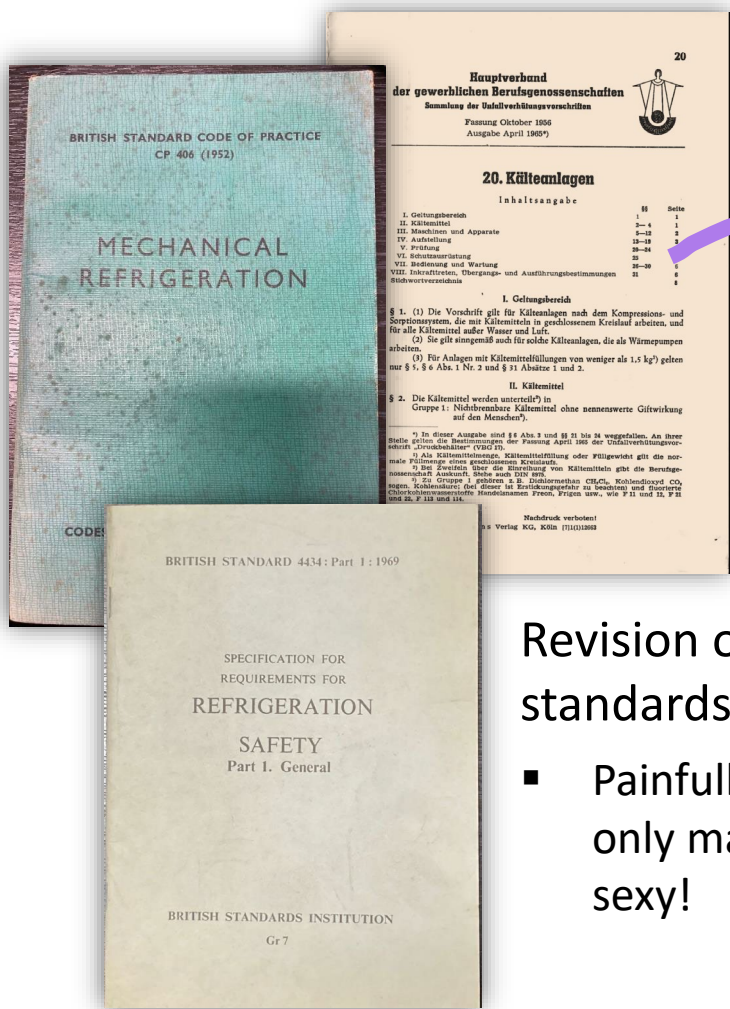
Actual/
empirical
hazards

Other
mech/elec
hazards



Discussions on HC flammability

Evolution of safety standards



Revision of safety standards

- Painfully slow and only marginally sexy!

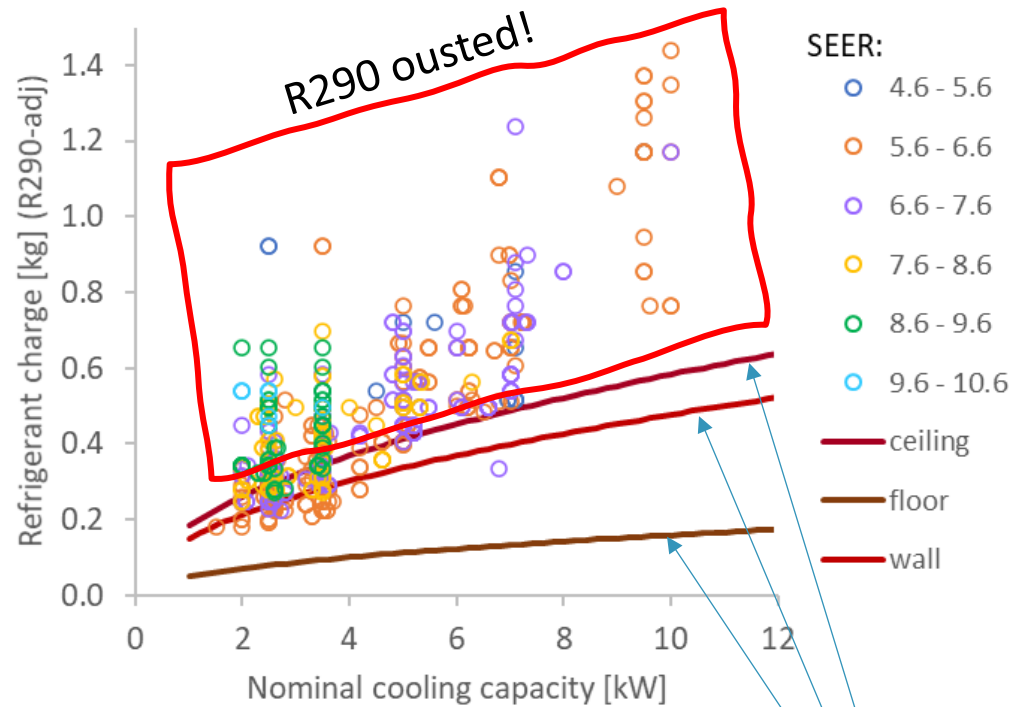


Charge quantity constraints

State of ACHP safety standards have greatly improved, but still need improvement

- Requires a lot of active participation, R&D and supporting data

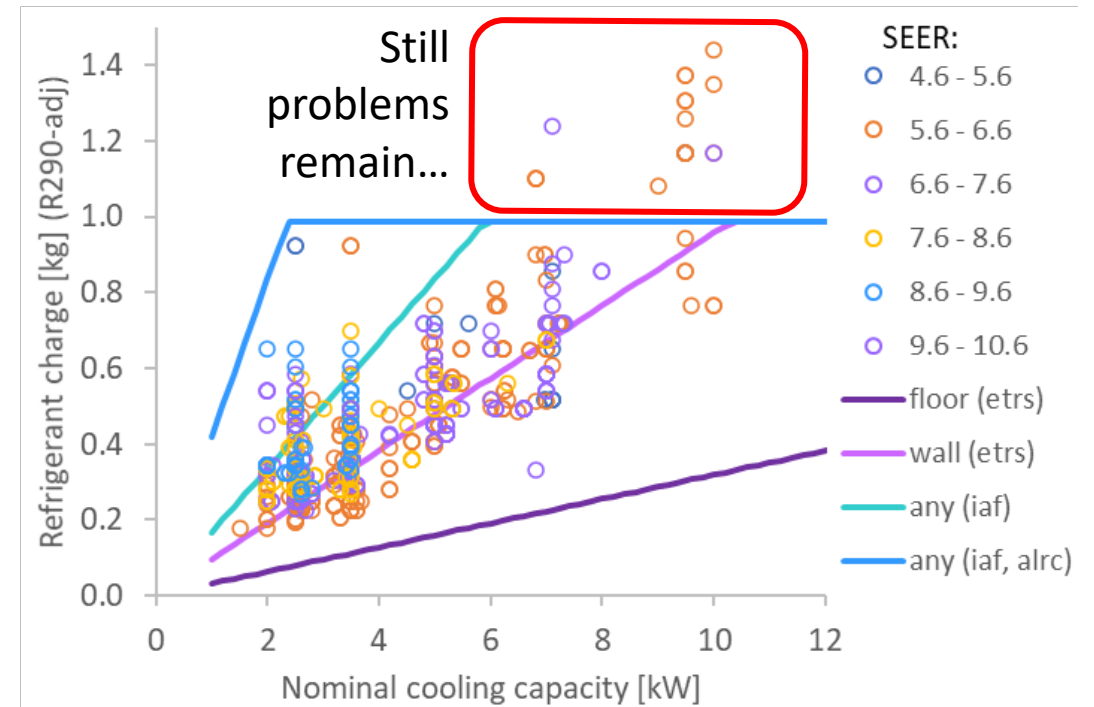
Circa. 2000 to 2020 in IEC 60335-2-40



*Charge quantity lines based on 200 W/m²

Calculation based on severely flawed logic

Since 2022 (IEC 60335-2-40: 2022)



*Data for 2300 EU R410A/R32 split ACs, with charge adjusted to R290 equivalent

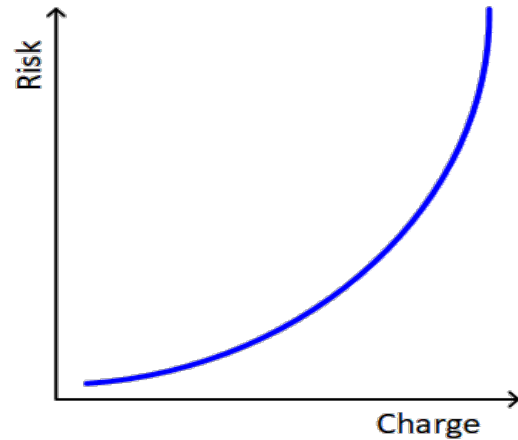
Larger charge amounts?

Risk of overpressure

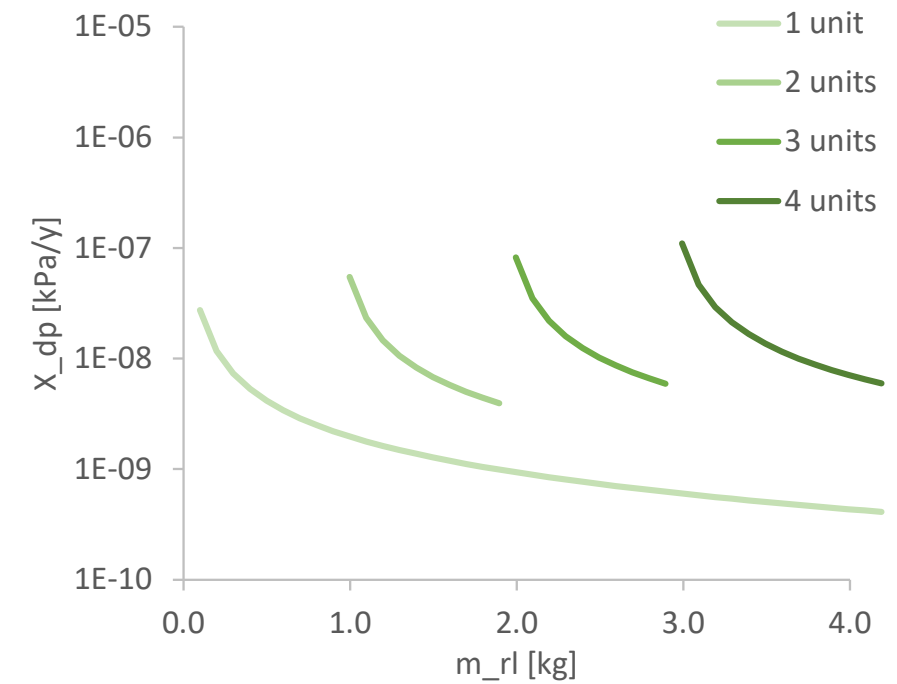
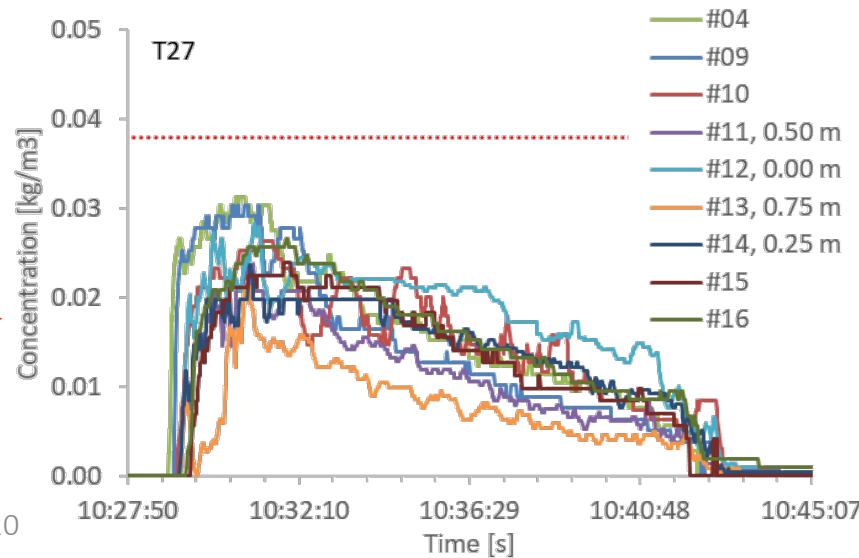
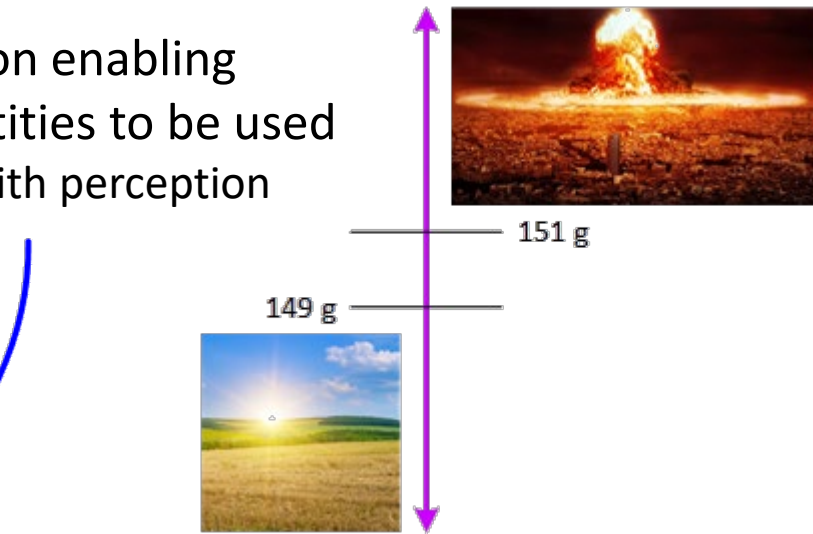
(ignition frequency × severity of ignition event)

Endless discussions on enabling greater charge quantities to be used

- Serious problems with perception



Test: 400 g, released at 180 g/min from IDU into small, closed room – far from flammable!



Increasingly large room (maintain 13 g/m³ of R290)

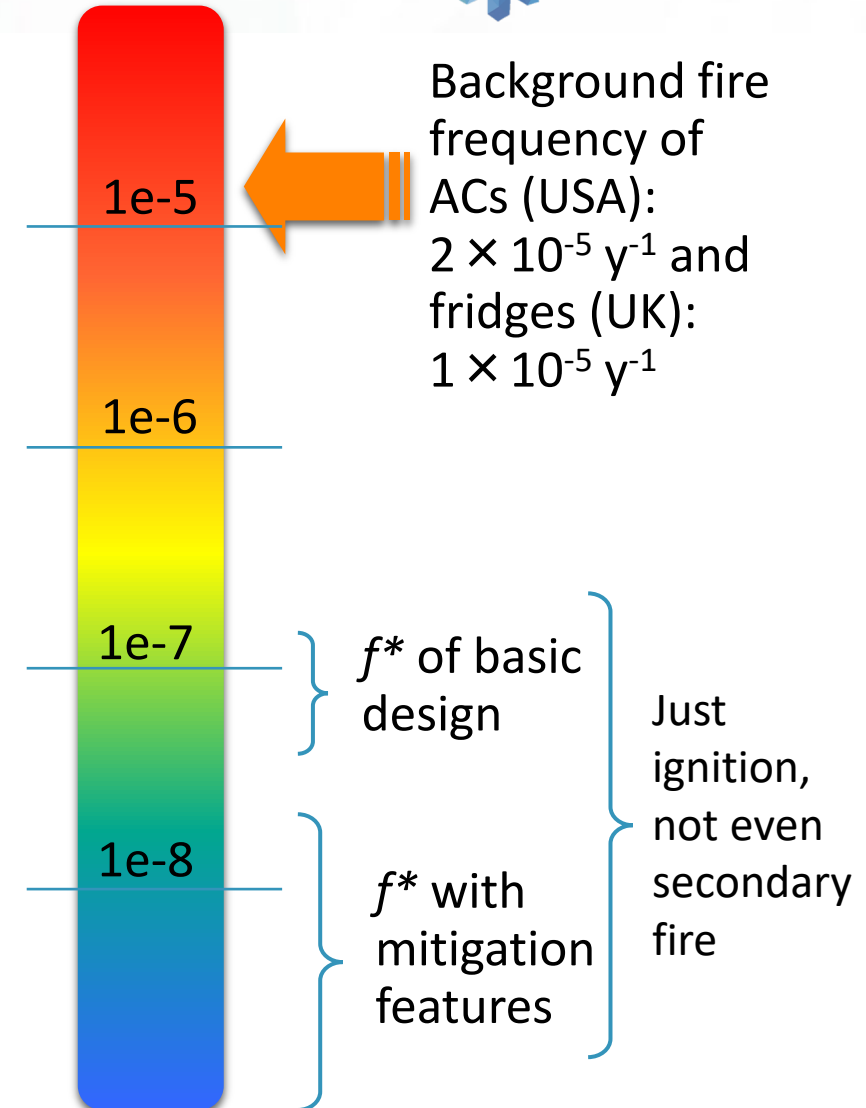
Safety and risk in context



Essential to consider flammability risk in context, e.g.

- In UK, approx. 500 house fires per year from gas heating (central and hot water) – 2/3rds gas and oil, 850 house fires from gas and oil space heating appliances – ½ and oil, ½ electric
- About 600 from “faulty appliance and leads” – various electrical faults
- Fire risk of 1×10^{-4} per year
- By comparison, HC AC/HPs (due to refrigerant leak), $\ll 1 \times 10^{-7}$ per year

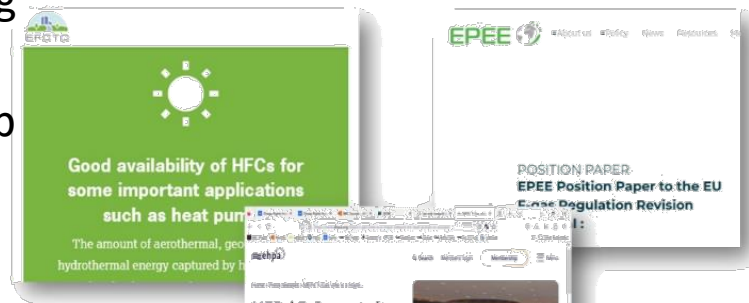
Not saying that leaks of flammable refrigerant is unimportant, but should not ignore other issues



There is light at the end of the pipe...

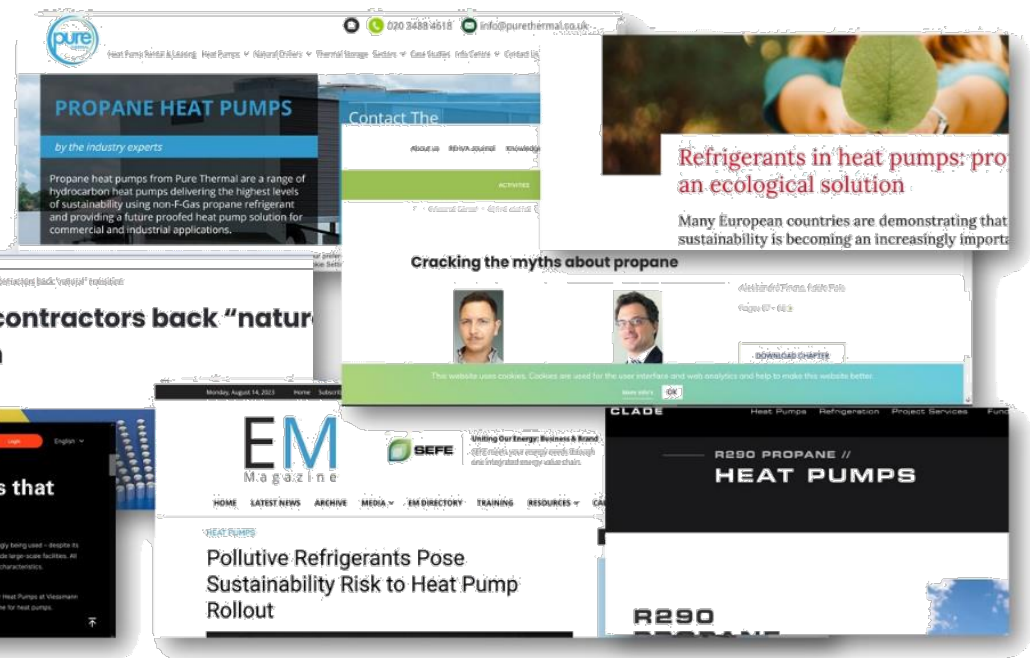
Why all the hoo-hah?

- Certain sectors generating negative propaganda
- Historic “no naturals” club
- Industry gossip and rumour



But the tide seems to be turning...

- What system manufacturers and environmental needs, should be driving the technology!



Thank you for your attention

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