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refrigerants delivered by mother nature



Different countries – different trends?

The situation of natural refrigerants

by

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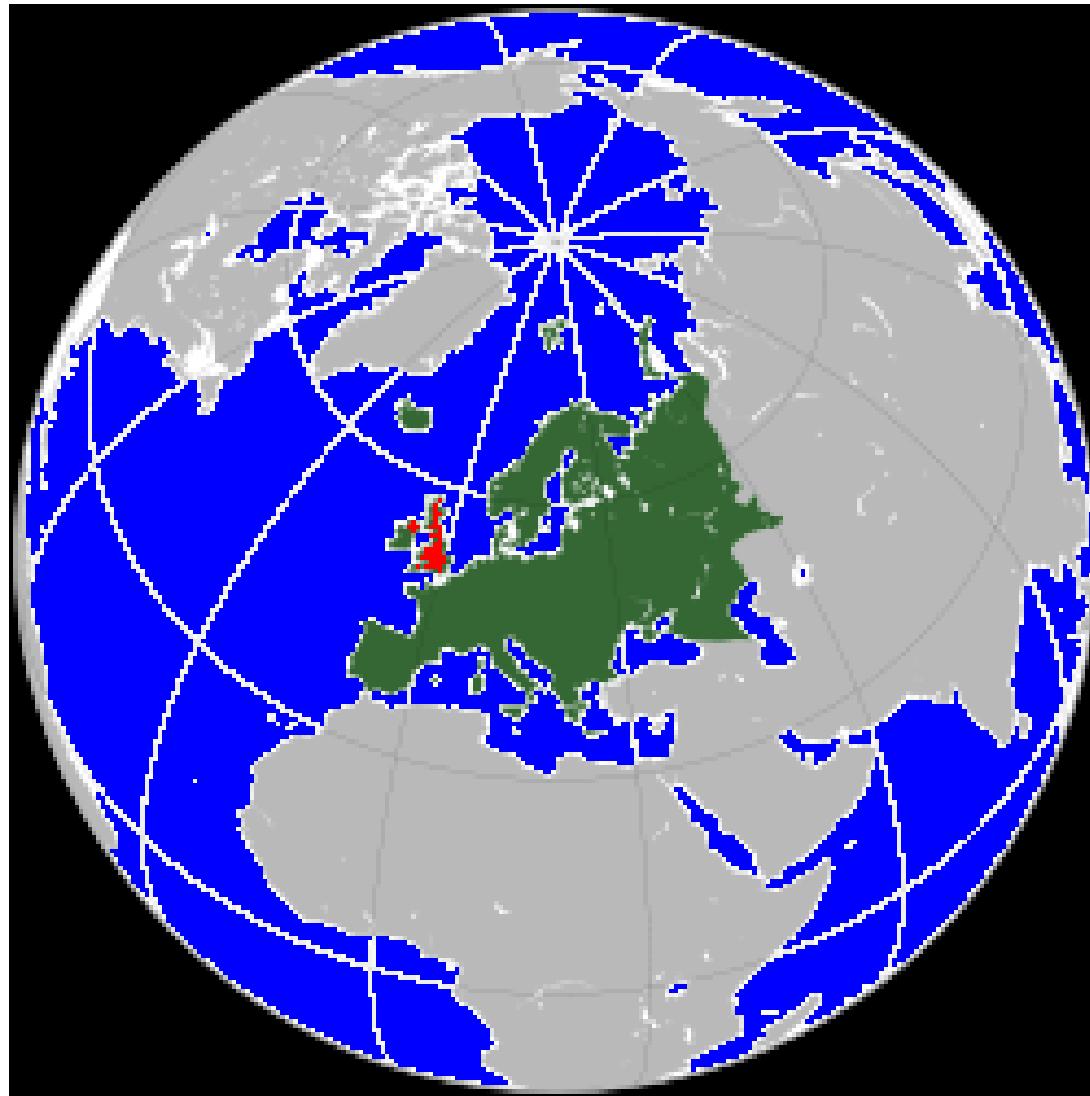
The Situation in the United Kingdom

by

Dr Andy Pearson

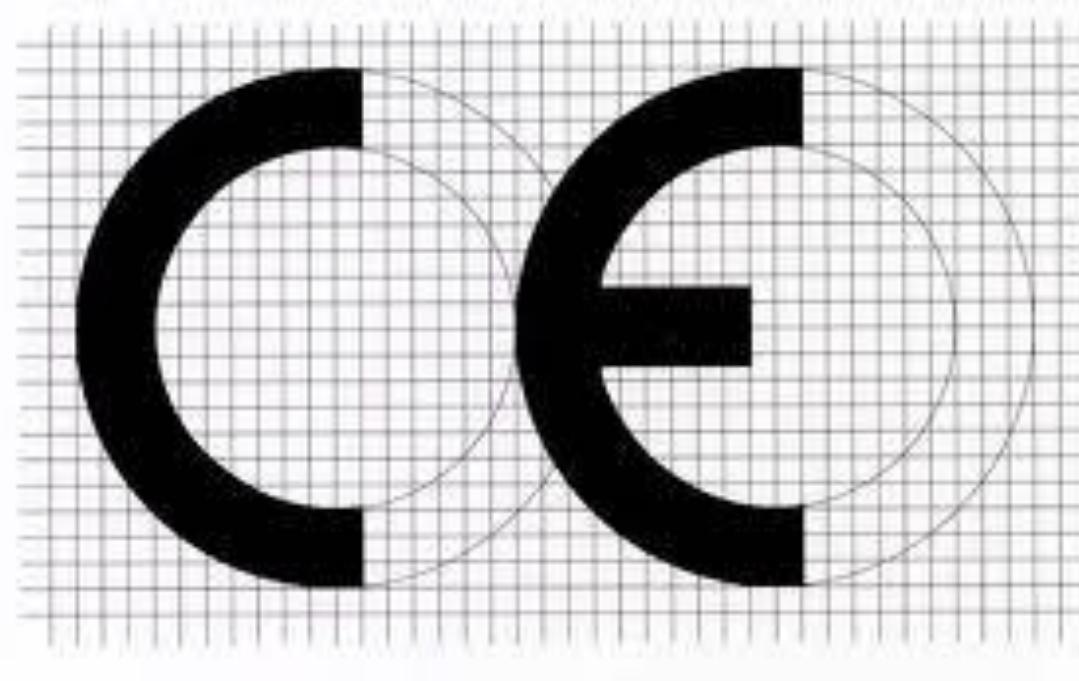


General Overview – The United Kingdom



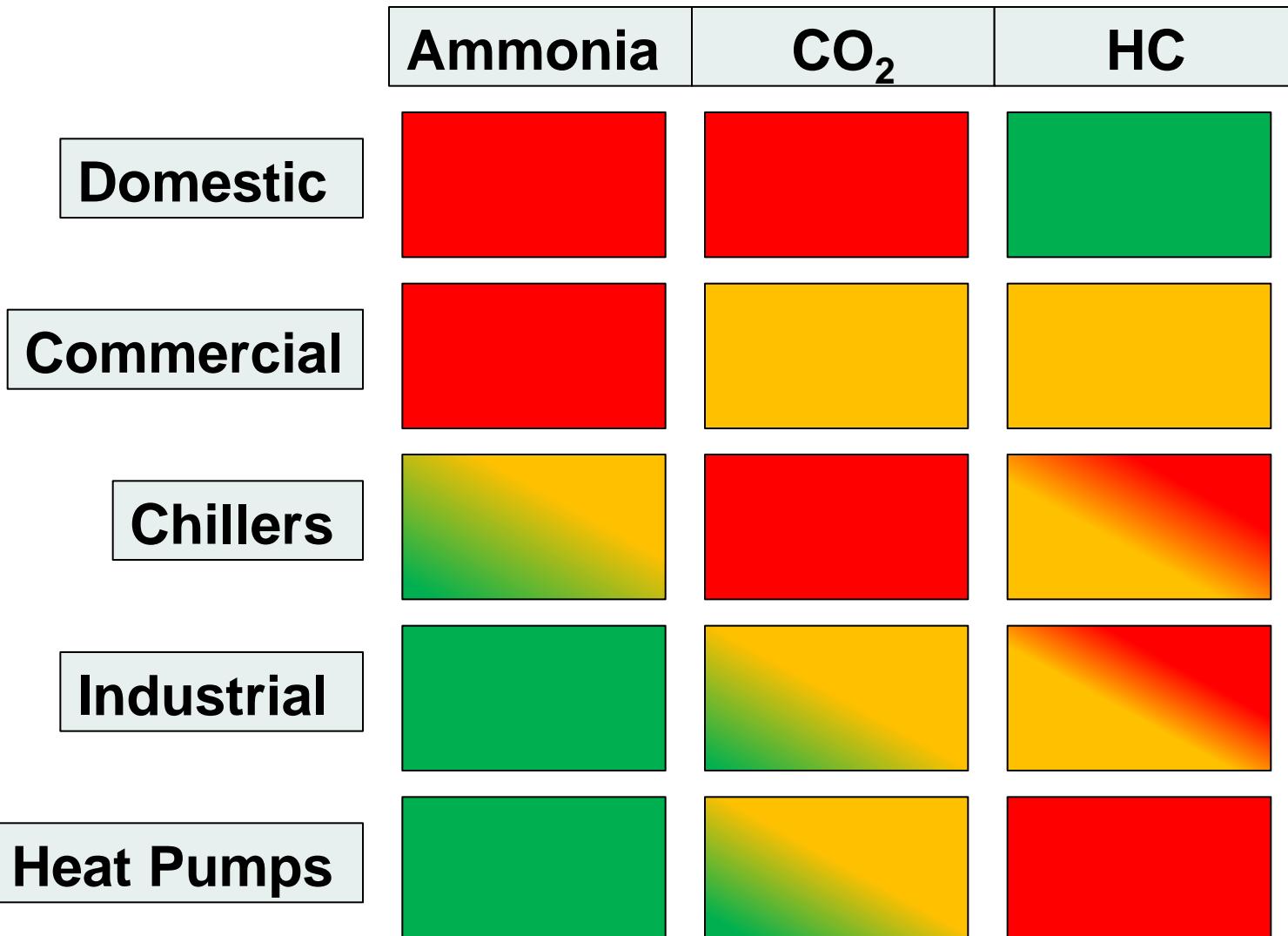
The United Kingdom is on the north west edge of Europe, separate from the main continent and not part of the Euro-zone.

UK legislation



UK legislation follows the EU with many product and safety laws based on the European directives, but the underlying health and safety rules are more "laissez-faire" than most Europeans

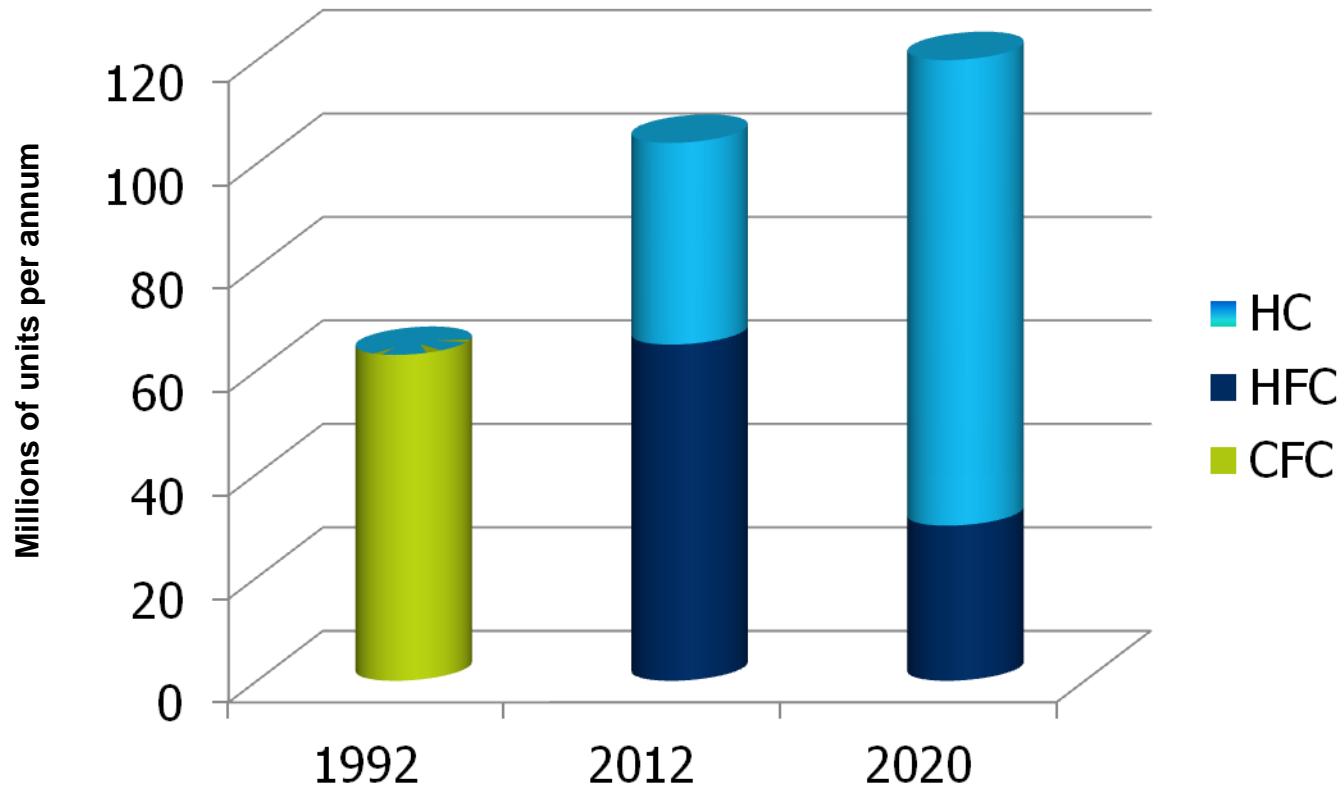
Market Matrix



Hydrocarbon systems in domestic refrigerations

- Domestic refrigerators – huge growth from a standing start

Domestic Refrigerator Global Production by Refrigerant Type



Hydrocarbon systems in supermarkets

- Other applications: retail and water chillers
- Integral cases and bottle coolers up to 150g
- Chillers with larger charge – up to 25kg



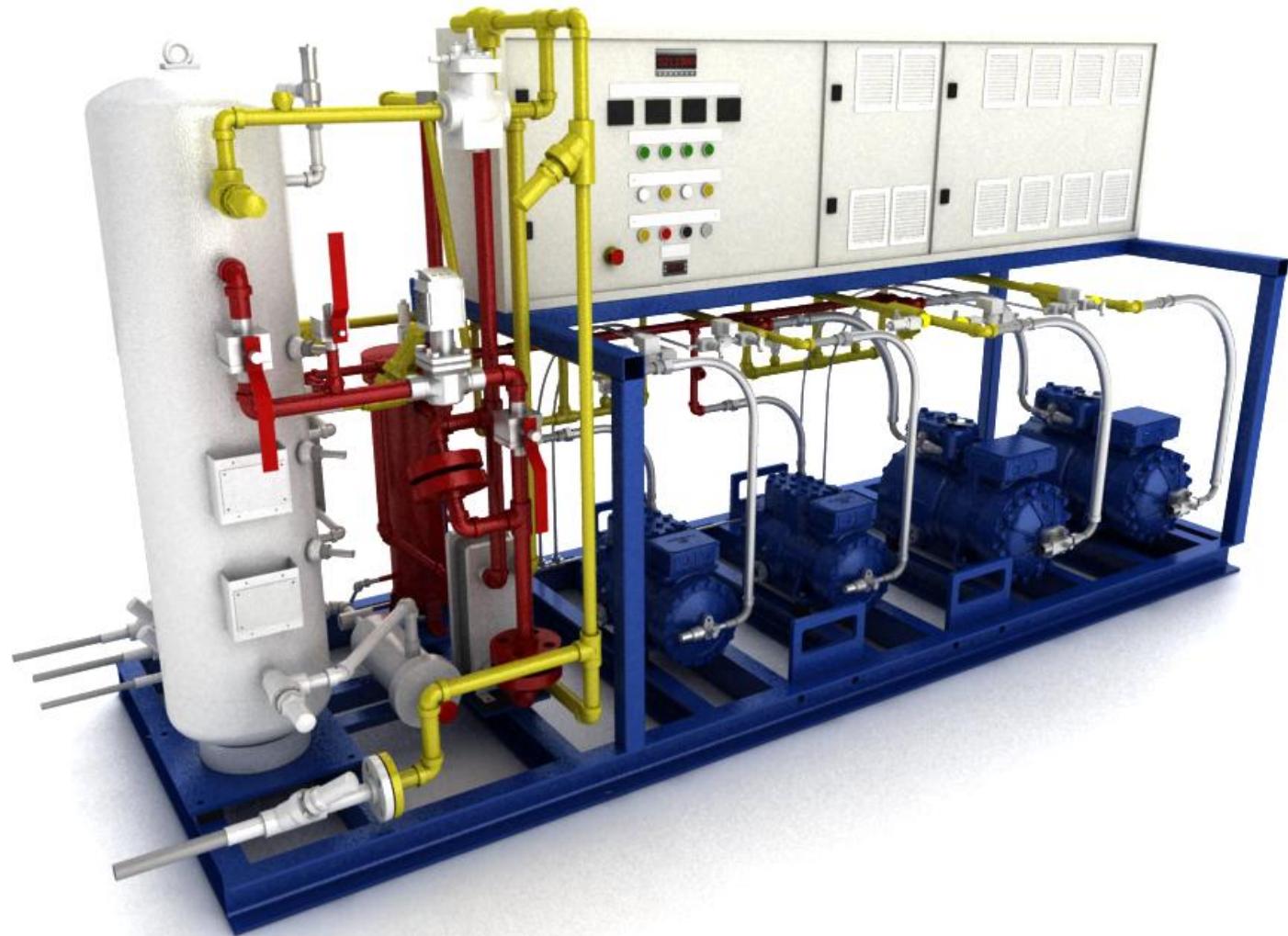
Graphics by Carrier and ICS Ltd

CO₂ in supermarket systems

- This is perhaps the area with greatest diversity of solution:
- The majority of systems are transcritical with a flash gas bypass system
- Transcritical overfeed systems were used by one supermarket, but have not been adopted more widely
- Secondary CO₂ has been adopted by one supermarket – this seems to have been the most efficient and least troublesome system, although it is expensive. There is not an energy penalty for using CO₂ as a secondary if the system is designed correctly.



Dual Temperature Transcritical Booster



Star CO₂ Low Pressure Receiver Unit (Chilled)

This system is designed to allow higher suction temperatures on the compressors by flooding through the evaporators. This also has the advantage of a lower standstill pressure in the event of a power cut because the receiver is at suction pressure.



CO₂ Pump Station

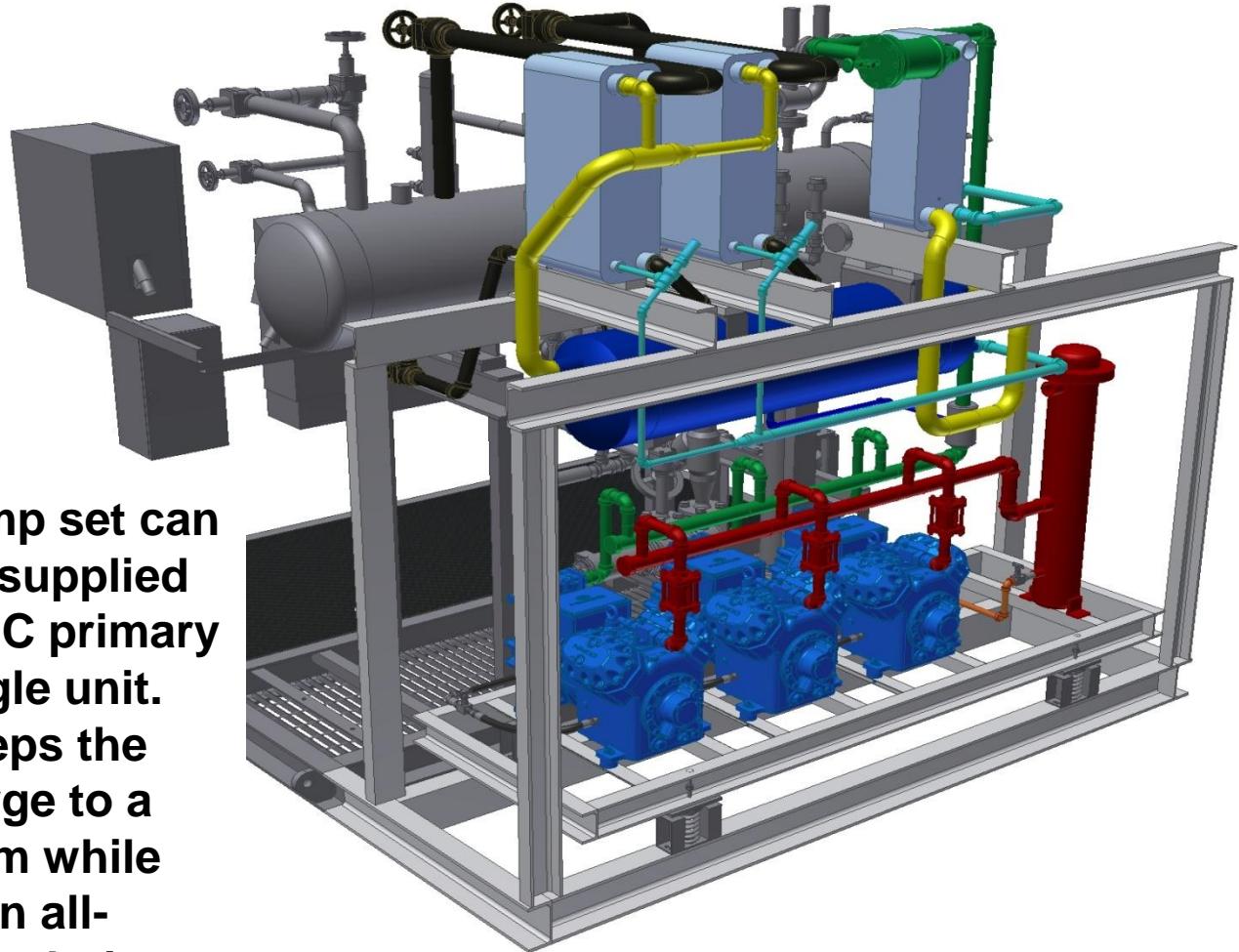
These units are retrofitted to HFC systems or installed on new stores with HFC or HC refrigerant as a cascade system. It would also be possible in future to replace the high stage HFC system with a CO₂ transcritical unit if desired.



CO₂ Pump Station



Hydrocarbon Cooled CO₂ Pump Station



The pump set can also be supplied with a HC primary in a single unit. This keeps the HC charge to a minimum while giving an all-natural solution.

Ammonia chiller systems

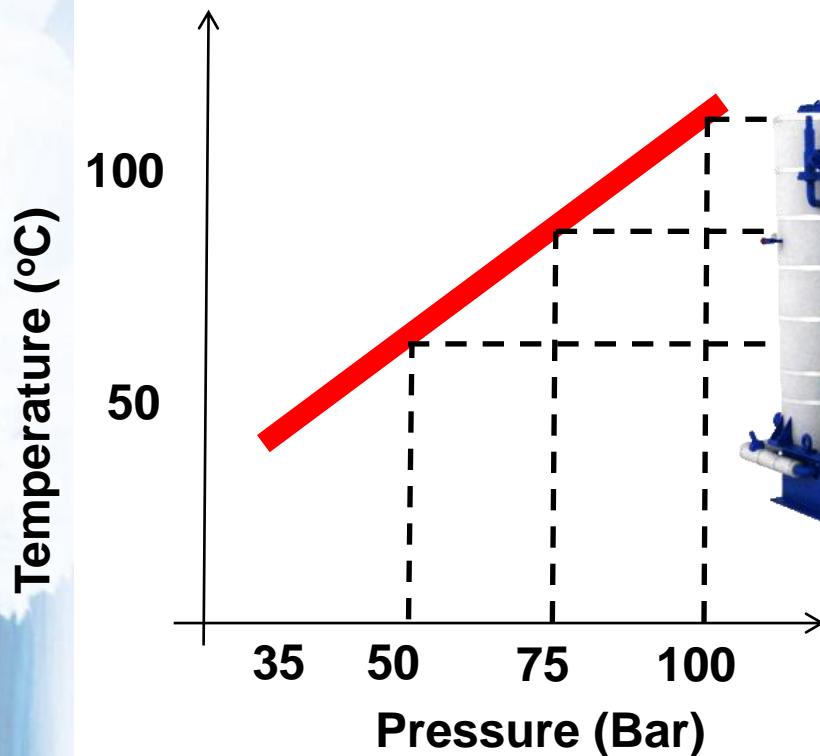
- Ammonia has been common in industrial systems for over 100 years, but less common in chillers
- Large variations from country to country in terms of safety legislation
- Some significant projects in building services in recent years
- Packaged chillers now much more common



Graphics by JCI and Star Refrigeration

A special word about ammonia heatpumps...

- Ammonia offers some unique advantages for HP applications
- Critical temperature is very high, but so is critical pressure
- Ammonia behaviour at high temperature and pressure is challenging – everything is intensified!



Graphic by Star Refrigeration

Market Matrix

	Ammonia	CO ₂	HC
Domestic	Red	Red	Green
Commercial	Red	Green	Green
Chillers	Green	Red	Green
Industrial	Green	Green	Green
Heat Pumps	Green	Green	Red

What's missing from the picture?

Split & Multi-split A/C

Ammonia	CO ₂	HC

There is no current solution with natural fluids for larger split air conditioners on the market in the UK (or anywhere else in the world)



Graphic by Daikin

Conclusions

- UK legislation has not hindered the uptake of natural refrigerants but it has not particularly helped either.
- The biggest advances are being driven by major supermarket chains
- Lack of service skills seems to be the biggest hurdle to overcome
- The domestic and industrial markets arrived at their solutions (hydrocarbon and ammonia) many years ago and are unlikely to change
- There is virtually no use of air or water as refrigerants at the present, and seems to be no prospect of any significant advance
- Air-conditioning for domestic is a small but growing market – all types of air conditioners have not yet adopted natural refrigerants

