

Transport, Industrial and Commercial Refrigeration

Graeme Maidment – BEIS, UK

euramm^on Symposium, 4 July 2022





Transport, Industrial and Commercial Refrigeration in the UK

Opportunities for Research and Innovation

Graeme Maidment

Dept of Business, Energy and Industrial Strategy, UK

4th July

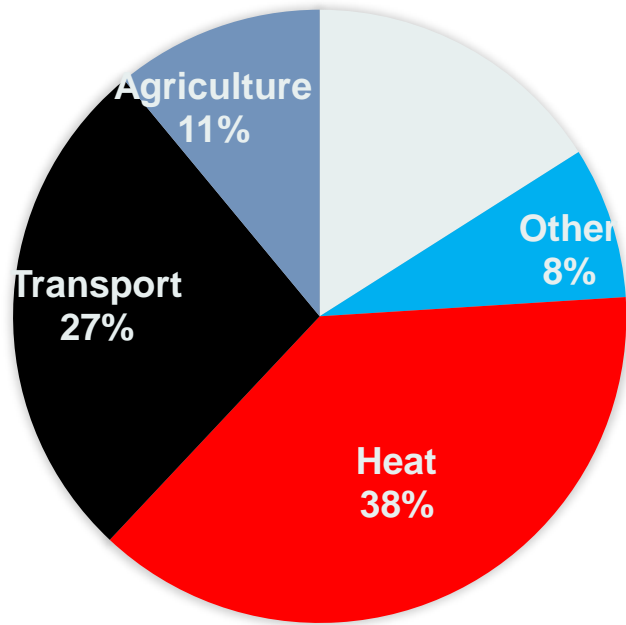


Outline

1. Context
2. Proposed TCR study
3. Complimentary existing Activities
4. Mission Innovation
5. Conclusion



Net-zero emissions by 2050

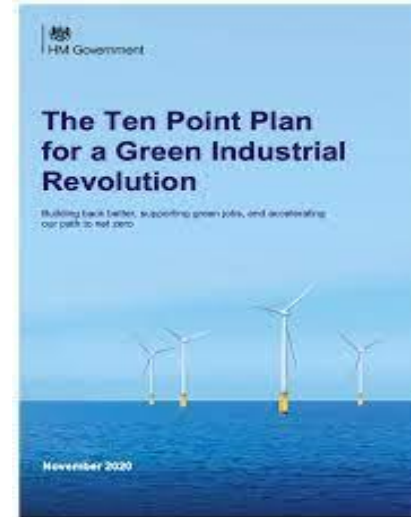


UK CO_{2e} emissions 2016



Clean Growth Strategy - a significant role for

- Low carbon heating,
- Delivering Clean, Smart, Flexible Power and
- Accelerating the shift to low carbon transport



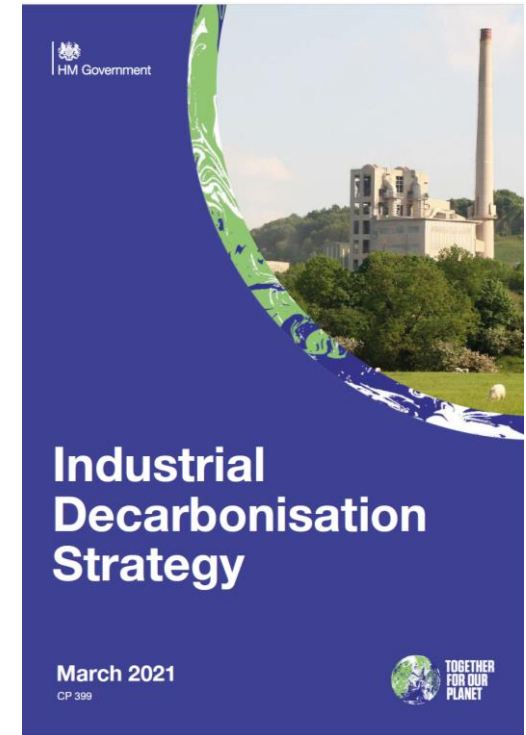
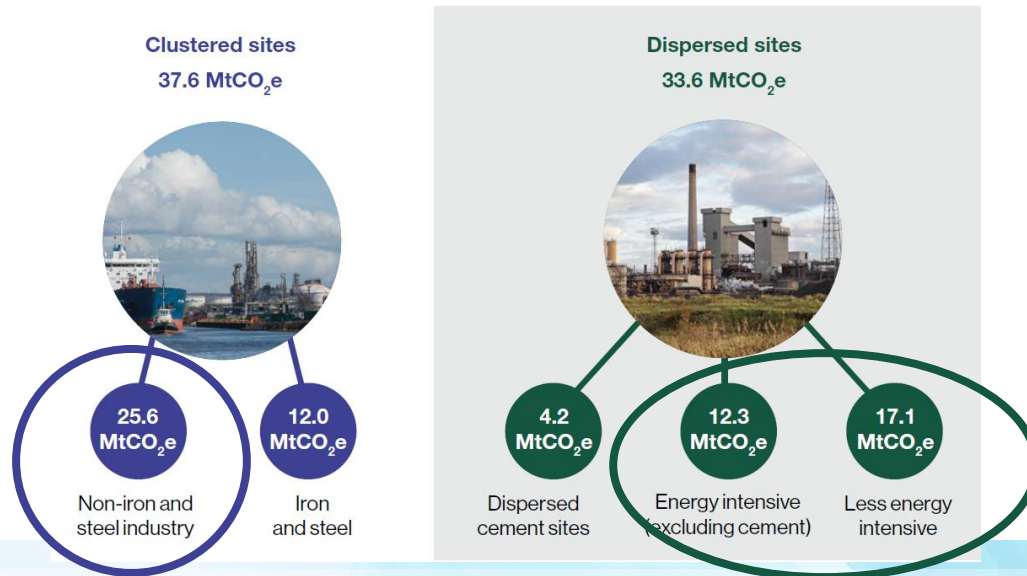
Ten Point Plan for a green industrial revolution includes installing 600,000 heat pumps/ year by 2028 and the transition to electric cars by 2030.



Energy efficiency a key instrument in energy security

Industrial Decarbonisation Strategy

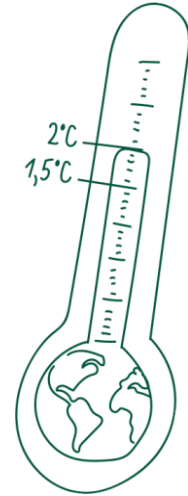
- UK industry sectors: metals & minerals, chemicals, food & drink, paper & pulp, ceramics, glass, oil refineries, etc,
- Account for 1/6th UK emissions



Reduce emissions from 2018 to 2035 by two thirds

Cooling as a priority

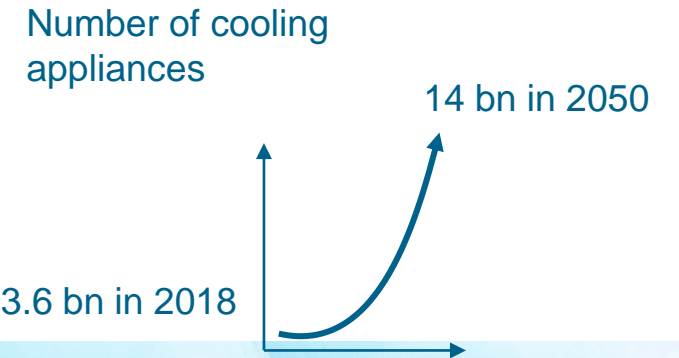
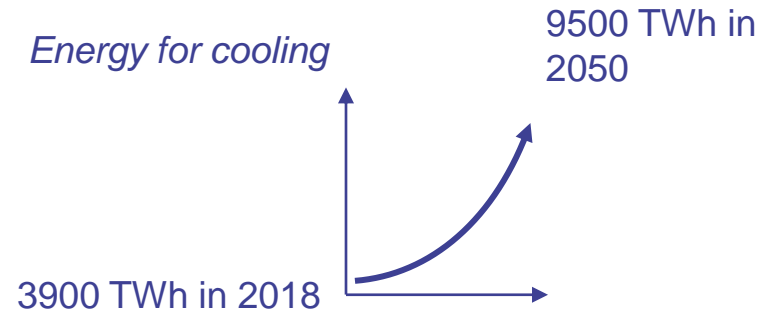
Global warming
"irreversible"
IPCC 2022



Cooling degree days
are going to increase

**Cooling essential to
reduce overheating,
food and
pharmaceutical waste**

UK committed to
Net Zero by 2050





The triple whammy of cooling





Food waste

- Food and drink industry is the largest manufacturing sector in the UK
- Responsible for 176 MtCO_{2e} emissions (excludes, pre-farm production, packaging, food waste, land use change)
- Food security is an integrated global issue - UK reliant on imports; 83% of fruits, 47% of vegetables imported
- Majority of companies SME (many micro SMEs)
- Climate change and impacts are an increasing priority



Climate Impacts On The UK

Cooling demand is expected to increase in the future

**29 cooling degree days
Gatwick – last 20 years**

**46 cooling degree days
Gatwick – last 4 years**

**Or the climate moved
50km south each year**

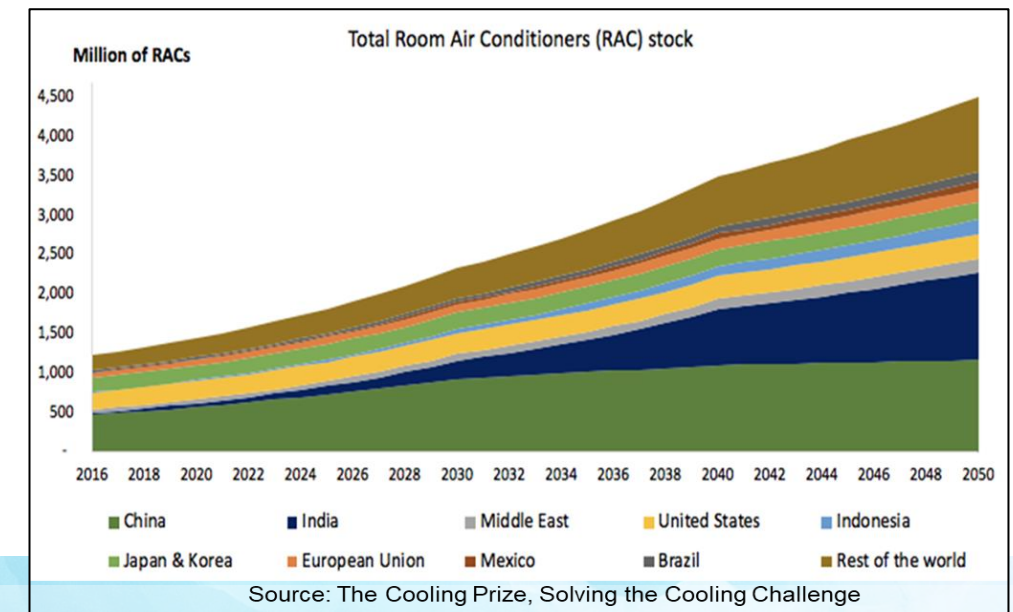
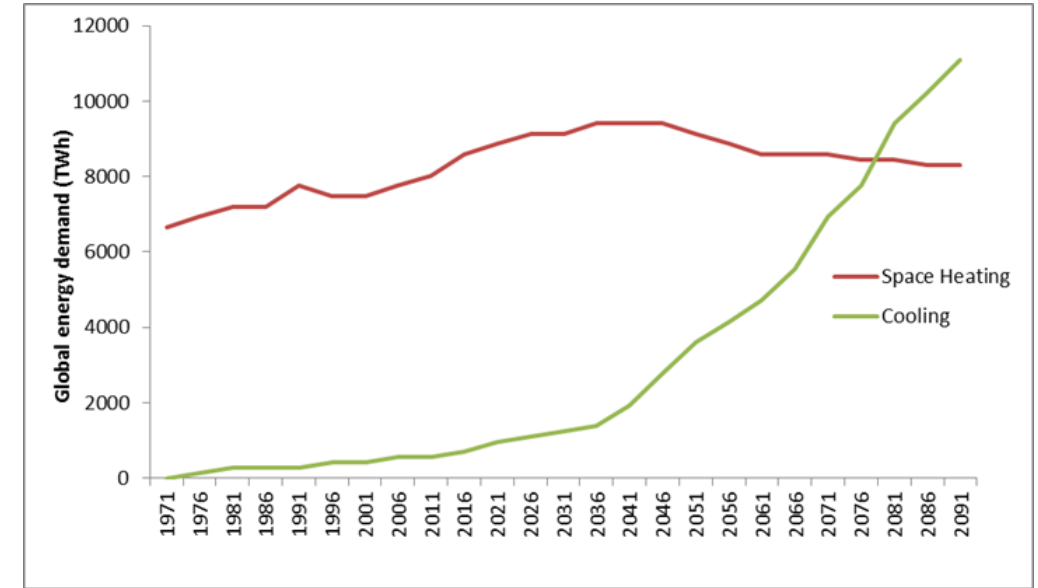
**52 cooling degree days
Rouen – last 20 years**

**By 2050 is the London climate
similar to Barcelona today?**

Emissions and Energy

How to deal with future trends?

- Heating/Cooling are:
 - Large users of energy
 - Producers of carbon
- Cooling demand
 - Some applications predicted to grow 50x
 - Adding 100GT to 2050
 - Equivalent to 0.5°C of additional warming
- Heat is responsible for 32% of total UK carbon emissions





COOLING IN 2050?

How do we change a consolidated industry?



Transport, Industrial and Commercial refrigeration

	Thermal comfort				Removing heat and maintaining stable temperatures for industrial and commercial purposes		Maintaining stable temperatures for food and medicine transport and preservation	
Application	Mobile Air Conditioning	Space Cooling			Industrial Refrigeration	Commercial Refrigeration	Transport Refrigeration	Domestic Refrigeration
		Cooling in passenger cars, commercial vehicles, buses, trains, planes etc.	Indirect district cooling and room air conditioning or fans for human comfort and safety in buildings			Used on farms, and in food processing (including marine) and pharmaceutical factories and product distribution centres	Used in supermarkets, restaurants and other retail premises, e.g. display cabinets and cold rooms	Movement of goods over land and sea, preserving their safety and quality, and extending shelf life
Technology	Mobile ACs	Heat pumps	Unitary ACs	AC chillers	Industrial refrigeration equipment	Commercial refrigeration equipment	Transport refrigeration units (TRUs) including shipping containers	Domestic refrigerators

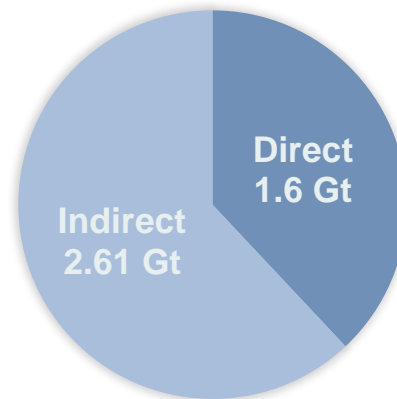
Cooling emissions



Globally



7-8% of GHG emissions
Total = 4.14 GtCO₂e

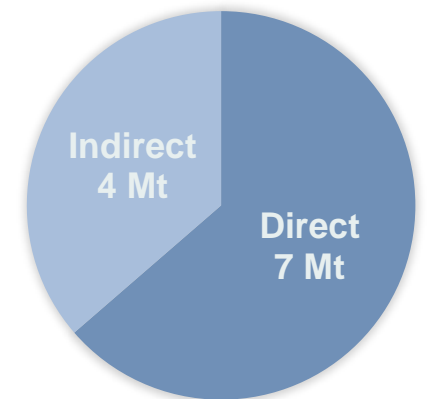


3.4% of global energy consumption (IEA, 2020)
17% of electricity use (IIR, 2017)



In the UK

1-2% of GHG emissions
Total = 11 MtCO₂e



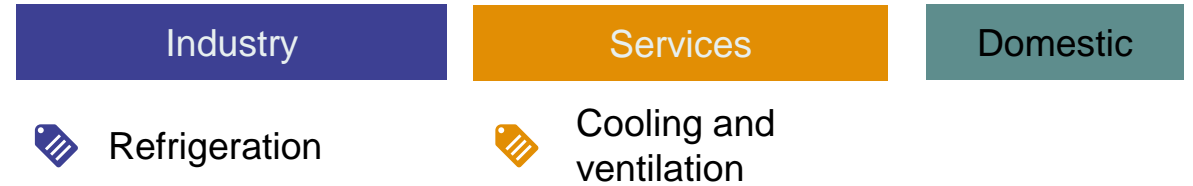
~ 6% of industrial electricity use,
~ 2% of total UK energy use

Let's break this down further...

UK national data

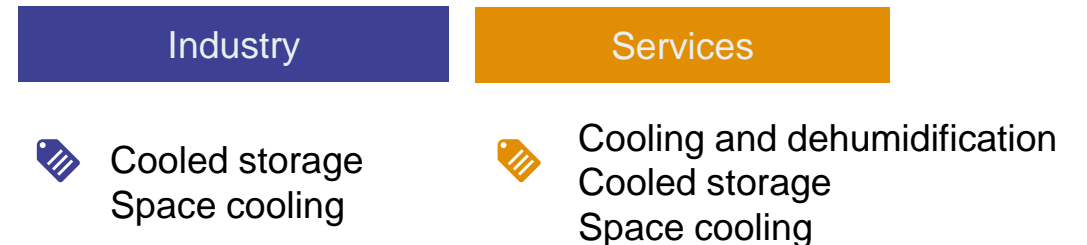
Three data sources

- Energy consumption UK 2020



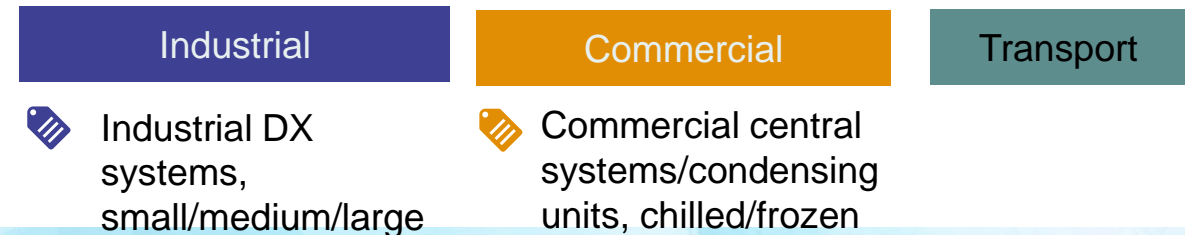
No data for data centres, pharmaceutical, transport refrigeration

- Building energy efficiency survey 2020

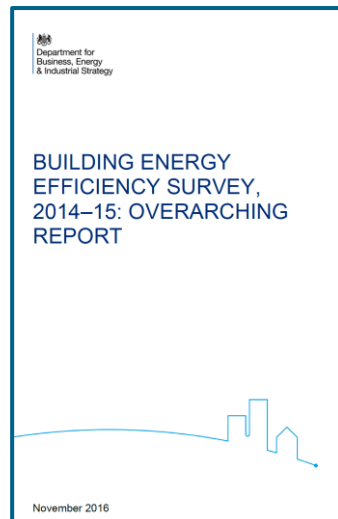


Data only for industrial buildings, no data for process energy use

- National Air Emissions Inventory 2020



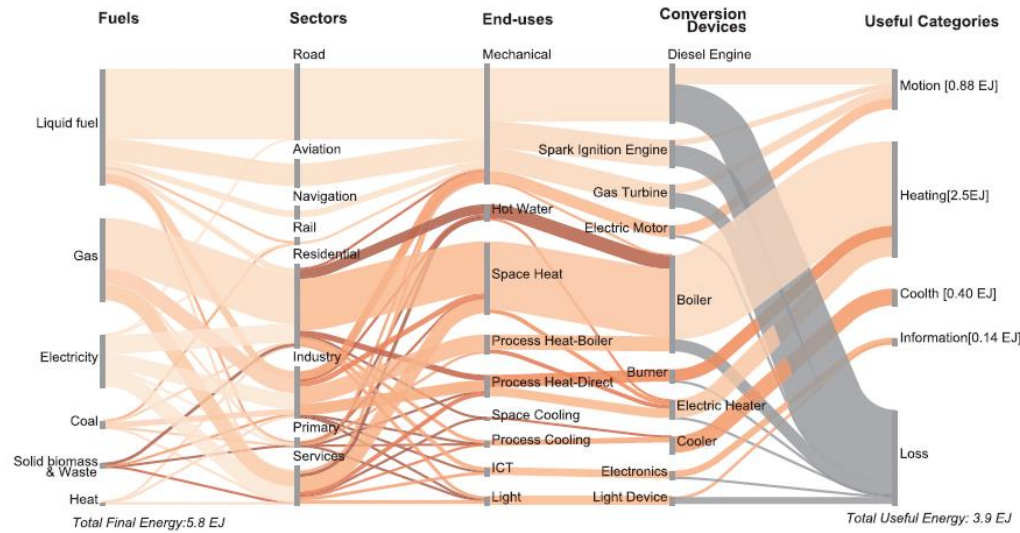
UK national data



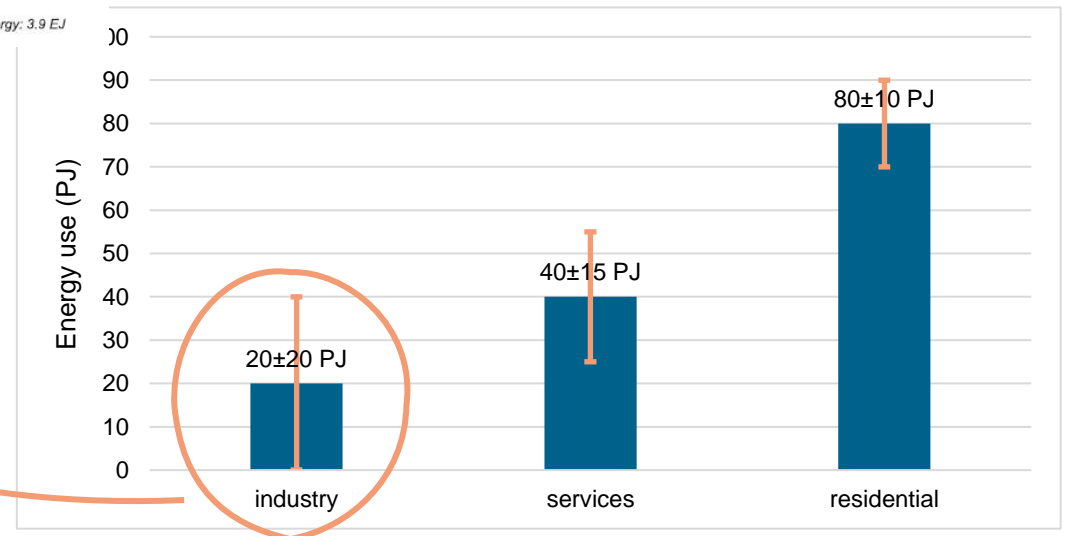
Annual energy consumption in GWh reported for cooling and ventilation in ECUK services (2019) data and for cooling, dehumidification and cold storage in BEES (2015), for the same sector breakdown

Sector	ECUK (GWh/y)	BEES (GWh/y)	Percentage difference
Community, arts and leisure	901	880	2%
Education	782	240	226%
Emergency Services	245	54	353%
Health	1760	500	252%
Hospitality	1113	1630	-32%
Military	221	84	163%
Offices	4358	2160	102%
Retail	2215	7910	-72%
Storage	495	540	-8%

Uncertainty

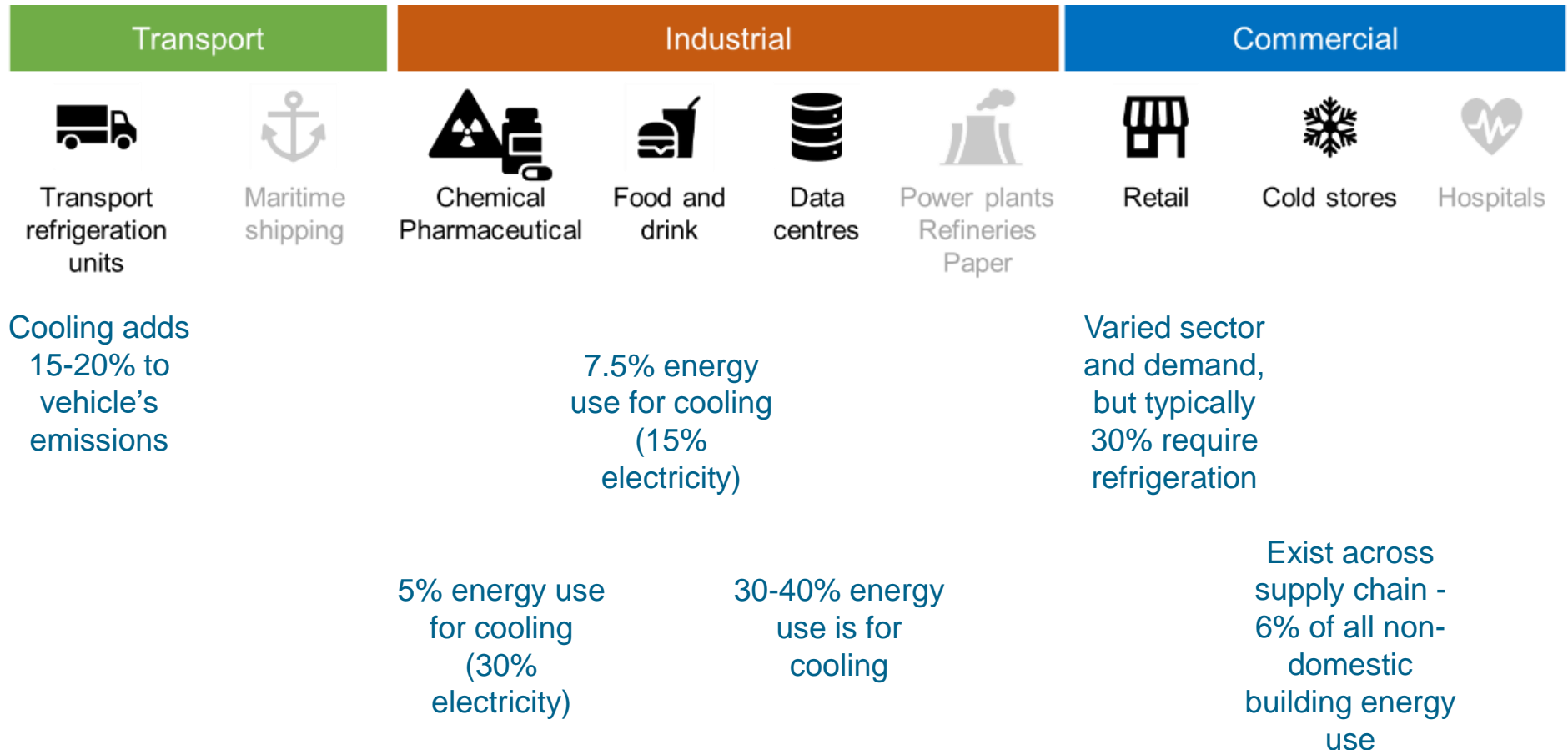


On average, 45% uncertainty in cooling energy use



100% uncertainty for industry

Important TICS sub-sectors



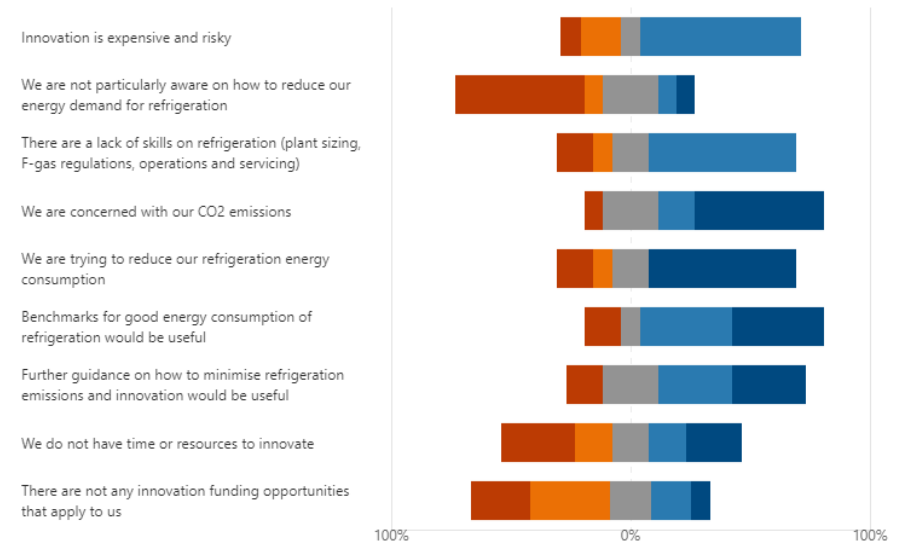
Stakeholder engagement

- Cold Chain Federation
- Food and Drink Federation
- Retail Energy Forum
- DfT
- Defra
- BEIS
- Sustainable logistics forum
- Tech, media and telecom forum
- Institute of Refrigeration
- Chemical Industries Association
- Air Conditioning and Refrigeration Board
- Federation of Environmental Trade Associations

19. To what extent do you agree with each of the following statements?

[More Details](#)

■ Completely disagree ■ Somewhat disagree ■ Indifferent ■ Somewhat agree ■ Completely agree





Stakeholder engagement



Lack of awareness of when energy consumption was “good”

Need industry benchmarks



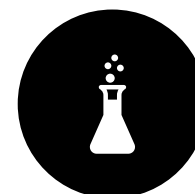
Would invest in energy efficiency for positive return on investment

Need to assist innovation appetite



Guidance on decarbonisation pathways

Assessment of abatement potential of innovations



Trade offs between refrigerant phase down and energy efficiency

Guidance on relative impact



Problems identified

Problem 1: Uncertainty of data on emissions from refrigeration

What are the current refrigeration energy demand and emissions across the transport, industrial and commercial sectors?

Problem 3: Lack of benchmarks

What is good or poor practice?

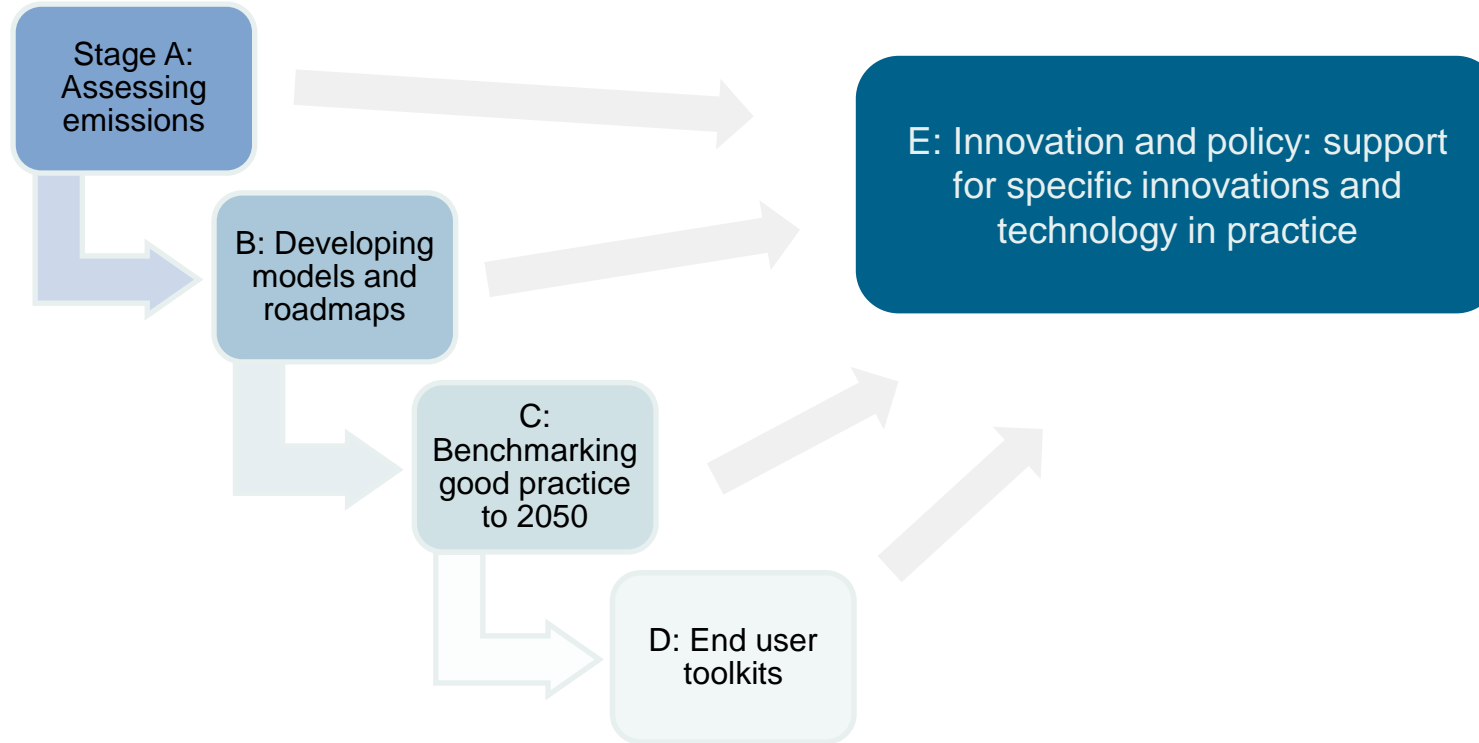
Problem 2: No plan for decarbonisation of refrigeration

How will this refrigeration demand increase?

Problem 4: Lack of tools, guidance and support

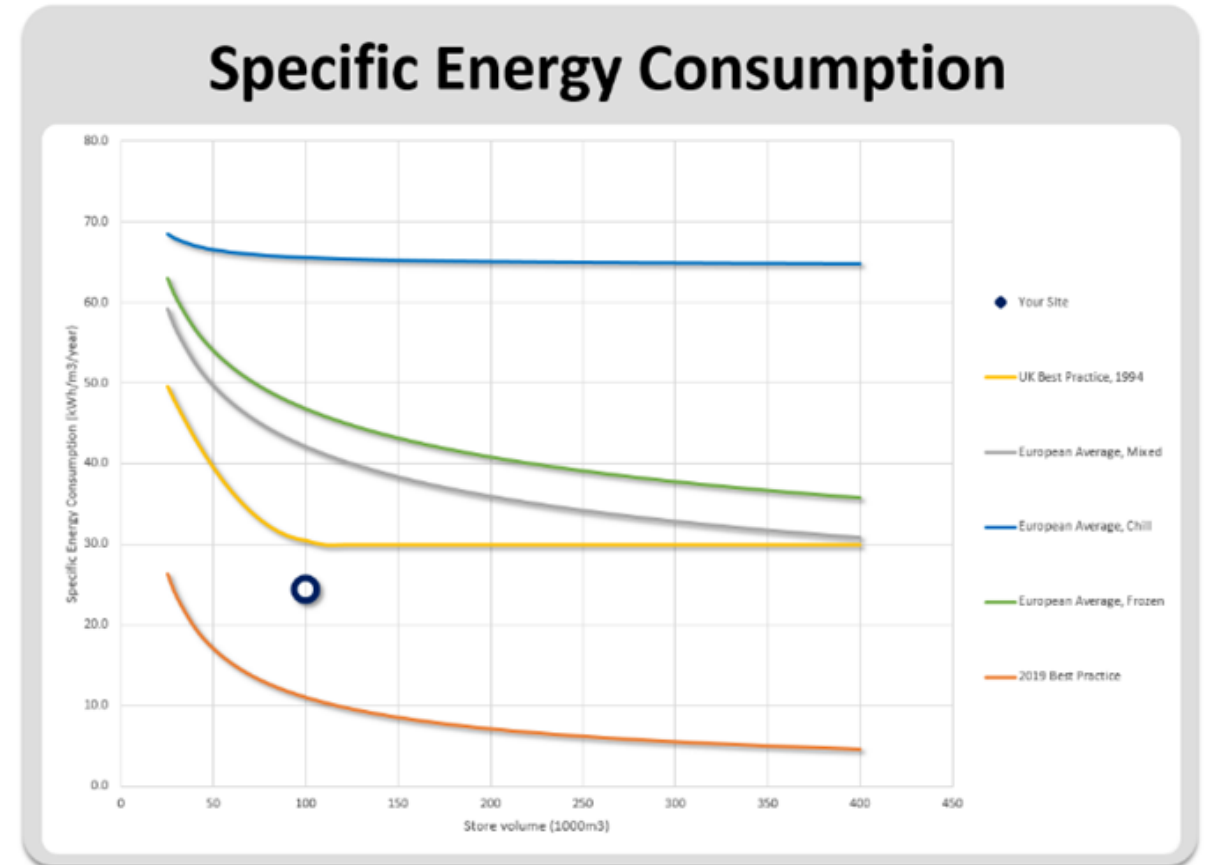
What tools do end users and practitioners need to deliver net zero in TICR sectors?
What are the most promising innovations to reduce energy demand in refrigeration, and which areas need government support or will be industry led?

Proposing a five stage research project



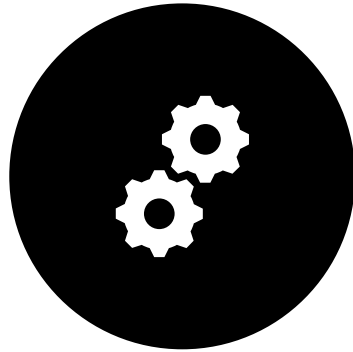
Benchmarking opportunities

- Climate Change Agreement data
- Big data opportunities
- Benchmarking
- National Australian Built Environment Rating Scheme (NABERS)

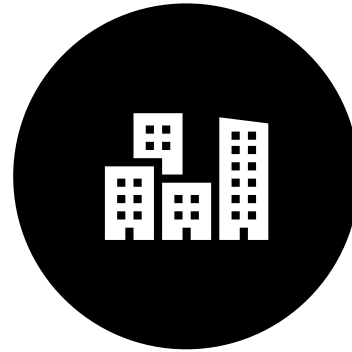


<https://www.star-ref.co.uk/news/star-refrigeration-launches-new-energy-consumption-benchmarking-app-for-the-tcsd-industry/>

Three categories of solutions



TECHNICAL AND
TECHNOLOGICAL



WHOLE BUILDING



PRACTICE
MAINTENANCE

TRLs?

Can they be
combined?

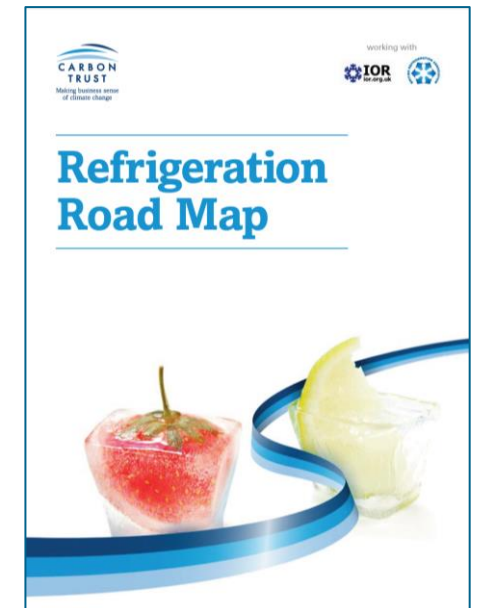
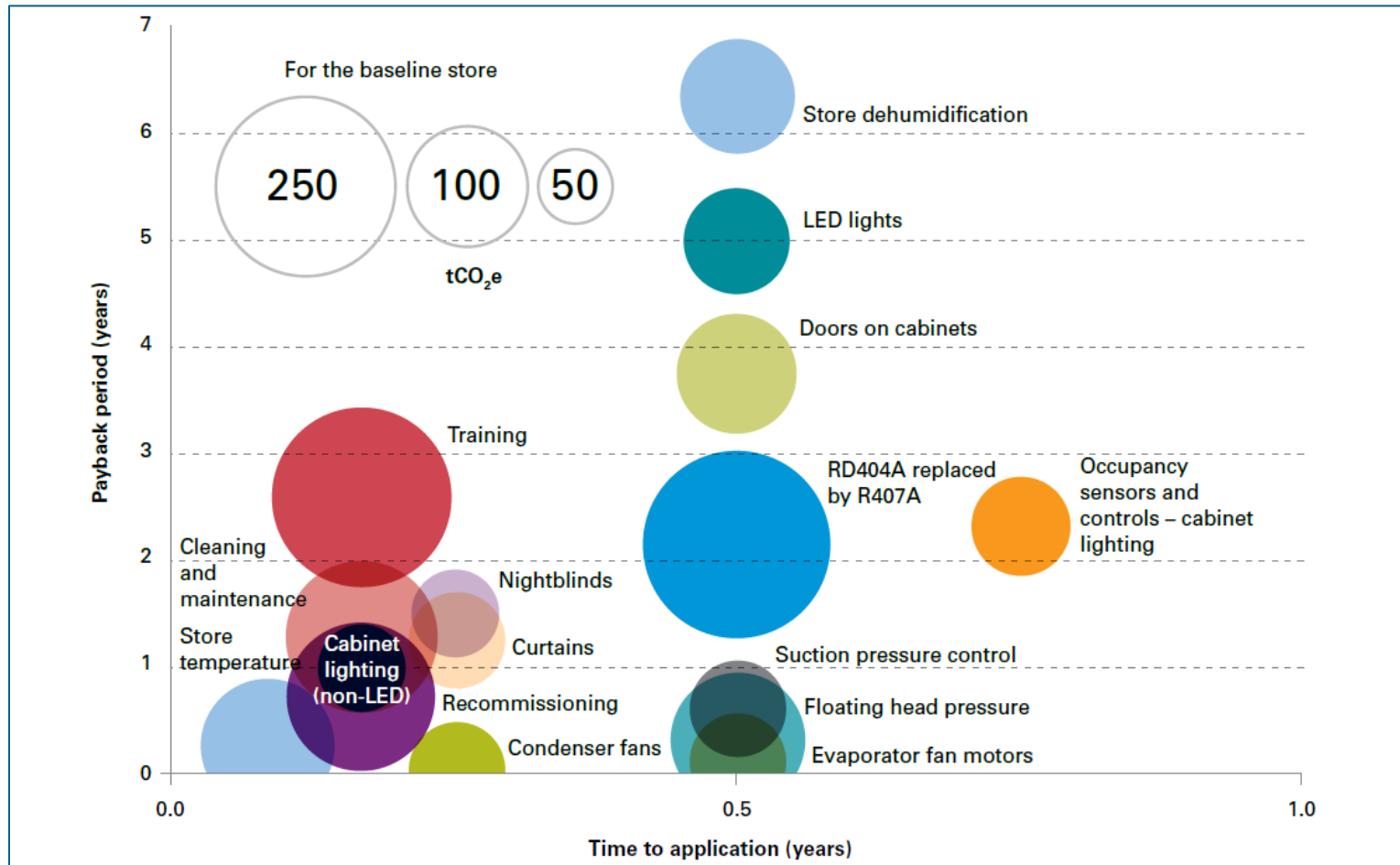
Cost?

External drivers
critical for system
integration

Cross-sector
application



End User Roadmaps



Innovation opportunities

- Industrial Energy Transformation Fund: £12m fund
- Industrial Energy Efficiency Accelerator: supports technology development TRLs 5-8
- Industry of Future programme (2021-2023): decarbonisation roadmaps for industrial sites
- Energy Entrepreneurs Fund: 9th phase, TRLs 3-4 to 6-8

A few examples

University of Hull – evaporative dew point cooler with COP of 40



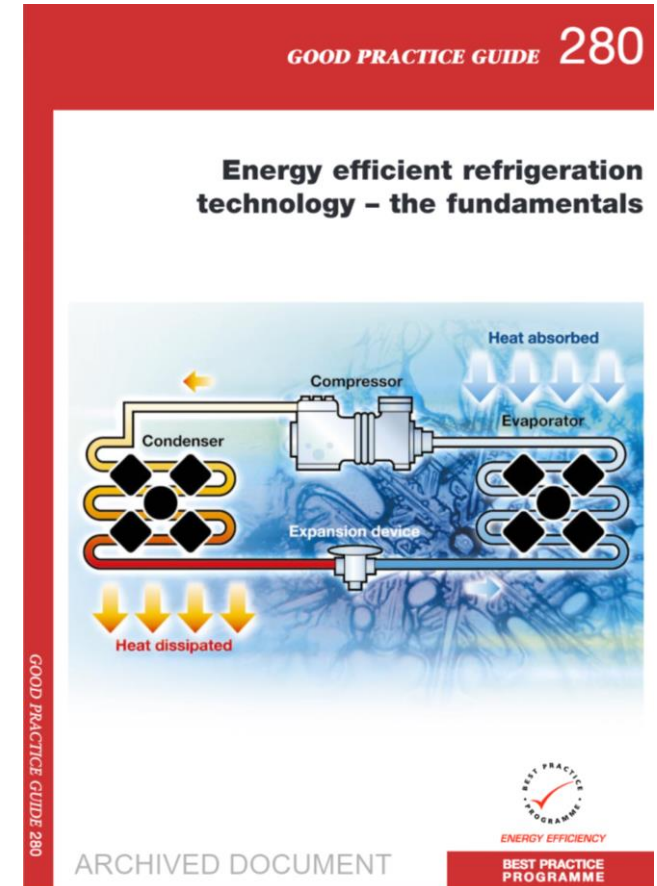
Aerofoil energy – new technology for supermarket cabinets



Sunswap – solar powered refrigeration units

End user tool kits

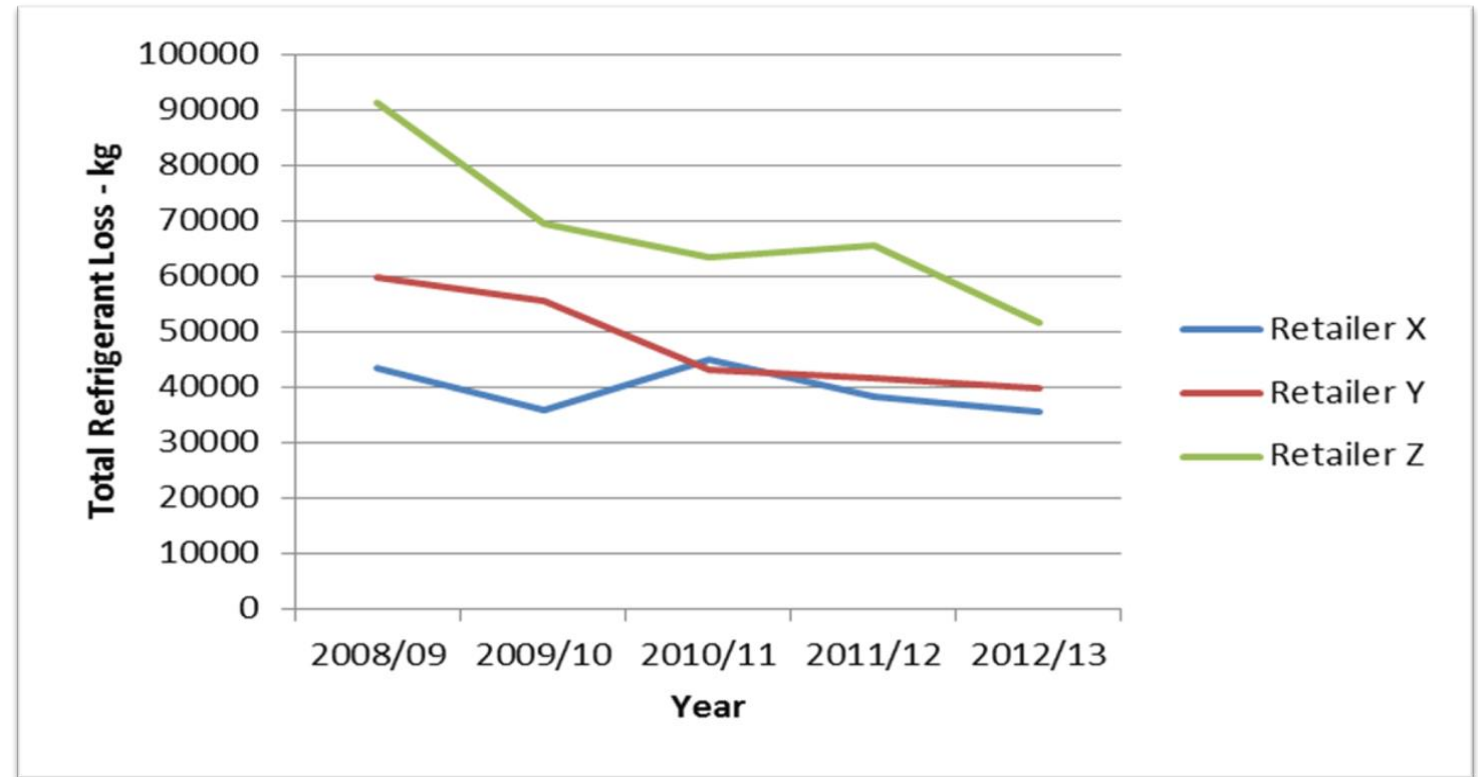
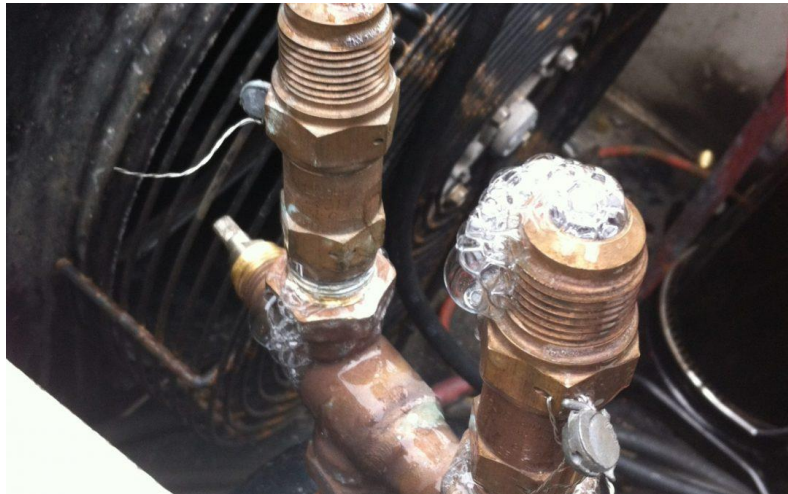
- Lots of resources already exist
- Can we put them in one place
- Lets have a look?



Zero Refrigerant Leakage



Reducing direct emissions from RACHP together





REAL Alternatives 4 Life

- Applies principles of REAL Zero to low GWP alternatives
- Address skills barriers with practical training material and train the trainer programme
- Addresses safety, reliability, efficiency and containment concerns
- Provides a consistency of training across EU (originally five languages).



E-LEARNING

Scope and history

FREE GUIDES

E-LIBRARY

CPD

ČESKY

DEUTSCH

EESTI

ESPAÑOL

FRANÇAIS

HRVATSKI

ITALIANO

NEDERLANDS

POLSKI

PORTUGUÊS

ROMÂNESC

SLOVENSKÝ

SUOMI

TÜRKÇE

ΕΛΛΗΝΙΚΑ

РУССКИЙ

The European F Gas Regulation encourages wider adoption of alternatives to high GWP HFC refrigerants. Industry groups are joining together to help provide information on the safe use of alternatives such as ammonia, hydrocarbon, carbon dioxide and low flammables through the REAL Alternatives 4 LIFE learning programme. Resources developed as part of the project offer innovative blended learning - a mix of e-learning, face-to-face training materials, practical exercises, assessments and an e-library of learning resources - the programme has brought together industry knowledge and expertise from across Europe about alternative refrigerants.

REAL Alternatives 4 LIFE has built on the successful REAL Skills Europe & REAL Zero containment approaches. (Refrigerants, Emissions And Leakage - Zero). It was prepared by a consortium of Partners from across Europe, co-funded by the EU, included training and professional institutes as well as employer representative bodies.

Industry stakeholders drawn from employers, manufacturers, trade associations and professional institutes have contributed learning material, advised on content, helped to pilot and to promote the programme as it developed.

The free multi-lingual learning materials are available for individual development or use as classroom training materials. They include e-learning content, electronic tools, a comprehensive library gathered from existing resources. The e-library contains over 100 useful industry resources.

How you can access the materials

[Sign up for our e-learning programme](#)

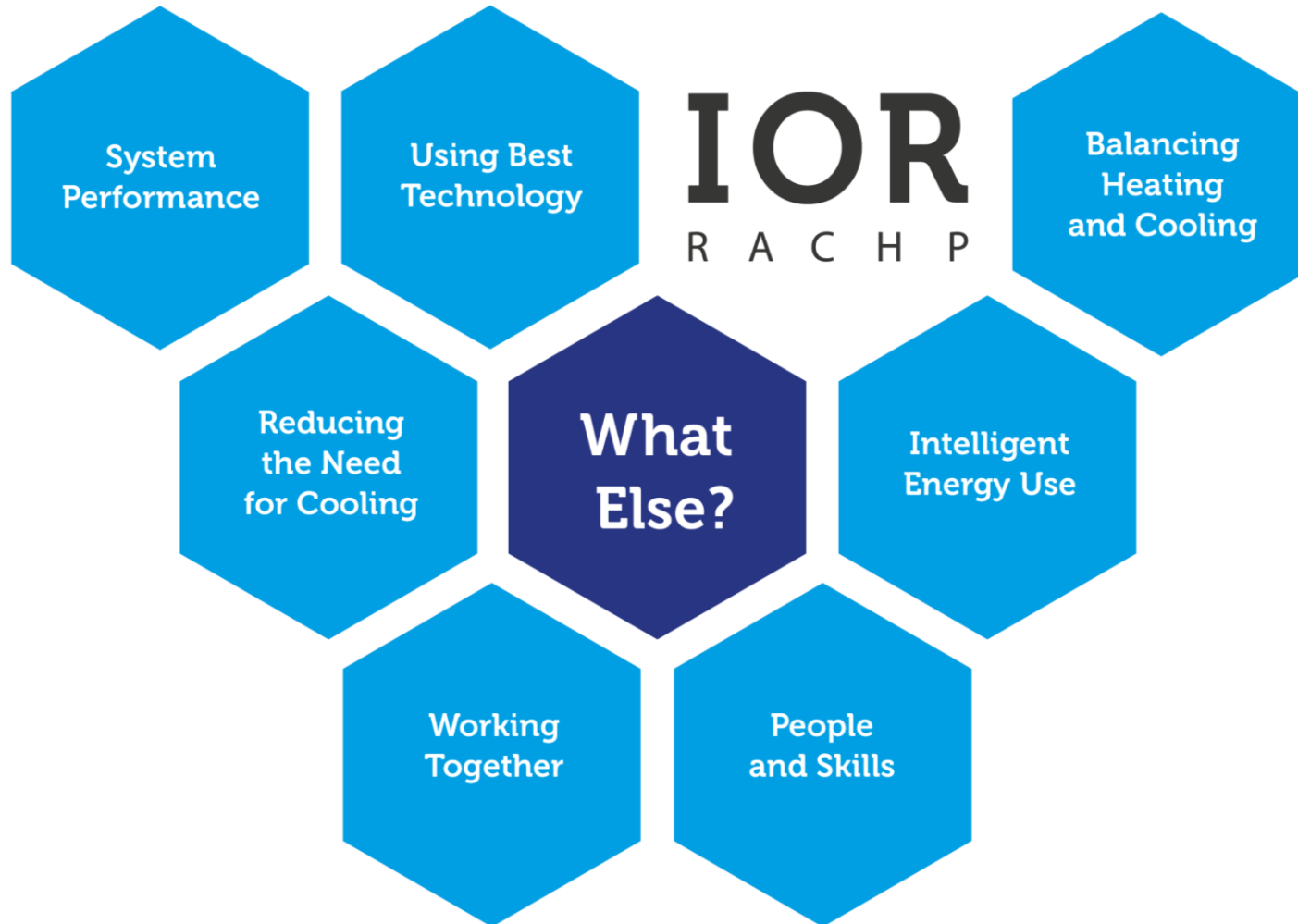
[Register on the website to download learning materials](#)

[View or add to our e-library of useful information from industry](#)





Beyond Refrigeration Initiative




- **Good Practice and Technology Guides**
- **Case Studies/Benchmarking**
- **Policy Papers for Stakeholders**
- **Communications campaign messaging**
- **Organisations working together**
- **CPD training on efficiency**

Beyond Refrigeration End User Roadmap

Published in June 2021



Beyond Refrigeration – an IOR template for the steps to Net Zero cooling 

Climate Change is an issue that everyone in all sectors needs to address. The purpose of *Beyond Refrigeration* is to develop guidance on how we can begin to address these issues in the refrigeration, air conditioning and heat pump sectors working back from what net zero in 2050 would look like. This document is a draft – inviting reflection, comment and discussion.

What does net zero mean? Put simply, net zero refers to the balance between the amount of greenhouse gas produced and the amount removed from the atmosphere. We reach net zero when the amount we add is no more than the amount taken away. A gross-zero target would mean reducing all emissions to zero – this is not realistic, so instead the net-zero target recognises that there will be some emissions but that these need to be fully offset. The UK is the world's first major economy to set the challenging target of being a net zero economy by 2050. The RACHP sector as a major user of energy (indirect emissions) and global warming gases (direct emissions) has an important part to play in this. You can read more about UK government net zero plans from the links at the end of this document.


Why is this important? If we do nothing today the cost to business is that we might not be in business by 2050. Net zero isn't just about using renewable energy – you need to make informed decisions about your future or risk being left with stranded assets – equipment you have to get rid of because it isn't compliant with government net zero policies and legislation or is costing you too much to run. A changing environment with more extremes of heat will put more demand on cooling processes. We need to reduce the climate impact of cooling activities whilst meeting the increasing demand for cooling services. All this, at the same time as improving safety, reliability and cost effectiveness. Businesses large and small, manufacturers or users of cooling need expert, independent guidance on how to address these challenges. They need to have a shared purpose and framework to work together in order to plan for their business' future based on understanding the total cost of ownership of their cooling equipment – financial and environmental.

How to use this template. The IOR as a charity has the remit to support the development of technology for the public benefit. It has developed the Beyond Refrigeration Net Zero template to help users of cooling to plan and take action starting with the end in mind. It identifies seven key areas that they need to address and provides suggested steps on how they can begin to work towards net zero in each of them. The steps begin by looking at what is a good starting point today and then provide a series of graded actions to take to that will help them move along a pathway towards an ideal end goal of net zero for that area.

The template is deliberately generic and not technology specific. In this way it can be adapted for use by any company or sector to help them to plan and review their strategies for working towards achieving net zero over the next 30 years. It was developed by a range of users and designers of cooling systems and will be regularly revised and updated as an evolving dynamic strategy as we move towards our shared goals. You will need more business specific advice and guidance on how to achieve these steps and there are plenty of resources already available or being developed on a sector by sector basis – we have included a list of resources at the end and these are useful for both larger businesses wanting an industry-standard comparison and smaller businesses who need help to get started. In addition Government schemes such as Climate Change Agreements, Enhanced Capital Allowances and Energy Technology Lists provide financial incentives that can support your choices.

How to get more involved. If you want to help this process to evolve and share steps you are taking towards net zero you can signpost additional resources and contribute to this work by signing up to our *Beyond Refrigeration* Working Groups at www.ior.org.uk/beyondrefrigeration

The process...



ior.org.uk/beyond-refrigeration



Working together



European Partnership for Energy
and the Environment



Policy Responses/Statements

- Response to the HBS strategy
- Heating & cooling policy brief
- Developing the best people and skills policy brief
- Statement of responsible refrigerant selection



MEMBERSHIP ▾ TECHNICAL ▾ ENVIRONMENT ▾ EDUCATION ▾ NETWORKING ▾ EVENTS ABOUT ▾ SHOP ▾

Home > News > Heat and Buildings Strategy

IOR members ready to deliver on Heat and Buildings Strategy

22 Oct 2021

The Institute of Refrigeration (IOR) welcomes the Government Heat and Buildings Strategy published earlier this week as a step towards net zero. In particular, we support the focus on the need to decarbonise virtually all buildings, the encouragement for heat pumps and heat networks, the emphasis on energy efficiency of buildings and the system-wide approach to energy. The need for a whole system approach to efficiency— rather than just a component focus - is something that the IOR has been eager to see within policy for many years. Equally the new focus on research and innovation, heat pump affordability and performance metrics for large industrial commercial facilities over 1000 m² is very much welcomed and will help the refrigeration, air conditioning and heat pump (RACHP) industry sectors make real and sustained progress towards supporting owner-operator net-zero goals.





Department for
Business, Energy
& Industrial Strategy



Innovation Community on

Affordable heating and cooling of buildings



MAXIMISING ENERGY EFFICIENCY

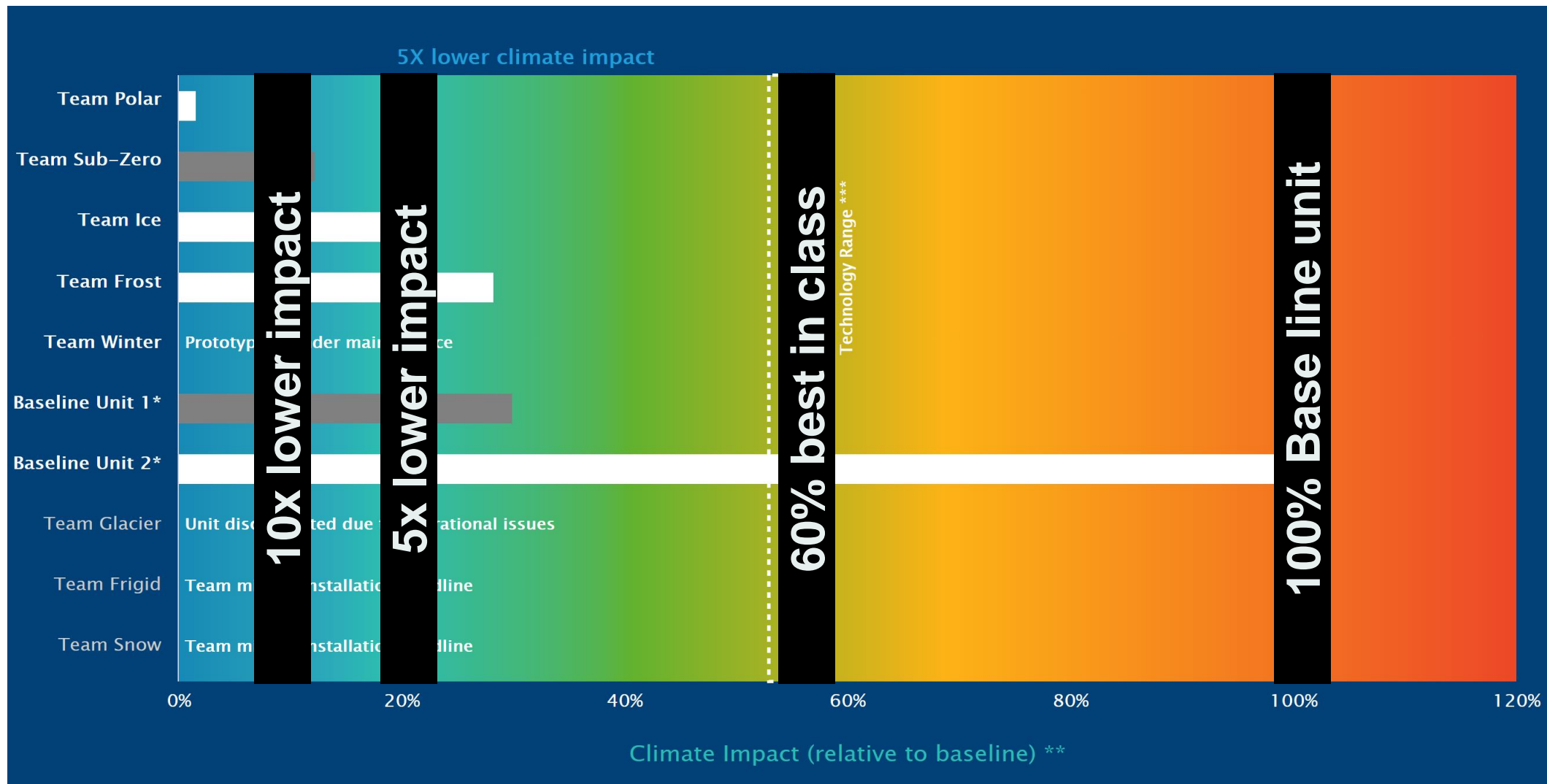


Improving our systems to achieve 5x lower climate impact

Global Cooling Prize



MAXIMISING ENERGY EFFICIENCY



Winning teams achieved >5x lower climate impact



TICR Funding

We are commissioning a research project to address some of these questions.

- Budget up to £680k**
- Application window May-June 2022**
- Project Sept 22-Aug 24**
- Supplier day 3rd May 2022 at 3pm**

<https://bidstats.uk/tenders/2022/W16/773128601>





Conclusions

- Need more robust information on current and future emissions
- Need to better understand potential innovations
- Provide support for end users to drive their decarbonisation
- Opportunities to work together



Thank you and Questions

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