Critical Decade for Climate Action Conference

8-10 SEPTEMBER | UNIVERSITY OF EAST ANGLIA | NORWICH, UK

Tyndall Centre for Climate Change Research 25

University of East Anglia

The University of Manchester

Newcastle University

University of Southampton

CRITICAL DECADE FOR CLIMATE ACTION CONFERENCE

Tuesday 9 September 2025

Parallel Session 8a
Time 14:15 – 15:45

Difficult to decarbonise sectors

Speakers: Paul Ekins (UCL), Danielle Densley Tingley (Sheffield), Asma Amamou (Newcastle), Lindsay-Marie Armstrong (Southampton)

Chair: Oliver Heidrich (Newcastle)
Rapporteur: Nicolas Labra Cataldo (Manchester)

Tyndall Centre for Climate Change Research

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Session outline

Paul Ekins, UCL – Why are some sectors of the economy so **difficult to decarbonise**?

Danielle Densley Tingley, Sheffield – Decarbonising **construction**: the challenges & opportunities

Asma Amamou, Newcastle – Healing without harming – the carbon challenge in **healthcare**

Lindsay-Marie Armstrong, Southampton – Decarbonising the **petrochemicals** sector: why its so tricky and sticky.

Panel discussion – chaired by Olivier Heidrich, Newcastle

Tyndall Centre for Climate Change Research

University of East Anglia

INSTITUTE FOR SUSTAINABLE RESOURCES

Why are some sectors of the economy so difficult to decarbonise?

Presentation to the Tyndall Centre Conference

'Our Critical Decade for Climate Action'

Professor Paul Ekins

Professor of Resources and Environmental Policy

UCL Institute for Sustainable Resources, University College London

University of East Anglia

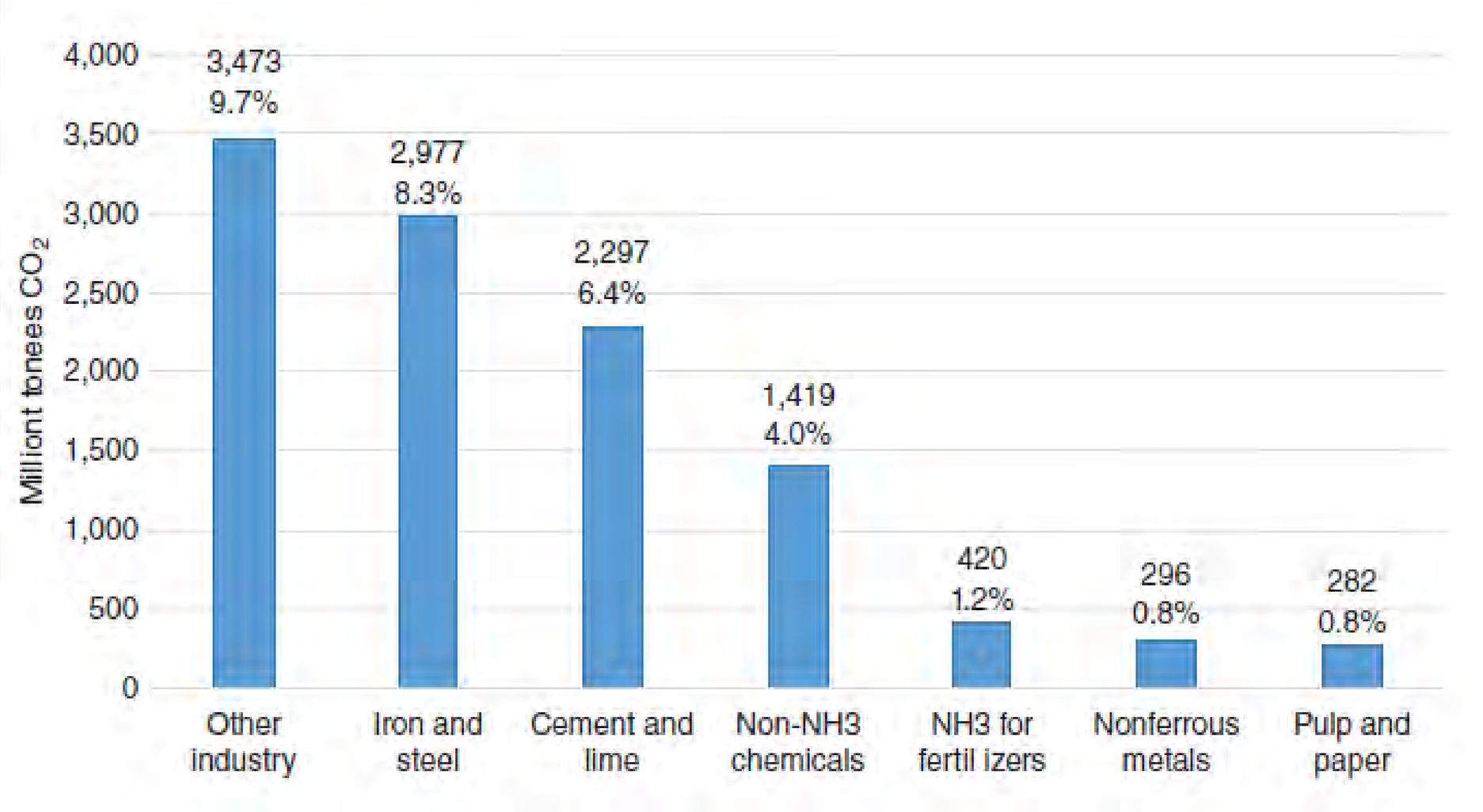
September 9, 2025

Structure of book

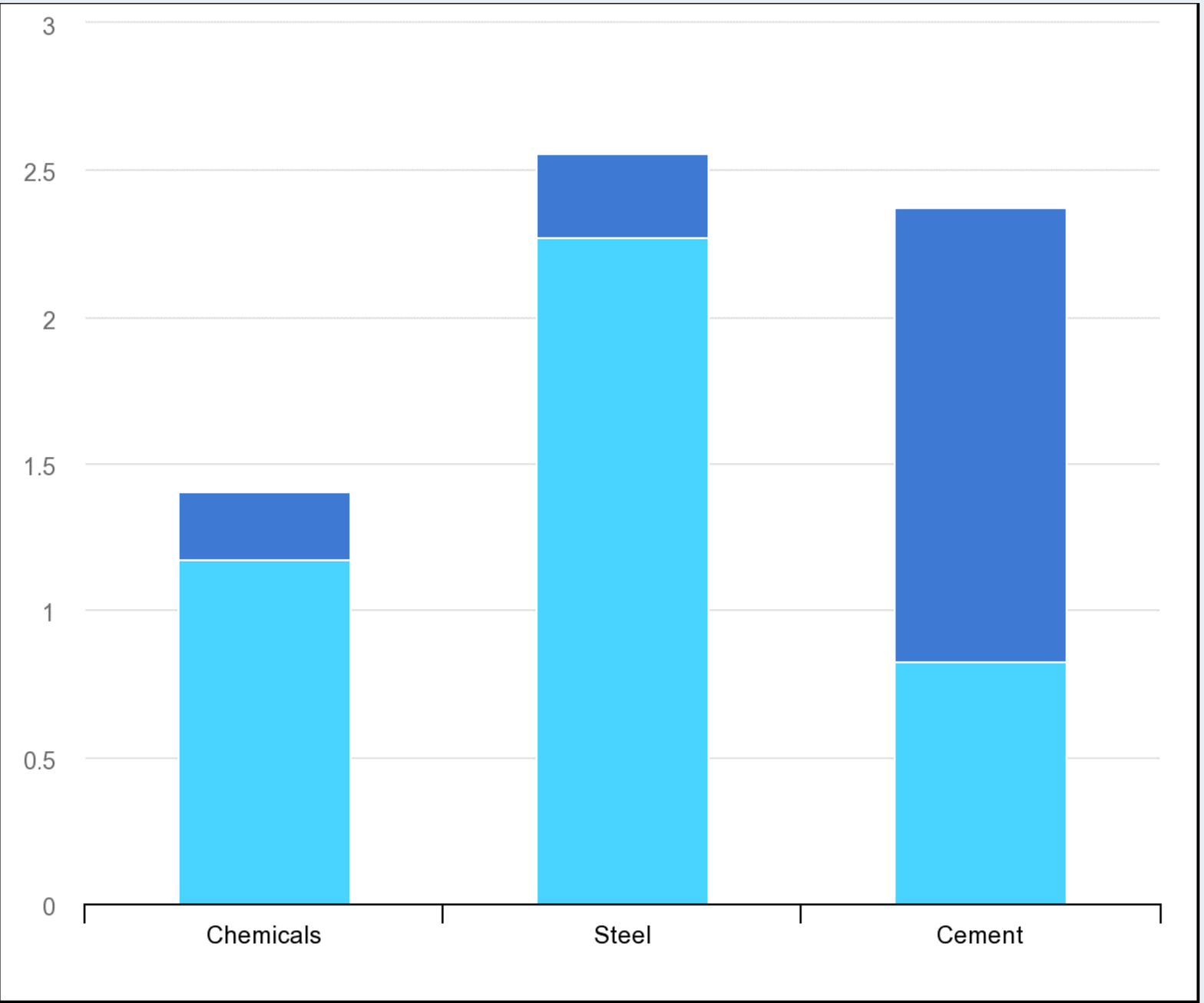
For book orders and to see endorsements: https://routledge.pub/Stopping-Climate-Change

Chapter 0: Introduction
Chapter 1: Why Real Zero
Chapter 2: The global context and pathways to Net Zero
Chapter 3: Energy efficiency, the ‘first fuel’
Chapter 4: Kicking the addiction to fossil fuels
Chapter 5: The future is electric
Chapter 6: Filling the gaps with bioenergy and hydrogen
Chapter 7: Carbon capture, use, storage and removal, and climate geoengineering
Chapter 8: The great enablers: digitalisation, the circular economy, and critical minerals for the clean energy transition
Chapter 9: Decarbonisation of buildings, transport, industry and business
Chapter 10: Feeding the world, reducing waste
Chapter 11: Economics of mitigation
Chapter 12: Policy and delivery
Chapter 13: Conclusion
Index

Global CO2 emissions from energy-intensive industries (2016)



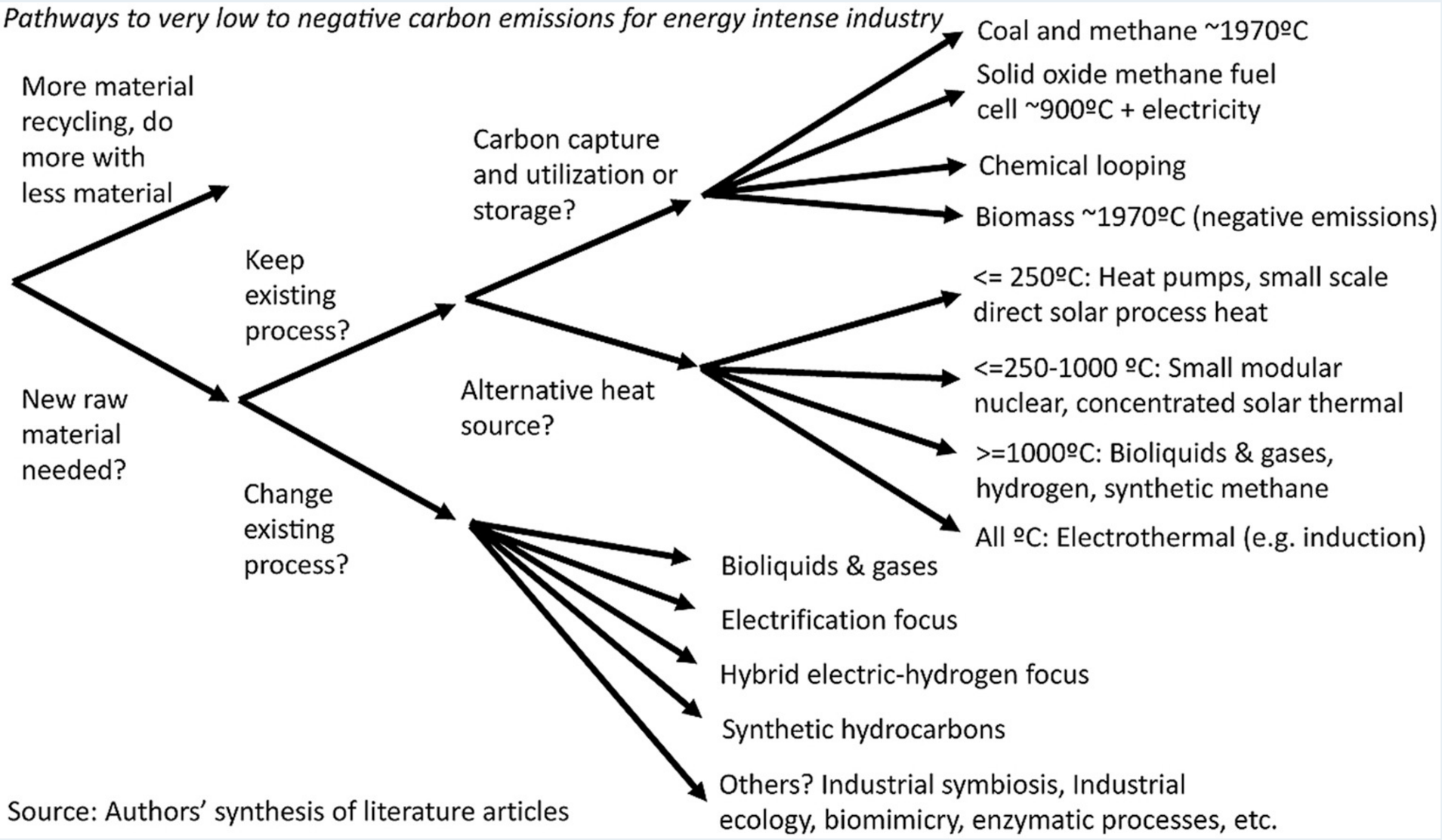
Source:
Bataille 2020
https://doi.org/10.1002/wcc.633



Energy (light blue) and process (dark blue) emissions from the three most carbon-emitting industrial sectors, GtCO2 per year, 2019

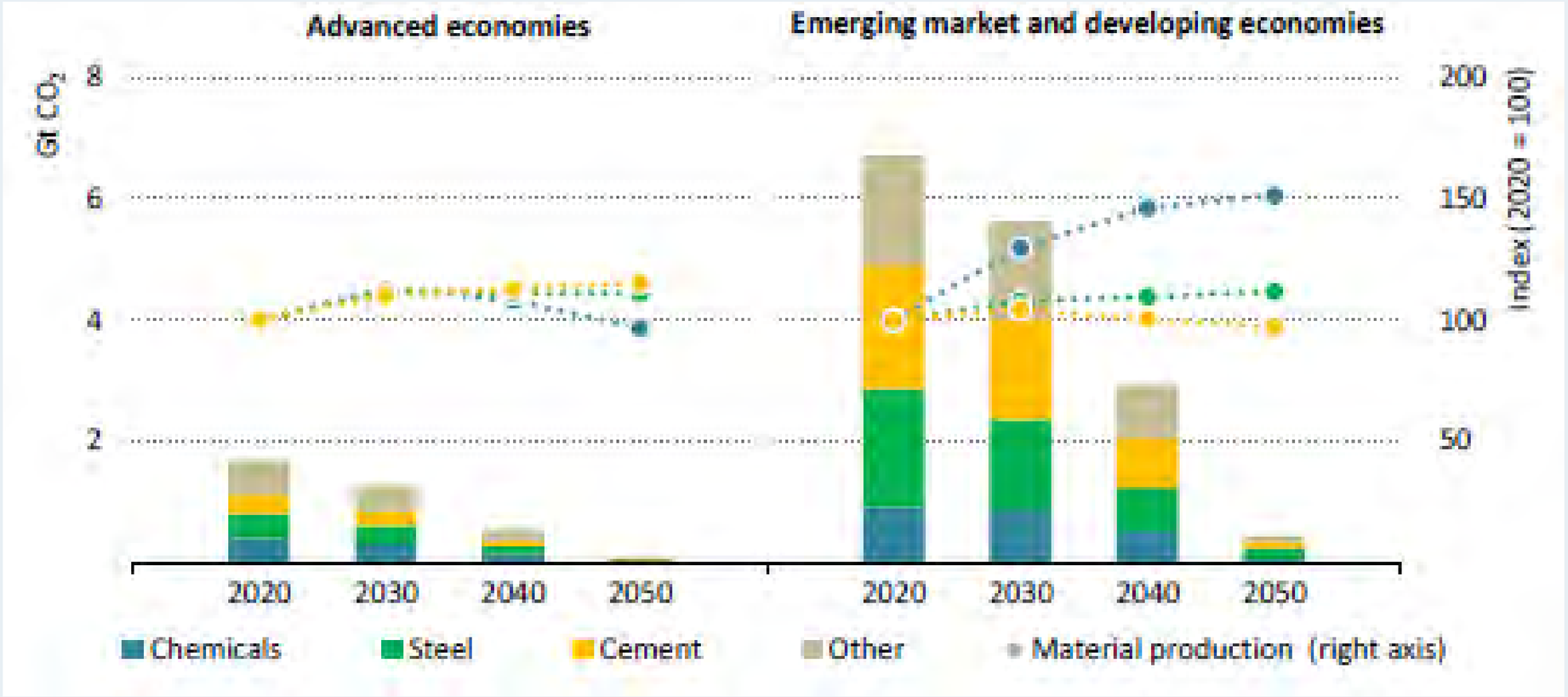
Source:
IEA, 2019
https://www.iea.org/articles/the-challenge-of-reaching-zero-emissions-in-heavy-industry

Options for decarbonising energy-intensive industries



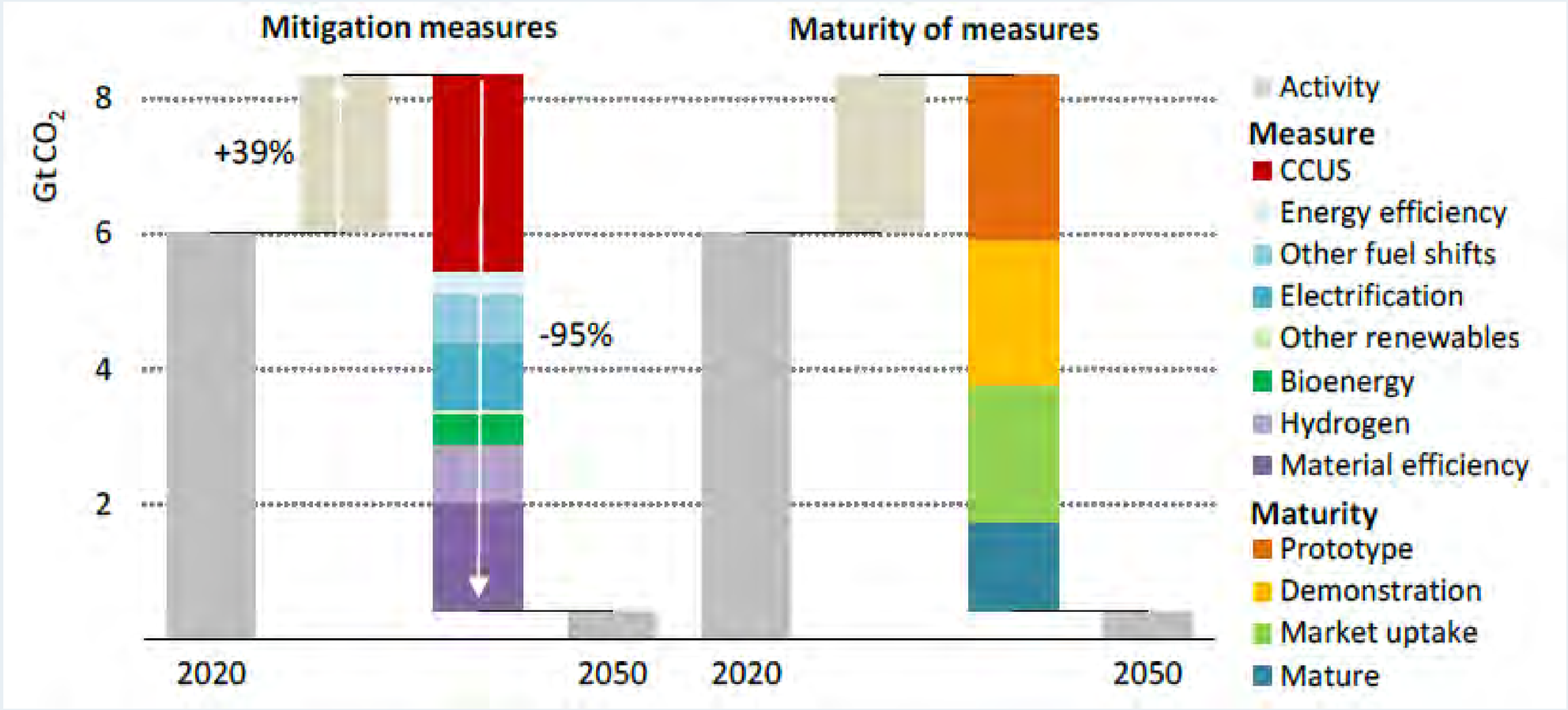
Source:
Bataille et al. 2018
https://doi.org/10.1016/j.jclepro.2018.03.107

CO2 emissions (left axis) of chemicals, steel and cement from 2020 to 2050 in the IEA Net Zero Emissions (NZE) scenario, by advanced, and emerging and developing, economies; material production (right axis)

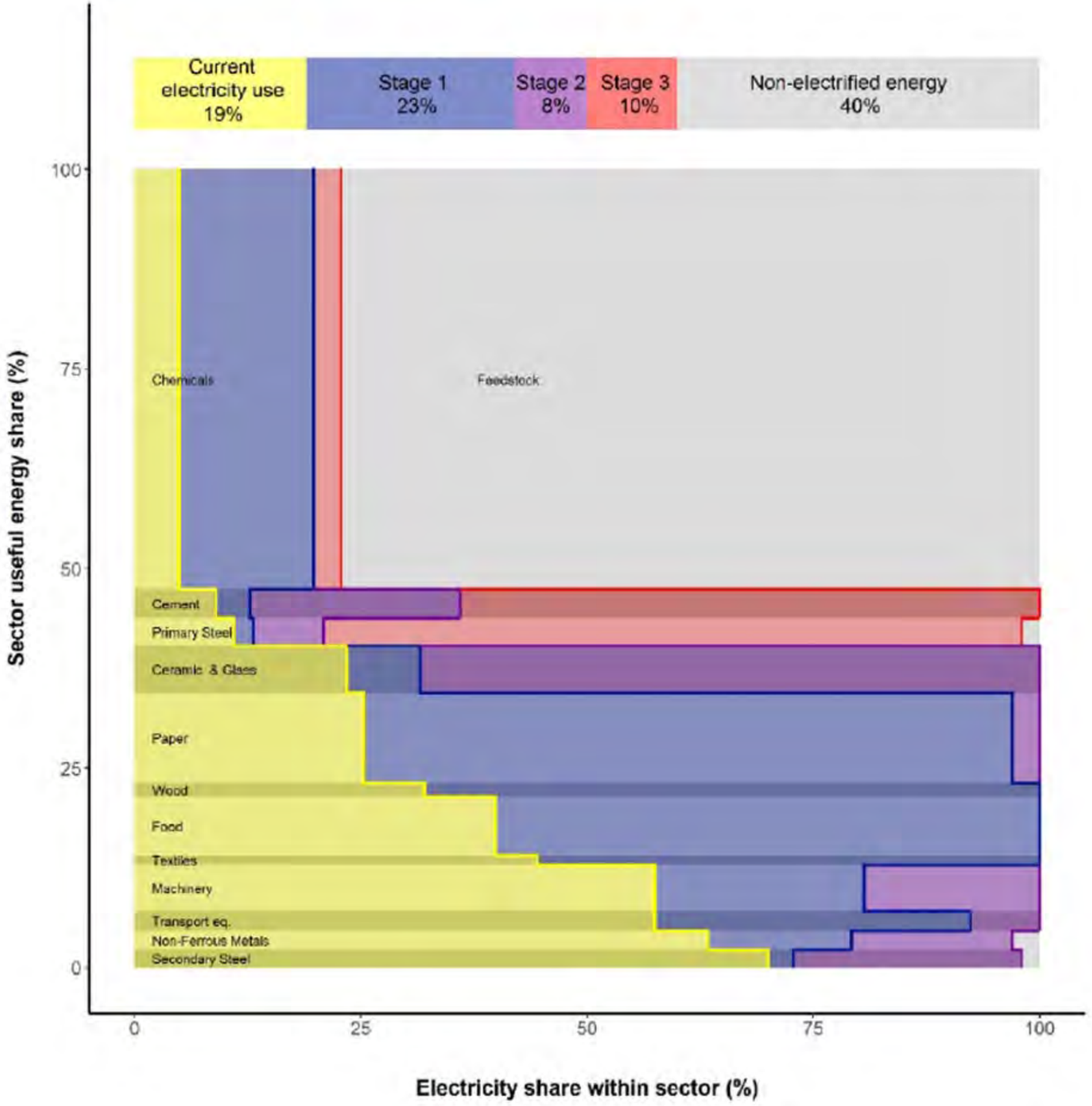


Source: IEA, 2021, Figure 3.15, p.122, https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

Least-cost decarbonisation of heavy industry in the IEA's NZE scenario



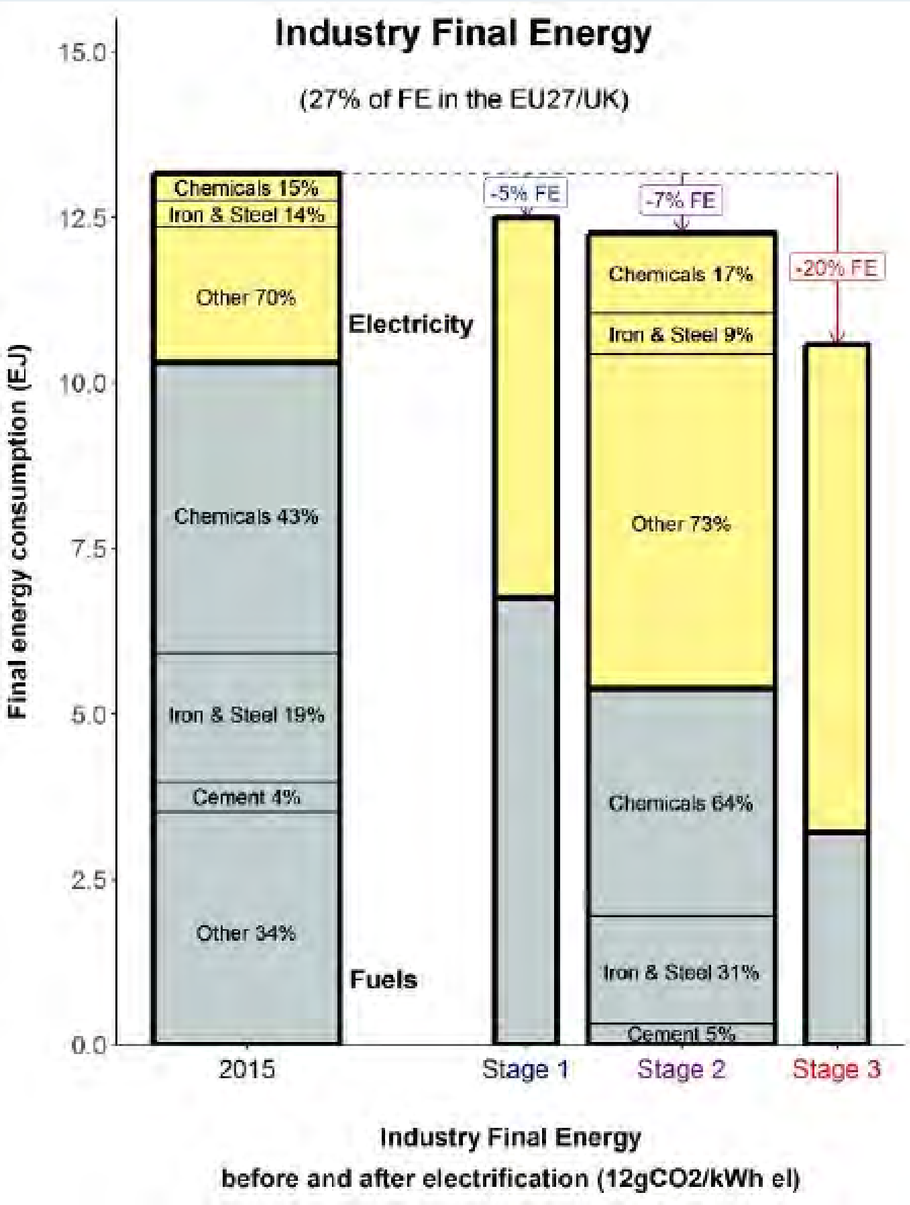
Source: IEA, 2021, Figure 3.16, p.123, https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf

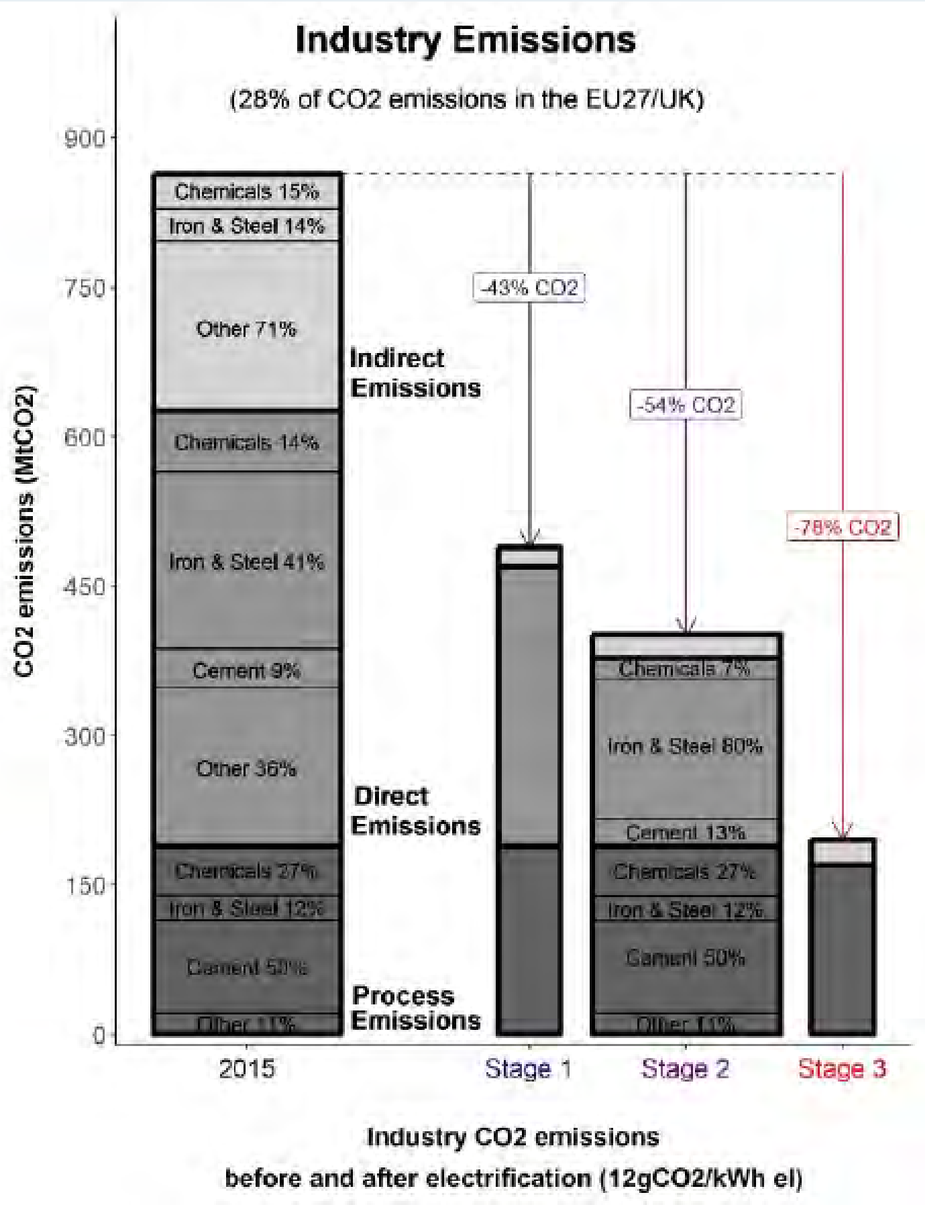


Decarbonisation of industry through electrification (1)

Source: Madeddu et al., 2020, Figure 2B, p.6, https://doi.org/10.1088/1748-9326/abbd02

Decarbonisation of industry through electrification (2)



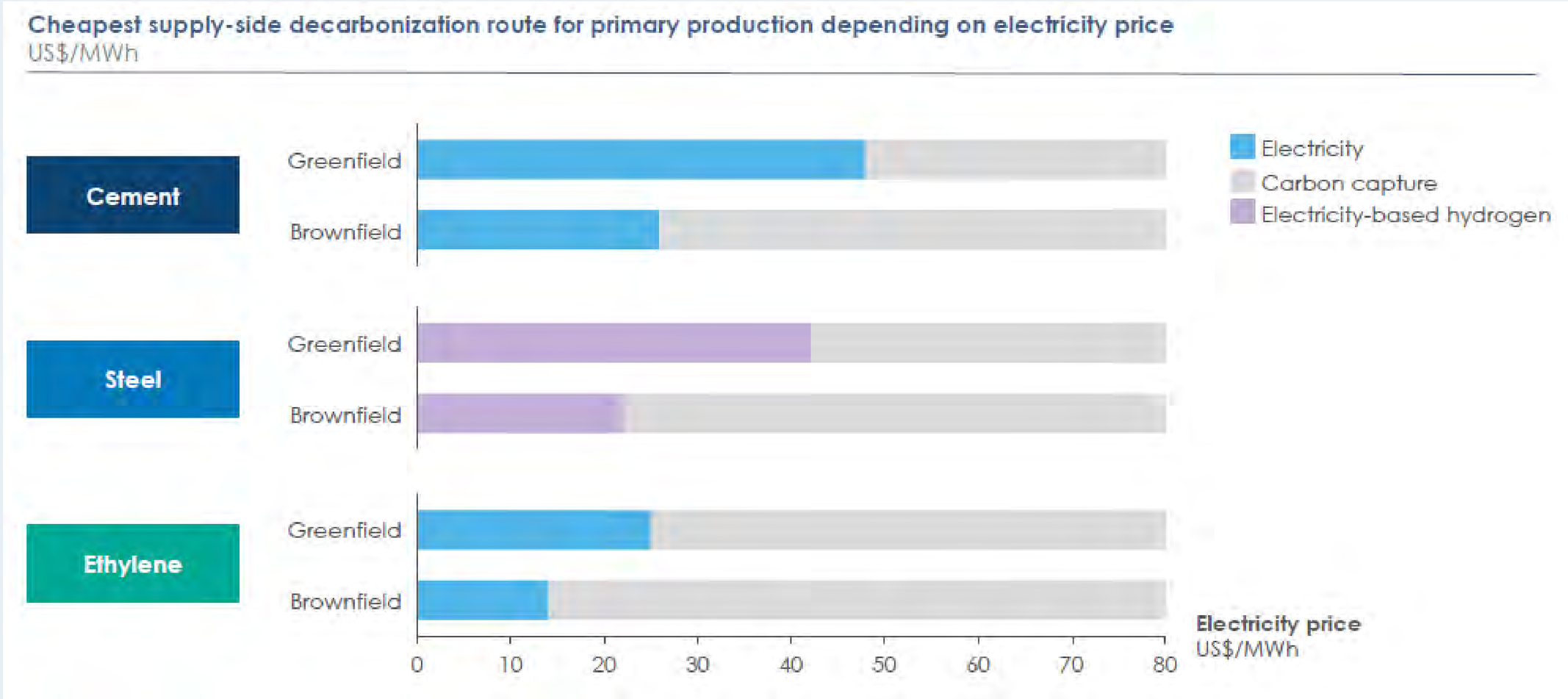


Source: Madeddu et al., 2020, Figure 2B, p.6, https://doi.org/10.1088/1748-9326/abbd02

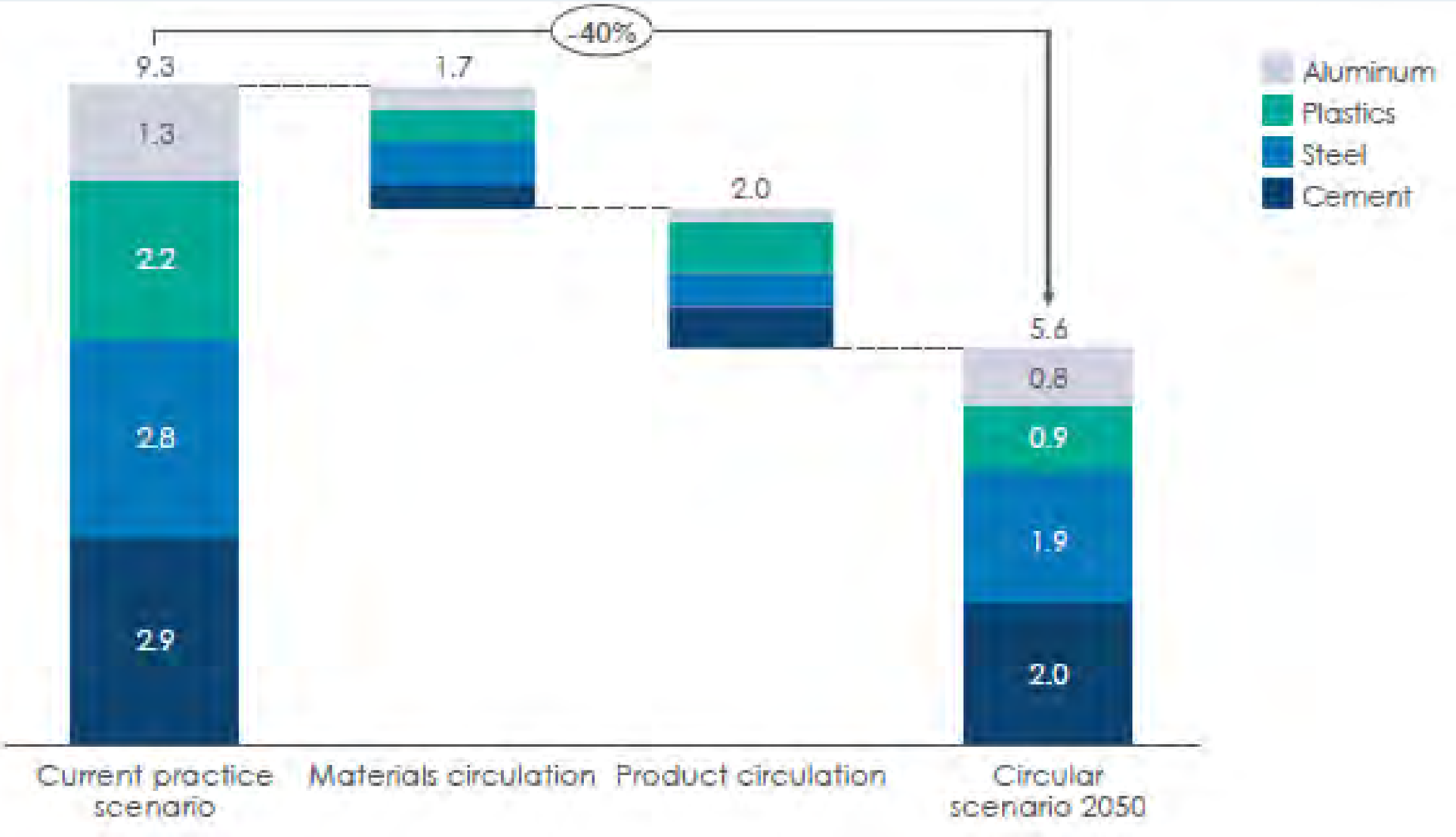
Use of electricity, hydrogen or CCUS in the decarbonisation of three heavy industry products

Source: Energy Transitions Commission, 2018, Exhibit 2, p.17

https://www.energy-transitions.org/publications/mission-possible/



Potential emissions reductions (GtCO2) from moving toward a more circular economy



Source: Energy Transitions Commission, 2018, Exhibit 2, p.17 https://www.energy-transitions.org/publications/mission-possible/

Conclusions

- Still a great continuing need for innovation, deployment of new technology to get costs down
- The critical issue is the cost of zero-carbon electricity
- The next most critical issue is the cost of electrolysers (plus availability of constrained renewables)
- Carbon capture and storage will be essential unless the costs of electricity and hydrogen fall to low levels
- Moving towards a circular economy (keeping products in use, recycling materials) can make a significant contribution
- Behaviour change least likely to make a significant difference

Thank you

p.ekins@ucl.ac.uk

www.bartlett.ucl.ac.uk/sustainable

For book orders and to see endorsements: https://routledge.pub/Stopping-Climate-Change

BuildZero

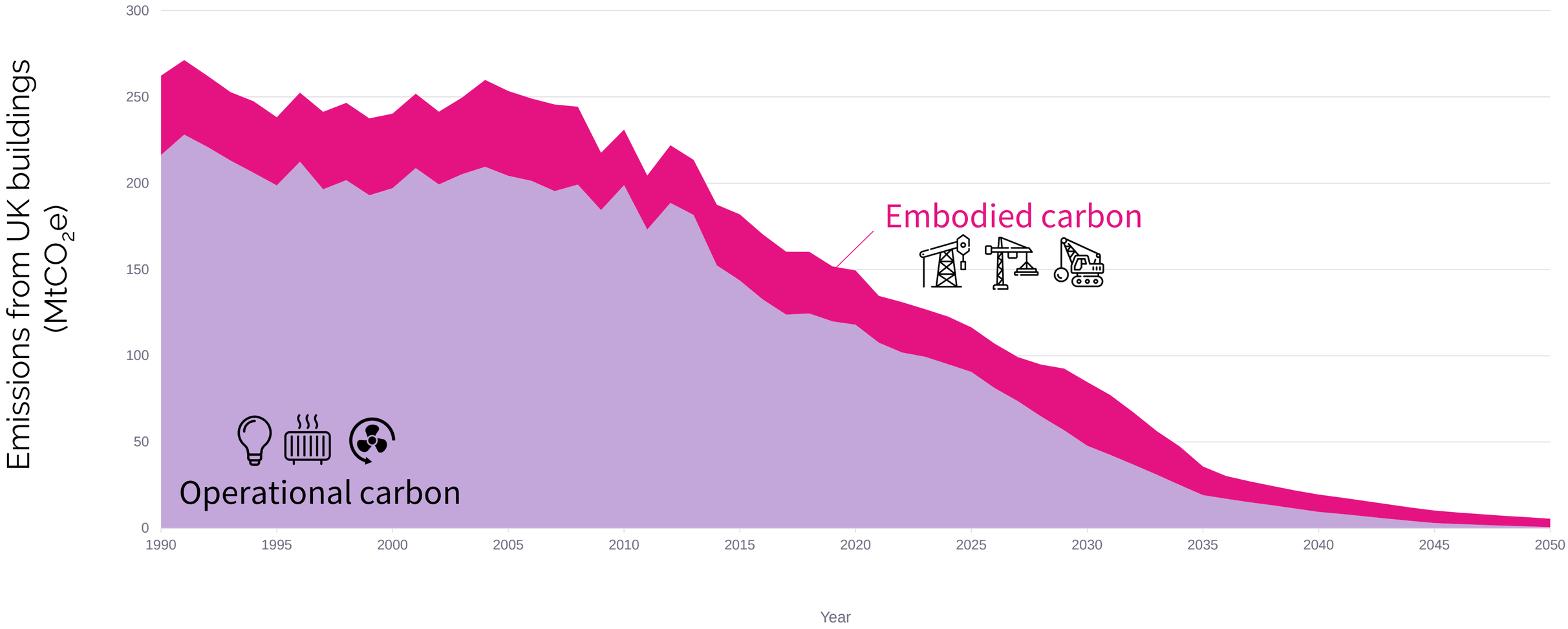
Decarbonising construction:

The challenges & opportunities

Prof Danielle Densley Tingley

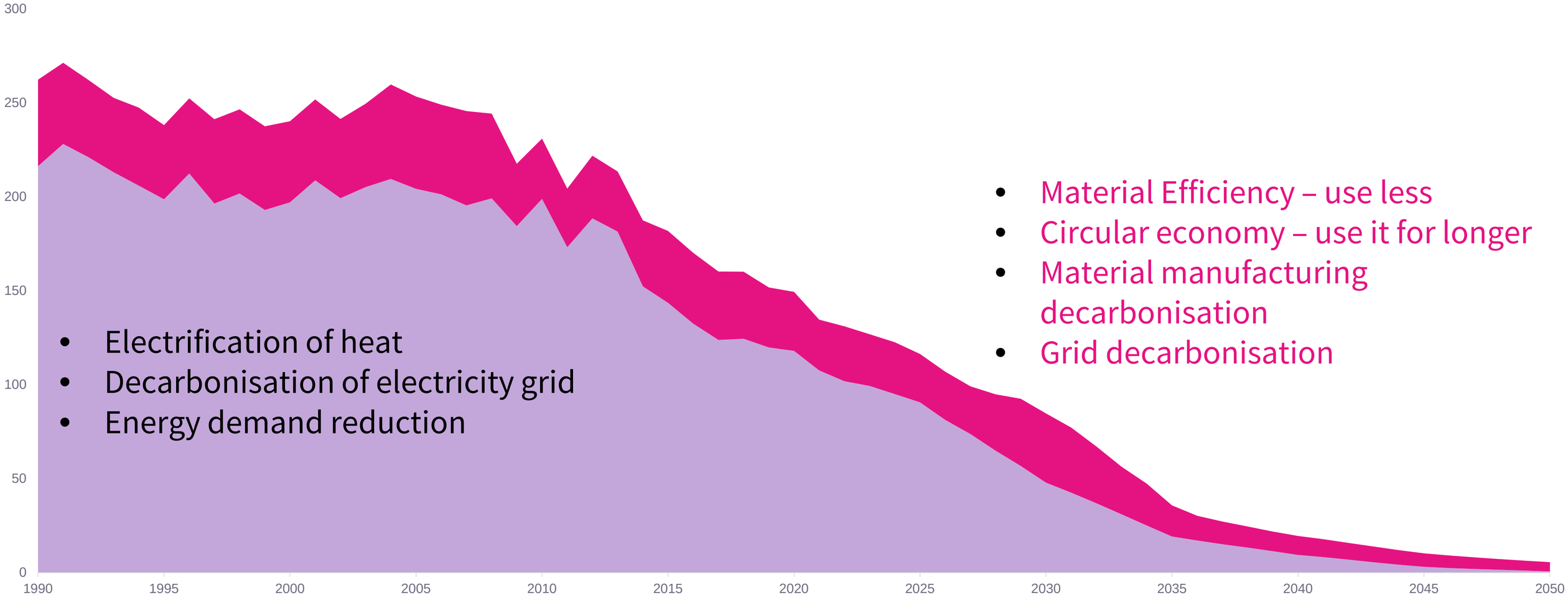
University of Sheffield

UKGBC construction decarbonisation pathway



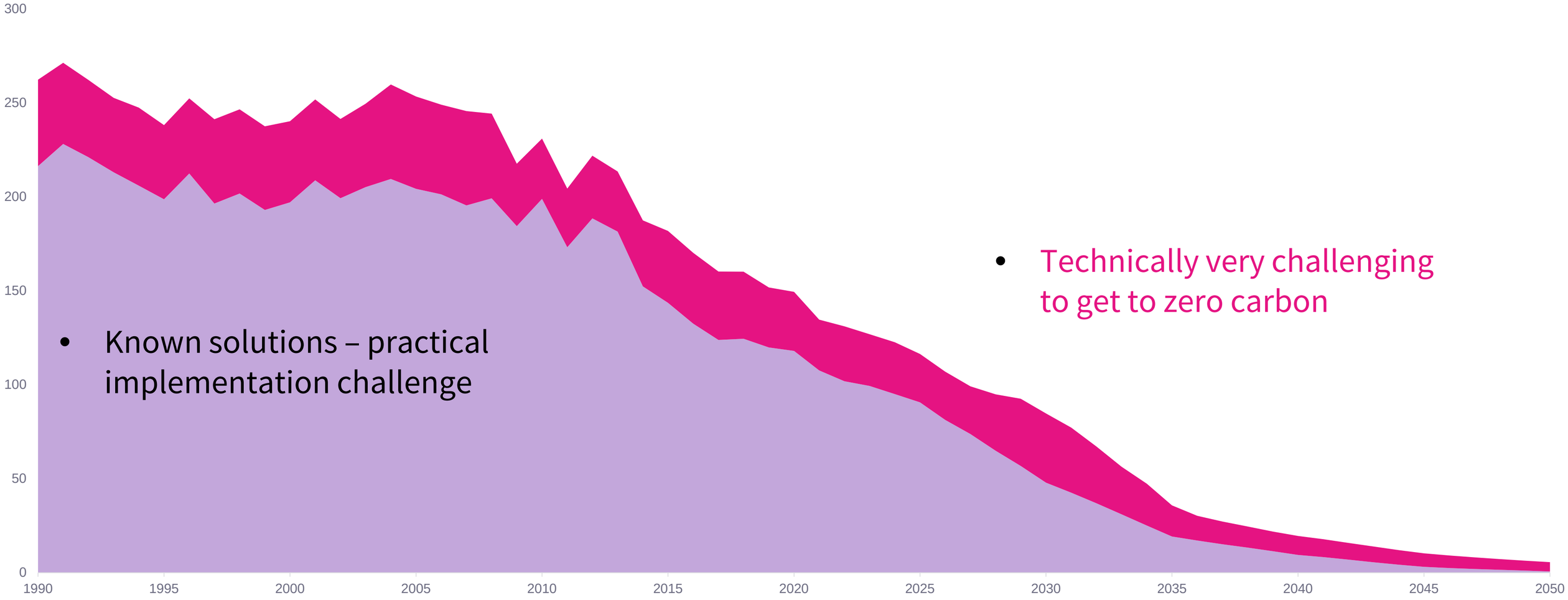
Data from: UKGBC (2021)

Likely reduction pathways



Data from: UKGBC (2021)

Challenges…



Data from: UKGBC (2021)

Retrofitting England’s Housing Stock

- ~25 million homes in England
- Old & largely inefficient stock
- Estimated 53% have wall insulation [1]
- 1% of homes have a heat pump as primary space heating system[1]
- Stock not currently compatible with net zero
- Decarbonising heating is a key challenge for decarbonisation

[1]English housing survey, 2023

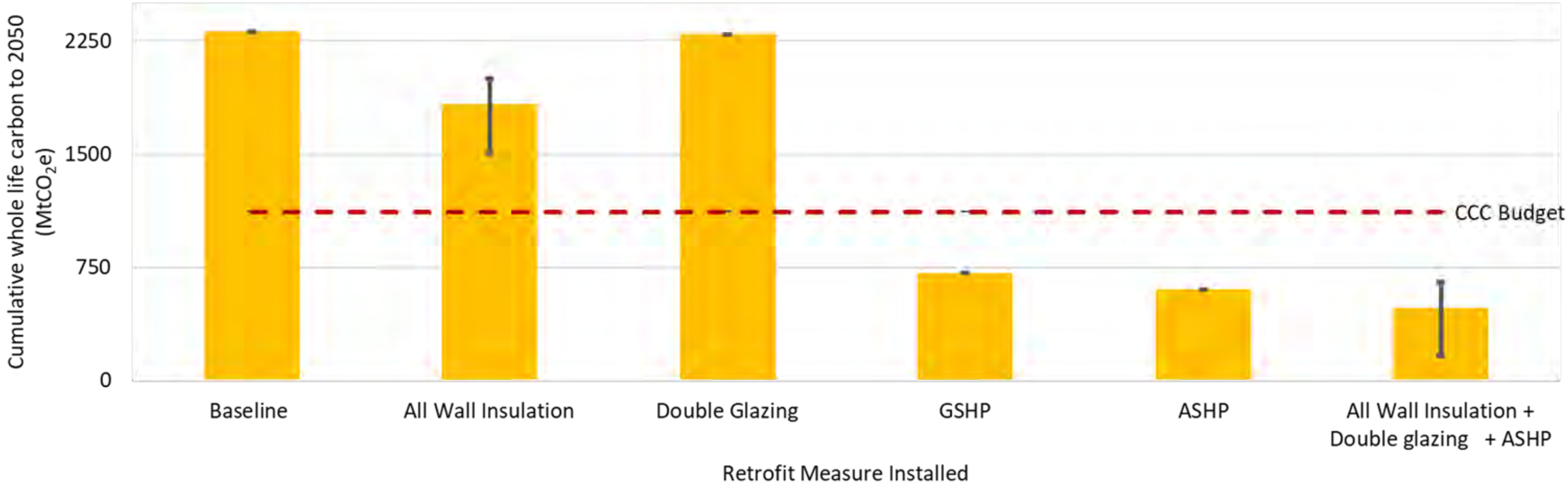
What does a net zero compatible housing stock look like?

Setting a residential carbon budget to 2050

CCC Budget	1119 $MtCO_2e$

*From 2021 – 2050, Based on the current share of domestic emissions

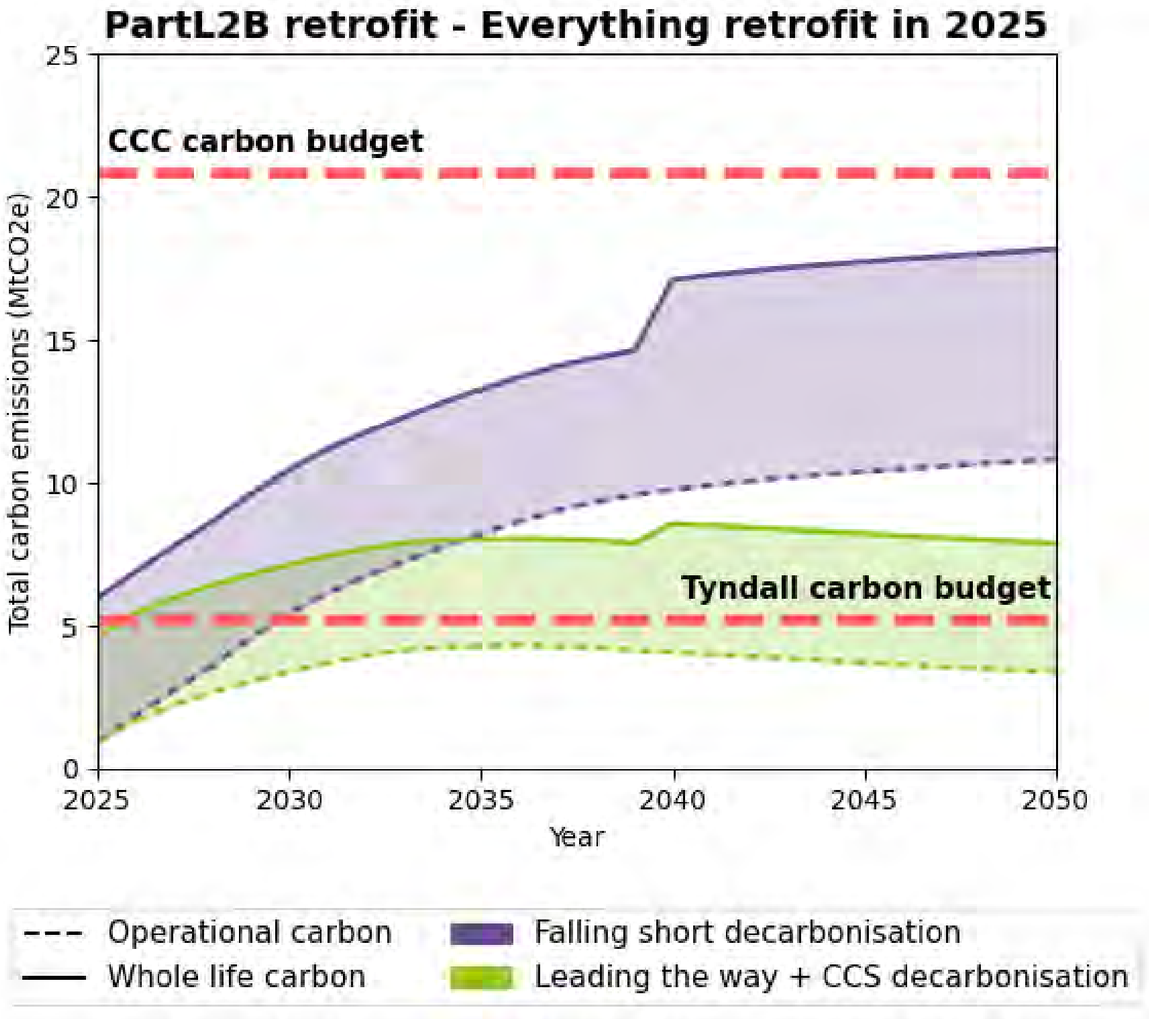
Cumulative whole life carbon to 2050

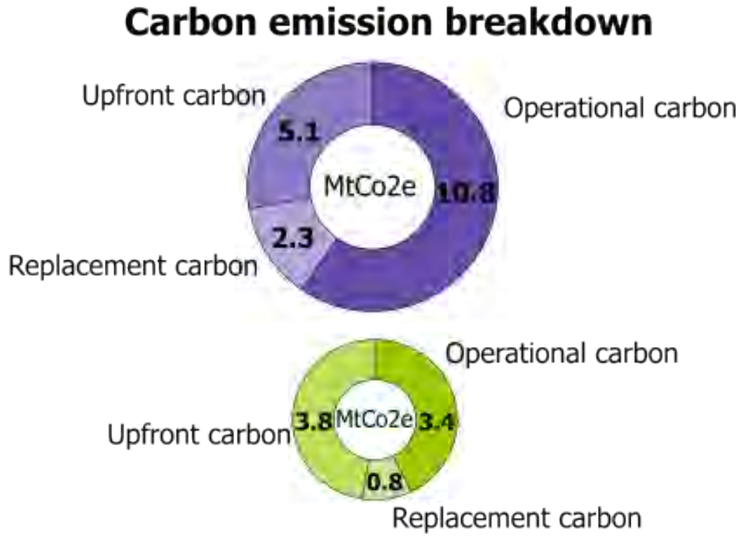


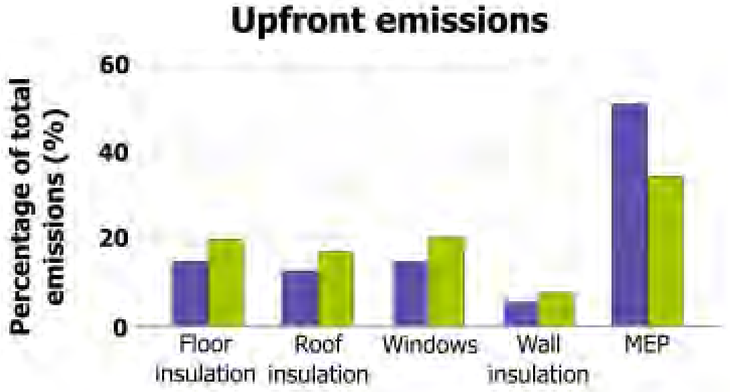
This assumes every house was retrofit in 2021!

Li, et al. 2022. Net zero by 2050: Investigating carbon-budget compliant retrofit measures for the English housing stock. Renewable and Sustainable Energy Reviews, 161.

Retrofitting England's School Stock



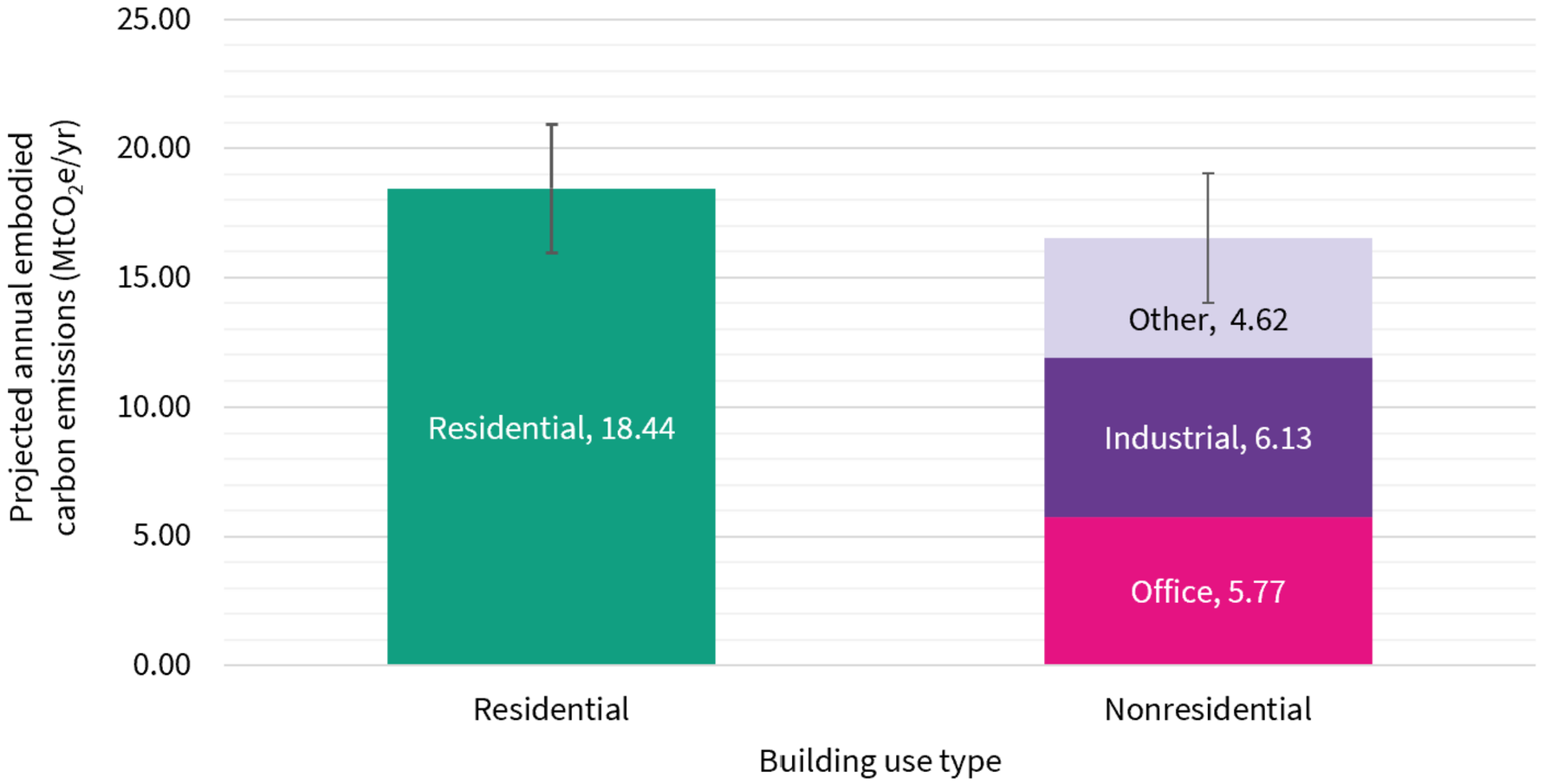




Abbey et al, *Under review*. Actions to decarbonise school buildings: a whole life carbon stock assessment

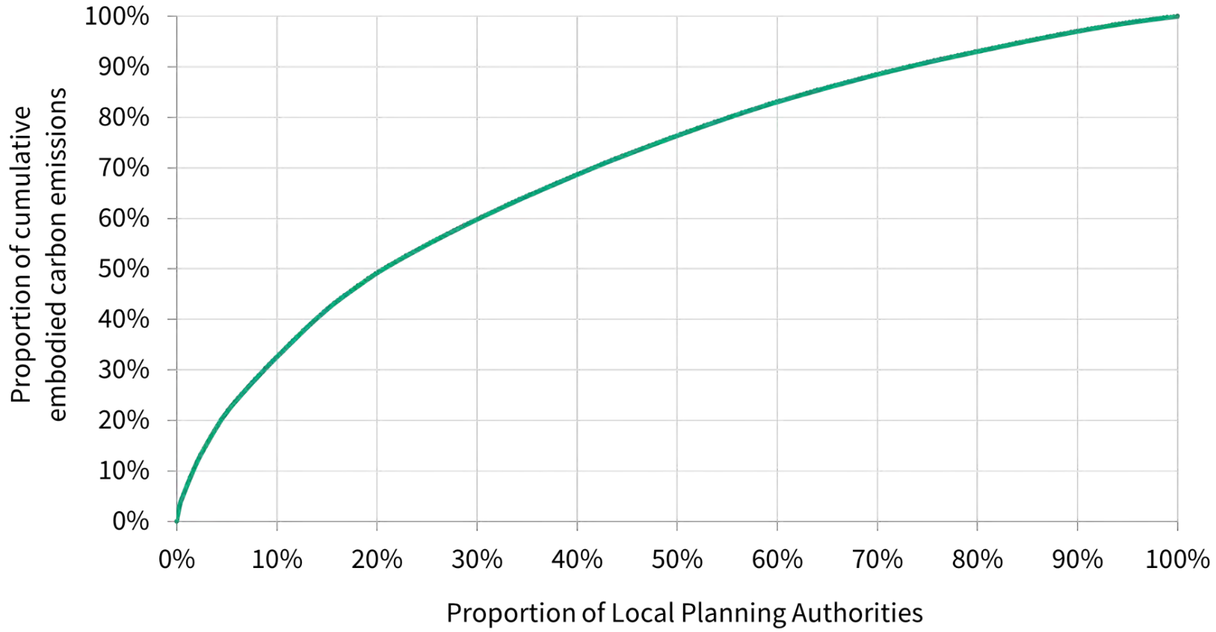
What about the 1.5 million new homes we need to build?

Projected embodied carbon from new construction



Gillott et al. (2025) Projected embodied carbon emissions from England's buildings by location, type and regulatory level BuildZero Briefing No. 1.
DOI: 10.15131/shef.data.29636411

Diffuse distribution of emissions



Gillott et al. (2025) Projected embodied carbon emissions from England's buildings by location, type and regulatory level BuildZero Briefing No. 1.
DOI: 10.15131/shef.data.29636411

What could national regulation achieve?

How can this be delivered at scale?

Gillott et al. (2025) Projected embodied carbon emissions from England's buildings by location, type and regulatory level BuildZero Briefing No. 1.
DOI: 10.15131/shef.data.29636411

BuildZero Vision

A future where the material needs of the UK's building stock can be met with zero raw material extraction, zero carbon & zero waste

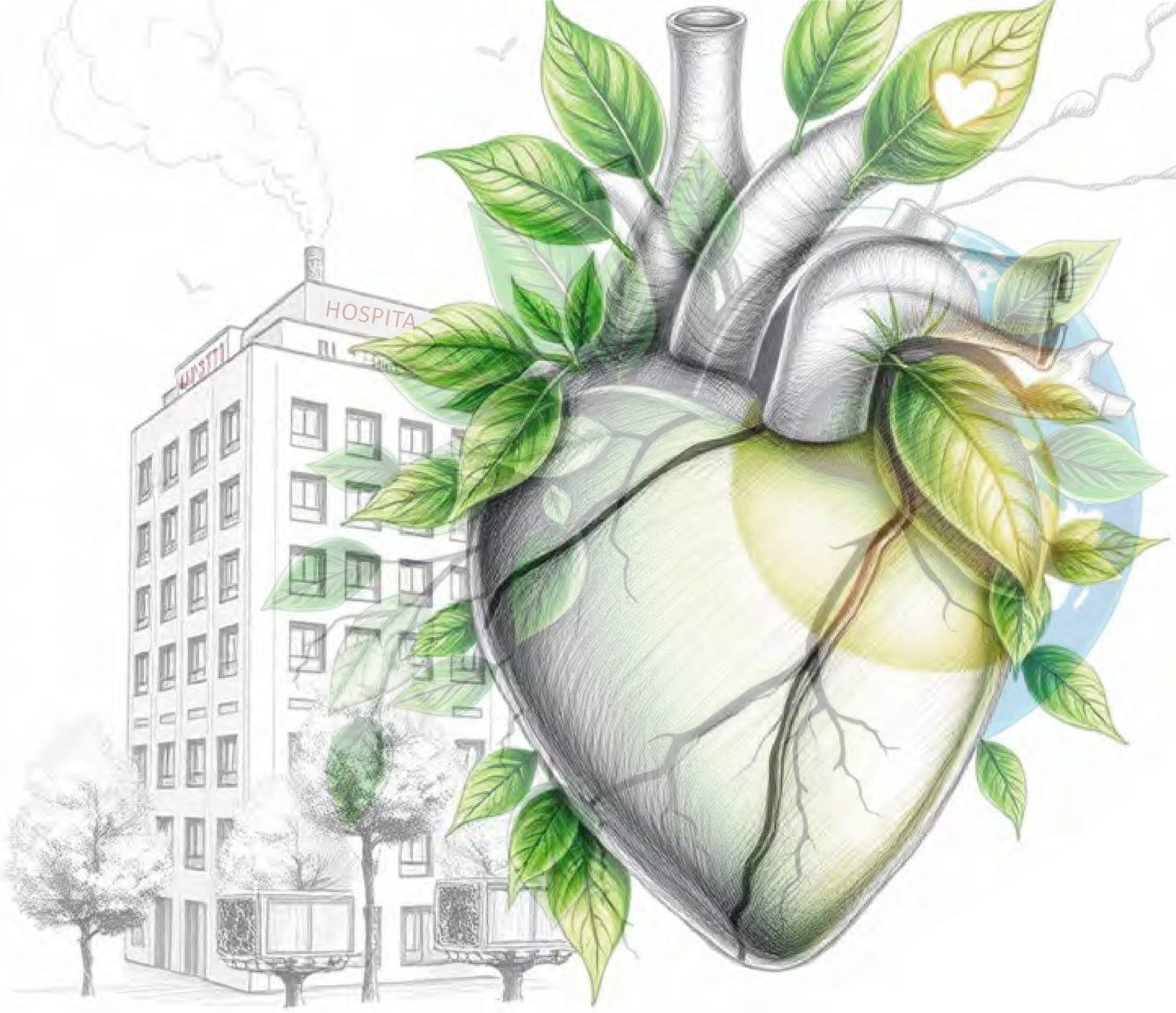
Questions?

Stay in touch:

BuildZero Research Programme

BuildZero@Sheffield.ac.uk

University of Sheffield

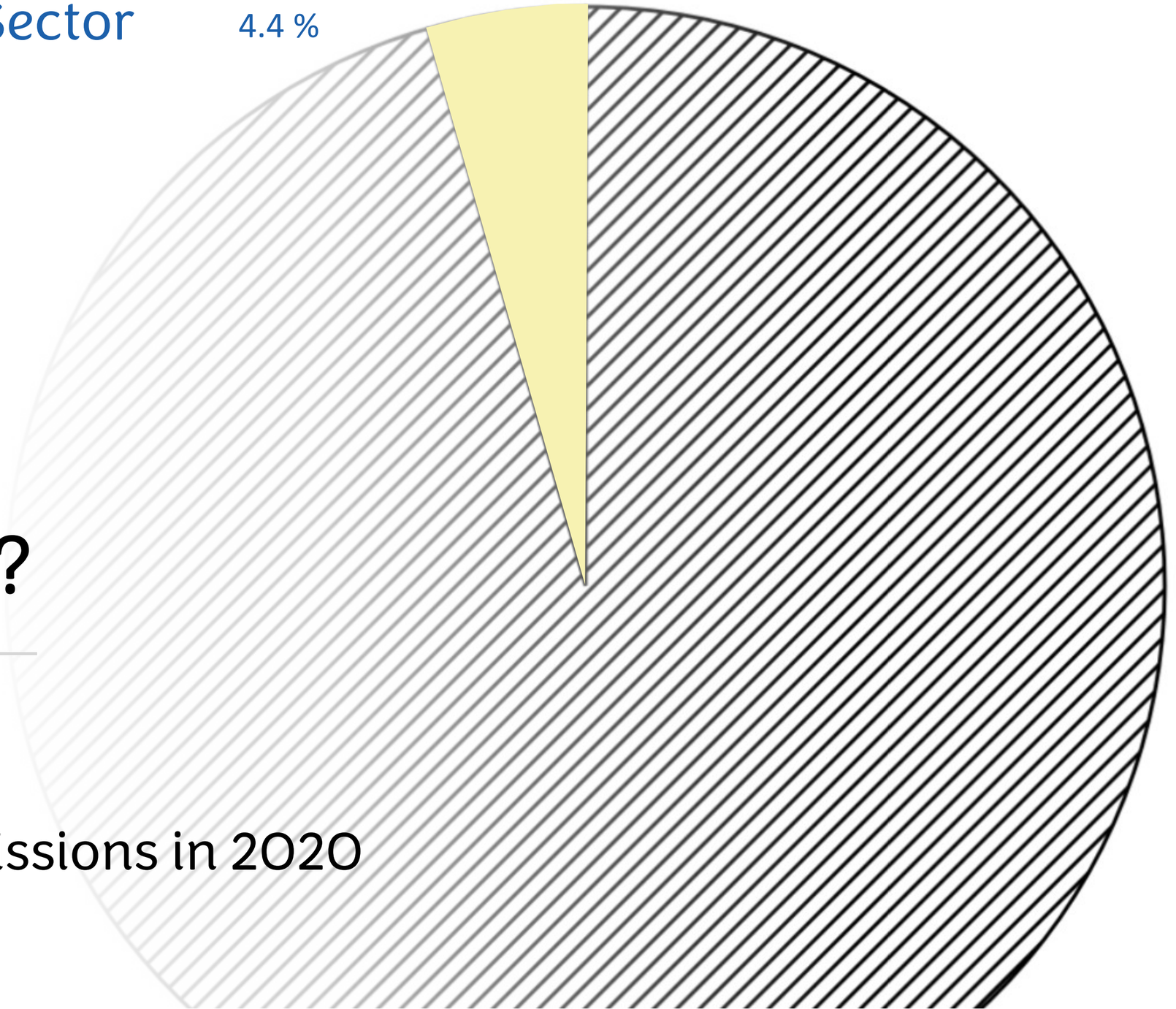


Healing without Harming

The Carbon Challenge in Healthcare

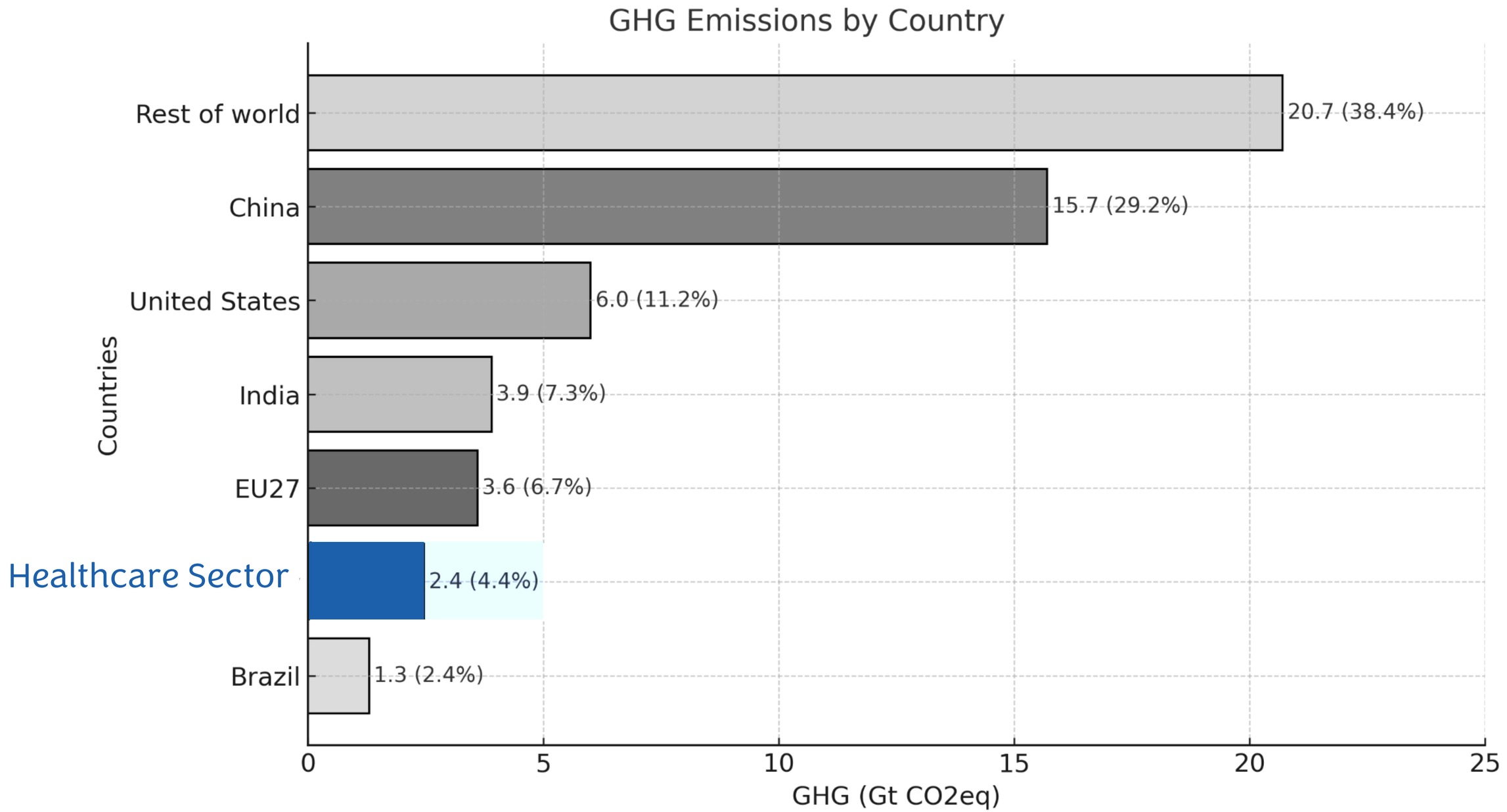
Presented by: Asma Amamou
Date: 09/09/2025

Healthcare Sector 4.4 %



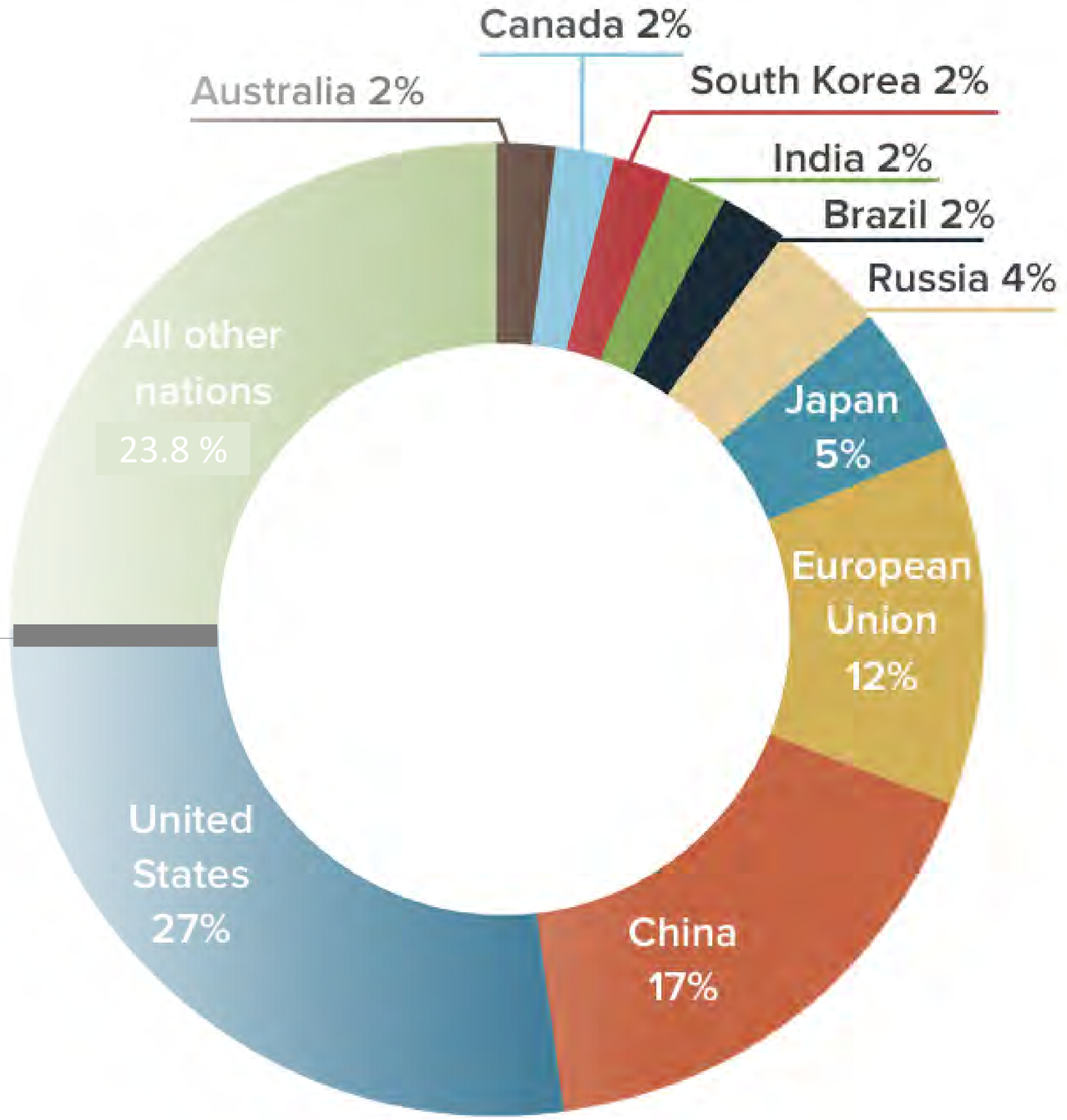
Did you Know ?

From global GHG emissions in 2020



Adapted from the report : GHG emissions of all world countries, Publications Office of the European Union, 2023, doi:10.2760/953332, JRC134504.

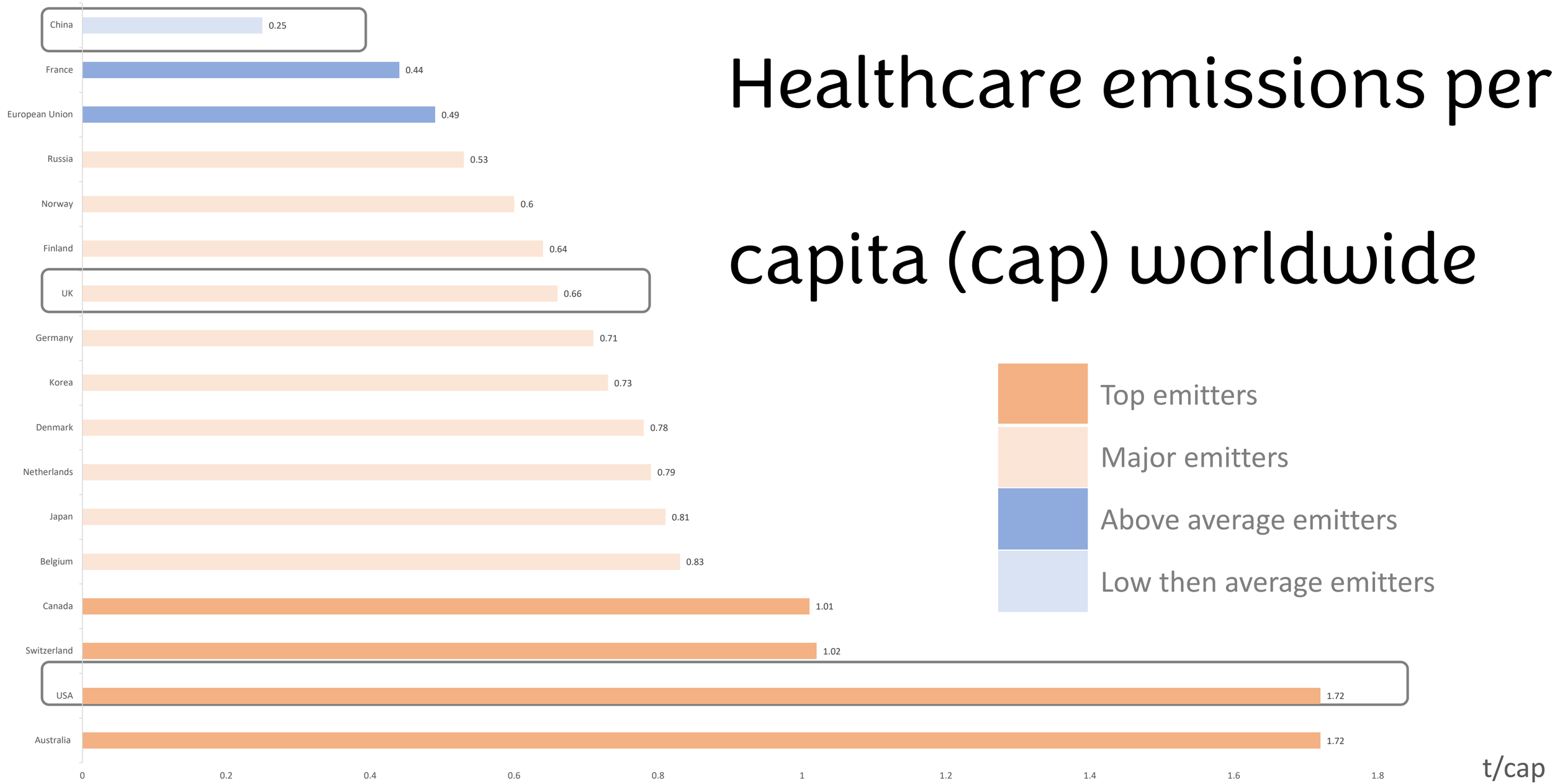
Top 10 emitters as % of global health care footprint



The UK 1.2 %

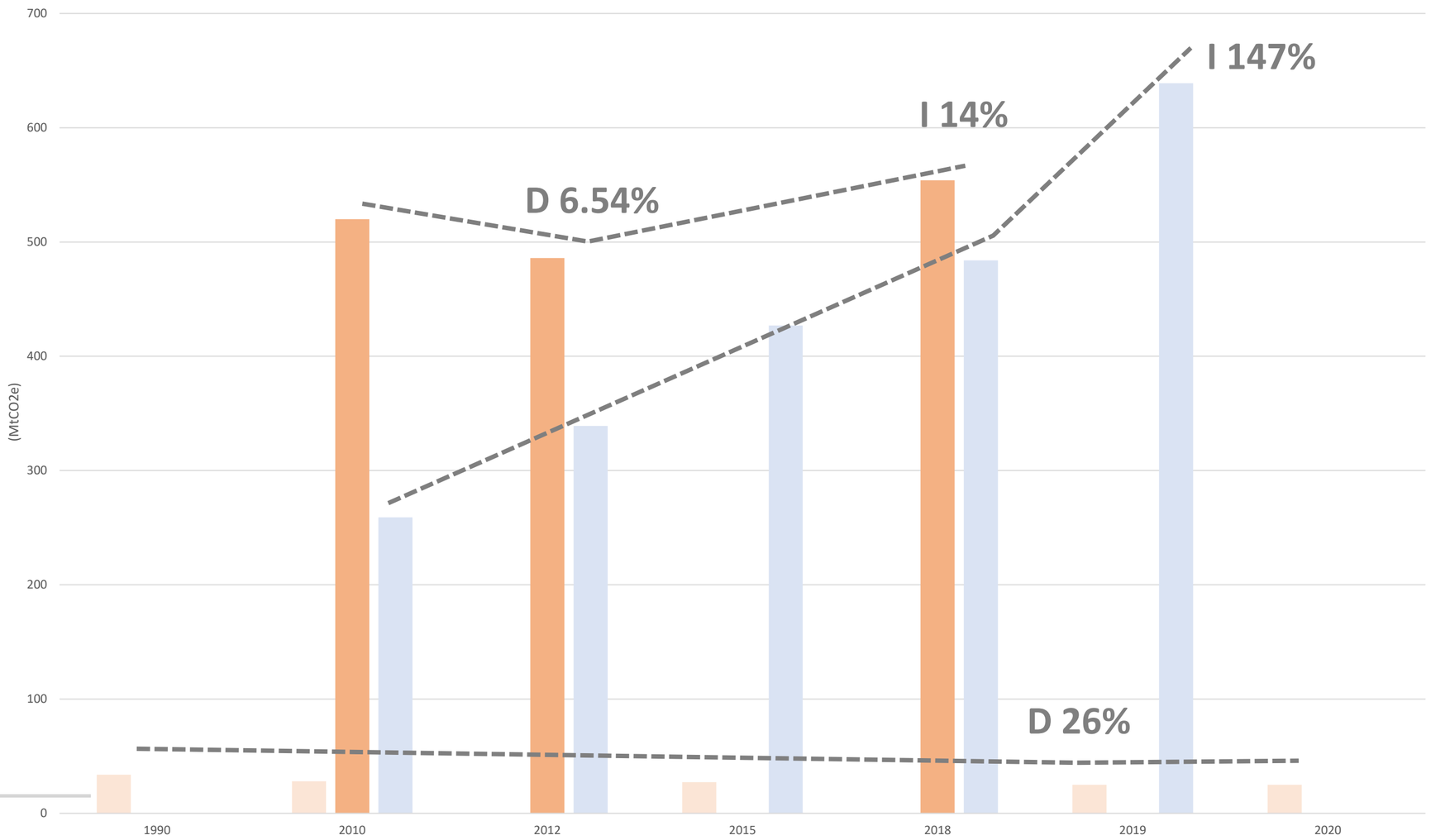
(Adapted from HCWH & Arup, 2019 : HEALTH CARE'S CLIMATE FOOTPRINT)

Healthcare emissions per capita (cap) worldwide



Selected countries based on data provided in Mominkhan, D. *et al.* (2023) doi:10.3389/fsuep.2023.1230253.

Trends in Healthcare Carbon Footprint



England NHS Carbon Footprint Plus

U.S Carbon Footprint

China Carbon Footprint

Scope 1, 2 & 3

D% : Decrease percentage

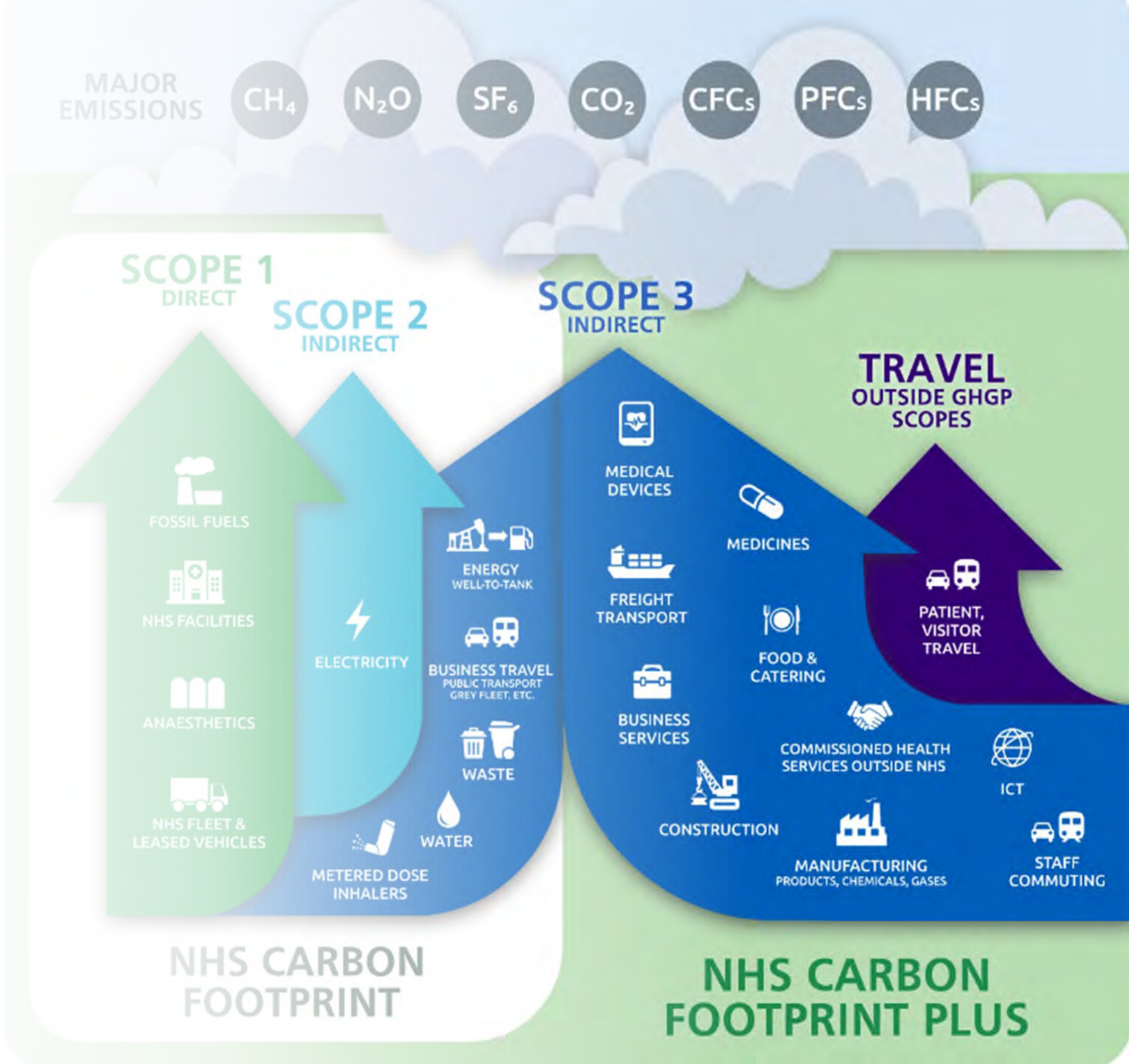
I% : Increase percentage

Based on data provided :

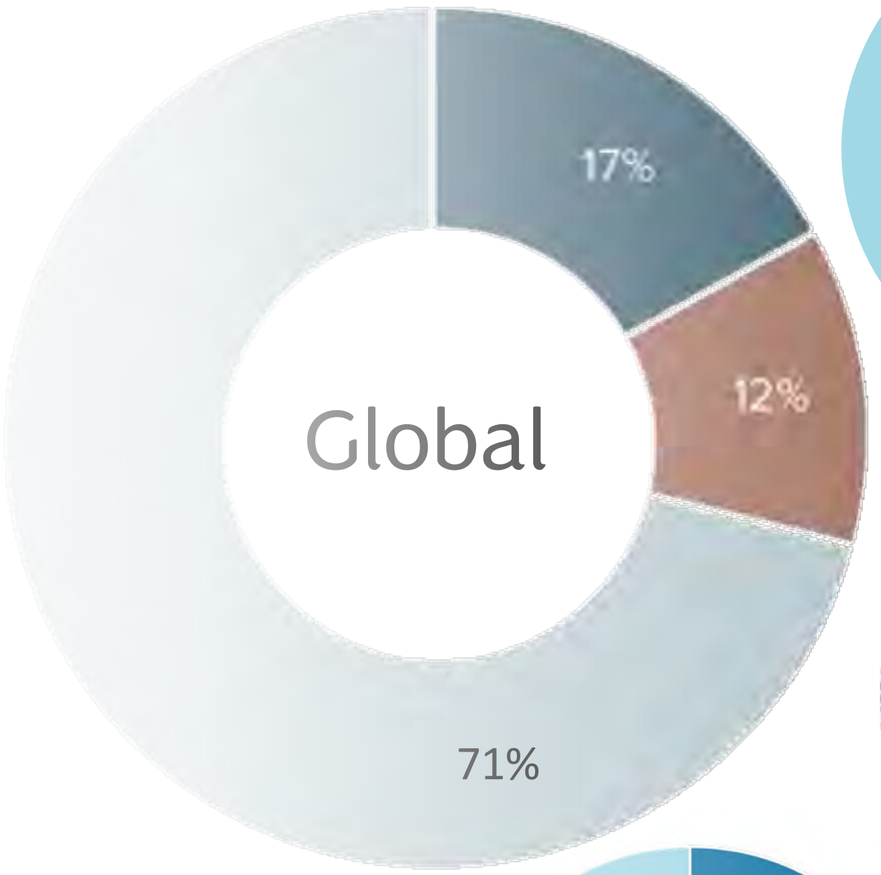
@: (NHS,2022) Delivering a 'Net Zero' National Health Service @ (Eckelman MJ et al., 2020) doi: 10.1377/hlthaff.2020.01247. @ (Zhao. H et al., 2025) doi.org/10.1016/j.spc.2025.08.017.

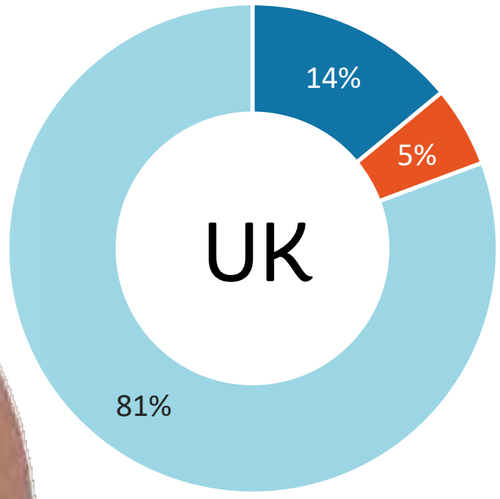
What's NHS Carbon Footprint Plus

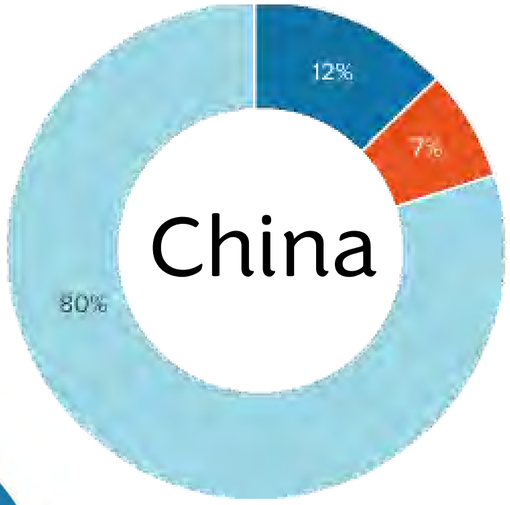
?

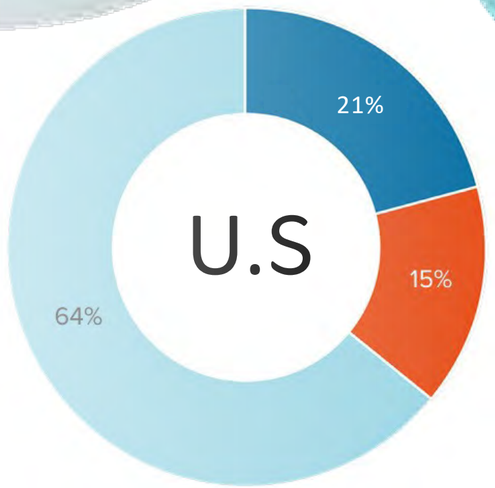


Healthcare footprint by GHGP Scopes









Scope 1
Scope 2
Scope 3

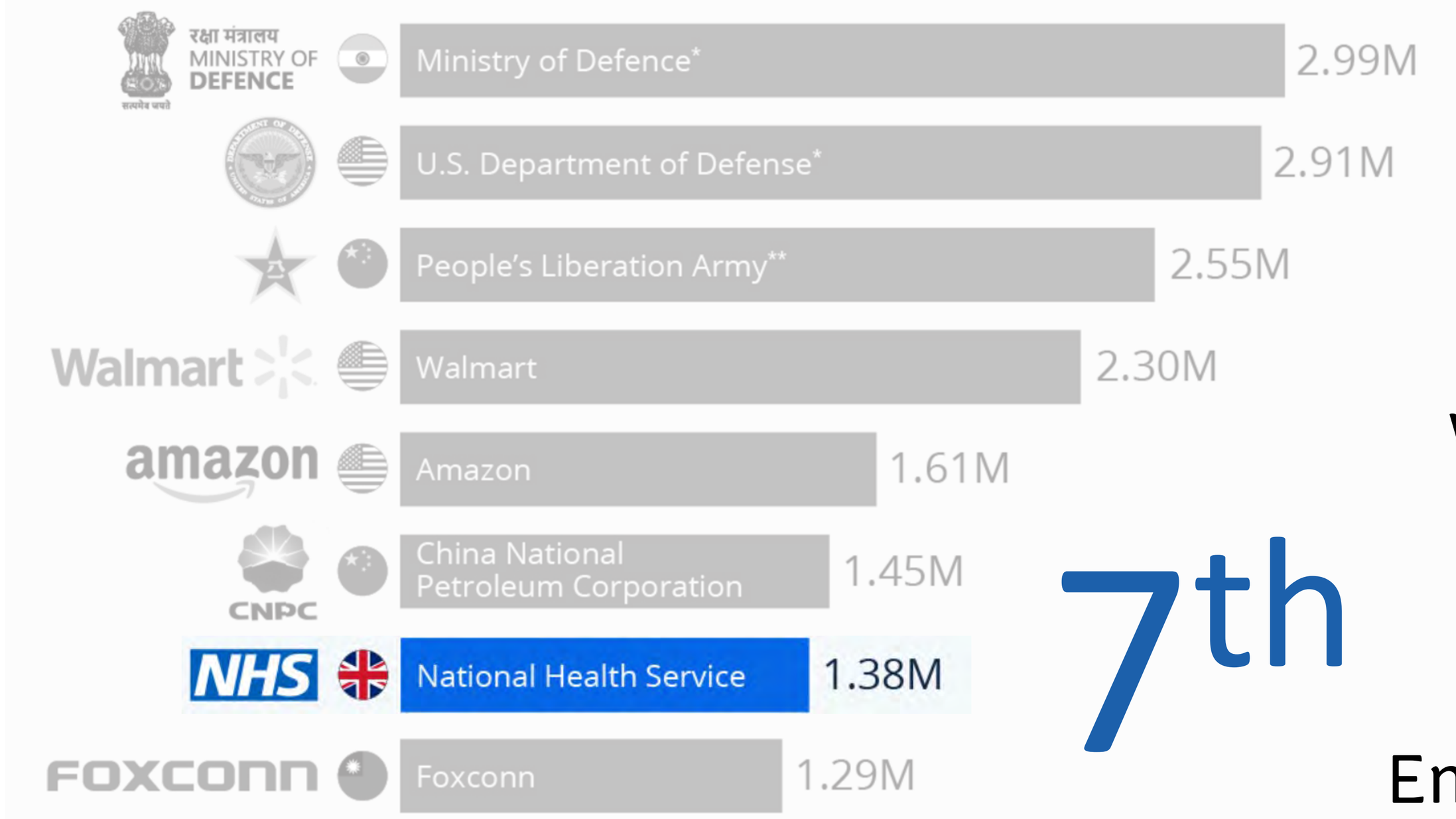
Healthcare Paradox :

Why It Matters ?

Saving lives but Harming the planet

Why The NHS?

The UK National Health Service



World's 7th Biggest Employer

According to Statista.com 2022

Biggest

Employer

in Europe

World’s Largest

Employer of Highly

Skilled Professionals

1st

Health System to embed net zero into legislation

The UK National Health Service (NHS)

2020

Set Net-Zero Target

2022

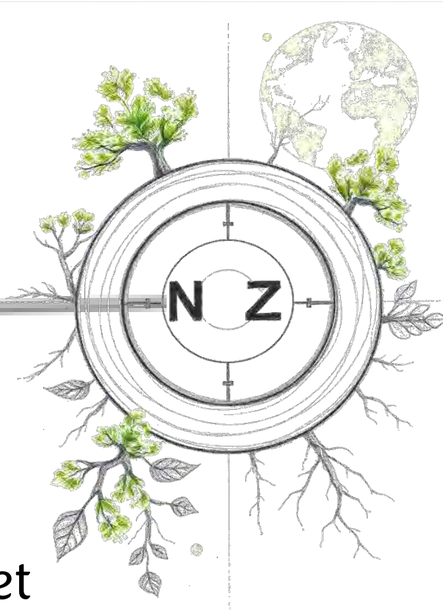
Embedded net zero into legislation, through the Health and Care Act 2022.

2040

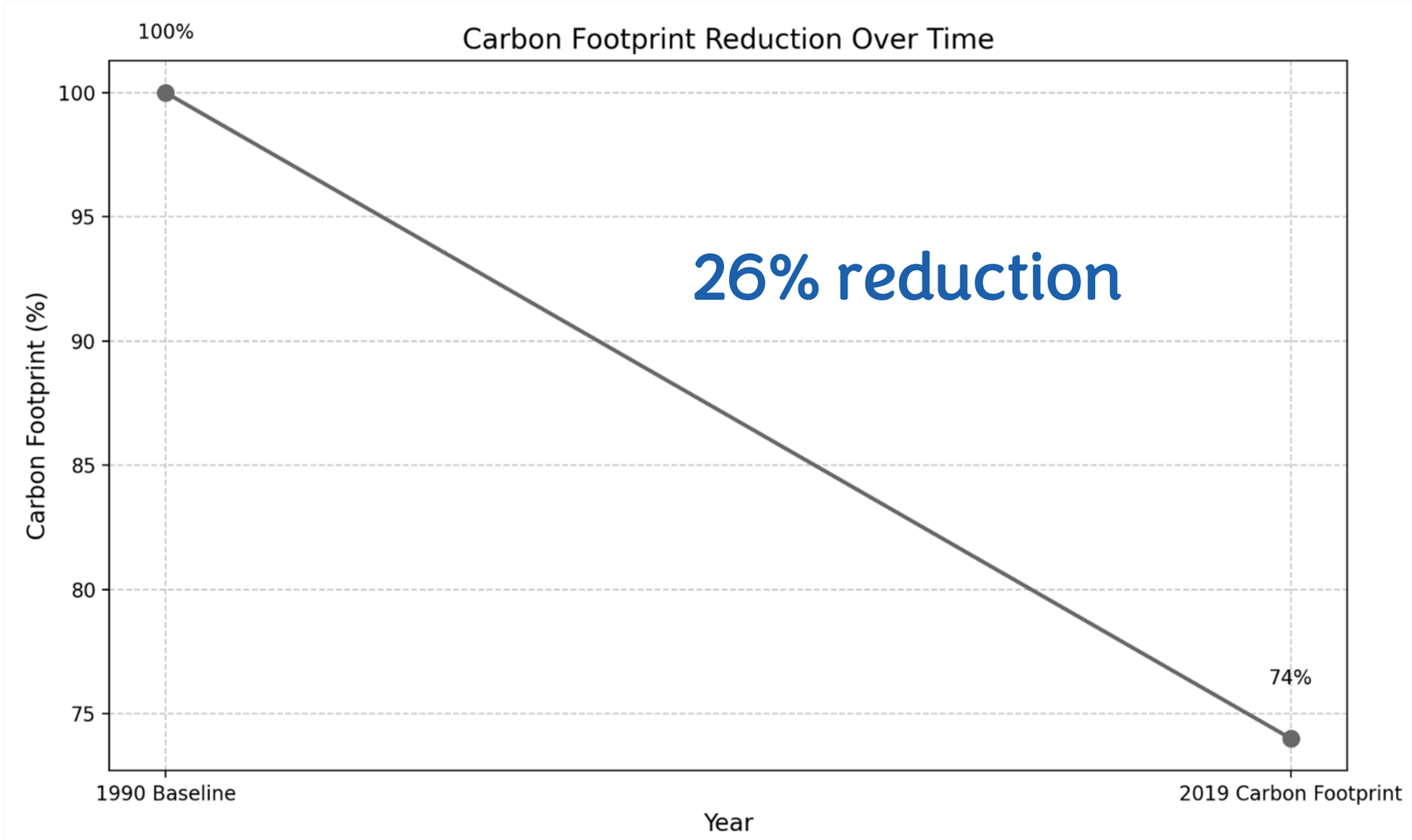
O Carbon Footprint Target

2045

O Carbon Footprint Plus Target



NHS Carbon Footprint



64%

Building Energy reduction

However,...

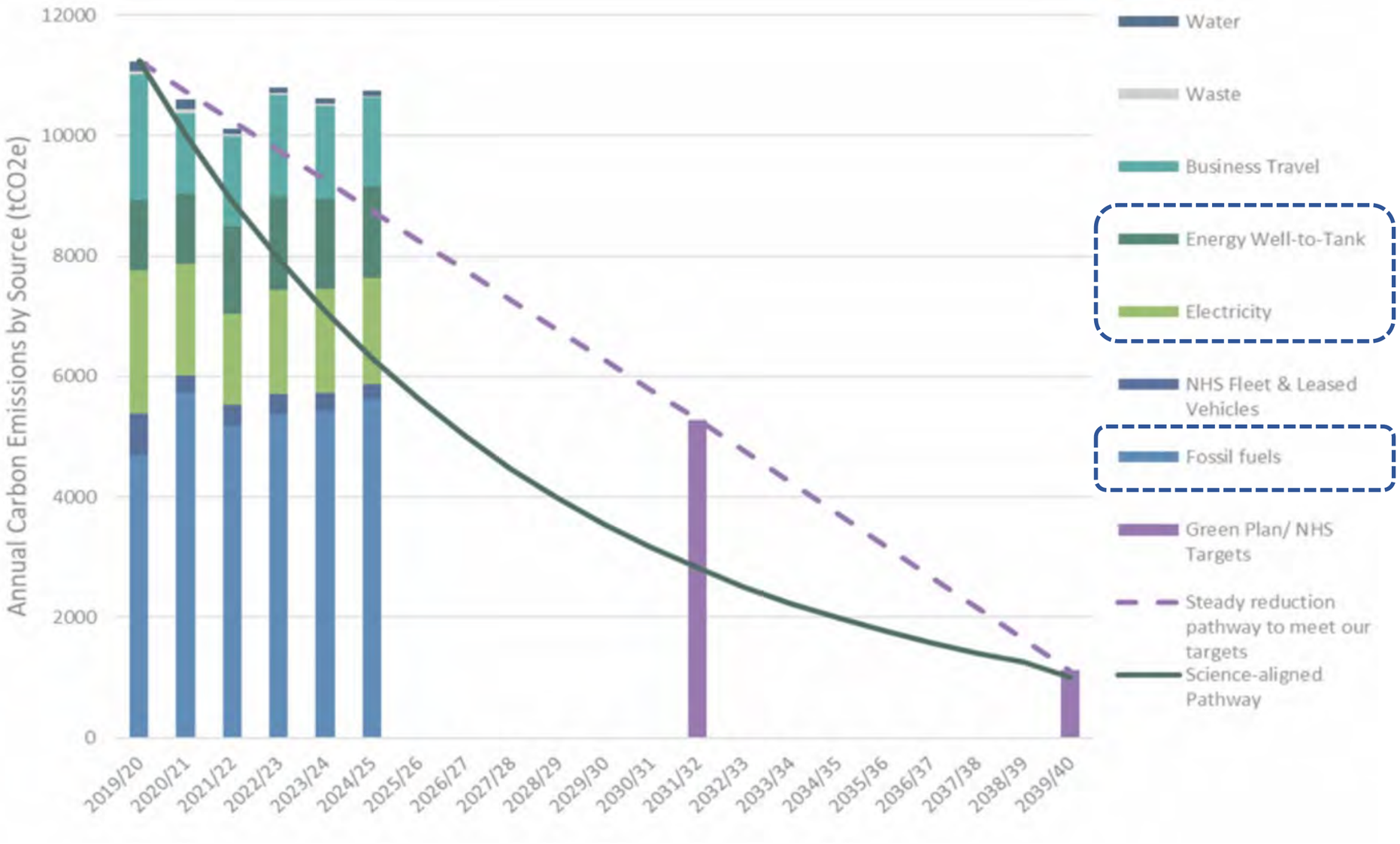
Since 2019,

Progress remains

slow

However,...

Case 1: Tees, Esk and Wear Valleys NHS Foundation Trust



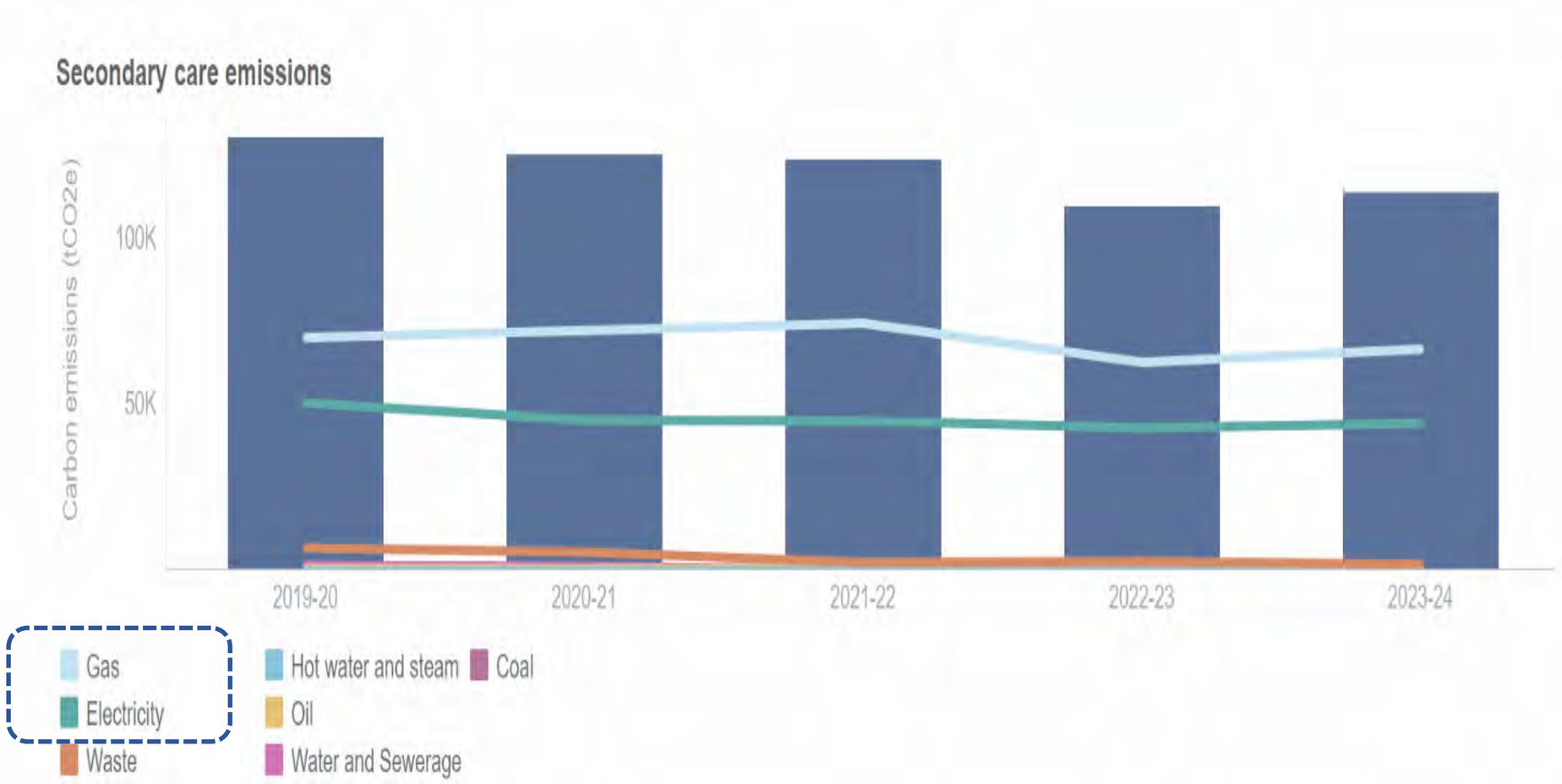
Since 2019,

Progress remains

slow

However,...

Case 2: North West London secondary care emissions



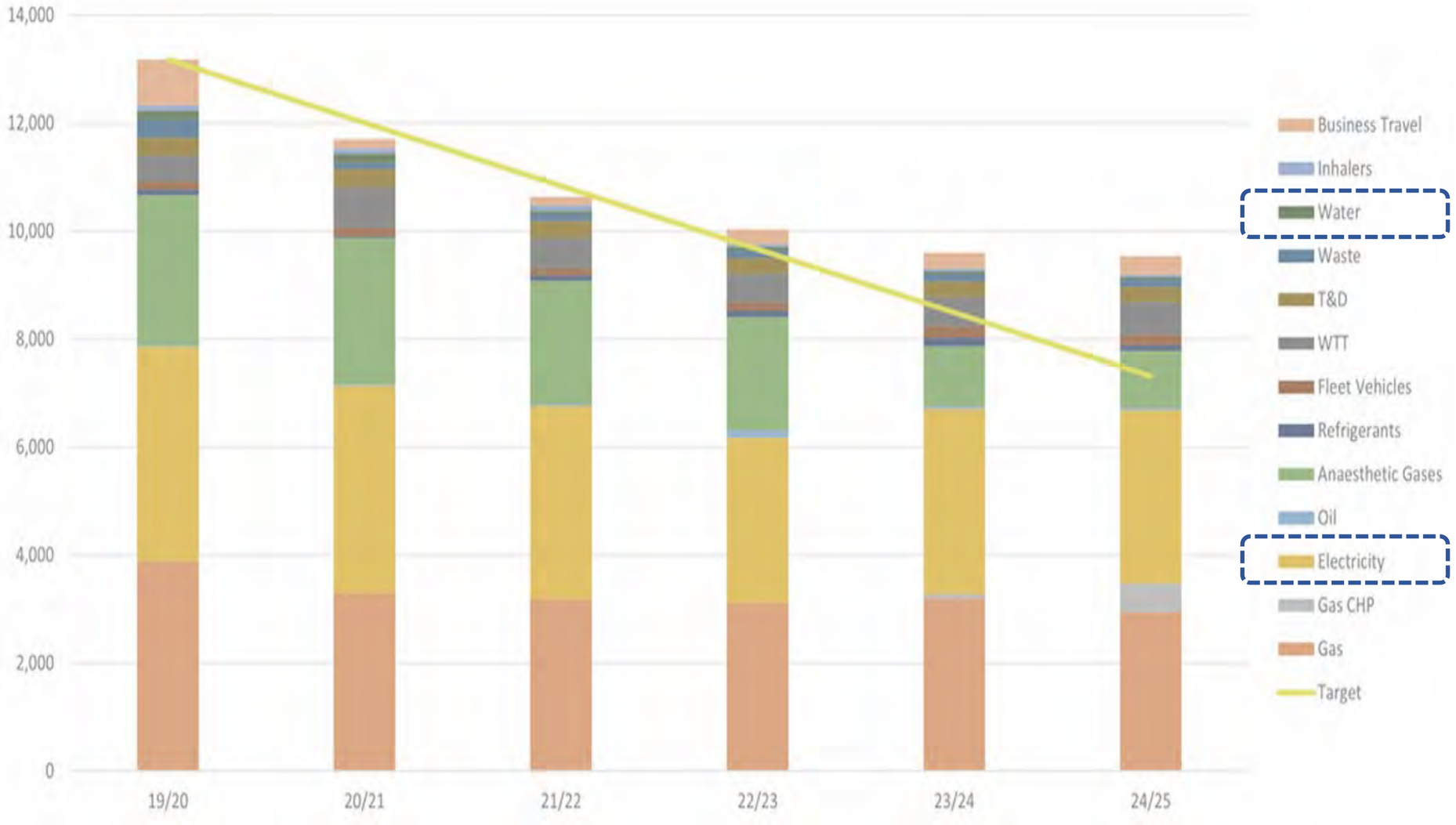
Since 2019,

Progress remains

slow

However,...

Case 3: Great Western Hospitals NHS Trust



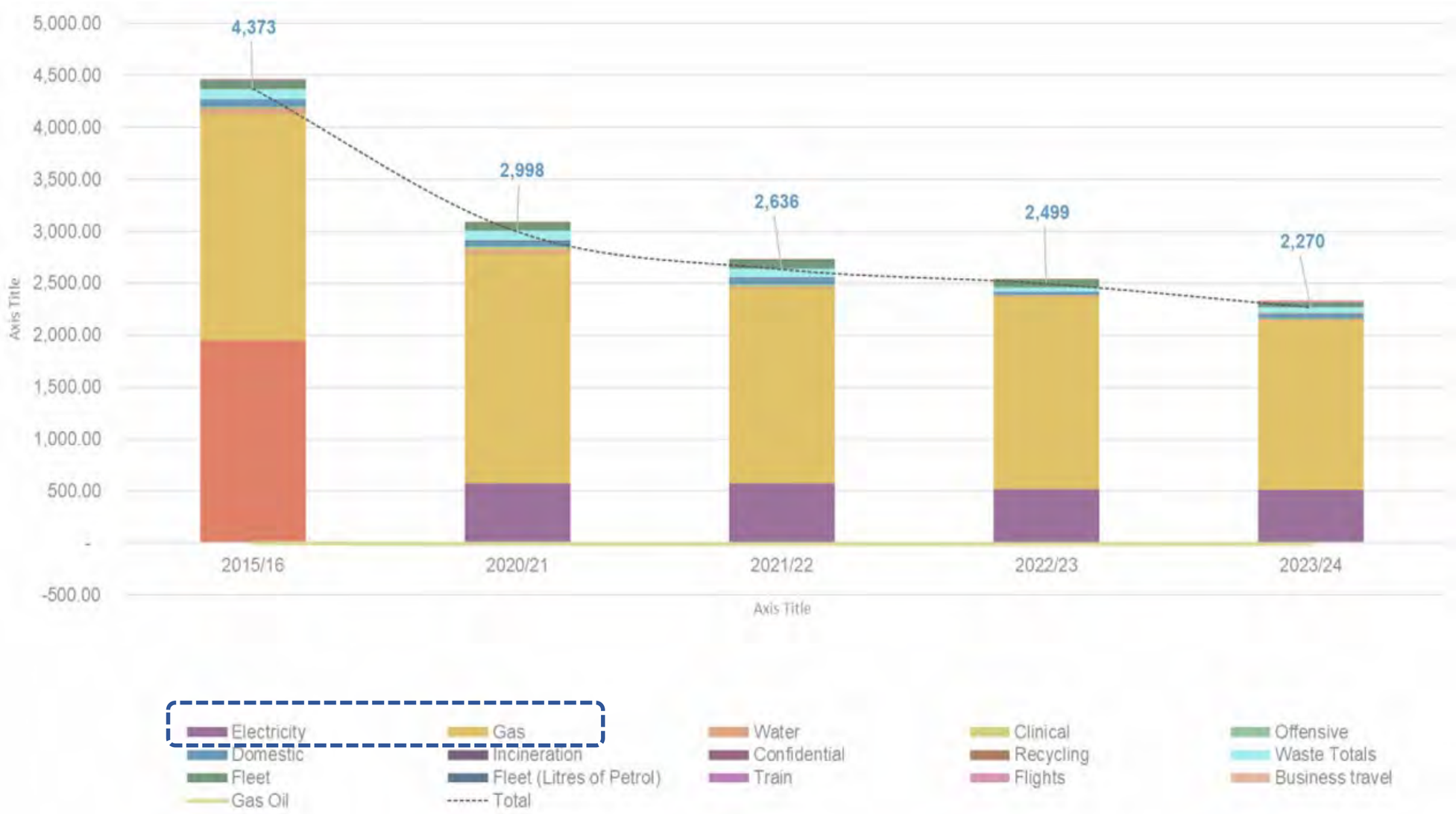
Since 2019,

Progress remains

slow

However,...

Case 4: Sheffield Health and Social Care NHS Trust



Since 2019,

Progress remains

slow

Why Progress

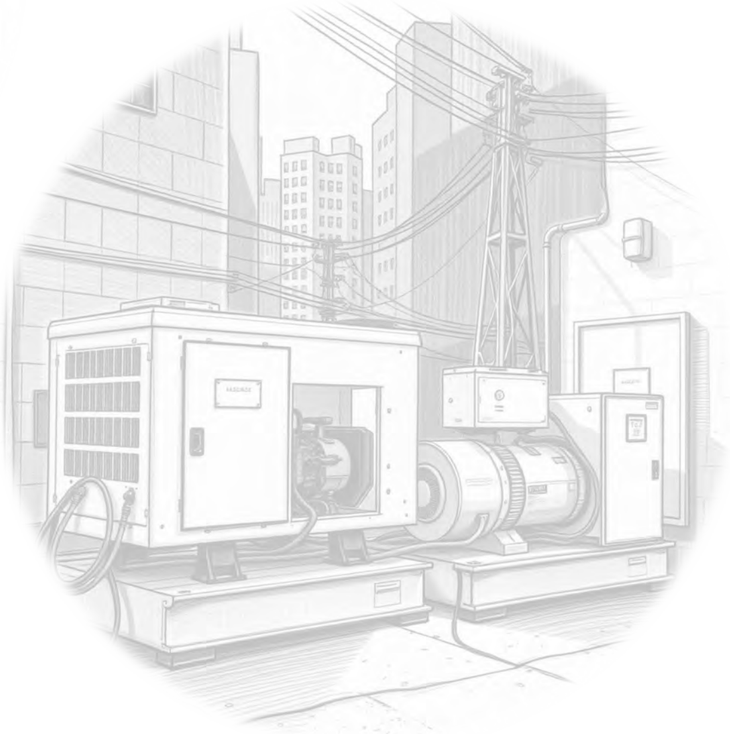
is Slow

?

Future Hospital

24/7 operations

Backup Generators



The Energy Problem

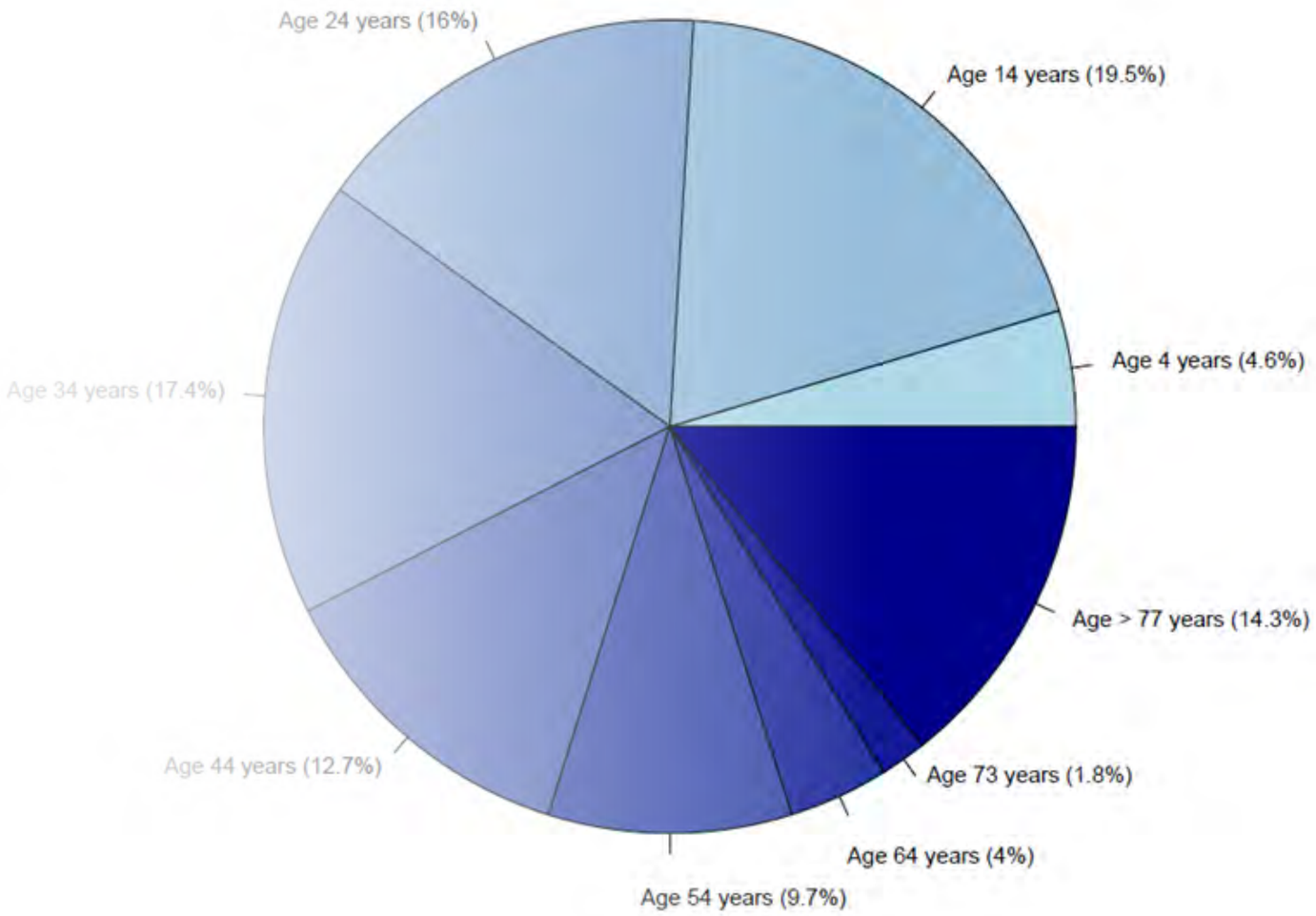
Sterilisation Requirements

214 Trusts, England

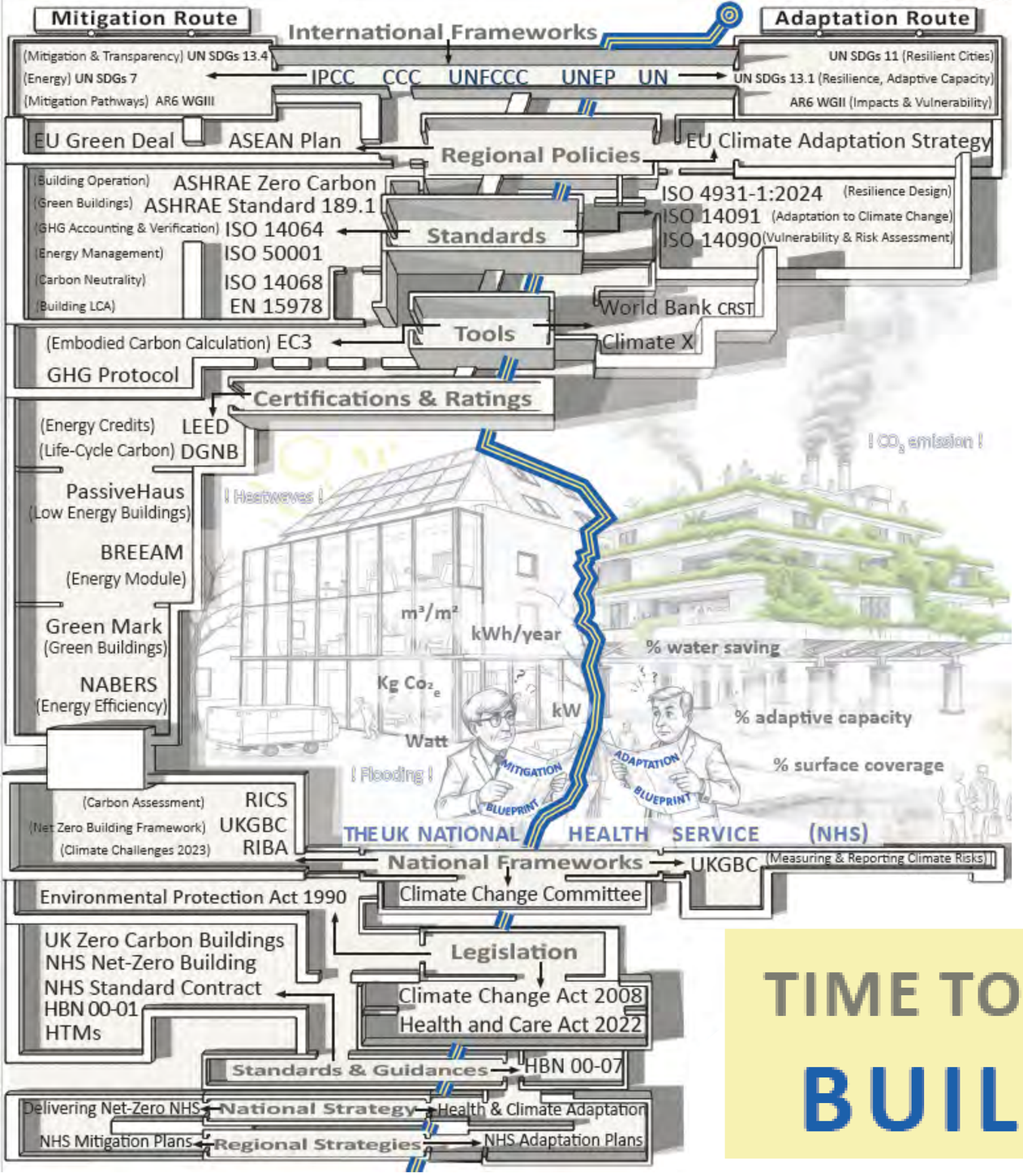
The Huge

Building Stock

13,135
Healthcare
Buildings



The Policy Gap



?

NHS

NHS Net Zero Building Standard

TIME TO **ESCAPE** THE HEALTHCARE **BUILDING POLICY MAZE**

Lack of Data

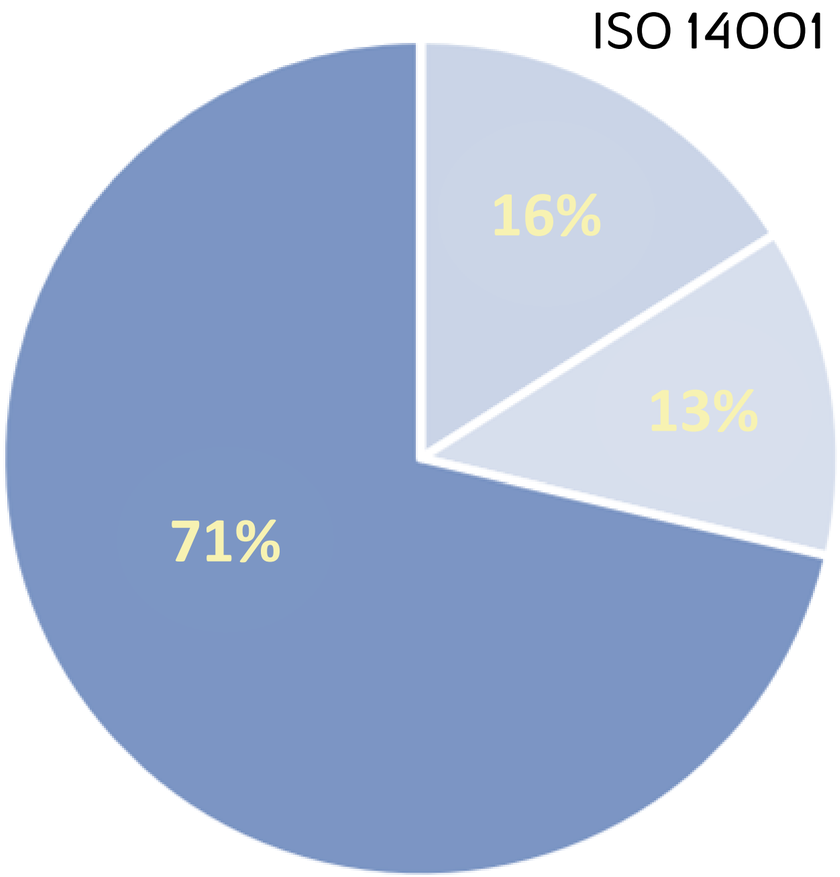
The Stringent

Timeline

+

Different Stages, Different Strategies

Environmental Management System



ISO 14001

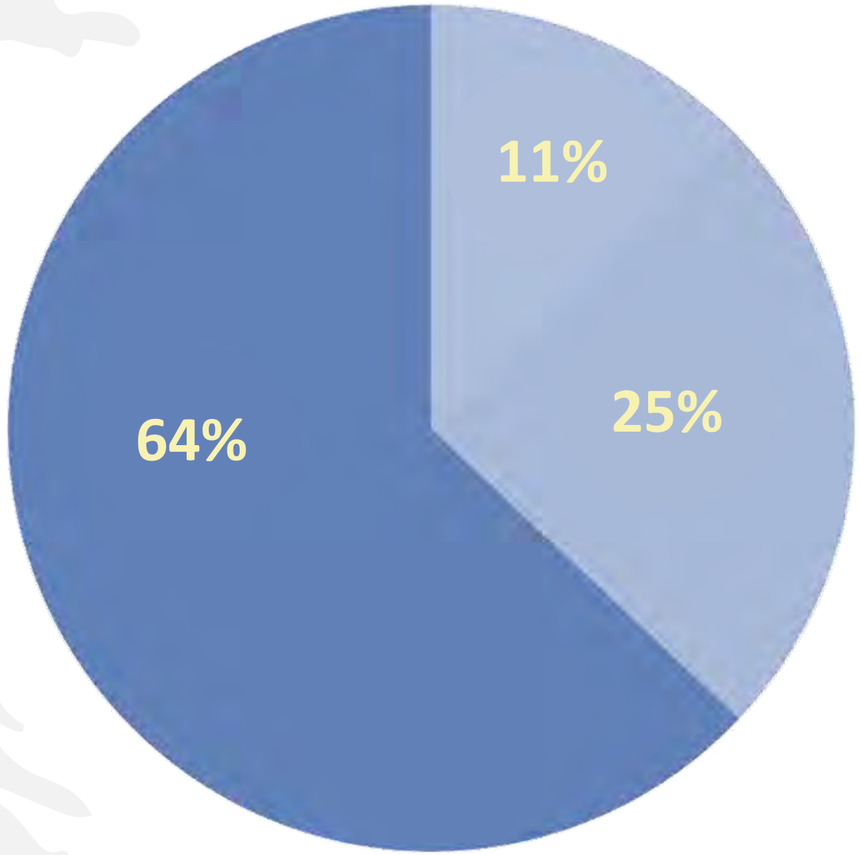
Own EMS

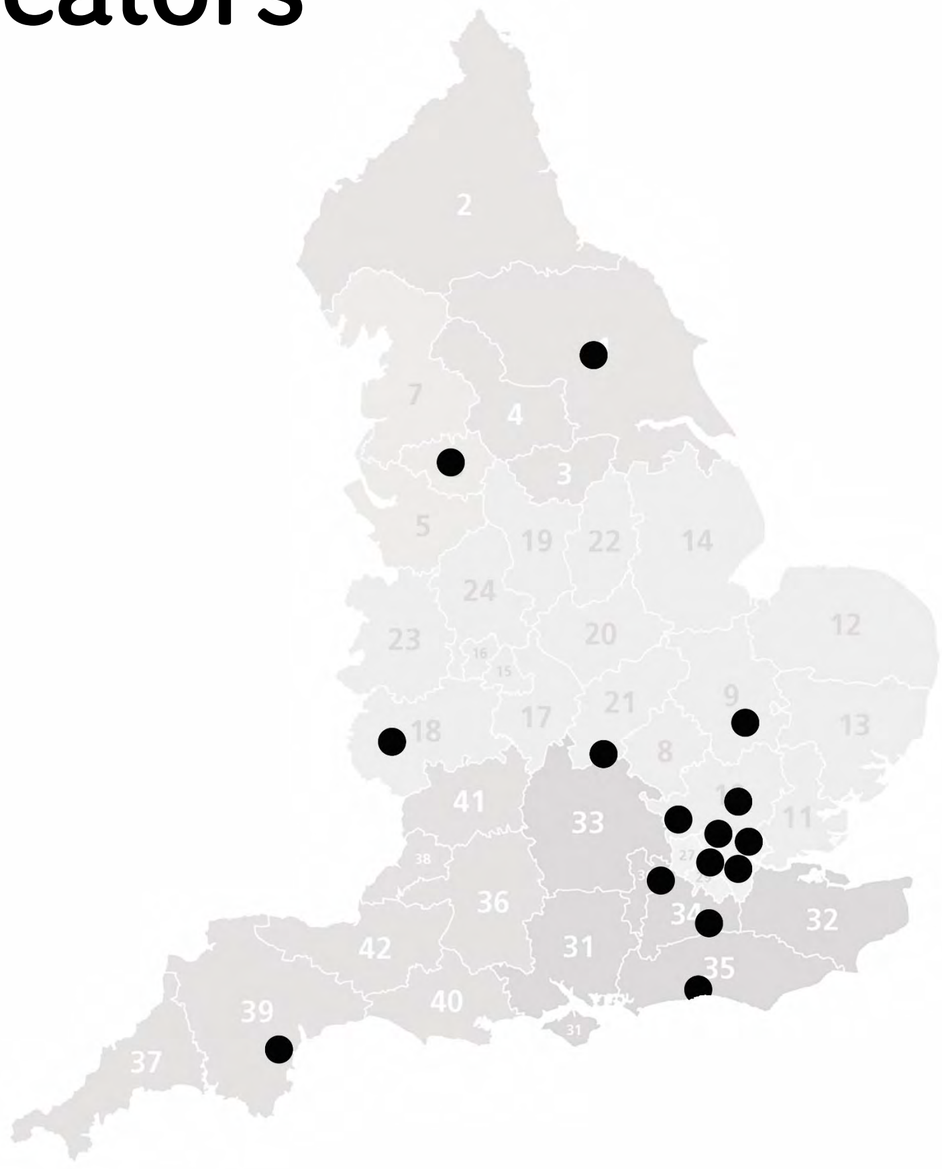
Energy Management ISO 50001

TBD

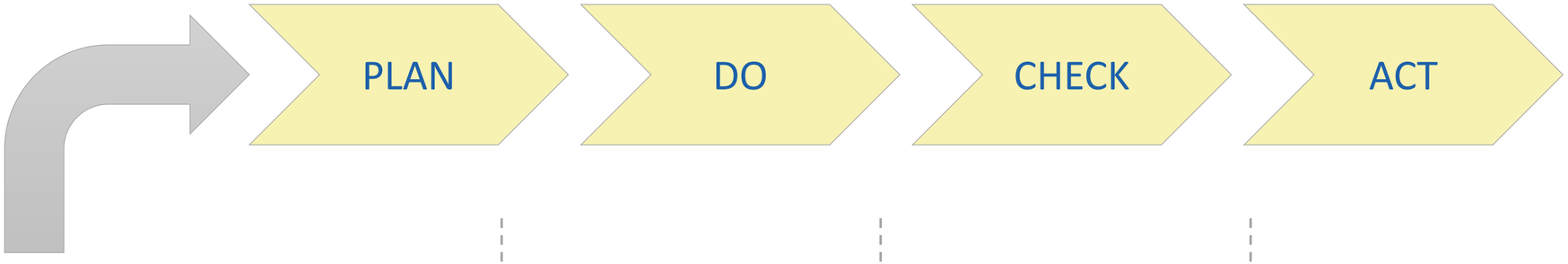
No EMS mentioned

Key Performance Indicators



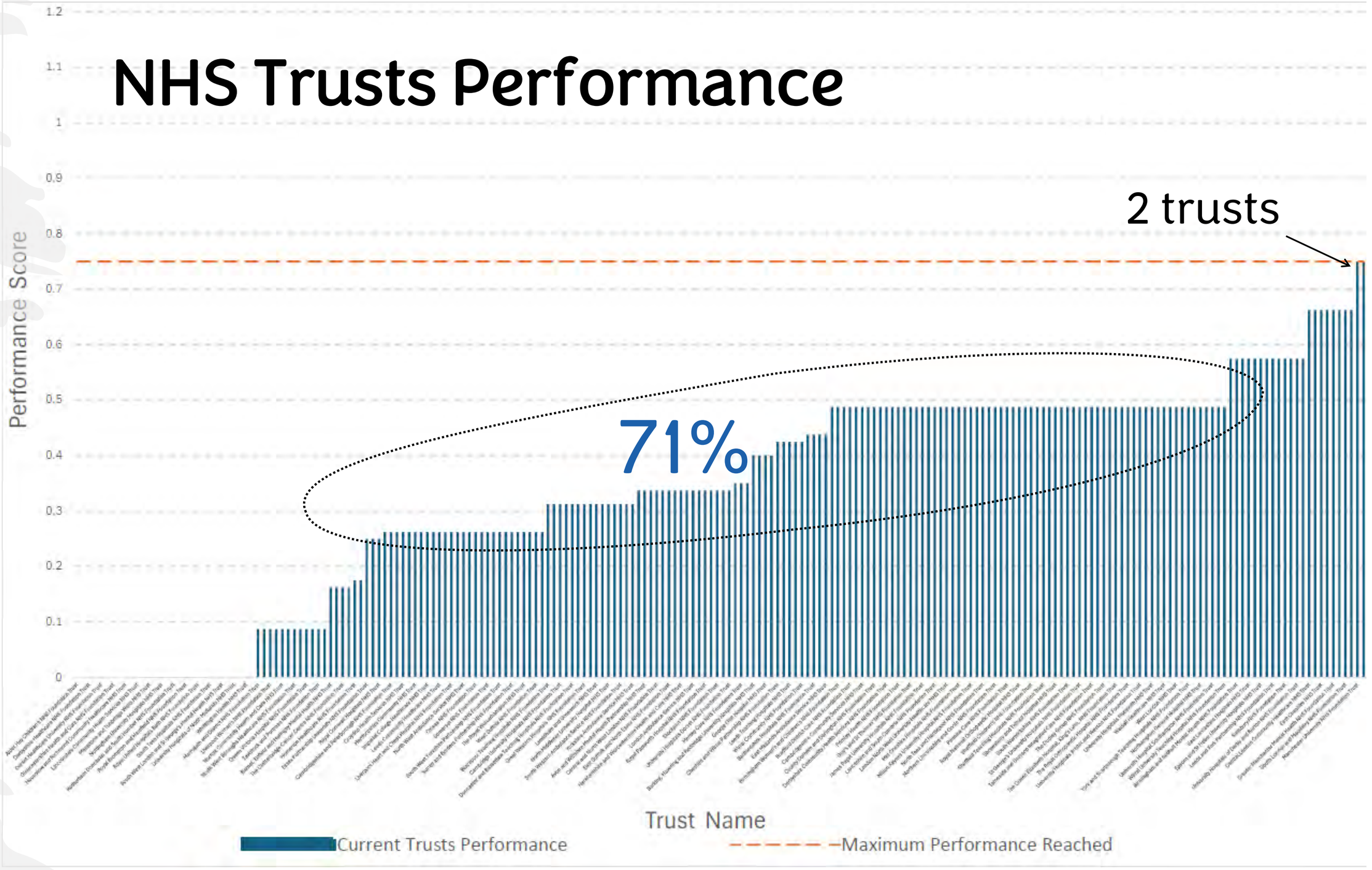


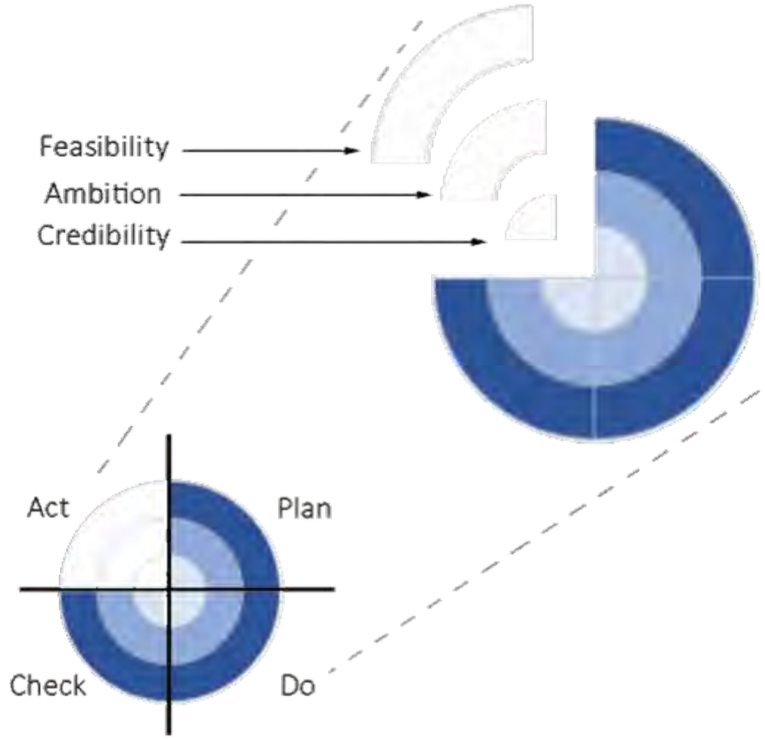
Performance Evaluation Matrix



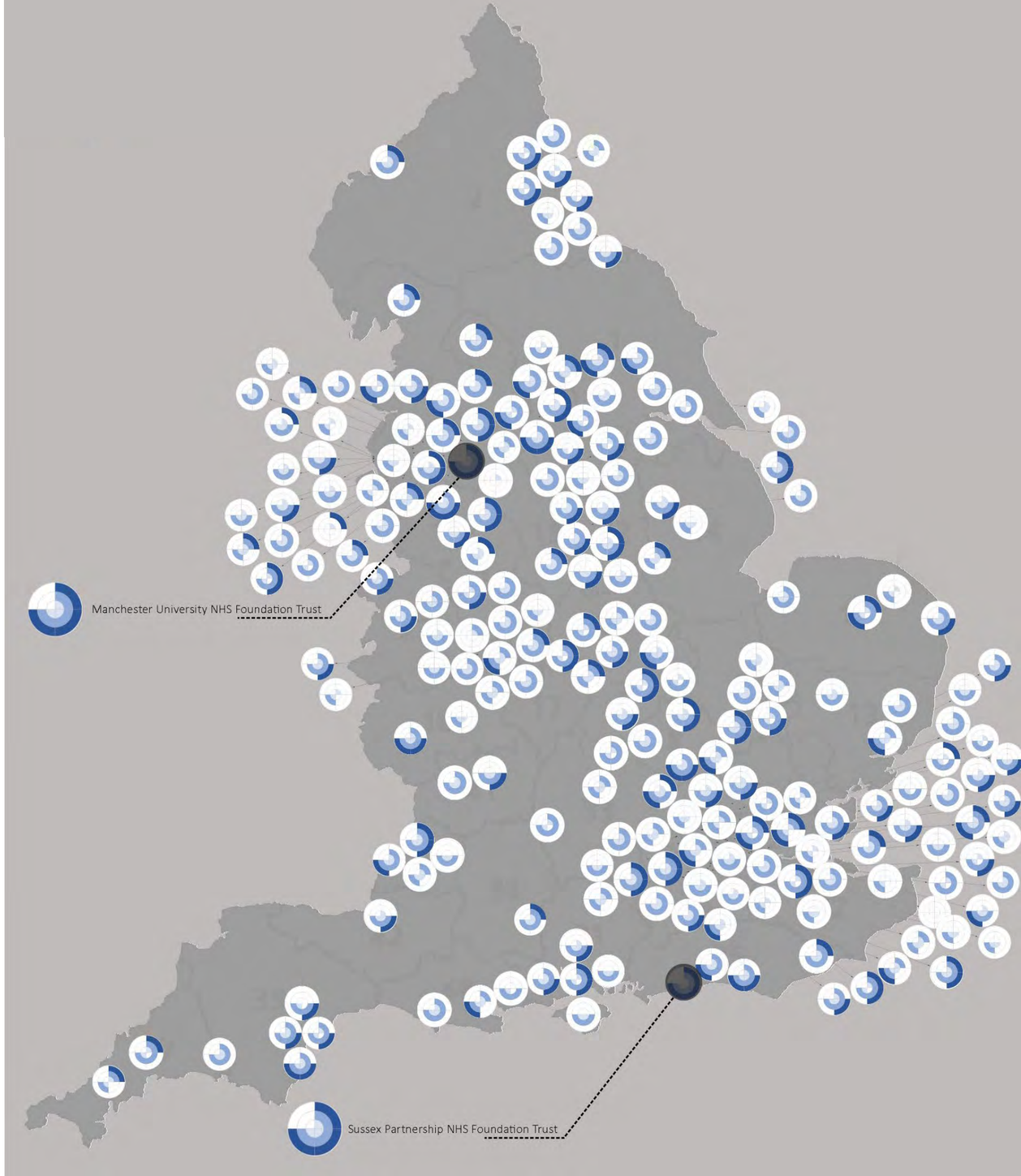
CREDIBILITY	Transparency	Conservativeness	Accountability	Continuous Improvement
AMBITION	Target	GHG Hierarchy Approach	Review of Ambition	Supporting Transition
FEASIBILITY	Science-Based approach	Urgency	Avoiding Adverse Impacts	Life Cycle Approach

NHS Trusts Performance





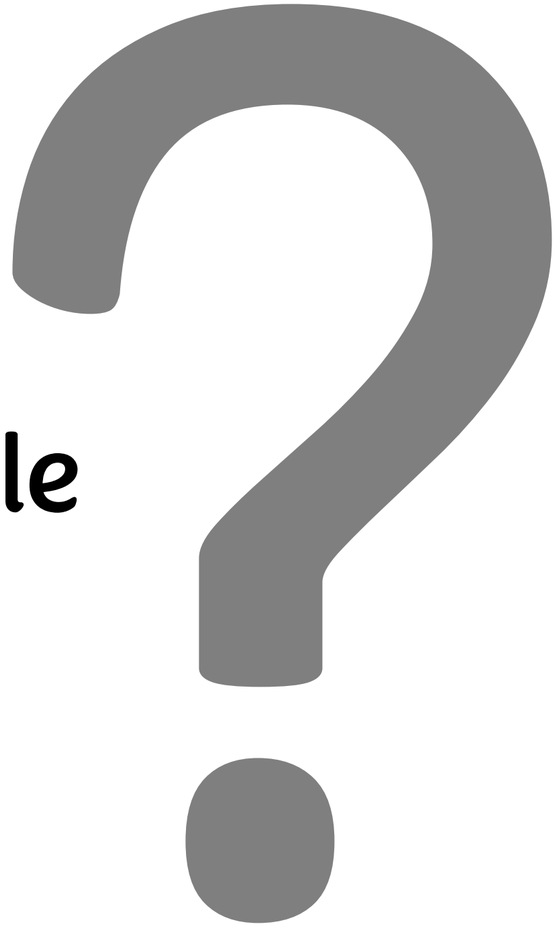
Can the NHS meet its 2040 net-zero target?



How Can Global Healthcare Settings

reach Net-Zero

Amid Industry Leader Struggle



Building and Environment
Volume 278, 15 June 2025, 112966

Net zero in healthcare buildings: Lessons from assessing the strategies of 214 NHS trusts in England

Asma Amamou [a], Stephen Blenkinsop [a], Clare Winter [b], Oliver Heidrich [a]

https://doi.org/10.1016/j.buildenv.2025.112966

Thank You

Part of PhD Research

- Newcastle University Supervisors:
  Dr Stephen Blenkinsop & Prof Oliver Heidrich
- Northumbria NHS Trust Supervisors:
  Dr Clare Winter, Jill Harland
  & Dr Elaine Winkley

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Decarbonising the petrochemical sector

Why it's so **tricky** and **sticky**…

Professor Lindsay-Marie Armstrong

9th September 2025

What are petrochemicals and why do they matter?

- Petrochemicals are chemical products derived primarily from **oil and gas**, including:
  - Plastics (e.g., polyethylene, polypropylene)
  - Fertilisers (e.g., ammonia, urea)
  - Solvents, detergents, synthetic rubber, resins, etc.
- In the UK, petrochemicals are a **critical industrial sector**:
  - Support other industries: construction, agriculture, healthcare, packaging, etc
  - Account for **~20–30% of industrial emissions**

Petrochemical emissions come from both energy use and material feedstock - making it unique and more complex!

The petrochemical sector is both TRICKY and STICKY — and that's the focus of this talk!

Tricky => technical barriers

High-temperature and energy intensive:

- Chemical manufacturing requires **extremely high temperatures (~850˚C)**
- Hard to electrify using current technologies -> fossil fuels still the norm

Long asset lifetimes:

- Plants are expensive and built to last 30–50 years
- Retrofitting or replacing them is a **huge financial and logistical challenge**

Carbon embedded in feedstocks:

- Many chemical products are **made *from*** hydrocarbons, not just powered by them
- **Replacing carbon content** is much harder than just swapping energy sources

Lack of mature alternatives:

- Technologies like green hydrogen, CO_2-based polymers, or bio-feedstocks exist but are **nascent, expensive, and not yet scalable**

Sticky => slow progress despite available solutions

Low demand-side pressure:

- Consumers don't see or understand the **emissions embedded** in products
- **No incentive for companies** to invest when there's no premium or demand

Policy gaps:

- The UK has limited **regulation targeting embedded carbon** in materials
- Subsidies and tax incentives for green alternatives are **still insufficient or inconsistent**

Cost and competitiveness concerns:

- Virgin chemical products **often cheaper than recycled** or bio-based alternatives
- Without carbon pricing or regulatory mandates, **companies stick with the status quo**

Infrastructural inertia:

- Supply chains, storage, distribution — **all tailored for fossil-based systems**
- Transitioning to low-carbon alternatives would require **systemic change**, not just switching out one component

Plastic production: A tricky and sticky example – the current

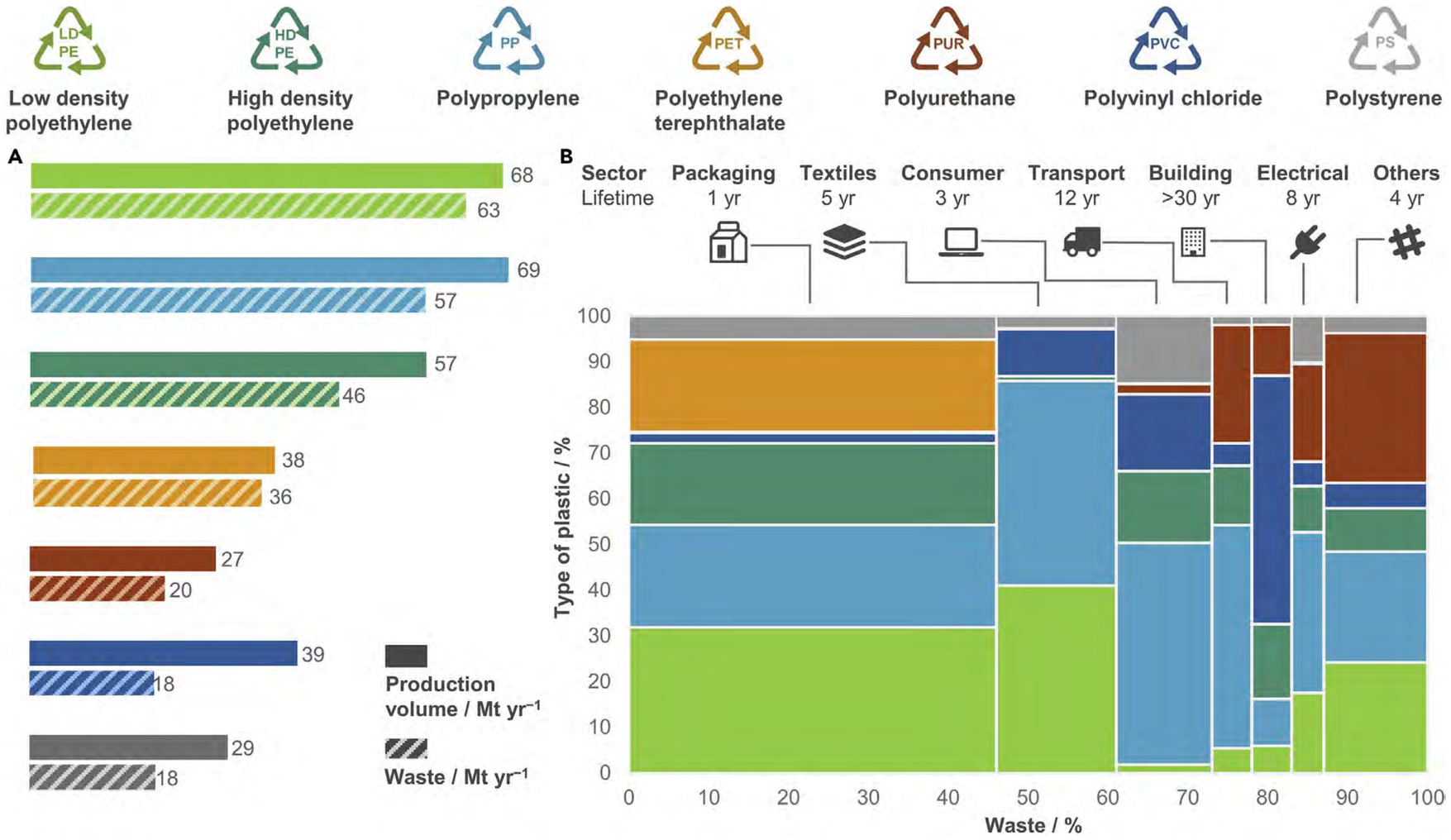

Image taken from : Martin, et al. **2021**: https://www.sciencedirect.com/science/article/pii/S2451929420306380

Plastic production: A tricky and sticky example – by 2050

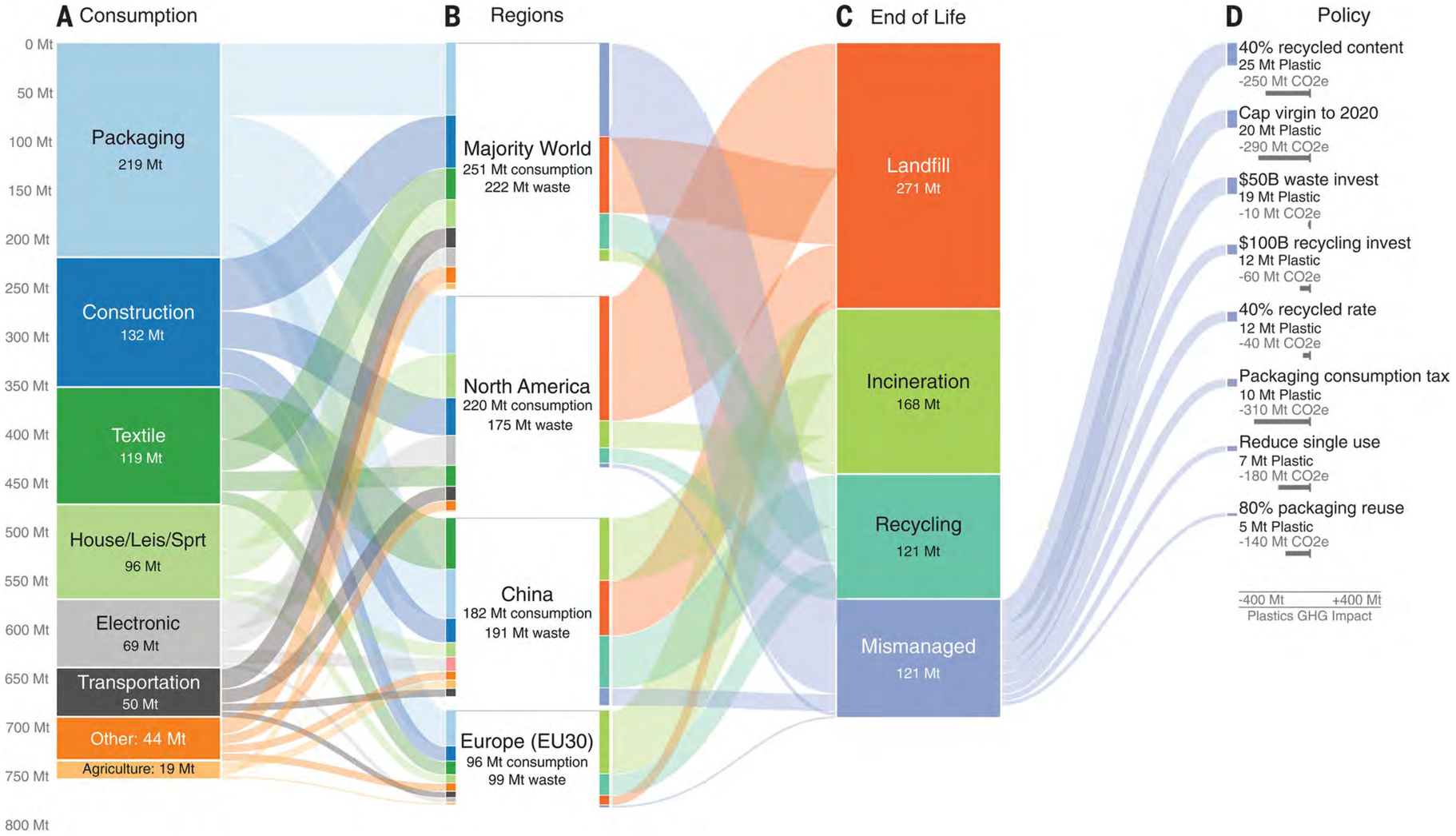

Image taken from : Pottinger, et al. **2024**: https://doi.org/10.1126/science.adr3837

Plastic production: A tricky and sticky example

Open question: **why is this tricky?**

- Complex feedstocks with chemical processes that are complex
- Catalysts need to be specialised and robust
- Manufacturing relies on steam cracking and oil-based feedstocks
- The high temperatures can cause toxic byproducts that need further processing
- …

Open question: **why is this sticky?**

- Recycled plastic is often lower quality and more expensive
- No requirement for recycled content in most products
- Waste collection and sorting systems are fragmented
- …

Unlocking progress in a sticky, tricky sector

Need for a whole-systems approach:

- Can't decarbonise in isolation - needs circular economy models, better waste infrastructure, demand reduction, etc

Stimulate demand:

- Public awareness campaigns and government procurement can drive uptake of low-carbon materials

Accelerate innovation funding:

- Government and private sector need to fund pilots and scale-up efforts

Stronger regulation and carbon pricing:

- Without firm policy drivers, the transition will be too slow

A critical decade for petrochemical decarbonisation

- The petrochemical sector isn't the largest emitter — but it's one of the **fastest growing** and most **deeply embedded**
- It's both **tricky (technical challenges)** and **sticky (slow change despite solutions)**
- Decarbonising this sector is essential to:
  - Achieve decarbonisation goals
  - Reduce plastic pollution and global emissions
  - Avoid carbon lock-in from long-lived industrial infrastructure

We need early, decisive action **NOW** to avoid much more expensive transitions later

UNIVERSITY OF Southampton

YOUR QUESTIONS

Session outline

Paul Ekins, UCL – Why are some sectors of the economy so **difficult to decarbonise**?

Danielle Densley Tingley, Sheffield – Decarbonising **construction**: the challenges & opportunities

Asma Amamou, Newcastle – Healing without harming – the carbon challenge in **healthcare**

Lindsay-Marie Armstrong, Southampton – Decarbonising the **petrochemicals** sector: why its so tricky and sticky.

Panel discussion – chaired by Olivier Heidrich, Newcastle

Tyndall Centre for Climate Change Research

University of East Anglia

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Thank you

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