



Centre for Industrial Energy, Materials and Products



# UK carbon emissions in design, construction and operation

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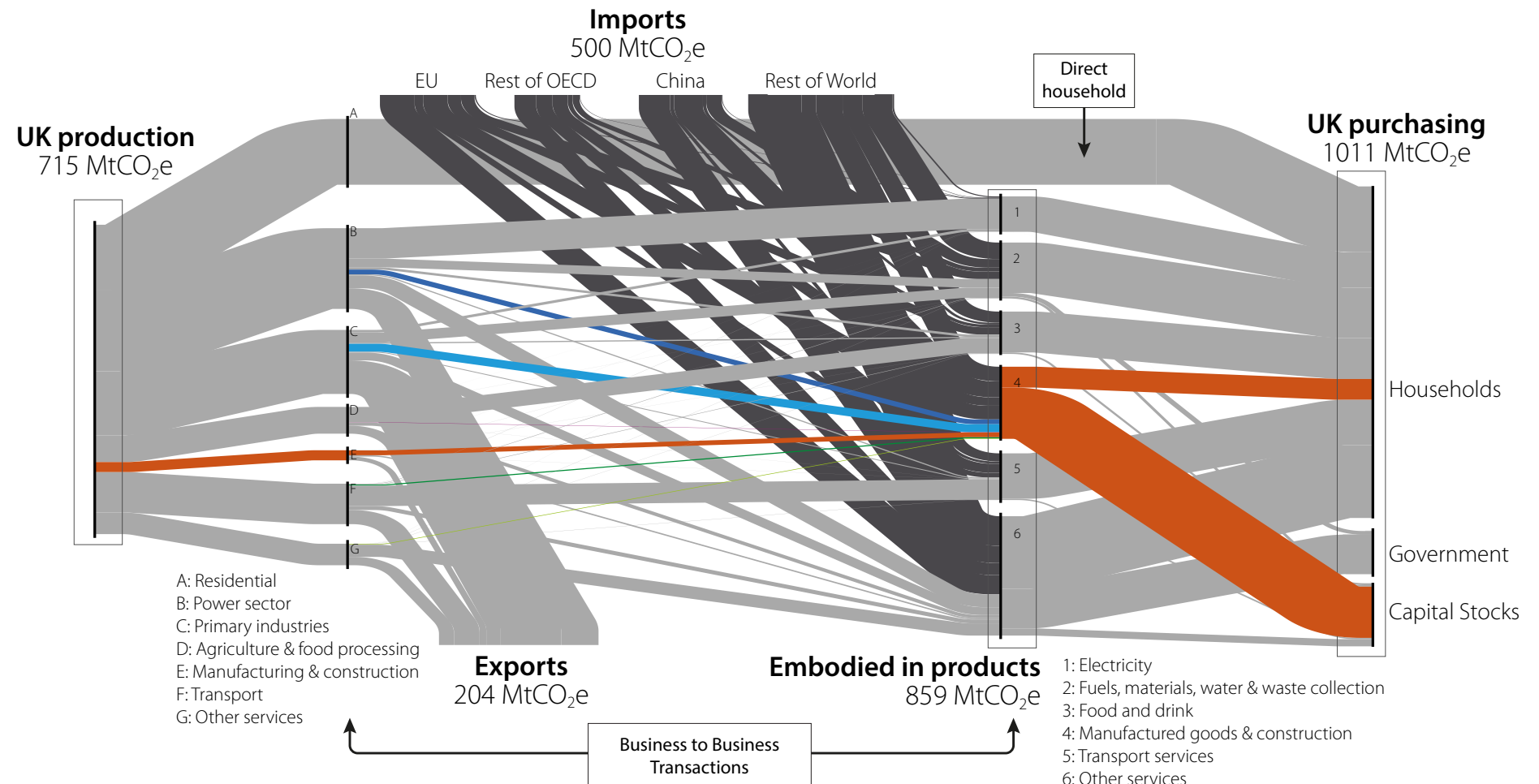
Research Fellow in Energy, Materials and Climate Policy  
University of Leeds

# Agenda

## This talk will cover

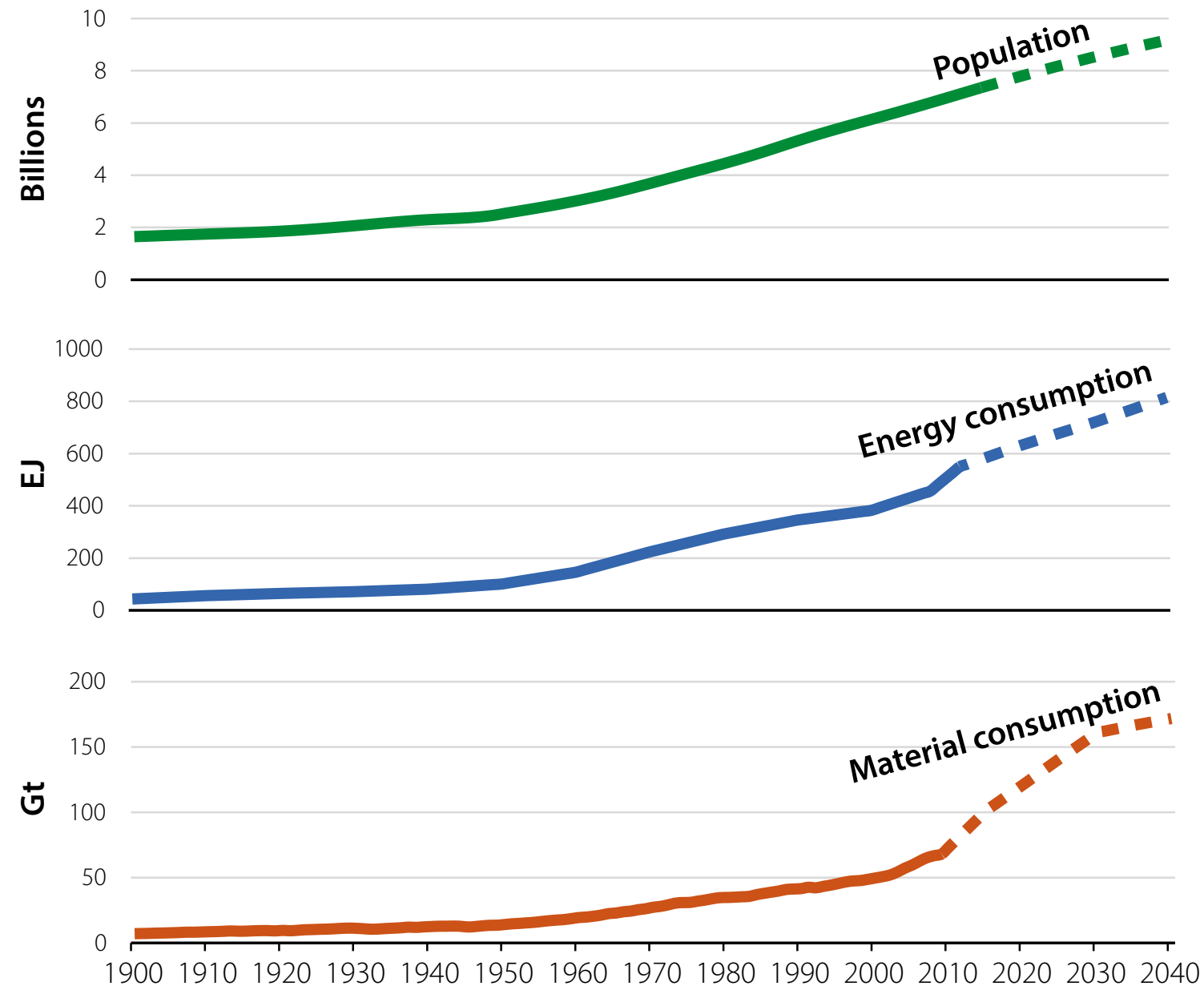
- » Update on global carbon emissions
- » The new carbon context post Paris
- » UK carbon emissions in design, construction and operation of built assets
- » Industry progress in carbon reduction
- » Current and upcoming guidance on carbon reduction
- » The global opportunity for carbon mitigation in construction

- » 1 of 6 RCUK funded interdisciplinary centres focussing on end use energy demand in the UK
- » *Working closely with government and industry, CIEMAP conducts research to identify all the opportunities along the product supply chain that ultimately deliver a reduction in industrial energy use*



# A century of growth

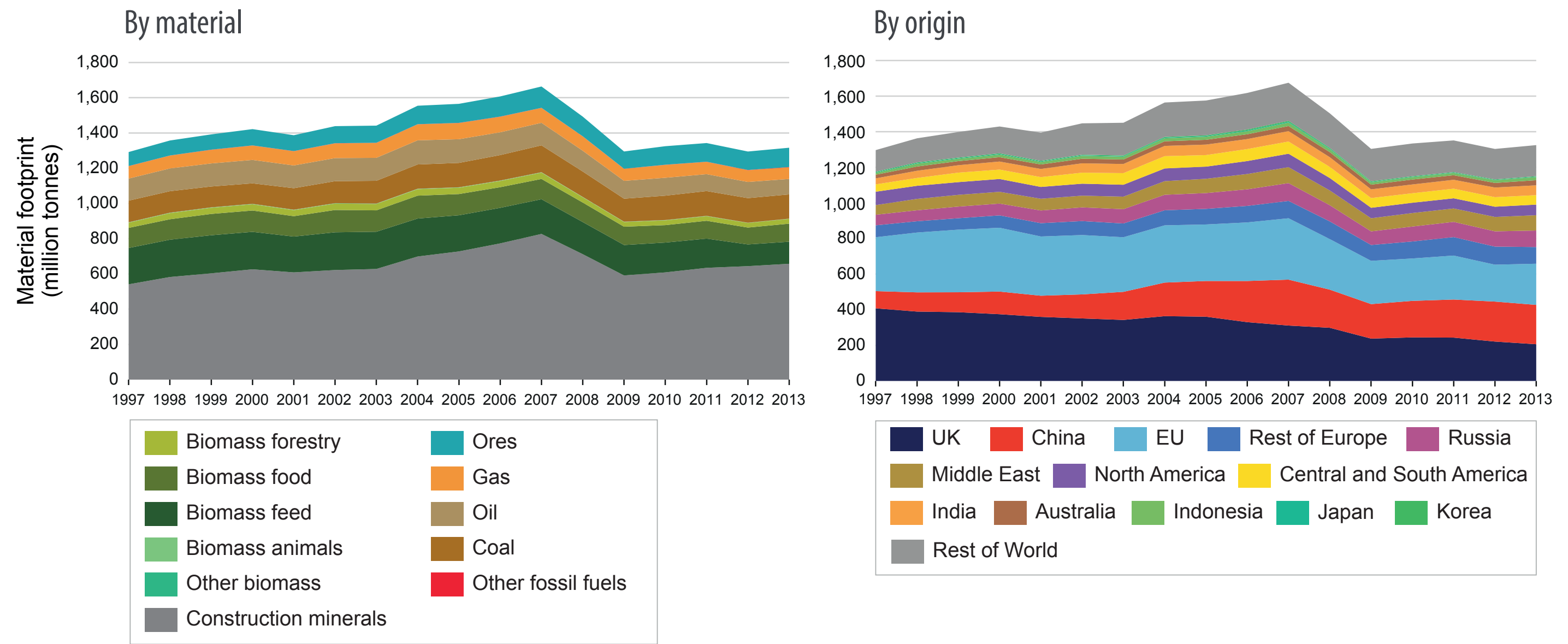
In population, energy and material consumption





# Material footprint of UK consumption

Over 1 billion tonnes of materials per year, mostly imported





# The global technosphere

~30 trillion tonnes of stuff we've created

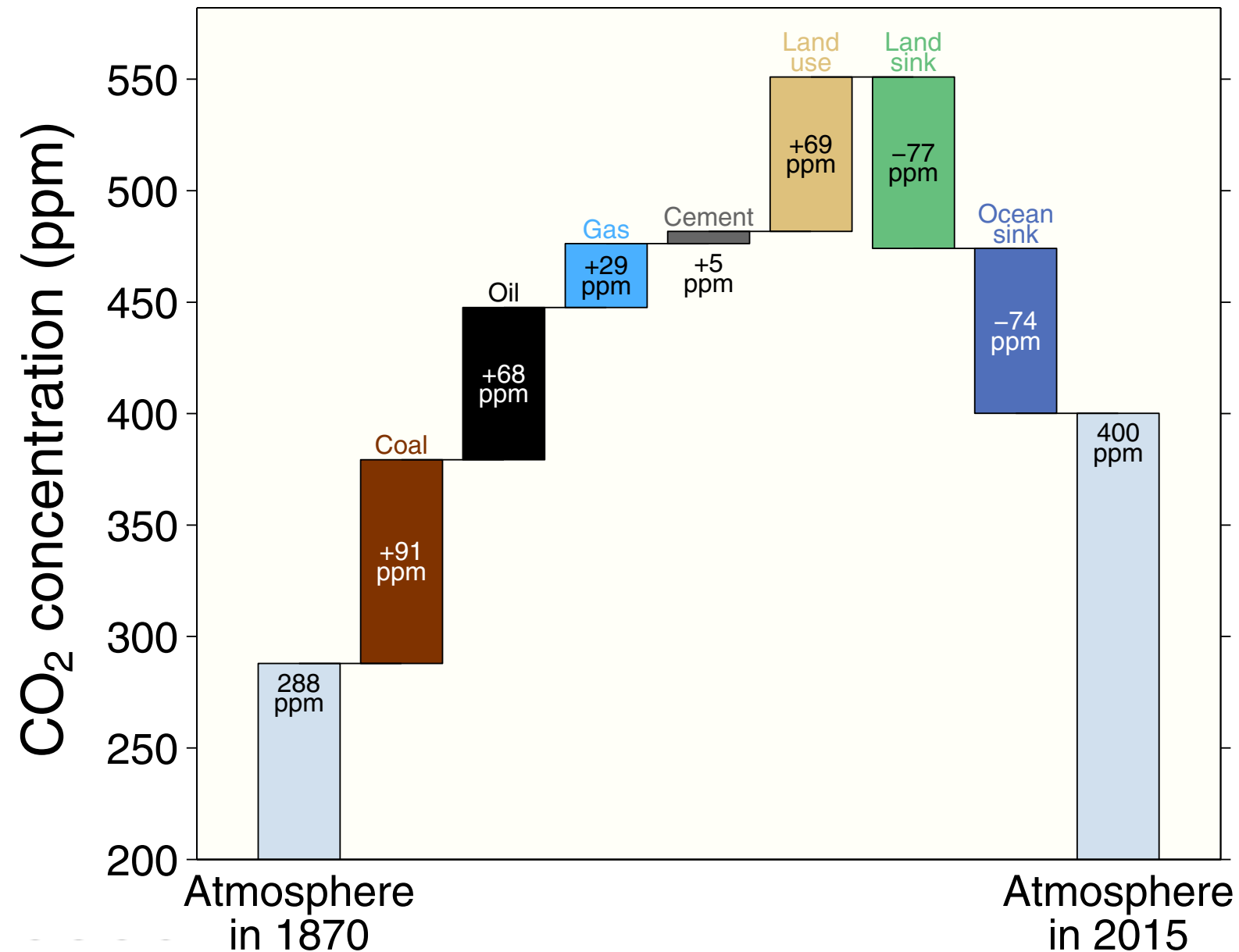


Photo of Tokyo courtesy of CTG/SF: <https://www.flickr.com/photos/27966213@N08/13987969379/>  
Estimate from Zalasiewicz et al. (2016) Scale and Diversity of the Physical Technosphere : A Geological Perspective.



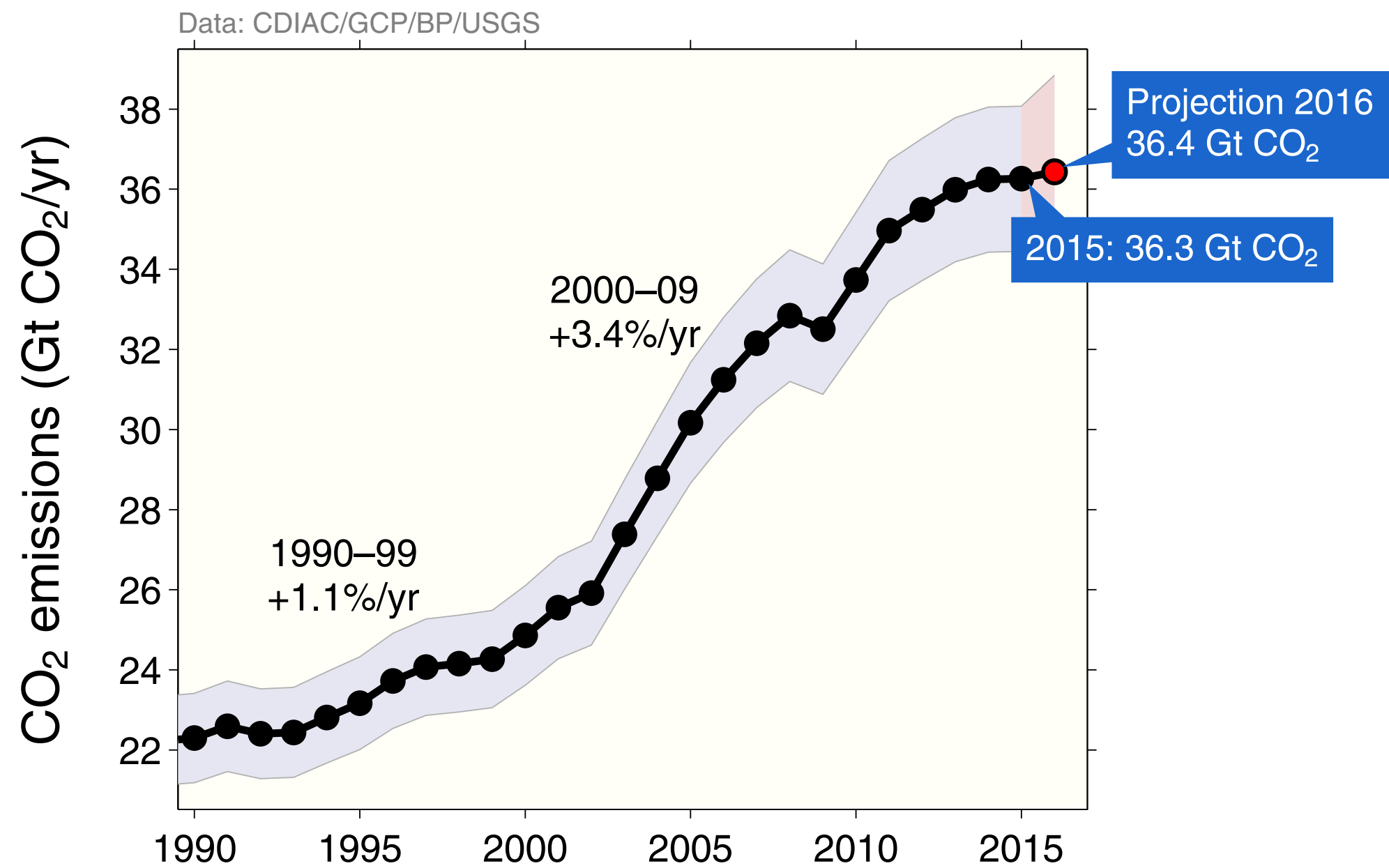
# Consequences for the climate

Current CO<sub>2</sub>, CH<sub>4</sub> & N<sub>2</sub>O concentrations unprecedented in >800,000 years



# Global emissions trend


2016 total similar to 2014




# Paris Agreement on climate change

## Global agreement in December 2015

- » Came into force on 4<sup>th</sup> November 2016
- » Commits to *“holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels”*
- » Goal of achieving *“a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century”* i.e. **net zero emissions**
- » Commits parties to global stock-take and ratcheting up of ambitions every 5 years

United Nations

Framework Convention on Climate Change

FCCC/CP/2015/L.9/Rev.1

Distr.: Limited  
12 December 2015

Original: English

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**Conference of the Parties**  
Twenty-first session  
Paris, 30 November to 11 December 2015  
Agenda item 4(b)  
**Durban Platform for Enhanced Action (decision 1/CP.17)**  
Adoption of a protocol, another legal instrument, or an agreed outcome with legal force under the Convention applicable to all Parties


**ADOPTION OF THE PARIS AGREEMENT**


**Proposal by the President**

**Draft decision -/CP.21**

*The Conference of the Parties,*  
*Recalling* decision 1/CP.17 on the establishment of the Ad Hoc Working Group on the Durban Platform for Enhanced Action,  
*Also recalling* Articles 2, 3 and 4 of the Convention,  
*Further recalling relevant* decisions of the Conference of the Parties, including decisions 1/CP.16, 2/CP.18, 1/CP.19 and 1/CP.20,  
*Welcoming* the adoption of United Nations General Assembly resolution A/RES/70/1, “Transforming our world: the 2030 Agenda for Sustainable Development”, in particular its goal 13, and the adoption of the Addis Ababa Action Agenda of the third International Conference on Financing for Development and the adoption of the Sendai Framework for Disaster Risk Reduction,  
*Recognizing* that climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus requires the widest possible cooperation by all countries, and their participation in an effective and appropriate international response, with a view to accelerating the reduction of global greenhouse gas emissions,  
*Also recognizing* that deep reductions in global emissions will be required in order to achieve the ultimate objective of the Convention and emphasizing the need for urgency in addressing climate change,  
*Acknowledging* that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples,

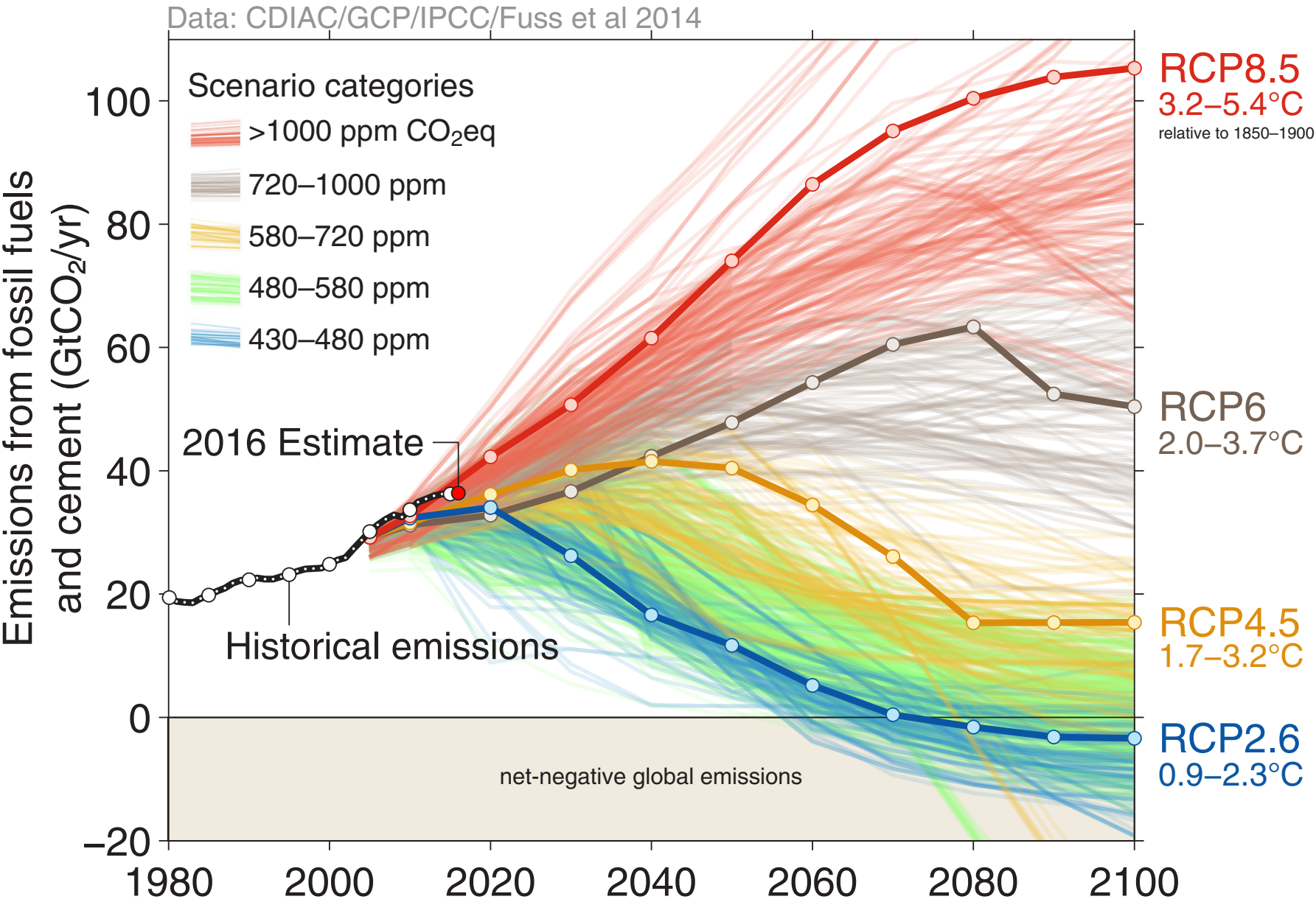
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# Emissions scenarios to 2100

Current commitments likely to yield around 3°C increase





# Global impacts of climate change

Will be “severe, pervasive and irreversible”





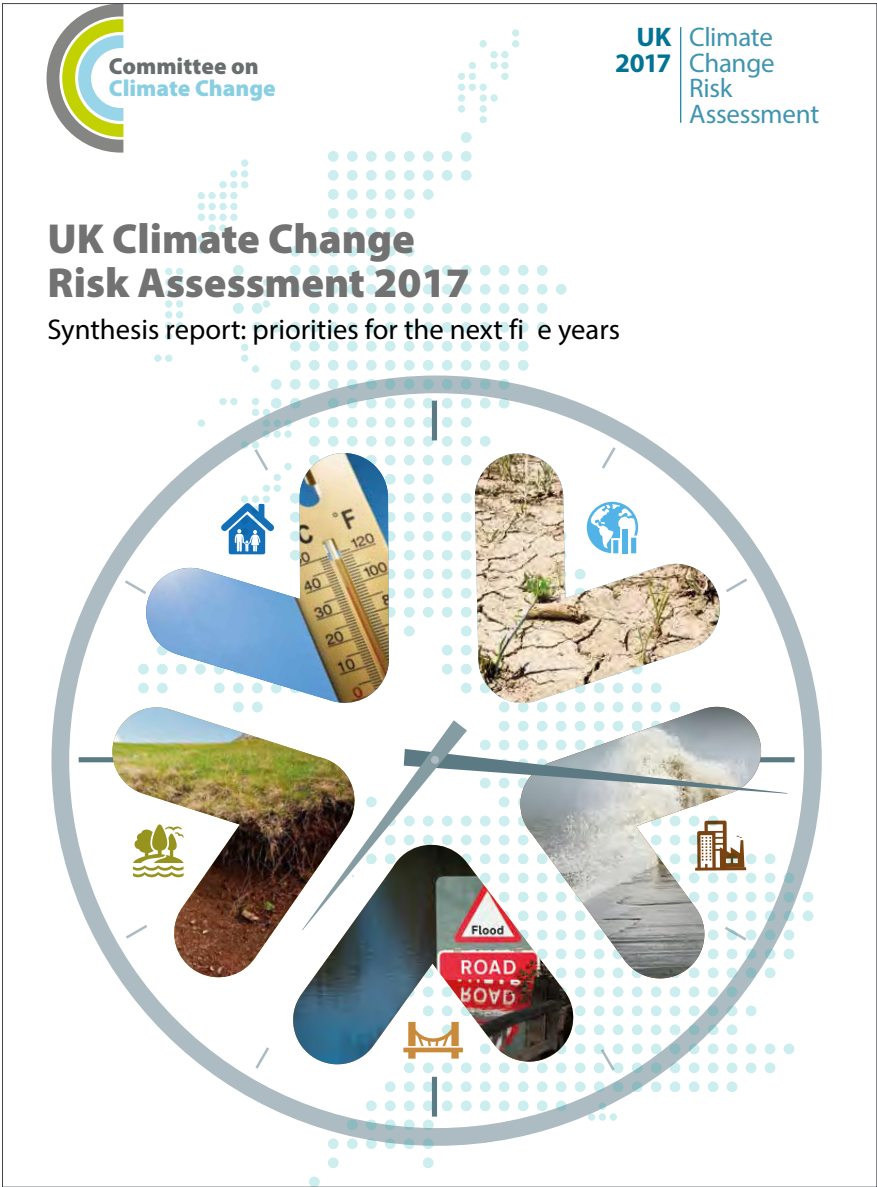
# Climate impacts in the UK

Over 20 areas identified where greater action is needed

Figure SR.1: Top six areas of inter-related climate change risks for the United Kingdom



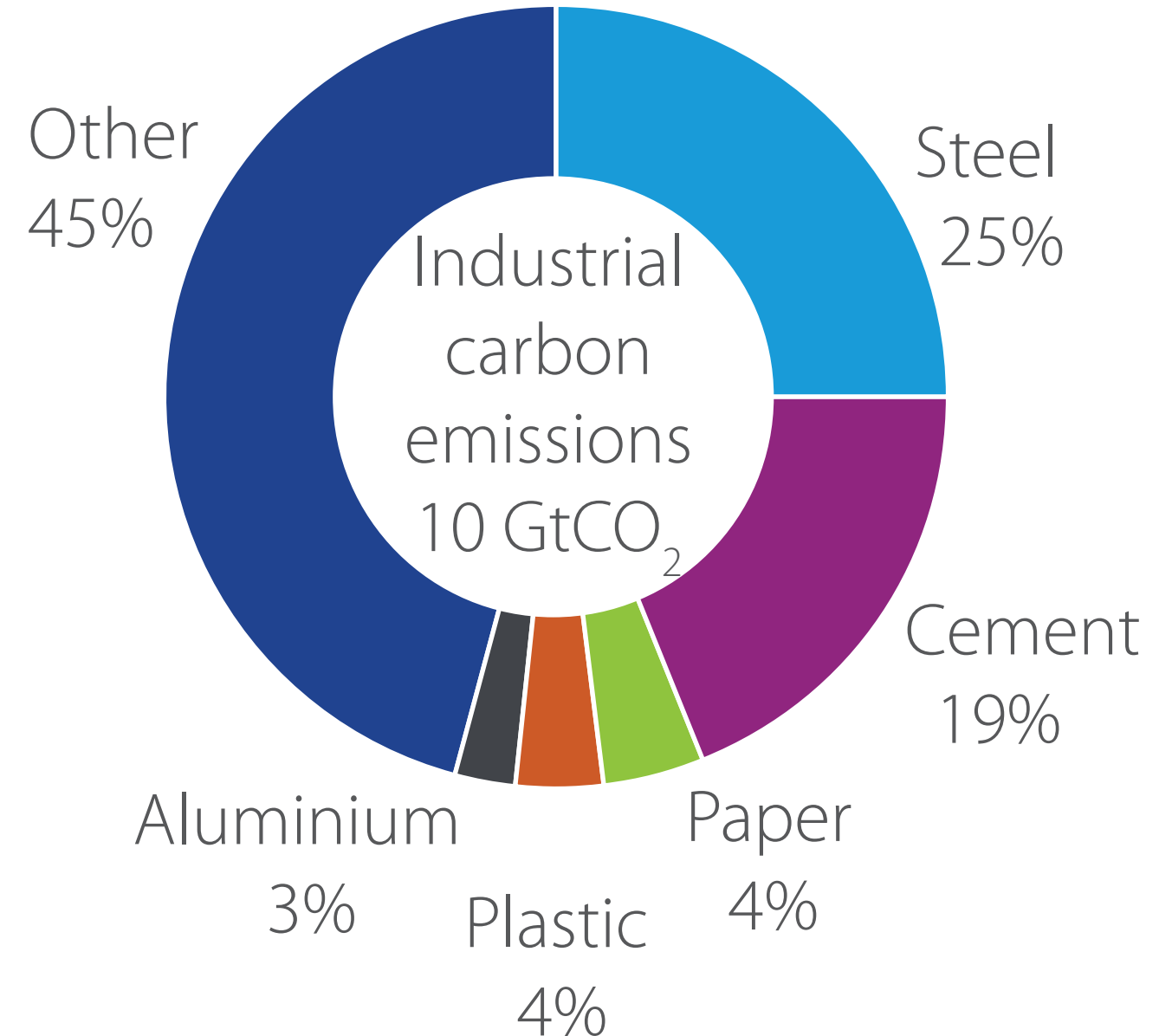
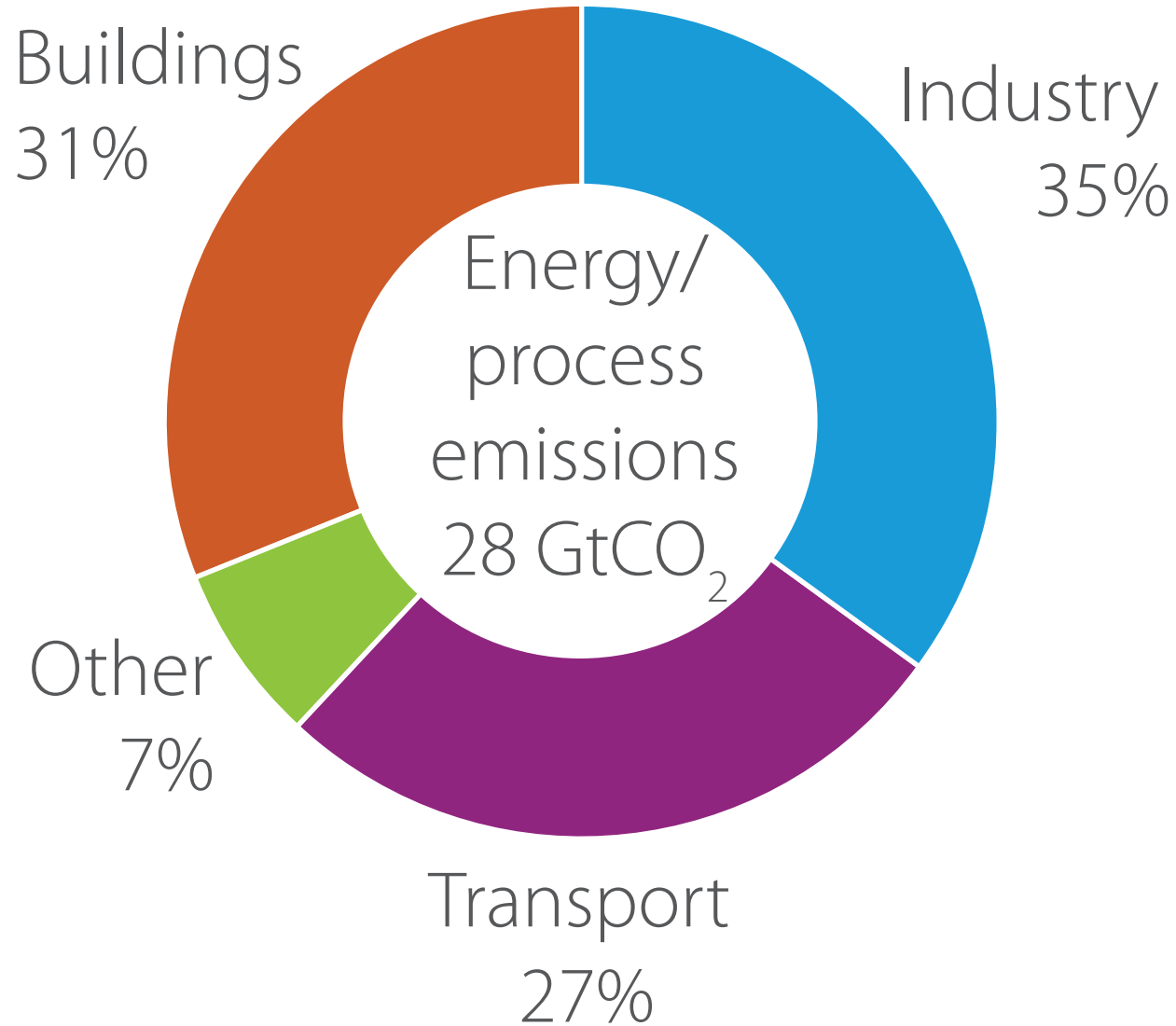
**Source:** ASC synthesis of the main areas of risk and opportunity within the chapters of the Evidence Report.  
**Notes:** Future magnitude is based on a combination of climate change and other drivers of risk (e.g. demographic change), taking account of how current adaptation policies and plans across the UK are likely to reduce risks.





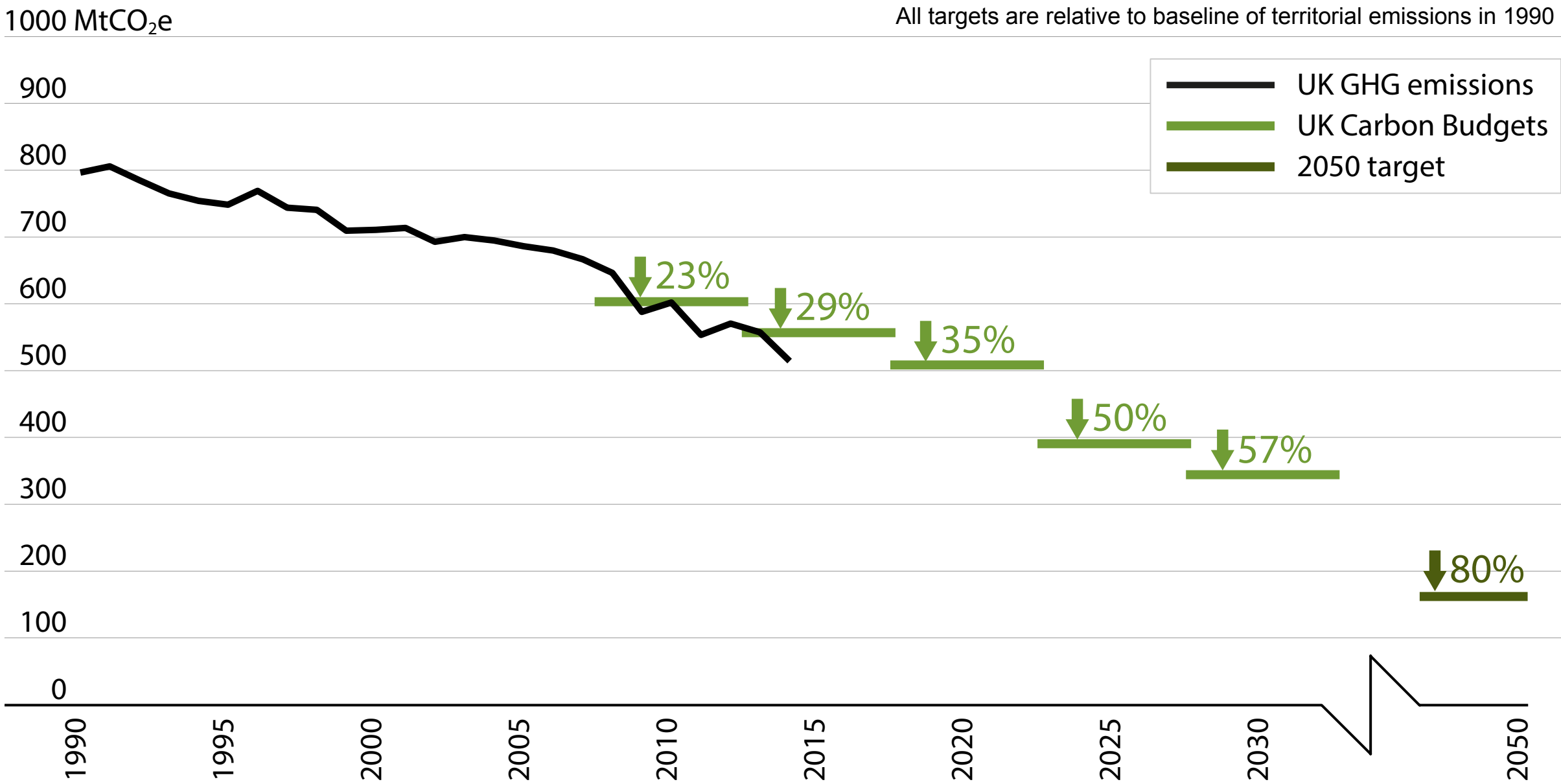
# Global energy & process emissions

The built environment is responsible for a significant portion directly and indirectly



# Current UK targets

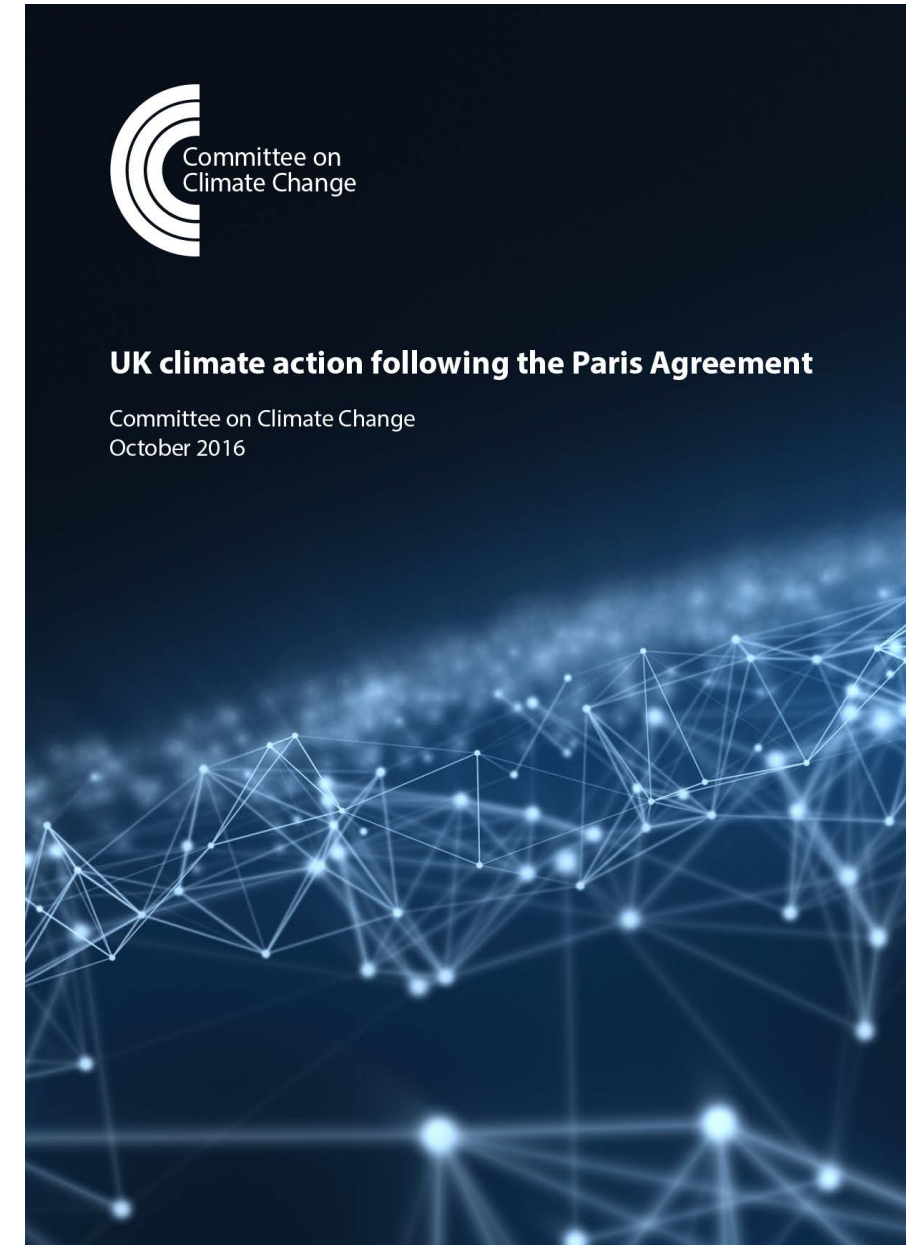
Series of legally binding 5 year carbon budgets



# New UK goal is net zero emissions

## Near the middle of this century

- » CCC advise Paris Agreement goals means UK must be net zero CO<sub>2</sub> by 2055-2075 for >66% chance of achieving 2°C or before 2050 for 1.5°C
- » UK Government has already intimated that the net zero goal must enter UK law: *“The question is not whether but how we do it”*

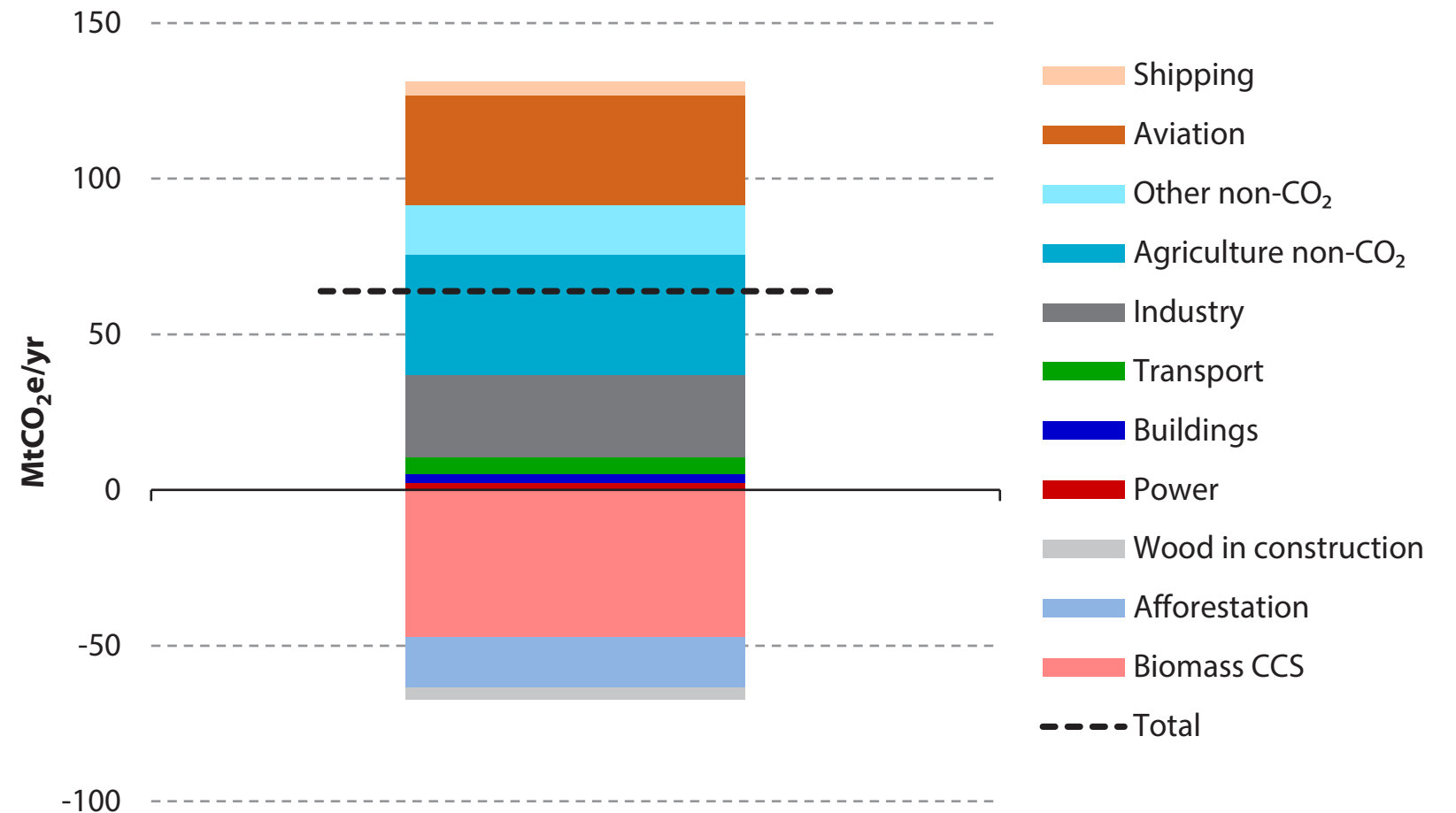


# Achieving net zero in the UK

## Will be extremely difficult

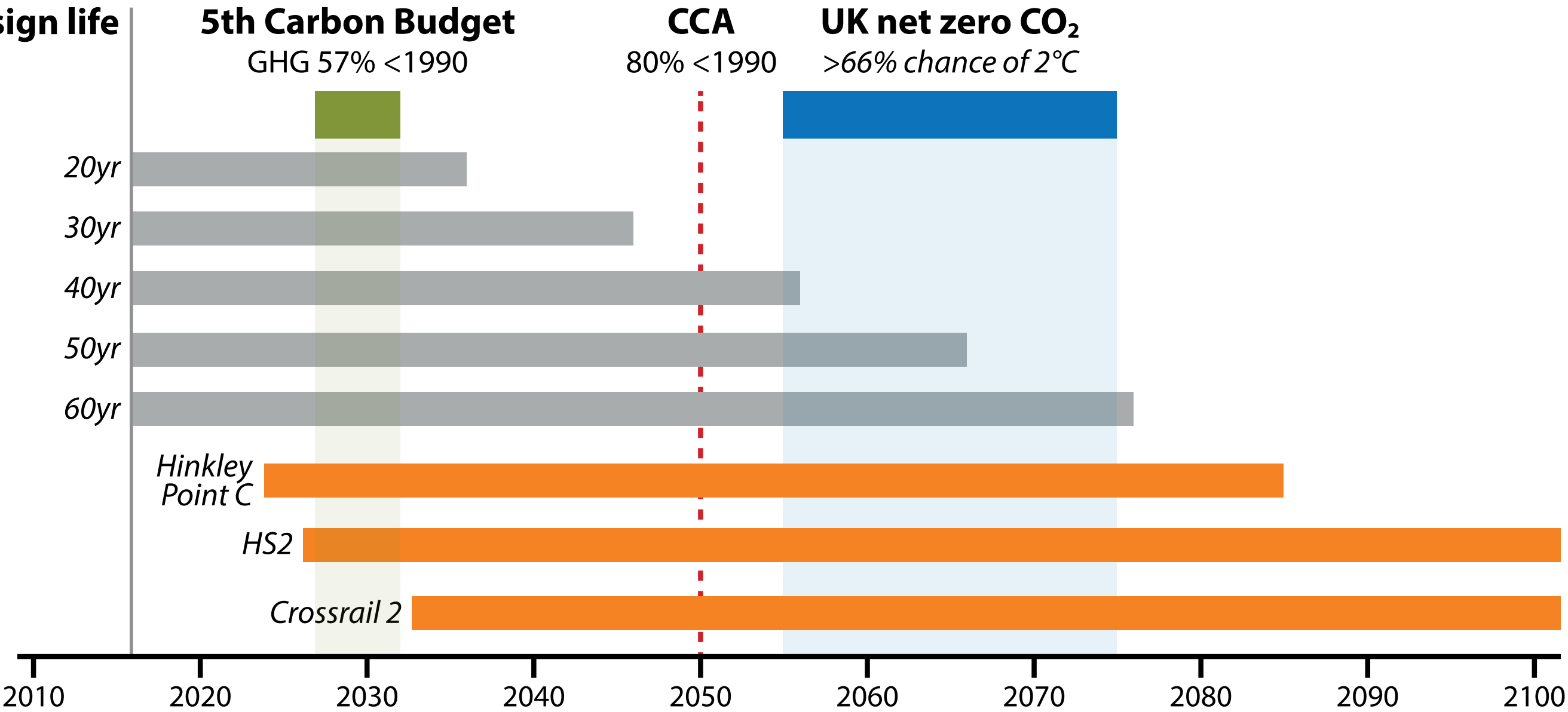
- » Requires maximum deployment of all identified mitigation options
- » Plus deployment of negative emissions technologies (up to max  $\sim 100$  MtCO<sub>2</sub>e/yr)
- » Plus further offsetting elsewhere
- » Remaining emissions in current CCC scenarios are predominantly from aviation, agriculture and industry (mainly materials production *i.e. construction products*)

**Figure 3.1.** Residual UK greenhouse gas emissions in 2050 under Max deployment across all sectors



# The implications for construction

Most assets under design now must operate in a net zero nation



# Construction 2025, GCB Routemap and ICR

## Reports set out required changes and target trajectory to 2050

- » Set ambitious carbon reduction targets
- » Provide baselines for ‘built environment’ and ‘infrastructure’ carbon emissions

EXECUTIVE SUMMARY | CONSTRUCTION 2025 5

**Lower costs**

33%

reduction in the initial cost of construction and the whole life cost of built assets

**Faster delivery**

50%

reduction in the overall time, from inception to completion, for newbuild and refurbished assets

**Lower emissions**


50%

reduction in greenhouse gas emissions in the built environment

**Improvement in exports**

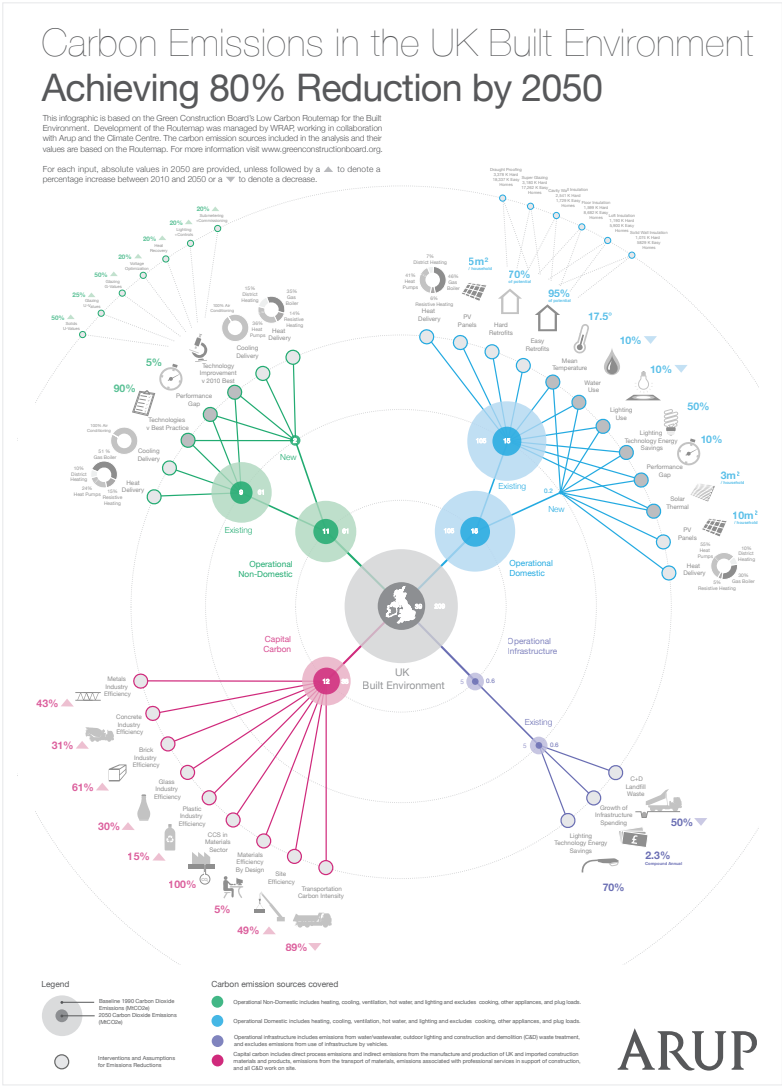
50%

reduction in the trade gap between total exports and total imports for construction products and materials



The global construction market is forecast to grow by over 70% by 2025.

Global Construction 2025; Global Construction Perspectives and Oxford Economics (July 2013)





HM Treasury

### Infrastructure Carbon Review

# Important considerations

## Boundaries and objectives

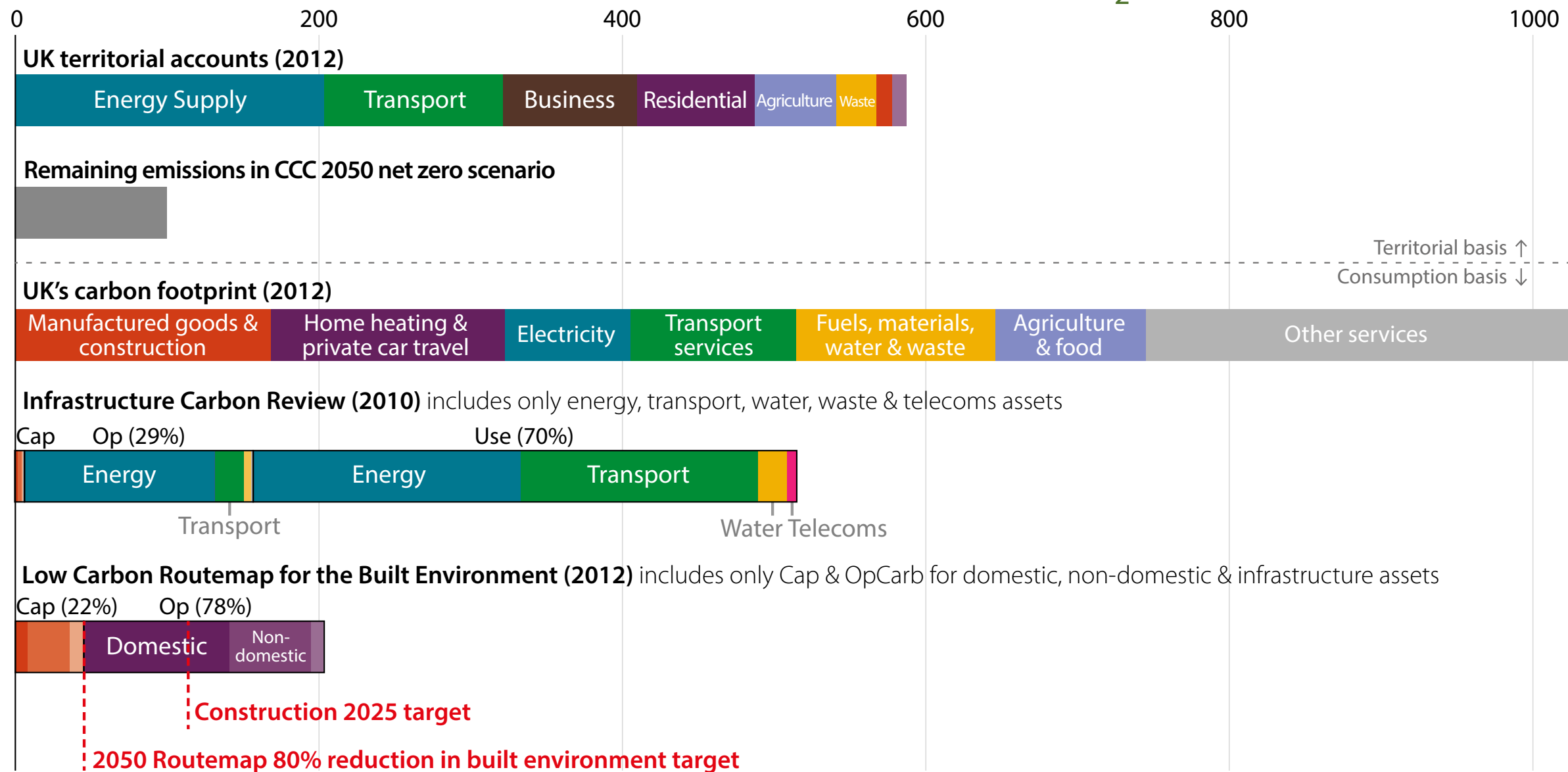
- » The **goal is reducing whole life carbon** on a **whole economy basis** across a **growing stock of assets**
- » Whole life carbon is made up of *Capital Carbon (CapCarb)*, *Operational Carbon (OpCarb)* and *Use Carbon (UseCarb)* – though the precise definitions vary between reports
- » Important to consider whether industry has **control** or **influence** over the carbon, **when** the emissions will occur, and what the realistic scope for mitigation is

## Baselines and methodologies

- » Numerous means of dividing the data which results in different baselines
- » Methodologies still under development and dependent upon coarse data
- » More collaboration and sharing of data will be crucial in improving understanding of how carbon is distributed along supply chains
- » The distribution of whole life carbon varies widely between projects, the following slides are an industry overview

# The challenge

## A snapshot of UK greenhouse gas emissions (MtCO<sub>2</sub>e)

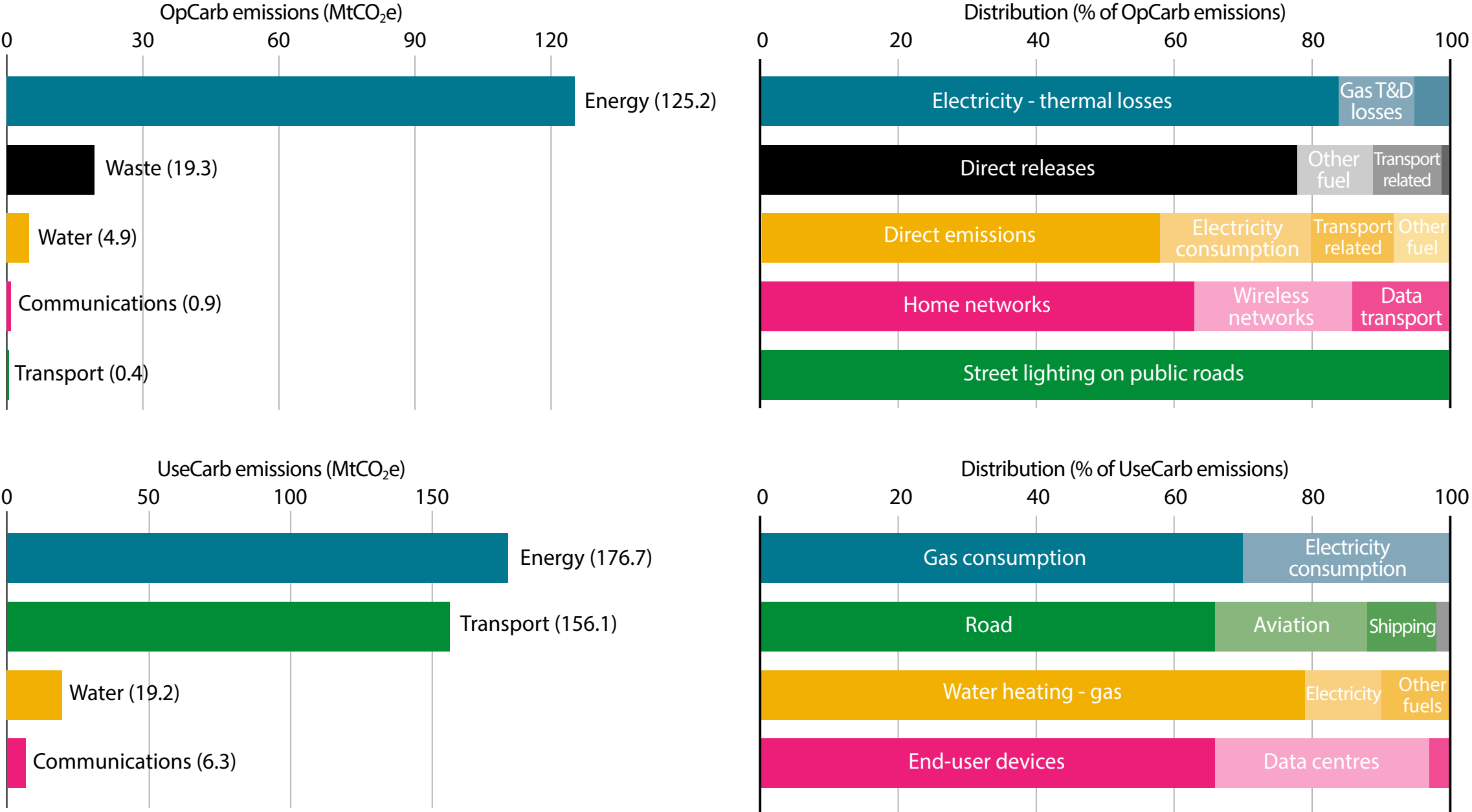


» Immediate priorities are energy & transport but long term targets require reductions everywhere, including CapCarb



# Operational Carbon & Use Carbon in infrastructure

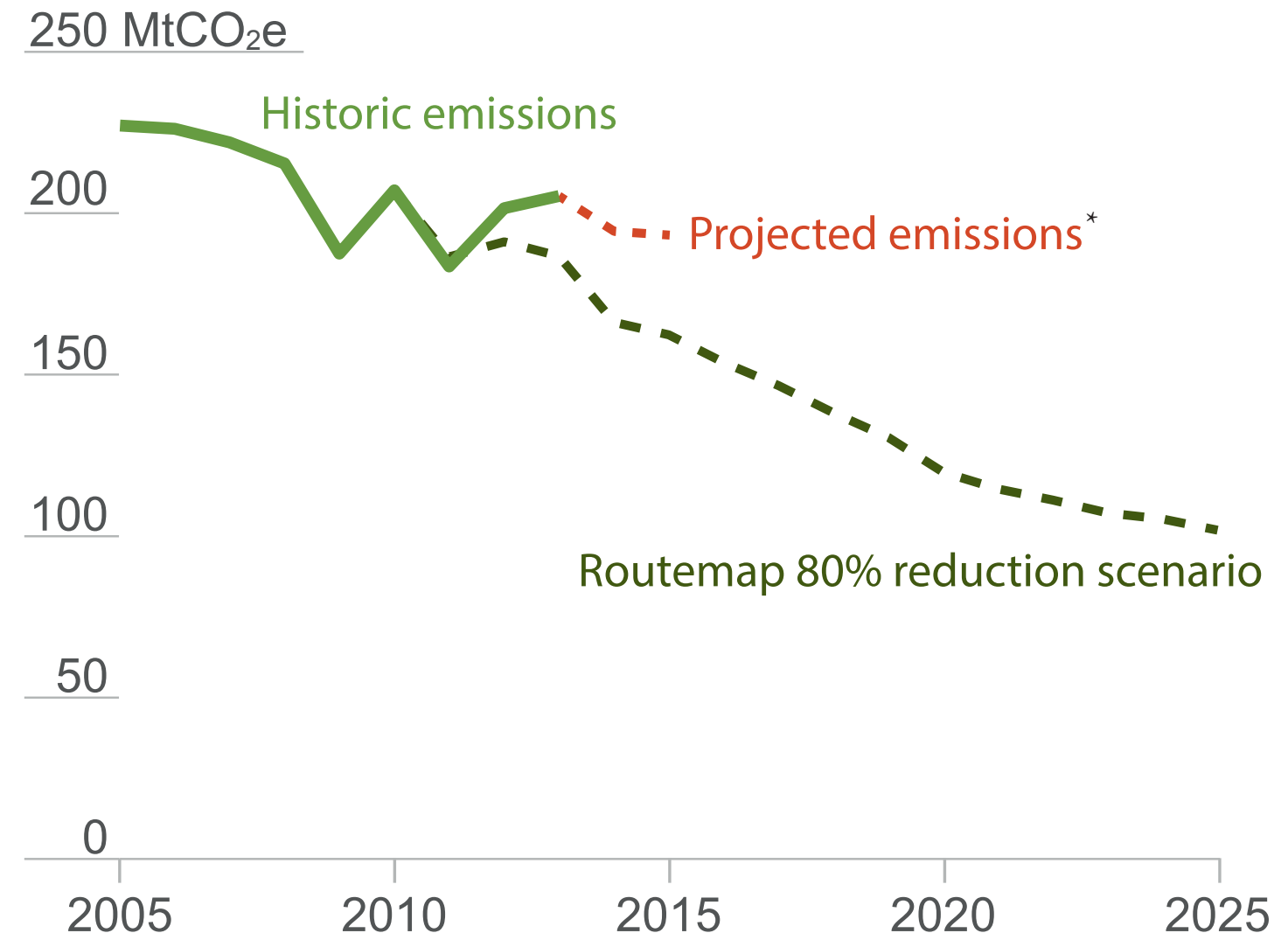
The bulk of emissions are related to energy and transport



# Progress reducing carbon in the built environment

Last Routemap progress report produced in December 2015

- » Progress to 2013 suggests we are not on trend to meet 2025 ambitions
- » CapCarb has increased since 2013 Routemap report
- » 2017 update will be produced soon

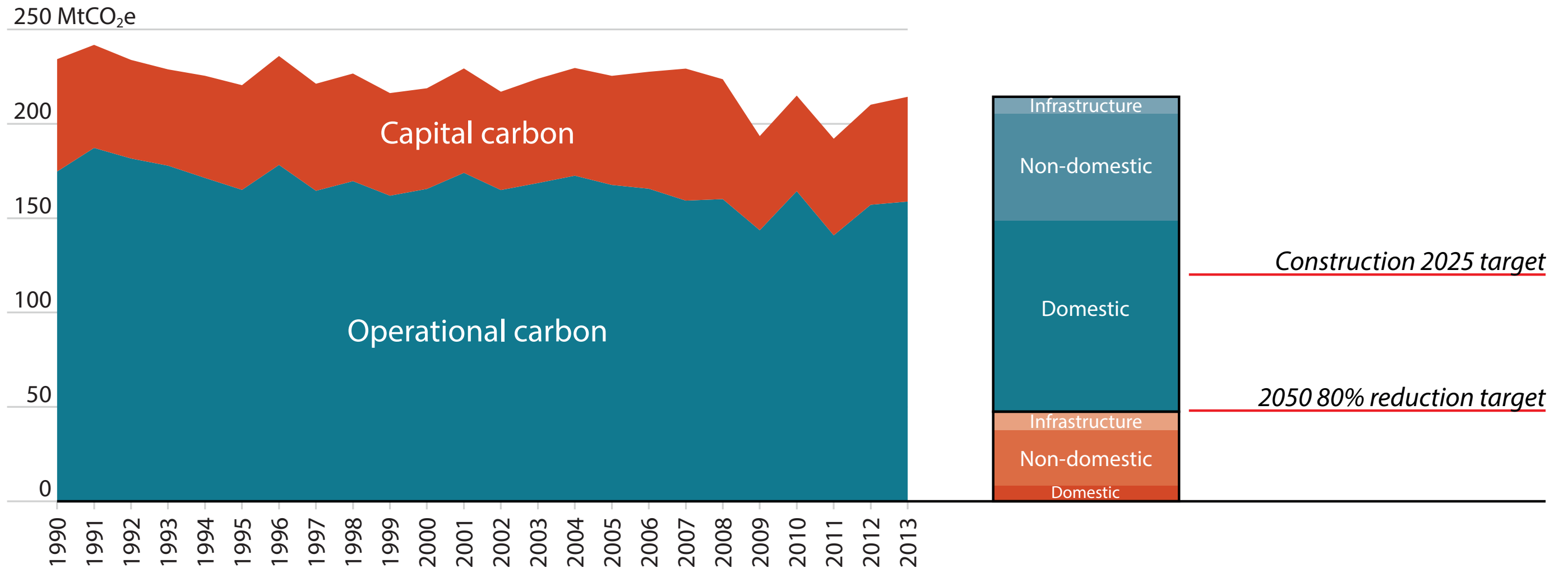


\* Projected emissions based upon analysis by presenter using reported OpCarb (including provisional statistics for 2015) and projected CapCarb (using reported financial value of output and extrapolating historic emissions intensity trend)

# The trend

## Built environment emissions 1990-2013

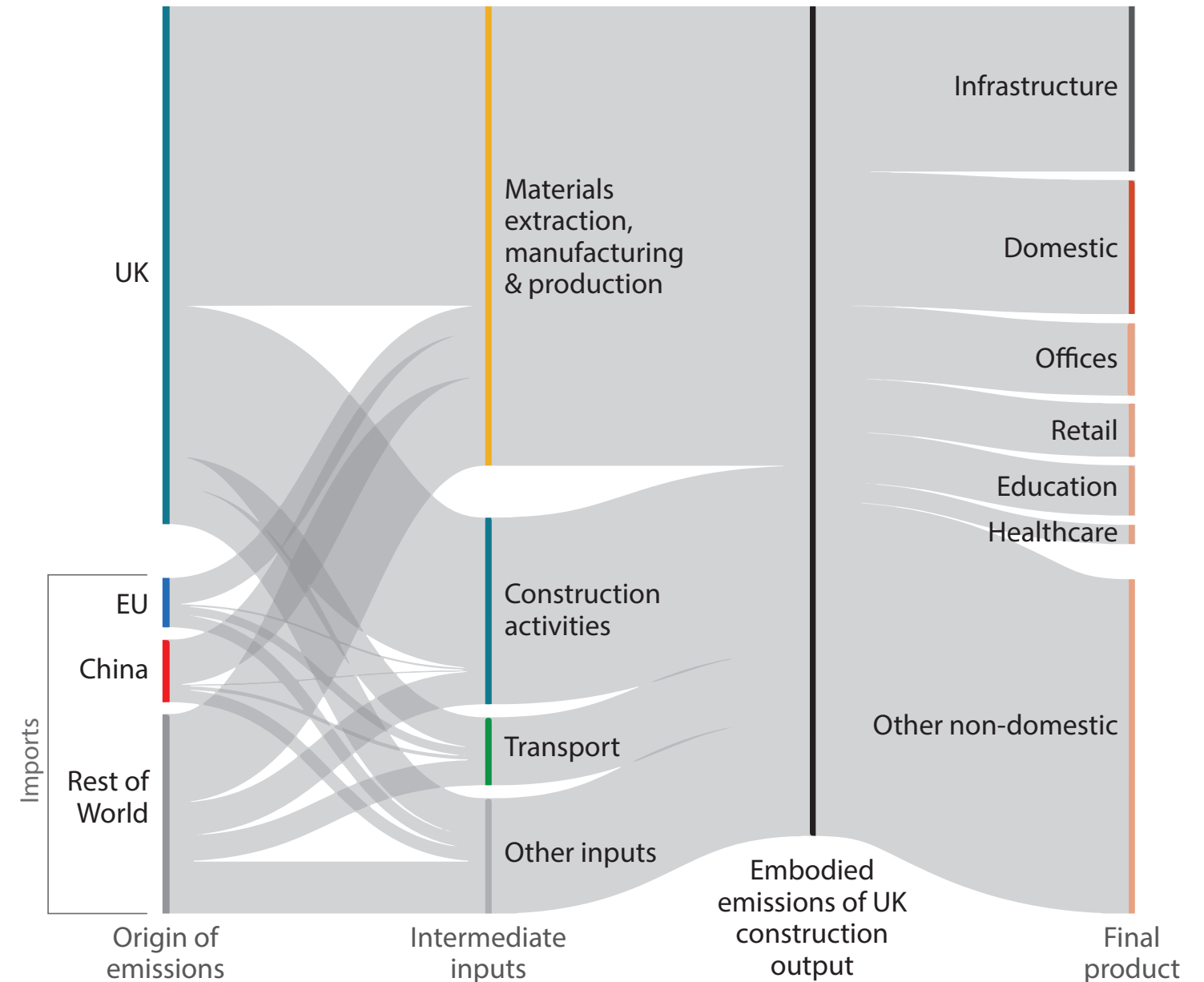
- » Slow reductions in operational carbon, recent increases in capital carbon
- » Impossible to achieve industry targets without reductions in **both** capital and operational carbon



# Capital Carbon in the built environment

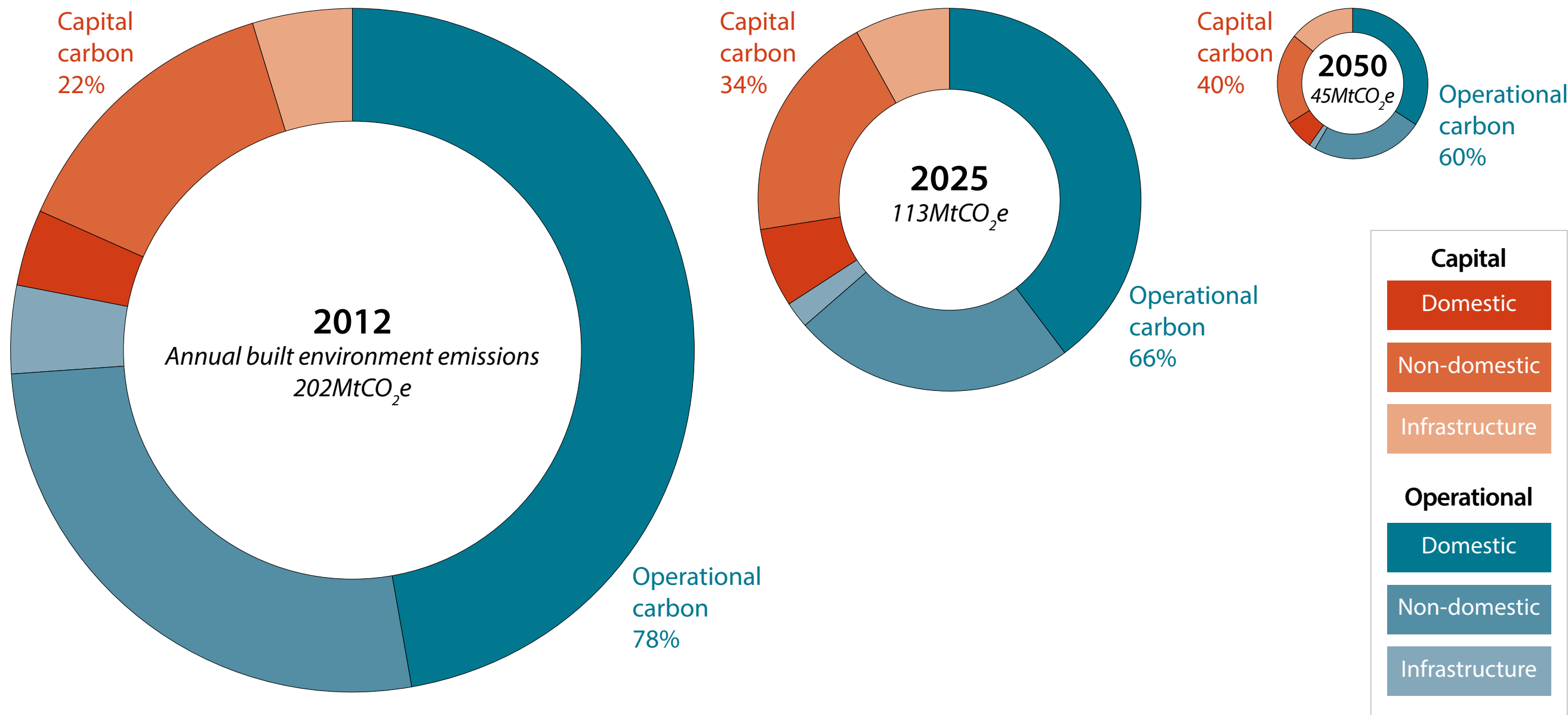
## Estimated carbon footprint of UK construction supply chains

- » Based on limited data
- » Past approaches (e.g. ICR) have mostly relied on financial proxies, disregarding the carbon intensity of different asset types
- » Inclusion of more asset level data and sectoral projections will improve understanding



# Capital Carbon is a growing share of whole life carbon

Particularly as operational emissions reduce



# Capital Carbon on most building projects

Is already a substantial proportion of whole life carbon

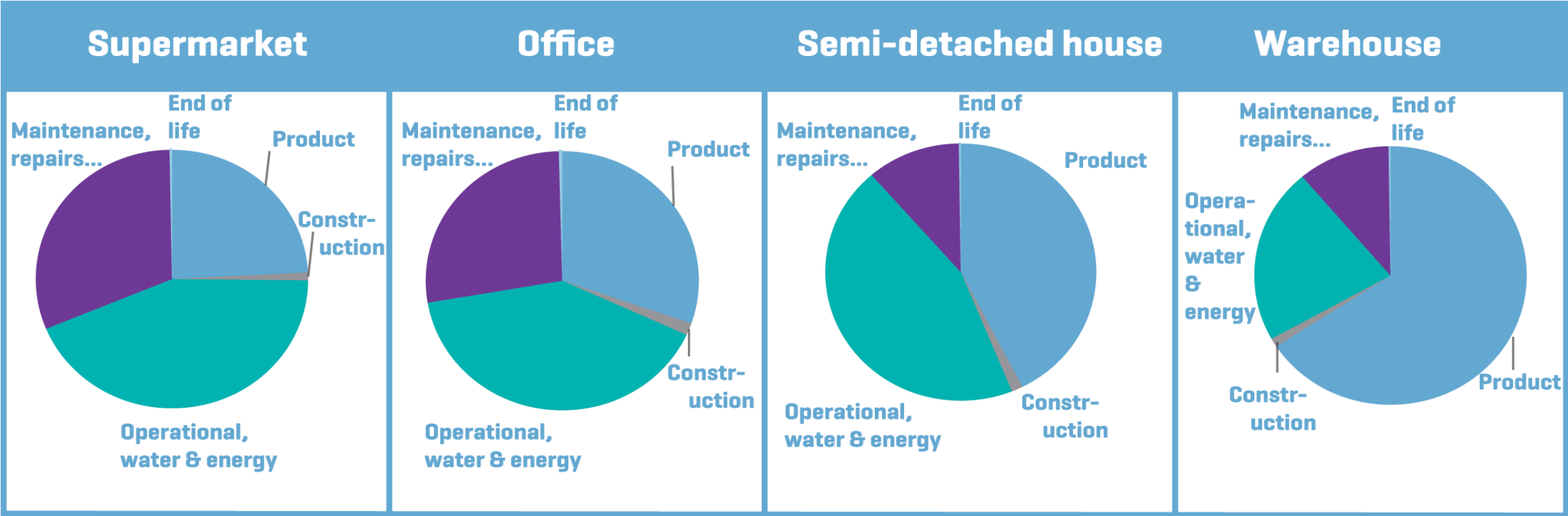


Figure 4: Relative impact of the consequent life cycle stages on the overall carbon footprint for different types of buildings, calculated over 30 years (the energy results have been based on the Building Regulations)



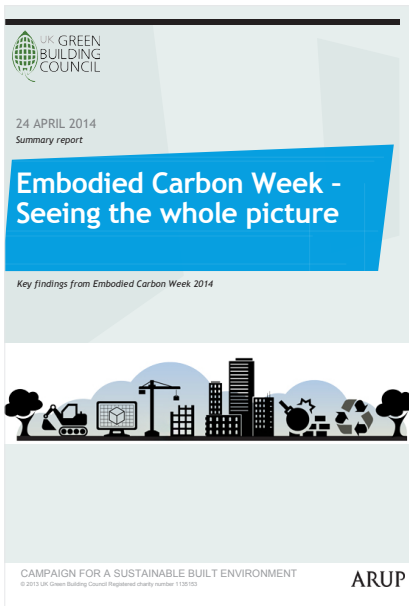
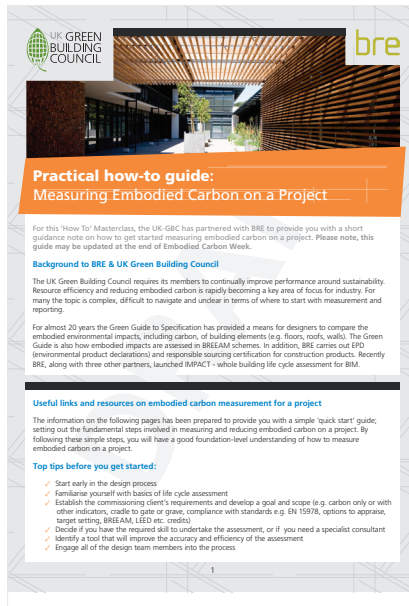
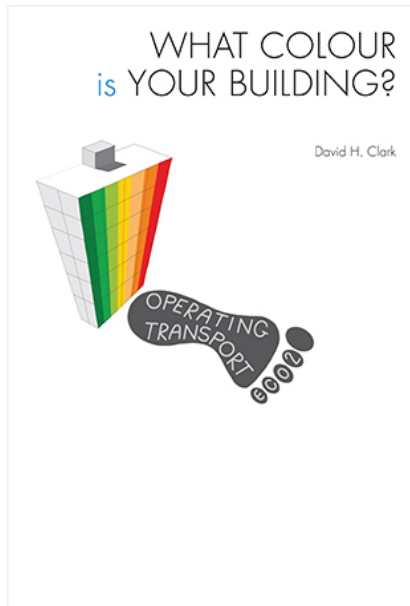
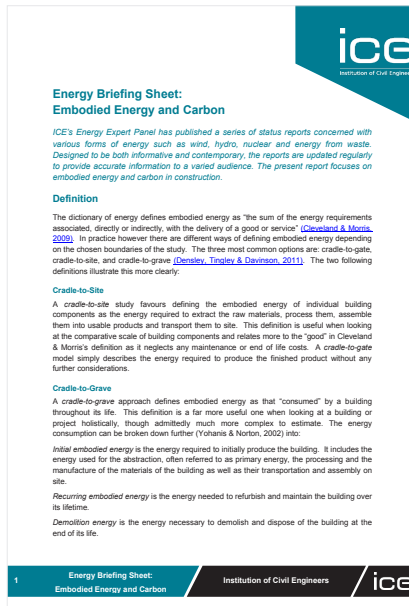
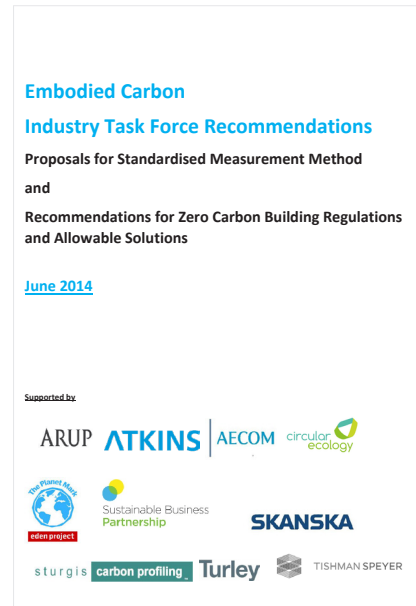
# Government Construction Strategy

## For the current parliament

- » The principal objectives include ambitions to:
  - “enable and drive whole-life approaches to cost and carbon reduction”*
  - and to *“develop data requirements and benchmarks for measurement of whole-life cost and whole-life carbon (embodied and operational)”*
- » *“Government contracts will encourage innovative sustainability solutions on carbon reduction where value can be demonstrated”*
- » Ultimately forming *“recommendations for a future approach”*



# Array of recent publications





# Upcoming guidance

## Due out later this year

- » UK-GBC 'Embodied Carbon: Developing a Client Brief' guidance document and supporting information
- » Outputs of Innovate UK Implementing Whole Life Carbon in Buildings project including RICS Professional Statement intended to ensure consistency in the assessment process
- » Springer book on 'Embodied Carbon in Buildings'
- » and many more...
- » *UK-GBC guidance will be launched at Ecobuild City Hall Session: Embodied Carbon – developing a client brief, **today at 16:30 - 17:45**. Full guidance available from UK-GBC website later today.*



## Embodied Carbon: Developing a Client Brief



March 2017

# Progress in carbon assessment practice

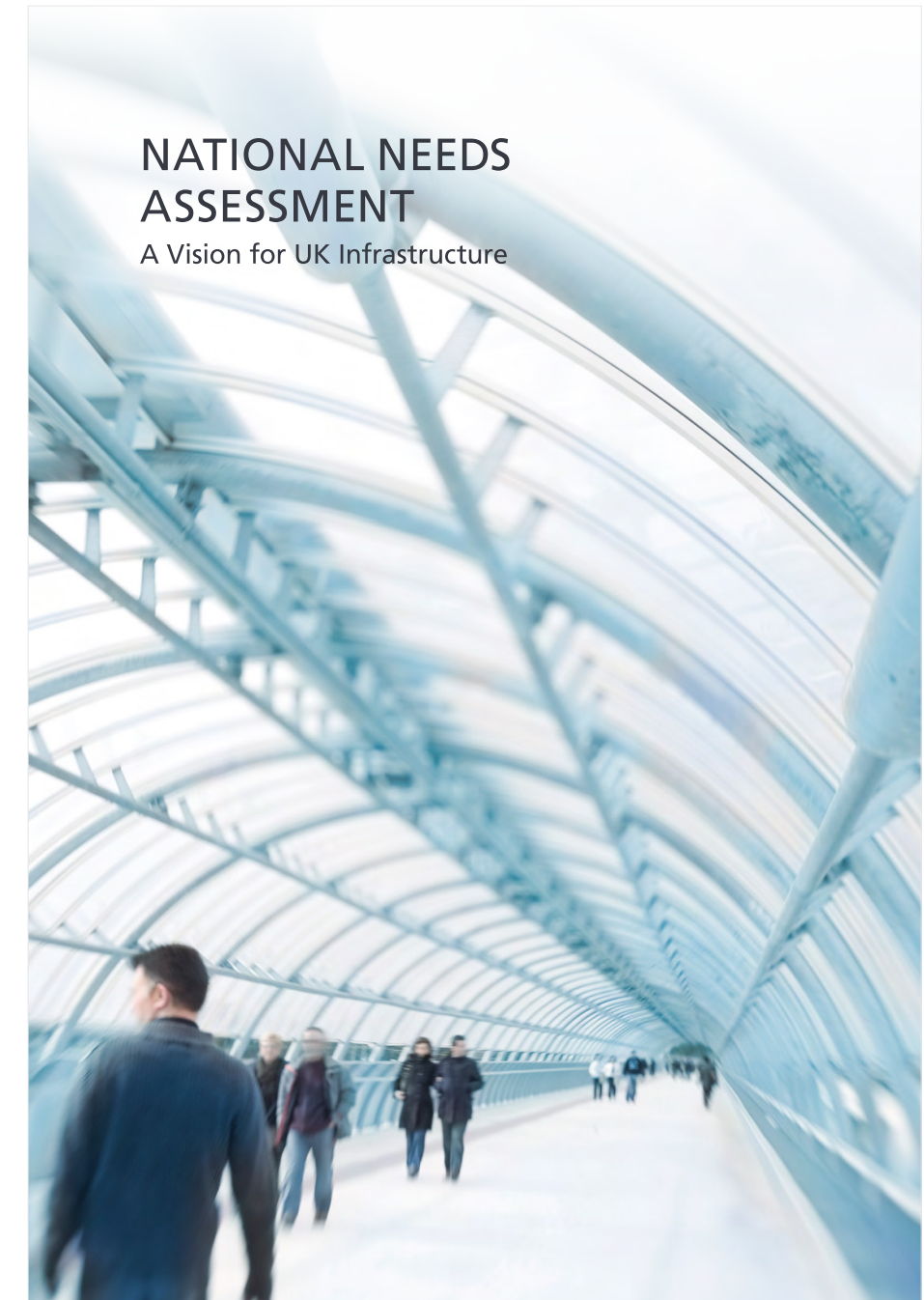
## Recent improvements but still much to be done

- » Assessment now routine in some sectors but still non-existent in others
- » Best practice yet to be effectively shared between infrastructure and buildings
- » Increasing availability of product data (e.g. >3500 verified EPDs plus >4000 unverified EPD) but still high dependency upon generic data
- » Practical challenges to be overcome e.g. gathering accurate data on site and improving carbon literacy
- » Benchmark data slowly emerging for some project types
- » Project carbon intensity targets have been introduced by some clients but project targets are not yet consistent with sectoral or national targets
- » International precedents for using carbon criteria to assess tenders in public procurement; the introduction of regulations requiring whole life carbon measurement and reporting; and regulation of environmental claims from product manufacturers

# National Needs Assessment

## Sets out significant challenges ahead

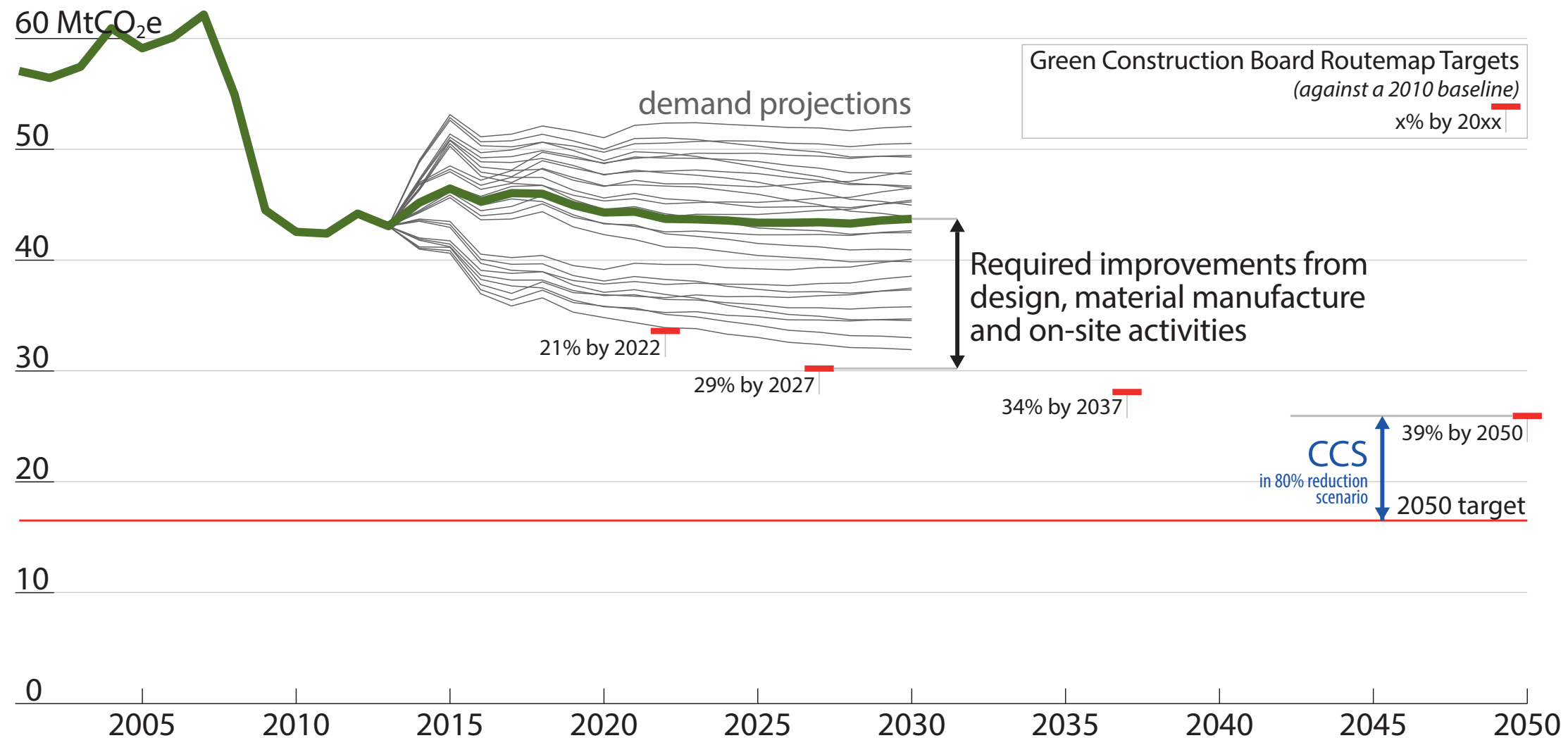
- » Projected population of 75 million by 2050
- » Need 300,000 new homes per year for foreseeable future
- » Traffic growth of up to 50% in some regions
- » High projected costs of flood risk management
- » Total energy demand may increase from 900 to 1200 TWh/year
- » Supporting ITRC analysis sets out carbon implications for a range of scenarios
- » Greater understanding of local considerations and interactions across this system of systems is essential in determining carbon impacts



# Required reductions in Capital Carbon

## Anticipated embodied emissions of UK construction 2001-2030

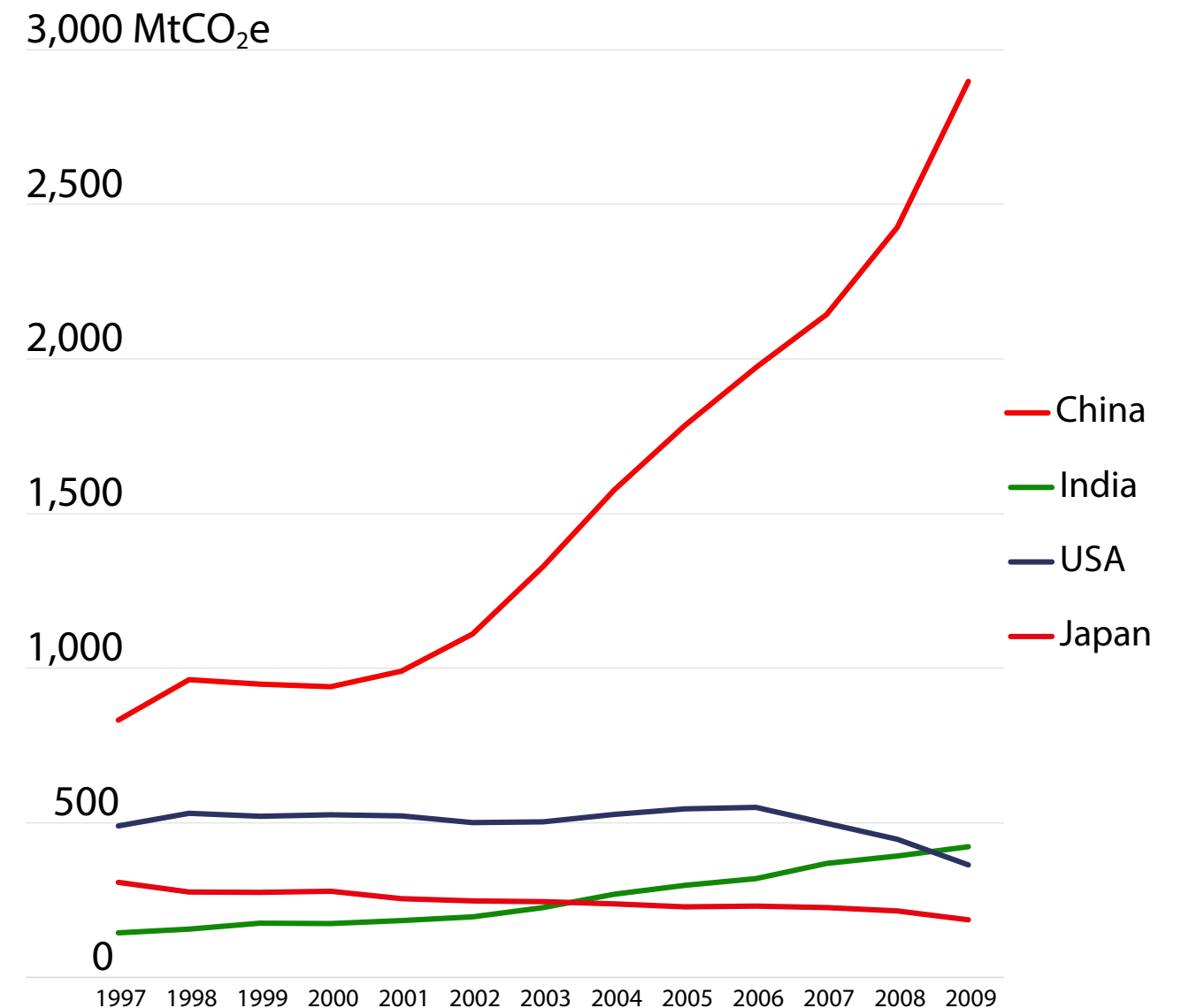
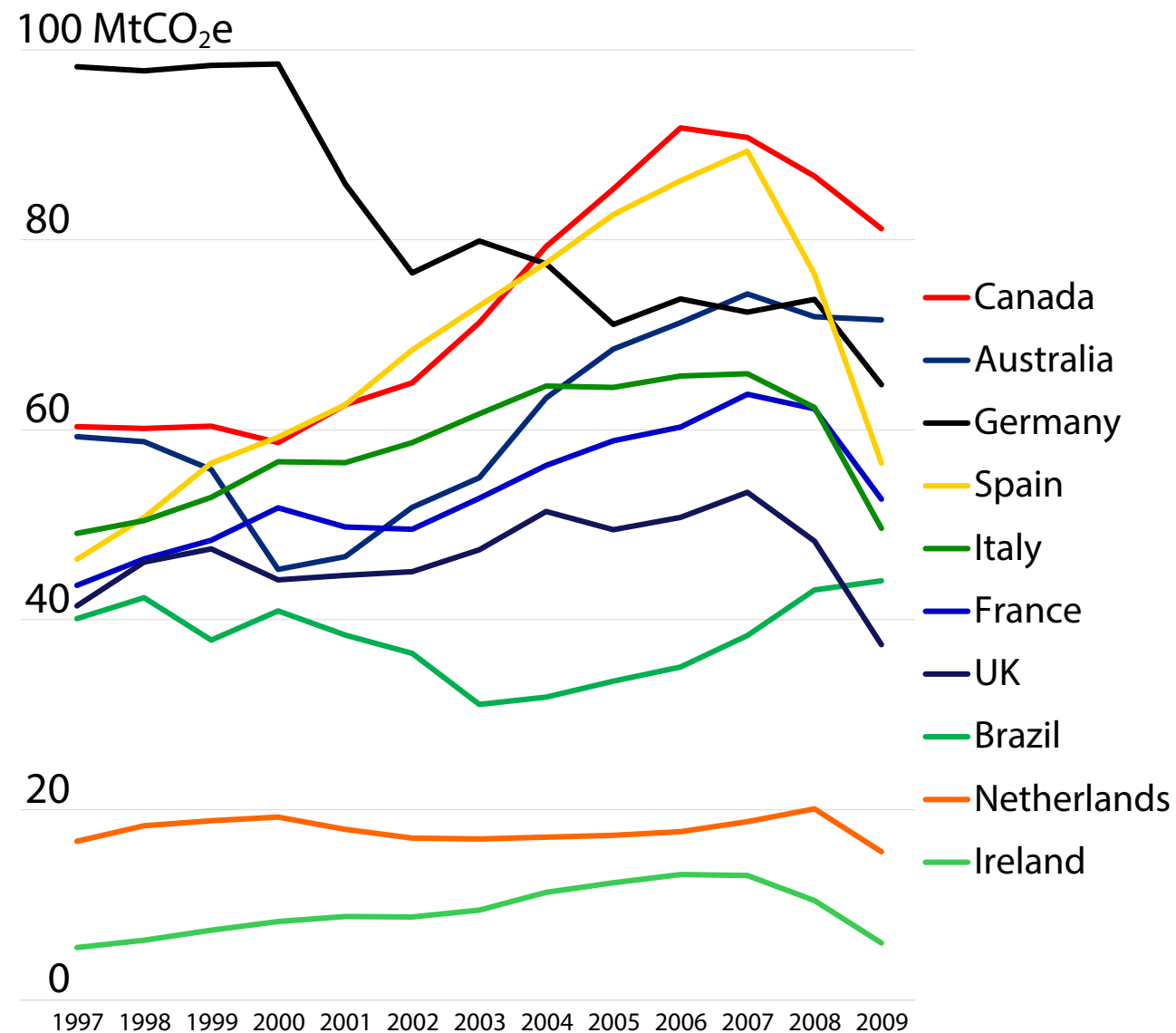
- » 27 scenarios using UK Buildings and Infrastructure Embodied Carbon model
- » **Including** improvements in grid intensity from DECC (2014)



# Vast international scope

## Greenhouse gas emissions of construction sector supply chain by country

» Construction firms in these 14 countries alone influence 4.4 GtCO<sub>2</sub>e of supply chain emissions





# Summary

## Achieving net zero this century requires urgent action now

- » The net zero emissions goal creates a new carbon context
- » Earlier mitigation will be more cost effective and reduces dependence upon unproven negative emissions technologies
- » Faster progress is needed to get the construction industry back on a trajectory that is consistent with our national targets
- » New tools and guidance have supported improvements in practice but these changes have only permeated certain sectors of the industry
- » Collaboration is needed to improve our understanding of how carbon is distributed
- » Scenario analyses show the likely impact of demographic trends and increasing significance of Capital Carbon
- » The substantial global scope for mitigation in construction means there will be a market for low carbon skills, products and expertise
- » The UK is well positioned to tap into this market but needs to stay ahead of the competition. That means driving best practice at home now.