Minimising Energy in Construction

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UNIVERSITY OF
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Introduction

COP21
limit temp.
rise to
<1.5ºC

2050
-80%
CO_2e

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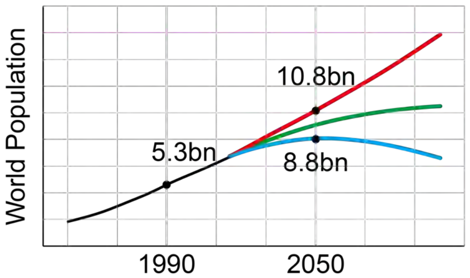

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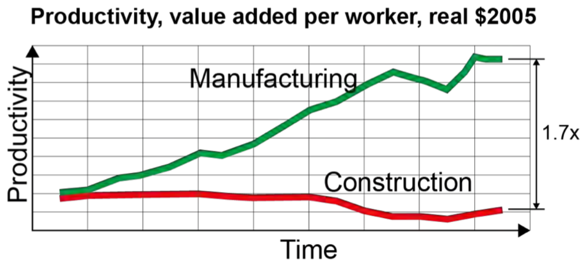

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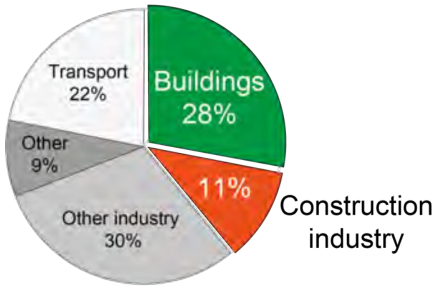

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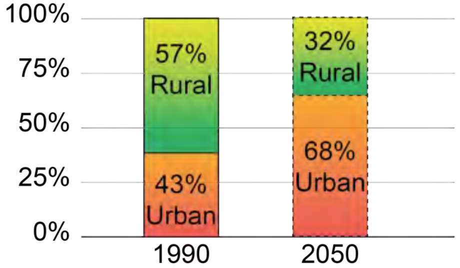

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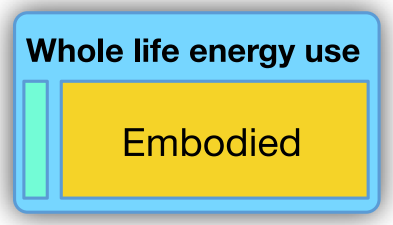
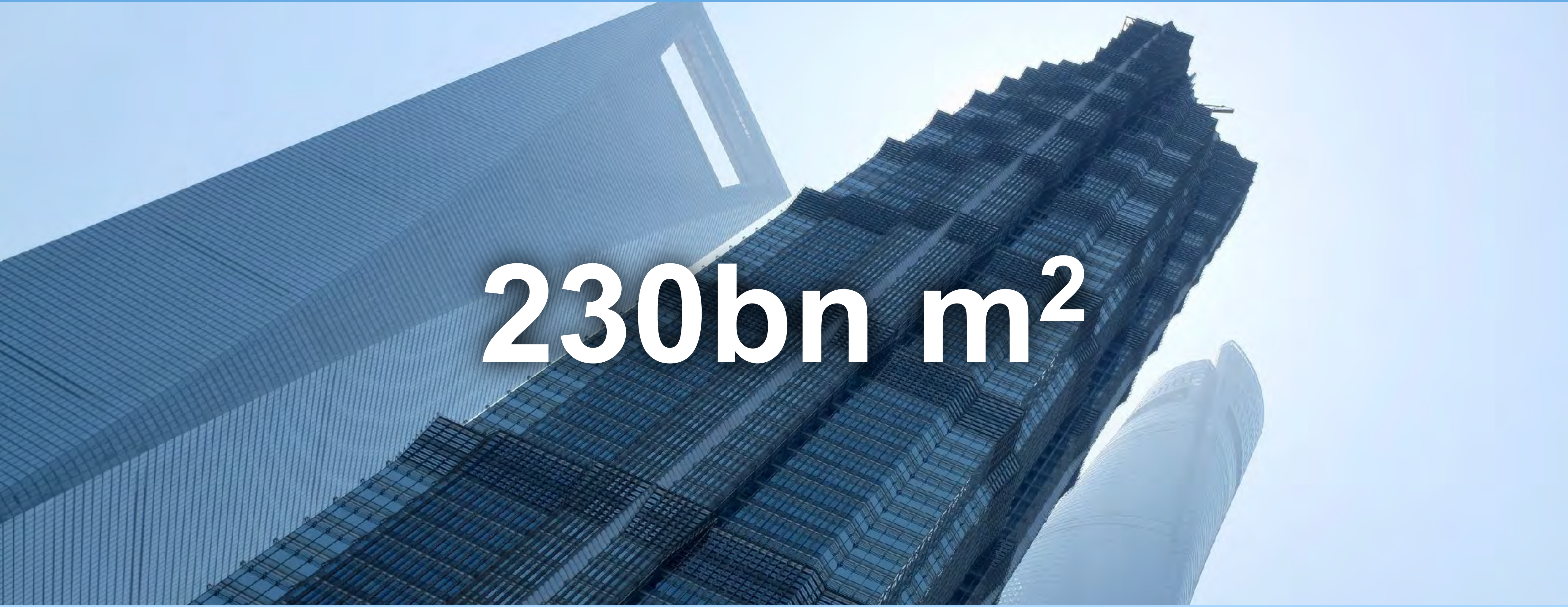


Introduction

50% waste

Thirion, C., Putting the material in the right place, 2012, UCL, London; Moynihan, M. Utilization of structural steel in buildings. Proc. R. Soc. A, 2014.

Introduction



UNEIEA Global Status Report 2017

MEICON

- Engineering and Physical Sciences Research Council (EPSRC)
  - Funding under “Feasibility Studies in Energy Research 2017”
  - £250k, two years, led by University of Cambridge

- **Long-term vision:**
  - Our long-term vision is for the built environment to be designed cost-effectively, based on whole life cycle energy consumption using minimum material resource for appropriate performance.
- **Immediate ambition**
  - To use feasibility studies to identify and address sources of wasted embodied energy, value-less cost, and performance over-design in the construction industry to transform sector wide design practice and define the research areas that will underpin this transformation

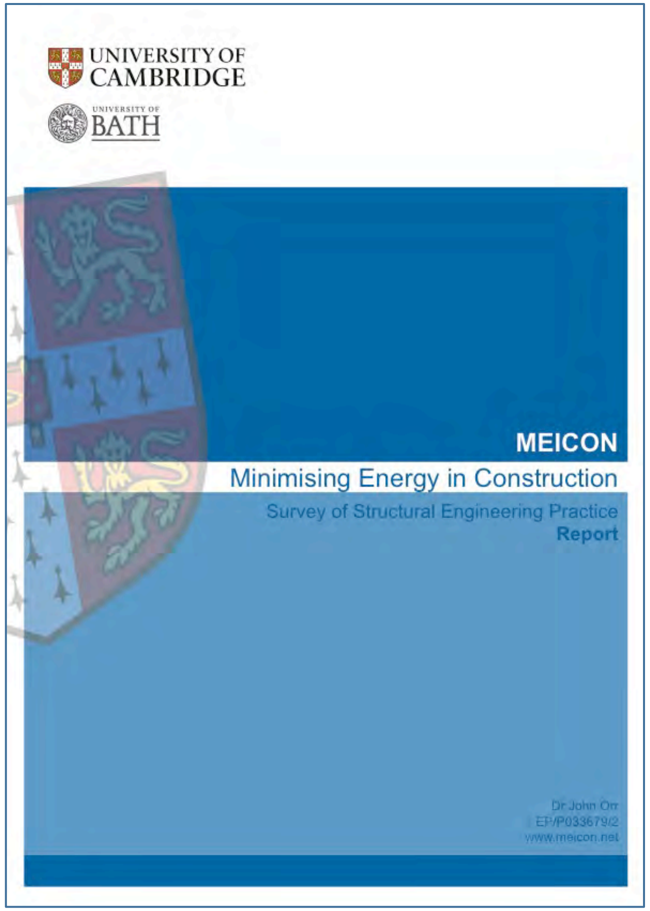
MEICON: Survey

“examine current culture and practice in structural engineering design as it relates to embodied energy”

MEICON: Survey

- **36 question anonymous online survey**
- Questions in seven sections:
  - 1) General; 2) Loading; 3) Serviceability; 4) Design; 5) Capacity; 6) Design Examples; 7) Population
- 129 submissions between August-October 2017
  - Taking a 95% confidence level, we have a margin of error of ±8.65%, making no assumptions about the skew of responses (the worst case).
  - Sample size doesn't need to be very large (if the population is c.>20,000 people)

MEICON: Survey



- Full details of all questions and their responses
- Presents survey results **plus** lots of new questions

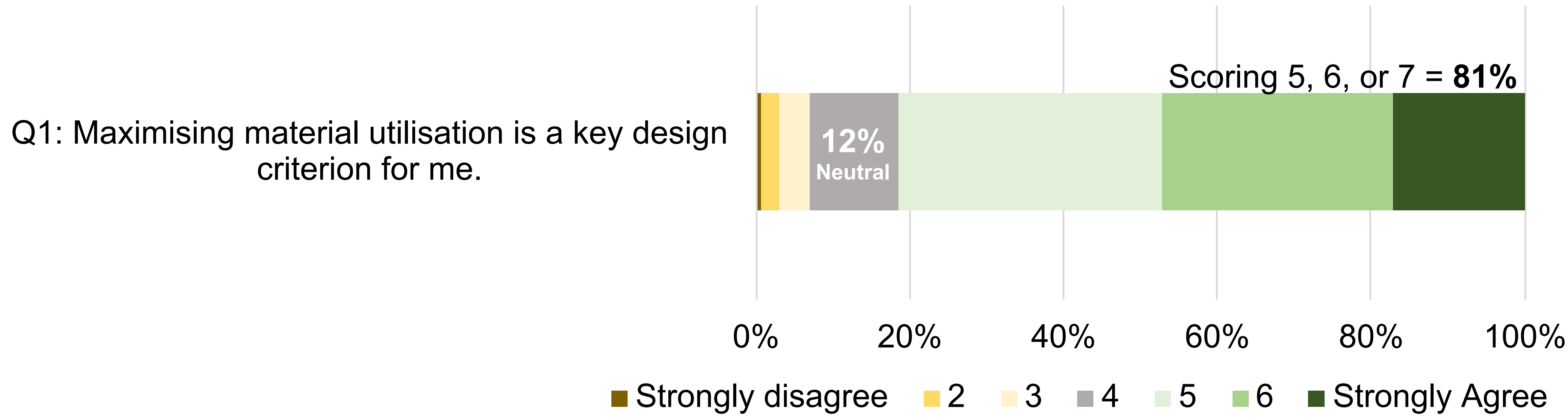
www.meicon.net/survey2018

- Accompanying academic journal paper in Resources, Conservation and Recycling, vol.140, https://doi.org/10.1016/j.resconrec.2018.09.015

MEICON: Survey

- **Population**
  - 89% structural engineers, 74% UK, 84% male
  - 26% graduates, 25% senior engineers, 16% director, 11% associates
  - 38% concept design, 45% detailed design
  - Average 16 years experience

MEICON: Survey



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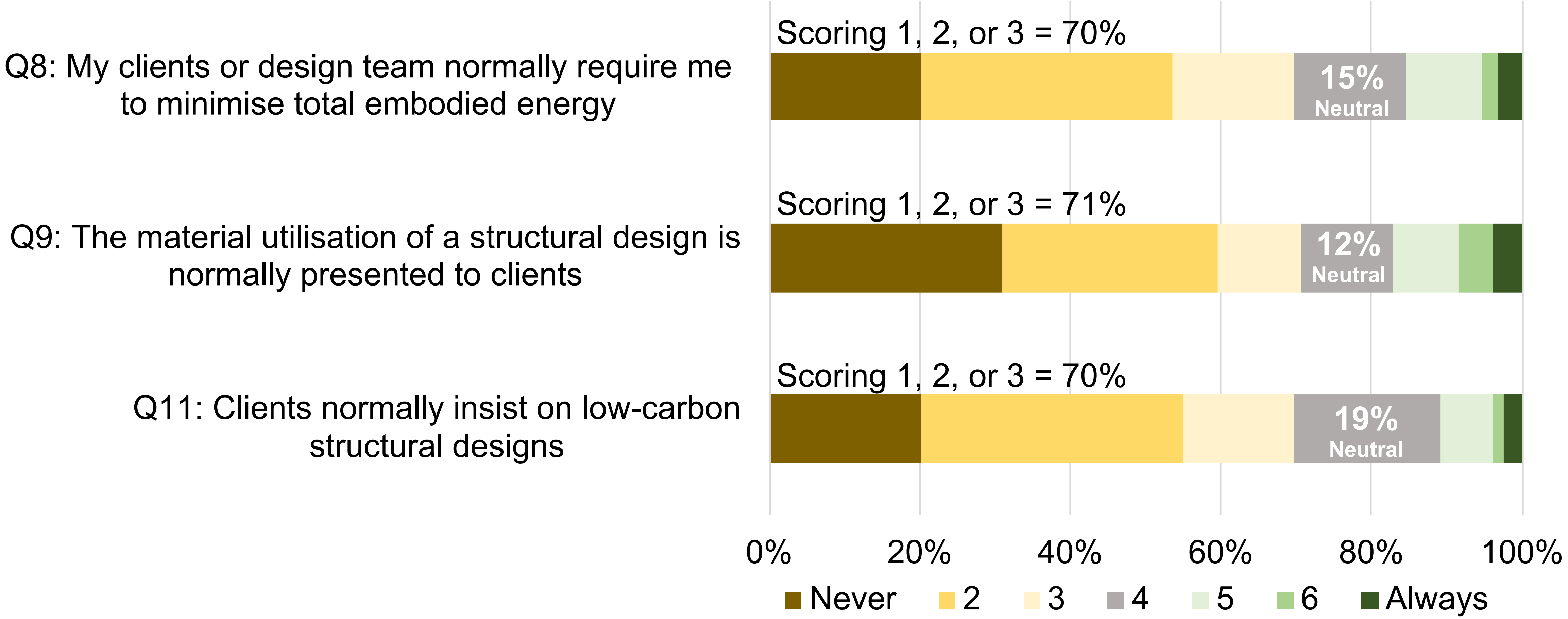
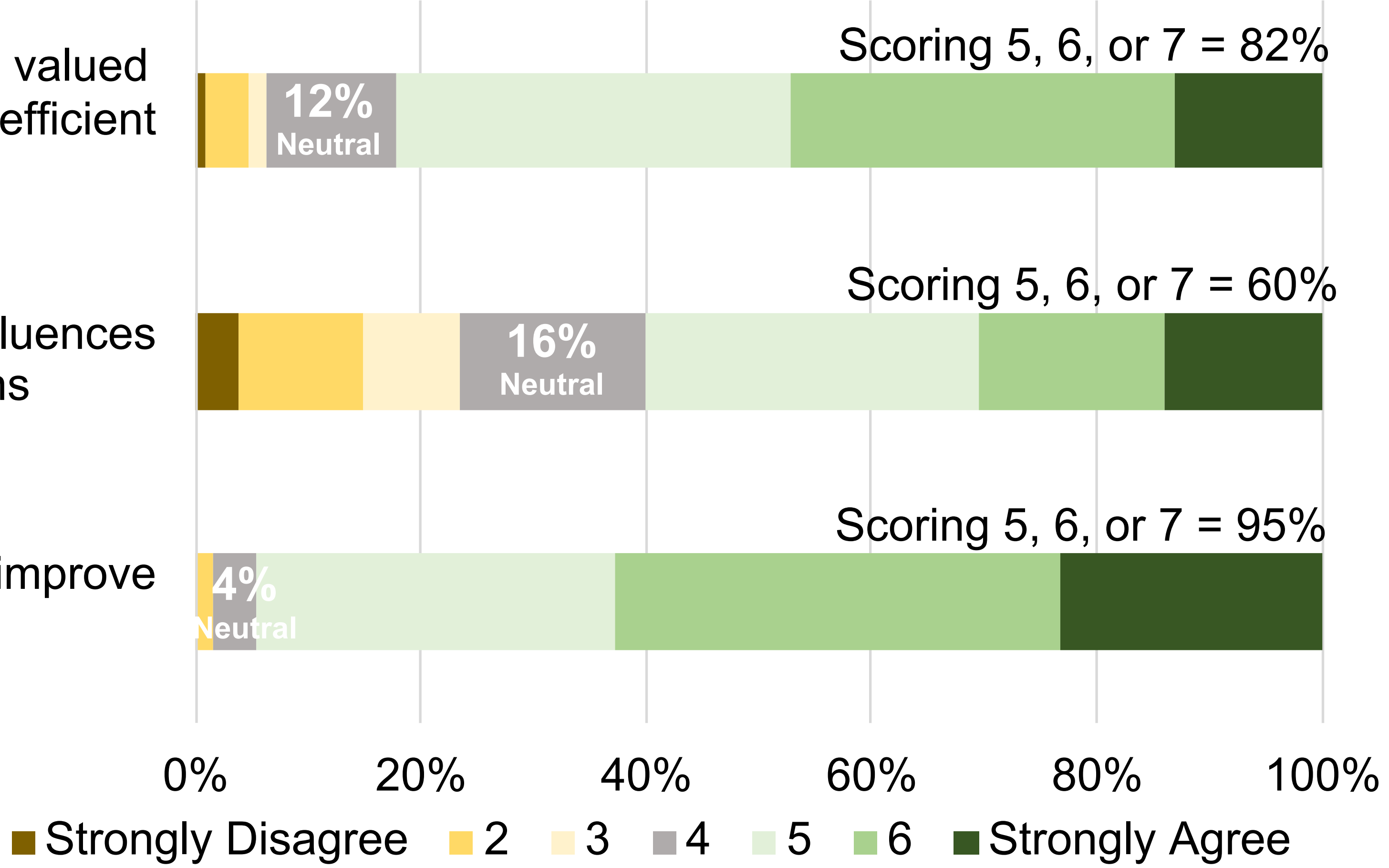


MEICON: Survey

Q4: An easily constructed structure is more valued by the whole design team than a materially efficient structure

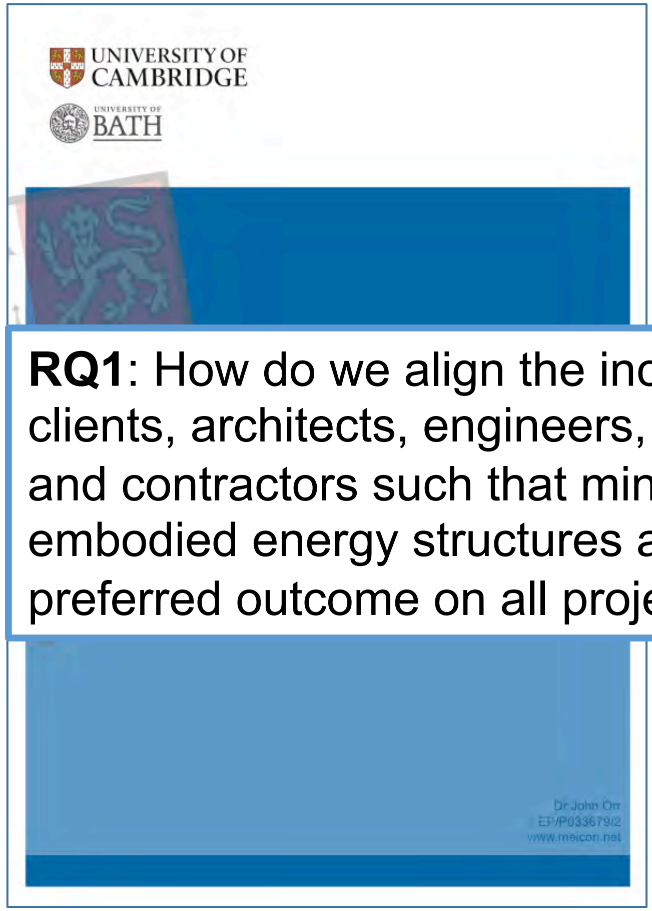
Q6: The potential for construction errors influences my structural member sizing decisions

Q7: I simplify my structural designs to improve constructibility




ACORN

MEICON: Survey



RQ1: How do we align the incentives of clients, architects, engineers, legislators, and contractors such that minimum embodied energy structures are the preferred outcome on all projects?

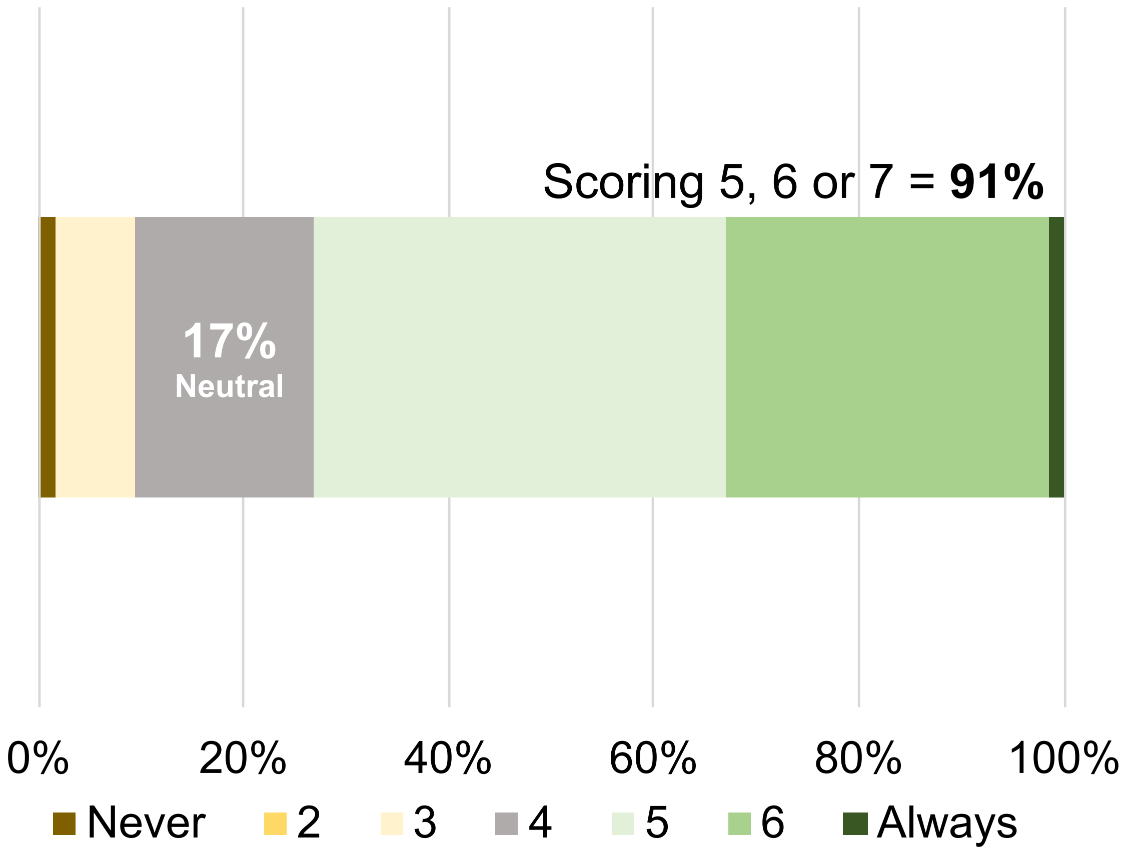
IQ1: Could we collectively define benchmark structural utilisation values against which new structural designs could be compared, to drive material efficiency?

IQ2: How might a calculation of material use per m^2 best be presented to clients, to drive material efficiency?

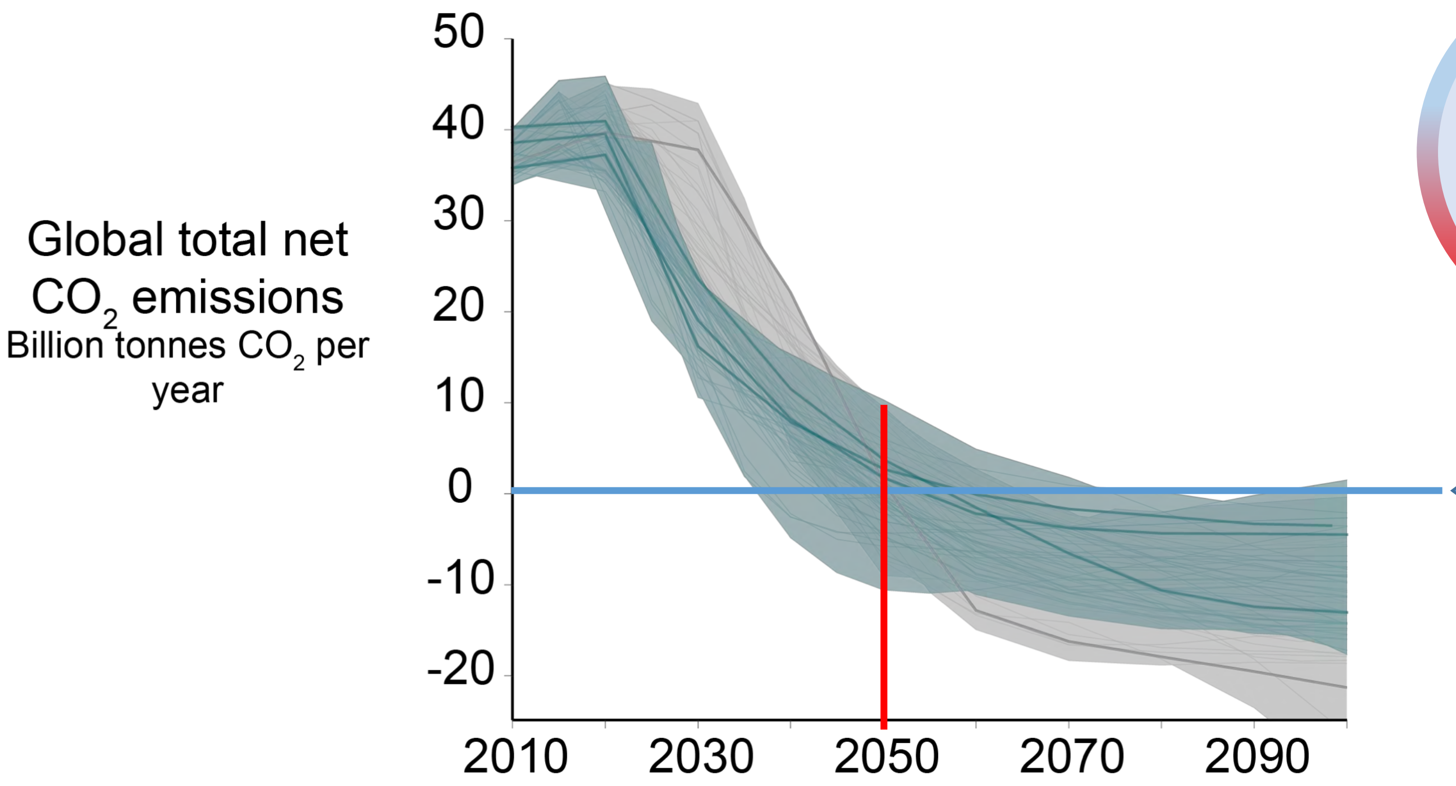
IQ3: How might designers demonstrate they are contributing to meeting Construction 2025 targets?

MEICON: Serviceability

Q20: In your experience, how often does the serviceability limit state govern the size of structural elements?



Pathways



Limit temp. rise to <1.5ºC

Budget to 2050 ≈580GtCO_2

0.0 GtCO_2/year

IPCC Special Report, Global Warming of 1.5ºC, http://www.ipcc.ch/report/sr15/

firmitatis,
utilitatis,
venustatis

Vitruvius, De architectura, Book 1, Chapter 3. 30BC

UNIVERSITY OF CAMBRIDGE

UNIVERSITY OF BATH

EPSRC
Engineering and Physical Sciences
Research Council