



CENTRE FOR RESEARCH INTO
ENERGY DEMAND SOLUTIONS



Capital carbon of transportation infrastructure

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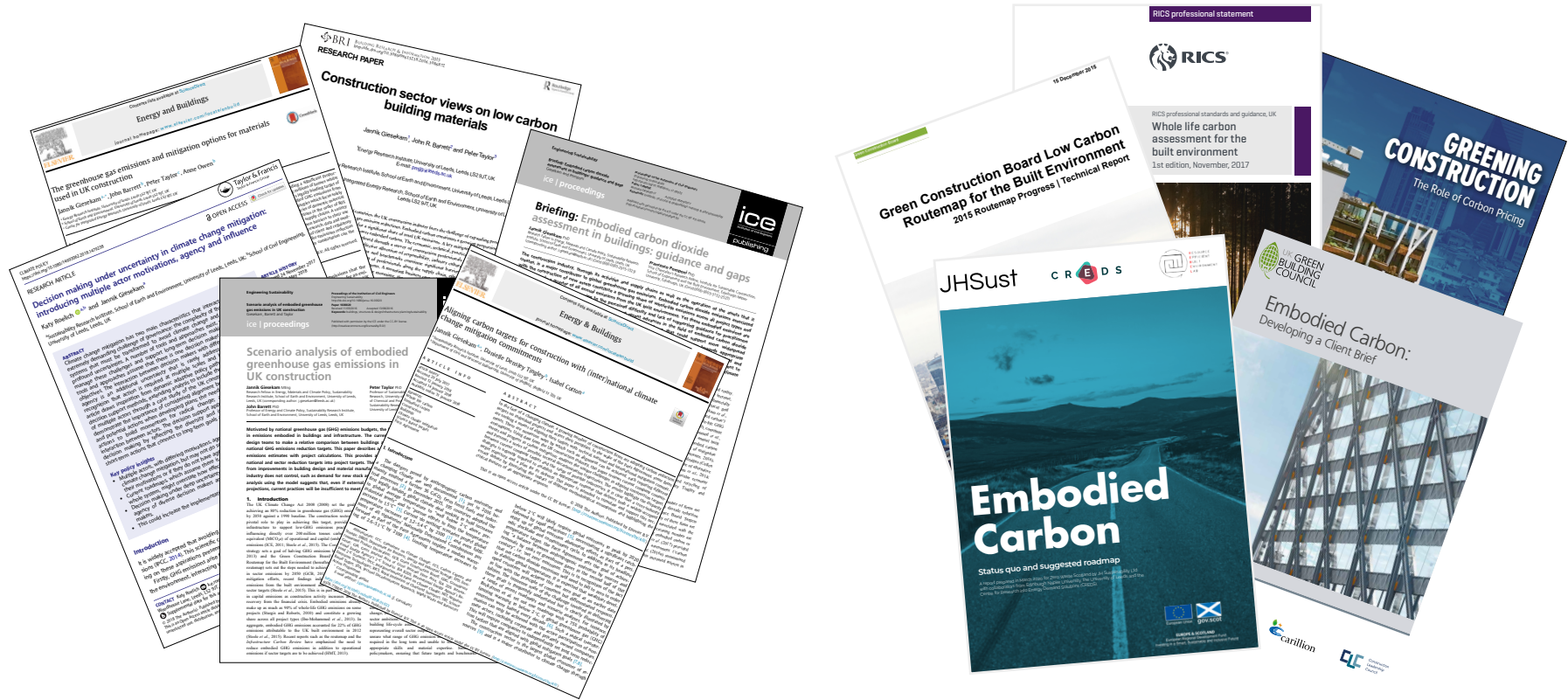
UK Research
and Innovation

these slides are available at www.jannikgiesekam.co.uk

Presentation structure

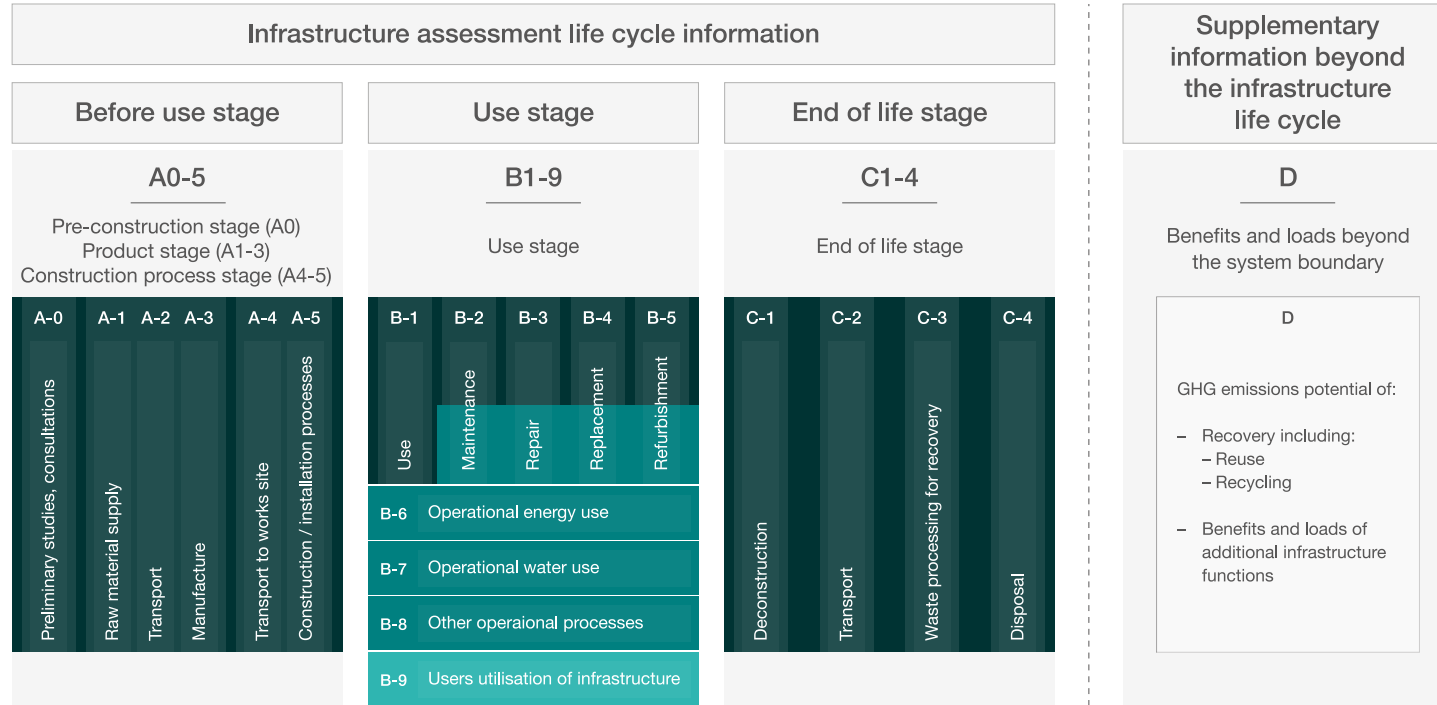
1. Terminology
2. Scale - national
3. Scale - project
4. Current assessment practice
5. Example problem
6. Scale - future
7. Suggestions

Past experience



Emissions from an infrastructure asset

- Capital GHG emissions
- Operational GHG emissions
- User GHG emissions



2020 Infrastructure Carbon Review update

UK Carbon Footprint 773 MtCO₂e

Includes all impacts of UK consumption - both territorial & imported emissions

100%

Infrastructure emissions 419 MtCO₂e

54%

All other emissions 354 MtCO₂e

From other sources

46%

Control 99 MtCO₂e

The infrastructure industry has control over **capital & operational carbon** associated with the construction, operation & maintenance of infrastructure assets

13%

Influence 320 MtCO₂e

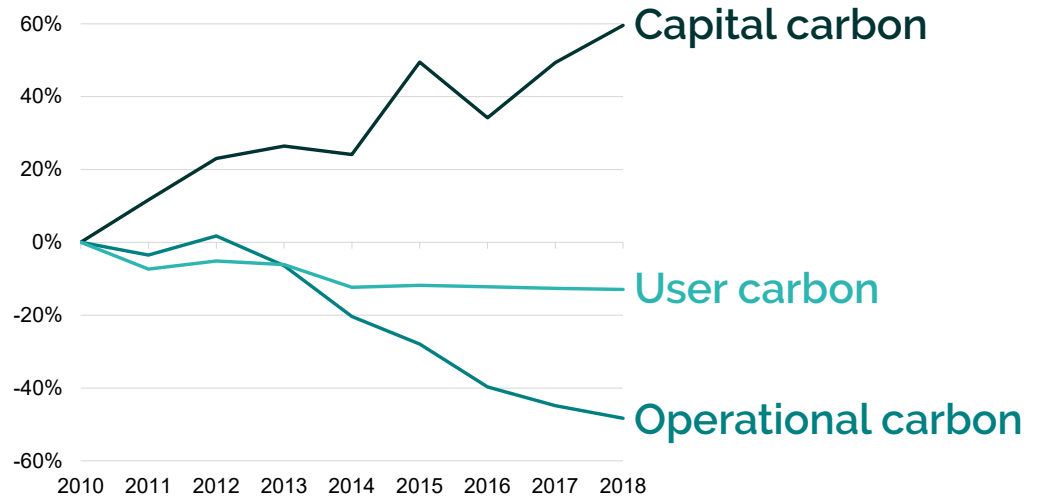
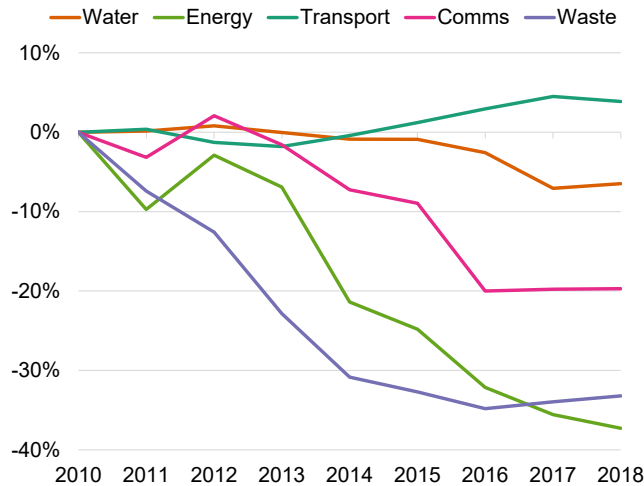
The infrastructure industry can influence emissions from end users, but typically action is also required by others to reduce these emissions

41%

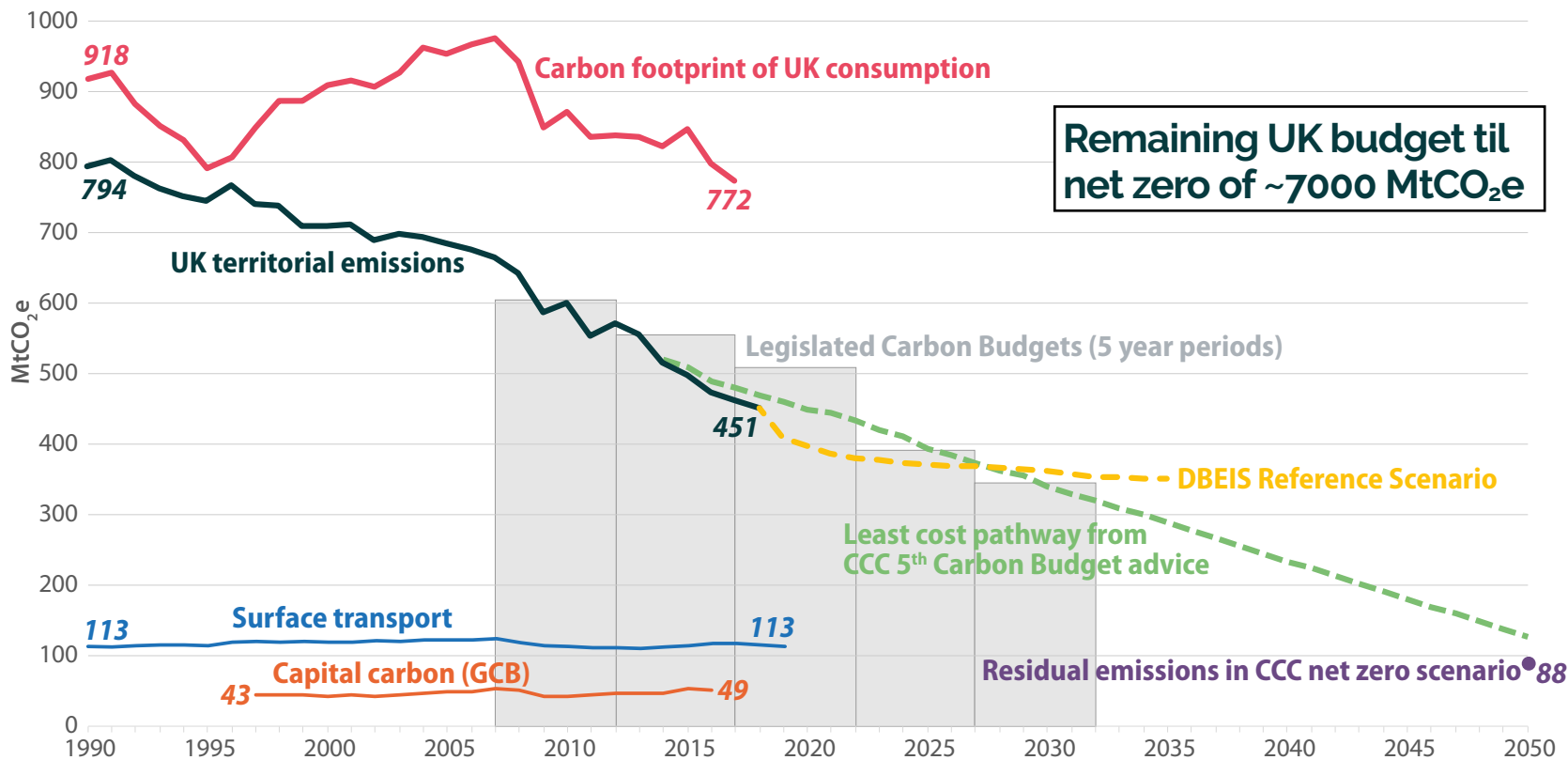
Infrastructure carbon changes from 2010-2018

Generally good progress with 23% reduction in total infrastructure carbon 2010-2018
& 44% reduction under 'control' of infrastructure industry

But **transport & capital carbon** increased



National scale - capital carbon compared to targets



Project scale - capital carbon

10 kt

100 kt

1 Mt

10 Mt



M54-M6 Link Road

81,890 tCO_{2e}

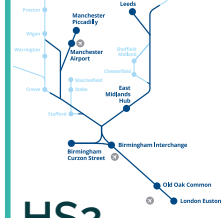
1.6 miles new road
2 new junctions
& some realignment



A14 extension

981,432 tCO_{2e}

23 miles of upgrades
7 miles widening
new bypass
& local modifications



HS2
13.3 MtCO_{2e}



Heathrow 3rd runway

3.6 MtCO_{2e}

Current assessment practice



Already routinely evaluated



Increasingly commonplace



Rarely evaluated

	Materials, products & components	Assets & projects	Asset portfolios	Investment plans, pipelines & scenarios
CapCarb				
OpCarb				
UseCarb				
<i>Recent trends</i>	Rapidly expanding range of Environmental Product Declarations (>8000); new and recently updated databases (e.g. ICE v3); suppliers increasingly able to provide information on request	Carbon assessment increasingly embedded into regulations (e.g. 2014/52/EU); organisational requirements and standards (e.g. Network Rail Environmental and Social Minimum Requirements)	Carbon management commonplace; many organisations with carbon KPIs (e.g. Highways England supply chain emissions); some benchmarking (though often only for OpCarb & UseCarb)	Increasingly detailed and integrated system models evaluating futures but CapCarb largely absent from models and rarely assessed for investment pipelines

Current research project

Creating open source resource to facilitate estimation of capital carbon of future projects and pipelines. Will include links to guidance & tools, amalgamating data from:

Materials, products & components:

EPD (Environmental Product Declaration) directories

Carbon factor databases (e.g. ICE database)

Bespoke tools

Assets & projects:

Independent LCA studies

Environmental Statements produced as part of EIA

Information from stakeholder databases



A9/Ag6 Inshes to Smithton
DMRB Stage 3 Environmental Impact Assessment Report
Appendix A17.2: Carbon Assessment

JACOBS

- treatment of wastes;
- transportation of waste and material;
- operational electricity consumption; and
- emissions associated with maintenance activities.

2.12 Footway quantities are not included in the pavement/sub base materials in Table 1, but are modelled and the impacts included in the results below. Footway construction depth is assumed to be 220mm, comprising Type 1 unbound mixture sub-base 150mm thick, dense macadam binder course with 20mm aggregate 50mm thick, close graded macadam surface course with 6mm aggregate 20mm thick = 5,245m³ (including 10% worst-case scenario contingency).

3 Results

3.1 Transport Scotland's Projects Carbon Tool was used to estimate the carbon emissions associated with the proposed scheme. The results are set out in Table 2, Table 3 and Table 4. The calculations are based on a worst-case scenario, including a 10% contingency to cover unknown items.

3.2 Table 2 shows the total carbon emissions anticipated from the proposed scheme throughout its lifetime, during construction and maintenance. It should be noted that that due to rounding of data outputs there are slight discrepancies between the totals presented in Tables 3 and 4, when compared to Table 2. It is confirmed that the information provided in these tables is correct as an output of the Carbon Tool.

Table 2: Proposed Scheme Emissions Summary (Worst Case Scenario Including 10% Contingency)

Carbon source	ICO ₂ e
Construction: Materials embodied	15,050
Maintenance: Materials embodied	13,975

3.3 Table 3 and Table 4 provide more detailed information on the carbon emissions for each of the 3 stages by splitting the figures into individual project elements and the carbon emissions for construction materials by type. All volumes shown are based on the worst-case scenario figures that include a 10% contingency.

Table 3: Summary by Project Elements (Worst-case scenario including a 10% contingency)

Project elements	Materials embodied (ICO ₂ e)	Maintenance (materials embodied) (ICO ₂ e)
Drainage	60	615
Earthworks	8,290	0
Fencing	120	470
Road Pavement	3,085	12,230
Safety Barriers	125	490
Signs	35	165
Structures (civils & buildings)	3,345	0

For more detail on assessment start with

Highways

[DMRB LA114](#)

[Highways England Carbon Tool](#) for monthly/quarterly supplier submissions

Rail

[Network Rail capital carbon guidance note](#)

[RSSB Rail Carbon Tool](#)

[Network Rail Environmental Strategy](#)

Example problem - significance criteria

From DMRB LA114:

3.19	Where a project stage extends over multiple carbon budget periods, the projects GHG emissions shall be reported against each carbon budget for each project stage.
3.20	The assessment of projects on climate shall only report significant effects where increases in GHG emissions will have a material impact on the ability of Government to meet its carbon reduction targets.
NOTE 1	<i>National policy states that "It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets".</i>
NOTE 2	<i>In the context of NOTE 1, it is considered unlikely that projects will in isolation conclude significant effects on climate.</i>

Every individual project deemed insignificant

e.g. A14 DCO determines emissions are “*negligible*” on this basis:



1.3.5 If all of these construction related emissions were emitted in the 3rd Carbon Budget period (2018-2022) it would amount to 0.025% of the budget for that period, or 0.12% of the UK's allowable annual emissions.

What about collectively?

In the absence of official estimates, others will step in, with negative consequences. e.g.



The carbon impact of the national roads programme

Lynn Sloman and Lisa Hopkinson

With contributions from Phil Goodwin, Jillian Anable,
Sally Cairns and Ian Taylor

July 2020

transport for quality of life

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By Roger Harrabin
BBC environment analyst

23 August

Climate change



Ballpark estimate for future transport infrastructure

Estimated Capital Carbon = Anticipated Capital Spend x Carbon Intensity

Anticipated Capital Spend

£120bn for transport (£640bn for all infrastructure) to 2027/28

Then ~£26-31 bn/yr to 2050 in line with National Infrastructure Commission

Carbon Intensity

Typically stated in gCO₂e/£ CAPEX (or tCO₂e/£m)

100-900 is typical range depending upon project type from literature reviews & project data

Top down construction sector average of 325 for most recent year

Good contractor (Skanska) 215 in 2018 - down from 351 in 2010; aiming for 130 by 2030

Ballpark estimate for future transport infrastructure

Estimated Capital Carbon = Anticipated Capital Spend x Carbon Intensity

Brackets are range

Per year

8 MtCO₂e (1.7-27.9) = **25** (17-31) x **325** (100-900)

Total to 2050

252 MtCO₂e (72-750) = **775** (718-833) x **325** (100-900)

More detailed estimate in preparation

Based on IPA National Infrastructure & Construction Pipeline

Based on 9% actual data; 66% estimated data; 25% no data

Draft report stage

See [Highways UK event](#) for further discussion



Suggestions

Start by implementing routine programme/portfolio level assessment of capital carbon

Integrate capital carbon into system models

Avoid potential challenges through transparent data and decision making



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Thank you

Please get in touch with any queries
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