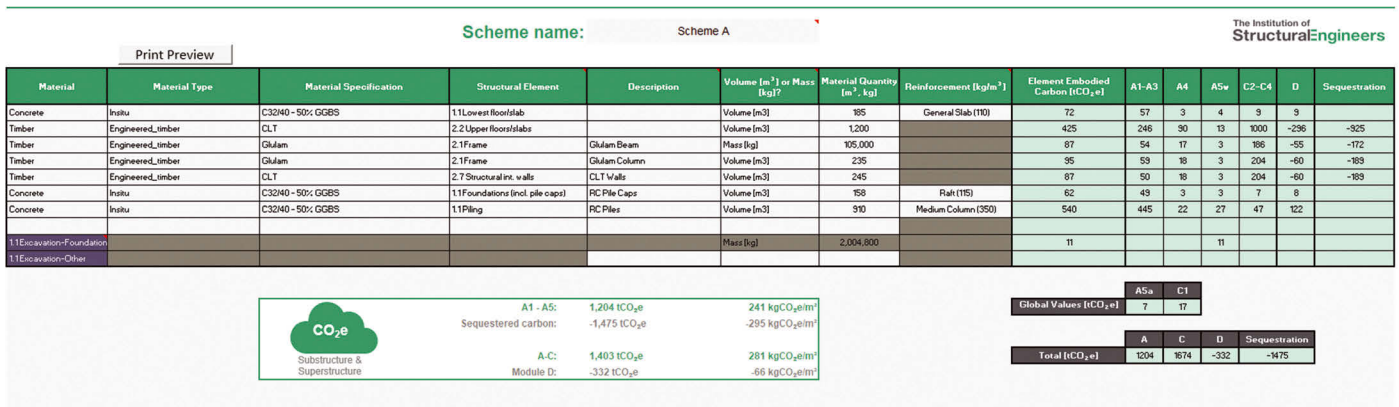# CO₂ 2.Low carbon

An introduction to The Structural Carbon Tool

Penny Gowler and **Will Arnold** preview a new embodied carbon tool that has been developed by Elliott Wood and the Institution of Structural Engineers.

↑FIGURE 1:
Scheme
input table

In August 2020, the IStructE released *How to calculate embodied carbon* ('HTCEC')[1] to enable engineers to calculate emissions in a consistent and robust way, allowing them to make meaningful carbon comparisons between designs, and identify opportunities for carbon reductions in their schemes.

In March 2021, this was followed by the launch of *The Structural Carbon Tool* ('the tool'; www.istructe.org/the-structural-carbon-tool/), an open-source Excel-based carbon estimator developed by Elliott Wood Partnership Ltd in conjunction with the IStructE. This article provides a brief overview of the functionality of the tool for the first-time user.

Use

Reflecting the fact that the engineer's first priority in the climate emergency is to minimise upfront embodied carbon emissions, the tool is intended to be used to inform decisions about how best to reduce carbon in a design.

It can do this by helping the engineer to:
→| **estimate** the amount of carbon in different parts of the design
→| identify **carbon hotspots and opportunities** to target for material reduction

→| understand **rough differences** between different structural options
→| **communicate** the impacts of decisions to the design and client team.

The tool has been set up primarily for building structures (new and reuse) but is also applicable to infrastructure projects*. It is provided on an open-source basis, and while all non-input cells are initially locked to prevent errors, the password is provided on the User Guide tab. We encourage engineers to integrate the tool into their existing digital workflows, and to share their modifications with others in the spirit of www.structuralengineersdeclare.com.

Inputs

To use the tool, the engineer starts by entering some basic project information (GIA and construction budget as a minimum), before opening the first Scheme tab **(Figure 1)**. In total, up to six options can be entered on different Scheme tabs.

Here the engineer will need to determine their expected material quantities using a method suitable for

the design stage (refer to HTCEC for guidance). The engineer should remain mindful of the level of uncertainty, and should consider whether non-structural items need including, such as fire protection.

Inputting data into the Scheme tab is as simple as selecting a material specification, structural element type (aligned with RICS BCIS standard form[2]), and then inputting the volume or mass of material. For concrete elements, there is then an option to add in a predefined reinforcement quantity, or this can be entered separately on a new line.

The tool then multiplies the quantities by the relevant carbon factors. By default, this is calculated using data from HTCEC, but these can be modified, or the user can add their own (in the Custom Data tab) if appropriate.

> ❝ **THE TOOL IS INTENDED TO BE USED TO INFORM DECISIONS ABOUT HOW BEST TO REDUCE CARBON**

*For infrastructure projects, certain parts of the spreadsheet may need editing by the user, e.g. updating A5a site activity emissions to reflect a more appropriate value for the work, and switching 'GIA' for 'Functional Area' or similar.
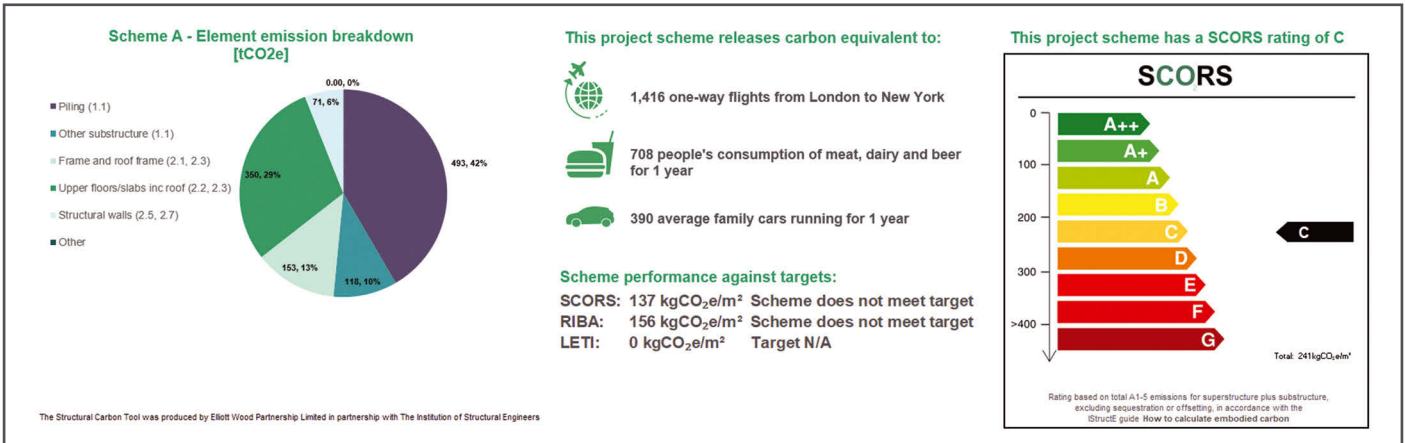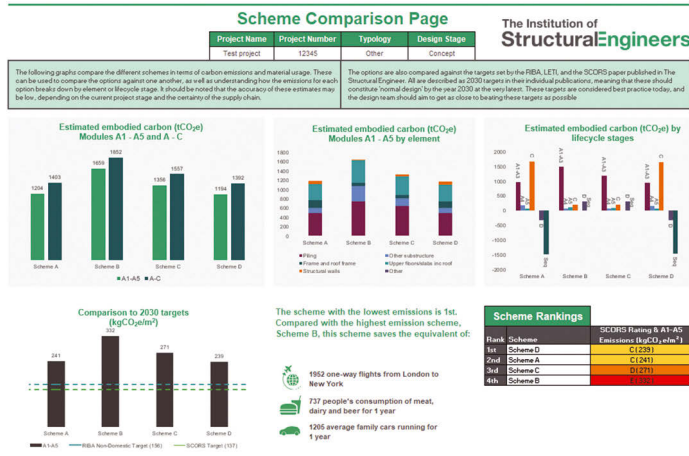
↖**FIGURE 2:** Outputs on Scheme page

↑**FIGURE 3:** Outputs on Comparison page

Outputs and interpretation

A series of outputs are displayed on the individual Scheme tabs **(Figure 2)**, as well as the Comparison tab **(Figure 3)**.

On the Scheme tabs, the aggregated A1–A5 and A–C emissions are displayed, along with sequestration and module D benefits/burdens. The distribution of carbon throughout the scheme is shown on a pie chart to identify carbon-intensive aspects of the design, allowing targeted conversations around how to reduce material use. A SCORS rating and some comparison metrics are also shown to enable discussion with others.

On the Comparison tab, scheme emissions are compared by lifecycle module as well as by aggregated A1–A5 and A–C emissions. A carbon/time graph is also provided showing the temporal effects of any sequestration, based on the forward-looking approach[3].

Penny Gowler
CEng, MIStructE

Penny is Associate Director at Elliott Wood with over 15 years' structural engineering experience. She is passionate about the sustainable design and refurbishment of buildings.

Will Arnold
MEng, CEng, MIStructE

Will is Head of Climate Action at the IStructE. He leads the Institution's response to the climate emergency, bringing this action into all aspects of its work, including the publication of best-practice emergency guidance.

**HAVE
YOUR
SAY**

@

tse@istructe.org

@IStructE
#TheStructuralEngineer
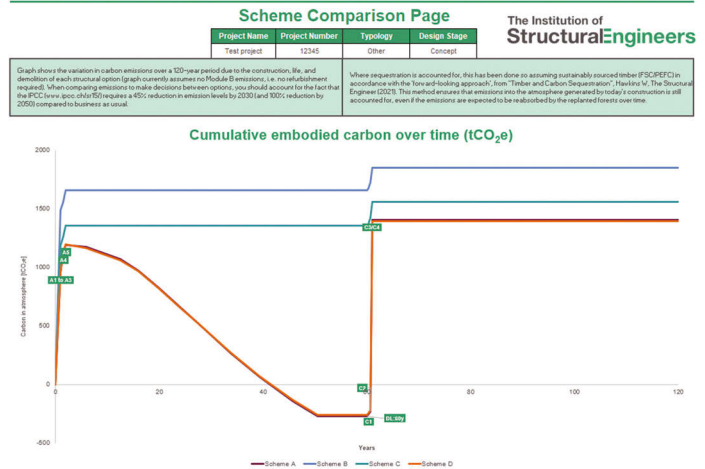
REFERENCES

1) Gibbons O.P. and Orr J.J. (2020) *How to calculate embodied carbon*, London: IStructE Ltd

2) RICS (2012) *Elemental Standard Form of Cost Analysis: Principles, Instructions, Elements and Definitions* (4th (NRM) ed.) [Online] Available at: www.rics.org/globalassets/rics-website/media/products/data-products/bcis-construction/bcis-elemental-standard-form-cost-analysis-4th-nrm-edition-2012.pdf (Accessed: March 2021)

3) Hawkins W. (2021) 'Timber and carbon sequestration', *The Structural Engineer*, 99 (1), pp. 18–20