

Engineering in the climate emergency: doing less, better

Mike White urges structural engineers to act now in their projects to reduce embodied carbon if we are to keep to the IPCC’s 1.5°C warming target.

As structural engineers, we’re all aware of the urgency and importance of tackling the climate crisis. But one of the biggest challenges we face is balancing our global responsibilities with the realities of our projects.

Why are we so important?

The UN Earth Summit in 1992 (30 years ago!) introduced the principle of ‘differentiated responsibilities’. This concept sets out that all nations have a shared responsibility to tackle climate change, but makes it clear that the responsibility is not shared equally.

Higher-income, industrialised countries have a greater responsibility than lower-income countries, as the former have mostly generated higher emissions to achieve their prosperity.

This concept applies to us on an individual level, as we structural engineers will specify thousands of tonnes of carbon-generating material in our careers. This means we have a differentiated responsibility to build less ‘stuff’ and, when we do, to build better.

How do we define ‘better’?

Many of us struggle to reconcile doing better with the inherent nature of our work. After all, Joni Mitchell’s lyric, ‘they paved paradise and put up a parking lot’, is still relevant more than 50 years after it was written.

Fortunately, there are frameworks we can use to understand some of the complexities of sustainability beyond embodied carbon:

UN Sustainable Development Goals

At a global level, the UNSDGs (Figure 1)¹ provide a framework for measuring sustainability. They are as wide-ranging as you might expect: 17 in total, each with sub-targets, ranging from tackling poverty to improving education, climate change and more.

At first glance, the UNSDGs can seem too broad to be relevant to any single project we work on, but they are important because they provide a framework for everyone everywhere to work to. Even if they don’t seem to directly relate to your project, ask yourself: ‘is what I’m doing in line with the spirit of the UNSDGs?’

Each goal is related to other goals, and so by tackling those areas where we can have the biggest impact, we help the world to move in the right direction. The UK government reports on national progress towards the UNSDGs, meaning a single action by any one of us in the UK is counted to hopefully inspire those in other countries to make similar efforts and multiply the effect to become a global movement.

They can also provide common ground. Your

client (e.g. a supermarket) may not be concerned about carbon emissions, but they are probably worried about something else (like food security). So it’s worth familiarising yourself with the UNSDGs – there’s probably something in them you hadn’t thought of that may well be relevant to your client.

Doughnut economics

We mustn’t forget that our work provides enormous social value. After all, a building is more than just a roof and some walls. Our hard work provides somewhere safe, somewhere warm (or cool), somewhere to learn, a place to play, a place to work, etc.

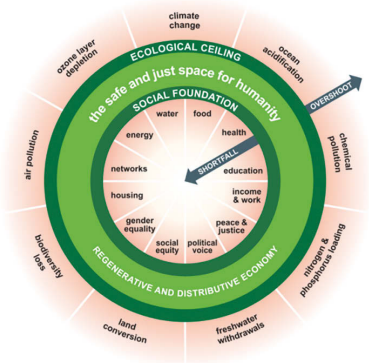
But we are quickly discovering how important it is to balance the social benefit of our work with the potential for ecological harm. This need for balance is nicely described by Kate Raworth’s concept of doughnut economics (Figure 2)^{2,3}, which includes ecological and social aspects, similar to the UNSDGs.

“**WE MUST MOVE TO A WORLD WHERE WE REUSE EXISTING BUILDINGS AS STANDARD**”

▼ FIGURE 1: UN Sustainable Development Goals



FIGURE 2: Doughnut of social and planetary boundaries



KATE RAWORTH AND CHRISTIAN GUTHRIE, CC-BY-SA 4.0

So far, we've been living and working outside the green 'doughnut', where improvements to raise communities above the social foundation come at the cost of surpassing the ecological ceiling⁴.

Figure 3^{5,6} shows that, over the last 70 years, there has been a matched increase in UK life expectancy (one indicator of a country's prosperity) and the global temperature. We have to decouple these two effects, but without sacrificing the social benefit the built environment provides.

Of course, one of the biggest current exceedances outside the safe doughnut comes in the form of climate change, particularly in industrialised nations. Carbon emissions are the primary factor we engineers can control and the Intergovernmental Panel on Climate Change (IPCC) data⁷ is clear: for the first time since the industrial revolution, the global emissions curve must point downhill.

And this has to happen fast.

FIGURE 3: UK life expectancy vs global temperature, 1951–2020

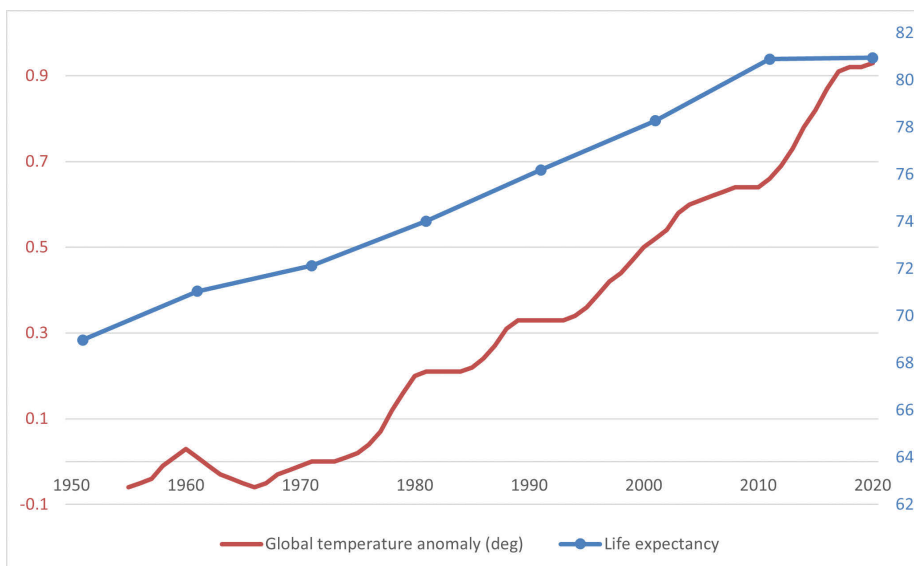
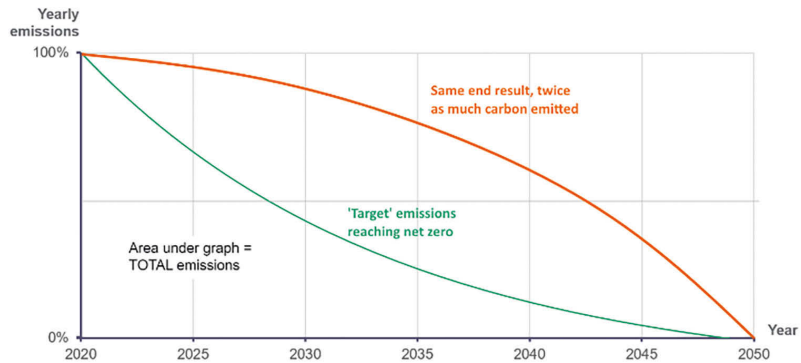


FIGURE 4: Carbon-emissions comparison of routes to net zero



The IPCC targets and the problem with efficiency

A key point from the IPCC report is that achieving net zero in 2050 is not our primary goal. The immediate focus must be on reducing emissions so that, by the time we reach 2050, we haven't overspent our carbon budget.

Figure 4 shows different routes to achieving the same net-zero target by 2050. The green line shows the 1.5°C IPCC-aligned curve, whereas the orange line is the same curve but inverted. The orange curve produces double the emissions!

Previous industry analysis⁸ shows that, on average, we overdesign our buildings beyond what is dictated by safety factors. We absolutely must start designing our buildings to be even more efficient, with utilisation ratios closer to 1.0, as it is an easy way to steepen the fall in the emissions curve.

But this alone will not solve the problem. After all, what happens to that efficiency gain?

By making our structures more efficient, we use less material, which in turn reduces the cost. This means our clients have more money left to spend elsewhere, potentially on another building project (especially if buildings get more efficient and become more affordable).

This scenario is borne out through history: new technologies are sold as emancipating the workforce from hard labour, but in practice the workers change role and become busier than ever trying to keep up with higher productivity brought about by the new technology.

This is why the IStructE's 'Hierarchy of net-zero design' (Figure 5)⁹ is so important – we must build more efficiently now to quickly reduce carbon emissions, but crucially we must move to a world where we reuse existing buildings as standard and avoid building new unless absolutely necessary.

What can you do?

1) Obey the hierarchy of net-zero design

It might feel counter-productive to tell our clients not to build the fantastic new building they're going to pay us a fee to design, but it's what we have to do. Paradise is better left unpaved.

Admittedly, not building a project is an extreme example and often won't be possible. In these cases, refurbishment of existing buildings has to become the go-to alternative that we (as a profession) recommend to our clients.

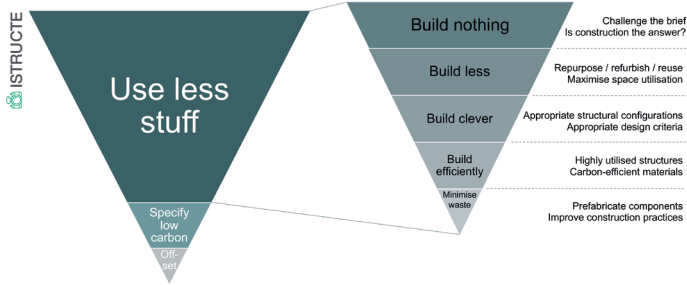
2) Change now

A typical project for many of us lasts one to five years from conception to completion. In five years' time, it will be 2027, when we need to be much further down that emissions curve. We simply don't have time to delay action until the next project – it must happen on the projects we're working on today.

3) Talk to others, and encourage them to talk

A key goal in political advocacy and campaigning is to give people 'permission' to hold a certain view by making it the social norm. We are social creatures and are influenced by

FIGURE 5: Hierarchy of net-zero design



those around us, so the more we all talk about the importance of sustainability, the more we feel empowered to make the right choices.

Hopefully, topics like the UNSDGs and doughnut economics give you a framework to talk to people with whom you otherwise might not have common ground.

We need a society-level movement to make impactful, positive change.

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Mike White is a Senior Engineer at Smith and Wallwork. He has a track record of working on mass timber and Passivhaus projects, and has links to climate advocacy groups.

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