CIE-MAP

Centre for Industrial Energy, Materials and Products

Reducing carbon in construction: a whole life approach

The UK construction sector is failing to meet its carbon reduction targets and needs to explore additional mitigation options. The carbon emissions from heating and lighting our buildings (*operational emissions*) have been falling but these are not the only emissions arising from the built environment. Sizeable carbon emissions are incurred in constructing, maintaining and demolishing an asset and producing the materials and components used throughout its life cycle (*embodied emissions*). Considering both the anticipated operational and embodied emissions of a built asset is considered a *whole life approach*. To date the construction industry has mainly focussed on reducing operational emissions, driven by changes in the building regulations and planning requirements. Extending the focus of project carbon assessments and targets from operational to whole life emissions presents designers, clients and contractors with a broader range of mitigation options. The faster proliferation of a whole life approach should be supported by national and local policies for which there are a number of international precedents. Targeted intervention from national and local government could drive innovation in design teams and supply chains, improve sector productivity, reduce the costs of UK buildings and infrastructure, create employment opportunities, boost export markets and deliver immediate reductions in carbon emissions.

Recommendations

1. The Government should establish a well resourced independent body to develop and accelerate the construction sector's decarbonisation agenda.
2. Local authorities should require assessment of whole life carbon emissions on significant schemes as part of the planning process.
3. All publicly funded building projects should include a whole life carbon assessment and whole life carbon targets where project benchmarks can be established.
4. The greenhouse gas emission reporting requirements for quoted companies should be extended to include scope 3 emissions associated with developing new facilities.
5. Product manufacturers should require Environmental Product Declarations to support environmental claims.

Challenges facing UK construction

The National Infrastructure Commission has highlighted three key challenges facing the construction sector: congestion, capacity and carbon[1]. By 2050 there are expected to be an extra 14 million people living in the UK and the construction sector must deliver the housing and infrastructure that will underpin their future prosperity. That requires dramatically increasing housebuilding, retrofitting one existing home every minute, and delivering an infrastructure pipeline worth in excess of £600bn. UK firms are also expected to capture an increasing share of the global market for sustainable construction and be at the forefront of delivering the Government's Clean Growth ambitions[2]. Meanwhile by 2025 the industry is expected to halve delivery time, cut costs by a third, halve the trade gap between exports and imports of construction products, and halve carbon emissions from the built environment[3]. All of this must be achieved by a highly fragmented sector with low financial margins and declining labour availability[4]. None of these targets will be met under business as usual conditions[4,8]. Therefore the construction sector must undergo a radical transformation over the next decade.

The Government has already set out some measures to transform infrastructure performance[5], and modernise the industry through the Construction Sector Deal as part of the Industrial Strategy[6]. This transformation must focus on reducing carbon whilst improving sector productivity through the adoption of more resource efficient designs, novel materials and delivery models. The successful transformation of this industry will be critical to achieving the Government's target of doubling resource productivity over the next 25 years[7] and meeting carbon targets.

Sector progress in cutting carbon

In 2013 the Green Construction Board (GCB) set out a Routemap to deliver an 80% reduction in built environment emissions by 2050[8]. Unfortunately the sector has already fallen behind the target trajectory (Fig1).

Built environment carbon emissions are typically split into *operational* and *embodied emissions*. Embodied emissions are those associated with producing building products, constructing and maintaining an asset and completing end of life disposal. Operational emissions are primarily those associated with the space heating and lighting of buildings and the operation of infrastructure assets. By 2014 the industry had achieved a 32% reduction in operational emissions compared with 1990 but only a 6% reduction in embodied emissions. Since the end of the recession embodied emissions have steadily increased. Without intervention, this trend is likely to continue with greater housebuilding and infrastructure development anticipated.

Delivering sector carbon targets

Delivering an 80% reduction in built environment emissions by 2050 will require reductions in both operational and embodied emissions (Fig2). CIE-MAP scenario analysis shows that anticipated reductions in the carbon intensity of the electricity supply are unlikely to offset the impacts of increasing construction activity[9]. Simply decarbonising the grid will not be enough to meet the built environment carbon targets. Sizeable additional reductions in embodied carbon intensity will need to be achieved through design changes and within construction supply chains. Given the current distribution of embodied emissions (Fig3), reductions across projects of all types will be required if the targets are to be met[10]. That means the current focus on reducing whole life emissions must extend beyond infrastructure projects to domestic and non-domestic buildings.

In the longer term, the Paris Agreement implies achieving a net zero carbon UK shortly after mid-century. Under any net zero scenario minimising embodied emissions from the built environment will reduce the need to adopt expensive negative emissions technologies, such as Bioenergy with Carbon Capture and Storage (estimated to cost $70-250 per tonne of CO_2), to achieve the net zero goal.

Figure 1: Progress against the Green Construction Board's Low Carbon Routemap

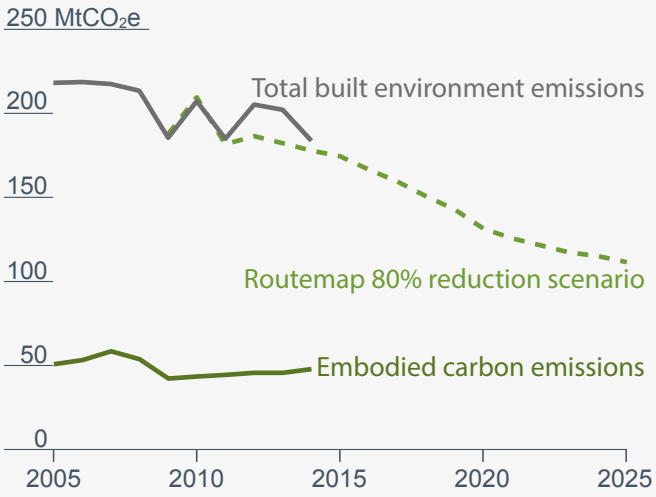


Figure 2: Built environment emissions and targets

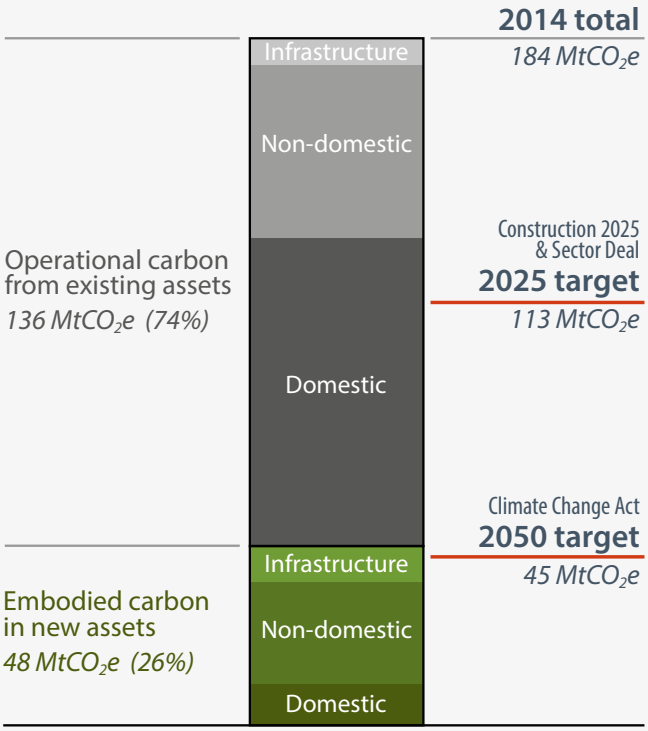


Figure 3: Distribution of embodied carbon emissions in 2011

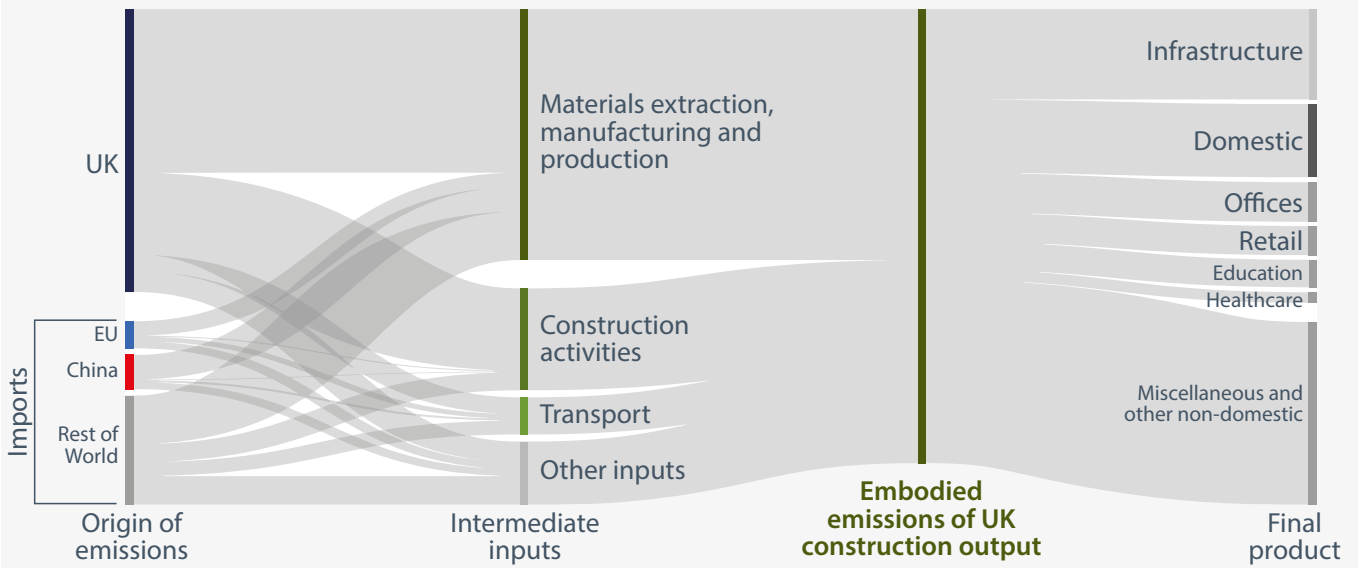
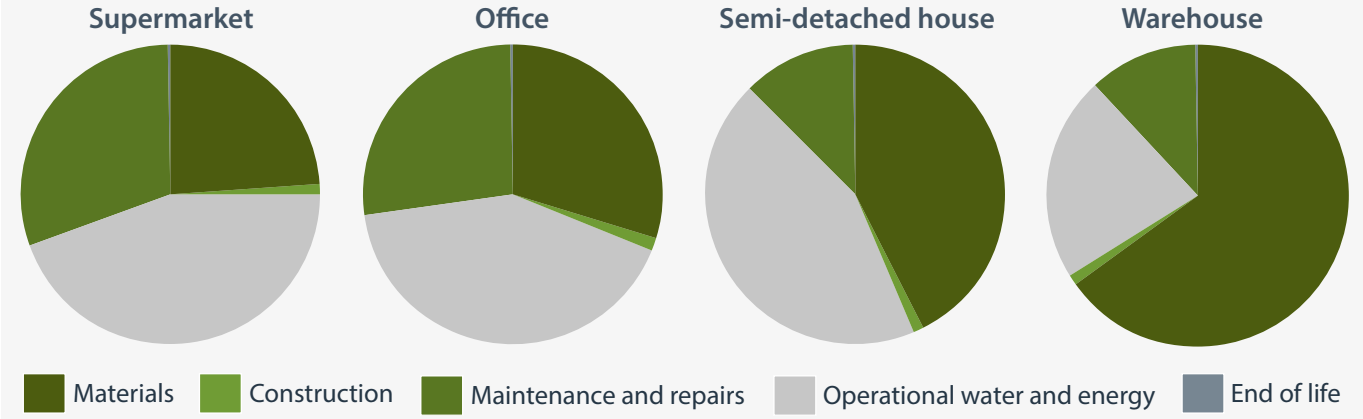


Figure 4: Typical breakdowns of whole life carbon emissions by project type[16]



Aligning company targets

Despite the urgent need for carbon reduction, as of July 2017 less than half of the top 70 UK construction firms by turnover had public carbon reduction targets. Those targets that have been established are mostly short term (typically out to 2020) and below the rates of reduction required by the sector as a whole[11]. In the past two years 17 UK firms involved in the built environment, such as Landsec, Laing O'Rourke and Bennetts Associates, have sought to align their targets with international climate commitments through the Science Based Targets initiative. This has led to a recent cross-industry call for the development of a common sectoral carbon reduction trajectory, consistent with the Paris Agreement, from which commensurate company and project targets can be derived[12].

If such a common trajectory is to be developed then it must be accompanied by a credible action plan. Unlike the GCB Routemap and Construction 2025 targets, a formal process for monitoring progress should also be established in advance. To ensure long term maintenance, CIE-MAP recommends that a permanent, well resourced and independent body is established to undertake development of a common trajectory and action plan. This new body would also undertake other tasks that support and promote deeper carbon reduction, such as compiling a central national database of life cycle assessment data and Environmental Product Declarations, and developing a low carbon building skills plan. Though this body would not have the regulatory powers to enforce targets, it should establish a public league table of company carbon reduction commitments to encourage greater transparency and competition. In the longer term this body would also advise on regulatory changes, such as the introduction of zero carbon targets, and provide a central resource for industry to overcome common information barriers.

A new focus on whole life emissions

Across most project types, embodied emissions are a sizeable and increasing share of the whole life total (Fig4). In spite of this many policy levers, such as the Building Regulations, continue to focus solely on operational emissions. Focussing on further incremental reductions in operational energy will require increasingly expensive solutions to achieve ever more marginal gains. CIE-MAP recommends changing the focus of carbon assessments to whole life emissions, which presents a broader range of mitigation options[13]. Whether through the use of alternative low carbon materials, more efficient structural design, or the increased use of recycled or re-used components, taking a whole life perspective offers a broader choice to designers trying to deliver low carbon solutions. On many projects savings in embodied emissions are also associated with reduced capital costs, as embodied emissions are often a proxy for material and fuel use. For instance, on their recent 21 Moorfields project, Landsec made capex savings of £300,000 by targeting whole life carbon reductions. These savings significantly outweighed the additional costs of carbon assessment and consultancy (£58,000). The carbon savings from reducing embodied emissions are also more immediate and predictable than anticipated future savings in operational emissions.

Supporting guidance and standards

There is a mounting body of guidance and standards supporting whole life carbon assessment and mitigation[14]. In November 2017 the Royal Institution of Chartered Surveyors (RICS) launched a new Professional Statement[15] that standardises whole life carbon assessment in the built environment. This will be mandatory for RICS members from May 2018 and provides a framework for consistent assessment and reporting across the industry. Clients will be able to request assessments to this standard, with a guidance package from UKGBC clearly explaining how to develop an effective brief addressing embodied emissions[16]. Using these documents, clients should feel comfortable commissioning and responding to whole life carbon assessments. CIE-MAP recommends that progressive clients go one step further and introduce embodied or whole life carbon targets on their projects at the earliest possible stage. This has already been done successfully on some projects and is now a routine feature of sustainability briefs for commercial developers such as British Land and Derwent London[10].

Barriers and benefits

In the past common barriers to more widespread whole life emissions assessment have included a lack of industry skills, perceptions of high costs, and a shortage of product carbon data and project benchmarks[17]. These have been compounded by a lack of drivers, with most assessments to date driven by client requirements or the moral convictions of individual practitioners. Though some of these barriers remain, there has been much progress in recent years. For instance the stock of Environmental Product Declarations is growing rapidly - with over 6000 now published - and, with the RICS set to gather project data in a granular standardised

form[15], accurate benchmarking of projects will soon be possible. As life cycle costing becomes more prevalent it is also becoming easier to make the business case for a broader set of solutions.

More widespread assessment could yield a range of benefits. For instance the introduction of whole life carbon targets could increase competition between design teams to deliver the lowest carbon solutions, and drive innovation within the supply chain as suppliers compete to provide lower carbon products. These low carbon products and design skills will have significant export potential as many other nations pursue deeper carbon reduction. Indeed, with incoming legislation such as the Buy Clean California Act, it may soon be essential to have low carbon credentials to export into certain markets.

Encouraging assessment

A number of actions could encourage more widespread whole life assessment and carbon reduction. CIE-MAP recommends that local authorities require whole life carbon assessments on all 'significant' schemes as part of the planning process. The definition of a significant scheme will vary between authorities. For instance the Greater London Authority may interpret this as applying to planning applications for schemes referable to the Mayor. Comparable requirements are already in place in nations such as the Netherlands and cities such as Zurich[18]. CIE-MAP also recommends that all publicly funded projects should seek to introduce whole life carbon targets where project benchmarks can be established. The UK's mandatory greenhouse gas emission reporting requirements for quoted companies should be extended to include the scope 3 embodied emissions associated with developing new facilities. To prevent potential greenwashing, all construction product manufacturers should be required to produce an Environmental Product Declaration to support any quantifiable sustainability claims made in the marketing of their products. Equivalent requirements for product manufacturers are already in place in France and Belgium[18].

Such interventions could motivate more widespread whole life carbon assessment. This in turn would support the development of low carbon expertise, accelerate data gathering and grow an industry with significant export potential. With design teams targeting whole life carbon reduction in countries such as Australia, Canada, China, Norway, Sweden, France, Germany, and the Netherlands, there is growing global demand and competition to develop low carbon construction solutions. There is a clear opportunity for the UK to become world leaders in this growing industry that will support skilled jobs, develop the market for low carbon products and significantly reduce carbon emissions. However, this will only be possible if swift action is taken to stimulate more widespread assessment.

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CIE-MAP

Working closely with government and industry, CIE-MAP conducts research to identify all the opportunities along the product supply chain that ultimately deliver a reduction in industrial energy use.

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