LOWERING CONSTRUCTION'S CARBON FOOTPRINT

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INTRODUCTION

As I write this article in the middle of July 2023 the main headline news is the record temperatures currently being suffered by the Mediterranean countries and the west coast of America. The prolonged periods of this excessive heat, resultant forest fires and in other areas the torrential flooding being encountered, are being described by the United Nations and international scientific bodies as sure indicators that the maleffect of much forecasted global warming is already upon us. The targets set for reduction of greenhouse gases by several international forums over many years, and the promises made by major governments to curb their usage of fossil fuels have not been met. Urgent action is required universally to mitigate future damage to the environment and ensure a habitable planet for our descendants.

TARGETS

Lowering the embodied carbon dioxide equivalent (embodied CO2e) of buildings is an essential response to national and global targets for carbon reduction. Embodied CO2e is the amount of greenhouse gases emitted to produce a material, product, or building. Globally, the construction industry is developing tools, databases, and practices for measuring embodied CO2e in buildings and recommending routes to reduction. It has been estimated that just three materials – concrete, steel, and aluminium – are responsible for 23% of total global emissions (most of this used in the built environment). According to the United Nations Environment Program Sustainable Buildings and Climate Initiative (2009), the building sector is responsible for 40% of global energy consumption, and 30% of anthropogenic greenhouse gas (GHG) emissions.

A slightly better number, but still a drastic number, in the UK, 25 per cent of total greenhouse gas emissions are attributable to the built environment. Greenhouse gases are emitted at every stage of the construction and use cycle, from the manufacture of materials through construction and maintenance to eventual demolition. Emissions from the built environment must be reduced if the UK is to meet net zero by 2050. Further, and more pressingly, the UK's Sixth Carbon Budget requires carbon emissions to be reduced by **78 per cent by 2035,** compared to 1990 levels. At COP26 the UK Government committed the UK to achieving a **68 per cent reduction in the UK's carbon emissions by 2030**, compared to 1990 levels. **This is only seven years away**.

MAJOR USES OF ENERGY

Rapid change in our actions is required. To effect change it is necessary to reduce the major energy uses of a building, which can be broadly identified as falling into three categories i.e., Capital Energy, Operational Energy and Transport Energy, each briefly described as follows:

- **Capital Energy** is that expended in the construction and subsequent demolition of the built environment. The creation of a building, although a one-off event, is estimated to equal between 10 and 30 years of Operational Energy[i] . Whilst for dwellings, Operational Energy exceeds Capital Energy in about the 20th year of building life (Fay 1999: 324), it is estimated to be sooner for commercial buildings which are subject more to economic forces. Capital Energy includes building disposal, which includes the dismantling and reprocessing of materials. **By investigating the amounts and types of energy used in the sourcing, manufacture, and installation of all materials in a building, it is possible to estimate the capital greenhouse gas budget.**
- **Operational Energy** is all the energy used to make a building function. It is possible to assess with some accuracy the various operational energies of a building and thus the level of greenhouse gas emission.
- **Transport Energy** is that expended by tenants and visitors of commercial buildings which are usually accessed 5 to 7 days every week. In a city, the normal occupants of a commercial building choose a variety of means to commute to and from their workplace. The location of the building relative to the dwellings of its users leads to the quantification of the Transport Energy and consequent greenhouse gas emissions related to the use of the building.

Recent innovations and regulation have helped to reduce operational impacts, but there has been a lack of comparable methodologies, data, and regulation to the reduce embodied impacts. In 2011 and 2012 the European Standards Committee moved towards addressing this in publishing the TC350 standards[ii] to **define the stages** which should be included for the

whole life-cycle impact assessment of buildings. The committee was developed to standardise methods for the assessment of sustainability aspects in construction works in the context of the UN Sustainable Development Goals.

THE FOOTPRINT COMPANY

As you may be aware DGA was recently acquired by TSA Management, an international project management and advisory consultancy. Previously, TSA acquired "The Footprint Company" to offer carbon management services. In the wake of the TC350 standards, The Footprint Company set up and manages one of the world's largest embodied carbon databases (The Green Book- one of the largest and most complete databases covering materials, assemblies, and projects, drawing from nearly 2,000 real case studies) and has developed proprietary carbon management tools including "The Footprint Calculator", an embodied carbon calculation tool. The Footprint Company supports clients to deliver net zero carbon while providing the data sets and carbon calculation tools to reduce the cost and complexity of embodied carbon project design.

In conjunction with The Footprint Company, DGA, alongside our sister company Henry Riley Associates, undertake the following:

- **Feasibility and initial Design**
  Benchmark to inform scale and performance targets. Establish initial upfront carbon impact and provide overall offset feasibility strategies and ratings guidance.
- **Concept and Design Development**
  Engage with design team and support major pathway design iterations providing specific carbon estimates and mitigation outcomes- monitor against targets and benchmarks. Specific carbon mitigation performance metrics for contract delivery.
- **Tender and contract documentation**
  Prepare performance related contract deliverables for Tender. Tender assessment and peer reviews. Update carbon estimates and or validate tender proposals and support integration into contract deliverables.
- **Construction and validation**
  Support contractors to embed and deliver carbon targets through procurement and guide continuous validation to as-built.

- **Builders' operation and CAPEX**
  Undertake carbon assessment of property operations and advise on mitigation pathways. Benchmark and performance improvement strategy for capital works.
- **Portfolio and Asset Net Zero Management**
  Define strategic portfolio or asset carbon management and reduction plans providing planned pathways to achieve Net Zero and or commitments within declared timeframes.
- **Impact across project life**
  Once we have delivered carbon savings through the design and construction phase, we can develop net-zero options through the occupation stage.

Further information on the services offered by "The Footprint Company" can be found at https://footprintcompany.com/

THE COST OF SUSTAINABILITY

Most construction professionals will be aware there is an exponential growth in interest amongst clients, contractors, and their supply chain in reducing their carbon footprint. Not only do we have a moral obligation to the future of our planet, but proof of such action is also becoming an imperative for pre-qualification on many tender lists, and end-using clients want to advertise to a very concerned and interested public that their carbon footprint has been mitigated as much as possible.

But how much does this mitigation cost? i.e., do sustainable buildings cost more to build and maintain?

A recent report[iii] demonstrated that sustainable construction, when compared to regular methods, brings a very small increase in upfront costs. However, this marginal increase of about 2% would, on average, pay for itself, with a life cycle saving of 20% of total construction costs, more than ten times the initial investment.

This is where the ongoing operation and maintenance costs of sustainable buildings really shine. A building of this nature will inevitably implement green measures such as:

- Efficient use of energy, water, and other resources
- Use of renewable energy, such as solar energy
- Pollution and waste reduction measures, and the enabling of re-use and recycling.

In doing so, significant cost savings are achieved by lessening the carbon footprint and reliance on natural resources, in turn making the building a net producer, rather than a net consumer of resources. Statistically, green buildings on average, are 14% less costly to operate than their traditional counterparts[iv].

So, to answer the question of: "Do sustainable buildings cost more?" The answer is overwhelmingly that it can (but often, it doesn't) and any additional costs more than pay themselves in the cost savings made through green operational practices like those mentioned above. Furthermore, there are other financial benefits of green buildings such as a higher asset value, rental income, occupancy rate, and productivity. Beyond financial returns, it has been found that a green building has health benefits for occupants. Green buildings have better air quality — e.g., materials that are not off gassing — and stimulate occupants to move, e.g. via accessible staircases.

There will always be those who do not believe in the need for sustainable or green measures in their buildings. However, as those measures become more mainstream, we anticipate there to be a societal tipping point, in which those who haven't acted will be spurred into doing so. At that point, the cost of inaction will quickly reveal itself, as in all likelihood, retrofitting existing buildings with green and sustainable measures will undoubtedly cost more than had they been handled from the outset. This will result in higher costs, and a lower chance of recouping those losses through the remaining life cycle of the buildings.

Notwithstanding the overall life cycle savings of green buildings, a current significant additional cost is the cost of design and longer construction times. Recent research shows that on average it can cost 5 per cent more on design fees and green building construction also takes 11 per cent longer than construction of a conventional building of comparable size. However, over time, learning and competition should eventually drive down both design costs and the longer construction time. Green construction is still novel.

Building costs also vary by green certification level. Recent research studied buildings certified through BREEAM, the most widely adopted environmental certification system for buildings in the UK. Like many green building certifications, the BREEAM program has multiple levels, from Pass to Outstanding.

Most green buildings in the UK – 82 per cent — are rated either BREEAM Very Good or Excellent. These are 5-19 per cent costlier to construct than non-certified projects [v]. By contrast, buildings at the lowest levels of BREEAM green certification (Good and Pass) have no environmental cost premium. The "green premium" that certified buildings can achieve increases with the certification level.

Notwithstanding the aforementioned marginal additional upfront costs, the major driver of sustainable buildings now are investment companies and pension funds. Simply put, if there are two buildings and one is more sustainable/environmentally friendly, that building gets the investment. This will only increase in the future.

THE GREEN FUTURE FOR THE CONSTRUCTION INDUSTRY

So, regarding the foregoing there is an imperative need to construct sustainably and it cannot be left to the whim of clients, contractors, or their supply chain to perform. Statutes have been passed and building regulations altered and expanded, and further will be required to ensure the construction footprint is minimised and completed buildings are operated as energy efficiently as possible with minimal green-house gas production. Measurement of embodied carbon is critical in this process.

The government is starting to listen to those voicing construction carbon concerns. Michael Gove recently shut down Marks & Spencer's Marble Arch demolition plans citing concern over carbon. Marks & Spencer sought to demolish an existing building in Oxford Street, London and construct a new 10 storey retail and office scheme. In his decision letter, Gove said he disagreed with M&S's argument that there was no viable and deliverable alternative to demolition, arguing that the project was not compatible with the transition to a low-carbon future and the need to reuse existing buildings and materials. Campaigners said the loss of the carbon emissions "embodied" in the building itself — from the energy used to create and transport the materials — gave it a significantly larger environmental footprint than a "retrofit" that would preserve parts of the

structure. In the absence of specific government policy on embodied emissions, the ruling is likely to be seen as a precedent for developers and planners in how to approach the question of whether to demolish or refit buildings. The Gove planning decision may have a significant effect on future planning applications and approvals.

As stated above, "The Footprint Company" (a DGA associated company) produces, and relies on, "The Green Book"- one of the largest and most complete data bases of embodied carbon .[vi] Analysis, recording and production of this data produces an essential tool in mitigating greenhouse gas emissions. May I suggest that there should be a contractual requirement upon designers in their professional appointments, and contractors and suppliers in their respective contracts, to provide data relating to specific sustainability matters. The data that should be provided could include schedules identifying:

1. When components are likely to require replacement and financial modelling of costs,
2. Anticipated consumption and costs of utilities during occupation, and
3. Total carbon performance at construction stage, during the life of the building and at the end of the building's life.
4. A post occupancy review by the project team to check on targets and to facilitate better performance on subsequent projects.

Standard forms of contract will be required to do more to address lifecycle matters, and a contractual commitment by all parties to a common approach at the earliest stage would facilitate the transfer of information and the alignment of stakeholder interests across a project. Standard forms of contract can assist to achieve sustainable objectives and if they addressed the performance of the completed works then they could be made legally binding. A form of contract, which applied throughout the design and construction phases and into the occupation of the completed works, would facilitate achieving a more sustainable building and more sustainable approach to the procurement of buildings. Further provisions could be incorporated within contracts to encourage performance outcomes during the design and construction phases. Some of these could be as follows:

- Payment against key performance indicators on mitigation of carbon emissions.
- Payments based upon the taking of specific steps intended to maximise sustainability.
- Payment of liquidated damages in the event the completed works failed to meet a particular standard of carbon emission.
- Payment of a bonus if the completed works exceed a particular standard.

- Extended defect correction period for operational elements of the works
- Make the Contractor (Specialist Contractor) responsible for the maintenance of key elements including M & E services during the occupation of the building for an initial minimum say 3-year contract period.
- Have the contractor provide training and advice to a facilities manager before and in the months following practical completion?
- Ensure that the lifecycle strategy is required to form a key component of the building manual, and that there is a requirement for a handover meeting on the topic between the contractor, client, and operator (when available) post PC.

The standard forms are answering the call for sustainability already. NEC 4 recently introduced an additional Optional X Clause X29: Climate Change. On 10 August 2022 my colleague Brendan Robinson published an interesting e-brief article titled "How does NEC deal with global climate change?" This can be found at http://www.dga-group.com/the-reading-room.

Likewise, JCT has Supplemental Provision 8 and Supplemental Provision 9, which can be used to effect more sustainable construction.

It has been argued that the above suggested imposed requirements are very prescriptive, and that more flexibility is required to enable client priorities to be met and that it requires a more collaborative approach, that aligns the supply chain and encourages innovation, so contracts that do this are what is required, not prescriptive clauses dictating specific measures. It is ultimately for the client organisation to determine what approach it wishes to adopt. The client's commitment and early involvement of the supply chain are, however, essential to achieve sustainability and reflect lifecycle costs both in the design and construction process.

The entire construction team – client down to subcontractors – need to buy into sustainability completely. Education is key, but until more organisations and clients are adequately educated on sustainability issues, perhaps in the short term the carrot and stick approach could work to focus the minds and will hopefully lead to questions being asked internally which lead to self-education - and that learning process requires to start now - or it may be too late!

Endnotes

i. https://www.arcom.ac.uk/-docs/proceedings/ar2002-129-136_Aye_et_al.pdf
ii. CEN TC350 Standards for Assessing Sustainability; EN 15942:2022
iii. https://www.fastbuildsupplies.co.uk/knowledge-hub/benefits-sustainable-construction-materials-practices/#:~:text=However%2C%20when%20compared%20to%20traditional,of%20the%20total%20construction%20cost.; 2022
iv. https://www.bdcnetwork.com/blog/green-buildings-dont-have-cost-more#:~:text=Green%20buildings%2C%20on%20average%2C%20are,is%20doubling%20every%20three%20years.
v. https://nbs.net/green-building-has-a-strong-business-case/#:~:text=Most%20green%20buildings%20in%20the,have%20no%20environmental%20cost%20premium.
vi. https://footprintcompany.com/the-greenbook/

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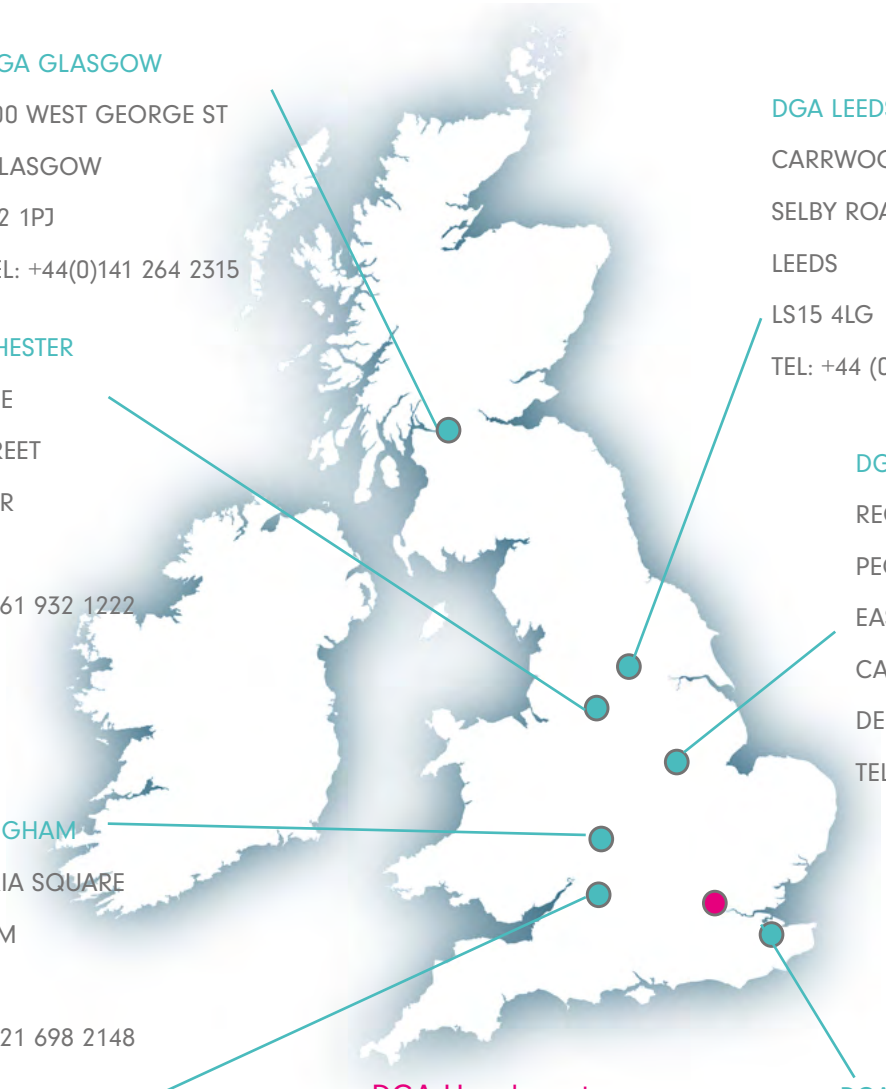

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