EMBODIED CARBON AND WHAT WE'RE DOING ABOUT IT

With the growing concerns about climate change and the urgent need to reduce greenhouse gas emissions, the construction industry has emerged as a significant contributor to environmental degradation. Beyond the operational stage of a building there is a less recognised factor that contributes to the whole life carbon (WLC) of a building - embodied carbon.

WHAT IS EMBODIED CARBON?

In its simplest form Embodied Carbon is the carbon dioxide (and equivalent GWP of other gases) emitted as a result of embodied energy.

The widely used (in the UK) Inventory of Carbon and Energy (ICE) produced by the University of Bath and published by BSRIA uses the following, more detailed, definition:

"Embodied energy (carbon) is the total primary energy consumed (carbon released) from direct and indirect processes associated with a product or service and within the boundaries of cradle-to-gate. This includes all activities from material extraction (quarrying/mining), manufacturing, transportation and right through to fabrication processes until the product is ready to leave the final factory gate" (i)

With the global construction sector accounting for a large portion of total carbon emissions, understanding and mitigating embodied carbon in construction has become essential.

EMBODIED CARBON WITHIN MEP

Most industry targets and benchmarks for embodied carbon primarily concentrate on architectural building materials, often overlooking the embodied carbon impact of Mechanical, Electrical and Plumbing (MEP) systems. However recent studies are shedding light on the substantial impact of embodied carbon associated with MEP systems. LETI states that MEP services represent around 15% of the embodied carbon in a new office development (ii).

The embodied carbon impact in MEP can be categorised into three categories within the life cycle stage, as shown below in Figure 1 (iii), CIBSE TM65:2021. A large proportion is associated with the product stage, this is because most MEP components are made of metals, electronics and plastics, and have a complex supply chain. The product stage includes the carbon emissions associated with extraction, transport and processing of materials and the energy consumption used to manufacture the product.

Analysis from 180 mechanical, electrical and public health products from various databases showed that the product stage (A1–A3) represents 92% of the embodied carbon impact.

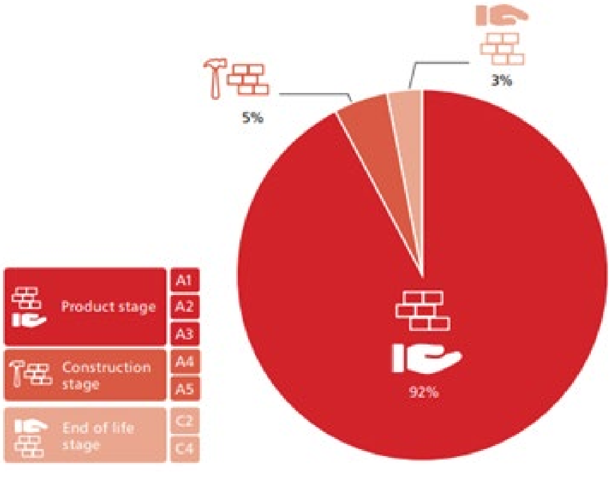

Figure 1 Breakdown of embodied carbon per life cycle stage; average results for 180 MEP products
(Figure 1.3 CIBSE TM65:2021)

The product stage of the embodied carbon life cycle in MEP systems offers significant opportunities for reducing carbon emissions and advancing sustainability in the construction industry.

STRATEGIES FOR REDUCING EMBODIED CARBON

MEP systems play a crucial role in ensuring the functionality of buildings and so their use cannot be eliminated. Consequently, it is imperative to account for embodied carbon into the design of these systems and utilise materials in the most efficient manner to minimise their environmental impact.

FloControl considers various aspects of design, manufacturing practices and operational efficiencies to reduce embodied carbon, such as:

1. **Design optimisation:** Collaborate with engineers and contractors to optimise the design and selections of hydronic valve and pipeline products. Minimise material usage through an integrated approach to hydronic system components. Development of modular systems to aid with reconfiguration and disassembly. Selection of valves with considerations to line sizes and valve turndown ratio to facilitate design change.
2. **Efficient manufacturing processes:** Offsite prefabrication to reduce on-site waste and energy consumption.
3. **Circular Economy Approach:** Materials and components selected for ease of disassembly for repurpose or recycling at the end-of-life stage.
4. **Collaboration and Education:** Provide education and training on embodied carbon reduction strategies to raise awareness within the construction industry.
5. **Continuous improvement:** Regularly review and update designs, technologies and incorporate latest advancements in reducing embodied carbon. Stay informed about emerging trends, regulations, and best practices to continually improve the environmental performance of building services.

OUR COMMITMENT TO ENVIRONMENTAL MANAGEMENT AND SUSTAINABILITY

FloControl recognises the role in addressing environmental management and sustainability by taking proactive measures through ISO 14001 accreditation, an internationally recognised standard for environmental management systems (EMS). The environmental pledges are to:

1. Reduce waste
2. Recycle
3. Reduce energy consumption
4. Choose environmental-friendly product options
5. Reduce use of water
6. Reduce levels of pollution

Individual focuses include: repurposing packaging by shredding incoming packages to use for packing protection for outgoing deliveries, lead-free flux in the soldering process (compatible with standard recycling processes) and energy reduction through switching off electrical equipment at night and weekends.

The drive towards lower energy use has led to a reduction in recorded figures between 2021 and 2022, at a time of business growth:

- Total Electricity KWh usage reduced by 15.7%
- Total Water m3 usage reduced by 8.3%
- Total Gas KWh usage reduced by 9.9%

Environmental management systems play a crucial role in helping manage environmental impact effectively, improve sustainability practices, and comply with environmental regulations.

EMBODIED CARBON CALCULATION

FloControl are developing processes in calculation of embodied carbon. A tool in this endeavour is the CIBSE TM65 guidance, developed by the Chartered Institution of Building Services Engineers (CIBSE). The CIBSE TM65 process is as follows, Figure 2 (V).

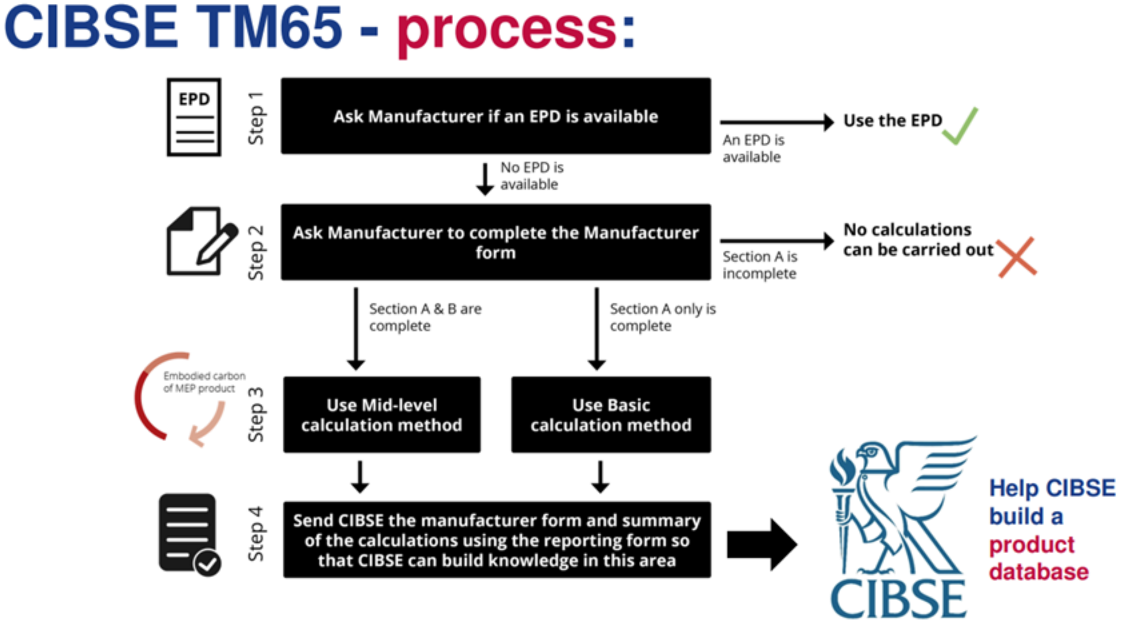

Figure 2 CIBSE TM65 - Process

Should Environmental Product Declarations (EPD) not be available then basic level or mid-level calculations can be made.

A basic level calculation method can be used when 'Section A' data is known. This data includes the following:

- Capacity of equipment/size
- Product service life (year)
- Product weight (kg)
- Material composition breakdown (95%)
- Components replaced over service life

Mid-level calculation achievable should 'Section A' date above is known with the addition of 'Section B' data. This data includes the following:

- Final assembly factory location
- Final assembly factory energy use (kW)
- Factories from supply chain location

Using the collected data and emission factors, FloControl can calculate the embodied carbon of their product and /assemblies. The results can be reported in terms of CO2 equivalents, providing a standardised measurement for comparison and benchmarking.

Utilising tools like CIBSE TM65 allows an assessment of the environmental impact of their offering and make informed decisions to minimise the carbon footprint.

COLLABORATIVE SOLUTIONS: WORKING WITH KEY SUPPLIERS TO REDUCE EMBODIED CARBON

While FloControl has an important role in material selection, calculations and design optimisation, working closely with key suppliers is essential for achieving significant reductions in embodied carbon.

Dynamic valve specialist FlowCon International commit to reducing their carbon footprint by registering to the Science Based Targets (SBTi), a clearly defined path to reduce emissions in line with the Paris Agreement Goals (IV). FlowCon commits to reduce absolute scope 1 (direct emissions) and scope 2 (indirect emissions) GHG emissions 30% by 2030 from a 2018 base year, and to measure and reduce its scope 3 (other indirect emissions).

In addition to FlowCon's commitment to reducing their carbon footprint, they also recognise the importance of documenting carbon footprint by offering a CO2 invoice at product level. Get in touch if you would like to receive a CO2 invoice for any of the FlowCon PICVs.

Key suppliers are important partners in reducing embodied carbon because of their influence over material selection, their ability to drive change within the supply chain, their access to data and transparency, their potential for continuous improvement, and their impact on product development. Collaborating with suppliers provides opportunities to create a more sustainable and low-carbon built environment by working together to reduce the carbon footprint of building services.

CONCLUSION

Efforts to reduce embodied carbon in building services are gaining momentum as the construction industry embraces sustainable practices. Material innovations, efficient design, life cycle assessments, prefabrication, renewable energy integration, and whole-life considerations are key strategies employed to minimise the carbon footprint of MEP systems. By adopting these approaches, professionals are playing a crucial role in advancing sustainability, creating buildings with reduced embodied carbon, and contributing to a more resilient and environmentally friendly future.

To request an embodied carbon invoice for Flowcon PICVs or for FloSets, please get in touch!

FOOTNOTES

I. Embodied Carbon: The inventory of carbon and energy, University of Bath. Latest version from http://wiki.bath.ac.uk/display/ICE/Home+Page. Printed version (as of January 2011) from BSRIA BG10/2011 (ISBN 978 0 86022 703 8)
II. LETI. LETI Embodied Carbon Primer [Supplementary guidance to the Climate Emergency Design Guide].
III. CIBSE. TM65 Embodied Carbon
IV. FlowCon International. FlowCon's Climate Account. https://flowcon.com/sustainability/climate-account
V. CIBSE TM65 Embodied Carbon Calculator. TM65 Tool BEAMA webinar - Carl Collins

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