Global review of Whole Life Carbon Assessments in the Built Environment

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Abstract

Assessing and reducing whole life carbon in the built environment is a global challenge. While operational emissions of buildings are currently being tackled by many government strategies, policies to reduce embodied emissions are yet to be widely implemented. This is due to evidence gaps facing policy makers and built environment professionals behind the tools, data, methods and policy options available to reduce embodied emissions. Greater international collaboration and knowledge sharing will be essential to fill common evidence gaps, particularly in developing countries which are expected to account for over two thirds of new buildings constructed between now and 2050. This paper addresses these gaps by presenting insights from a recent international workshop and proposes areas of focus for a future global forum.

4700 words (excluding tables and figures)

1.0 Introduction

The construction and operation of buildings accounts for an estimated 37% of global energy-related CO_2 emissions (1). Over the period 1990-2019 global emissions from buildings increased by 50% as in most regions, improvements in efficiency were outmatched by growth in floor area (2). Despite anticipating continued growth in building stock, The Marrakech Partnership for Global Climate Action suggests emissions from the built environment must be halved by 2030 for a pathway consistent with delivering the Paris Agreement (3). Whole life carbon assessments (WLCAs) are increasingly used to understand the emissions associated with the whole life cycle of a building: comprising operational emissions from building use, and embodied emissions from design, materials, manufacturing, construction, maintenance and end-of-life (4).

This paper reviews international implementations of policy, methodologies, and data sources for WLCA of buildings, captured through a unique gathering of global experts. The paper is structured as follows. Section 1 sets the context for this review, and sections 2 to 5 summarise learning outcomes of different elements of the workshop. The conclusion outlines the need, purpose and desirable features of an ongoing forum for international collaboration and knowledge sharing as WLCA is increasingly integrated into policy.

1.1 Global context

The growing significance of embodied carbon and the common challenges associated with WLCA have been highlighted by the Global Alliance for Buildings and Construction (Global ABC) status reports (1), roadmaps (5) and Green Building Council campaigns (4). Nearly 80 countries have building energy codes (1) but only a handful have policies which mandate whole life carbon assessment or restrict embodied carbon emissions from construction (6). The majority of these are located in Europe (as discussed in recent policy reviews by OneClickLCA and Ramboll (7,8)). In addition, there are a growing number of policy initiatives by North American states (9) and a plethora of policy approaches being pursued at a city, local authority or municipality level (10).

Development of compliance infrastructure, such as national assessment methodologies and data directories, that may support routine assessment or underpin future mandatory requirements is also underway in many countries, such as New Zealand (11) and Brazil (12). However, many of the countries where the greatest future construction activity is anticipated (5) do not yet have such compliance infrastructure or resources to develop it. As the most rapidly urbanising continent on the planet, African professionals are well aware of the surging demand for building materials with an estimated 70% of the African building stock in 2040 yet to be built, yet embodied carbon (typically 1/3 of a building's footprint) is largely ignored (1). Across the continent, steel and cement alone already account for 38% of African emissions (1) and will rapidly expand without further intervention to drive low carbon construction. It is therefore important to include countries at different stages of economic and policy development in the conversation when developing consistent standards and innovative practices.

International research initiatives such as the IEA Technology Collaboration Programme on "Energy in Buildings and Communities'" working group on Life Cycle Assessments (13), and academic or practitioner-led networks such as the Carbon

Leadership Forum (9), have demonstrated an increasing interest in comparisons between international approaches (14,15). However, although WLCA has received increasing attention amongst policy makers and practitioners in a small number of regional fora such as the annual Nordic Climate Forum for Construction (16), there is currently no global annual forum or platform for policy makers dedicated to WLCA in buildings. The international workshop described subsequently in this paper constituted a first attempt to gather such a global policy community with interest in WLCA.

1.2 WLCA in the UK

In the UK, over recent years WLCA has become increasingly embedded in public procurement requirements (17,18), local authority planning requirements (19), voluntary industry led commitments (20), and has been the subject of industry-led campaigns (21) and proposed legislation (22,23). In the UK there is extensive guidance (e.g. (25–27)), and growing consensus around methodologies (28), but assessment is constrained by inconsistent practices and partial data availability. The UK Government has recognised “that whole life carbon assessments are likely to have a significant role to play” and has committed to “consult in 2023 on our approach and interventions to mainstream the measurement and reduction of embodied carbon in the built environment” (24). To better understand the fast-changing global policy environment on Whole Life Carbon, the UK Government’s Department for Business, Energy and Industrial Strategy (BEIS) sought to organise a global gathering in conjunction with major stakeholders to share experiences and discuss common challenges in WLCA.

1.3 International workshop on whole life carbon assessment in the built environment

The event held on 25th-26th October 2022 was jointly organised by BEIS, the University of Strathclyde, the International Deep Decarbonisation Initiative (IDDI) (29) and the Global ABC. Invites were targeted to policy makers, policy influencers and technical experts in the field of WLCA, standards, regulation and policy development, with a deliberate attempt to present global case studies at different levels of development. The workshop sold out its 300 tickets to participants from 41 different countries, with approximately 80 attending in person and 120 attending online across different time zones. The format and content of the event was informed by initial stakeholder engagement in summer 2022 which raised 16 common topics of interest. The first 200 event registrants were asked to prioritise the 16 topics which were distilled into 11 focused sessions with 40 speakers from 22 countries. The agenda and presentations can be viewed on the event website[1]. Attendees were requested to respond to a pre-event questionnaire on WLCA in their country. This paper was prepared with reference to the collated pre-event information, a review of slides and recordings from the event and follow-up with some presenters. Subsequent sections present a summary of the insights from each session by drawing on relevant presented case studies, as mapped in Table 1.

[1] https://international-workshop-on-whole-life.b2match.io/

Summary section	Source of information from the workshop
2.0 Insights on actors of Whole Life Carbon policy-making in 19 countries	Pre-event questionnaire (from 19 international responses)
3.0 Methodologies, data sources and data	Session 2B: Developing national methodologies Session 3B: Developing national data sources: examples from Italy, Croatia, Brazil, Nigeria, Ireland Session 5B: Expanding product data: expansion of use of Type III EPDs, alternatives, verification
4.0 Benchmarking and emissions reduction potential	Session 2A: Setting limits and targets Session 3A: Implementation of WLCAs: challenges implementing, measuring success and compliance Session 4A: Emissions reduction potential: in Sub-Saharan Africa, globally, and EU studies
5.0 Policy levers	Session 1: Building consensus around new policies, with keynote on the experience in Finland Session 4B: Policy levers - policy roadmaps at national level, for industry, and city level Session 5A: Beyond policy: role of incentives and enablers for WLC assessments
6.0 Discussion on role for an International Forum	Session 6: Discussions on global initiatives, shape and host of continuing a forum, steps to take forward

Table 1 – Mapping workshop outputs to sections discussed in the global review

2.0 Insights on actors of Whole Life Carbon policy-making in 19 countries

A pre-event questionnaire gathered information on maturity of methodologies, data sources, and policies. Figure 1 maps out the responses received by outlining in black the countries with a response. No respondents were from countries that currently implement mandates on WLC assessments or life cycle assessments of buildings, infrastructure or construction projects. However, 7 noted that mandates on WLC were in development.

Of the 19 international respondents, 8 identified a governmental department (Mexico, NZ, Spain, Tunisia, Colombia, Australia, Egypt and Nigeria) as responsible for regulating emission from the built environment, 5 stated that it was not yet regulated (Nigeria, Germany, Brazil, India and Australia) and the remaining 6 gave no response. These represented a spread of responses across the Global North and South, although conflicting respondents from the same countries (Nigeria and Australia) show that confusion exists around responsibilities.

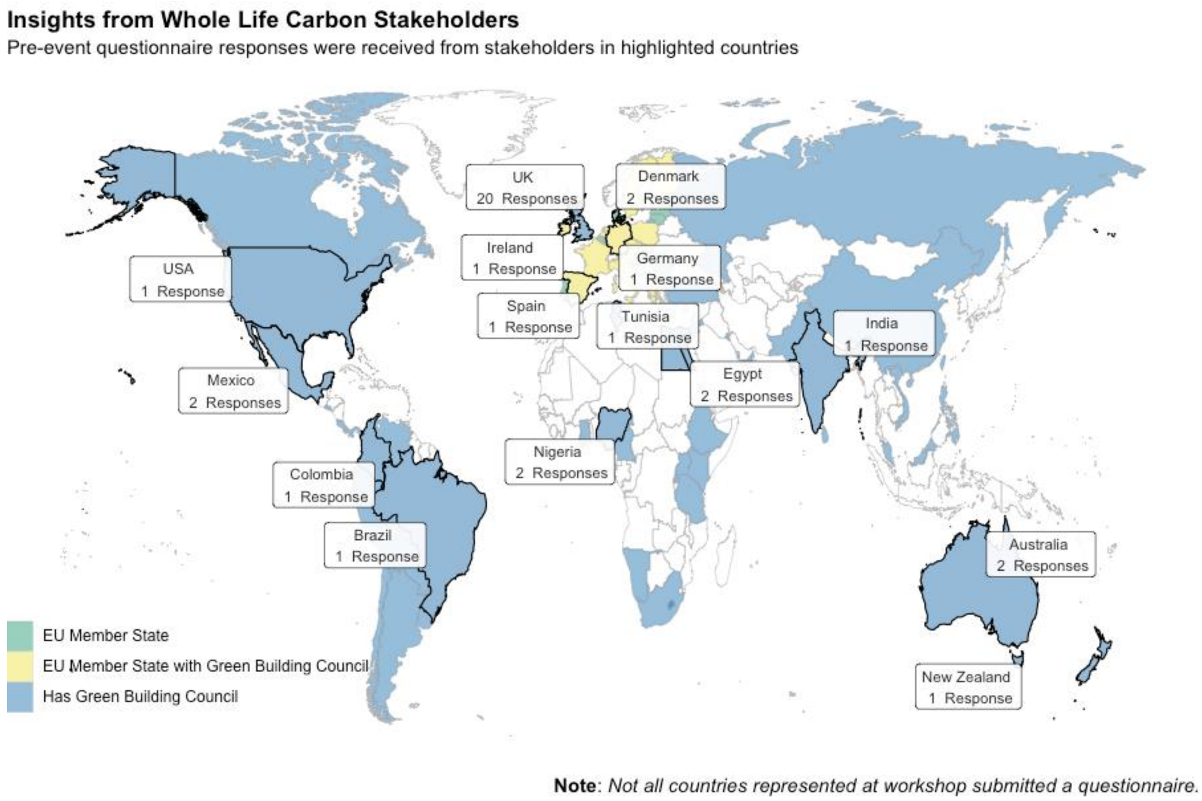

Figure 1: Map of Responses to Pre-Workshop Questionnaire

When asked who the main actor organisations on WLC in their country were, 9 respondents identified Green Building Councils (GBC). Indeed, as can be seen in Figure 1 where countries with GBC are shaded in blue, nearly all responses came from countries with a GBC. There are over 70 national GBCs, which are part of a global network recognised by the World Green Building Council (WGBC). GBCs are non-profit non-governmental organisations, typically funded by built environment organisations, with the aim to “ensure that global, national and local building policies are aligned with the Paris Agreement goals” (30). Other identified organisations included a mix of governmental organisations and non-profits.

3.0 Developing consistent national methodologies and data sources

To track reduction of WLC in the built environment requires emissions to be consistently measured. However, despite the existence of well-established international standards for general Life Cycle Assessments (ISO 14044), building LCAs (BS EN 15978), and construction works LCAs (BS EN 17472), the standards are still relatively open for interpretation. Variations often relate to different minimum reporting requirements (e.g. only stages A1-A3), hierarchy of data sources, reporting periods and design lives of materials, calculation methods, and the timing of WLCAs within the design/construction process (31). In this section, we present different country examples to illustrate the various approaches based on national contexts.

3.1 Standardising Whole Life Carbon Assessment methodologies

International standards are designed to be high-level so they can be applied internationally and as such there is a case for developing country-specific methodologies. More locally representative standards can provide more detailed guidance based on the building stock, supply chain, local building materials and construction methods. However, at present most countries do not have agreed national methodologies. For instance, in a 2020 public consultation in New Zealand, 79% of 374 respondents cited a “lack of an agreed methodology” as the greatest barrier to tracking and reducing WLC in buildings (32).

Several countries have developed national methodologies and can inform the process development for other countries. Based on experience from Switzerland, France, UK, European Union, Brazil, Tunisia, and New Zealand, we have produced a list of principles and mechanisms that help support the development of national methodologies:

- Engagement of public sector bodies (from local to national level) to agree consistent rules for calculating WLC (e.g. specifying minimum reporting requirements for life cycle stages and building elements, provision of generic data);
- Clear outcomes for LCAs (e.g. purpose of the LCA, how it is to be used);
- Transparent and publicly accessible data sources with clear quality markers to develop a data hierarchy (i.e. selection preference of data sources);
- Training for accessing data sources and understanding the methodology;
- Coordination between public and private sector to provide company LCA data and ensure industry will engage with the methodology;
- Test phases to trial methodologies and evaluate implementation challenges;
- Clear guidance on how to treat current emissions (upfront), future (operational and end-of-life), biogenic carbon, and emissions removals;
- Development of a reporting mechanism (a consistent reporting format, repository, compliance).

Based on these principles, different approaches can be taken. In France, the RE2020 assessment method is very prescriptive and LCA tools need to license the methodology from the government to be compliant. The methodology includes consideration of the timing of emissions, carbon storage in the building, and maximum values specific to the building (33). In New Zealand, a recently developed methodology follows five scope areas: building elements, life cycle stages, emissions and removals, data hierarchy and results format (34). This methodology now needs to be tested with stakeholders and further steps are required to implement into a regulatory instrument, including: tools to check for compliance, data sources, implementation procedure etc. In the UK the recognised WLC methodology is a Professional Statement developed by a group of professional bodies led by the Royal Institute for Chartered Surveyors (RICS). This is currently being updated to contain prescriptive guidance for all aspects of LCAs, including retrofits, mechanical, electric and plumbing (MEP) components, and infrastructure projects (28). This methodology is openly accessible and can be applied in several countries, albeit with some adaptation for local contexts.

3.2 Developing national data sources

Data sources, or Life Cycle Inventories, are databases of LCAs at either “entity” level (building, infrastructure LCA) or “product” level (construction materials and products). While there are several international databases for embodied carbon worldwide, most of them commercial (such as OneClickLCA, SimaPro, Tally), with a few public registers of product data (such as the ICE database or Building Transparency’s EC3 Tool). A few countries have developed national open access and verified databases, and most of them contain data from Western Europe and North America, with limited data from developing countries. In this section, we discuss product data, and present examples of developing databases for three different regions: Europe, Brazil and Nigeria.

The input data for Life Cycle Inventories varies from embodied carbon factors derived from national consumption data (e.g. Greenhouse Gas Inventory data), to detailed and verified Type III Environmental Product Declarations (EPD).

EPD are documents that communicate the embodied emissions (and other indicators) of a product to the end user. The number of verified EPD compliant with the BS EN 15804 has grown from a few hundred in 2011 to tens of thousands in 2022 (35), making them an international standard of choice in the construction sector. This is largely due to increasing standardisation of verification procedures and “Product Category Rules” through standards such as BS EN 15804, ISO 21930, verification platforms such as the EcoPlatform, and data formats such as ILCD+EPD (InData, 2018), OpenEPD (BuildingTransparency, 2020) and EN ISO 22057. However, globally EPD coverage and use in construction remain low, with several different standards in existence (e.g. Greenhouse Gas Protocol, ISO 14067, ISO 21930 PAS 2050). For instance, in Egypt there are only 10 manufacturers that own multiple EPD. Incentives and frameworks need to be developed to enable an open and interoperable system to allow for cheap, efficient, and accurate construction of an EPD in which all parties have confidence in its outputs.

Even though EPD are mostly available in Europe, availability of EPD data varies widely within the continent. A recent study proposed a methodology to develop data sources for Ireland, Croatia and Italy based on a classification of data quality which could be applied to initiatives across the world (36). The data are classified by availability, with categories such as production of construction materials in the country (percentage of imports), and uptake of EPD across the country (from no EPD, to global or national EPD to size of EPD uptake across the market). The report presented a step-wise approach on data quality to develop default values and standardised an approach for data variation across the three countries.

Brazil has developed the SIDAC database to support the development of guidelines to integrate LCAs into public policies (12). The tool gathers embodied carbon data for 90% of the main construction materials used in Brazil. The emissions data is less precise than EPD: it is derived from energy consumption and CO2 emissions from extraction and manufacturing, and do not include emissions from water consumption, other raw materials used, transport, construction or disposal. However, the lower data requirement is expected to increase the uptake. The database is open access, and people can upload Brazilian construction product data which is independently verified. Data owners have more data access than the general public to protect disclosure rights.

The Nigerian Green Building Council (NGBC) is leading efforts to develop an embodied carbon database. The NGBC led a scoping study to determine its country-specific route: to borrow from existing data or build anew for the local context. The table below summarises the barriers and opportunities of each approach by focusing on an example for a widely used 9'' concrete block (37). The dichotomy between the two approaches highlights the need for knowledge sharing between different countries. For example, the learnings of the European and Brazilian studies mentioned here could be applied to inform the development of a data source in Nigeria.

Approach	Borrow (from a similar database such as open access and English language ICE)	Build new
Challenges (focusing on the example of a common 9'' concrete block in Nigeria)	Slight variations between products in different countries (e.g. 9'' concrete blocks have slightly different dimensions in UK and Nigeria) Different aggregate and cement mixes Different energy intensity values Different manufacturing processes Would likely need to "borrow" from several databases to cover range of widely used products in Nigeria	Difficult to source data on cement and aggregates from multiple small suppliers across the country Uncertainty around the quantity and useability of raw data available Large data gaps Requires development of robust yet flexible data "cleaning" procedure Train staff to ensure quality Funding for time and resource requirements
Advantages	Cheaper and faster to develop as can copy a pre-existing resource Faster availability of data can generate more interest in the database Build local knowledge in life cycle data of materials in the country and internationally Can emulate best practice	Can tailor input fields to reflect type of data collected in the country Build local knowledge in life cycle data of materials in the country Can foster local interest by developing a national consortium of stakeholders like in Brazil SIDAC case

Table 2 – Nigerian example showing challenges developing national data set, adapted from (37)

4.0 Using WLCA for emissions reduction

The goal of increasing uptake of WLCAs is reducing emissions in the built environment, but it is difficult to directly attribute emissions reduction to the use of assessments themselves. We present in section 4.1 requirements and case studies of introducing limit values, and review case studies showcasing emissions reduction potential in Section 4.2.

4.1 Introducing limit values

Most WLCA benchmarks for the built environment are designed by analysing a sample of the building stock. Consequently, examples for setting limit values for whole life carbon of buildings are mostly from the Global North, due to the larger amount of available data. For instance, a recent study published by Ramboll (15) compared data availability across Europe and found the top 5 countries where it was possible to access over 50 detailed case studies available were France, Sweden, Denmark, The Netherlands, and Belgium (15). When adjusting to match life cycle stages and reference periods, this study found that the average WLC emission intensity was 600 $kgCO_2/m^2$, where 67% was linked to upfront carbon (modules A1-A5). However, it was noted that this baseline could be an underestimate due to (a) LCAs used were more likely to be carried out on ambitious “green” buildings, and (b) to make the baseline value consistent across country methodologies not all life cycle modules from EN15978 were included.

Baselines can be used to set limit values or to benchmark against best practice. We present here two national examples: Denmark and the UK. Whole life carbon values are plotted against the target year in Figure 2. Denmark will introduce limit values from new construction from 2023 in the Building Code, as set out in the Danish National Strategy for Sustainable Construction (38). The maximum limit of 600 $kgCO_2eq/m^2$ will initially be for larger (>1000m^2) buildings, and become stricter in 2025, 2027 and 2029 to 375 $kgCO_2eq/m^2$. There are additional, more ambitious voluntary targets shown in with purple circles in Figure 2. Limit values were derived from a study of 60 building LCAs (39), and only apply to stages A1-A3 due to data availability. Further studies are underway to ascertain achievable targets for A4-A5 stages.

In the UK, limit values have been suggested by professional bodies and green building standards. The Scotland Net Zero Public Buildings Standard (18) stipulates new public buildings should achieve 600 kgCO2e/m2 for stages A1-A5, which matches the European baseline value estimated by Ramboll. The Greater London Authority (GLA) (19) and the RIBA 2030 Climate Challenge (40) have set benchmarks that new buildings should compare with, and separated by building type such as residential and offices. As can be seen in Figure 2, the range of benchmark values can vary widely in ambition, depending on the building type and life cycle stages considered. The GLA for instance proposes different targets for stages A1-A5 compared with B and C (excluding B6 and B7). These large variances highlight that building stock analysis would be required when implementing national legislation.

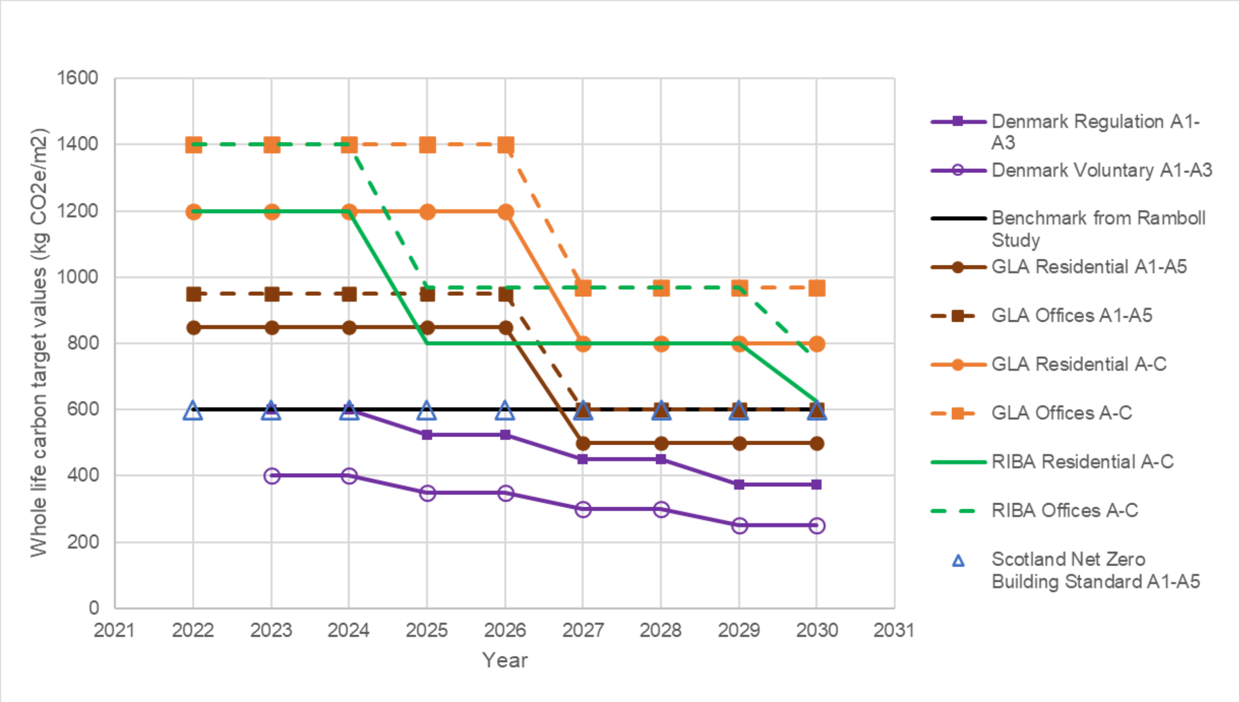

Figure 2: Benchmark WLC values described in Section 3. Life cycle modules refer to BS EN 15978. Denmark values (purple lines) are limits set for modules A1-A3. The GLA values are for modules A1-A5 (brown lines) and A-C (orange lines), and separate for office and residential buildings. GLA values from 2022 onwards are benchmarks to be compared with and not limit values. GLA values from 2026 are the authors' interpretation of "aspirational benchmarks" and have been assumed to be from 2026 for graphical representation. The RIBA values refer to the RIBA 2030 Climate Challenge which are voluntary performance targets for embodied carbon on modules A-C.

4.2 Case studies of emissions reduction potential

a. Map carbon reduction measures against building stock models

The European Union has commissioned a study to catalogue and map all the possible carbon reduction measures onto archetype LCAs of the building stock (8). Measures were categorised by project stage, whether they are demand (e.g. building design) or supply side (e.g. low carbon materials), life cycle stage, and building components. The study's initial estimates suggest that 30-50% of the EU's WLC emissions of EU building stock could be reduced annually depending on the ambition of different policies (41). The report with further detail on measures with biggest impact, and potential emissions reduction, will be published in 2023.

b. Digital tools to test carbon reduction measures at design and requirements phase

WLCAs at early design stages can enable the comparison of different design options. Several organisations have developed digital tools to compare LCAs (42). Integration with Building Information Modelling (BIM) which is widely used is seen as having significant potential, although studies suggest that this may limited to the A1-A3 LCA stages. The software CAALA (43) for example automatically calculates the carbon reduction impact of modifying a building's configuration using parametric LCA results based on a 3D drawing. Testing on a specific case study, different combinations (adding PV, size of underground parking, or construction materials) could vary WLC by -50% to +10% (44).

c. Reducing demand for cement and steel in countries with high new build

Steel and cement cause the largest share of embodied emissions in the built environment, representing 4% and 7% of global energy-related emissions respectively (5). Fast developing countries have significant new housing, infrastructure and sustainability needs and cannot easily reduce reliance on concrete as a low-cost and versatile building material. Four strategies to reduce concrete demand are: reduce concrete in buildings, reduce clinker in cement, reduce CO2 from clinker production, and reduce cement in concrete. The IEA noted that decarbonisation of cement is not on track, with an increase of 1.5% in CO_2 intensity of cement production between 2015 and 2021, and recommends increasing investment and finance for R&D and deployment for low-carbon technologies to achieve Paris Agreement targets (45). From a resource efficiency standpoint, the use of supplementary cementing materials from waste is promising. For example, in Europe, fly ash and silica fume are becoming widely used, but these are scarcely available in Africa. On the other hand, bio-wastes are abundantly available from rural areas in many African countries and could be used as concrete constituents with further R&D (46). The geographical disparity between cement demand and production also calls for further international knowledge-sharing on low carbon alternatives.

5.0 Developing an enabling environment through policy and stakeholder engagement

Developing an enabling environment for WLCAs and thereby reducing built environment emissions is a complex problem. As shown in previous sections, the breadth of actor organisations spanning different geographical scales (local to international), roles in the economy (government to industry), as well as different economic realities means responsibility may lie in different policy areas. In this section, we first review selected policy options, then we discuss the enabling role of different stakeholder groups.

5.1 Policy roadmap development

Ensuring that Whole Life Carbon is considered requires effective regulation. Policy roadmaps can be an effective tool to evaluate different options and provide stakeholders with clear direction. OneClickLCA reviewed carbon regulations in 12 countries and the EU for decarbonisation impact and policy openness and found that countries took very different approaches (7). European countries are leading the way with mandatory building LCAs but North American states are catching up fast with the adoption of Buy Clean Acts which mandate the procurement of construction materials and products with lower embodied carbon on public projects (9). The report advocates that the largest decarbonisation impact would be driven through binding regulatory limits, simple reporting systems, use of existing standards where possible, and regulation to level the playing field (7).

The World Green Building Council have identified four policy areas which represent pathways for regulating WLCA:

1) Building regulations: Building codes and regulations offer an obvious pathway to regulating WLC in new and existing buildings, setting targets as is already done for energy consumption/operational emissions in many countries.
2) Waste and circularity: Policy can introduce requirements for consideration of WLC in construction products at end of life to promote reuse and retrofit over new build.
3) Sustainable public procurement: Public procurement can be leveraged to build demand, skills, and supply chains to deliver on WLC targets and limits.
4) Sustainable finance: Similar to public procurement can be linked to WLC targets to build demand, skills, and supply chain.

The EU is currently developing a region wide roadmap for reducing Whole Life Carbon in the built environment (47). It is still determining the level of ambition, whether to prescribe a regional roadmap or national ones, and whether milestones should be set for embodied, operational, or whole life carbon. There is consensus however that assessment and reporting should be required before countries can develop quantified targets. The roadmap aims to leverage existing EU policy initiatives such as the Energy Efficiency Directive and updates to the Energy Performance of Buildings Directive.

5.2 Building consensus across stakeholders

While previous sections discussed in length WLCA methodologies and data sources, which are the specialism of built environment professionals such as engineers and architects, there are several other stakeholders who may influence the discourse. In this section, we review some key stakeholders and actor organisations and how they interact with WLC policies. This non-exhaustive list of stakeholders is represented in Figure 3 with examples of specific organisations.

a. Finance

Real estate accounts for $326 trillion (48) Savills Research, Oxford Economics) and is the largest global asset class. Asset owners such as pension funds, sovereign wealth funds and insurance companies are at the intersection of 55% of financial flows to European real estate - the single largest player in the built environment (49). For residents, as affordability and accessibility are key, WLCA must be interpretable and affordable. Consequently, policy for low carbon buildings must include the finance and asset aspects of the built environment in all world regions, shown in Green in Figure 3.

b. Construction Industry

There is a disparity of access to data and tools for WLCA for large and small engineering firms, and across the world. Licenses to access databases and software can start at £5,000, staff need to be trained to make reliable assumptions, especially when there may not be accurate data. On the other hand, large organisations like Arup have agreed to voluntarily assess WLC for all of its projects globally and have assessed over 1200 projects (50). The study highlighted that material efficiency should be prioritised over low carbon materials due to the lag in innovation material availability. The disparity in access to tools and knowledge to perform such studies suggests that regulation ought to play a role to level the playing field and incite other organisations to track embodied carbon.

c. Green building certifications

The role of international engagement and green building institutions cannot be overlooked. The results from our survey found that different standards were used across the world, such as STAR, Edge, DNGB and BREEAM. The inclusion of WLC elements in the standards, and the use of standards to attract financing cannot be dismissed. In Egypt for example, EPD are increasingly being developed due to their requirement for selected green building standards, and as a green credential for manufacturing companies (51).

d. Public procurement

International target setting is a powerful lever to drive change in several countries. One such example is the Industrial Deep Decarbonisation Initiative (IDDI), which aims to increase the market share of low carbon construction products. The UK, India, Germany, Canada, and the UAE pledged to adopt green public procurement principles, such as procuring steel and cement products with EPD (29). The IDDI pledge was announced at the Clean Energy Ministerial in September 2022, and countries are planning to consult in 2023 on the detail.

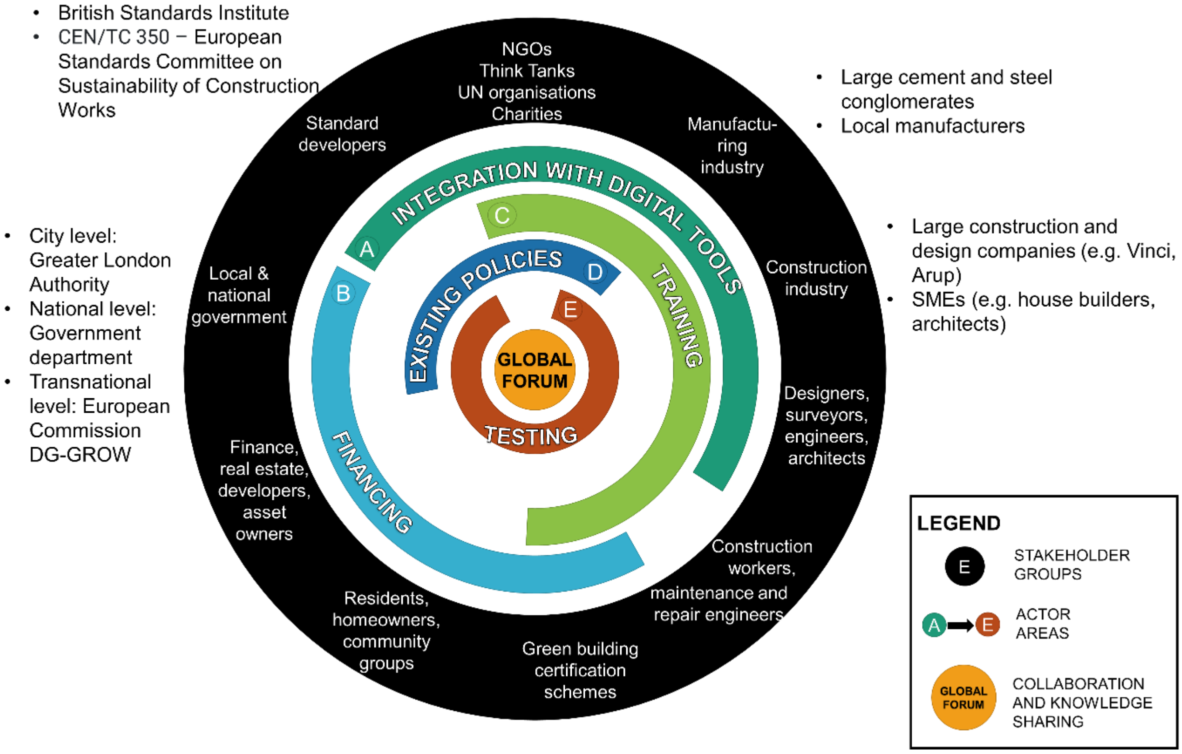

Figure 3: Global forum action areas and key stakeholder groups

6.0 Discussion on role for an international forum

Reducing emissions in the built environment brings with it challenges: a need for more and better data, added transparency and simplicity in assessment, and the ability to design and implement well-informed policy. However, with a complex supply chain, applying WLCA internationally requires globally concerted effort to track emissions and develop markets for low carbon materials. Methodologies to track data need to be implementable in many countries to provide widespread data, but also need to be nationally specific to account for regional differences in procurement or energy mix. In this paper, we showed various examples of countries at different stages of WLCA adoption, and presented different options for developing data sources, policies, and methodologies across the world. The replicability of these examples showed the potential of sharing knowledge to overcome these challenges.

A regional example of this is the Nordic Sustainable Construction programme. This is an initiative set up in recognition that the ambitious Net Zero goals set by Denmark, Finland and Sweden needed to be mirrored by neighbouring countries (e.g. Iceland and Norway), which can be achieved through sharing of knowledge and harmonisation of approaches. Through this platform, Nordic countries have collaborated on developing a common database, pooled common resources for training and developing a circular economy of construction materials.

A global forum could be developed using the Nordic forum as a template. Event participants overwhelmingly supported the creation of an ongoing forum. We suggest five areas that a global forum on WLC policy could act on:

A. Enable better understanding of the potential of integrating WLCAs into digital tools. For example, it can present the main digital standards for EPD such as OpenData, showcase challenges and potential of integrating with BIM, and innovations such as Building Passports or tools yet to be developed.
B. Understand the economic implications of WLCA to inform policy makers on the impact of green building certification schemes, to ESG demands from asset owners, insurance packages, to assist in developing roadmaps.
C. There is unequal access to WLC training to built environment professionals across the world. The forum could provide a platform to share training material, reducing costs for developing countries and reducing the need to always develop new material.
D. Provide a platform to present how existing policies have been leveraged to reduce WLC, for example through Waste or Energy Efficiency regulation. This can be useful as it is common for policy makers to develop policies based on other countries' similar experiences.
E. Disseminate learnings from the "Testing phase" of implementing new policies related to WLC. This could speed up WLC policy deployment across the world as so that countries can learn from others' experience, and hence speed up their WLC policy development.

Based on these five principles, the organisers are currently investigating the format of an effective forum. In addition to being a knowledge sharing exercise, it was agreed at the workshop that specific outputs should be delivered. As an output for this first international workshop, we are currently preparing a detailed global review which examines the concepts presented in this paper in more depth.

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