Calculate embodied carbon – Let’s do it right

ECOS recommendations on the delegated act on the Union framework for the calculation of lifecycle GWP for buildings

February 2025

Contents

Introduction 3
Recommendations 4
Follow EN 15978 & introduce third party verification of assessments 4
Include all stages, modules & building's parts 5
Account for proxy data for quantities and emissions 8
Set science-based targets & limit values 10
Sources 11

Introduction

With the adoption of the recast Energy Performance of Buildings Directive in spring 2024 (EPBD), the European Union introduces in the EU acquis the mandate for operators in the construction industry to calculate embodied emissions stemming from buildings' lifecycle (Art. 7)[i]. This is considered a groundbreaking novelty from the 2018 version of the same directive which only focused on operational emissions, i.e., those emissions from technical buildings systems such as lighting, heating, ventilation and cooling.

To facilitate this gear shift, the recast EPBD introduces two key definitions in Article 2:

- *'whole-life-cycle greenhouse gas emissions' means greenhouse gas emissions that occur over the whole life cycle of a building, including the production and transport of construction products, construction-site activities, the use of energy in the building and replacement of construction products, as well as demolition, transport and management of waste materials and their reuse, recycling and final disposal (24);*

and:

- *'life-cycle global warming potential' or 'life-cycle GWP' means an indicator which quantifies the global warming potential contributions of a building along its full life cycle (25).*

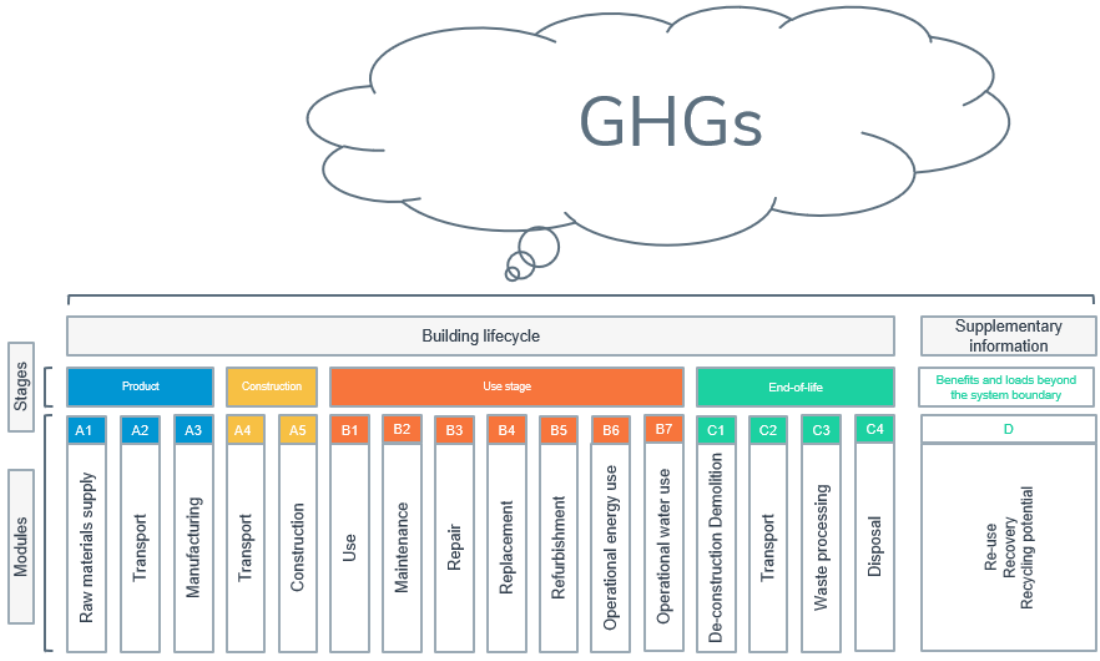

Figure 1: Building's lifecycle – previous version EN15978

Figure 1 conveys the scope of the analysis, i.e., the stages along a building life from which emissions can occur. The lifecycle GWP is the indicator that includes the totality of these emissions of greenhouse gases (GHGs). The indicator is to be expressed in $kgCO_2$-equivalent by square meter of useful floor area (Annex III).

The assessment of lifecycle global warming potential for buildings is mandated in Art. 7(2), where the methodology for the calculation, the timeline and the scope are set:

- *Member States shall ensure that the life-cycle GWP is* ***calculated in accordance with Annex III*** *and* ***disclosed in the energy performance certificate*** *of the building:*

  (a) from ***1 January 2028****, for* ***all new buildings*** *with a* ***useful floor area larger than 1 000 m²****;*
  (b) from ***1 January 2030****, for* ***all new buildings****.*

The same article goes a step further in clause (5), mandating countries to set maximum limit values for new buildings. These values must be in line with the objective of climate neutrality as per the European Climate Law[ii], and follow a downward trajectory.

- *(5) By 1 January 2027, Member States shall* ***publish*** *and* ***notify*** *to the Commission a* ***roadmap*** *detailing the* ***introduction of limit values on the total cumulative life-cycle GWP of all new buildings*** *and* ***set targets for new buildings from 2030****, considering a* ***progressive downward trend****, as well as* ***maximum limit values****, detailed for different climatic zones and building typologies. Those maximum limit values shall be* ***in line with the Union's objective of achieving climate neutrality****.*

To support EU countries on these provisions, the Commission is currently drafting a delegated act to "*set out a Union framework for the national calculation of life-cycle GWP with a view to achieving climate neutrality*", which should be adopted by 31 December 2025 (Art. 7(3)).

At the time of writing, the consortium of consultants working on the preparatory study for DG ENER is drafting its recommendations[iii].

Recommendations

ECOS recommends the adoption of a delegated act that conveys in a transparent, comprehensive and ambitious manner the lifecycle GWP assessment of buildings. The main recommendations can be clustered around the methodology to use, the stages, modules and buildings' part to include in the assessment, as well as the data fed into the assessment.

Follow EN 15978 & introduce third party verification of assessments

ECOS recommends that the methodology should be based upon **the latest version of standard EN 15978[1],** which sits at the basis for the voluntary framework of Level(s). The use of EN 15978 is already

[1] The revision is expected to be published in 2025.

mandated in the text of the recast EPBD (Annex III) and provides a good methodological foundation to calculate life-cycle buildings' emissions. The methodology is widely used, well-accepted, up-to-date, and familiar to industry: any divergence from it should be avoided to reduce inconsistencies to the maximum extent. The standard EN 15978 describes, in essence, aggregation of construction products emissions' information allocated to the stages where the emissions are generated, as a function of products' use. The standard allows to map emissions coming from the construction of the building, its use and its deconstruction.

How does EN 15978 work in essence for a given building?

If a certain amount and quality of steel is used for a given building, the GHG emissions from production stated in the Environmental Product Declaration (EPD) (soon to be embedded into the Declaration of Performance and Conformity) will be accounted for in stage A1-A3, and emissions from transporting the steel to site are accounted for in A4. At site level, emissions from construction will be accounted for in A5, and emissions form operational energy systems will be accounted for in B6. The standard works using both hard data and assumptions, such as when estimating emissions for stages C and D.

The total sum of all stages and modules should mirror how emissive a given building is.

Importantly, **third party verification of assessments should be mandated in the delegated act**. While the revised standard includes a section on Verification of Assessment, it should be explicit in the delegated act that third-party verification is needed.

Include all stages, modules & building's parts

In the workshop organised on 22 October 2024 by the consultants currently informing the Commission position on this topic[2], the following approach reported in Figure 2 was presented. Figure 2 below is the updated version of Figure 1 above, and the new assessment framework according to the current revision of standard EN 15978; some modules and stages have been added for sake of completeness of the assessment of a building lifecycle.

2 The consortium of consultants is formed by Viegand Maagøe, COWI and Exergia. More information can be found at: Home - Whole Life-Cycle greenhouse gas emission reporting for buildings

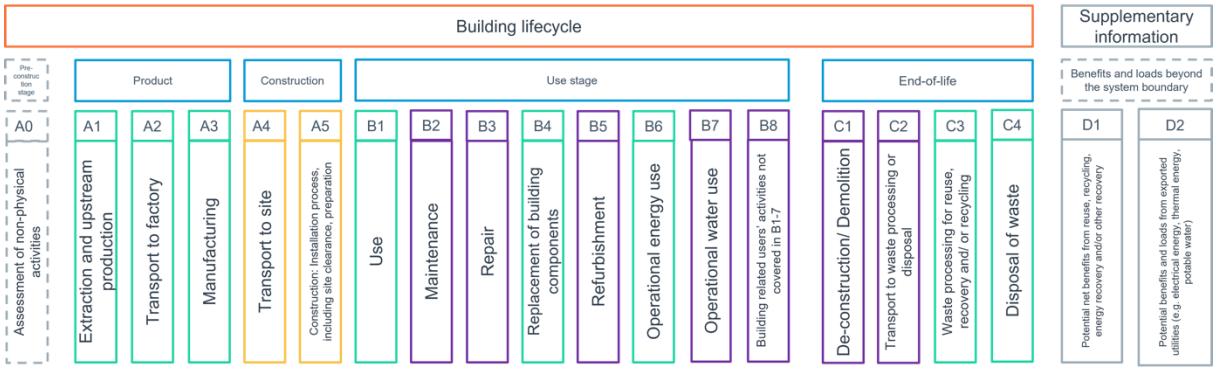

Figure 2: Consultants' proposed approach on assessing LCGWP

The consultants suggest mandating the assessment of all stages from A to C, making optional the assessment of A0 and D. Regarding modules, they suggest that the delegated act should introduce limit values per module for the green modules in Figure 2; calculations should be conducted on the yellow modules and default values should be used to fill the gaps for purple modules.

Green modules	Limit values
Yellow modules	Mandatory calculation of CO2e emissions
Purple modules	Default values allowed

Table 1: Schematic view of the consultants' position for the delegate act

The approach is similar to the one adopted by the standardisation community in the revision of the standard EN 15978, with some differences. The current version of the standard clarifies that:

- Regarding Module D. this should be mandatory to assess, yet it should be specified that it is beyond the system boundary.
- For the use stage, in module B6 non-regulated building technical systems[3] are only recommended to be assessed. Likewise, in module B7 other building integrated technical systems should be assessed.

EN 15978 mandates the assessment of all modules, from cradle-to-grave. Currently countries are not aligned in what stages and modules to report on to comply with their current legislation, with a general preference to require only upfront emissions, i.e., A 1-3. This holds true today, despite substantial communication effort to promote lifecycle assessments around Level(s) in the past years: the lack of EU legislation on life-cycle emissions, and loose nature of the previous version of the standard led to the current different approaches, which, generally promote short-term thinking and short-term solutions. For instance, currently Sweden mandates the report of upfront emissions, meaning only modules A1-3, A4-5, focusing on sourcing of materials and construction. Denmark, on

[3]These are technical systems like escalators, security and communication systems.

the other hand, mandates the reporting of A1-3, B4, B6, C3-4 and D1 and D2 in a separate declaration[iv4].

Sweden	Denmark	Lifecycle (total)
A1-3 A4-5	A1-3 B4 B6 C3-4 D (separately)	A1-3 A4-5 B1-8 C1-4 D1-2

Table 2: 'Lifecycle' climate declaration of Sweden and Denmark

It is key that the delegated act harmonises the scope of the assessment and mandates to include **all lifecycle stages and modules**, as otherwise comparisons across countries will become impossible. **These assessments currently fail to cater for the emissions stemming from the entire lifecycle of a building**.

Additionally, countries may differ in what building parts and what buildings type they mandate to assess, creating another level of difference between assessments. While Art. 7(5) clearly reports that all buildings type should be included, the delegated act should make it crystal clear for operational purposes: **all types of building and their parts** (e.g., shell (sub/super structure), core (fittings, furnishing, services), external works (utilities, landscaping) are to be included in the scope of the assessment as required by Level(s). **The more complete the scope of the assessment, the likelier it is to find emission hotspots that were previously under the radar**. The same legal text presented in the Introduction specifies that '*all new buildings*' are in scope. This may complicate the assessment at the beginning, yet doing otherwise will be a missed opportunity to collect emission data along the supply chain and unveil likely emission hotspots that are currently off the radar.

Finally, information related to the module **D should also be mandatorily assessed, reported separately, nevertheless**. Yet, counting its benefits and loads into limit values should not be considered at this stage: module D is a best-case scenario and the emissions that are projected for it cannot be guaranteed at this stage – the possibility to play with numbers in this module are unfortunately too high to ignore.

Circularity in the assessment of buildings: aspiration and practice

The current version of EN 15978 describes stage D as where to include the environmental benefits and/or loads that occur beyond the building system boundary, resulting from the net flows of virgin materials or products to be reused for the first time crossing the system boundary. This includes reuse, recycling and energy recovery. **Stage D should be mandated, and transparently and**

[4] For further reading on Denmark, please check Buildings' Life Cycle Assessments gain ground in the Nordics | Nordic Sustainable Construction. For Sweden, please check Climate declaration for new buildings - Boverket

realistically separately reported in any lifecycle assessment, with little room for accountancy tricks by operators. It should not count towards setting limit values nor legal compliance, however.

Different considerations, however, should be kept in mind on the relation between circularity and the current methodology for assessing buildings' lifecycle environmental impacts.

- The current standard EN 15978 assumes, by convention, that the lifecycle of a building start with greenfield construction; demolition of existing assets is counted in A5. This central assumption may be the case, yet it already skews the modelling towards new building rather than renovations.
- Circularity is also not favoured by the compromised reference study period that is assumed for the assessment (50 years, as mandated in Annex III of the EPBD and standard EN 15978). While some buildings can have a service life of 50 years, this may not be the case. Perversely, the 50 years' timescale could incentivise the choice of construction products that are 'just right' for accounting reasons, while disregarding the potential to support more long-lasting and circular products and materials.
- Module D1 has limited potential to be used as a metric for quantifying circularity and assessing future resource efficiency, as currently no one can guarantee what will happen to buildings at the end of their life cycle. In addition, it is ill-suited to count for any repurposing of already fully or partially recycled/reused materials.
- The benefit of reusing building elements is also not properly accounted for in the current methodology in module D. Research is undergoing to suggest the accounting for in-situ building elements within Module B5, allowing the assessment to cater for the benefits of multiple times reuse within the system boundary.[v]
- The new CPR will require declarations of performance and conformity (DoPC) when reused products are placed on the market (Art. 3(5). The emissions related to the reused product should be accounted for at stage A of a new project. By supporting this shift, the regulation ushers in proper reuse of products and transparent accounting of their emissions; this contrasts with module D which is, at present, a stage allowing operators to play with projected emissions for (possible) recycling or reuse scenarios.

Regarding circularity in the assessment of buildings, numerous new Working Groups at CEN/CENELEC level are starting work covering topics such as design for circularity, reuse of products, assessment of circularity and guidelines for pre-demolition and pre-redevelopment audits.

Account for proxy data for quantities and emissions

The veracity of assessments can be shaky when estimating the needed quantities for the project or when general, non-specific data related to environmental impacts are used.

The delegated act must introduce a way to clearly identify what proxy data are present in the assessment and account for these. Inspiration can be drawn from the ''contingency system factor' adopted, for instance, in the RICS WLCA Standard 2023[vi] for quantities and carbon emission data. This

system applies mandatory additional contingency percentages to the assessment to inform the client about the 'uncertainties' adopted. These percentages are then aggregated into a single % figure that represents the level of uncertainty of the project data at whatever stage it is at, at material or emission level, and weight on the result.

- **On material quantities**: Early design stage assessments will attract a higher percentage contingency than an assessment done during later project stages. This is summed to a 'quantity uncertainty factor', applied based on the expected accuracy of the materials used. It is added to all modules as required. This percentage would be high when estimates or benchmark data is used, but low when actual measured material quantities are used. For instance, actual measured and delivered quantities will be fed into the assessment without contingency factor, whereas an assessment based on a benchmark (e.g., a previous similar building) would get a high contingency factor.

- The same principle applies to **emission data**. In this case, a 'carbon data contingency factor' is applied based on the quality of carbon data used for the construction products chosen for the project. As explained in a recent ECOS paper, varying levels of data quality and a lack of transparency prevail in today's market of construction products lifecycle assessments[vii]. As the lifecycle GWP assessment at building level will be at best as accurate as the data considered at product level, this aspect is of paramount importance. The main issue lays in the use of generic (or secondary) data representing industry averages, and the proportion of those to specific (or primary) data, i.e., directly accessed from the supply chain and production process.

Specific data (primary)	General data (secondary)
Direct data retrieved from production. Imply a monitoring system at production level.	Proxy data and/or averages. Easy to retrieve from inventories but may underestimate the environmental impacts.
Full score	Penalty factor

Table 0-3: Primary and secondary data

The 'carbon uncertainty factor' is added to all modules where it is relevant. The added percentage will be high when generic data is used, and low when product specific data is used. The carbon data uncertainty factor is made up of several variables such as geographical representativeness, technological representativeness, and whether the data is up to date or not[5].

This methodology can be **complemented with the disclosure of the ratio between primary and secondary data**, to clearly inform the client of the assessment on the data quality and the consequential representativeness of the assessment[viii].

[5] For further reading, please check Table 11 of the RICS standard available here: Whole_life_carbon_assessment_PS_Sept23.pdf

Set science-based targets & limit values

Limiting CO_2-equivalent emissions per project is key to support the uptake of low-carbon construction products. By setting maximum emissions limits, EU countries have the chance to provide legal clarity to the construction industry to invest in future-proof technologies and products.

Among the different options to set binding limits, **countries should not concede to upwards asks by industry and design Paris-agreement-aligned carbon budget and limits** that would support mitigation of global warming. To do so, the methodology explored in the report by Ramboll and Aalborg University can be used[ix].

EU countries should introduce in their roadmap cumulative limit values (i.e., limit values per lifecycle), optionally specify limit values per module to give clarity to the industry on calculations (e.g., limit value for upfront emissions A1-3 and limit value for operational energy use B6). **However, in any case the achievement of the total cumulative limit value should be mandatory with transparent emissions allocation at module level**. In no case the delegated act should open the door for the establishment of limit values for specific modules only, as this would go against the EPBD legal text in Art. 7(2).

Sources

i Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast) (Text with EEA relevance). Available online at: Directive - EU - 2024/1275 - EN - EUR-Lex

ii Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'). Available online at: Regulation - 2021/1119 - EN - EUR-Lex

iii For more information, please check: Home - Whole Life-Cycle greenhouse gas emission reporting for buildings

iv Nordic Sustainable Construction 2024. Overview of Nordic Climate Declarations and Limit Values Integration. Available online at: Overview of Nordic Climate Declarations and Limit Values Integration | Nordic Sustainable Construction

v Van Gulck, Lisa. Approach for Environmental Assessments of Remountable Building Elements : Navigating Reuse Uncertainties. Ghent University. Faculty of Engineering and Architecture, 2024

vi RICS 2024. Whole life carbon assessment for the built environment. Available online at: Whole_life_carbon_assessment_PS_Sept23.pdf

vii ECOS 2024. Strengthening Environmental Product Declarations. Available online at: ECOS-Strengthening-Environmental-Product-Declarations-October-2024.pdf

viii ECOS 2024. Strengthening Environmental Product Declarations. Available online at: ECOS-Strengthening-Environmental-Product-Declarations-October-2024.pdf

ix Le Den X, Steinmann J, Röck M, Birgisdottir H, Horup L H, Tozan B, Sørensen A. Towards EU embodied carbon benchmarks for buildings - Summary report, 2022, https://doi.org/10.5281/zenodo.6397514