

CARBON ACCOUNTING - ACCOUNTING OF FUTURE

Abstract

Embodied carbon accounting measures the total greenhouse gas emissions generated during the entire life cycle of a material or product or organisation — from raw material extraction and manufacturing to transport, construction, maintenance, and eventual disposal or recycling. Unlike operational carbon, which changes over time based on energy use, embodied carbon is locked in before a project or product is even used. It reveals hidden supply chain hotspots, drives immediate upfront emission cuts before a project begins, ensures regulatory compliance, and prevents greenwashing. It also helps organisation to face ESG issues effectively.

Nowadays a lot of international activities have also taken place in this field. This article talks about accounting process of embodied carbon as well as international practices to give a fair idea about the nitty-gritty of embodied carbon accounting.



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Introduction

Accounting world is changing very fast and accounting for embodied carbon is an emerging accounting modality. It measures the greenhouse gas emissions arising from the entire life cycle of a product or building or organisation, like emissions from raw material extraction, processing, manufacturing, transportation, construction, maintenance, utilisation and lastly demolition. It involves collecting relevant data and converting that information into an estimate of greenhouse gas emissions.

So far estimating greenhouse gas emissions is concerned, it involves multiplying activity data (such as fuel or electricity used) by an emission

factor (such as CO₂ released per kilowatt-hour). Total emissions are measured in carbon dioxide equivalents (CO₂e) across three scopes: (i) direct operational emissions, (ii) indirect energy purchases, and (iii) supply chain impacts for taking further important decisions.

The accounting process may be summarised in following steps –

- i. Identification of relevant activities.
- ii. Collection of quantitative data.
- iii. Application of appropriate emission factors.
- iv. Calculation of emissions.
- v. Classification and documentation.
- vi. Reporting and interpretation.
- vii. Use of information for decision-making.

However, instead of measuring only monetary values, carbon accounting measures environmental impact in terms of CO₂e. A simple calculation can be represented as:

Embodied Carbon = Quantity of Material × Embodied Carbon Emission Factor

For example, if a project uses 100 tonnes of a material with an emission factor of 1.8 tonnes CO₂e per tonne of material, then Embodied Carbon = 100 × 1.8 = 180 tonnes CO₂e

Let us see the process of Accounting in detail -

Step 1: Defining the Scope:

The first step is to determine what is being measured - a product, a building, a process, a project or the whole organisation. The boundaries should specify which stages of the life cycle are included. ISO 14040 may be helpful here in identifying goal and scope definition as a fundamental part of life-cycle assessment.

Step 2: Identifying Materials and Activities:

The organisation should identify all significant materials and activities & operations which are contributing to embodied carbon. These may include raw material, other important materials like cement / concrete / steel / aluminium / glass / bricks / timber/ paint / mineral etc, transportation, machinery, repairs and replacements, processing, demolition, waste disposal etc.

Step 3: Collecting Activity Data:

The next step is to collect information such as quantities purchased, distances transported, energy used and expected replacement cycles. Bills of quantities, purchase records, invoices, material specifications and supplier information can provide useful data in this regard.

Step 4: Applying Emission Factors:

Emission factors convert physical quantities into estimated greenhouse gas emissions. For example, the quantity of material or mineral like coal used can be multiplied by an appropriate emission factor to estimate its associated CO₂e.

Step 5: Calculating Total Embodied Carbon:

The emissions associated with different materials and activities are then calculated and added together as follows -

Total Embodied Carbon = Σ (Activity Data $\times$ Relevant Emission Factor)

The result can be expressed as total tonnes or tonne per unit of production of CO₂e.

Step 6: Analysing the Results:

The final step is to present the results clearly.

Organisations can identify which materials or activities contribute the largest share of embodied carbon which can allow management to compare alternatives and identify opportunities for carbon reduction.

GRI and Embodied Carbon

The Global Reporting Initiative (GRI) does not have a standalone topic standard explicitly named “Embodied Carbon”. Instead, embodied carbon is accounted for and disclosed as part of Value Chain (Scope 3) greenhouse gas (GHG) emissions under the overarching GRI Climate Change standards. Historically reported under GRI 305: Emissions 2016, these disclosures transition to the newly released GRI 102: Climate Change 2025 standard, which officially becomes effective on January 1, 2027. Within the GRI framework, these “cradle-to-gate” or lifecycle impacts are integrated through specific disclosures:

- A. Disclosure 102-7 recommends that organizations must report gross upstream and downstream Scope 3 emissions across 15 distinct categories. Embodied carbon typically sits in Category 1 (Purchased Goods and Services) and Category 2 (Capital Goods).
- B. Disclosure 102-8 allows companies to normalize embodied carbon data (e.g., kg-CO₂e per square meter of building area or per metric ton of product produced).
- C. Disclosure 102- 1 and 4 demand disclosure of organization-wide or project-level emissions reduction targets and transition plans, specifying how the entity intends to lower value chain carbon to align with a 1.5°C pathway.

Basically, GRI serves as a disclosure framework rather than a structural accounting methodology. To quantify embodied carbon for a GRI Standards disclosure, reporting organizations must use recognized external carbon accounting standards:

- ▲ The GHG Protocol: Specifically, the GHG Protocol Corporate Value Chain (Scope 3) Standard.
- ▲ Lifecycle Assessments (LCAs): Project

or product-level footprints evaluated via Environmental Product Declarations (EPDs) or Whole Building LCAs (WBLCA) to supply the raw data required for the Scope 3 filings.

It may also be mentioned here that the updated GRI 102 Climate Change standard has been explicitly aligned with global financial and regulatory mandates to prevent duplicate reporting. Meeting the GHG emissions disclosures under IFRS S2 (International Sustainability Standards Board) or the EU's ESRS / CSRD requirements automatically satisfies the parallel emission components within GRI. This is highly relevant as jurisdictions like the EU and select US states move toward mandating embodied carbon reporting for construction materials.

Role of Life Cycle Assessment in Carbon Accounting

Life Cycle Assessment (LCA) is one of the most important approaches used to measure environmental impacts associated with products and processes. It considers the life cycle of a product or organisation rather than focusing on a single stage. ISO 14040 provides a framework covering goal and scope definition, life-cycle inventory analysis, life-cycle impact assessment and interpretation.

Generally LCA has four major stages:

- A. Scope Definition – In this stage the purpose of the assessment and its boundaries are established.
- B. Life-Cycle inputs – Then actual data relating to materials, energy, transportation and other inputs and outputs are collected.
- C. Life-Cycle Impact Assessment – In the third stage the environmental impacts associated with the collected data are evaluated.
- D. Interpretation – Lastly the results are analysed to identify significant environmental impacts and opportunities for improvement.

Importance of Accounting for Embodied Carbon

1. Supports Climate Change Mitigation – Whole world is now a days talking about reducing

emissions and measuring emissions is the first step towards it. As CMAs we all know that the any cost cannot be effectively managed if it cannot be correctly measured.

2. Improves Decision-Making - Carbon information empowers decision-makers to compare alternative materials and processes. For example, two materials may have similar financial costs but significantly different carbon footprints. Carbon accounting makes this difference visible to enable the management in taking right and just decision.
3. Encourages Sustainable Construction - In construction industry, embodied carbon accounting can encourage the use of recycled materials, low-carbon concrete, responsibly sourced timber, efficient transportation and material reuse.
4. Helps Investors – Modern and aware investors increasingly consider environmental, social and governance (ESG) factors when evaluating organisations for investment.
5. Assist Stakeholders- Reliable carbon information can help stakeholders understand environmental risks and sustainability performance.
6. Supports Net-Zero Objectives – Government of India is emphasising on Net-Zero and this accounting can help in this direction.

Bottlenecks in accounting for embodied carbon

- a. Lack of Reliable Data - Accurate calculation requires detailed and correct data about input materials and production processes which is the basic bottleneck.
- b. Different Calculation Methods - Different standards, databases and assessment methodologies may produce different results. Consistency is therefore important for meaningful comparison. I expect an account standard (CAS) from our ICAI on this topic soon.
- c. Complex processes - Modern products often involve raw materials and complex manufacturing processes and therefore tracking emissions throughout the supply

chain can be difficult.

- d. Cost involved - Detailed carbon assessments require specialised knowledge, software and data, which may result in increase in cost. Many organisations may find it difficult to allocate sufficient resources.

Future of Embodied Carbon Accounting

The importance of embodied carbon accounting is expected to increase as governments, businesses, investors and consumers demand greater environmental transparency. ESG reporting has become an important part of integrated reporting. In the future, organisations may increasingly integrate carbon information into budgeting, procurement, project appraisal, risk management and sustainability reporting. The Institute of Cost Accountants of India may issue accounting standard (CAS) to help industries in the accounting.

The process of embodied carbon accounting can help organisations identify high-emission materials and activities, compare alternatives, improve procurement decisions and develop strategies for reducing emissions.

International Practice

- EU European Performance of Buildings Directive (EPBD) mandates reporting of whole-life carbon (WLC) for large buildings from 2028 and eventually expanding to all buildings from 2030.
- EU Carbon Border Adjustment Mechanism (CBAM) charges tariffs on embedded emissions of imported carbon-intensive goods (steel, cement, aluminum, etc.) to prevent carbon leakage. Reporting of same started from 2023.
- The UNFCCC tracked emissions on a production basis (emissions released within physical national borders). However, because international trade accounts for roughly 22% to 25% of global CO₂ emissions via embodied carbon in traded goods, modern practice is steering towards consumption-based accounting. This shift holds importing nations accountable for their “carbon loophole” and encourages greener global procurement strategies. **MA**

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