HEAT

ASIA LOW CARBON BUILDINGS TRANSITION PROJECT
Life Cycle Assessment for Transitioning to a Low-Carbon Economy

Managing Embodied Carbon in the Building and Construction Sector in Cambodia

Discussion on Policy Options

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GGGI

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ASIA LOW CARBON BUILDINGS TRANSITION PROJECT

Life Cycle Assessment for Transitioning to a Low-Carbon Economy

Global Green Growth Institute
Jeongdong Building 19F
21-15 Jeongdong-gil
Jung-gu, Seoul 04518
Republic of Korea

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Acronyms and Abbreviations

ALCBT	Asia Low Carbon Buildings Transition
BREEAM	Building Research Establishment Environmental Assessment Method
C&D	Construction & Demolition
EDGE	Excellence in Design for Greater Efficiencies
EPDs	Environmental Product Declarations
EPR	Extended Producer Responsibility
EU	European Union
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GPP	Green Public Procurement
GRIHA	Green Rating for Integrated Habitat Assessment of India
GWP	Global Warming Potential
LCA	Lifecycle Assessment
LCB	Low carbon buildings
LEED	Leadership in Energy and Environmental Design
MRV	Monitoring, Reporting and Verifying
MLMUPC	Ministry of Land Management, Urban Planning and Construction
PCRs	Product Category Rules
PEFC	Programme for the Endorsement of Forest Certification
UNDP	United Nations Development Programme
WBLCA	Whole Building Life Cycle Assessment

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Authors:

1. Ngovveng Chheng, National MRV and Building LCA Expert (Cambodia), HEAT GmbH
2. Rohit Nepali, Project Manager, Climate Change Analyst, HEAT GmbH
3. César Jiménez, Project Manager, Senior Consultant Climate, HEAT GmbH

Reviewers:

1. Dietram Oppelt, Managing Director, HEAT GmbH
2. Nathalie Andre, Country Representative, GGGI Cambodia
3. Julie Robles, Project Manager, Asia Low Carbon Buildings Transition (ALCBT), GGGI
4. Md. Mahfuzur Rahman, Senior Officer- Sustainable Energy, GGGI Cambodia
5. Nera Mariz Puyo, Sr. Associate- Knowledge Management, GGGI
6. Vuthy Va, Officer- Sustainable Energy, GGGI Cambodia
7. Chan Oussa Suong, Associate- Sustainable Energy, GGGI Cambodia

Executive Summary

This report, prepared under the **Asia Low Carbon Buildings Transition (ALCBT) Project**, presents recommended policy options for managing **embodied carbon** in Cambodia's rapidly expanding building and construction sector. Embodied carbon is the total greenhouse gas (GHG) emissions associated with the extraction, manufacturing, transportation, installation, and disposal of construction materials. Amid accelerated urbanization and infrastructure growth, managing embodied carbon is both an **environmental necessity and an economic opportunity** for Cambodia. According to a recent GGGI report[1], the building and construction sector contributed roughly **30% of Cambodia's energy-related emissions in 2022**, with material-related emissions playing an increasing role in the country's overall climate footprint as the expansion of building floor area drives rising demand for cement, steel, and other carbon-intensive materials.

Cambodia has begun laying the groundwork for embodied-carbon management, with European Norm (EN) 15804-compliant Environmental Product Declarations (EPDs) for cement and clinker providing a local evidence base for piloting low-carbon material standards and green procurement — signaling a growing commitment to data-driven, low-carbon development.

Globally, embodied carbon from residential and commercial buildings accounts for **about 7% of annual GHG emissions[2]**. For Cambodia, where construction depends heavily on imported, carbon-intensive materials such as cement and steel, the systematic reduction of embodied carbon can enhance **competitiveness, attract green investment, reduce costs over the life cycle of buildings**, and improve climate resilience. Early action is also critical for maintaining **export-market readiness**, particularly in light of the European Union's (EU) Carbon Border Adjustment Mechanism (CBAM) and other emerging sustainability standards.

International experience[3] shows that embodied-carbon reductions of 20–40% in concrete and steel are achievable through EPD-based specifications and Global Warming Potential (GWP) limits, often at less than a 1% increase in cost — demonstrating that Cambodia can set ambitious low-carbon targets without significant cost impacts.

[1] Global Green Growth Institute (GGGI). *Pathway to Low-Carbon Buildings in Cambodia: Policy Landscape, Institutional Frameworks, and Entry Points. Asia Low Carbon Buildings Transition (ALCBT) Project*, September 2025. https://alcbt.gggi.org/pathway-to-low-carbon-buildings-in-cambodia-policy-landscape-institutional-frameworks-and-entry-points/
[2] Energy Transitions Commission. *Achieving Zero-Carbon Buildings: Electric, Efficient and Flexible*. Report. February 2025. https://www.energy-transitions.org/publications/achieving-zero-carbon-buildings/
[3] Ibid.

Analysis of Challenges and Opportunities

Despite the clear rationale, Cambodia faces specific barriers that limit the adoption of low-carbon construction practices:

1. **Lack of data and transparency:** Reliable local datasets and certified **EPDs** remain scarce. Only one major producer, Chip Mong Cement, currently has an internationally verified EPD. The absence of standardized **Product Category Rules (PCRs)** and a national carbon-footprint database hampers benchmarking and policy design.
2. **High initial costs:** Low-carbon materials often entail higher upfront costs compared to conventional, carbon-intensive options. In Cambodia's price-sensitive market, this cost differential discourages builders and developers from investing in sustainable alternatives without clear regulatory or financial incentives.
3. **Evolving policy framework:** Cambodia's building and energy codes, as well as the Cambodia Sustainable Finance Taxonomy, are under development, while embodied-carbon considerations remain at an early stage. Enforcement and inter-agency coordination require strengthening.
4. **Skills and capacity gaps:** Limited expertise in **life-cycle assessment (LCA)**, carbon accounting, and green construction slows policy implementation and industry adoption.

Opportunities and Entry Points:

1. Cambodia can leverage international best practices and regional partnerships to integrate embodied-carbon management into its regulatory and market systems.
2. Early adoption of green building codes, material standards, and procurement policies will position Cambodia as a competitive player in sustainable construction.

Effectively addressing the challenges and connecting them with emerging opportunities will require a suite of targeted, synergistic policy interventions that lay a strong foundation in the short term, integrate new practices in the medium term, and transform the market in the long term.

Policy Options and Recommendations

The following policy options are proposed to help Cambodia progressively integrate embodied-carbon considerations across the building and construction value chain:

1. **National Building Code and Standards**:
    - Establish green building code incorporating embodied carbon considerations, drawing from frameworks like LEED (Leadership in Energy and Environmental Design), EDGE (Excellence in Design for Greater Efficiencies), and BREEAM (Building Research Establishment Environmental Assessment Method).
    - Establish minimum performance requirements for high-impact construction materials (cement, steel, insulation).

2. **Material Specifications and Measurement**:
    - Implement material specifications that promote locally sourced, low-carbon alternatives when available, and establish a material-tracking system.
    - Mandate Life-Cycle Assessments (LCAs) for major projects and require Environment Product Declarations (EPDs) for construction materials.
    - Develop national digital tools and **carbon benchmarking databases** to support data-driven design such as using building emission assessment tool (BEAT)[4] which is publicly available at no cost.
3. **Public Procurement and Fiscal Policies**:
    - Implement Green Public Procurement (GPP) to prioritize low-carbon materials in publicly funded projects.
    - Apply fiscal instruments—tax reductions, targeted subsidies, or credit guarantees—to encourage market adoption.
4. **Workforce Development and Training**:
    - Promote and update BEAT[5] and LCB training program[6] which include **LCA and embodied-carbon modules** for engineers, architects, and policymakers.
    - Establish accredited national training and certification programs.
5. **Circular-Economy and Waste Regulation:**
    - Implement Construction & Demolition (C&D) waste-management policies to promote recycling, reuse, and material recovery.
    - Apply Extended Producer Responsibility (EPR) to hold manufacturers accountable for the lifecycle carbon impact of their products.

A set of policy instruments (Table 1) is identified as a priority for Cambodia to consider as a way forward. By introducing these instruments, Cambodia can enhance its economic competitiveness, attract investments, improve climate resilience, and support sustainable urban development. Stronger policies, capacity-building efforts, and market incentives can accelerate the transition to low-carbon construction.

[4] HEAT GmbH and Global Green Growth Institute (GGGI). *BEAT: Building Emission Assessment Tool*. Asia Low Carbon Buildings Transition (ALCBT) Project. https://beat-alcbt.gggi.org/.
[5] Ibid.
[6] Global Green Growth Institute (GGGI). *LCB Training Modules*. Asia Low Carbon Buildings Transition (ALCBT) Project. https://alcbt.gggi.org/lcb-training-modules/

Table 1. Recommended phased policy approach to transition to low-carbon construction

Policy Instrument	Short-term (1–3 years) – Foundation	Medium-term (3–7 years) – Integration	Long-term (7 + years) – Transformation
Data, EPDs & PCRs	Initiate national database; pilot EPDs	Expand sector coverage	Mandatory disclosure for major materials
Building Codes	Draft voluntary green-building guidance	Integrate embodied-carbon limits	Enforce mandatory national code
Economic Instruments	Assess fiscal options	Launch tax and subsidy pilots	Implement mature carbon-pricing or CBAM-aligned incentives
GPP	Introduce pilot tenders	Scale across ministries	Full integration into procurement law
Capacity & Training	Promote and update BEAT/LCB modules	Institutionalize in universities	Continuous professional certification
C&D / Circularity	Design C&D guidelines	Implement EPR pilots	National waste-loop regulation

Together, these phased policy instruments create a coherent transition pathway: ***short-term*** pilots build data, capacity, and confidence; ***medium-term*** measures mainstream embodied-carbon practices across institutions and markets; and ***long-term*** regulations and incentives lock in a low-carbon construction system.

Conclusion

By advancing this phased policy package, Cambodia can **reduce the carbon footprint of its construction sector, attract investment, and position itself as a regional leader in sustainable building**. Integrating embodied-carbon policy within the **Nationally Determined Contributions (NDCs) and Long-Term Low Emission Development Strategies (LEDS) frameworks**, supported by training, data infrastructure, and fiscal incentives—would help align national practices with internationally recognized standards, notably EN 15804 for product-level data (EPDs) and EN 15978 for whole-building life-cycle assessment. Such alignment would enhance transparency, comparability, and future market readiness, while providing a robust foundation for Cambodia's long-term net-zero transition.

1. Introduction

1.1 About the ALCBT project

The Asia Low Carbon Buildings Transition (ALCBT) Project is a five-year, multi-stakeholder initiative that seeks to reduce GHG emissions by catalyzing a nationwide transition towards low-carbon buildings (LCBs) in five Asian countries: Cambodia, India, Indonesia, Thailand, and Vietnam. Funded by the German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN) through the International Climate Initiative (IKI), the project is implemented by the Global Green Growth Institute (GGGI) in partnership with the ASEAN Center for Energy (ACE), Energy Efficiency Services Limited (EESL), and HEAT GmbH[7]. In Cambodia, the Ministry of Land Management, Urban Planning, and Construction (MLMUPC) is the government counterpart for project implementation. Project interventions address regulatory, capacity, and financing gaps that hinder large-scale adoption of LCBs and establish technically defined GHG emission-reduction targets for building materials and operations, particularly cooling.

1.2 Objectives of this Report

This report, accompanied by brief case studies, serves as a discussion paper to inform local policymakers in Cambodia's building and construction sectors on managing embodied carbon, with the aim of supporting sustainability goals amid rapid urbanization and infrastructure growth. It invites feedback from both policymakers and practitioners to support consultation, foster consensus, and promote the embodied carbon agenda within the sector.

[7] HEAT GmbH. *Asia Low Carbon Buildings Transition (ALCBT)*. https://www.heat-international.de/project/asia-low-carbon-buildings-transition-alcbt/

2. Rationale for Managing Embodied Carbon

2.1 What is Embodied Carbon?

There is no internationally accepted definition of embodied carbon (see below Table 2 and Figure 1), despite its significance in the built environment. However, the common characteristics of embodied carbon can be summarized as follows:

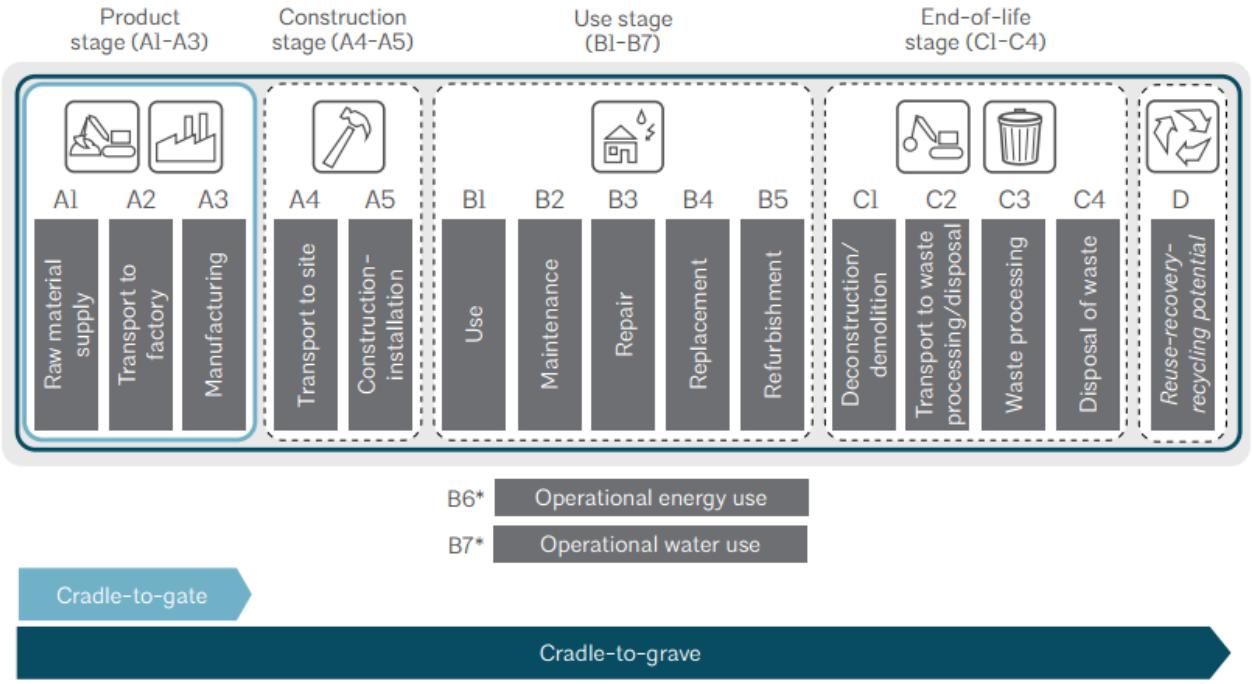
- ***Life-cycle-based*** – Covers emissions from raw material extraction through end-of-life disposal.
- ***Material-specific*** – Linked to the carbon footprint of construction materials (e.g., concrete, steel, and wood).
- ***Non-operational*** – Excludes emissions from building use (e.g., heating, cooling, and electricity).
- ***Supply chain impact*** – Includes emissions from manufacturing, transportation, and on-site construction.
- ***End-of-life consideration*** – Accounts for the impacts of demolition, recycling, and disposal.
- ***Cumulative effect*** – Represents emissions locked into a building from the outset, unlike operational emissions, which can be reduced over time.
- ***Reduction potential*** – Can be minimized through material choices, reuse, and circular economy strategies.

Table 2: Various definitions of embodied carbon

Entities	Definition of Embodied Carbon
Intergovernmental Panel on Climate Change (IPCC)	Embodied carbon includes emissions from raw material extraction, manufacturing, transportation, construction, and demolition of buildings or infrastructure
ISO (International Organization for Standardization) 14067	Defines embodied carbon as the sum of GHG emissions over the life cycle stages of a product, excluding operational emissions.
EN 15978	Embodied carbon refers to life-cycle GHG emissions from the sourcing of building materials through end-of-life disposal, categorized into stages: • A1–A3: Product (raw materials, transport, manufacturing) • A4–A5: Construction (transport, installation) • B1–B7: Use (maintenance, repair, replacement)

	• C1–C4: End-of-life (demolition, disposal)
World Green Building Council (WGBC)	Embodied carbon includes emissions from the entire supply chain of a building's materials, from extraction to disposal, emphasizing the need for reduction through circular economy principles.
Carbon Leadership Forum (CLF)	Defines embodied carbon as the CO_2-equivalent emissions of materials and construction processes before a building becomes operational.

Figure 1. Life cycle stages for building products (EN 15978:2011 and ISO 21930:2017).



Source: (Carbon Leadership Forum, 2023b)

2.2 Why Managing Embodied Carbon Matters?

The global floor area is expected to grow by approximately 50% by 2050[8]. Building construction at the current embodied carbon intensity could lead to around 75 $GtCO_2$ in cumulative emissions from now until 2050[9]. There is less emphasis on embodied carbon in policy and industry compared to operational emissions. Embodied carbon from residential and commercial buildings contributes 2.6 $GtCO_2$ annually, or 7% of global emissions, linked to the annual addition of approximately 5 billion m^2 of new building stock. Another 6% of yearly emissions also come from embodied carbon in new infrastructure, such as roads, bridges, railways, industrial facilities, ports, and pipelines. These emissions predominantly result from

[8] International Energy Agency (IEA), *World Energy Outlook 2019*. https://www.iea.org/reports/world-energy-outlook-2019
[9] Energy Transitions Commission. Achieving Zero-Carbon Buildings: Electric, Efficient and Flexible. London: Energy Transitions Commission, 2025. https://www.energy-transitions.org/publications/achieving-zero-carbon-buildings/

the production of materials, with 95% originating from the manufacture of iron and steel and of cement and concrete.

However, implementing feasible actions to decarbonize the production of cement/concrete, steel, and other building materials could reduce these emissions to approximately 40 $GtCO_2$. Further reductions to about 30 $GtCO_2$ could be achieved through improvements in building design and construction techniques, as well as the elimination of unnecessary overbuilding[10]. Key rationales for managing embodied carbon include the following:

1. ***Cost savings and value creation*** – Efficient material use and low-carbon alternatives can reduce construction costs and enhance asset value in a carbon-conscious market.
2. ***Material efficiency and circular economy*** – Reducing embodied carbon promotes sustainable material use, recycling, and waste minimization, thereby lowering resource depletion.
3. ***Regulatory and policy compliance*** – Many governments and green building standards (e.g., LEED, BREEAM, EU Taxonomy) are setting stricter requirements for embodied carbon reduction.
4. ***Climate change mitigation*** – Embodied carbon accounts for a significant share of global CO_2 emissions, making its reduction crucial for achieving net-zero targets.
5. ***Long-term carbon lock-in*** – Unlike operational carbon, embodied carbon is emitted before a building is even used, locking in emissions that cannot be reversed.
6. ***Resilience and future-proofing*** – Managing embodied carbon prepares buildings for future carbon pricing, regulations, and stakeholder expectations.
7. ***Holistic sustainability approach*** – Addressing both embodied and operational carbon ensures a comprehensive reduction in a building's total environmental impact.

2.3 Rationale for Cambodia to Manage Embodied Carbon

In developing countries such as Cambodia, managing embodied carbon in the building and construction sector represents both an environmental necessity and an economic opportunity. Rapid urbanization and infrastructure expansion require cost-effective and resource-efficient solutions to ensure long-term sustainability. Given the country's reliance on imported materials, rising construction costs, and tightening global climate regulations, reducing embodied carbon can enhance economic competitiveness, attract investment, and strengthen resilience. Additionally, as Cambodia expands its exports of construction materials, effective embodied carbon management will be critical to maintaining market access and meeting international sustainability standards.

[10] Ibid.

Economic and Financial Rationales

1. ***Cost savings and energy efficiency*** – Importing high-carbon materials such as cement and steel can be costly. Construction projects can achieve significant cost savings and improve energy efficiency by using locally sourced, low-carbon alternatives. Several case studies demonstrate that optimizing material mixes, specifications, and procurement processes can achieve 19–46% reductions in embodied carbon with less than 1% increase in project cost, even before considering advanced or alternative materials. [11]

2. ***Investment and market competitiveness*** – Global investors increasingly prioritize sustainable projects. Alignment with green building standards (e.g., EDGE, LEED) can enhance Cambodia's access to climate finance, green bonds, and international markets.

3. ***Export market readiness under carbon regulations*** – As Cambodia seeks to expand exports of construction materials (e.g., cement, steel, bricks), managing embodied carbon ensures compliance with international sustainability standards. With the EU and UK moving toward stricter carbon regulations, including CBAM, it is increasingly crucial for Cambodia's export sectors to adopt sustainable practices to maintain market access and global competitiveness.

4. ***Job creation and industry growth*** – The shift to low-carbon construction promotes innovation, supports local industries (e.g., locally sourced, sustainable materials manufacturing), and creates new jobs in green building.

Environmental and Social Rationales

1. ***Resource efficiency and sustainable material use*** – Cambodia's construction sector relies heavily on energy-intensive, imported materials. Promoting sustainable, locally sourced options (e.g., bamboo, compressed earth bricks) reduces emissions and enhances material security.

2. ***Compliance with local regulations*** - Although Cambodia does not have specific regulations and policies on embodied carbon, other relevant regulations may still be applicable, including the Environmental and Natural Resources Code and the National Energy Efficiency Policy (NEEP).

3. ***Climate resilience and disaster preparedness*** – As Cambodia faces climate-related risks (e.g., extreme weather, flooding), the use of low-carbon, climate-resilient materials can enhance infrastructure durability and reduce long-term environmental degradation.

4. ***Air quality and public health benefits*** – Reducing embodied carbon lowers emissions from cement production and material transport, improving air quality and public health, particularly in urban areas.

[11] Rocky Mountain Institute (RMI), *Low-Cost, High-Value Opportunities to Reduce Embodied Carbon in Buildings*, 2021, https://rmi.org/low-cost-high-value-opportunities-to-reduce-embodied-carbon-in-buildings

5. ***Sustainable urban development*** – Managing embodied carbon ensures that new infrastructure and housing are built with minimal environmental impact, reducing Cambodia's overall carbon footprint amid rapid urbanization.

2.4 Cambodia's Challenges in Embodied Carbon Management

While managing embodied carbon is essential for sustainable development, Cambodia, like many countries, faces several challenges in implementing effective carbon reduction strategies. These barriers stem from economic, institutional, technical, and capacity constraints that limit the construction sector's transition to lower-carbon materials and practices.

1. ***Lack of data: Scarcity of local EPDs and carbon footprint databases –*** A major challenge is the limited availability of reliable local data on material emissions. EPDs, PCRs, and carbon footprint databases are essential for assessing the impacts of different building materials. PCRs establish a standardized methodology for developing EPDs, ensuring consistency and comparability across materials. However, as of 2024, Cambodia has only two EN 15804I-compliant EPDs for cement and clinker and lacks a national EPD registry[12], which constrains informed decision-making by developers, policymakers, and manufacturers. In addition, limited awareness among local manufacturers of embodied carbon concepts and the importance of product-level carbon data for their businesses, partially due to cost barriers, weakens the overall demand–supply feedback loop for low-carbon materials. Without standardized carbon accounting, comparing materials and setting reduction targets remains challenging, hindering the adoption of low carbon practices. According to a survey[13] of 15 EPD certification operators, creating an EPD would cost around USD 13,000–41,000.

2. ***High initial costs*** - Although low-carbon materials can offer long-term benefits, their upfront costs are often higher than conventional alternatives, like cement and steel, due to limited domestic production, lack of economies of scale, and higher import costs. In Cambodia's price-sensitive market, where construction projects often prioritize cost over sustainability, builders and developers may be reluctant to invest in low-carbon options without financial incentives or regulatory requirements.

3. ***Limited policy enforcement*** - While Cambodia has introduced building guidelines and environmental regulations, enforcement remains weak. The ongoing development of key policies such as national Green Building Scheme and Building Energy Efficiency Design Guidelines, presents a critical opportunity to institutionalize the management of embodied and operational carbon within the sector.

4. ***Limited institutional capacity*** - Fragmented mandates across ministries, limited technical staffing, and resource constraints hinder effective implementation. Weak monitoring

[12] Siam City Cement Public Company Limited. *Environmental Product Declarations for Clinker and Camel Green Cement Produced in Cambodia* (EPD-IES-0011570:001; EPD-IES-0011571:001). International EPD System. https://www.environdec.com/library/epd11570; https://www.environdec.com/library/epd11571.
[13] Tomohiro Tasaki *et al*., "International Survey of the Costs of Assessment for Environmental Product Declarations," *Procedia CIRP* 61 (2017): 727–31, https://doi.org/10.1016/j.procir.2016.11.158.

and enforcement mechanisms make it difficult to track compliance, resulting in slow adoption of sustainable practices and continued reliance on carbon-intensive materials. With few dedicated units and heavy reliance on donor-driven projects, institutional ownership remains limited, slowing the shift toward low-carbon construction.

5. ***Skills and capacity gaps: Need for training in LCA methodologies*** – LCA is a key tool for measuring embodied carbon, yet Cambodia lacks sufficient expertise. There is a shortage of trained professionals, including engineers, architects, and policymakers, capable of assessing embodied carbon and integrating LCA into decision-making processes. Universities and vocational training institutions offer limited courses on sustainable construction and LCA, resulting in a persistent skills gap in the industry. Without targeted capacity-building and formal training programs, the transition to a low-carbon construction sector is likely to remain slow and challenging.

2.5 Entry points for Cambodia to Manage Embodied Carbon

Despite the challenges, effective management of embodied carbon presents significant opportunities for Cambodia, including enhanced economic competitiveness, increased investment, improved climate resilience, and more sustainable urban development. The ALCBT report, *Pathway to Low Carbon Buildings in Cambodia: Policy Landscape*, *Institutional Frameworks*, *and Entry Points* [14], provides a detailed stocktake of the current policy and institutional landscape and identifies strategic entry points for policymakers and stakeholders to address carbon emissions in the building and construction sectors. The following sections of this report focus on the policy entry points and implementation pathways for managing embodied carbon in Cambodia's building and construction sectors.

[14] GGGI. Pathway to Low-Carbon Buildings in Cambodia: Policy Landscape, Institutional Frameworks, and Entry Points. ALCBT Project, September 2025. https://alcbt.gggi.org/pathway-to-low-carbon-buildings-in-cambodia-policy-landscape-institutional-frameworks-and-entry-points/

3. Policy Options for Managing Embodied Carbon in Cambodia

3.1 National Building Code and Standards

Developing a coherent regulatory framework would allow Cambodia to guide its rapidly growing construction sector toward low-carbon pathways while aligning with regional and international good practice. Cambodia can benefit from developing a national building code that integrates embodied carbon considerations from the outset. Establishing clear, practical guidelines on low-carbon materials, energy efficiency, and lifecycle assessments would help ensure that rapid urbanization translates into sustainable and climate-resilient growth. The following proposed policy options provide a roadmap for incorporating embodied carbon to Cambodia's building and construction regulations. Further details on Cambodia's policy landscape, institutional frameworks, existing gaps, and actionable policy tools for low-carbon buildings, can be found in the GGGI report *Pathway to Low Carbon Buildings in Cambodia: Policy Landscape, Institutional Frameworks, and Entry Points*[15].

3.1.1 Establish Green Building Code with Embodied Carbon Considerations

This policy option builds on evidence from GGGI scenario analysis, which shows that integrating operational efficiency measures and embodied carbon considerations into green building codes is an effective next step once basic energy codes are under development. Many countries have introduced green building codes that require or incentivize embodied carbon reductions, such as Singapore (see Box 1).

Considering ongoing government processes related to the building energy code and the potential inclusion of green-building elements by the National Council for Building Technical Regulations (NCBTR), Cambodia would be well positioned to develop its own green building code aligned with the emerging National Buildings Taxonomy. Drawing on international frameworks such as LEED, EDGE, BREEAM, and Malaysia's Green Building Index, this code could define performance benchmarks for embodied carbon, provide targeted incentives for low-carbon materials, and introduce lifecycle assessments for large public projects, thereby creating a coherent framework that links policy, classification, and performance standards across the construction sector.

[15] Ibid.

Box 1. Singapore's Green Building Regulation

Singapore has integrated embodied carbon management into its construction sector through progressive regulations under the *Green Mark Certification Scheme*[16], developed by the Building and Construction Authority (BCA). The scheme sets carbon-intensity benchmarks for materials and requires LCAs for large-scale developments across both public and private sectors. Large-scale developments, typically projects with a gross floor area exceeding 50,000 square meters and substantial material consumption, include major commercial complexes, industrial facilities, and large residential or mixed-use developments, all of which are required to conduct comprehensive LCAs to evaluate and manage embodied carbon.

In 2021, Singapore introduced the *Built Environment Sustainability Roadmap*, which aims to reduce embodied carbon by 20% by 2030 through stricter building codes, mandatory carbon reporting, and incentives for sustainable construction materials. These regulations encourage developers to use low-carbon concrete, prefabricated materials, and recycled steel, significantly lowering the carbon footprint of new buildings (Building and Construction Authority, 2024).

Additionally, Singapore's public procurement policies prioritize sustainability by requiring government-funded projects to adhere to low-carbon construction standards. The city-state also supports the adoption of mass-engineered timber (MET), which has been used in high-rise developments like the Nanyang Technical University (NTU) Academic Building South, cutting embodied carbon by up to 40% compared to conventional materials. Financial incentives, including grants for green buildings and tax rebates for sustainable materials, further accelerate the transition to a low-carbon built environment, positioning Singapore a regional leader in embodied carbon reduction.

3.1.2 Introduce Minimum Performance Requirements & Low-Carbon Material Standards

Introducing minimum performance requirements for high-impact materials such as cement, steel, and insulation would allow Cambodia to progressively manage embodied carbon while fostering local innovation. GGGI modelling highlights that cement and steel demand will increase significantly under all development scenarios, making material efficiency and emissions intensity critical leverage points. This recommendation also reflects findings from the ALCBT Project, which identify the lack of standardized performance benchmarks for high-impact construction materials as a key gap in Cambodia.

Phasing in low-carbon material standards could encourage manufacturers to adopt cleaner production methods and stimulate domestic markets for sustainable materials. Establishing minimum performance requirements for energy efficiency and low-carbon material standards

[16] Building and Construction Authority (BCA). "Green Mark Certification Scheme." *BuildSG*. https://www1.bca.gov.sg/buildsg/sustainability/green-mark-certification-scheme

will encourage the production and use of low-carbon cement (e.g., blended cement), recycled steel, and locally sourced sustainable materials like bamboo or compressed earth bricks. These standards could be introduced gradually, allowing industries sufficient time to adapt while incentivizing innovation and investment. Box 2 provides a case from Japan, where low-carbon materials are regulated and incentivized through performance-based material standards.

Box 2. Japan's Top Runner Program and Low-Carbon Material Standards

Japan has been a leader in energy efficiency and low-carbon material regulation, integrating stringent performance standards to reduce embodied carbon in the construction sector. The *Top Runner Program*[17], initially designed to improve energy efficiency in appliances, has been expanded to include building materials such as insulation, windows, and roofing materials. This approach ensures that materials used in construction meet high energy-efficiency benchmarks, thereby reducing both operational and embodied carbon emissions. Additionally, Japan promotes the use of low-carbon cement and recycled steel by setting strict GHG emission limits for manufacturers and offering financial incentives to encourage the adoption of sustainable practices (IEA, 2024).

To further reduce embodied carbon, *Japan's Act on the Promotion of Low-Carbon Cities* encourages municipalities to implement green construction standards that prioritize local, sustainable materials such as engineered timber and low-carbon concrete. The government also provides subsidies and tax incentives for builders using certified low-carbon materials. As a result, major urban projects, including Tokyo's Olympic venues, incorporated recycled wood, sustainable concrete, and energy-efficient insulation, demonstrating how regulatory measures can drive large-scale reductions in embodied carbon while fostering sustainable urban development.

3.2 Specifications for Materials and Better Measurement of Embodied Carbon

3.2.1 Specifications for Materials

This recommendation is informed by ALCBT analysis, which identifies the limited availability of standardized material specifications and lifecycle data as a major barrier to low-carbon construction in Cambodia. GGGI scenario analysis further underscores the importance of material-level interventions to address emissions growth linked to rapid expansion of building floor area. Cambodia can benefit from gradually implementing material specifications that promote low-carbon alternatives. Close cooperation between the Ministry of Land Management, Urban Planning, and Construction (MLMUPC) and Ministry of Industry, Science, Technology and Innovation (MISTI) could help define and enforce standards for carbon-intensive materials, ensuring consistency across the supply chain. Establishing a material-

[17] International Energy Agency (IEA). "Top Runner Programme." *Policies Database*. https://www.iea.org/policies/1945-top-runner-programme

tracking system and promoting material passports would enhance transparency, recyclability, and circularity in construction. Mandatory reporting on material lifecycles for large and mega construction projects could further incentivize circular economic practices, reducing demand for virgin resources and lowering emissions from extraction and production. Box 3 shows how an EPD policy has been introduced in South Korea, with a particular focus on concrete.

Key material specifications include:

- **Mandating Environmental Product Declarations (EPDs)** for key construction materials (e.g., cement, steel, and insulation) to improve transparency of carbon footprints and enable informed material selection.
- **Setting Global Warming Potential (GWP) limits** for high-impact materials to ensure that developers prioritize lower-carbon options in project design.
- **Encouraging performance-based concrete specifications**, allowing the use of supplementary cementitious materials (SCMs) like fly ash and slag, thereby reducing reliance on Portland cement.
- **Requiring sustainable wood certification**, such as Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC), in public and private projects to promote responsible forestry.
- **Incorporating carbon considerations into bidding and procurement** processes by evaluating both cost and carbon intensity, incentivizing contractors to select low-carbon materials and suppliers.

Cambodia could explore adopting the *Model Embodied Carbon Specifications* approach to enhance transparency, standardize practice, and drive sustainability while reducing development costs in the construction sector. Such an approach would be most effective if developed through consultation with manufacturers, builders, and design professionals to ensure practicality and industry buy-in. By mandating the use of EPDs and strictly enforcing GWP limits for construction materials, this framework would help Cambodian developers and manufacturers reduce the carbon footprint of building projects. Integrating such specifications would align Cambodia with international best practices, improve market competitiveness, and support compliance with evolving global regulatory requirements—thereby fostering a more sustainable built environment and enabling green economic growth through innovation.

Box 4 shows a case from the Washington State Department of Commerce, where a model embodied carbon specifications approach covers products including structural concrete, reinforcing steel products, structural steel, and wood products, and applies to the construction of new state buildings over 9,300 sqm (phasing down to 4,650 sqm in 2027). RMI's report[18] highlights that material specification and substitution are among the most cost-effective strategies for reducing embodied carbon. Case studies show 19–46% emission reductions achievable at less than 1% additional cost by choosing lower-carbon materials during design

[18] Matt Jungclaus, Rebecca Esau, Victor Olgyay, and Audrey Rempher, *Reducing Embodied Carbon in Buildings: Low-Cost, High-Value Opportunities* (Basalt, CO: Rocky Mountain Institute [RMI], July 2021). https://www.rmi.org/download/29005/

and specification. The report also notes that adopting a whole-building design approach can unlock even greater reductions across the construction process.

Box *3.* South Korea's Environmental Product Declaration Policy

South Korea has successfully integrated EPDs and GWP limits into public procurement policies, driving demand for low-carbon materials. The *Korean Green Standard for Energy and Environmental Design* (G-SEED)[19] requires EPD-certified materials for government-funded projects (Korea Institute of Civil Engineering and Building Technology, 2024). Additionally, South Korea's *Mandatory Low-Carbon Procurement Policy*, part of the broader Carbon Neutrality Vision and Strategy for Industry and Energy, prioritizes suppliers with verified carbon-reduction strategies, influencing the entire construction supply chain (South Korea Ministry of Environment, 2021).

To optimize concrete use, the *Korean Ministry of Land, Infrastructure, and Transport* has implemented performance-based concrete specifications that allow reduced cement content and extended cure times to improve durability while lowering emissions. Cambodia could adopt a similar approach by introducing GWP thresholds in procurement, supporting local material innovation, and promoting performance-based concrete standards.

Box *4.* Model Embodied Carbon Specifications Approach

The *Model Embodied Carbon Specifications*[20], developed by the Washington Department of Commerce in collaboration with the Carbon Leadership Forum, establish clear project requirements for the integrating EPDs and enforcing GWP limits for key construction materials (Carbon Leadership Forum, 2023a). These specifications support compliance with the Washington Buy Clean and Buy Fair (BCBF WA) legislation by ensuring that both public and private construction projects meet rigorous environmental standards. Initially, the specifications apply to large-scale public building projects exceeding 100,000 square feet, with phased thresholds that will eventually lower to 50,000 square feet by 2027, thereby driving the market toward more sustainable material choices and lower embodied carbon.

Under these specifications, products such as ready-mix concrete, shotcrete, reinforcing steel, and post-tensioning steel are rigorously evaluated for their embodied carbon content, with strict GWP limits imposed to reduce overall emissions. The mandatory submission of EPDs ensures transparency in the carbon accounting process and facilitates a data-driven approach to material selection. This framework not only helps construction teams and developers make informed, low-carbon decisions but also incentivizes local

[19] G-SEED Secretariat. "녹색건축인증 [Green Standard for Energy and Environmental Design]." http://www.gseed.or.kr/

[20] Carbon Leadership Forum, *Model Embodied Carbon Specifications*, January 2025. https://carbonleadershipforum.org/model-embodied-carbon-specifications/#:~:text=The%20Model%20Embodied%20Carbon%20Specifications%20incorporate%20project%20requirements,global%20warming%20potential%20%28GWP%29%20limits%20for%20construction%20products.

manufacturers to adopt greener production practices, ultimately contributing to a more sustainable built environment in Washington state.

3.2.2 Better Measurement of Embodied Carbon and Lifecycle Emissions

To effectively manage embodied carbon, the Cambodian government could implement three complementary policy measures:

1. mandating LCA for major projects,
2. requiring EPDs supported by PCRs for construction materials, and
3. developing digital tools and carbon benchmarking databases.

Together, these measures would enhance transparency, data quality, and decision-making across the construction sector. A phased verification system—starting with self-declarations and selective audits and evolving toward full third-party verification—would balance credibility with practicality given current institutional capacity. Box 5 shows how Thailand integrates LCA requirements, EPDs, and digital benchmarking tools into its sustainable construction policies.

LCA Requirements

In the medium term, Cambodia could progressively introduce LCA requirements for large-scale infrastructure and commercial projects, beginning with voluntary pilots integrated into existing environmental-impact assessment processes. This would require establishing LCA guidelines aligned with international best practices and providing capacity-building programs for developers and regulators. Public infrastructure projects, such as roads, transport hubs, and government buildings, could lead by example by incorporating LCA into design and procurement processes.

EPD Requirements

To improve transparency in material selection, Cambodia could gradually introduce EPD requirements for high-impact materials such as cement, steel, and bricks. A crucial first step in this process is establishing PCRs, which provide a standardized methodology for developing EPDs, ensuring consistency and comparability across materials. To safeguard credibility, the government should also establish a robust verification system to oversee the accurate development of EPDs. Additionally, offering financial incentives to manufacturers producing certified low-carbon materials would further encourage industry-wide adoption of sustainable practices. Public procurement policies can further drive EPD adoption by prioritizing materials with verified carbon footprints in government-funded projects.

Digital Tools and Databases for Carbon Benchmarking

The government can support industry-wide carbon benchmarking by creating a national carbon intensity database and promoting digital assessment tools like the Building Emission Assessment Tool (BEAT),[21] developed under the ALCBT project. BEAT establishes a national database for Cambodia and enables developers to estimate embodied carbon accurately in projects, ensuring compliance with emerging carbon regulations. Collaboration with

[21] HEAT GmbH and Global Green Growth Institute (GGGI). *BEAT: Building Emission Assessment Tool*. Asia Low Carbon Buildings Transition (ALCBT) Project. https://beat-alcbt.gggi.org/.

international organizations and regional networks can help Cambodia refine localized emission factors and integrate national databases with regional carbon-reporting frameworks.

Considering that developing an EPD can cost around US $15,000 and Cambodia currently has limited local verification capacity, adopting a phased national approach would be both practical and cost-effective. Cambodia could begin by promoting government-recognized self-declarations, complemented by selective third-party audits and recognition of internationally verified EPDs. This approach would reduce upfront costs, strengthen institutional and technical capacity, and gradually build confidence and credibility in the system. Over time, this foundation would support a smooth transition toward comprehensive third-party verification while already delivering the benefits of low-carbon materials and green public procurement. This phased approach would allow Cambodia to gradually strengthen institutional and technical capacity while enabling industries to gain familiarity with EPD and LCA processes before moving toward full-scale regulatory implementation.

Box *5.* Thailand's Integration of Lifecycle Assessment (LCA) and local Environmental Product Declarations (EPDs)

Thailand has integrated LCA requirements, EPDs, and digital benchmarking tools into its sustainable construction policies[22] (Lorenz & Partners, 2020). The Thailand Greenhouse Gas Management Organization (TGO) [23] mandates LCAs for large-scale projects, particularly in the cement and steel industries, to track and reduce emissions. Thailand's Low-Carbon City Program [24] encourages developers to incorporate LCA findings into design and material selection, driving demand for sustainable construction (Partnership on Transparency in the Paris Agreement, 2017).

Thailand has also developed a national EPD database[25] for key construction materials to ensure transparency in carbon accounting and material selection (Thailand Environment Institute, 2024). The government has also introduced digital carbon benchmarking platforms, helping developers assess embodied carbon across supply chains. By implementing similar measures, Cambodia could create a data-driven regulatory framework that enhances carbon accountability and promotes low-emission building practices.

[22] Lorenz & Partners, "NL208 Green Building in Thailand: Thai Green Building Code and Further Relevant Regulations," Lorenz & Partners Newsletter No. 208. https://www.lorenz-partners.com/newsletter-no-208/
[23] Thailand Greenhouse Gas Management Organization (TGO). Homepage (Thai). https://www.tgo.or.th/2023/index.php/th/
[24] International Partnership on Transparency in the Paris Agreement. "Good Practice: Low Carbon City (LCC) Programme in Thailand." https://transparency-partnership.net/publications-tools/good-practice-low-carbon-city-lcc-programme-thailand
[25] Thailand Environment Institute (TEI). "EPD Thailand." https://greenlabel.tei.or.th/en/epd-thailand/

3.3 Public Procurement and Fiscal Policies

3.3.1 Public Procurement and Government-led Initiatives

Public procurement can play a catalytic role in signaling demand for low-carbon materials and rewarding early movers. This recommendation draws on ALCBT case studies showing that public procurement has been an effective entry point for creating early demand for low-carbon materials in comparable emerging markets. Cambodia can leverage GPP as a powerful market signal by prioritizing low-carbon materials in publicly funded projects such as roads, schools, and hospitals. Embedding embodied-carbon criteria into procurement processes would stimulate innovation among local industries and demonstrate that sustainable construction is both feasible and cost-effective. Such initiatives could be coordinated under the leadership of the Ministry of Economy and Finance (MEF) through the EU Policy Support Component. At a later stage, sector-specific specifications for buildings should be developed and led by the Ministry of Land Management, Urban Planning, and Construction (MLMUPC), in consultation with other relevant ministries. In South Korea, GPP is also enforced to reduce embodied emissions from construction projects (see Box 6).

Public procurement policies should prioritize or mandate embodied carbon reductions by requiring government-funded projects (e.g., schools, hospitals, and infrastructure) to use certified low-carbon materials and meet embodied carbon thresholds. This approach would create sustained market demand for sustainable construction materials and practices. In addition, low-carbon infrastructure policies can be introduced for mega- and large-scale government-led projects, including bridges, airports, and transport hubs, to ensure they meet carbon footprint criteria. This can be achieved through mandatory LCA, embodied carbon caps, and material-efficiency requirements. Such policies would set a benchmark for the private sector, demonstrating that low-carbon construction is both technically feasible and economically viable, while stimulating market demand for alternative materials.

Box 6. South Korea's Green Public Procurement and Low-Carbon Infrastructure Policies

South Korea has successfully integrated GPP and low-carbon infrastructure policies to reduce embodied carbon in its construction sector. The *Green Purchasing Act*[26] mandates that all government-funded projects prioritize certified eco-friendly materials, requiring agencies to procure low-carbon cement, recycled steel, and bio-based insulation. As a result, over 50% of public buildings in South Korea now meet green construction standards, significantly cutting the country's embodied carbon footprint.

Regarding infrastructure, South Korea has implemented carbon footprint regulations for transport and energy projects. The government's *Low-Carbon Green Growth Strategy*[27]

[26] Republic of Korea. *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis* (Act No. 18469, September 24, 2021). *Statutes of the Republic of Korea (KLRI)*. https://elaw.klri.re.kr/eng_mobile/viewer.do?hseq=53038&type=part&key=39

[27] OECD Development Centre. "Korea's Low-Carbon Green Growth Strategy." *OECD Development Centre Working Papers*, no. 310 (2012). https://www.oecd.org/en/publications/korea-s-low-carbon-green-growth-strategy_5k9cvqmvszbr-en.html

enforces strict carbon limits for major projects, such as Seoul's Sustainable Transport Initiative, which incorporates low-carbon concrete and recycled asphalt to minimize environmental impact (OECD, 2012). The success of these policies has encouraged wider industry adoption of sustainable construction practices, proving that strong government leadership can drive large-scale reductions in embodied carbon. Cambodia may explore similar approaches by embedding low-carbon criteria into public procurement laws and prioritizing green infrastructure investments.

3.3.2 Introduce Incentives and Fiscal Policies

Economic incentives are crucial for encouraging the adoption of low-carbon construction practices. Cambodia could consider a mix of fiscal and financial instruments—such as targeted tax incentives, import-duty exemptions for low-carbon materials, or preferential loans for green construction projects—to lower upfront costs and encourage private investment. Over time, introducing carbon-based pricing or CBAM-aligned incentives could further drive efficiency improvements while supporting industrial competitiveness.

This policy option responds to findings from the ALCBT stakeholder and policy review, which highlight upfront cost concerns and limited access to tailored finance as key barriers to low-carbon construction. GGGI scenario analysis further indicates that targeted fiscal incentives are particularly effective during early market transformation phases.

Tax incentives and subsidies can also accelerate the transition to sustainable construction. Cambodia could consider offering tax deductions or targeted subsidies to manufacturers producing certified low-carbon materials and developers using recycled concrete, engineered would lower upfront costs, making sustainable materials more competitive relative to traditional, carbon-intensive options. These market-based approaches would reduce emissions and stimulate green investments in Cambodia's construction industry. Introducing such fiscal measures through pilot programs would allow policymakers to evaluate cost-effectiveness and industry response before scaling up.

To effectively reduce embodied carbon, the government could also explore introducing a carbon tax on high-emission materials like cement and steel. This would encourage investment in cleaner production technologies and alternative materials, including geopolymer concrete and bamboo. Such measures could be complemented by a cap-and-trade system that sets progressively lower carbon limits for construction materials, enables trading of emission allowances, and incentivizes efficiency improvements in material production, as demonstrated in China (Box 7) and the Netherlands (Box 8). The Netherlands' **DuboCalc** tool has proven that sustainable public procurement can deliver real results—

cutting embodied carbon and energy use by around 50% (≈52,800 tCO_2e) and reducing project costs by nearly €100 million in the A6 motorway project[28].

Box 7. China's Carbon Pricing and Green Incentives for Construction

China has implemented carbon pricing mechanisms and financial incentives to reduce emissions in its construction sector. The country launched its *Emissions Trading System* (ETS) in 2021, initially targeting power generation and is being gradually expanded to include carbon-intensive industries like cement and steel. In Guangdong and Hubei, pilot cap-and-trade programs have successfully reduced industrial carbon emissions, encouraging manufacturers to adopt energy-efficient kilns and alternative cement blends. Additionally, China has explored carbon tax policies at the local level, pushing the use of low-carbon materials and construction techniques (IEA, 2020).

The Chinese government also offers tax incentives and subsidies for projects using low-carbon cement, recycled steel, and renewable-powered production facilities. Under the *Green Building Action Plan*, developers receive financial rewards for meeting strict embodied carbon reduction targets. In cities like Shenzhen, public procurement policies require government buildings to use a minimum percentage of recycled construction materials, boosting demand for sustainable alternatives. These combined approaches demonstrate how carbon pricing and fiscal incentives can scale up low-carbon materials while maintaining economic competitiveness.

Box 8. The Netherlands' Incentives and Procurement Policies

The Netherlands has adopted incentive-driven and procurement-based policies to reduce embodied carbon in the building and construction sector. A key initiative is the *Building Decree 2012 (later called the Decree on the Construction of the Living Environment)*, which mandates carbon footprint assessments for new buildings and sets embodied carbon limits[29] (Government of the Netherlands, 2020). *The Dutch* government provides financial incentives to encourage compliance, including tax benefits and subsidies for developers using low-carbon materials such as recycled concrete, bio-based insulation, and sustainable timber. Additionally, the *Innovation Partnership for Sustainable Construction* offers funding for research into low-carbon technologies, helping industries transition toward greener alternatives.

Public procurement has been a major driver in lowering embodied carbon, mainly through the *DuboCalc tool* [30], a carbon-based tendering system for infrastructure projects (Rijkswaterstaat [Ministry of Infrastructure and Water Management of Netherlands],

[28] Procura+ Network. Sustainable Reconstruction of the Motorway A6: Procura+ Case Study — Rijkswaterstaat. May 2017. https://procuraplus.org/fileadmin/user_upload/Procuraplus_case_study_Rijkswaterstaat.pdf
[29] Informatiepunt Leefomgeving (IPLO). "Besluit bouwwerken leefomgeving (Bbl)." *Informatiepunt Leefomgeving (IPLO)*. https://iplo.nl/regelgeving/omgevingswet/inhoud/besluit-bouwwerken-leefomgeving/
Rijkswaterstaat. "DuboCalc Portal." https://www.dubocalc.nl/en/

2024). This tool quantifies the embodied carbon of materials and construction processes, prioritizing contractors with low-carbon bids in government-funded projects. For example, in the *Rijkswaterstaat highway project*, contractors using circular materials and carbon-reducing techniques received preference, cutting embodied carbon by nearly 30%. By linking procurement policies to sustainability targets, the Netherlands has successfully scaled up demand for low-carbon construction materials, fostering a competitive and eco-friendly building sector.

3.4 Workforce Development and Readiness for Green Buildings

3.4.1 Capacity Building, Industry Training, and International Partnership

A skilled workforce is essential for effective implementation of embodied carbon policies. Workforce development should include upskilling and reskilling employees, providing mentorship and on-the-job training, and expanding access to formal education and digital learning platforms. These strategies help create an agile and adaptable workforce capable of meeting evolving industry demands and successfully implementing embodied carbon policies, as demonstrated in India (see Box 9).

Cambodia can benefit from expanding partnerships with universities, professional bodies, and regional organizations to develop national training programs on LCA, green building design, and embodied-carbon management. In Cambodia, the building and construction sector involves a diverse set of stakeholders, each playing a role in shaping low-carbon development. Their approaches to capacity building vary depending on institutional mandates and areas of expertise. Table 3 below summarizes key stakeholders and their potential roles in capacity-building initiatives.

Partnerships with regional organizations, such as the ACE, can facilitate knowledge transfer and provide technical assistance for policy development and enforcement. Collaboration with international organizations, such as GGGI, and as well as partnerships with developed countries, can further strengthen technical expertise and institutional capacity. These partnerships can provide access to advanced technologies, funding, and international best practices for reducing embodied carbon. This effort is currently supported by GGGI through the ALCBT Project, including the ongoing LCB Training Program delivered in partnership with the Institute of Technology of Cambodia. The program targets building-sector professionals from government agencies, material manufacturing industries, developers, contractors and building owners, as well as architects, designers, energy auditors, Energy Service Companies (ESCOs), and banking and financing institutions.[31] Strengthening institutional and professional capacity will require cooperation among government, academia, industry, and development partners.

[31] Global Green Growth Institute (GGGI). ALCBT Project in Cambodia. Asia Low Carbon Buildings Transition (ALCBT) Project. https://alcbt.gggi.org/cambodia/

Box 9. India's Capacity Building and Industry Training

India has implemented capacity-building and industry-training programs to support embodied carbon reduction in its construction sector. *The Green Rating for Integrated Habitat Assessment (GRIHA)*[32], India's national green building certification system, includes mandatory training for architects, engineers, and developers on LCA, sustainable material selection, and carbon footprint reduction strategies (GRIHA Council, 2024). Through partnerships with organizations like *The Energy and Resources Institute (TERI) and the Indian Green Building Council (IGBC)*[33], specialized courses and certification programs have been developed to educate professionals on low-carbon construction practices, ensuring the industry can effectively implement embodied carbon management.

In addition, the Indian government launched the *Energy Conservation Building Code (ECBC)* training initiative to strengthen the capacity of policymakers, builders, and local authorities' in energy-efficient and low-carbon building materials. The *Construction Skills Development Council of India (CSDCI)*[34] also plays a key role by offering vocational training in green construction techniques, such as the use of fly ash bricks, bamboo composites, and recycled aggregates. These initiatives have helped mainstream low-carbon construction knowledge across urban and rural development projects, enabling wider adoption of embodied carbon reduction strategies.

[32] GRIHA Council. "GRIHA Rating." *Green Rating for Integrated Habitat Assessment (GRIHA)*. https://www.grihaindia.org/griha-rating
[33] Indian Green Building Council (IGBC). Homepage. https://www.igbc.in/
[34] Construction Skill Development Council of India (CSDCI). Homepage. https://www.csdcindia.org/

Table 3: Cambodia Building and Construction Sector Stakeholders

Entity Types	Stakeholder name[35]	Common mandates/ interests	Approaches for a capacity building initiative
National government, sub-national government and sectoral ministries	• Ministry of Land Management, Urban Planning and Construction (MLMUPC) • Ministry of Environment (MoE) • National Council for Sustainable Development (NCSD) • Ministry of Mines and Energy (MME)	• Develop, enforce, and align green building policies and regulations with international sustainability standards. • Drive economic growth and environmental protection through sustainable public infrastructure and urban planning.	• Establish collaborations and public–private partnerships to coordinate capacity-building activities. • Organize targeted policy forums, workshops, and pilot projects to disseminate best practices and update regulatory frameworks.
Construction companies/developers / investors	• Word Bridge Homes Co ltd. • Urbanland Asia • Chip Mong Group Co. Ltd • Ly Hour • Hong Piv • Comin Khmer Co. Ltd. • Mega Cambo Construction Company Ltd • Khun Sea Development Group	• Reduce operating costs and enhance competitiveness by adopting sustainable, low-carbon construction practices. • Ensure compliance with evolving environmental regulations to secure access to international markets.	• Participate in industry training sessions and certification programs on sustainable construction and embodied carbon management. • Engage in collaborative research and pilot projects that demonstrate the benefits of innovative

[35] Not exhaustive list

Entity Types	Stakeholder name[35]	Common mandates/ interests	Approaches for a capacity building initiative
			green technologies.
Manufacturers of construction materials	• Chip Mong Insee Cement (CMIC) • Kampot Cement Co., Ltd • ISI Group	• Improve production efficiency and reduce costs • Enhance compliance with emerging environmental standards and disclosure requirements	• Technical support and training • Facilitate pilot projects, benchmarking exercises, and industry forums.
Architect & Design companies	• V.Build CC Design & Construction Co.; Ltd • BMK Architects • 7P Architecture Studio • Aerne architects & associates	• Integrate sustainable design principles and low-carbon strategies to meet client and regulatory demands. • Differentiate their services through innovative, energy-efficient, and climate-responsive building designs.	• Offer and attend continuing professional development courses and specialized workshops on green design. • Foster international and local collaborations to share emerging technologies and design best practices.
Real estate services providers	• Knight Frank • CBRE • IPS • Century 21 Cambodia • Elevated Realty	• Accurately assess and enhance property values by incorporating sustainability and green certification status.	• Develop training modules on green building appraisal techniques and energy performance metrics.

Entity Types	Stakeholder name[35]	Common mandates/ interests	Approaches for a capacity building initiative
		• Drive market demand for sustainable buildings by highlighting the long-term benefits of green design.	• Collaborate with certification bodies to integrate sustainability criteria into real estate valuation models.
Green buildings/ GB certification providers	• Bureau Veritas • Vattanac Capital Tower • The Factory Phnom Penh • United Nations Development Programme (UNDP) Cambodia office • V.Build CC Design & Construction Co.; Ltd	• Ensure credibility and transparency in the certification process to build trust among stakeholders. • Promote widespread adoption of green certification standards to advance low-carbon construction practices.	• Organize capacity-building workshops and seminars on certification processes and updated standards. • Collaborate with international bodies to harmonize local certification practices with global benchmarks.
Financial / Banking	• International Finance Corporation (IFC) • Agricultural and Rural Development Bank (ARDB) • SME Bank of Cambodia • ACLEDA • FTB	• Mitigate financial risks associated with high-carbon investments and support the shift toward sustainable projects. • Enhance portfolios by integrating green financing	• Develop and promote specialized green financial products (e.g., green bonds, sustainability-linked loans). • Conduct training and knowledge-sharing sessions on green

Entity Types	Stakeholder name[35]	Common mandates/ interests	Approaches for a capacity building initiative
		options that reward sustainable building practices.	finance and risk management for industry professionals.
Academia	• Institute of Technology of Cambodia (ITC) • Royal University of Fine Arts (RUFA) • Paññāsāstra University of Cambodia (PUC) • Royal University of Phnom Penh (RUPP)	• Advance research on sustainable construction practices and innovative low-carbon technologies. • Build a pipeline of skilled professionals by incorporating green building concepts into academic curricula.	• Establish collaborative research programs and partnerships with government and industry stakeholders. • Develop specialized courses, certificate programs, and workshops focused on sustainable design and embodied carbon.
Development Partners, NGO and Civil Society	• Global Green Growth Institute (GGGI) • UNDP Cambodia • UNEP • UN-Habitat in Cambodia • Habitat for Humanity • Cambodia Institute for Urban Studies (CIUS)	• Advocate for inclusivity and sustainable urban development. • Ensure transparency and accountability in adopting green building practices across communities.	• Facilitate public awareness campaigns, community outreach programs, and stakeholder consultations. • Provide technical assistance, grants, and support for capacity-building

Entity Types	Stakeholder name[35]	Common mandates/ interests	Approaches for a capacity building initiative
	• People in Need (PIN)		initiatives in green construction.
Industry associations	• Board Engineers of Cambodia • Board Architects of Cambodia • Cambodia Society of Architects (CSA) • Cambodia Constructors Association (CCA) • Housing Development Association of Cambodia (HDAC) • EuroCham Cambodia • Cambodia Green Building Council (CamGBC)	• Represent and advance industry interests by promoting best practices in sustainable construction. • Influence policy-making and standard-setting processes by leveraging collective industry expertise.	• Organize conferences, training sessions, and roundtable discussions to share knowledge and innovative solutions. • Develop standardized guidelines, toolkits, and resources that help members adopt and implement green building practices.

3.4.2 Development and Adoption of Standard Training Modules on Green Buildings

The Cambodian government, in collaboration with educational institutions and industry associations, could establish standardized national training modules on green building and embodied-carbon management. Aligning these modules with regional accreditation frameworks would enhance recognition, participation, and quality assurance, while ensuring that training content keeps pace with evolving market needs. Seeking regional and international accreditation for training modules and examinations would further increase participation and professional recognition. A Japanese case in promoting sustainable building design and adaptive reuse to minimize embodied carbon is also presented in Box 10.

In this context, the ALCBT Project offers comprehensive training modules designed to advance expertise in low carbon building strategies, covering:

- Necessary modules: https://alcbt.gggi.org/lcb-training-modules/
    - Module 1: Introduction to Climate Change and Low Carbon Transition
    - Module 2: Fundamentals of Building Energy Efficiency and Management
    - Module 3: Low Carbon Building Assessment
    - Module 4: Financial Instruments and Market Mechanisms
- Dedicated tools and targeted training for embodied carbon management at building and sector levels
    - Building Emissions Assessment Tool (BEAT): https://alcbt.gggi.org/lca-tool/
    - Training and materials on Lifecycle Carbon Assessment Using BEAT in Cambodia https://alcbt.gggi.org/training-on-lifecycle-carbon-assessment-using-the-building-emission-assessment-tool-beat-in-cambodia/
    - Common Carbon Metric (CCMv2): https://alcbt.gggi.org/mrv-tool/
    - LCA publications using BEAT in Cambodia: https://alcbt.gggi.org/publications/

Box 10. Japan's Circular Building Design and Adaptive Reuse Policies

Japan has successfully implemented policies that promote sustainable building design and adaptive reuse to minimize embodied carbon. The *Act on Promoting Circular Economy and Sustainable Buildings* encourages developers to retain existing structures whenever feasible. Financial incentives, such as low-interest loans and property tax reductions, have significantly increased building retrofits and renovations, reducing emissions associated with energy- and carbon-intensive new construction.

Japan has also developed strict material efficiency guidelines and whole-building life-cycle assessment (WBLCA) requirements for new developments. The government supports modular and prefabricated construction methods that improve material efficiency, reuse, and structural disassembly. Additionally, Japan promotes the use of carbon-sequestering materials like engineered wood and bamboo, which are increasingly common in residential and commercial buildings. Cambodia could adopt similar strategies by integrating reuse incentives into urban planning policies and developing mandatory WBLCA guidelines for large-scale developments.

3.5 Waste and Circular Economy

Cambodia stands to gain significant economic and environmental benefits by adopting construction and demolition (C&D) waste-management policies that promote recycling, reuse, and material recovery. Establishing C&D waste-processing facilities, setting recovery targets, and encouraging Extended Producer Responsibility (EPR) would help create a circular

construction economy and reduce reliance on virgin materials. Establishing C&D waste processing facilities and enforcing material recovery targets will ensure that valuable resources—such as concrete, steel, and wood—are diverted from landfills and reintegrated into the construction supply chain. In India (Box 11), resource efficiency and embodied carbon policies are introduced to incentivize the use of recyclable, salvaged, and locally sourced materials, while in Denmark (Box 12), demolition projects are required to document, sort, and reuse materials.

EPR policy can encourage manufacturers to manage the full lifecycle carbon impact of their products. By promoting tracking, reporting, and mitigation of material emissions, such policies support the shift toward low-carbon production and circular economy practices. Cambodia could benefit from introducing eco-labelling systems and producer take-back programs that incentivize durable, recyclable, and carbon-efficient designs. Such circular-economy measures, when embedded in building codes and procurement standards, would help institutionalize resource efficiency across the sector.

Box 11. India's Construction and Demolition (C&D) Waste Management and Extended Producer Responsibility (EPR) Framework

India has successfully implemented resource efficiency and embodied carbon policies in the construction sector. The Indian National Resource Efficiency Policy (2019) and the GRIHA rating system promote the use of recyclable, salvaged, and locally sourced materials. These frameworks provide incentives for public and private buildings to adopt low-carbon materials such as reclaimed wood, low-carbon cement, and natural finishes. India's Construction and Demolition (C&D) Waste Management Rules (2016) mandate material recovery and reuse plans for large-scale developments, with cities like Bengaluru and Delhi requiring the use of recycled content in government projects. This has led to widespread use of materials like crushed concrete for road sub-bases and reclaimed bricks, helping reduce demand for virgin resources and cutting embodied carbon emissions.

In addition, India is making strides in Extended Producer Responsibility (EPR) with mandates covering plastics, e-waste, and industrial materials, and early discussions are underway to include building materials under carbon accountability. Some major cement and steel producers have voluntarily implemented carbon disclosure and material take-back programs to align with India's net-zero targets. These comprehensive policies and voluntary industry actions show how C&D waste management and EPR frameworks can drive systemic reductions in embodied carbon. Cambodia can draw from this model by embedding material efficiency requirements in building codes and offering incentives for using low-carbon and reclaimed materials to ensure sustainable growth in its construction sector.

Box 12. Denmark's Circular Economy in Construction

Denmark has successfully integrated material reuse and low-carbon certification[36] into its construction sector. The *Danish Resource Strategy* [37] requires demolition projects to carefully document, sort, and reuse materials like concrete, bricks, and steel (The Danish Government, 2018). This is supported by the material passport system that tracks carbon footprints and recyclability, ensuring that components can be repurposed in future projects. As a result, significant urban developments, such as the *Copenhagen Metro expansion*, have reused up to 70% of demolished materials, significantly cutting embodied carbon.

Denmark has also established strict certification standards for low-carbon materials under its *Danish Building Regulations*[38]. Government incentives, including green tax benefits and procurement requirements, promote the use of low-carbon cement and timber-based construction. These policies have accelerated the adoption of alternative materials like geopolymer concrete and engineered wood, contributing to an estimated 30% reduction in embodied carbon emissions from construction over the past decade. Cambodia could adopt similar policies by establishing recyclability requirements, certification schemes, and circular procurement standards, ensuring sustainable growth in its building sector.

[36] The Danish Government. *Strategy for Circular Economy: More Value and Better Environment through Design, Consumption, and Recycling*. September 2018. https://ddrn.dk/wp-content/uploads/2024/01/alle-faktaark-1.pdf
[37] Ministry of Environment of Denmark. *Action Plan for Circular Economy: National Plan for Prevention and Management of Waste 2020–2032*. July 2021. https://ddrn.dk/wp-content/uploads/2020/12/DK-strategy-2018.pdf
[38] Danish Enterprise and Construction Authority. *Building Regulations 2010 (BR10)*. English translation. https://historisk.bygningsreglementet.dk/file/155699/BR10_ENGLISH.pdf

4. Recommendations and Next Steps

While challenges remain, Cambodia's growing policy momentum, improving institutional coordination, and international partnerships provide a solid foundation for mainstreaming embodied-carbon management in the building and construction sector. Continued collaboration among ministries, development partners, academia, and the private sector will be essential to translate policy options into measurable progress and sustained outcomes. Effective management of embodied carbon can deliver significant economic benefits, such as cost savings, enhanced market competitiveness, and job creation, alongside environmental and social gains, including improved resource efficiency, climate resilience, and public health outcomes.

Notwithstanding Cambodia's considerable potential to advance low-carbon construction, several policy and implementation challenges merit attention. These include the limited availability of localized material-emissions data (such as EPDs), relatively elevated upfront investment requirements for low-carbon materials, weak enforcement of existing building regulations, and gaps in technical expertise and institutional capacity, particularly in LCA methodologies and practice. Addressing these barriers through coordinated policy measures, targeted capacity building, and sustained international collaboration will be critical to achieving Cambodia's sustainable development objectives in the built environment sector.

A complementary suite of policy instruments, incentives, and tools can be combined into an effective framework for managing embodied carbon. Stronger policies, capacity building, and market incentives can accelerate Cambodia's transition toward low-carbon construction. Given Cambodia's current context, the following strategic opportunities and priority policy options can help relevant sectors and stakeholders start integrating embodied carbon considerations.

4.1 Strategic Opportunities for Cambodia

1. Leverage International Frameworks, Tools, and Partnerships

Cambodia can draw on established practices and tools from ASEAN, the EU, and global green-building frameworks (LEED, EDGE, BREEAM) to accelerate the integration of embodied-carbon requirements into its national policies, standards, and implementation mechanisms.

2. Early Adoption Creates Competitive Advantage

Early establishment of embodied carbon codes, standards, and procurement policies enables domestic industries to prepare for future export markets, regional alignment, and access to climate finance. Proactive adoption strengthens Cambodia's competitiveness as global carbon regulations and sustainability expectations continue to tighten.

4.2 Priority Policy Directions

1. National Building Code and Material Standards

Importance: Building codes form the backbone of embodied-carbon management. Without minimum performance requirements, market transformation remains largely voluntary and progresses slowly.

Recommended actions:

- **Develop national green building regulations** that incorporate embodied-carbon limits, drawing on international certification frameworks.
- **Establish or update a national buildings taxonomy** to define "green," "low-carbon," and "high-impact" buildings in support of the Cambodia Sustainable Finance Taxonomy Framework.
- **Introduce disclosure requirements for EPDs** for high-emission construction materials, such as cement, steel, and insulation.

Expected impact: These measures will create predictable market signals, reduce high-emission construction practices, and align Cambodia with emerging global carbon-border adjustment mechanisms.

2. Material Specifications, Measurement, and Data Systems

Importance: Reliable data and transparent material information are essential for LCA, target setting, and effective low-carbon procurement.

Recommended actions:

- **Develop material specifications** that promote low-carbon substitutes, including blended cement, recycled aggregates, and green steel.
- **Mandate LCAs** for major public and private construction projects.
- **Require EPDs** for commonly used construction materials, supported by national PCRs.
- **Establish national digital databases and benchmarking tools** to support designers, engineers, and regulators.

Expected impact: These actions support evidence-based policymaking, improve transparency in material markets, and empower industry stakeholders to innovate and reduce emissions.

3. Green Public Procurement (GPP) and Fiscal Incentives

Importance: Government procurement is among the most powerful levers for driving early and sustained market demand for low-carbon materials.

Recommended actions:

- **Introduce GPP pilot tenders** that require embodied-carbon reporting and the use of low-carbon material.
- **Scale GPP across ministries**, particularly for public housing, transport infrastructure, and large public works.

- **Introduce fiscal instruments**, such as VAT reductions, targeted subsidies, and credit guarantees to support sustainable construction practices.

Expected impact: These measures will create predictable demand, reduce cost barriers, incentivize private investment, and accelerate scaling of low-carbon industries.

4. Workforce Development and Training

Importance: The technical skills needed for embodied carbon management, including LCA, energy modeling, digital tools, and carbon accounting, are not yet widely available in Cambodia.

Recommended actions:

- **Expand BEAT and LCB training programs** to include dedicated modules on embodied carbon and LCA.
- **Institutionalize training** through universities, professional associations, and accreditation bodies.
- **Establish national certification schemes** for LCA practitioners, auditors, and green-building professionals.

Expected impact: These actions will build long-term national capacity, reduce reliance on international expertise, and support implementation of new codes and standards.

5. Circular Economy and Construction and Demolition (C&D) Waste

Importance: C&D waste is a major source of embodied emissions. Recycling, reuse, and material recovery can significantly reduce material-related carbon.

Recommended actions:

- **Develop national C&D waste guidelines** emphasizing recycling, reuse, and material recovery.
- **Pilot Extended Producer Responsibility (EPR)** mechanisms for high-impact materials, such as steel, cement, and insulation.
- **Establish national regulations** supporting recycling markets and circular-material supply chains, complemented by C&D waste management requirements and EPR frameworks to promote material recovery and reuse.

Expected impact: These measures will reduces waste, cut lifecycle emissions, and support the transition toward a circular construction economy.

4.3 Pathway for Implementation

Cambodia can sequence policy implementation across three-time horizons, as outlined in Table 1 of this report:

- **Short term (1–3 years):** Establish foundational elements, including databases, guidelines, voluntary standards, and technical capacity building.

- **Medium term (3–7 years):** Integrate embodied-carbon limits into regulations, expand GPP, and scale fiscal incentives.
- **Long term (7+ years):** Achieve market transformation through mandatory codes, full digital data systems, and circular-economy regulations.

4.4 Conclusion

Cambodia has a strong opportunity to position itself as a regional leader in low-carbon construction. By adopting an integrated package of policy instruments, combining strengthened building codes, improved data systems, targeted incentives, skilled workforce development, and circular-economy measures, the country can unlock substantial economic, environmental, and social benefits. Sustained collaboration among government agencies, the private sector, academia, and development partners will be essential to translate policy options into measurable progress and results. With consistent leadership and coordinated action, Cambodia can build a resilient, competitive, and low-carbon built environment that supports national climate goals and long-term sustainable development.

References

Building and Construction Authority. (2024). *Green Mark Certification Scheme*. https://www1.bca.gov.sg/buildsg/sustainability/green-mark-certification-scheme?

Carbon Leadership Forum. (2023a). *Model Embodied Carbon Specifications*. Policy Toolkit. https://carbonleadershipforum.org/model-embodied-carbon-specifications/#:~:text=The%20Model%20Embodied%20Carbon%20Specifications%20incorporate%20project%20requirements,global%20warming%20potential%20%28GWP%29%20limits%20for%20construction%20products

Carbon Leadership Forum. (2023b, November 29). *AIA-CLF Embodied Carbon Toolkit for Architects*. https://www.aia.org/resource-center/aia-clf-embodied-carbon-toolkit-architects#:~:text=The%20AIA-CLF%20Embodied%20Carbon%20Toolkit%20for%20Architects%20serves,taken%20to%20reduce%20embodied%20carbon%20in%20their%20projects.

Energy Transition Commission. (2025, February). *Achieving Zero-Carbon Buildings: Electric, Efficient and Flexible*. https://www.energy-transitions.org/publications/achieving-zero-carbon-buildings#download-form

Global Green Growth Institute (2025). *Pathway to Low Carbon Buildings in Cambodia: Policy Landscape, Institutional Frameworks, and Entry Points*. https://alcbt.gggi.org/pathway-to-low-carbon-buildings-in-cambodia-policy-landscape-institutional-frameworks-and-entry-points/

Government of the Netherlands. (2020). *Decree on the construction of the living environment*. https://iplo.nl/regelgeving/omgevingswet/inhoud/besluit-bouwwerken-leefomgeving/

GRIHA Council. (2024). *Green Rating for Integrated Habitat Assessment (GRIHA)*. GRIHA Rating. https://www.grihaindia.org/griha-rating

Government of the Netherlands. (2020). *Decree on the construction of the living environment*. https://iplo.nl/regelgeving/omgevingswet/inhoud/besluit-bouwwerken-leefomgeving/

IEA. (2019). *The critical role of buildings: Perspectives for the clean energy transition*. IEA, Paris. https://www.iea.org/reports/the-critical-role-of-buildings

IEA. (2020). *China's Emissions Trading Scheme*. https://www.iea.org/reports/chinas-emissions-trading-scheme

IEA. (2024). *Top Runner Programme*. https://www.iea.org/policies/1945-top-runner-programme

India Ministry of Environment, Forest and Climate Change (MoEFCC). (2016). *C&D Waste Management Rules*. http://oscngt.upsdc.gov.in/pdf/act/Construction%20and%20Demolition%20Waste%20Management%20Rules,%202016.pdf

India Ministry of Environment, Forest and Climate Change (MoEFCC). (2019). *National Resource Efficiency Policy (NREP),*. https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1583056

Korea Institute of Civil Engineering and Building Technology (KICT). (2024). *Green Standard for Energy and Environmental Design*. Overview of the certification system. http://www.gseed.or.kr/board.do?pageNum=1

Lorenz & Partners. (2020). *NL208 Green Building in Thailand*. Lorenz & Partners: Legal, Tax and Business Consultants. https://www.lorenz-partners.com/newsletter-no-208/

OECD. (2012). *Korea's Low-Carbon Green Growth Strategy*. https://www.oecd.org/en/publications/korea-s-low-carbon-green-growth-strategy_5k9cvqmvszbr-en.html

Partnership on Transparency in the Paris Agreement. (2017). *Good Practice: Low carbon city (LCC) programme in Thailand*. Partnership on Transparency in the Paris Agreement. https://transparency-partnership.net/system/files/document/Good%20Practice-Thailand-Low%20Carbon%20City%20Programme.pdf

Rijkswaterstaat (Ministry of Infrastructure and Water Management of Netherlands). (2024). *DuboCalc* [DuboCalc 6.0]. DuboCalc. https://www.dubocalc.nl/en/

South Korea Ministry of Environment. (2021). *Carbon Neutrality Vision and Strategy for Industry and Energy*. https://english.motie.go.kr/eng/article/EATCLdfa319ada/897/view

Thailand Environment Institute. (2024). *Environmental Product Declaration EPD Thailand*. Thailand Environment Institute. https://greenlabel.tei.or.th/en/epd-thailand/

Appendix: Glossary of Key Terms

Selected terms used in Embodied Carbon & Sustainable Construction are provided to facilitate understanding.

1. **Adaptive Reuse** – The process of repurposing existing buildings instead of demolishing them, reducing waste and embodied carbon while preserving cultural heritage.
2. **Biogenic Carbon** – The carbon stored in natural materials, such as timber or bamboo, which absorbs CO_2 during growth. If sourced sustainably, these materials can reduce a building's carbon footprint.
3. **Building Energy Efficiency** – The ability of a building to use less energy while maintaining comfort, often achieved through insulation, smart lighting, efficient HVAC systems, and passive design.
4. **Building Retrofit** – Upgrading an existing building's energy efficiency and materials to reduce its operational and embodied carbon, instead of demolishing and rebuilding.
5. **Carbon Footprint** – The total amount of CO_2 and other GHG emissions a building or material generates. Measured in kilograms (kg) or metric tons (t) of CO_2 equivalent.
6. **Carbon Intensity** – The amount of carbon emissions per unit of material or energy. For example, kg CO_2 per m^2 of concrete or g CO_2 per kWh of electricity.
7. **Carbon Sequestration** – The process of capturing and storing CO_2 from the atmosphere, often in forests, soil, or bio-based building materials like wood, hempcrete, and algae-based panels.
8. **Circular Economy in Construction** – A strategy that focuses on reusing, recycling, and repurposing materials to reduce waste and embodied carbon. For example, using demolished concrete in new construction instead of producing fresh cement.
9. **Cradle-to-Cradle (C2C)** – A circular economy concept where materials are designed for continuous reuse or recycling, avoiding landfill waste and reducing embodied carbon.
10. **Cradle-to-Gate** – A type of LCA that assesses emissions from raw material extraction to factory output (before transport or construction). Used in **EPDs** to evaluate material carbon footprints.
11. **Cradle-to-Grave** – A full life cycle assessment covering all **stages from raw material extraction to disposal** (end-of-life phase). This is a key approach in **whole life carbon accounting**.
12. **Cradle-to-Site** – Similar to cradle-to-gate but extends to the point where materials arrive at the **construction site**. Includes **transportation emissions**.
13. **Decarbonization** – The process of reducing carbon emissions from buildings by improving energy efficiency, switching to low-carbon materials, and using renewable energy.

14. **Embodied Carbon** – The total greenhouse gas (GHG) emissions associated with the extraction, manufacturing, transportation, installation, and disposal of building materials. For example, the CO_2 emitted when producing cement or steel.
15. **Embodied Carbon Intensity (ECI)** – The amount of embodied carbon per **square meter (kg CO_2e/m^2)** of a building. Used to compare materials and projects.
16. **Embodied Energy** – The total amount of energy used to extract, manufacture, transport, and install a material, directly linked to its embodied carbon.
17. **Environmental Product Declaration (EPD)** – A standardized report that provides detailed data on a product's environmental impact, including its carbon footprint, across its lifecycle. Think of it as a "nutrition label" for materials like concrete, glass, or insulation.
18. **Global Warming Potential (GWP)** – A measure of how much heat a greenhouse gas traps in the atmosphere over a specific period, typically 100 years. Expressed as CO_2 equivalent (CO_2e), it helps compare the impact of different gases.
19. **Heat Island Effect** – Urban areas absorb and retain heat due to **concrete and asphalt surfaces**, leading to higher cooling energy demand.
20. **Life Cycle Assessment (LCA)** – A scientific method used to measure the environmental impact of a building or product throughout its life, from raw material extraction to disposal. LCA helps architects and developers make more sustainable choices.
21. **Low-Carbon Materials** – Construction materials designed to have a lower carbon footprint, such as recycled steel, low-carbon concrete, and sustainably sourced timber.
22. **Material Passport** – A digital or physical record of a building material's origin, composition, carbon footprint, and recyclability, facilitating reuse in a circular economy.
23. **Net Embodied Carbon** – The embodied carbon of a building minus any carbon sequestration from bio-based materials or other offsets.
24. **Net Zero Carbon Building** – A building that balances its carbon emissions with carbon savings, meaning it either emits no CO_2 or offsets its emissions through renewable energy or carbon capture methods.
25. **Operational Carbon** – The GHG emissions released from energy use in buildings during their operation, such as electricity for lighting, heating, and cooling. Reducing operational carbon often involves energy efficiency measures and renewable energy use.
26. **Passive Design** – A design approach that maximizes natural ventilation, daylighting, and insulation to reduce the need for mechanical heating or cooling, thus cutting operational carbon.
27. **Product Category Rules (PCRs)** – The guidelines that define how to calculate and report environmental impacts in an EPD for specific product categories. For example, PCRs ensure that all EPDs for cement follow the same rules, making them comparable.

28. **Sustainable Procurement** – The practice of selecting low-carbon, eco-friendly materials and suppliers who follow sustainable production methods.
29. **Thermal Mass** – The ability of a building material (e.g., concrete, brick) to absorb, store, and slowly release heat, reducing energy demand for heating and cooling.
30. **Whole Life Cycle Assessment (WLCA)** – A **comprehensive evaluation** of a building's environmental impact **from raw material extraction to end-of-life** (demolition or reuse). It includes **both embodied and operational carbon**, helping designers make informed, low-carbon choices.

About ALCBT Project

The Asia Low Carbon Buildings Transition (ALCBT) Project seeks to significantly reduce GHG emissions by catalyzing nationwide transition towards low-carbon buildings in Cambodia, India, Indonesia, Thailand, and Vietnam. The project is led by the Global Green Growth Institute (GGGI), in partnership with the ASEAN Centre for Energy (ACE), Energy Efficiency Services Limited (EESL), and HEAT GmbH. It is funded by the Government of Germany's Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN) via the International Climate Initiative (IKI).

In Cambodia, the project is implemented in partnership with the Ministry of Land Management, Urban Planning, and Construction (MLMUPC). It conducts assessments and develops tools and measures for low carbon buildings, focusing on Phnom Penh, and designed for replication in other Cambodian cities.

About GGGI

Global Green Growth Institute (GGGI), headquartered in Seoul, Republic of Korea is a treaty-based international, inter-governmental organization dedicated to supporting and promoting strong, inclusive and sustainable economic growth in developing countries and emerging economies.

About ACE

The ASEAN Centre for Energy (ACE) is an intergovernmental organization within the Association of Southeast Asian Nations' (ASEAN) structure that represents the 11 ASEAN Member States' (AMS) interests in the energy sector.

About EESL

Energy Efficiency Services Limited (EESL) is a super energy service company under the India's Ministry of Power. It seeks to unlock energy efficiency market in India through innovative business models and has expanded its operations in other Asian countries.

About HEAT International

HEAT International is an independently acting consulting firm with 30 years of experience in the field of climate, heating & cooling, and transport. HEAT's goal is to support countries in their effort to mitigate emissions and to implement transformative pathways towards zero GHG emission solutions.

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Life Cycle Assessment for Transitioning to a Low-Carbon Economy | **PROJECT**

alcbt.gggi.org

GGGI Cambodia

4F, Ministry of Environment, Sangkat Tonle Bassac, Khan Chamkarmon, Phnom Penh, 120101, Cambodia

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