ASIAN DEVELOPMENT BANK

Technical Note

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REG: Mainstreaming Nature-Positive Investments for Green, Resilient, and Inclusive Recovery

Sustainable Construction Materials Market Analysis - Cambodia

ABBREVIATIONS

Abbreviation	Description
ADB	Asian Development Bank
ASTM	American Society for Testing and Materials
BFS	Blast Furnace Slag
CBCMA	Cambodian Building and Construction Materials Association
CCA	Cambodian Constructors Association
CDRI	Cambodia Development Resource Institute
CIDC	Cambodian Construction Industry Development Council
CO_2	Carbon Dioxide
DMCs	Developing Member Countries
EDGE	Excellence in Design for Greater Efficiencies
EPD	Environmental Product Declaration
GCCA	Global Cement and Concrete Association
GDC	General Department of Customs and Excise of Cambodia
GDT	General Department of Transport
GHG	Greenhouse Gases
GNR	Getting the Numbers Right (sustainability monitoring system for the global cement industry)
GWP	Global Warming Potential
HCPR	Hot Central Plant Recycling
HMA	Hot-mix Asphalt
ISC	Institute of Standards of Cambodia
ISAC	National Standardization Agency of Cambodia
ISO	Organization for International Standardization
LCA	Life Cycle Assessment
LEED	Leadership in Energy and Environmental Design
LEED v4.1	Latest Version of LEED Certification
ME	Ministry of Environment
MLMUPC	Ministry of Land Management, Urban Planning, and Construction
MME	Ministry of Mines and Energy
MISTI	Ministry of Industry, Science, Technology and Innovation
MOC	Ministry of Construction
MOIT	Ministry of Industry and Trade
MPWT	Ministry of Public Works and Transport
N/A	Not Available / Not Applicable
NCBTR	National Council for Building Technical Regulations
NCSD	National Council for Sustainable Development
NPI	Nature Positive Investments
NSCC	National Standardization Council of Cambodia
OPC	Ordinary Portland Cement
PCB	Portland Cement Blend
PCBBFS	Portland Cement Blend with Blast Furnace Slag
PFA	Pulverized Fuel Ash
RAP	Recycled Asphalt Pavements
RAP	Recycled Asphalt Pavement
SCM	Supplementary Cementitious Material

SGBC	Singapore Green Building Council
TIS	Thai Industrial Standard
WMA	Warm-mix Asphalt

CONTENTS

I. INTRODUCTION

1. The regional knowledge and support technical assistance (TA) "Mainstreaming Nature-Positive Investments for Green, Resilient and Inclusive Recovery" seeks to put in place the enabling conditions to increase and accelerate nature-positive investments (NPI). The TA aims to strengthen ADB's business processes, metrics, and governance for NPIs and provide developing member countries (DMCs) with the required institutional capacity to integrate nature into national strategic planning, development, and investment decision-making processes. The TA supports knowledge generation and sharing to provide an evidence-based model for enabling technical solutions for NPI. The TA includes multiple activities, including Sustainable Construction Materials Market Analysis, which is the subject of this Technical Note.

2. Construction materials such as concrete contribute up to 8% of global emissions. This technical note on "Sustainable Construction Materials Market Analysis" presents the methods used and findings of identified opportunities to improve resource efficiency for the following critical construction materials – Asphalt, cement, concrete, and steel.

3. Among the countries selected as strategic pilots for this initiative in Southeast Asia are Cambodia, Laos, the Philippines, and Vietnam. This report covers the findings in Cambodia.

Box 1: Terms of reference for the study are as follows:

a). Carry out national market analysis using established survey for identified opportunities to improve resource efficiency for the following critical construction materials – asphalt, cement, concrete and steel.
b). Document data collection methodology for the country;
c). Recommendation on next steps around existence or opportunities of / implementation of national green certification system and EPD or equivalent.
d). Draft a technical note reporting on availability and provisional costings of identified opportunities, against technical standards

II. METHODOLOGY

4. **Kick-off.** A kick-off meeting was held with counterpart agencies, such as the Asian Development Bank in Cambodia. ADB Cambodia agreed to act as a counterpart and to help make introductions to ministries and other entities where required.

5. **Desk study.** The literature search initially included the following:

Roadmaps
- road maps on sustainable materials use existing in the country, if any, and
- best practice international models of roadmaps for sustainable materials use.

Environmental Product Declarations or certificates
- search the International and Southeast Asian EPD library to see if there are any local suppliers holding EPDs
- search the Green Buildings Council directory to see if there are any local suppliers holding certificates
- search of LEED and EDGE building directories to study the extent and impact of material-related criteria
- search nationally available eco-labels for certification types related to construction material

Research papers
- studies on the use of greener materials or techniques in the country and region
- CO2 emissions data for conventional products or greener alternatives

Regulatory framework
- Government resolutions
- Technical standards

6. A completed questionnaire in Appendix 1 for comparison between the study countries contains information from the desk study regarding the regulatory and standards framework.

7. **Identification of potential opportunities.** Identifying potential opportunities to improve resource efficiency is challenging since it requires both an understanding of the market as well as the technical details of the product. Examples of possible methods to identify opportunities are shown in Box 2.

Box 2: How to identify "opportunities to improve resource efficiency"?

a) where a greener alternative is widely used internationally but less so in the country

b) where suppliers have already chosen to obtain product environmental certification, possibly in response to demands from their customers (e.g. export customers, or private sector)

c) where greener alternatives exist on the market and are being used by the private sector on green buildings projects (such as LEED certified buildings) but not yet on government budget projects

d) where both normal and greener alternatives exist on the market but due to pricing the greener alternatives still have limited market share.

e) where substantially greener alternatives exist but there seems to be a barrier to their wider application e.g. design standards, cost norms, industry practice, regulatory framework

8. **Meetings with sector agencies.** Meetings were held with the following agencies to explain the study, propose potential opportunities, request data, or respond to questionnaires. Meetings were held with:

a) Ministry of Environment (MoE), National Council for Sustainable Development
b) Ministry of Public Works and Transport (MPWT)
c) Ministry of Industry, Science, Technology & Innovation (MISTI), National Standardization Council of Cambodia (NSCC),
d) Ministry of Public Works and Transport (MPWT)
e) Cambodian Building and Construction Materials Association (CBCMA)

9. An Overview of Ministries and Organizations related to responsibilities is as follows:

Ministries Overseeing Cement Manufacturing and Construction Materials

- Ministry of Industry, Science, Technology & Innovation (MISTI)
  Oversees cement manufacturing and construction materials in Cambodia, establishing standards for industrial processes and ensuring quality control for materials like rebar.
- Ministry of Public Works and Transport (MPWT)
  It plays a key role in infrastructure regulation, including road construction and building standards, and ensures compliance with safety requirements for cement, concrete, and public projects.
- Ministry of Land Management, Urban Planning, and Construction (MLMUPC)
  Regulates building permits and sets quality guidelines for construction materials, including rebar.
- Ministry of Environment (MoE)
  Regulates the environmental impacts of cement production, focusing on emission standards and waste management to minimize CO2 emissions.
- Ministry of Mines and Energy (MME)
  Oversees raw material extraction and indirectly regulates the rebar supply chain.

Organizations Contributing to Standardization and Policy Development

- National Standardization Council of Cambodia (NSCC)
  Operates under MISTI to set national standards for construction materials like cement and concrete, ensuring safety, quality, and environmental compliance.
- Institute of Standards of Cambodia (ISC)
  The insititute develops and enforces national standards for construction materials.
- Reporting to the Ministry of Environment, Cambodia's National Council for Sustainable Development (NCSD) is a policy-making body established in May 2015 to promote sustainable development and balance economic, environmental, social and cultural factors. It coordinates climate change initiatives, integrates ecological aspects into national planning, and reports its progress and recommendations directly to the Cambodian government.
- As part of the MLMUPC, Cambodia's National Council for Building Technical Regulations (NCBTR) plays a crucial role in the construction industry by developing and enforcing technical building standards. Established by Sub-Decree No. 103 ANK.BK, the NCBTR ensures that Cambodian building practices are safe, sustainable, and aligned with national development goals. It reports its progress to the Royal Government of Cambodia.

Collaborative Industry Bodies

- Cambodian Building and Construction Materials Association (CBCMA)

Works with the government to advocate for the cement and construction materials industry, assisting in developing standards and policies.

- Cambodian Constructors Association (CCA)
  Collaborates with the government to promote construction standards.
- Cambodia Development Resource Institute (CDRI)
  Contributes to sustainable development standards and practices in construction, working with government agencies to improve materials and methods.

Regulatory Bodies for Trade and Customs

- Cambodia General Department of Customs and Excise (GDC)
  The GDC regulates the import and export of construction materials.

10. Data on pricing was obtained from interviews with contractors and suppliers. Expert advice was mainly received through questioning engineers working in design or construction, particularly materials engineers responsible for testing and approving materials during construction.

III. IDENTIFIED POTENTIAL OPPORTUNITIES FOR IMPROVED RESOURCE EFFICIENCY

11. Based on the desk study, meetings with sector agencies, and consultation with materials specialists and designers. The following potential opportunities were identified, and market analysis was undertaken.

Table 1: Opportunities selected for market analysis

Material	**Conventional product**	**Greener alternatives**	**Basis for the opportunity**
Asphalt	Hot-mix asphalt	a) Warm-mix asphalt (WMA) b) Recycled asphalt pavings (RAP)	Potential to mitigate carbon emissions during road construction, increase the resilience of pavement layers, and extend their lifespan.
Cement	Portland cement (PC)	a) Portland cement blend (PCB) b) Blast furnace slag cement (PCB_{BFS})	Conventional products and greener alternatives coexist in the market, and PCB already has a significant market share due to its lower cost. However, there may be potential to reduce PC usage further, increase PCB blend percentages, and increase blast furnace slag usage.
Concrete	Concrete using Portland cement blend (PCB)	a) Low-carbon concrete b) Blast furnace slag concretes (PCB_{BFS})	Potential to reduce PC usage further, increase PCB blend percentages, and increase blast furnace slag usage.
Reinforcing steel	Virgin steel	a) Steel produced from scrap	Both products coexist on the market with similar prices, although they have very different CO_2 footprints.

IV. MARKET ANALYSIS FOR THE POTENTIAL OPPORTUNITIES

A. Description of the asphalt market

12. Cambodia imported approximately 1,000,000 tons of bitumen in 2023. This volume translates to roughly 10 million m³ of asphalt. These imports were sourced primarily from Singapore, The Middle East, Thailand[1], Taiwan, Vietnam and China[2].

Hot-mix asphalt is the standard product available in the market, and greener options such as warm-mix asphalt and use of recycled asphalt plannings (RAP) are not yet available.

13. An overview of the bitumen/asphalt market is as follows:
Cambodia does not produce bitumen domestically. Asphalt production in Cambodia is primarily managed by companies that import and distribute asphalt products, as the country lacks domestic refineries. Notable companies are:

- Tipco Asphalt (Cambodia) Co., Ltd. is a subsidiary of Tipco Asphalt Public Company Limited, a leading manufacturer and distributor of asphalt products in the region[3].
- Apex Industrial Co., Ltd. is a Cambodian-owned company that supplies asphalt products sourced from petroleum producers in Thailand and Singapore.[4]
- Kampuchea Tela Co., Ltd. is known for providing high-quality asphalt, among other petroleum products[5].

Market Overview. Detailed information about companies' market share and distribution in Cambodia is unavailable in public sources.

Capacity and Range of Products. With current imports accounting for the entire demand, the market capacity is equivalent to the annual bitumen import. The future domestic production capacity will depend on the refinery upgrades and operational efficiency. The market includes three primary types of bitumen products:

- Hot, thick bitumen: Suitable for direct application in large-scale paving projects.
- Drummed bitumen: Offers flexibility for smaller projects and storage.
- Medium curing (MC) or emulsion asphalt: Used for specific applications, including surface sealing and patchwork.

14. A survey conducted through internet searches did not identify a market offering greener asphalt using either warm-mix or recycled asphalt pavements (RAP). A telephone survey was undertaken with suppliers in Phnom Penh and its vicinity, all of whom confirmed that they currently only provide standard hot-mix, not warm-mix, or use of RAP.

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[1] Bitumen Imports from Thailand to Cambodia Link
[2] Petroleum bitumen exports to Cambodia in 2023Link
[3] Tipco Company Website Link
[4] Apex Industrial Company Website Link
[5] Kampuchea Tela Company Website Link

15. MPWT also confirmed this [6]; the ministry has been studying RAP stockpiling and its potential for integration into new asphalt mixes. Discussions on introducing standards for RAP use in road construction occur, though no formal regulations currently exist.

16. With no local reference found, calculations of greenhouse gas reduction made by researchers of the University of Transport Technology in neighboring Vietnam are shown in the following Table[7], indicating a baseline figure of 48kg CO_2 / ton of hot-mix asphalt and 16% reduction achievable for central batch mixing using warm-mix with 20% RAP.

Table 2: CO_2 reduction calculated for greener asphalts

	Mix proportions					CO_2 kg/ton	Reduct-ion (%)
	RAP %	Bitumen in RAP	New bitumen	Bitumen with additives	Asphalt emulsion		
Baseline (hot-mix)							
Hot-mix asphalt (HMA)	0	0	5			48.13	0
Greener alternatives							
Hot central plant recycling (HCPR)	20	0.8	4.2			41.75	13.3
Warm central plant recycling (WCPR)	20	0.8	0	4.2		40.58	15.7
Cold central plant recycling (CCPR)	91.8	3.7	0		3.2	28.69	40.4

Notes: Available CO_2 data are generic, approximate CO_2 emissions per ton for various asphalt production methods not specific to Cambodia[8].

[6] Interview held with MPTW officials on January 23, 2025

[7] "Effective greenhouse gas emission reduction when applying some new technologies to replace traditional hot asphalt concrete technology", Environment magazine, 16 July 2023 link

[8] Energy Usage and Greenhouse Gas Emissions of Pavement Preservation Processes for Asphalt Concrete Pavements Link

B. Description of the cement market

17. An overview of the cement market is as follows:

Production and exports. Cambodia's cement production is primarily driven by four large producers, including Kampot Cement, Chip Mong Insee, Thai Boon Rong Cement and Battambang Conch Cement, with an annual production capacity of approximately 9 million tons. In 2022, the country produced 7.7 million tons of cement. Most of the cement produced is consumed domestically due to the robust growth in Cambodia's construction sector.
As of December 2024, Cambodia hosts four notable cement production plants. The following table summarizes their key details: It's noteworthy that the Cambodian cement industry has been expanding to meet the growing domestic demand, with local production meeting around 90% of the country's cement needs.

Plant Name	Location	Owner	Annual Production Volume	Use of sustainable practices
Kampot Cement Co. Ltd.[9]	Kampot Province	Khaou Chuly Group and Siam Cement Group (SCG)	Approx. 2,200,000 tons	Energy Efficiency, Alternative Fuels, ISO 14001:2015 Env. Mgmt.
Chip Mong Insee Cement Corp.	Kampot Province	Chip Mong Group and Siam City Cement	Approx. 1,900,000 tons	Energy-Efficiency, Alternative Fuels, Use of Blended Cement, Renewable Energy Utilization
Battambang Conch Cement Co.[10]	Battambang Province	Conch International Holding (HK) Limited	Approx. 1,800,000 tons	Energy-Efficiency, Alternative Fuels, PM and NO2 reduction[11]
Thai Boon Rong Cement Co. Ltd.[12]	Kampot Province	Thai Boon Rong Co. Ltd.	Approx. 900,000 tons	N/A

Regarding using alternative fuels for low-carbon production, specific data for Cambodian cement plants is limited.

Growth. Cement production increased from 8.5 million tons in 2021 to 8.9 million tons in 2022.

[9] News Kapot Cment Plant Link
[10] News Battambang Cement Plant Link
[11] Annual Report Battambang Conch Link
[12] News Thai Boon Plant Link

Imports. Cambodia imports additional cement to meet local demand, which exceeds production levels. In 2022, the country consumed over 10 million tons of cement, requiring imports to bridge the gap.

Capacity and Utilization. Cambodia's cement factories operate slightly below their full production capacity. In 2022, the utilization rate was about 90% (7.7 million tons produced out of 9 million tons capacity). Expanding production to meet domestic demand remains a priority, with additional investments being explored, such as feasibility studies for new plants in Kampong Speu province.

Range of cement products. Based on the use of SCMs and additive mixtures during production, different cement types exist; some of the key information is as follows:

Table 3: Key cement types

Name	**International Standard**	**Example Nomenclature**	**Permitted Blend %**
Portland Cement	ISO 197-1:2011 or ASTM C150	OPC	Ground limestone up to 5%
Portland Composite Cement or Portland Blended Cement	ISO 197-1:2011 or ASTM C595	PCC or PCB	Up to 40% of total additives, with supplementary cementitious materials (SCMs) not exceeding 20%, or up to 50% with the use of blast furnace slag (≥10%).

Ordinary Portland Cement (OPC) has a high clinker content of approximately 95%, significantly contributing to carbon emissions during its production. While OPC offers rapid strength development and is well-suited for high-strength construction applications, it is only moderately durable and less suitable for environments requiring long-term resistance to aggressive conditions.

In contrast, Portland Composite Cement (PCC) or Blended Portland Cement (PCB) contains a lower clinker content, typically ranging between 65% and 79%, with the remainder consisting of supplementary cementitious materials (SCMs) such as fly ash, slag, or limestone. These additives reduce the carbon footprint of PCC/PCB and enhance its durability and resistance to chemical attacks. This makes PCC/PCB ideal for moderate-strength construction projects, especially in applications where durability and sustainability are priorities, such as residential buildings, marine structures, and infrastructure requiring long-term performance.

Sustainability Practices. Sustainability practices in the country's cement industry are developing, including impact mitigation of the manufacturing processes by adopting alternative fuels, renewable energy, and heat recovery practices.

18. Substantial effort was made to obtain baseline statistics on a) breakdown of cement consumption by type OPC and PCC/PCB, b) average CO_2 emissions by cement type, and c) average blend % by cement type. However, such data is either not collected by sector agencies or the industry association, or they cannot disclose it, and most firms seem unwilling to disclose it.

19. Some reference or indicative data was received by a) verbal estimates from the cement association, b) EPDs published by one company[13] for their product range, and c) information published in sustainability or ESG reports by a few companies. The data set is shown in the following Table. The relationship between blend % and CO_2 emissions for a leading manufacturer in Cambodia is illustrated in the following Figure and Table.

Figure 1: Relation between OPC and PCC/PCB of various Blend %

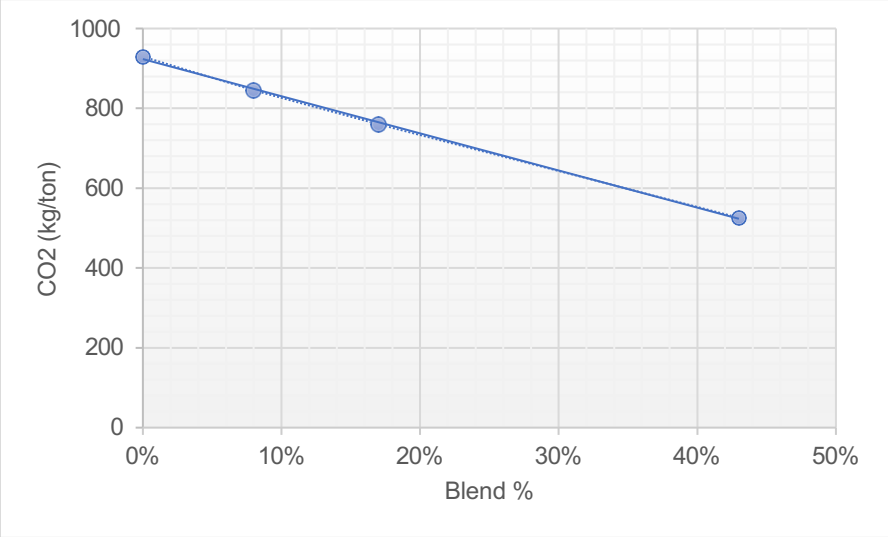

Table 4: Dataset of cement baseline data

Company	Type	Bag/bulk	% blend	CO_2 (kg/ton)	Product Name
Reference					
ChipMong INSEE	Clinker (OPC)	Bag		929.5	Clinker
Baseline (PC and low blend PCB)					
Chip Mong INSEE	PCB	Bulk	8	844.8	Camel Opti Flow
Chip Mong INSEE	PCB	Bag	17	760.5	Camel Strong
Greener alternatives (high blend PCB)					
Chip Mong INSEE	PCB	Bag	43	525.9	Camel Green
Greener alternatives (slag cements PCB_{BFS})					
N/A					

[13] See EPD of ChipMong Cement attached in the appendix.

Local Availability of Fly Ash and Blast Furnace Slag
Cambodia operates several coal-fired thermal power plants, primarily in Preah Sihanouk Province. Below is a table summarizing these facilities, including their locations, capacities, and available information on fly ash production.

Table 5: Coal Power Plants in Cambodia and their anticipated output

Power Plant Name	**Location**	**Capacity (MW)**	**Annual Output (GWh)**	**Fly Ash Production (tons/year)**
Sihanoukville CIIDG Power Station	Stung Hav, Preah Sihanouk	405	~3,000	N/A
Cambodia Electric Limited (CEL) Power Plant 1	Preah Sihanouk Province	270	~2,000	N/A
Cambodia Electric Limited (CEL) Power Plant 2	Preah Sihanouk Province	150	~1,200	N/A

Note: The annual output is estimated based on typical capacity factors for coal-fired power plants. Actual figures may vary.

Data for these plants' respective fly ash output is not publicly available. However, such can be estimated based on typical coal combustion processes. Coal-fired power plants produce approximately 10% of their coal consumption as fly ash. Given that one megawatt-hour (MWh) of electricity generation consumes about 0.5 tons of coal, a combined annual output of 6,200 GWh would lead to 310,000 tons of fly ash.

Cambodia has no known blast furnaces for steel production, as described in the later steel section; hence, blast furnace slag as a supplemental cementitious material in cement has minimal availability in Cambodia unless imported. Steel production yields slag at about 10% to 15% of raw steel output.

A study focusing on a cement plant in Cambodia indicated the potential for using biomass, such as wood chips and rice husks, as fuel substitutes to mitigate air emissions[14].

[14] Research Study Kampot Cement Plant Link

C. Description of the concrete market

20. An overview of the concrete market is as follows:

Production. Concrete production can apply several modes, including a) Ready-mix Production at Commercial Batching Plants, b) Ready-mix Production at Mobile Batching Plants, and c) Production Using Mobile Concrete Mixers.
Transportation cost constraints limit delivery distances, necessitating local production hubs. Ready-mix concrete is typically delivered within a 50-80 km radius to ensure quality and cost-efficiency. Commercial batching plants range from 30m³/hour to 150m³/hour, with storage silos typically holding 40-100 tons of raw materials.

Market. Approximately 50-60% of concrete is for residential and commercial building projects. Industrial Applications encompass 20-30%, driven by factories, warehouses, and economic zones, whereas Infrastructure represents 15-25%, including roads, bridges, and government-led infrastructure projects.

21. Overview of the Development of Green Concrete in Cambodia
Sustainable construction is still emerging but is growing steadily due to increased environmental awareness and the adoption of green standards. A key player in this market is Chip Mong Insee Cement Corporation (CMIC), a joint venture between Chip Mong Group and the Thai-based Siam City Cement Corporation (SCCC), which focuses on producing green concrete with sustainable materials and processes. Such development is also the case for its competitor, K-Cement Co. Ltd., a subsidiary of Siam Cement Group (SCG), also based in Thailand.

SCG is a member of the Global Cement and Concrete Association (GCCA) and is committed to producing net zero concrete by 2050. Its efforts support the supply of sustainable materials consistent with green building certification schemes, including making available EPDs for its products.

22. Industry Challenges and Opportunities
Consultations with Cambodian construction firms reveal several insights like those observed in other Southeast Asian markets:

- Low-carbon concrete is often not used for civil engineering projects due to strict specifications from international project donors, which frequently prevents usage for structural components.
- International green building systems are becoming stricter in their criteria and scoring systems, but the construction industry has yet to align with these demands fully.
- Building developers in Cambodia often prioritize operational energy efficiency and location over material sustainability during the early stages of project design. Attention to material credits, such as low-carbon concrete, is typically introduced later in the design process.
- Reuse of construction and demolition waste, such as coarse aggregates, is limited or non-existent due to cost and logistical challenges. Partial credits are sometimes obtained by repurposing rejected concrete batches, which are returned to plants to wash and recover coarse aggregates.

- To address sand scarcity, some local producers experiment using alternative materials, such as granite crusher dust, to replace river sand in fine aggregates. This practice helps them earn sustainability credits.

23. Current Baseline and Innovations in Low-Carbon Concrete

Concrete production in Cambodia essentially uses Ordinary Portland Cement (OPC) as a baseline, with average CO2 emissions of approximately 252.9 kg/m³ (global estimate) for a standard mix for commercial construction. Blended Portland Cements also find usage, with minimal information on content and fractions used. Making this information more accessible and adopting low-concrete innovations could substantially lower the carbon footprint of concrete production.

24. Specifications and Practices in Infrastructure Projects

Infrastructure projects in Cambodia typically specify traditional PC cement to estimate higher costs, especially during project budgeting stages. These requirements are sometimes relaxed during implementation.

25. Sustainable Concrete Products in Cambodia

Producers are researching the use of low-carbon concrete products in Cambodia. K-Cment and CMIC are actively pursuing sustainable practices to reduce their carbon footprint. Both companies have undertaken several initiatives to enhance environmental sustainability; the following are related to CMIC:

Initiative	Chip Mong Insee Cement (CMIC)	K-Cement (SCG Cambodia)
Green Product Development	CMIC EPD Data	SCG Low-Carbon Cement
Solar Power (Renewable Energy) Integration	CMIC Solar Project	SCG Sustainability
Sustainable Limestone Extraction	CMIC Sustainability Efforts	SCG Sustainability
Sustainable Concrete Products	CMIC Sustainability Steps	SCG Low-Carbon Cement
Energy Efficiency Improvements	CMIC Sustainability Steps	SCG Sustainability Report
Waste Heat Recovery (WHR)	CMIC WHR Initiative	SCG Sustainability Report
Alternative Fuels and Raw Materials (AFR)	CMIC Environmental Performance	SCG Sustainability

26. Adoption and Certification

CMIC is currently the only cement producer that provides environmental product declarations (EPDs) for its products. K-Cement provides EPDs related to the Thai manufacturing process for Low-Carbon Cement, which they claim to be similar.

D. Description of the steel market

27. An overview of the steel market is as follows:

Production and Exports. Cambodia's steel production is relatively modest. The country primarily relies on imports to meet its steel demand and does not have a significant steel export market. The focus is on importing steel to support its growing construction sector[15] [16].

Imports. Cambodia primarily imports steel from China, Vietnam, Thailand, and Japan. In 2023, imports were around 13 million tons. The main types of steel imported are hot-rolled coil, galvanized products, and rebar steel[17].

Capacity and Utilization. As of December 2024, there is only one local steel production plant owned by Chinese investor Hong De Sheng (Cambodia) Steel Co. Ltd. in Kampong Speu Province since 2020, mainly producing straight and coiled reinforcing bar and wire rod, likely using electric arc furnace(s)[18]. It utilizes recycled steel and metal scrap as its primary raw materials. Two blast furnace steel production plants are under planning, with locations and planned annual production capacities as shown below.

Table 6: Steel Production Plants, currently under planning

Plant Name	Location	Furnace Type	Anticipated Annual Production Capacity (tons)
Cambodia Iron and Steel Preah Vihear Plant[19]	Rovieng, Preah Vihear	Blast Furnace-Basic Oxygen Furnace (BF-BOF)	1,000,000
China Baowu Phnom Penh Steel Plant[20]	Phnom Penh	Blast Furnace-Basic Oxygen Furnace (BF-BOF)	3,100,000

While specific details on the types of furnaces used are not publicly disclosed, steel mills of this type typically use electric arc furnaces (EAFs) because they melt scrap more efficiently. The environmental impact is significantly lower compared to traditional blast furnaces. This method significantly reduces carbon emissions compared to producing steel from raw materials in blast furnaces (BFs) and blast oxygen furnaces (BOFs). The estimated reduction in carbon emissions is substantial, typically in the range of 60% to 75**%**.

The following table summarizes the information on identified rebar steel suppliers in Cambodia:

[15] Steel Import News 1 Link
[16] Steel Import News 2 Link
[17] Steel Import News 3 Link
[18] Phnom Penh Posr Link
[19] Cambodia Iron and Steel Preah Vihear Plant Wiki Link
[20] China Baowu Phnom Penh steel plant Wiki Link

Table 7: Suppliers for Construction Steel in Cambodia

Company Name	**Type**	**Production Location**	**Annual Capacity**	**EPD Data**
Hong De Sheng Steel[21] [22]	Steel products **from scrap**, including rebar	Kampong Speu Province	500,000 tons	N/A
ISI Steel Supplier	Rebar, others for local construction	Imported - Vietnam	N/A	N/A
Chip Mong (Hoa Phat Vietnam)	Rebar, others for local construction	Imported- Vietnam	N/A	N/A
Bao Tin Steel (Bao Tin Vietnam)	Rebar, others for local construction	Imported - Vietnam	N/A	N/A

Notes: The specific production capacity for most companies is not well-documented in publicly available sources, as are detailed information on their carbon emissions. Environmental Product Declaration (EPD) data for steel rebar production are currently unavailable for these manufacturers.

Besides Hong De Sheng steel, sources do not indicate that the suppliers' imported steel derives from recycled scrap, commonly referred to as "green steel." However, considering the already established technical notes on sustainable building materials in Vietnam, one can assume that green steel can be imported if demanded. However, this means that in addition to the product's manufacturing, the environmental impact of the required transportation should be considered.

28. The following table references the technical notes in Vietnam, showing the potential of importing green steel into Cambodia.

Table 8: CO2 data of rebar steel from recycling scrap in Vietnam

Company	**Type**	**Production location**	**EPD date**	**CO_2 (kg/ton)**
Tung Ho Steel Vietnam Corporation	CB300- CB500, 10-50mm, from scrap	Phu My, Ba Ria Vung Tau, Vietnam	16 Nov. 2023	1,010
VAS Group Nghi Son JSC	CB300- CB500, 10-40mm, from scrap	Nghi Son, Thanh Hoa, Vietnam	10 May 2024	739

[21] Steel Processing Plant News Link
[22] Steel Plant News Link

E. Overall findings of the market analysis for potential opportunities

29. Findings of market analysis for the potential opportunities are summarized in the following Table.

Table 9: Summary of opportunities for improved resource efficiency of asphalt

	Greener alternative	Specification	Ecolabel/ Certification	Annual consumption of conventional material (tons or m3)	Unit cost of conventional material (USD/ton or m3)	Annual availability of greener alternatives (tons)	Unit cost of greener alternative (USD/ton)	% of greener alternative domestic production	Names of possible suppliers	Notes
	Asphalt									
1.0	**Warm-mix asphalt** **Recycled asphalt paving (RAP)**	N/A N/A	N/A N/A			N/A N/A	N/A N/A	0% 0%	*[Summary data]*	> See notes at the bottom of the table
			Virgin Hot-Mix Asphalt (HMA)							
1.1		Grades AC 40/50, 60/70 & 80/90 comply with ASTM or AASHTO	N/A	N/A	N/A estimated $650-900 for asphalt cement			0%	TIPCO (Cambodia) Co. Ltd.	All companies are the main suppliers of Bitumen (Asphalt) Products.
		N/A	N/A	N/A	N/A estimated at $150 to $240			0%	Kampuchea Tela Co., Ltd.	

		N/A	N/A	N/A	N/A estimated at $150 to $240			0%		Apex Industrial Co., Ltd.	
			Warm-Mix Asphalt (WMA)								
1.2	**Warm-mix asphalt**	N/A	N/A			N/A	N/A	0%	Pilot Project Required	N/A	Government & Supplier Initiative required
			Recycled Asphalt Paving (RAP)								
1.3	**RAP (Cold in-place recycling for road refurbishment)**	N/A	N/A			N/A	N/A	0%	Pilot Project Required	TIPCO (Cambodia) Co. Ltd.	The company is currently applying for certification with MPWT.
1.4	**RAP for New Road Construction)**	N/A	N/A			N/A	N/A	0%	Pilot Project Required	N/A	Government & Supplier Initiative required

Notes:

1. Warm-mix asphalt is not yet available on the market. The estimated carbon footprint of hot-mix asphalt typically ranges from 70 to 150 kg CO_2eq per ton; this can be reduced by up to 30% when using WMA.
2. No records of the RAP utilization or available RAP stockpile exist.
3. There is no record of overall cost performance for both alternatives.
4. For RAP, the price range depends on whether such is assumed free or charged.
5. For RAP utilization, HMA can be reduced by approximately 20% when using 30% Reclaimed Asphalt Pavement (RAP), and 27% with 50% RAP.

Table 10: Summary of opportunities for improved resource efficiency of cement

	Greener alternative	Specification	Ecolabel/ Certification	Annual consumption of conventional material (tons or m3)	Unit cost of conventional material (USD/ton or m3)	Annual availability of greener alternatives (tons)	Unit cost of greener alternative (USD/ton)	% of greener alternative domestic production	Names of possible suppliers		Notes
	Cement										
2.0	**Blended or Compiled cements (PCB or PCC)**		2 companies have EPDs	N/A	N/A	N/A	N/A	100%	[Summary data]		> See notes at the bottom of the table
			OPC								
2.1		ASTM 150 GB175 2007 TIS15-2547	No	1.8M tons total	$95.00				CONCH OPC Type I	Battambang Conch Cement Co Ltd	Bag, no CO2 data
		TIS 2594-2556 ASTMC1157 GU	No	N/A	$97.00				Kongchack Red OPC Type I	Asia Cement Co Ltd	Import from Thailand Bag, no CO2 data
		TIS 15 Part1 2555 ASTMC1157 GU	No	13.5M tons total	$97.00				TPI Polene PC Type I (Red)	TPI Cement (Laos) Co Ltd	Import from Thailand Bag, no CO2 data
			PCB with EPD or Ecolabel								
2.2		TIS 2594-2556 ASTM C1157.	EPD			1.5M tons total	$101.00	100%	Camel Opti Flow	Chip Mong Inseen	PCB Bulk, % blend not disclosed, 844.8 kgCO2eq/ton

		TIS 2594-2556 ASTM C1157/C1157M Type GU.	EPD			1.5M tons total	$101.00	100%	Camel Strong	Chip Mong Inseen	PCB Bag, % blend not disclosed, 760.5 kgCO2eq/ton
		TIS 80-2550	EPD			1.5M tons total	$101.00	100%	Camel Green	Chip Mong Inseen	PCB Bag, % blend not disclosed, 527 kgCO2eq/ton
		TIS 2594-2556 GU ASTM C 1157 GU	TPIL Green Label			13.5M tons total	$98.50	N/A	TPI Polene (299) Hydraulic Cement	TPI Cement (Laos) Co Ltd	PCB, % blend not disclosed, no CO2 data
		ASTM C595	EPD (Thailand)			2.2M tons total	$101.00	100%	K Cement Low-carbon	Kampot Cement Co Ltd	PCB Bag, 83-86 % clinker, 789 kgCO2eq/ton
		ASTM C595	EPD (Thailand)			2.2M tons total	$101.00	100%	K Cement Low-carbon	Kampot Cement Co Ltd	PCB Bulk, 83-86 % clinker, 784 kgCO2eq/ton
			PCB without EPDs or Ecolabel								
2.3		ATSM C595	N/A			1.8M tons total	$95.00	N/A	CONCH PCB	Battambang Conch Cement Co Ltd	PCB bulk, % blend not disclosed, no CO2 data
		TIS 80 2550	N/A			N/A	$97.00	N/A	Kongchack PCB Hydraulic Cement	Asia Cement Co Ltd	PCB bulk, % blend not disclosed, no CO2 data * No offiical label reference found
		TIS 80 2550	N/A			N/A		N/A	TPI Mixed Cement 199	TPI Cement (Laos) Co Ltd	Import from Thailand Bag, no CO2 data

Notes:

1. Green alternative is on the market.
2. Conventional product (OPC) still exists as a) standards may require its use for high strength concretes 50MPa or higher, b) it minimizes transport costs to ready-mix plants if blending will occur there, and c) designers or contractors may select it for reliability.
3. The fly ash stockpile in Cambodia is limited, with insufficient processing and management quality.
4. The lower cost of PCB encourages its use.

Table 11: Summary of opportunities for improved resource-efficiency of concrete

	Greener alternative	Specification	Ecolabel/ Certification	Annual consumption of conventional material (tons or m3)	Unit cost of conventional material (USD/ton or m3)	Annual availability of greener alternatives (tons)	Unit cost of greener alternative (USD/ton)	% of greener alternative domestic production	Names of possible suppliers	Notes
Concrete										
3.0	**Low-Carbon Concrete**		1 company has EPDs			N/A	N/A	N/A	[Summary data]	> See notes at the bottom of the table
	Carbon Mineralization Concrete (CMC)		N/A			N/A	N/A	N/A		
		Conventional Ready-Mix Concrete								
3.1		ASTM and EU	EPD exists for cement	N/A estimated As 10-15,000 m3 per day	$60 -75			N/A	Chip Mong Concrete Co. Ltd.	Chip Mong Concrete operates 14 batching plants across Phnom Penh, Kandal, and Sihanoukville, supported by a fleet of over 300 mixing trucks
		ASTM	N/A	6,000 m3 per day	$50 -65			0%	DIPB Cement Co., Ltd.	DIPB has 7 Batching Plants mostly outside Phnom Penh
		Low-carbon Ready-Mix Concrete								

3.2	**Low-Carbon Concrete**	ASTM, EU, and TCVN	EPD		$60 -75	48,000	$65-75	100%	CPAC (Cambodia) Co. Ltd.	CPAC uses Low-Carbon Cement (K-Cement) in combination with fly ash (20-30% for normal strength, 55-75% for high value-added strength) and additives. The company has altogether 24 batching plants % GWP (Total): Approximately 353-396 kgCO2eq. per m3
		ASTM, EU, and TCVN	N/A (likely to be similar to CPAC)		$60 -75	N/A	$65-75	100%	K-Concrete Co. Ltd.	K-Concrete uses Low-Carbon Cement (K-Cement) combined with fly ash (20-30% for normal strength, 55-75% for high value-added strength) and additives. The company has altogether five batching plants.
		Carbon Mineralization Concrete								
3.3	**Carbon Mineralization Concrete (CMC)**	TCVN 9340, ASTM C494 - Type S	N/A			N/A	N/A	0%	N/A	Carbon mineralization concrete incorporates carbon mineralization, a process in which carbon dioxide (CO_2) reacts with minerals (e.g., calcium or

										magnesium oxides) to form stable carbonates. This technique permanently sequesters CO_2 while improving concrete properties such as strength and durability.

Notes:
1. Low-carbon concrete is slowly coming to the market.
2. With multiple ready-mix concretes on the market, they are usually driven by cost competition and focus on conventional concrete mixtures.
3. Strength proofing prioritizes ensuring that the concrete meets the required specifications for structural integrity over environmental considerations.
4. Currently, there is no proof of the availability of CMC

Table 12: Summary of opportunities for improved resource efficiency of reinforcement steel

	Greener alternative	Specification	Ecolabel/ Certification	Annual consumption of conventional material	Unit cost of conventional material (USD/ton or m3)	Annual availability of greener alternatives (tons)	Unit cost of greener alternative (USD/ton)	% of greener alternative domestic production	Names of possible suppliers	Notes
	Reinforcing Steel									
4.0	**Rebar produced from scrap**	Several, depending on the importing or partnering country, i.e., TCVN 1651-1 JIS G 3112 ASTM A615/A706	1 firm produces steel from scrap	N/A	N/A	N/A	14.1	N/A	[Summary data]	> See notes at the bottom of the table
4.1		**Rebar produced from Virgin steel**								
		TCVN 1651-1 JIS G 3112 ASTM A615/A706	No		N/A estimated at $470				Hoa Phat Steel (Import VN) Chip Mong Trading Co. Ltd.	Virgin steel production emits approximately 2.77 tons of CO_2eq per ton of steel.
4.2		**Rebar produced from scrap**								
		N/A	N/A			500,000	N/A estimated at $500	100%	Hong De Sheng Hong De Sheng Steel Co Ltd	Steel made from recycled materials can reduce emissions to

											around 1.40 to 1.86 tons of CO_2eq per ton.
		TCVN 1651-2018	N/A			N/A	$540-575	N/A	VNSTEEL (Import VN)	Chip Mong Trading Co. Ltd.	
		TCVN 1651-1	(Documentation for LEED)			N/A	$530-540	100%	Pomina Steel (Import VN)	Bao Tin Steel Co. Ltd.	

Notes:
1. Steel produced from scrap reduces CO2 emissions by 50–70% compared to virgin steel produced in a coal-fired blast furnace, making it a more sustainable option for the construction industry. However, this depends on factors such as the energy mix (e.g., renewable vs. fossil fuels), process efficiencies, and the region's infrastructure
2. The estimated domestic consumption of construction steel in Cambodia is between 1 and 2 million tons, driven by urbanization and infrastructure development projects.
3. The pricing of virgin steel and steel from scrap depends on the international market prices of iron ore and scrap. Consequently, the market share between these two types of steel fluctuates. Imports of both steel and scrap also contribute to price volatility, which is further influenced by regional economic factors, production methods, import duties, and logistics.
4. Regional trade practices and the demand for recycled materials in construction shape the import of scrap steel. The reference price for scrap steel typically ranges between $380 and $420 per ton, depending on international market conditions and transportation costs.
5. Suppliers in Cambodia adopt varied pricing strategies. These include ex-factory prices, pricing at distribution centers in significant provinces (e.g., Phnom Penh), or delivered-to-site costs. This diversity complicates direct price comparisons, adding another layer of complexity to market dynamics.

V. ENVIRONMENTAL IMPACT OF MATERIAL IMPORTS

30. As part of this market analysis, the import aspect is crucial for several reasons. Cambodia's domestic production capacity for materials such as steel, cement, and advanced green alternatives is relatively underdeveloped. For example, the country's minimal steel production leads to a shortage of byproducts, such as blast furnace slag, which can be used in green building materials. This shortage requires importing such materials to meet local demand.

31. Countries with well-established industries produce cutting-edge, greener building materials like low-carbon cement, recycled steel, and innovative composites. Importing these products allows Cambodia to access materials that meet international environmental and performance standards and may not be available locally. Imported building materials often influence local market prices. Fluctuations in global supply chains, transportation costs, and tariffs directly affect the affordability and feasibility of adopting greener alternatives. Analyzing these dynamics is critical to understanding the economic viability of greener building materials.

32. Cambodia is part of a highly interconnected regional market, particularly within ASEAN. Countries with more advanced manufacturing capabilities, such as Thailand, Vietnam, and China, are essential suppliers of building materials. Import trends open opportunities for collaborations and trade agreements to support the adoption of greener materials.
As part of green building material consideration, the carbon footprint associated with importing them—due to transportation and logistics—can offset some environmental benefits. Therefore, analyzing the trade-off between importing green materials and developing local manufacturing capabilities is essential. For better clarity, the following Table overviews the primary importing countries for each material and integrated routes:

Material	**Primary Importing Countries**	**Import Logistics**	**Key Routes/Ports/Border Points**
Asphalt (Bitumen)	Singapore, Thailand, Vietnam	Imported via sea in bulk, stored at terminals near ports, and transported inland to construction sites via road or rail.	- **Sihanoukville Port** (primary entry point for sea imports)- Transported inland via **railway** (Sihanoukville-Phnom Penh)- Overland imports via **Thailand**.
Supplementary Cementitious Materials (SCMs)	Vietnam, Thailand, Indonesia	SCMs like fly ash and slag are imported via sea and river. Smaller quantities may arrive via land routes.	- **Sihanoukville Port** (sea imports)- **Mekong River** (imports via **Vietnam** ports like Cái Mép and Saigon)- Overland routes from **Vietnam** and **Thailand**.
Steel	China, Vietnam, Thailand	Imported in bulk via sea and land; large shipments are handled through ports, while smaller consignments may arrive by road.	- **Sihanoukville Port** (sea imports)- **Mekong River** (imports via Vietnam)- Overland routes via **Thailand** (e.g., Poipet, Cham Yeam).

Cement	Vietnam, Thailand, China	Imported as bagged cement or clinker. Complementary to domestic production, clinker is used in local grinding facilities while finished cement is ready.	- **Sihanoukville Port** (sea imports)- **Land borders** with **Vietnam** (e.g., Bavet) and **Thailand** for smaller consignments.

Notes

- Sihanoukville Port: Central hub for large-scale imports arriving by sea, including bitumen, SCMs, steel, and clinker. The port connects to Phnom Penh and other regions through a railway line and road network.
- Mekong River: Supports imports from Vietnam, particularly SCMs, steel, and smaller quantities of asphalt and cement, leveraging Vietnamese ports for river transport.
- Land Routes from Thailand: Vital for overland transport of construction materials, including steel, cement, and asphalt, primarily through road networks, with key border crossings at Poipet (near Siem Reap) and Cham Yeam (near Koh Kong).
- Regional Trade: Vietnam and Thailand combine steel, cement, and asphalt. China is a major supplier of steel.

Cambodia's dependence on imports requires policy frameworks that promote sustainable procurement and regulate imported materials' quality and environmental impact. Market analyses must consider how these policies can encourage greener building practices.

VI. CERTIFICATION

A. Introduction

33. The terms of reference include investigating and recommending the existence or possibilities for implementing a national green certification scheme and an Environmental Product Declaration (EPD) or equivalent scheme. This section first introduces the sustainable building certification schemes relevant to Cambodia and then the product certifications that are often associated with these building certification schemes.

B. Sustainable buildings certifications

34. Sustainable building certifications assess and recognize buildings that meet certain sustainability requirements or standards. Governmental, non-governmental or mixed entities may administer these rating systems. Some call themselves National Green Building Councils of the global World Green Building Council (WorldGBC), a network representing many of the world's building certifications. However, there are also independent green building rating systems.

35. Considering Cambodia, the notable schemes that have been considered in this study are as follows:

- LEED – The “Leadership in Energy and Environmental Design” building assessment scheme from the United States is an internationally applicable scheme recognized worldwide. In Cambodia, so far, 12 buildings are LEED-certified[1].

Platinum	1
Gold	9
Silver	1
Certified	1
Total	**12**

- EDGE Building – Developed by the International Finance Corporation (IFC), the EDGE (Excellence in Design for Greater Efficiencies) certification system improves sustainability and resource efficiency in the design and operation of buildings. It mandates a reduction in energy consumption, water use, and embodied energy by at least 20% compared to traditional practices. Currently, EDGE has three buildings certified for Cambodia[2].
  EDGE assesses energy consumption in the production of building materials – including extraction, manufacturing, and transportation – to help builders select materials with a lower carbon footprint. The app also suggests alternatives such as fly ash concrete or recycled steel to minimize environmental impact.
  The system is particularly beneficial in emerging markets, where resource efficiency and cost savings are essential for sustainable urban growth. The cloud-based software allows designers to enter project specifications and calculate resource efficiency, providing insights into material selection, operational efficiency, and potential cost savings.

[1] Certified LEED projects in Cambodia as of December 2024 Link
[2] Certified EDGE Building projects in Cambodia as of December 2024 Link

- CamGBC – The “Cambodia Green Building Council” is a private organization promoting sustainable building practices across Cambodia. Its CAMEEL rating system we are aligned with WGBC’s Quality Assurance Guide for Green Building Rating Tools in terms of green building rating tool development, implementation, and operations. CamGBC provides a building certification system adapted from the LEED framework. While the organization offers a structured pathway to recognize and certify green buildings, it is important to note that no projects in Cambodia have achieved certification under the CamGBC system[3].

- CamGCGB – The CamGCGB (Guidelines and Certification for Green Building) is a separate certification framework currently in its legislative draft stage. Designed for application to both new and existing buildings, CamGCGB represents a comprehensive set of guidelines tailored to the Cambodian context, focusing on sustainability, energy efficiency, and environmental performance[4].
  The system is poised to be formalized into a statutory regulation, referred to as a Praka, under the jurisdiction of two key government bodies, the Ministry of Environment (MoE), which oversees environmental protection and sustainable development policies, and the Ministry of Land Management, Urban Planning and Construction (MLMUPC), which governs land use, construction standards, and urban planning.
  The aim of the CamGCGB is to institutionalize green building principles into Cambodia's regulatory framework. Once enacted, it will provide legally binding guidelines for developers and property owners to follow, ensuring consistent and enforceable standards for sustainable construction.
  The CamGCGB system is based on adapting selected criteria from the South Korean G-SEED system and the German DGNB system, which was the first to include a life cycle assessment as well life cycle costing for material uses and building operations. However, market studies showed that there is currently insufficient capacity to conduct such an assessment on a widespread basis. The life cycle assessment criterion is temporarily removed and will be introduced in later development phases when capacity building through training and database development would enable such an introduction.

36. The scoring systems are somewhat similar across the schemes, with highest weighting given to energy efficiency during use, to location and transportation, and to indoor environmental quality etc. In contrast, the weighting given to materials and resources used is construction is relatively low, typically around 10-15% of the score.

37. The schemes continue to evolve and issue new versions.
- LEED v4.1 also awards points for a) having at least 20 products from at least 5 different manufacturers each having an EPD type III[5], and b) having at least 5 products from at least three different manufacturers that have a compliant embodied carbon optimization report or action plan separate from the Life cycle analysis or EPD[6].

[3] CamGBC website Link
[4] Cambodia Guidelines and Certification for Green Building (CamGCGB) Link
[5] Highest points are given for a product specific EPD, externally reviewed, compliant with both ISO 14025 and either EN 15804 or ISO 21930
[6] The LEED points system relating to EPDs is complex, it is found in full at Link

- The EDGE system, version 3.1.0, uses predefined settings to calculate the material efficiency of building components based on industry standards and life cycle assessments, providing reliable estimates for embodied energy and resource impacts. It features a comprehensive database of materials like concrete, steel, bricks, and wood, with predefined values for embodied energy and carbon footprints derived from recognized life cycle inventory data. It adjusts material impacts using regional settings for local manufacturing processes and transportation distances, ensuring relevant results. The system provides default material intensity values for walls, floors, roofs, and facades, allowing users to select or modify materials to improve efficiency and assess their impact on embodied energy. The system sets benchmarks to encourage reductions in embodied energy by promoting alternatives with lower carbon footprints providing immediate feedback on savings from material adjustments. It enables real-time experimentation with materials while emphasizing cost-effective strategies that maintain structural integrity and aesthetics. For EDGE certification, a building must reduce its embodied energy by at least 20% compared to a baseline, with simplified calculations through predefined settings.

38. Examination of scoresheets of LEED buildings in Cambodia showed that they tend to score poorly for the section of materials and resources used. This may be because LEED now emphasizes whole-life carbon calculation, use of materials having EPDs, and use of recycled aggregates, but these methods are not yet in everyday use.

39. The EDGE-certified buildings in Cambodia vary in their ability to reduce embodied energy contained in materials. Two projects focus primarily on energy and water efficiency measures, resulting in moderate embodied energy savings. The third project, an adaptive reuse of an existing building, reduces embodied energy by reusing materials such as floor slabs, roofs, and walls. While this approach minimizes waste and meets sustainability goals, it does not significantly reduce embodied energy compared to potential innovative material alternatives.
The limited progress in reducing embodied energy can be attributed to several factors. Reliance on imported materials limits access to low embodied energy options, and sustainable materials often have higher upfront costs and limited availability. Therefore, the cases highlight the need for more locally sourced, sustainable materials and improved green building practices to reduce embodied energy.

C. Product certification

40. The driving forces behind the development of product certification of sustainable building materials appear to be (a) the ability of a developer to earn points towards a sustainable building certification by using product-certified materials and (b) the import certification requirements, in particular for the EU carbon border tax, the transition period of which started on 17 May 2023. This may sound redundant because there are limited export products for the construction industry produced in Cambodia. However, broader trends in sustainability and international trade suggest that product certification remains relevant and potentially crucial for the future.
To understand what a green certification represents and the quality of information it provides, the details of its requirements need to be reviewed carefully. The ISO defines different types of labels that can be used for products. Below is an outline of the ISO-defined labels in the 14000 series and what is being claimed. Product certifications in the United States are mostly Type I and Type II labels. In contrast, Type III labels are becoming more common in Europe and for manufacturers with an international focus.

Table 13. ISO-defined Types of Green Product Certification Labels

Type	ISO Number	What the label does
Type I	ISO 14024	Seal of approval for multi-attribute requirements
Type II	ISO 14021	Verifying single-attribute environmental claims for energy consumption, emissions, or recycled content. It can be first-party, self-declared manufacturer claims. However, many manufacturers are beginning to seek third-party verification of those claims in response to industry demand.
Type III	ISO >14025	Comprehensive environmental product disclosure and detailed product information. Like an Environmental Product Declaration (EPD)

41. Two types of certificates sre considered:
    1. ISO 14024 Type I Certificates issued by Green Building Councils or other entities
    2. ISO 14025 Type III Certificates issued by Environmental Product Declaration program operators

42. **Type I Certificates**. There are several major manufacturers in the Cambodian cement industry, but publicly available information on ISO Type I eco-label certifications has not been published. Chip Mong Insee Cement Corporation (CMIC) and Kampot Cement Co., Ltd., the most prominent players in the market, emphasize sustainability but do not have published Type I certification details. Other notable manufacturers include Battambang Conch Cement Co., Ltd., Cambodia Cement Chakrey Ting Factory Co., Ltd., and Thai Boon Roong Cement Co., Ltd., all of which publicly contribute to local production but do not offer certification information.

43. **Type II Certificates.** Cambodia is not currently listed in the Southeast Asia EPD library[7]. However, an examination of the EPD library revealed that in Cambodia's rebar, cement, and asphalt categories, only one company had an EPD for four of its cement products, which is Chip Mong Insee Cement Cooperation[8].

44. While LEED accepts Type I certificates for low-emitting materials, they are not typically used to demonstrate resource efficiency and low-carbon footprint as part of the certification process. Instead, LEED focuses on comprehensive Environmental Product Declarations (EPDs) and other third-party certifications that provide detailed information about a product's environmental impacts, including its carbon footprint and resource efficiency.

45. **Other certificates.** As part of sustainability efforts, the Cambodian government has collaborated with international organizations to establish eco-labeling for construction materials. These aim to promote materials with lower environmental impacts, although detailed product-level eco-labels are still emerging[9].

[7] EPD Library Database, listing ISO 14024 accredited products Link
[8] EPD Library Seach Link
[9] UNESCAP/Cambodia ECO Label in Construction: Policy Brief Link

D. Conclusions Regarding Certification Schemes

46. The following conclusions are made regarding sustainable building and building materials certification schemes:

1. The green building systems have a clear objective and substantially meet that objective. However, materials and their embodied carbon account for around 10-15% (LEED) to 30% (EDGE) of the rating score.
2. These building certification systems are not appropriate for use on infrastructure projects. For civil engineering, disclosure of CO_2 emissions and cement composition is fundamental to comparing alternative design solutions or bids; hence, using EPD declarations seems essential.
3. Current product certification systems lack quantitative data for asphalt, cement, or steel, which would not contribute to the case of civil works (although one firm's steel is identified as being produced from recycled materials). LCAs using databases with general material information would be required to determine sustainable options.
4. LEED gives credits for using whole-life carbon assessment, and submission of EPDs seems to drive moves towards more widespread use of EPDs. However, in Southeast Asian countries, LEED primarily aims at high-end developments related to international corporations, constituting a usually modest fraction of the country's construction sector.
5. Addressing various factors, including building certifications and the specific needs of urban and rural infrastructure projects, is essential for effectively incorporating green construction materials. In Cambodia, where infrastructure is rapidly expanding and rapid urbanization is occurring, Environmental Product Declarations (EPDs) can support the transition to greener construction practices.
6. Creating an EPD requires analyzing input material and energy data over a defined production period, typically one year. Providing precise and comprehensive life cycle analyses, EPDs help identify sustainable alternatives, which is key for making informed procurement decisions. EPDs further facilitate sustainable choices that align with environmental goals when combined with life cycle costing.

- For pavements constructed with asphalt, EPDs play a critical role. These EPDs cover asphalt mixtures and aggregates.
- Likewise, creating an EPD for cement involves assessing the environmental impact of the materials used and the production process. This analysis can significantly influence the selection of more sustainable options for construction projects.
- For concrete, ready-mix plants in Cambodia may face challenges due to the diversity of concrete mixes they produce. Developing specific EPDs for custom mixes, such as those required for large-scale developments, can be time-intensive. However, cement EPDs, being more standardized, offer a more practical solution and are particularly useful for projects in less developed areas.
- Adopting EPDs for reinforcement steel in Cambodia could significantly enhance the sustainability of construction projects. When steel is produced from recycled scrap, substantial CO_2 reductions are achieved, which may reduce the immediate need for detailed EPDs during the early stages of adoption. However, as green practices continue to gain traction in Cambodia's growing construction sector, EPDs will become increasingly essential for ensuring long-term environmental performance.

VII. CONCLUSIONS AND WAY FORWARD

47. Opportunities identified and an assessment of their relative potential are summarized as follows:

- Asphalt currently has a low potential for improved resource efficiency in Cambodia. Greener products such as warm asphalt and recycled asphalt plannings (RAP) are not yet available on the market due to higher costs, time requirements, and limited demand, despite offering an estimated CO_2 reduction of around 16% with 20% RAP content.

- Cement is considered to have moderate potential for improved resource efficiency. Cambodia imports significant cement from neighboring countries like Vietnam and Thailand. These countries can access supplementary cementitious materials such as fly ash (PFA) and blast furnace slag (BFS), used in blended cement to reduce CO_2 emissions. Over time, greener blended cement products (e.g., PCB) have gained traction in Cambodia due to their relatively lower cost. However, further optimization of cement usage is necessary, and future improvements will depend on incorporating CO_2 emission reduction criteria into purchasing decisions alongside price considerations.

- Concrete is considered to have relatively good potential as a candidate for improved resource efficiency in Cambodia. Products offering reduced CO_2 emissions, such as concrete made with partial replacement of PCBs, are becoming available on the market. These products can achieve CO_2 emission reductions of up to 30% or more at a small price premium. However, the opportunity is constrained by the limited availability of blast furnace slag, which is in high demand regionally. Expanding resource-efficient concrete adoption in Cambodia will require efforts to increase the supply of sustainable inputs and greater awareness among construction stakeholders.

- Reinforcement Steel is considered to have a high potential for improved resource efficiency. Cambodia already has one plant producing steel from recycled scrap, which typically offers 50 – 70% CO_2 reduction compared to virgin steel. Reinforcement steel supply heavily depends on imports from neighboring countries such as Vietnam and Thailand, and purchasers could, if they so wished, easily switch from a selection of virgin steel in favor of the rebar produced from scrap.

48. As the following steps, the issues proposed for study and verification are as follows:

- **Asphalt.** Verification with sector agencies [10] to determine whether adoption of the proposed greener alternatives forms part of their decarbonization strategy in the short term.

[10] The Ministry of Public Works and Transport (MPWT) oversees the planning, development, and maintenance of the national road network, including asphalt road construction and related policies. The General Department of Transport

Cement and concrete. Verification by sector agencies[11] that current design regulations, cost norms, and contract forms do not hinder optimal resource efficiency or else make proposals to remedy any issues identified. Industry agencies should consider risk allocation when selecting cement and concrete solutions. Such can be through a prescriptive approach by regulators or customers, who further bear the risk, or by incentivizing contractors to select solutions by giving them the freedom to choose compliant solutions and thereby bear a higher risk.

- **Reinforcing steel.** Verification by sector agencies[12] that there are no technical issues with production and quality control of reinforcing steel made from scrap that could limit its wider usage, or else make proposals to remedy any problems identified.
  Verification by sector agencies promoting the greener alternative and reducing the usage of the standard product would not result in unacceptable negative economic impacts on producers of the standard product, or if there are, propose a transitional timeline to mitigate their effects.

49. Regarding the issues for verification mentioned above, the following additional information is noted:

- **Asphalt.** Reclaimed asphalt pavement (RAP) reuse is limited in Cambodia due to challenges in material variability and lack of demand for its reuse.

(GDT), part of the MPWT, manages road infrastructure such as asphalt roads and highways, working closely with local authorities and stakeholders. The Ministry of Environment (MoE) sets environmental standards for construction materials like asphalt, ensuring compliance with Cambodia's regulations. The Cambodian Construction Industry Development Council (CIDC) promotes the construction industry, providing guidance and standardization for asphalt road projects. The National Standardization Agency of Cambodia (ISAC), under the Ministry of Industry, establishes standards for construction materials, ensuring quality and safety. Provincial and Municipal Departments of Public Works and Transport oversee local infrastructure projects that involve asphalt.

[11] The Ministry of Industry, Science, Technology & Innovation (MISTI) oversees cement manufacturing and construction materials in Cambodia, establishing standards for industrial processes. The Ministry of Public Works and Transport (MPWT) plays a key role in infrastructure regulation, including road construction and building standards, and ensures compliance with safety requirements for cement and concrete projects. The Ministry of Environment (MoE) regulates the environmental impacts of cement production, focusing on emission standards and waste management to minimize CO2 emissions. The Cambodian Building and Construction Materials Association (CBCMA) collaborates with the government to advocate for the cement and construction materials industry, helping to develop relevant standards and policies. The Cambodia Development Resource Institute (CDRI) contributes to sustainable development standards and practices in construction, working with government agencies to improve materials and methods. The National Standardization Council of Cambodia (NSCC), under the Ministry of Industry, sets national standards for construction materials like cement and concrete, ensuring safety, quality, and environmental compliance.

[12] The Ministry of Industry, Science, Technology and Innovation (MISTI) oversees industry standards and quality control for construction materials like rebar. The Ministry of Public Works and Transport (MPWT) establishes standards for construction materials in public projects. The Ministry of Land Management, Urban Planning, and Construction (MLMUPC) regulates building permits and sets quality guidelines for materials, including rebar. The Cambodian Constructors Association (CCA) collaborates with the government to promote construction standards. The Institute of Standards of Cambodia (ISC) develops and enforces national standards for construction materials. The Cambodia General Department of Customs and Excise (GDC) regulates the import and export of construction materials. Finally, the Ministry of Mines and Energy (MME) oversees raw material extraction and indirectly regulates the rebar supply chain.

Batching plants can typically handle 25-40% RAP without significant modifications. However, achieving a higher RAP content would require investment in specialized equipment, such as RAP pre-heating systems.

- **Cement and Concrete.** Understanding current resource efficiency in Cambodia requires examining local project case studies and identifying practical factors influencing client and contractor decisions. Factors such as material availability, cost, and project-specific constraints play a role. Incremental efficiency improvements may be achievable on a project-by-project basis. For example, composite cements are already available in the market due to their lower cost and availability. Still, opportunities for further optimization exist through improved mix designs and supplementary materials like fly ash or slag, subject to their availability.

  Reinforcing Steel. Although Cambodia currently relies on imported steel, global trends may influence its market. If regional markets like Vietnam and Thailand aggressively promote the use of scrap for steel production, demand for scrap metal could increase significantly. Such would drive competition at international scrap auctions in the US, Korea, and Japan, potentially increasing the cost of inputs for Cambodian producers and importers who rely on these same markets. Some concerns exist about the quality of rebar produced from scrap. Independent testing and adopting international standards could help achieve greater confidence in steel quality.

50. **Mechanisms to Promote Resource Efficiency**. While this study identifies opportunities to enhance resource efficiency, further discussions with Cambodian stakeholders are essential to determine appropriate promotion mechanisms. Regulatory options may include mandating minimum RAP content in asphalt or incentivizing greener products like blended cement through price preferences in procurement. Although not yet implemented in Cambodia, a cap-and-trade mechanism could be explored as a long-term strategy to reduce greenhouse gas emissions and encourage sustainable practices in the construction sector.

51. **Way Forward.** This study explored opportunities to enhance resource efficiency and promote sustainable alternatives in asphalt, cement, concrete, and steel. Most suppliers need to increase transparency regarding the environmental benefits of their products to permit comparison between other options. Government budgeting and cost estimation regulations must also reflect greener alternatives in project cost calculations at the feasibility and detailed design phases. Essential information should consist of the following:

a) product composition and/or manufacturing method
b) carbon footprint, and
c) standard/grade/material properties

Further engagement with Cambodian stakeholders is needed to identify effective mechanisms for promoting these sustainable alternatives, ensuring alignment with national priorities and practical implementation in the construction sector.

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APPENDIX 1: QUESTIONNAIRE FOR COMPARISON BETWEEN THE STUDY COUNTRIES

1.0 Regulatory Framework and Environmental Standards		
1.1	Are there national strategic goals to promote sustainable development and circular economy, including resource efficiency in the construction sector?	Yes. Cambodia's Nationally Determined Contributions (NDC) aim for net-zero emissions by 2050, with a target of 41.7% reduction below business-as-usual levels by 2030. The pledge includes sector-specific goals: 50% reduction in forestry and land use, 40% in energy, 23% in agriculture, 42% in industry, and 18% in waste. The country plans to utilize both international support and domestic innovations to achieve these targets. Cambodia's National Circular Economy Strategy and Action Plan (2021-2025) aims to transition from a linear to a circular economy, focusing on sustainable growth in the construction sector. The plan seeks to promote a prosperous economy, an inclusive society, and a healthy environment through efficient use of resources. Key initiatives include:' a) Procurement - Promoting sustainable energy and materials in construction and real estate. - Developing alternatives to single-use plastics using recycled materials. - Creating eco-industrial parks by assessing infrastructure needs and improving existing EIA requirements. b) Manufacturing - Improving raw material efficiency and promoting sustainable construction. - Advocating for green construction practices that prioritize energy and water efficiency. c) Recycling - Implementing strategies to reduce construction waste and promote reuse of materials. - Improve waste management systems and promote the 4Rs (Reject, Reduce, Reuse, Recycle). - Establish policies for recycling demolition materials and household waste. In addition, Cambodia plans to develop a Sustainable Consumption and Production (SCP) plan to mitigate environmental impacts in various sectors.
	If YES, please give details of strategic goals related to:	
	a) Sourcing	
	b) Manufacture	
	c) Recycling	
1.2	Do the laws and regulations of country set a specific target for achieving resource efficiency in the use of critical construction raw materials – Asphalt, cement, concrete and steel?	Yes/No. While there are no specific targets for asphalt, cement, concrete and steel, existing legal frameworks, policies and action plans guide the construction sector towards sustainable procurement, manufacturing and recycling practices. Results related to resource efficiency in construction: a) Energy efficiency/captured carbon: - Promote the use of sustainable energy and materials and energy efficiency: Cambodia aims to promote sustainable
	If YES, please give details of the relevant regulatory framework.	
	a) Energy Efficiency/Embodied Carbon	
	b) Water use	
	c) Mining of raw materials	

		energy and energy efficiency in various sectors, including the construction and real estate sectors, by implementing pilot initiatives and developing benchmarks. - Develop and implement energy efficiency enabling legislation: These include a national energy efficiency policy, a sub-decree on energy efficiency, and green building guidelines. - Promote sustainable building designs: These include energy efficiency requirements in new buildings. b) Water use: - Sustainable water use: Promote the reduction of drinking water demand by recycling wastewater and using local sources and rainwater. - Reduce water use and minimize water pollution: This is a goal for sustainable building design. - Implement all measures in Cambodia's National Biodiversity Strategy and Action Plan (2016) under "Theme 7: Sustainable Water Resources". c) Mineral resource mining: - Ensuring that mineral resource mining does not occur in protected areas: Sources emphasize promoting responsible mining practices and ensuring that mining activities do not negatively impact protected areas. - Implementing all measures set out in Cambodia's National Biodiversity Strategy and Action Plan (2016) under "Theme 4: Sustainable Mining." - Establishing a legal instrument for artisanal and small-scale mining to ensure safe, efficient, and environmentally sustainable practices. Relevant laws and regulations: - The Law on Environmental Protection and Natural Resources Management (1996) provides a framework for environmental protection and natural resource management in Cambodia. - Sub-Decree No. 72 on the Procedure for Environmental Impact Assessment (1999): Outlines environmental impact assessment requirements for projects and activities that could potentially impact the environment, including construction and resource mining. - Water Resources Management Law (2007): Provides scope for the development of technical standards and for monitoring and controlling the disposal of water-polluting substances. - Sub-Decree No. 42 on Urbanization of the Capital, City and Urban Areas (2015): Regulates land use and construction activities in urban areas, including Phnom Penh, to promote sustainable development and environmental protection. - Environmental and Natural Resources Code: This code outlines the principles of environmental protection and natural resource management in Cambodia. It includes provisions on sustainable public procurement and producer responsibility aimed at promoting resource efficiency. - Public Procurement Law (2023): Includes Green Public Procurement (GPP) but lacks specific environmental criteria or guidelines. - Roadmap and Action Plan for Sustainable Public Procurement (2024-2035): This plan sets out strategic objectives and measures to promote sustainable consumption and production, including in the construction sector.

1.3	Please provide information on government economic policies or financial incentives, such as tax breaks, subsidies, grants, or other support mechanisms for construction materials.	Yes/No There are no specific incentives for construction materials such as asphalt, cement, concrete, and steel; broader government policies encouraging sustainable practices and resource efficiency could indirectly support the construction sector by promoting environmentally friendly materials. Future government strategies include several economic policies and financial incentives aimed at sustainable procurement and a circular economy, which could impact the construction materials sector: Tax incentives: - Sustainable products: The government plans to offer tax incentives and subsidies for alternatives to single-use plastics, encouraging the use of recycled materials in construction. - Recycling equipment: Subsidies or tax breaks for modern recycling equipment will encourage using recycled materials. Financial support: - Recycling initiatives: Financial support, such as loans and subsidies, will support recycling facilities and encourage the reuse of construction materials. - Pilot initiatives: Projects that demonstrate sustainable materials can encourage innovation in construction. - Material recovery: Support is provided to improve material recovery and increase recycling rates. Other support mechanisms: - Sustainable public procurement (SPP): Integrating sustainable standards into public procurement can increase demand for green building materials. - Promoting repair and reuse: Promoting material repair can reduce waste and improve resource efficiency. - Research support: Promoting research on recycled products in Southeast Asia can encourage innovation in the sector. Indirect incentives: - Landfill fee: Introducing a landfill fee can encourage waste diversion from landfills and promote recycling in construction. Qualified Investment Projects (QIPs): The Investment Law of 2021 defines QIPs as projects eligible for investment incentives in Cambodia that are officially registered and approved by the Council for the Development of Cambodia (CDC). QIPs are essential to attract foreign direct investment, promote industrial growth, and support socio-economic progress. These projects meet specific government criteria to promote economic development. Once approved, the granted QIP status gives access to various incentives, such as tax exemptions and customs relief, to encourage investment in priority sectors. QIP types either involve the sale of goods outside Cambodia, providing goods/services to export-oriented industries, or serving the domestic market. They target priority sectors such as high-tech, agriculture, tourism, education, health, logistics, and green energy under the 2021 Investment Law.

		Investors must register with the Council for the Development of Cambodia (CDC) and obtain a registration certificate that complies with the “one-stop service” process. Tax exemptions for existing QIPs extension are calculated proportionally to the additional investment. The following highlights the key aspects: Income tax exemption - QIPs can benefit from tax exemptions of 3 to 9 years, depending on the investment sector and activity. - After the exemption period, a graduated tax rate applies for six years: 5% in the first two years, 10% in the next two, and 15% in the last two. Special depreciation option - Investors can opt for accelerated depreciation, where 40% of capital expenditure can be deducted, with additional allowances of up to 200% for eligible expenditure (e.g., training, R&D, or advanced technologies). Customs and VAT exemptions - QIPs are exempt from customs duties and VAT on imported materials, equipment, and inputs related to the approved project. Export-oriented QIPs also benefit from these exemptions for materials used in production. Additional incentives - QIPs are exempt from up to 150% deductibility for expenses related to R&D, vocational training, or improvements in worker welfare.
1.4	Does your country have construction and demolition (C&D) waste laws/rules/regulations that mandate minimum use of C&D waste in construction and building projects? If YES, please give details of the targets for the construction sector. a) Landfill b) Recycling	Yes/No While specific targets for C&D waste utilization in construction projects are unavailable in the sources, Cambodia's overall strategies prioritize waste reduction, material reuse, and recycling, suggesting a future direction toward incorporating C&D waste in construction activities. Findings highlight several initiatives and strategies aiming to reduce C&D waste and promote its recycling and reuse: - Develop a strategy to reduce C&D waste and promote material reuse in the construction industry: This strategy, mentioned in the National Circular Economy Strategy and Action Plan (2021-2025), signifies the government's intention to address C&D waste. - Develop guidelines for treating, storing, and recycling demolished construction materials and municipal waste: This action under the National Circular Economy Strategy and Action Plan indicates a move towards establishing best practices for C&D waste management and recycling. Details regarding specific targets for the construction sector related to landfill diversion and recycling of C&D waste are not available in the provided sources. Here's what the sources do mention regarding landfill and recycling in the context of C&D waste: a) Landfill - Improve landfill disposal and operations: Cambodia focuses on improving landfill site management and transitioning from open dumpsites to controlled or sanitary landfills. This initiative aims to mitigate the environmental and health risks associated with improper waste disposal, including C&D waste.

		- Introduce landfill gate fees: By implementing landfill gate fees, the government seeks to encourage waste diversion from landfills, promoting recycling and reuse of materials, including those from C&D waste. b) Recycling - Promote the 4Rs policy (refuse, reduce, reuse, recycle): This policy is a key element of Cambodia's waste management strategy, encouraging waste reduction at the source and promoting recycling, which could include C&D waste. - Support recycling initiatives and facility capacity improvements: The government plans to provide financial and technical support to enhance recycling initiatives and infrastructure, which could include facilities processing C&D waste.
1.5	Do regulations for cement and concrete permit the incorporation of Supplementary Cementitious Materials (SCMs) such as Ground Granulated Blast Furnace Slags (GGBS), Pulverized Fly Ash (PFA), limestone, calcinated clay, natural pozzolana, etc.? If YES, please provide details of the national standards for blended cement.	Yes. Regulations permit the use of Supplementary Cementitious Materials (SCMs) like Ground Granulated Blast Furnace Slag (GGBS) and Pulverized Fly Ash (PFA) to enhance concrete performance and sustainability by partially replacing Ordinary Portland Cement (OPC). However, specific national standards for these materials are not widely detailed in publicly available regulations. Instead, local practices often follow international standards such as ASTM and ISO. Blended cement containing SCMs—such as fly ash (up to 30%) and GGBS (up to 50-55%)—is commonly used across Southeast Asia (Qu et al., 2022; Raghav et al., 2021). Its benefits include a reduced carbon footprint and improved durability. Construction professionals in Cambodia typically refer to international standards to ensure compliance. Key Cambodian construction codes, such as the Cambodian Standards (CS) under the Ministry of Industry, provide general guidelines but do not explicitly address SCMs. Cambodian standards related to cement and concrete include: - CS 0073: 2004 — Standard for Portland Cement - CS 00103: 2004 — Standard for Testing Methods for Portland Cement - Section 03052 — A document specifying requirements for cement used in structural concrete in Cambodia. In the absence of detailed local standards, Cambodia frequently adopts or aligns with international standards in the construction sector. These include: ASTM Standards - ASTM C618: Specifications for fly ash and natural pozzolans in concrete. - ASTM C989: Definition of ground granulated blast-furnace slag (GGBS) and its application in cementitious mixtures. - ASTM C1240: Specification for silica fume used as a mineral admixture in concrete. EN Standards (European Norms) - EN 197-1: Specification for common cement, including blended cement with SCMs. - EN 450-1: Focus on fly ash for concrete. ISO Standards - ISO 14001: Addresses environmental management aspects of using SCMs to reduce emissions.

		- ISO 22965-1: Details concrete specifications, including mixtures containing SCMs. ACI Guidelines - ACI 232.2R: Discusses the use of fly ash in concrete. - ACI 233R: Focuses on using GGBS as a supplementary material.
1.6	Do regulations allow for using natural fiber composites in Reinforced Cement Concrete (RCC)? If YES, please give details.	No, not for civil engineering use. In Cambodia, no explicit regulatory framework clearly supports or prohibits the use of natural fiber composites (such as bamboo, hemp, or other plant fibers) in Reinforced Cement Concrete (RCC). However, experimental applications have been documented, such as using bamboo reinforcement in concrete road pavements under initiatives like the ILO's "Low-Cost Surfacing" project near Siem Reap[1]. These trials aimed at testing the viability of natural fibers in concrete for specific low-cost applications. Bamboo, while having potential as reinforcement, faces challenges such as low elastic modulus, susceptibility to moisture, and poor bonding with concrete (Bala & Gupta, 2023). For the international context, advancements in glass-fiber reinforced concrete (GFRC) and other fiber-reinforced composites are widely recognized globally and often aligned with standards like ACI 544 for fiber-reinforced concrete.
1.7	Do regulations allow for alternate binding materials, such as rubber tires, plastic, and other similar materials, as substitutes for Asphalt in constructing asphalt concrete roads or other related applications? Please elaborate on any specific guidelines or provisions that permit or regulate the use of these materials.	Polymer-modified bitumen using crumb rubber or polymers such as SBS is permitted under Vietnamese standards (22 BC 319 - 04, TCVN 11193:2021). However, its use is mainly limited to asphalt paving on structures/viaducts that use thin surfacing layers or are in heavily trafficked locations.
1.8	Does your country have national standards permitting the use of recycled co-products or waste materials (RCWMs) such as Reclaimed asphalt pavement, Construction and Demolition (C&D) wastes, Recycled concrete aggregate, blast furnace slag, steel furnace slag, foundry sand, etc., to replace coarse and fine aggregates? If YES, please give details of relevant national standards. Please provide any specific quality guidelines or quality standards that govern their use.	No, not for civil engineering use. Cambodia currently lacks specific national standards explicitly permitting or regulating the use of Recycled Co-Products or Waste Materials (RCWMs) like Reclaimed Asphalt Pavement (RAP), Construction and Demolition (C&D) waste, or Recycled Concrete Aggregates (RCA) as substitutes for coarse and fine aggregates in construction. However, the Institute of Standards of Cambodia (ISC), established in 2008, aligns with ASEAN harmonization efforts and European standards, which may influence the gradual adoption of RCWM-related practices.
1.9	Does your country have a national standard on using bamboo as a structural material in building construction and an	No, not for civil engineering use.

[1] DEVELOPMENT OF LOCAL RESOURCE BASED STANDARDS SEACAP 19 Technical Paper No. 1 Bamboo Reinforced Concrete Pavements

<table>
<tr><td></td><td>adequate testing facility for testing bamboo as per standards?</td><td colspan="3"></td><td></td></tr>
<tr><td></td><td>If YES, please provide details of national standards on bamboo.</td><td colspan="3"></td><td></td></tr>
<tr><td colspan="6">2. Availability and Cost of Sustainable Materials</td></tr>
<tr><td colspan="6">Blended Cement</td></tr>
<tr><td>2.1</td><td>Can you provide a broad estimate (with information source) of the market share and cost comparison of blended cement or blend Portland cement with Supplementary Cementitious Materials (SCMs) such as Ground Granulated Blast Furnace Slags (GGBS), Pulverized Fly Ash (PFA), limestone, calcinated clay, natural pozzolana, etc. with that of Portland Cement?</td><td colspan="3"></td><td>In Cambodia, Portland cement is predominantly used in the cement industry. Statistics are not published or publicly disclosed. Nevertheless, blended cement with additional cementitious materials (SCMs) such as ground granulated blast furnace slag (GGBS), fly ash, limestone, burnt clays, and natural pozzolans is gaining importance due to its sustainability benefits, especially in infrastructure and large-scale projects.
Market share
Blended cement has a smaller but growing market than conventional Portland cement. Local production of blended cement is increasing as part of efforts to reduce carbon emissions, which are supported by global and regional green construction trends[2].
Cambodia's top five cement producers produced 7.7 million tons in 2022, with Portland cement dominating the supply chain. However, green cement, including SCM-based products, is expected to grow significantly due to environmental concerns.

Cost Comparison
- Blended cement is generally more cost-effective than Portland cement because SCMs partially replace clinker (the most energy-intensive and expensive component).
- Depending on availability and logistics, materials such as fly ash and slag can reduce production costs by up to 20–30%.
In Cambodia, the cost difference can vary depending on the country's proximity to SCM sources (e.g., fly ash or slag imports from neighboring countries such as Vietnam or Thailand).
Drivers of adoption
- Growing interest in reducing the carbon footprint in construction has driven demand for SCMs.
- Large infrastructure projects offer cost-effective and long-term opportunities for blended cement.
- International influence from donors and investors advocating for green construction standards is promoting the use of blended cement in Cambodia.</td></tr>
<tr><td></td><td colspan="4">Please provide company details, where available.</td><td></td></tr>
<tr><td></td><td>SCMs</td><td>Market share</td><td>Cost Comparison</td><td>Company Details</td><td></td></tr>
<tr><td></td><td>Pulverized Fly Ash</td><td>N/A</td><td>N/A</td><td>N/A</td><td rowspan="2">The market survey was conducted for cements, not their component parts. Furthermore, most firms strictly do not disclose composition details of their cements, merely that they comply with the relevant standard, which for PCB may be within a range</td></tr>
<tr><td></td><td>Blast Furnace Slag</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
</table>

[2] Cambodia's cement producers output 7.7Mt in 2022 Link

	Calcinated clay	N/A	N/A	N/A	of 5 - 70% of SCM of various types. Only 1 firm has EPDs showing blend proportions and CO_2 emissions for each product. In Cambodia, the market share of Supplementary Cementitious Materials (SCMs) in cement production is influenced by environmental concerns and cost factors. The most used SCMs are Pulverized Fly Ash (PFA) and Blast Furnace Slag, favored for their availability and cost advantages[3]. PFA is widely used due to its cost-effectiveness, particularly near coal-fired power plants, with potential savings of about 18% compared to Portland cement. However, high transportation and storage costs can reduce these benefits. Blast Furnace Slag, which can replace up to 50% of Portland cement, typically offers around 9% savings but is dependent on steel production facilities, and its scarcity in Cambodia may increase transportation costs. Calcined clay and natural pozzolanas are less common in Cambodia. While calcined clay has environmental advantages and potential cost benefits, its use is limited by supply chain issues. Natural pozzolanas tend to be more expensive to source and transport than PFA and slag.
	Natural pozzolana	N/A	N/A	N/A	
	Others, if any	N/A	N/A	N/A	
Recycled Materials					
2.2	Can you provide a broad estimate (with information source) of market share of Recycled, co-products or waste materials (RCWMs) and their cost comparison vis-à-vis virgin coarse or fine aggregates?				There is currently no market for recycled coarse and fine aggregates as input material for concrete or Asphalt.
	RCWMs	Market Share	Cost Comparison	Company Details	
	Reclaimed asphalt pavement	N/A	N/A	N/A	
	Recycled concrete aggregates	N/A	N/A	N/A	
	Blast furnace slag	N/A	N/A	N/A	
	Foundry sand	N/A	N/A	N/A	
	Other materials, if any	N/A	N/A	N/A	
2.3	Please provide information on the availability and cost of options for resource efficient asphalt, such as:				There is currently no market supply of WMA or permeable pavements since there is no demand yet. Most road construction materials are still traditionally sourced. However, there is an ongoing push for sustainable infrastructure, including urban road projects that could support more sustainable materials soon.
	Warm-mix Asphalt (WMA)				
	Permeable Pavements				*Permeable pavement is not applied.*
2.4	Please provide information on the availability and cost of options for				Despite some challenges, adopting resource-efficient practices like Waste Heat Recovery (WHR) and solar photovoltaics in

[3] Market Research Link

	resource efficiency in manufacturing, such as:	cement and steel production offers significant opportunities in Cambodia.
	Waste Heat Recovery	Companies such as Chip Mong Insee Cement Corporation are exploring rooftop solar systems for energy efficiency. WHR can reduce energy costs in cement production by 10-15%, but high capital costs and limited local maintenance expertise hinder widespread adoption. Similar technologies in Vietnam and Thailand have successfully lowered operational costs, especially since electricity is a major expense[4] [5]. Financial incentives and supportive regulations for WHR could help mitigate these issues. Solar power is also becoming essential for resource efficiency. A study for Chip Mong Insee Cement assessed the potential of rooftop solar to reduce reliance on grid electricity[6]. While installation and maintenance costs exist, long-term electricity savings can justify the investment. Photovoltaic systems can contribute to greener production and possibly qualify for government incentives, though details on subsidies in Cambodia are still being developed. Cambodia is exploring green energy solutions under the ASEAN framework, including tax exemptions and financing for technologies like WHR and solar energy. However, specific incentives for the cement and steel industries remain under-documented, and regulations may evolve as sustainable practices gain interest.
3. Innovation & Market Development Opportunities		
3.1	Could you provide specific examples of recent technological innovations or advancements in the country that have improved the resource efficiency of key construction materials like Asphalt, cement, concrete, and steel?	Composite Pavement Systems: A study in Cambodia evaluated the performance of a composite pavement using a roller-compacted cement (RCC) base with a modified asphalt layer called multi-layered bituminous surface treatment (MAST). The findings indicated this composite structure outperformed traditional Cambodian pavements, showing improved resilience against heavy truck traffic and environmental challenges like rainfall, which could reduce maintenance needs and material waste (Elipse et al., 2023). A notable advancement in asphalt technology involves the use of modified asphalt binders. For example, research on incorporating crumb rubber, a recycled rubber product made from scrap tires that have been ground into small pieces, into asphalt has led to increased durability, noise reduction, and improved skid resistance, which is especially beneficial for Cambodia's roads subjected to heavy traffic and extreme weather conditions. Additionally, the incorporation of reclaimed asphalt pavement (RAP) is gaining traction, allowing for the reuse of old materials in new mixtures reducing the need for virgin aggregates and bitumen [7]. Co-Processing of Steel Slag in Cement: Cambodia, along with other Southeast Asian countries, has implemented a co-

[4] Presentation on WHR in Cement Plant Link
[5] WHR News Link
[6] PV for Cement Plant Link
[7] MoE collaboration on RAP implementation Link

		processing strategy where iron and steel by-products are incorporated into cement production. This regional approach enhances material efficiency by reusing industrial by-products and significantly reduces carbon emissions and raw material usage, creating a circular economy in construction materials (Cravioto et al., 2021). Recycled Aggregates and Waste in Concrete: Recycled materials such as steel slag and recycled concrete aggregate (RCA) have been used in Cambodia's concrete production. These materials are integrated to reduce natural aggregate consumption and improve concrete's thermal and mechanical properties. For instance, incorporating steel slag has shown benefits like enhanced thermal conductivity and better temperature management in concrete, which is especially useful for energy efficiency in hot climates (Durdyev et al., 2018; Jiao et al., 2020).
3.2	Can you describe any national programs, policies, or incentives that promote research and development in new construction materials and technologies, particularly those enhancing resource efficiency? How effective have these programs driven innovation and adoption in the construction sector?	Although there is some awareness among Cambodian construction professionals about sustainable construction, the adoption of sustainable practices and materials remains low[8]. Barriers include limited awareness, high costs, and reluctance to adopt new technologies (Durdyev et al., 2018). A study focusing on the Phnom Penh construction industry identified significant barriers, including financial, governmental, and technical obstacles, that hinder the uptake of sustainable practices and materials. Addressing these barriers is essential for future progress (On & Techapeeraparnich, 2021). Incentive programs fostering local decision-making have shown potential in reducing unsustainable practices in other sectors and could inform similar approaches in construction (Travers et al., 2011).
3.3	What are the predominant challenges or obstacles in adopting new technologies for construction material efficiency in your country, such as cost, technical expertise, or industry resistance? What strategies or measures are governments and businesses implementing to address these challenges?	Cambodia's construction sector is primarily driven by cost, making locally produced sustainable materials often inaccessible. The industry should focus on building local capacity, investing in material research, and initiating pilot projects to address this. Successful material applications should be documented and standardized to promote wider adoption, and Environmental Product Declarations (EPDs) for low-carbon performance should be provided. Collaboration among ministries is essential to align specifications and procurement processes with sustainability goals and foster a unified approach to construction practices. Research institutions and development aid agencies should develop and support pilot projects for scalable solutions, bridging national strategies with real-world applications through trade and professional associations. The government could offer financial incentives, such as tax breaks or subsidies, to encourage the use of sustainable materials. Additionally, collaboration with ASEAN neighbors is crucial for exchanging expertise, harmonizing standards, and promoting low-carbon construction techniques across the region.

[8] Market Trends 2024 Link

3.4	How is the construction industry in the country fostering collaborations with technology companies, startups, and academic research institutions to innovate in resource-efficient materials, technologies, and methods? Are there any notable partnerships or collaborative projects that have yielded significant advancements?	Leading firms in construction materials, such as asphalt, cement, and steel, hold a significant share of the market. Many private-sector companies, many of which are publicly traded, establish strategic partnerships with international firms to supply materials, equipment, and consulting services. It is essential to involve these sectors in national and global product associations to strengthen the alignment of national strategies and cooperation goals. These associations can be crucial in disseminating important information to the public. Additionally, academic research institutions must be more proactive in supporting studies on low-carbon materials. A notable example of collaboration in this field is the Cambodia Construction Industry Expo 2024. This event brought together various stakeholders, including private companies, government representatives, and universities, to explore innovations in construction technology. It highlighted the increasing trend of cooperation between industry leaders and technology developers, particularly in sustainable construction materials and energy-efficient technologies.
4. Supply Chain Management Practices		
4.1	In what ways is digital technology, such as real-time tracking systems or predictive analytics, being utilized in the supply chain to improve the efficiency, accuracy, and transparency of material distribution? Can you provide examples of successful implementations that led to tangible improvement in resource efficiency?	The primary input materials for cement manufacture are typically sourced locally, so advanced supply chain management is not applicable. Some firms rely on local input materials for steel manufacturers, while others use imported ore and fuel. Many firms are located on coastal sites with port facilities permitting access by large vessels to import input materials and export products.
4.2	How are sustainable sourcing practices for construction materials integrated into supply chain management? What measures are in place to verify the sustainability of sourcing materials from upstream supply chain partners, and what challenges have been encountered in implementing these practices?	No information is available.
4.3	Can companies provide specifications demonstrating increased resource efficiency? What standards and accreditations are most widely used? Please list.	Only a few firms publish annual sustainability of ESG reports that set their targets, achievements, and applied methods. Firms' certification systems often include those of their imported countries. Please refer to the main text section on certification. Moreover, although regulatory standards for product compliance exist, enforcement and consistent application remain challenging. This may also affect sustainable practices. Local authorities often lack the resources for comprehensive compliance inspections, which involve adherence across the supply chain. This can lead to variability in sustainability practices among suppliers, depending on location and project scale. For large-scale projects, government agencies like the Ministry of Environment require Environmental Impact Assessments (EIA), which ensures that some sustainability standards are met for larger projects.
5. Questions for Contractors/ Industry Associations		
5.1	In the context of the economic situation in the country, what do market players face the significant specific economic challenges and opportunities in adopting	Cambodia faces significant challenges in adopting resource-efficient construction practices due to economic factors like high material costs and limited financial access. Yet, the country also benefits from government support, increasing demand for

	resource-efficient materials and practices in construction projects?	affordable housing, and opportunities for foreign investment in sustainable infrastructure.
5.2	Could you provide an in-depth analysis of the current availability of key construction materials such as Asphalt, cement, concrete, and steel in your country and whether this supply is sufficient to meet the existing and projected demands for infrastructure development? Please elaborate on factors such as domestic production capacities, reliance on imports, and any known constraints or challenges in sourcing these materials.	Cambodia's construction industry is facing limited knowledge about the costs and benefits of sustainable materials, coupled with their scarcity and lack of eco-labeling or limited building certification. This knowledge gap and a slow regulatory environment discourage investment in sustainable solutions. The industry also struggles with a shortage of technical expertise and the perception that resource-efficient materials are too expensive. However, the Cambodian government is already promoting sustainable infrastructure and green building practices. Establishing the country's first scrap steel processing facility enhances recycling efforts and provides low-carbon steel. Although asphalt recycling is underutilized, it presents further opportunities for innovation. Regarding the studied materials, asphalt and steel offer development opportunities in resource management. The first scrap steel factory's decision points in the right direction in facilitating local scrap resources and offering local low-carbon products. Asphalt should go in a similar direction, as the utilization of asphalt waste and aggregates seems unclear. The local availability of key additives, such as fly ash, limestone or blast furnace slag, is limited for cement or concrete.
5.3	Could you provide an overview of the national standards and regulations in your country related to the production of cement and concrete, mainly focusing on the incorporation of Supplementary Cementitious Materials (SCMs) such as Ground Granulated Blast Furnace Slags (GGBS), Pulverized Fly Ash (PFA), limestone, calcined clay, natural pozzolana, etc.?	Guided by the Institute of Standards of Cambodia (ISC), national standards align with international practices to enhance product quality and protect consumers. Incorporating SCMs reduces reliance on clinker, lowering the carbon intensity of cement production. Cambodia's regulatory framework, aligned with ASEAN and European Union standards, encourages using alternative materials while ensuring compliance with technical performance criteria. ASTM and EN standards govern SCM usage; for instance, ASTM C595 and EN 197-1 provide specifications for blended cement containing limestone and other SCMs (Thomas et al., 2010).
5.3.1	Please elaborate on how these standards accommodate or regulate the substitution of clinker with SCMs, both in cement production and in the production of concrete at batching plants at construction sites.	Batching plants must follow national standards in concrete production to maintain required metrics like compressive strength and durability. Batching plants at construction sites must comply with these national standards for concrete production. This ensures that concrete mixes containing SCMs maintain the required performance for construction applications, such as compressive strength and durability. SCMs are typically monitored through certification processes managed by the ISC, which oversees compliance with relevant standards.
5.4	In the context of country's construction industry, could you discuss the presence and scope of national standards or regulations that permit the use of	Several national standards and regulations in Cambodia regulate using materials in construction projects. - The National Construction Code[9], adopted by the National Assembly in 2019, defines the principles, regulations,

[9] National Construction Code Cambodia Link

	Recycled, Co-products, or Waste Materials (RCWMs) like Reclaimed Asphalt Pavement, Construction and Demolition (C&D) wastes, Recycled Concrete Aggregate, Blast Furnace Slag, Steel Furnace Slag, Foundry Sand, etc., as substitutes for traditional coarse and fine aggregates in construction projects?	techniques, and procedures for the construction sector in Cambodia. It provides guidelines for the use of construction materials. - The Water Pollution Control Sub-Regulation, administered by the Ministry of Environment (MoE), regulates the concentration of wastewater pollutants discharged into public water areas or sewers. - Technical construction standards also ensure that construction materials meet quality and safety requirements. The Ministry of Industry, Mines, and Energy (MIOME) oversees the implementation of standards for construction materials. The extent to which extend recycled by-products or waste materials (RCWMs) are allowed as materials in construction projects are used is unclear due to contradicting sources.
5.4.1	Please elaborate on the extent to which these materials are integrated into construction practices, any specific guidelines or quality standards that govern their use, and the impact these practices have on the sustainability and efficiency of construction projects.	Waste reduction strategies in Cambodia's construction industry include using recycled aggregates, though this remains limited in practice with no source found. Pilot projects help demonstrate these materials' performance and support waste diversion from landfills. Such initiatives aim to increase the adoption of recycled aggregates in construction.
5.5	Could you provide an overview of how your country's national standards address alternate binding materials, such as rubber tires, plastic, and other similar materials, as substitutes for Asphalt in constructing asphalt concrete roads or other related applications? Please elaborate on any specific guidelines or provisions that permit or regulate the use of these materials.	Due to limited standards and presence, alternative binding materials like rubber and plastic are not yet widely used in Cambodia. The Ministry of Environment aims to collaborate for pilot projects to explore such alternatives and eventual regulatory support[10].
5.6	Could you discuss how your country encourages and incentivizes companies in the building and construction sector to adopt system standards and accreditations such as ISO 14001/OSHAS 18001, LEED, BREEAM, or align with guidelines and formal initiatives like ISO 26000, GRI, the United Nations Global Compact, and the World Business Council for Sustainable Development? Please elaborate on any specific guidelines or provisions that permit or regulate the use of these materials.	Large infrastructure projects are often financed internationally for civil engineering projects, so relevant standards in the country-specific specifications must also be met in addition to local standards. As a result, sustainable material alternatives are often not considered in the project specifications. To date, green building standards have not been applied to government buildings. However, Green Building Guidelines and Certifications (CamGCGB) are considered mandatory for future public and probably private construction projects. While the government encourages practices aligned with green building standards, direct financial incentives are minimal. To date, developers primarily seek LEED certification to increase the market value of their projects. Since material efficiency includes difficult-to-achieve criteria, many projects in this category achieve limited results.
5.7	What are current approaches, programs, and models for imparting skill	Academia is beginning to integrate resource efficiency into its teaching programs. Green building organizations, such as EDGE

[10] MoE collaboration on RAP implementation Link

	development training to construction sector employees on improving sustainability and circularity, including resource efficiency in infrastructure projects, especially for SMEs engaged as subcontractors?	and LEED, provide online knowledge-sharing and training opportunities leading to accreditation for submitting projects for certification. Related ministries, including the National Council for Sustainable Development, offer initiatives focused on knowledge sharing and capacity building for their ongoing projects through workshops. Professional and trade associations promote sustainable practices by organizing industry events, workshops, and knowledge-sharing sessions. They collaborate with international and regional partners to introduce green building practices within the Cambodian industry. For instance, the Cambodia Constructors Association (CCA) helps promote sustainable practices by organizing industry events, workshops, and knowledge-sharing sessions. This collaboration with international partners brings eco-friendly construction practices into Cambodia's industry.
5.8	What roles do construction materials associations (global/regional) or collectives of construction companies play in facilitating the exchange of information on good practices aimed explicitly at enhancing resource efficiency in the use of construction materials? If so, could you describe the functions and activities of such associations, including how they promote knowledge sharing, the adoption of efficient practices, and any collaborative projects or initiatives they have spearheaded?	The current presence and impact of construction materials associations and collectives seem below what they can achieve. They fall short as informants or critical enablers of resource-efficient practices by fostering knowledge sharing, driving innovation, and enabling collaboration. Instead, most advancements arise from government partnerships with non-governmental organizations (NGOs), which provide knowledge and capacity building. However, pilot projects often struggle due to financial constraints and slow progress stemming from limited government capacity.
5.9	Could you elaborate on any recent advancements, challenges, or notable projects related to using RCWMs as coarse or fine aggregates as substitutes for virgin aggregates in the country?	Unfortunately, the current database search identified no Cambodia-specific studies or projects. Yet, the study provided broader regional and global insights into using recycled aggregates from construction and demolition (C&D) waste in concrete. Cambodia could benefit from tailored research and pilot projects to explore recycled aggregate use in local construction, supported by regional collaboration. Adopting successful models from neighboring countries could help establish processing infrastructure and quality standards. Research examples indicate a growing interest in Southeast Asia, including frameworks to develop durable, cost-effective, and green concrete using recycled aggregates. These efforts aim to reduce carbon footprints and conserve raw materials but face challenges like economic feasibility and lack of awareness (Makul et al., 2021). Studies have demonstrated that recycled aggregates can meet performance criteria for non-structural applications. Advanced sorting and granulation technologies, such as those described in Hong Kong's initiatives, may provide models for Cambodia (Tam et al., 2005). The lack of national standards for using recycled aggregates remains a barrier to adoption in many developing countries, including Southeast Asia (Behera et al., 2014). Similar to global contexts, challenges include quality inconsistency of recycled aggregates and contamination by materials like gypsum or clay, which can negatively affect concrete durability (Martín-Morales et al., 2011). Recycled

		aggregates have been effectively used in road construction and precast concrete blocks, offering opportunities for Cambodia to apply such practices in infrastructure projects.
5.10	Could you elaborate on any recent updates, innovations, or notable projects incorporating alternative materials as substitutes for steel in reinforced concrete structures? Please discuss how these changes have impacted your country's construction practices and resource efficiency.	No, not for civil engineering works. It is for niche uses in rural projects for non-structural elements. While adopting alternative materials in Cambodia remains in its early stages and is mainly limited to niche, non-structural uses, ongoing research and pilot projects in other related countries highlight their potential to revolutionize construction practices. If durability, scalability, and cost challenges can be overcome, these materials may reduce environmental impact, dependency on imports, and resource inefficiency in the long term.

Appendix 2: LEED Scorecards from Building Certifications in Cambodia

1000119173, Phnom Penh

Laurelton Cambodia - Canteen building

LEED BD+C: New Construction (v4)

GOLD, AWARDED JAN 2023

SUSTAINABLE SITES — AWARDED: 4 / 10

Prereq	Construction activity pollution prevention	0 / 0
Credit	Site assessment	1 / 1
Credit	Site development - protect or restore habitat	0 / 2
Credit	Open space	0 / 1
Credit	Rainwater Mgmt	0 / 3
Credit	Heat island reduction	2 / 2
Credit	Light pollution reduction	1 / 1

WATER EFFICIENCY — AWARDED: 9 / 11

Prereq	Outdoor water use reduction	0 / 0
Prereq	Indoor water use reduction	0 / 0
Prereq	Building-level water metering	0 / 0
Credit	Cooling tower water use	0 / 2
Credit	Water metering	1 / 1
Credit	Outdoor water use reduction	2 / 2
Credit	Indoor water use reduction	6 / 6

ENERGY & ATMOSPHERE — AWARDED: 26 / 53

Prereq	Fundamental commissioning and verification	0 / 0
Prereq	Minimum energy performance	0 / 0
Prereq	Building-level energy metering	0 / 0
Prereq	Fundamental refrigerant Mgmt	0 / 0
Prereq	Minimum Energy Performance (2024 Update)	0 / 0
Credit	Enhanced commissioning	4 / 6
Credit	Advanced energy metering	1 / 1
Credit	Demand response	0 / 2
Credit	Renewable energy production	3 / 3
Credit	Enhanced refrigerant Mgmt	1 / 1
Credit	Green power and carbon offsets	0 / 2
Credit	Optimize Energy Performance (2024 Update)	0 / 20
Credit	Optimize energy performance	17 / 18

MATERIAL & RESOURCES — AWARDED: 5 / 13

Prereq	Storage and collection of recyclables	0 / 0
Prereq	Construction and demolition waste Mgmt planning	0 / 0
Credit	Building life-cycle impact reduction	3 / 5
Credit	Building product disclosure and optimization - environmental product d...	0 / 2
Credit	Building product disclosure and optimization - sourcing of raw materia...	0 / 2
Credit	Building product disclosure and optimization - material ingredients	0 / 2
Credit	Construction and demolition waste Mgmt	2 / 2

INDOOR ENVIRONMENTAL QUALITY — AWARDED: 6 / 16

Prereq	Minimum IAQ performance	0 / 0
Prereq	Environmental tobacco smoke control	0 / 0
Credit	Enhanced IAQ strategies	2 / 2
Credit	Low-emitting materials	1 / 3
Credit	Construction IAQ Mgmt plan	1 / 1
Credit	IAQ assessment	0 / 2
Credit	Thermal comfort	0 / 1
Credit	Interior lighting	2 / 2
Credit	Daylight	0 / 3
Credit	Quality views	0 / 1
Credit	Acoustic performance	0 / 1

INNOVATION — AWARDED: 6 / 6

Credit	Innovation	5 / 5
Credit	LEED Accredited Professional	1 / 1

REGIONAL PRIORITY CREDITS — AWARDED: 4 / 4

Credit	Optimize energy performance	1 / 1
Credit	Enhanced IAQ strategies	1 / 1
Credit	Outdoor water use reduction	1 / 1
Credit	Indoor water use reduction	1 / 1

LOCATION & TRANSPORTATION — AWARDED: 2 / 20

Credit	LEED for Neighborhood Development location	0 / 16
Credit	Sensitive land protection	1 / 1
Credit	High priority site	0 / 2
Credit	Surrounding density and diverse uses	0 / 5
Credit	Access to quality transit	0 / 5
Credit	Bicycle facilities	0 / 1
Credit	Reduced parking footprint	1 / 1
Credit	Green vehicles	0 / 1

INTEGRATIVE PROCESS CREDITS — AWARDED: 1 / 1

Credit	Integrative process	1 / 1

TOTAL 63 / 110

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM

1000032649, Phnom Penh

Laurelton Cambodia

LEED BD+C: New Construction (v2009)

CERTIFIED, AWARDED SEP 2016

SUSTAINABLE SITES — AWARDED: 9 / 26

SSp1	Construction activity pollution prevention	REQUIRED
SSc1	Site selection	1 / 1
SSc2	Development density and community connectivity	0 / 5
SSc3	Brownfield redevelopment	0 / 1
SSc4.1	Alternative transportation - public transportation access	0 / 6
SSc4.2	Alternative transportation - bicycle storage and changing rooms	1 / 1
SSc4.3	Alternative transportation - low-emitting and fuel-efficient vehicles	3 / 3
SSc4.4	Alternative transportation - parking capacity	0 / 2
SSc5.1	Site development - protect or restore habitat	1 / 1
SSc5.2	Site development - maximize open space	1 / 1
SSc6.1	Stormwater design - quantity control	0 / 1
SSc6.2	Stormwater design - quality control	0 / 1
SSc7.1	Heat island effect - nonroof	1 / 1
SSc7.2	Heat island effect - roof	1 / 1
SSc8	Light pollution reduction	0 / 1

WATER EFFICIENCY — AWARDED: 8 / 10

WEp1	Water use reduction	REQUIRED
WEc1	Water efficient landscaping	4 / 4
WEc2	Innovative wastewater technologies	0 / 2
WEc3	Water use reduction	4 / 4

ENERGY & ATMOSPHERE — AWARDED: 14 / 35

EAp1	Fundamental commissioning of building energy systems	REQUIRED
EAp2	Minimum energy performance	REQUIRED
EAp3	Fundamental refrigerant Mgmt	REQUIRED
EAc1	Optimize energy performance	4 / 19
EAc2	On-site renewable energy	7 / 7
EAc3	Enhanced commissioning	0 / 2
EAc4	Enhanced refrigerant Mgmt	0 / 2
EAc5	Measurement and verification	3 / 3
EAc6	Green power	0 / 2

MATERIAL & RESOURCES — AWARDED: 4 / 14

MRp1	Storage and collection of recyclables	REQUIRED
MRc1.1	Building reuse - maintain existing walls, floors and roof	0 / 3
MRc1.2	Building reuse - maintain interior nonstructural elements	0 / 1
MRc2	Construction waste Mgmt	2 / 2
MRc3	Materials reuse	0 / 2
MRc4	Recycled content	0 / 2

MATERIAL & RESOURCES — CONTINUED

MRc5	Regional materials	2 / 2
MRc6	Rapidly renewable materials	0 / 1
MRc7	Certified wood	0 / 1

INDOOR ENVIRONMENTAL QUALITY — AWARDED: 4 / 15

EQp1	Minimum IAQ performance	REQUIRED
EQp2	Environmental Tobacco Smoke (ETS) control	REQUIRED
EQc1	Outdoor air delivery monitoring	0 / 1
EQc2	Increased ventilation	0 / 1
EQc3.1	Construction IAQ Mgmt plan - during construction	1 / 1
EQc3.2	Construction IAQ Mgmt plan - before occupancy	0 / 1
EQc4.1	Low-emitting materials - adhesives and sealants	0 / 1
EQc4.2	Low-emitting materials - paints and coatings	1 / 1
EQc4.3	Low-emitting materials - flooring systems	0 / 1
EQc4.4	Low-emitting materials - composite wood and agrifiber products	0 / 1
EQc5	Indoor chemical and pollutant source control	0 / 1
EQc6.1	Controllability of systems - lighting	0 / 1
EQc6.2	Controllability of systems - thermal comfort	0 / 1
EQc7.1	Thermal comfort - design	1 / 1
EQc7.2	Thermal comfort - verification	1 / 1
EQc8.1	Daylight and views - daylight	0 / 1
EQc8.2	Daylight and views - views	0 / 1

INNOVATION — AWARDED: 4 / 6

IDc1	Innovation in design	0 / 1
IDc2	LEED Accredited Professional	0 / 1

REGIONAL PRIORITY CREDITS — AWARDED: 4 / 4

EAc1	Optimize energy performance	1 / 1
EAc5	Measurement and verification	1 / 1
WEc1	Water efficient landscaping	1 / 1
WEc3	Water use reduction	1 / 1

TOTAL 47 / 110

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM

1000062925, Kandal

Bowker Garment Cambodian Factory Phase 2

LEED BD+C: New Construction (v2009)

GOLD, AWARDED SEP 2016

SUSTAINABLE SITES — AWARDED: 21 / 26

SSp1	Construction activity pollution prevention	REQUIRED
SSc1	Site selection	1 / 1
SSc2	Development density and community connectivity	5 / 5
SSc3	Brownfield redevelopment	0 / 1
SSc4.1	Alternative transportation - public transportation access	6 / 6
SSc4.2	Alternative transportation - bicycle storage and changing rooms	0 / 1
SSc4.3	Alternative transportation - low-emitting and fuel-efficient vehicles	3 / 3
SSc4.4	Alternative transportation - parking capacity	2 / 2
SSc5.1	Site development - protect or restore habitat	0 / 1
SSc5.2	Site development - maximize open space	0 / 1
SSc6.1	Stormwater design - quantity control	1 / 1
SSc6.2	Stormwater design - quality control	1 / 1
SSc7.1	Heat island effect - nonroof	1 / 1
SSc7.2	Heat island effect - roof	1 / 1
SSc8	Light pollution reduction	0 / 1

WATER EFFICIENCY — AWARDED: 10 / 10

WEp1	Water use reduction	REQUIRED
WEc1	Water efficient landscaping	4 / 4
WEc2	Innovative wastewater technologies	2 / 2
WEc3	Water use reduction	4 / 4

ENERGY & ATMOSPHERE — AWARDED: 21 / 35

EAp1	Fundamental commissioning of building energy systems	REQUIRED
EAp2	Minimum energy performance	REQUIRED
EAp3	Fundamental refrigerant Mgmt	REQUIRED
EAc1	Optimize energy performance	19 / 19
EAc2	On-site renewable energy	0 / 7
EAc3	Enhanced commissioning	0 / 2
EAc4	Enhanced refrigerant Mgmt	2 / 2
EAc5	Measurement and verification	0 / 3
EAc6	Green power	0 / 2

MATERIAL & RESOURCES — AWARDED: 0 / 14

MRp1	Storage and collection of recyclables	REQUIRED
MRc1.1	Building reuse - maintain existing walls, floors and roof	0 / 3
MRc1.2	Building reuse - maintain interior nonstructural elements	0 / 1
MRc2	Construction waste Mgmt	0 / 2
MRc3	Materials reuse	0 / 2
MRc4	Recycled content	0 / 2

MATERIAL & RESOURCES — CONTINUED

MRc5	Regional materials	0 / 2
MRc6	Rapidly renewable materials	0 / 1
MRc7	Certified wood	0 / 1

INDOOR ENVIRONMENTAL QUALITY — AWARDED: 1 / 15

EQp1	Minimum IAQ performance	REQUIRED
EQp2	Environmental Tobacco Smoke (ETS) control	REQUIRED
EQc1	Outdoor air delivery monitoring	0 / 1
EQc2	Increased ventilation	0 / 1
EQc3.1	Construction IAQ Mgmt plan - during construction	0 / 1
EQc3.2	Construction IAQ Mgmt plan - before occupancy	0 / 1
EQc4.1	Low-emitting materials - adhesives and sealants	0 / 1
EQc4.2	Low-emitting materials - paints and coatings	0 / 1
EQc4.3	Low-emitting materials - flooring systems	0 / 1
EQc4.4	Low-emitting materials - composite wood and agrifiber products	0 / 1
EQc5	Indoor chemical and pollutant source control	0 / 1
EQc6.1	Controllability of systems - lighting	1 / 1
EQc6.2	Controllability of systems - thermal comfort	0 / 1
EQc7.1	Thermal comfort - design	0 / 1
EQc7.2	Thermal comfort - verification	0 / 1
EQc8.1	Daylight and views - daylight	0 / 1
EQc8.2	Daylight and views - views	0 / 1

INNOVATION — AWARDED: 3 / 6

IDc1	Innovation in design	0 / 1
IDc2	LEED Accredited Professional	0 / 1

REGIONAL PRIORITY CREDITS — AWARDED: 4 / 4

EAc1	Optimize energy performance	1 / 1
WEc1	Water efficient landscaping	1 / 1
WEc2	Innovative wastewater technologies	1 / 1
WEc3	Water use reduction	1 / 1

TOTAL 60 / 110

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM

1000066279, Phnom Penh

Coca Cola Cambodia greenfield project

LEED BD+C: New Construction (v2009) — **GOLD, AWARDED FEB 2017**

SUSTAINABLE SITES — AWARDED: 17 / 26

SSp1	Construction activity pollution prevention	REQUIRED
SSc1	Site selection	1 / 1
SSc2	Development density and community connectivity	0 / 5
SSc3	Brownfield redevelopment	0 / 1
SSc4.1	Alternative transportation - public transportation access	6 / 6
SSc4.2	Alternative transportation - bicycle storage and changing rooms	0 / 1
SSc4.3	Alternative transportation - low-emitting and fuel-efficient vehicles	3 / 3
SSc4.4	Alternative transportation - parking capacity	2 / 2
SSc5.1	Site development - protect or restore habitat	0 / 1
SSc5.2	Site development - maximize open space	1 / 1
SSc6.1	Stormwater design - quantity control	1 / 1
SSc6.2	Stormwater design - quality control	1 / 1
SSc7.1	Heat island effect - nonroof	1 / 1
SSc7.2	Heat island effect - roof	1 / 1
SSc8	Light pollution reduction	0 / 1

WATER EFFICIENCY — AWARDED: 5 / 10

WEp1	Water use reduction	REQUIRED
WEc1	Water efficient landscaping	2 / 4
WEc2	Innovative wastewater technologies	0 / 2
WEc3	Water use reduction	3 / 4

ENERGY & ATMOSPHERE — AWARDED: 20 / 35

EAp1	Fundamental commissioning of building energy systems	REQUIRED
EAp2	Minimum energy performance	REQUIRED
EAp3	Fundamental refrigerant Mgmt	REQUIRED
EAc1	Optimize energy performance	8 / 19
EAc2	On-site renewable energy	7 / 7
EAc3	Enhanced commissioning	0 / 2
EAc4	Enhanced refrigerant Mgmt	2 / 2
EAc5	Measurement and verification	3 / 3
EAc6	Green power	0 / 2

MATERIAL & RESOURCES — AWARDED: 6 / 14

MRp1	Storage and collection of recyclables	REQUIRED
MRc1.1	Building reuse - maintain existing walls, floors and roof	0 / 3
MRc1.2	Building reuse - maintain interior nonstructural elements	0 / 1
MRc2	Construction waste Mgmt	2 / 2
MRc3	Materials reuse	0 / 2
MRc4	Recycled content	2 / 2

MATERIAL & RESOURCES — CONTINUED

MRc5	Regional materials	2 / 2
MRc6	Rapidly renewable materials	0 / 1
MRc7	Certified wood	0 / 1

INDOOR ENVIRONMENTAL QUALITY — AWARDED: 5 / 15

EQp1	Minimum IAQ performance	REQUIRED
EQp2	Environmental Tobacco Smoke (ETS) control	REQUIRED
EQc1	Outdoor air delivery monitoring	0 / 1
EQc2	Increased ventilation	0 / 1
EQc3.1	Construction IAQ Mgmt plan - during construction	1 / 1
EQc3.2	Construction IAQ Mgmt plan - before occupancy	1 / 1
EQc4.1	Low-emitting materials - adhesives and sealants	1 / 1
EQc4.2	Low-emitting materials - paints and coatings	1 / 1
EQc4.3	Low-emitting materials - flooring systems	1 / 1
EQc4.4	Low-emitting materials - composite wood and agrifiber products	0 / 1
EQc5	Indoor chemical and pollutant source control	0 / 1
EQc6.1	Controllability of systems - lighting	0 / 1
EQc6.2	Controllability of systems - thermal comfort	0 / 1
EQc7.1	Thermal comfort - design	0 / 1
EQc7.2	Thermal comfort - verification	0 / 1
EQc8.1	Daylight and views - daylight	0 / 1
EQc8.2	Daylight and views - views	0 / 1

INNOVATION — AWARDED: 5 / 6

IDc1	Innovation in design	0 / 1
IDc2	LEED Accredited Professional	0 / 1

REGIONAL PRIORITY CREDITS — AWARDED: 4 / 4

EAc1	Optimize energy performance	1 / 1
EAc5	Measurement and verification	1 / 1
WEc1	Water efficient landscaping	1 / 1
WEc3	Water use reduction	1 / 1

TOTAL — 62 / 110

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM

1000151828, Phnom Penh

UNDP Office, Cambodia

LEED O+M: Interiors (v4.1)

GOLD, AWARDED APR 2022

WATER EFFICIENCY — AWARDED: 10 / 15

Credit	Water Performance	10 / 15

ENERGY & ATMOSPHERE — AWARDED: 29 / 34

Prereq	Energy Efficiency Best Mgmt Practices	0 / 0
Prereq	Fundamental Refrigerant Mgmt	0 / 0
Credit	Energy Performance	29 / 33
Credit	Enhanced Refrigerant Mgmt	0 / 1

MATERIAL & RESOURCES — AWARDED: 7 / 8

Prereq	Purchasing Policy	0 / 0
Prereq	Facility Maintenance and Renovations Policy	0 / 0
Credit	Waste Performance	7 / 8

INDOOR ENVIRONMENTAL QUALITY — AWARDED: 12 / 22

Prereq	Minimum IAQ	0 / 0
Prereq	Green Cleaning Policy	0 / 0
Credit	Indoor Environmental Quality Performance	12 / 20
Credit	Integrated Pest Mgmt	0 / 1
Credit	Green Cleaning	0 / 1

INNOVATION — AWARDED: 0 / 1

Credit	Innovation	0 / 1

LOCATION & TRANSPORTATION — AWARDED: 13 / 14

Credit	Transportation Performance	13 / 14

INTEGRATIVE PROCESS CREDITS — AWARDED: 0 / 2

Prereq	Social equity within the community	REQUIRED
Prereq	Social equity within the operations and maintenance staff	REQUIRED

TOTAL 71 / 100

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM

1000141621, HA NOI

TechnoPark Tower

LEED BD+C: Core and Shell (v4)

PLATINUM, AWARDED NOV 2021

SUSTAINABLE SITES — AWARDED: 11 / 11

Prereq	Construction activity pollution prevention	0 / 0
Credit	Site assessment	1 / 1
Credit	Site development - protect or restore habitat	2 / 2
Credit	Open space	1 / 1
Credit	Rainwater Mgmt	3 / 3
Credit	Heat island reduction	2 / 2
Credit	Light pollution reduction	1 / 1
Credit	Tenant design and construction guidelines	1 / 1

WATER EFFICIENCY — AWARDED: 10 / 11

Prereq	Outdoor water use reduction	0 / 0
Prereq	Indoor water use reduction	0 / 0
Prereq	Building-level water metering	0 / 0
Credit	Cooling tower water use	2 / 2
Credit	Water metering	1 / 1
Credit	Outdoor water use reduction	2 / 2
Credit	Indoor water use reduction	5 / 6

ENERGY & ATMOSPHERE — AWARDED: 21 / 53

Prereq	Fundamental commissioning and verification	0 / 0
Prereq	Minimum energy performance	0 / 0
Prereq	Building-level energy metering	0 / 0
Prereq	Fundamental refrigerant Mgmt	0 / 0
Prereq	Minimum Energy Performance (2024 Update)	0 / 0
Credit	Enhanced commissioning	6 / 6
Credit	Advanced energy metering	1 / 1
Credit	Demand response	0 / 2
Credit	Renewable energy production	3 / 3
Credit	Enhanced refrigerant Mgmt	1 / 1
Credit	Green power and carbon offsets	0 / 2
Credit	Optimize Energy Performance (2024 Update)	0 / 20
Credit	Optimize energy performance	10 / 18

MATERIAL & RESOURCES — AWARDED: 6 / 14

Prereq	Storage and collection of recyclables	0 / 0
Prereq	Construction and demolition waste Mgmt planning	0 / 0
Credit	Building life-cycle impact reduction	3 / 6
Credit	Building product disclosure and optimization - environmental product d...	0 / 2
Credit	Building product disclosure and optimization - sourcing of raw materia...	1 / 2
Credit	Building product disclosure and optimization - material ingredients	0 / 2
Credit	Construction and demolition waste Mgmt	2 / 2

INDOOR ENVIRONMENTAL QUALITY — AWARDED: 7 / 10

Prereq	Minimum IAQ performance	0 / 0
Prereq	Environmental tobacco smoke control	0 / 0
Credit	Enhanced IAQ strategies	1 / 2
Credit	Low-emitting materials	2 / 3
Credit	Construction IAQ Mgmt plan	1 / 1
Credit	Daylight	2 / 3
Credit	Quality views	1 / 1

INNOVATION — AWARDED: 6 / 6

Credit	Innovation	5 / 5
Credit	LEED Accredited Professional	1 / 1

REGIONAL PRIORITY CREDITS — AWARDED: 4 / 4

Credit	Optimize energy performance	1 / 1
Credit	Enhanced IAQ strategies	0 / 1
Credit	Site development - protect or restore habitat	0 / 1
Credit	Rainwater Mgmt	1 / 1
Credit	Outdoor water use reduction	1 / 1
Credit	Indoor water use reduction	1 / 1

LOCATION & TRANSPORTATION — AWARDED: 18 / 20

Credit	LEED for Neighborhood Development location	0 / 20
Credit	Sensitive land protection	2 / 2
Credit	High priority site	3 / 3
Credit	Surrounding density and diverse uses	6 / 6
Credit	Access to quality transit	4 / 6
Credit	Bicycle facilities	1 / 1
Credit	Reduced parking footprint	1 / 1
Credit	Green vehicles	1 / 1

INTEGRATIVE PROCESS CREDITS — AWARDED: 1 / 1

Credit	Integrative process	1 / 1

TOTAL 84 / 110

40-49 Points	50-59 Points	60-79 Points	80+ Points
CERTIFIED	SILVER	GOLD	PLATINUM