CONSTRUCTION INDUSTRY COUNCIL

CIC GREEN PRODUCT CERTIFICATION

Assessment Standard

Precast Concrete

(Version 2.0)

Precast Concrete

Summary of Assessment Criteria

CORE CRITERIA

Criteria	Requirements	Verification	Point		Index
			Basic	+Bonus	
CARBON					
CFP quantification	Provide a life cycle assessment report with the carbon footprint of products (CFP) in $kgCO2_e/t$ of product, covering at least A1 to A3 and meet the requirement in Table 3.	CFP quantification report OR Environmental Product Declaration (EPD)	**50**	+10/ +20 +30/ +40	4.1.1
		Subtotal:	**50**	+40	

NON-CORE CRITERIA

Criteria	Requirements	Verification	Points	Index
			+Bonus	
RESOURCE				
Recycled materials	Achieve the required minimum percentage of recycled materials in the concrete mix and reinforcing bar. **Recycled Materials** / **Percentage** Pulverised Fuel Ash (PFA) as SCM in concrete — 25% Ground Granulated Blast-furnace Slag (GGBS) as SCM in concrete — 40% Recycled coarse aggregates in C25-35 concrete mix — 20% Silica Fume (SF) as SCM in concrete — 5% Recycled content in reinforcing bar — 80%	Concrete mix details And Material summary with supporting (e.g. declaration letter, purchase order, etc.)	+5	4.2.1
Solid Waste Reuse	Products that achieve a solid waste utilisation rate of at least 95%	Waste management plan and policies	+5	4.2.2
Water Management	Option A: Water Consumption Reporting: Report both potable and non-potable water usage in the production process of the past year.	Water consumption report	+5/+10	4.2.3.1

<table>
<tr><th>Criteria</th><th>Requirements</th><th>Verification</th><th>Points
+Bonus</th><th>Index</th></tr>
<tr><td rowspan="2"></td><td>Water Recycling Program:
Develop and implement water recycling program during the manufacturing process.</td><td>Documentation on water recycling</td><td rowspan="2"></td><td>4.2.3.2</td></tr>
<tr><td>Option B:
Water Management System:
Process valid certificates under ISO 14046: Water footprint Assessment</td><td>ISO Certificate</td><td>4.2.3.3</td></tr>
<tr><td>Mould Circularity</td><td>Mould Recycling:

Use recyclable material for mould production.</td><td>Production log and relevant documentation</td><td>+5</td><td>4.2.4</td></tr>
<tr><td>Energy Management</td><td>Achieve the energy consumption requirement during concrete curing:

<table><tr><th></th><th>+ 5 Bonus Points</th><th>+ 10 Bonus Points</th></tr><tr><td>Energy Consumption for Concrete Curing</td><td>≤ 60%</td><td>≤ 40%</td></tr></table></td><td>Energy Management Plan

And

Energy Consumption Record</td><td>+5/+10</td><td>4.2.5</td></tr>
<tr><td colspan="5">ENVIRONMENT</td></tr>
<tr><td>Regional Materials</td><td>Meet 95 % localisation degree of raw materials.</td><td>Self-prepared calculation report with supporting documents (e.g. purchase order, location map, etc.)</td><td>+5</td><td>4.3.1</td></tr>
<tr><td>Use of Green Product</td><td>Product with the use of certified green products.</td><td>Concrete mix details with supporting documents (e.g. declaration letter, purchase order, etc.)

Green product certification of the raw material used.</td><td>+5</td><td>4.3.2</td></tr>
<tr><td colspan="5">PERFORMANCE</td></tr>
<tr><td rowspan="3">Advancement</td><td colspan="4">Applicants are encouraged to meet the following criteria:</td></tr>
<tr><td>1. Compressive Strength Evaluation Indicator</td><td>Laboratory Test Report with Calculation</td><td rowspan="2">+5</td><td rowspan="2">4.4.1</td></tr>
<tr><td>2. Protective Layer Thickness Deviation</td><td>Drawings</td></tr>
</table>

Criteria	Requirements	Verification	Points +Bonus	Index
	3. Quality of Products	And Photo record And Inspection Record		
	4. Product Identification Requirements			
	Additional Bonus Points if the Applicant can meet either one of the requirements below:			
	1. Product Traceability	Photo record And Relevant Document	+5	
	2. Voluntary Product Certification	Certification		
INNOSMART				
Innovations & Additions	Adopt new practice, technology and strategy; *OR* Achieve exemplary performance	Narrative with supporting	+5	4.5.1
		Subtotal:	+10 (Maximum)	

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1. INTRODUCTION

1.1 PURPOSE

The CIC Green Product Certification Scheme (the "Scheme") is a green product labelling scheme, owned by the Construction Industry Council (CIC) and implemented by the Hong Kong Green Building Council (HKGBC). The primary goal of the scheme is to support Hong Kong's transition to a low-carbon economy by encouraging the adoption of environmentally friendly construction practices.

With the Green Product Certification, various stakeholders, including consumers, building professionals, construction practitioners and policymakers, can easily and unequivocally identify environmentally preferable construction materials and building products. This certification serves as a reliable indicator of a product's sustainability, helping to drive market demand for greener options.

To ensure the credibility and effectiveness of the certification, the CIC and the HKGBC has jointly developed this Technical Assessment Standards (the "Standard"), which sets out the assessment criteria and their benchmarks to govern the application and award of a label under the Scheme. The comprehensive assessment evaluates the overall sustainability of construction materials and building products across multiple dimensions. These dimensions include environmental impact, resource efficiency, technical performance, and the use of smart manufacturing technologies.

The Standard is divided into two main parts:

- General Requirements (Refer to General Requirements provided in separate document). This part introduces Scheme's framework, outlines the application procedure, and details the grades.

- Technical Requirements (This document refers). This part defines the principles, requirements and guides for quantifying and reporting the products' carbon footprint (CFP), along with other sustainability assessment criteria and scoring standards.

This Standard neither modifies nor supersedes laws and regulations. Compliance with this Standard is not a substitute for, and does not assure, compliance with any applicable laws or regulations. Compliance with all applicable laws and regulations is a prerequisite for the manufacturing and marketing of the product.

The Scheme is owned by the Construction Industry Council (CIC), 38/F, COS Centre, 56 Tsun Yip Street, Kwun Tong, Kowloon, Hong Kong; and operated by Hong Kong Green Building Council (HKGBC), 1/F, Jockey Club Environmental Building, 77 Tat Chee Avenue, Kowloon Tong, Hong Kong, Phone: +852 3994 8888, Email: cicgpc@hkgbc.org.hk

1.2 BACKGROUND AND SCOPE

Precast concrete is produced by casting concrete in a reusable moulds or "form" and then being cured in a controlled environment, e.g. under specific humidity, temperature and pressure, and transported to the construction site for installation. Precast concrete represents a modern industrial solution in construction, offering numerous benefits that enhance the efficiency, sustainability, and quality of building projects.

The production process for precast concrete is carried out at ground level in a controlled environment, which significantly enhance safety during fabrication by minimising the risks associated with working at height or in unpredictable outdoor conditions commonly encountered on construction sites. Additionally, the controlled conditions of a precast yard ensure superior quality control of both materials and workmanship compared to the variable environment of a construction site. This results in more consistent, reliable, and durable concrete components. Precast concrete also provides numerous other advantages, including faster project timelines, reduced labour requirements on-site, and cost efficiency. Its combination of safety, durability, and precision makes it an essential solution for creating high-quality, long-lasting structures.

The scope for this standard in commonly used precast concrete components in Hong Kong, including (i) Structural precast concrete; and (ii) Architectural precast concrete (Table 1).

Table 1: Product Categorisation under the CIC Green Product Certification

Product Category	Product Sub-category
i. **Structural precast concrete**	Beam, slab, column
ii. **Architectural precast concrete**	Staircase, façade

2. DEFINITIONS & ACRONYMS

2.1 TERMS RELATING TO PRECAST CONCRETE

For Terms related to Ready-mixed concrete and Reinforcing bar and structural steel please refer to the Technical Requirements under *Ready-mixed Concrete* and *Reinforcing Bar and Structural Steel*.

Structural Precast Concrete	Refers to concrete components that are manufactured in a controlled environment using reusable mould, then transported to construction sites for assembly. These components are designed to bear loads and are integral to the structural integrity of buildings and other infrastructures. Common examples include precast beams, columns, wall panels, floors, and staircases.
Architectural Precast Concrete	Precast products designed with specific standards for uniform appearance, surface details, color, and texture, often used for aesthetic purposes in buildings.

Formwork	Temporary or permanent mould into which concrete is poured to achieve the desired shape. In precast production, formwork can be made from various materials including wood, steel, and fiberglass.
Curing	The process of maintaining adequate moisture, temperature, and time to allow the concrete to achieve its desired strength and durability after casting.
Moulds	Moulds, also referred to as forms, are essential tools used in the construction industry to shape and define concrete products during the casting process. In the context of precast concrete, moulds are reusable structures made from various materials such as steel, plastic, rubber, or fiberglass.

2.2 TERMS RELATING TO LIFE CYCLE ASSESSMENT (LCA)

For terms related to LCA please refer to General Requirements.

3. CFP STUDY – PRODUCT CATEGORY RULE (PCR)

3.1 GOAL

The goal of carrying out a CFP study is to calculate the potential contribution of a specific precast concrete to climate change expressed as CO_{2e} by quantifying all significant GHG emissions and removals over the precast concrete product's life cycle.

The CFP study reports submitted by Applicants will be evaluated by HKGBC for product certification purpose. This is facilitated by identical CFP quantification and communication requirements under the same product category as stipulated in Annex C of ISO 14067:2018.

This section sets the PCR of ready-mixed concrete products for CFP quantification and reporting under the Scheme following the four phases of life cycle assessment (LCA), i.e. goal and scope, LCI, LCIA, and life cycle interpretation. Applicants should refer to the principles and methodology detailed in ISO 14067:2018 and WBCSD (2011) for CFP quantification and reporting.

3.2 PRODUCT DESCRIPTION AND DECLARED UNIT

The CFP study should be conducted on a per-product basis. Refer to Section 1.2 for the description of precast concrete covered under this Technical Requirement.

The CFP study shall be conducted on a per-product basis, from cradle to gate, with an emphasis on assessing the environmental impact associated with the production of one metric tonne (1,000 kg) of precast concrete product.

The CFP Study shall include at least the following description of the product

- Product manufacturer
- Production method
- Technical data and properties of raw materials (e.g. ready mixed concrete and steel products)

3.3 SYSTEM BOUNDARY

The Technical Requirement is developed to capture the product stage A1-A3 (Cradle-to-gate) as defined in ISO 14067:2018, ISO 21930:2017, GB/T 24067-2024 or BS EN 15804:2012+A2:2019.

3.3.1 Overview of Process Map of Precast Concrete Manufacturing

The precast concrete manufacturing process begins with the delivery and handling of essential raw materials, such as reinforcing bars, cement, aggregates, cementitious materials, and admixtures etc. Upon arrival, these materials are inspected to ensure compliance with quality standards and are stored under appropriate conditions. For a detailed guidance on the production processes associated with these raw materials, Applicants should refer Technical Requirements under *Ready-mixed Concrete* and *Reinforcing Bar and Structural Steel*.

Reusable moulds are prepared for casting by cleaning and inspecting them to eliminate defects. The raw materials are mixed in a concrete mixer to achieve a uniform consistency, before being poured into the prepared moulds, where reinforcing bars are positioned in accordance with the design specification.

Once cast, the components undergo a curing process in a controlled environment to ensure optimal strength and durability. Quality control measures, including compressive strength test and dimensional accuracy checks, are implemented throughout the process to ensure compliance with established standards. After curing, the components are carefully demoulded, inspected for defects, and subjected to any necessary finishing operations, such as surface treatments or coatings.

The final precast components are then stored in designated storage areas prior transportation to construction sites. To enhance operational efficiency, manufacturers should prioritise effective management of water, energy, and other inputs during production. Additionally, waste handling and disposal must be implemented to minimise environmental impact.

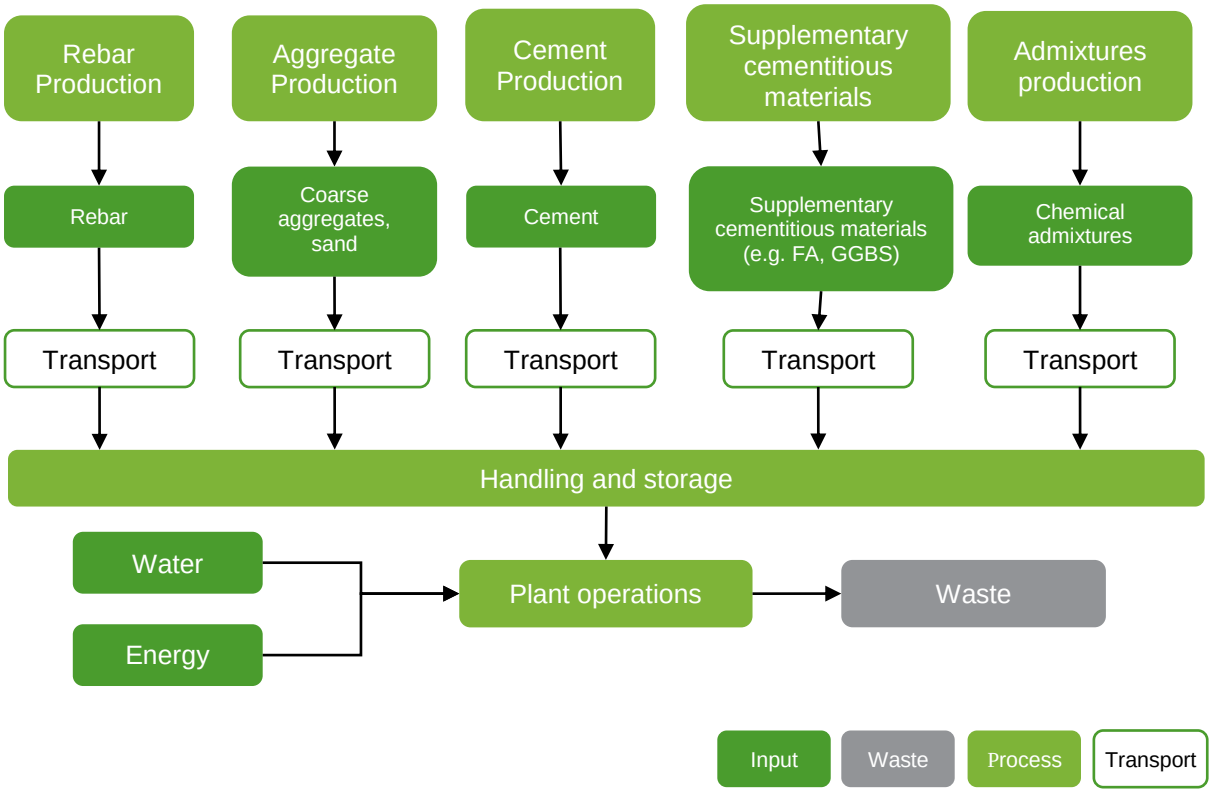

Figure 1 Process Map of Precast Concrete Manufacturing.

3.3.2 Sources of GHG Emissions

The qualitative and quantitative data for inclusion in the life cycle inventory shall be collected for all unit processes that are included in the predefined system boundary and process map. The assessment and reporting of GHG emissions and removals of precast concrete are divided into direct emissions and indirect emissions.

Direct vs. Indirect Emissions

The direct emissions stem from sources that are owned or controlled by the material supplier. The indirect emissions originate from sources that are controlled by third parties, but they are nonetheless related to the activities of the material supplier.

WBCSD (2013b)

The GHG assessment framework is developed based on the ISO 14067:2018 "Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification". The Applicant is required to quantify and report the carbon footprint of major materials (i.e. ready mixed concrete and reinforcing bar) used for specific precast concrete product using the CFP quantification tool (in Excel format) provided by our designated operator, HKGBC or providing an EPD report compliance with applicable standards, including ISO 14025:2006, ISO 14067:2018, ISO 21930:2017, GB/T 24067-2024 or BS EN 15804:2012+A2:2019.

The assessment of the GHG emissions generated and removed throughout the precast concrete production processes shall be made based on an attributional approach, i.e. by assessing the carbon contents associated with inputs and outputs of a specific process. For instance, the GHG emissions of by-product gases, either for internal or external use,

should first be subtracted within the process boundary. Subsequently, the GHG emitted from the fuel combustion and chemical reduction owing to the use of the by-product gas associated with the assessed product should be assessed and reported in the subsequent processes.

3.3.2.1 Direct Emissions

The sources of direct GHG emissions include combustion of fuels.

i) Combustion of Fuels

GHG emitted from combustion of fuels is reported separately, by the following application types, to provide flexibility in the aggregation of emissions:

- Raw material preparation (e.g., bought raw materials, handling and storage)
- On-site transportation
- Equipment
- Room heating / cooling
- On-site power generation

Carbon in fuels is assumed to be fully oxidized. The resulting overestimation of emissions will usually be small and can be neglected in the CFP assessment. The fuels used in precast concrete production are categorized into conventional, alternative and biomass fuels for carbon footprint quantification and reporting. If the electrical power is generated by third parties where the activities are not owned or controlled by the material manufacturers and suppliers, it should be referred to the "external electricity production" under indirect emissions.

The sources of direct GHG emissions related to ready-mixed concrete and reinforcing bars such as alternative fossil fuel and biomass fossil fuels, please refer to Technical Requirements under *Ready-mixed Concrete* and *Reinforcing Bar and Structural Steel*.

3.3.2.2 Indirect Emissions

Key indirect GHG emissions arising from the production of precast concrete include: i) external production of electricity consumed by precast concrete manufacturers; ii) production of bought raw materials, energy commodities ; iii) off-site transportation; and iv) land use change.

i) External Electricity Production

When a supplier of grid electricity can deliver a specific electricity product with specific life cycle data and guarantee that the electricity sale and the associated GHG emissions are not double counted, life cycle data for that electricity product shall be used. When the supplier of electricity does not provide specific GHG data for the specific electricity product, the GHG emissions associated with the national grid where the life cycle stage occurs shall be used. Where a country does not have a national grid but has several unconnected grids or several countries share a common grid, GHG emissions associated with the relevant grid from which the electricity is obtained shall be used. If specific life cycle data on a process within

the electricity supply system are difficult to access, data from recognised databases may be used.

The GHG emissions shall include: the emissions arising from the generation of electricity, e.g. combustion of fuels, and generation of electricity lost in transmission and distribution in the grid; upstream GHG emissions (e.g. the mining and transport of fuel to the electricity generator or the growing and processing of biomass for use as a fuel); downstream GHG emissions (e.g. the treatment of waste arising from the operation of nuclear electricity generators or treatment of ashes from coal fired electricity plants).

ii) Production of Bought Raw Materials and Energy Commodities

GHG emissions and removals associated with both concrete and reinforcing bar production are calculated by multiplying the consumption of raw materials by their respective embodied carbon emission factors from the Inventory of Carbon and Energy (ICE) database, as provided in the CFP quantification tool. For concrete, this involves materials like cement and aggregates, while for reinforcing bar, it includes materials such as limestone, dolomite, iron ore, coke, and lime. Primary emission factors should be used if available, and details on selecting data sources can be found in the "Data Requirement" section. This approach ensures a comprehensive assessment of the carbon footprint for both concrete and steel products.

GHG emissions from the mining and production of energy ware such as coal, natural gas, oil, petcoke, etc. used in the manufacturing process should also be accounted for under the indirect emissions. Applicants should apply the emission factor provided by region specific databases or well recognised sources (e.g. Ecoinvent, China Energy Statistical Yearbook, Japan CFP database, etc.).

iii) Off-site Transportation of Raw Materials to Manufacturing Plant

Applicants are required to specify the mode of transportation (e.g. road, rail, water or aircraft), type of activity data, vehicle type, distance travelled, fuel used, etc. to measure the GHG emissions associated with off-site transportation of raw materials to the manufacturing plant (see **Error! Reference source not found.**). When t ransportation is outside Hong Kong or the fuel consumption of non-road transport is not known, the fuel / distance-based approach is applicable to the case. The transport emissions associated with the cement product can be measured by adopting the WRI's protocol, namely "GHG Emissions from Transport or Mobile Sources1" (version 2.7, 2024) or equivalent resources if deemed appropriate. The fuel-based approach only applies to the case when the transportation happens within Hong Kong and the fuel consumption data are known. The fuel-based emission factors can be obtained from the EPD and EMSD guideline, namely "Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings (Commercial, Residential or Institutional Purposes) in Hong Kong" (2010 Edition). Fuel consumption data can also be estimated based

[1] The tool is accessible at: https://ghgprotocol.org/calculation-tools-and-guidance

on the energy consumption indicators as provided by EMSD Energy Consumption Indicator.

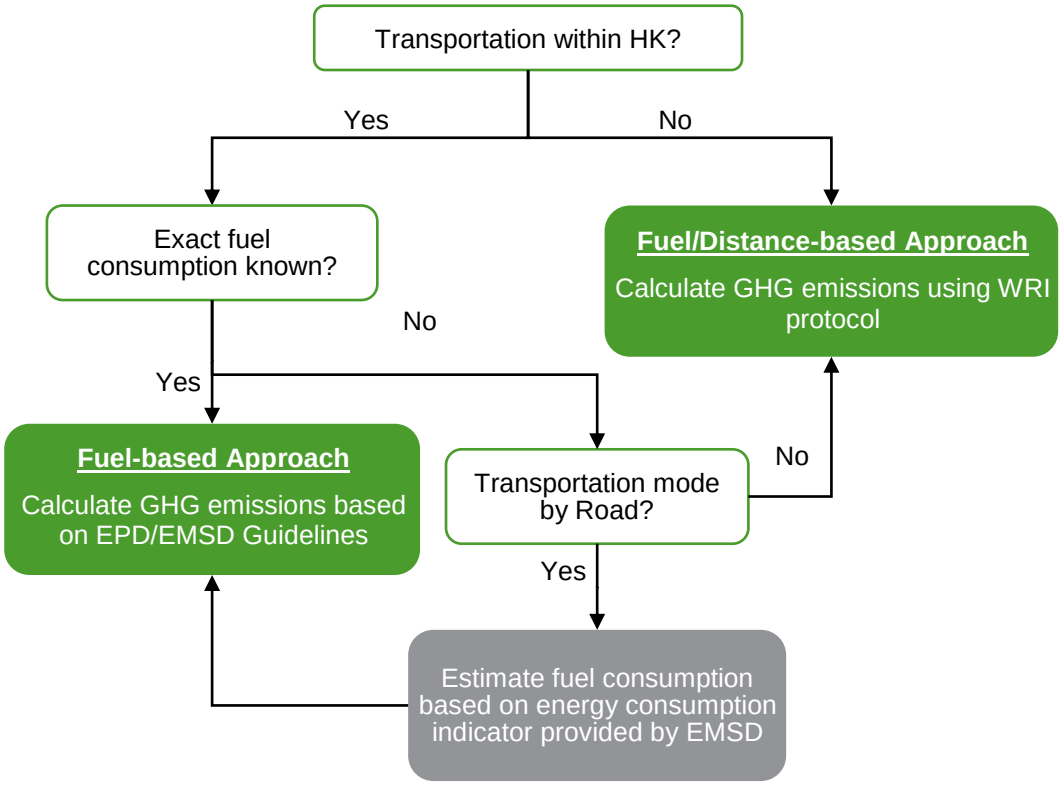

Figure 2 Method Selection for Off-Site Transporation Emission Calculation

iv) Land Use Change

The GHG emissions and removals occurring as a result of direct land use change shall be assessed in accordance with internationally recognised methods such as the IPCC Guidelines for National Greenhouse Gas Inventories and included in the CFP. If plant-specific data are applied, they shall be transparently documented in the CFP study report. If a national approach is used, the data shall be based on a verified study, a peer reviewed study or similar scientific evidence and shall be documented in the CFP study report. Indirect land use change can be ignored in CFP studies under the CIC Green Product Certification.

Table 2 Parameters and Data Sources for Calculating the Carbon Footprint of Precast concrete Products

Emission components		Parameters	Units	Sources of parameters
Direct Emissions	***Fuels Combustion***	Quarrying / Mining raw-materials	t GJ/t fuel tCO_2e/GJ fuel	Fuel Consumption: measure at plant level Emission factors: IPCC defaults or measured
		On-site transportation		
		Equipment		
		Room Heating & Cooling		
		On-site power generation		
Indirect Emissions	**External electricity production**	Power bought from external grid	GWh	Measured at plant level
		Emission factor	tCO_2e/GWh	Applicant-specific value or country grid factor
	Production of bought raw materials and energy commodities	Net raw materials and energy commodities purchased	t	Measured at plant level
		Emission factor	tCO_2e/t	Default factor / Input
	Off-site transportation	Mode of transportation Type of activity data Vehicle type Distance travelled Fuel consumed	Measured using WRI protocol/EPD /EMSD guidelines	
	Land use change	Emission factor	Measured in accordance with IPCC Guidelines	

3.3.3 Guidelines for Inclusion of Similar Product

Similar products manufactured at one or multiple locations owned by the same manufacturer that fall under the same Product Category Rule, may be incorporated under in a single group product same certification, contingent upon the core manufacturing processed being fundamentally the same.

Additionally, when preparing the application, the applicant must ensure the following:

- The products must be for the same type of component. For example, slabs and beams cannot be combined in the same application.
- The material used in the precast concrete must share identical physical and mechanical properties, production method, such as compressive strength of ready-mixed concrete, yield strength and tensile strength for reinforcing bar.
- All products included in the same group product certification must meet the same benchmark level under Carbon Label. The variation in CFP among all products shall be within 10%.

Once the Applicant chooses to apply through the group certification, the data reporting for the grouped products shall follow either one of the below approaches.

- **Weighted Average Calculation:** The average must be weighted according to the production volumes of the included products, if applicable. This means that products with higher production volumes will have a greater influence on the overall average, providing a more accurate representation of environmental performance.
- **Worst-Case Reporting:** If a single value is selected for each impact category across all products, the reported value should reflect the worst performance within the range of variation.

4. REQUIREMENTS

4.1 CARBON

4.1.1 CFP quantification– Core Criteria

The Applicant is required to achieve 50 Basic Points under this section. Additionally, the Applicant can achieve maximum 40 Bonus Points under this section.

Requirements

The Applicant shall provide a life cycle assessment report for quantification and reporting of the carbon footprint of products (CFP), following the guidance addressed in the General Requirements and detailed system boundary and GHG emissions related to the raw material used (i.e. ready mixed concrete and reinforcing bar) listed in Section 3. The CFP study report should be prepared in accordance with ISO 14067:2018.

OR

The Applicant shall provide the CFP value of the raw material used (i.e. ready mixed concrete and reinforcing bar) from a product-level EPD certified in accordance with ISO 14025:2006, ISO 14067:2018, ISO 21930:2017, GB/T 24067-2024, or BS EN 15804:2012.

Points will be awarded according to the certification level of the raw material used, as listed in Table 3. The certification level of the raw material used is defined according to Table 4 for ready-mixed concrete and Table 5 for reinforcing bars.

Table 3: Benchmark for Precast Concrete Products under the CIC Green Product Certification

	Certification Level	
Points	**Ready-mixed Concrete**	**Reinforcing Bar**
50 Basic +40 Bonus	A	A
50 Basic + 30 Bonus	B or above	B or above
50 Basic + 20 Bonus	C or above	C or above
50 Basic + 10 Bonus	D or above	D or above
50 Basic	E or above	E or above

Table 4 Benchmark for ready-mixed concrete under the CIC Green Product Certification

	CFP ($kgCO_2e/m^3$)								
Certification Level	**C20**	**C30**	**C35**	**C40**	**C45**	**C50**	**C60**	**C70**	**C80**
A	<206	<227	<248	<268	<286	<303	<303	<375	<375
B	207-229	227-252	248-275	268-299	286-319	303-338	303-378	375-419	375-419
C	230-253	253-279	276-305	300-330	320-352	339-374	379-418	420-463	420-463
D	254-277	280-306	306-335	331-363	353-386	375-410	419-458	464-507	464-507
E	>277	>306	>335	>363	>386	>410	>458	>507	>507

Table 5 Benchmark for Reinforcing Bar under the CIC Green Product Certification

Certification Level	**CFP** (tCO_2e/t of product)
A	<1.01
B	1.01-1.97
C	1.97-2.16
D	2.16-2.43
E	2.43-2.77

Verification

- CFP quantification report in accordance with ISO 14067:2018, OR
- Product-level Environmental Product Declaration (EPD) in accordance with ISO 14025:2006, ISO 14067:2018, ISO 21930:2017, GB/T 24067-2024 or BS EN 15804:2012.

4.2 RESOURCE

4.2.1 Recycled Materials - Non-Core Criteria

The Applicant can achieve maximum 5 Bonus Points under this section.

Requirements

5 Bonus Points will be awarded for the products adopt required recycled materials in either ready-mixed concrete or reinforcing bars during the production process of precast concrete products. The eligible recycled contents are listed in Table 6.

Table 6: Eligible SCM and recycled contents

Eligible SCM and Recycled Contents	**Required Percentage**
Pulverised Fuel Ash (PFA) as SCM in concrete mix	25%
Ground Granulated Blast-furnace Slag (GGBS) as SCM in concrete mix	40%

Eligible SCM and Recycled Contents	Required Percentage
Silica Fume (SF) as SCM in concrete mix	5%
Recycled aggregates in C20 concrete mix	100%
Recycled aggregates in C25-35 concrete mix	20%
Recycled contents in reinforcing bar	80%

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Concrete mix details with source of raw materials, quantity used, and mass percentage, and
- Material summary with detailed breakdown of the raw materials used by weight, and specifying the proportion of recycled materials
- Relevant supporting documentation such as declaration letter to verify the use of recycled materials in the production process, purchase order / delivery notes for raw materials purchased, etc.

4.2.2 Solid Waste Reuse - Non-Core Criteria

The Applicant can achieve maximum 5 Bonus Points under this section.

Requirements

Manufacturers that achieve a solid waste utilisation rate of at least 95% will receive 5 bonus points. Comprehensive utilisation of solid waste includes both recycling and reuse by the manufacturer itself, as well as recycling and utilisation by qualified third-party organizations. The utilisation rate of solid waste is defined as the mass percentage of solid waste generated during the production of steel and steel components that is effectively utilised. The solid waste utilisation rate is calculated using the formula:

$$R = \frac{M_r}{M_p} \times 100\%$$

where:

R = Utilisation rate of solid waste generated during the production process.

M_r = The mass of solid waste diverted from landfill during the statistical period, measured in kilograms (kg).

M_p = The mass of solid waste generated during the statistical period, measured in kilograms (kg).

The definition of common solid waste is listed in Table 7. The utilisation rate of solid waste generated during the production process should be calculated over a statistical period of 12 months. If the manufacturer has not been in operation for 12 months, the period can be appropriately shortened but should not be less than 6 months.

Table 7: Types of Solid Waste

Common Solid Waste	Description
Returned Concrete	Cement and aggregates that wasted due to spillage, over-ordering, or improper handling during the batching process.
Cured Concrete Waste	Leftover concrete from mixing or casting processes that cannot be reused directly in structural elements.
Excess Raw Materials	Excess concrete/ rebar and off-cuts from the production of precast concrete components

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Solid waste audit reports with the types and quantities of solid waste generated and diverted from landfill during production, and calculation of utilization rate over the statistical period.
- Descriptions outlines the waste management initiatives / policies within the organisation.
- Relevant supporting documentation such as declaration letter, trip ticket, delivery note for recycling solid waste.

4.2.3 Water Management – Non-core Criteria

The Applicant can achieve maximum 10 Bonus Points under this section.

The Applicants can select one of the options below and comply with any or all the requirements under that option to achieve associated points. Each option is eligible for a maximum 10 Bonus Points.

Option A:

4.2.3.1 Water Consumption Reporting – Non-core Criteria

Requirements

5 Bonus Points for reporting both potable and non-potable water usage in the production process of the past year.

Verification

Water consumption report, support by water usage data acquired from water meter, water sub-meter, water bill or other equivalent documents.

4.2.3.2 Water Recycling Program – Non-core Criteria

Requirements

5 Bonus Points for developing and implementing water recycling program during the manufacturing process.

Verification

Documentation demonstrating the implementation of water recycling program, support by drawings, water usage data acquired from water sub-meter or other equivalent documents.

Option B:

4.2.3.3 Water Management System – Non-core Criteria

Requirements

10 Bonus Points for possessing valid certificates under ISO 14046: Environmental management – Water footprint – Principles, requirements and guidelines.

ISO 14046 is a framework for assessing the water footprint of products, processes, and organizations. It provides principles, requirements, and guidelines for conducting and reporting water footprint assessments. it helps organizations evaluate and improve their water management practices.

Verification

A valid ISO 14046 Certificate issued by accredited certification bodies.

4.2.4 Mould Circularity – Non-core Criteria

The Applicant can achieve maximum 5 Bonus Points under this section.

Mould Recycling

Requirements

5 points for adopting recyclable materials in the moulds production. This ensures that the moulds can be effectively recycled at the end of life.

Verification

To obtain the points under this criterion, following documents shall be provided for verification:

- A declaration letter stating the material used for mould production, supported by documents including but not limited to material summary with purchase order / delivery notes, photo record or other equivalent information.

4.2.5 Energy Management – Non-core Criteria

The Applicant can achieve maximum 10 Bonus Points under this section.

Requirements

Points are awarded for demonstration the compliance of percentage of energy consumed for concrete curing process, as listed in Table 8. The manufacturer should enhance the production under effective energy management policies, procedures, programmes to achieve low energy consumption during the concrete curing process.

Table 8: Points allocation for energy consumption in concrete curing

Points	Energy consumed for concrete curing
10 Bonus	≤ 40%
5 Bonus	≤ 60%

The calculation of energy consumption for concrete curing is defined according to the formula:

$$S = \frac{E_e}{E_t} \times 100\%$$

where:

S = Percentage of energy consumed for concrete curing process per product line.

E_e = Energy consumed for concrete curing process during the statistical period per product unit

E_t = Total energy consumed for precast concrete products per product line during the statistical period.

The data should be calculated over a statistical period of 12 months. If the manufacturer has not been in operation for 12 months, the period can be appropriately shortened but should not be less than 6 months.

Verification

To obtain the points under this criterion, following documents shall be provided for verification:

- Provide records of energy consumption and demonstrate the percentage of energy consumed for the concrete curing process, through readings from sub-meter or fuel purchase record.
- Descriptions outlines energy-saving measures implemented within the manufacturer.

4.3 ENVIRONMENT

4.3.1 Regional Materials – Non-core Criteria

The Applicant can achieve maximum 5 Bonus Points under this section.

Requirements

Products that achieve a 95% localisation degree of raw materials will be granted 5 bonus points. The localisation degree of raw materials is calculated based on the percentage of materials transported within certain distances with appropriate transportation methods.

The calculation focuses on the primary raw materials, according to formula below.

$$T = \frac{M_{gt}}{M_t} \times 100\%$$

where:

T = The localisation degree of raw materials

M_{gt} = The total amount of primary raw materials used during the statistical period that were transported over a distance within an 800km radius of the HKSAR by road transportation, within a 1,600km radius by rail transportation, or within a 4,000km radius by sea transportation, excluding water, measured in tons (t)

M_t = The total amount of raw materials used during the statistical period, excluding water, measured in tons (t)

A statistical period of 12 months should be used. If the manufacturer has not been in operation for 12 months, the period can be appropriately shortened but should not be less than 6 months.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- A self-prepared calculation report with relevant supporting, including but not limit to, purchase order forms showing the quantity of raw materials used, a map showing the origin for each raw material, the location of the plant, and the transportation methods

4.3.2 Use of Green Products – Non-core Criteria

The Applicant can achieve maximum 5 B*onus Points under this section*

Requirements

5 Bonus Points for product that demonstrates the use of certified green products.

To promote the use of environmentally friendly products that have a minimal ecological impact, Applicants are encouraged to use raw materials that are certified as green products.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Material summary report detailing the raw materials used with associated quantity and source and
- Green Product Certification of the raw materials from its suppliers, and
- Relevant supporting documentation such as declaration letter to verify the use of recycled materials in the production process, purchase order / delivery notes for raw materials purchased, etc.

4.4 PERFORMANCE

4.4.1 Advancement – Non-core Criteria

The Applicant can achieve maximum 10 Bonus Points under this section.

Requirements

5 bonus points will be awarded for products meeting ALL quality assurance criteria, as listed below.

- Compressive Strength Evaluation Indicator
- Protective Layer Thickness Deviation
- Quality of Products
- Product Identification Requirements

4.4.1.1 Compressive Strength Evaluation Indicator

The product shall achieve a compressive strength evaluation indicator (U) of ≥1.4 for six consecutive batches.

The mechanical performance evaluation indicators for products are calculated based on GB/T 50107 using the formula:

$$U = \frac{\mathrm{m_{fcu}} - \lambda_1 \times S_{\mathrm{fcu}}}{1.4\, f_{\mathrm{cu,k}}}$$

Where:

U - Single inspection batch product compressive strength evaluation indicator.

$\mathbf{m_{fcu}}$ - Average compressive strength of concrete cubes in the same inspection batch, accurate to 0.1, in units of N/mm².

λ_1 - Qualification evaluation coefficient, selected according to Table 9: Qualification evaluation coefficientTable 9.

S_{fcu} - Standard deviation of the compressive strength of concrete cubes in the same inspection batch, accurate to 0.1, in units of N/mm². If the calculated standard deviation of the inspection batch is less than 2.5 N/mm², take 2.5 N/mm².

fcu,k - Standard value of concrete cube compressive strength, accurate to 0.1, in units of N/mm².

Table 9: Qualification evaluation coefficient

Nos. of precast concrete	10-14	15-19	≥20
λ	1.15	1.05	0.95

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Concrete cube test reports with actual comprehensive strength conducted by a laboratory accredited under HOKLAS, in accordance with the testing methods specified in CS1:2010, and
- Calculate of single inspection batch product compressive strength evaluation indicator

1. Protective Layer Thickness Deviation

The thickness of the concrete cover to reinforcement shall not be less than 25 mm.

The product must maintain a concrete cover thickness within a tolerance of ±5 mm from the specified value.

The product shall follow the requirements outlined in the Code of Practice for Fire Safety in Buildings and the Code of Practice for Precast Concrete Construction.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Drawing of the precast concrete
- Inspection records of the precast concrete (Including photo record)

2. Quality of Products

Product appearance has general defects but is treated to meet standards.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Inspection records of the precast concrete, including photographic documentation

3. Product Identification Requirements

The identification content should include at least the component number, location, qualified status, installation direction, and functional identification of embedded parts.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Photographic records demonstrating permanent markings or labels that include all necessary information, such as component number, location, qualified status, installation direction, and functional identification of any embedded parts.The product will receive additional 5 bonus points if it meets either of the following criteria:

1. Product Traceability:

Products marked with a spray code or having a chip implanted for traceability.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- Photographic records of the precast concrete must confirm the presence of either a spray code or a chip (or chip indicator). If a chip system is used, a method for scanning and recording the chip data must be implemented.
- Catalogue of the chip system.

2. Voluntary Product Certification:

Products that have obtained voluntary product certification from recognized certification organizations.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- A copy of the valid product certification certificate.

4.5 INNOSMART

4.5.1 Innovations & Additions – Non-core Criteria

Requirements

5 Bonus Points will be granted for manufacturers demonstrating innovation in sustainable production practices.

Examples of incorporating various smart technologies to improve efficiency, reduce energy consumption, and optimise performance are listed in Table 9.

Table 10: Example of innovative and smart technologies.

Decarbonisation Strategies	• Investigate the use of carbon capture and storage (CCS) technologies to capture and sequester the CO2 emissions generated during the cement production process. • Implement the use of low-carbon transportation fuels, such as biofuels or electric vehicles, for the concrete delivery fleet
Environmental Impact Reduction	• Integrating GPS technology into delivery truck routing can significantly reduce fuel consumption and emissions by optimising routes based on real-time traffic conditions and delivery locations. • GPS data can be combined with telematics to monitor truck performance and driving behaviour. This allows for targeted training to improve fuel efficiency and reduce emissions from the concrete delivery fleet.
Digitalisation and Data-Driven Optimization	• Develop a comprehensive digital platform that integrates all aspects of the concrete production and delivery process, enabling data-driven decision-making and optimisation. • Implement advanced analytics and machine learning algorithms to optimize the concrete mix design, production parameters, and delivery logistics based on real-time data.
Health and Safety Enhancements	• Integrate wearable sensors and Internet of Things (IoT) devices to monitor the health and safety of workers in the concrete production facility and during delivery. • Develop real-time hazard detection and warning systems to identify and mitigate potential risks, such as equipment malfunctions or environmental hazards.
Quality Assurance	• RFID (Radio Frequency Identification) technology enhances efficiency and traceability in the precast concrete industry by enabling real-time tracking of components throughout their lifecycle. By embedding RFID tags, manufacturers streamline inventory management, improve quality control, and maintain detailed records of each product's history, ensuring compliance with industry standards and enhancing operational accountability.

Verification

To obtain the points under this criterion, the following documents shall be provided for verification:

- A written report with a maximum length of 1,000 words. The report should clearly outline the proposed solution, objectives, and evaluation methods used to meet the criteria established by Smart Technologies.
- Attachments that provide evidence of implementation, along with relevant technical specifications that support the claims made in the report.

5. SCORING

The points for meeting each criterion stated in this Standard are summarized below.

Table 11: Points to be awarded under the assessment criteria of this Standard

Label	Evaluation criteria	Points		Related Beam Plus Credits
		Basic	+Bonus	
Carbon	CFP quantification [CORE]	**50**	+40	MW 10
Resource	Recycled materials		+5	MW 6
	Solid Waste Reuse		+5	
	Water Management		+5/+10	
	Mould Circularity		+5	
	Energy Management		+5/+10	
Environment	Regional Materials		+5	MW 8
	Use of Green Products		+5	MW 9
Performance	Advancement		+5/+10	
InnoSmart	Innovations & Additions		+5	IA
	Total:	**50**	**+50**	

Applicants must demonstrate that they have achieved the basic points under the CORE criteria. Applicants may apply for up to TWO assessment criteria beyond the Carbon Label, allowing for a maximum of 10 bonus points. These bonus points can be earned from any assessment criteria under the Resources, Environment, Performance, and InnoSmart Labels.

Related BEAM Plus Credits refer to these relevant credits under BEAM Plus New Buildings Version 2.0, as listed below.

- MW 3: Prefabrication
- MW 6: Recycled Materials
- MW 8: Regional Materials
- MW 10: Life Cycle Assessment
- Innovations & Additions

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