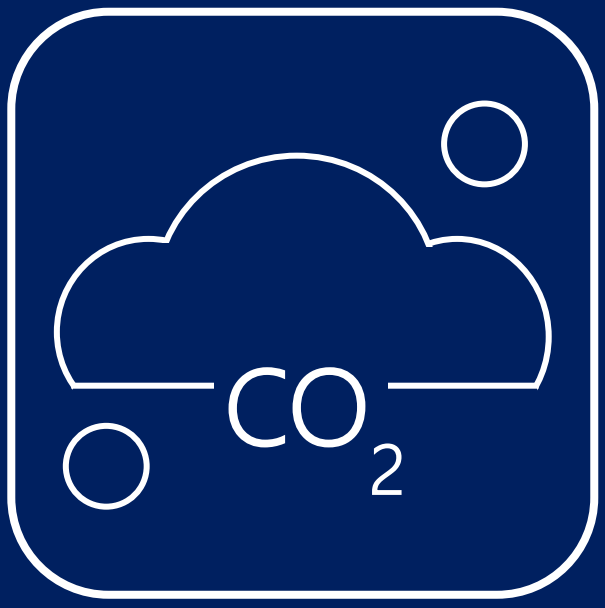


Green Mark 2021

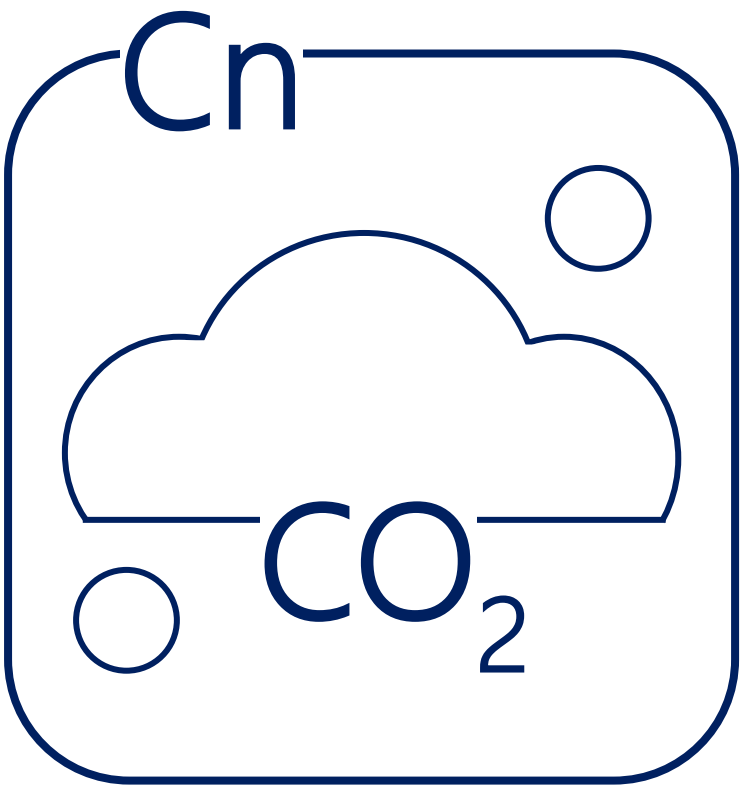
Cn

Whole Life Carbon

The Whole life Carbon section looks at the projects carbon footprint, with a focus on embodied carbon, the use of sustainable construction or retrofit materials and methods, as well as the role of tenants and their fit outs. The section will also evaluate building owners on their transition towards carbon neutrality at the asset level, translating the corporate objectives into tangible outcomes, as well as their support for tenants to do the same.

The GM 2021 Whole life Carbon section (Cn) has been created leveraging leading international movements such as the World Green Building Council's Net Zero Carbon Buildings commitment, and professional standards such as the RICS Whole life carbon assessments for the built environment.

The section has been refined through a collaborative approach with the Singapore Green Building Council, the National Environment Agency, the JTC corporation and the Public Utilities Board.



Helps projects meet targets under the following SDGs

Revision	Description	Effective Date
R0	Launch for Pilot	22 April 2021
R1	1st Edition	1 November 2021
R2	2nd Edition with updates	1 January 2024

WHOLE LIFE CARBON

CN1 CARBON	Green Mark Points	
CN1.1 Whole Life Carbon	**New**	**Existing**
CN1.1 Whole Life Carbon (WLC) Assessment Whole Life carbon assessment consistent with EN 15978 and EN 15804. *Useful references: https://www.rics.org/globalassets/rics-website/media/news/whole-life-carbon-assessment-for-the--built-environment-november-2017.pdf* *https://www.architecture.com/-/media/GatherContent/Whole-life-carbon-assessment-for-architects/Additional-Documents/11241WholeLifeCarbonGuidancev7pdf.pdf*		
(i) **Minimum Scope Requirement of WLC Assessment** **Minimum Scope of WLC assessment** Building elements to be included: 1. Substructure 2. Superstructure Lifecycle stages to be included: 1. Product stage [A1-A3] 2. Construction Stage [A4-A5] 3. Maintenance Stage [B2] Façade 4. Replacement Stage [B4] ACMV 5. Operational Energy [B6] • *New building projects that conduct the **full scope** of WLC assessment will score up to additional 2 points under the **Innovation section**.* • *New building projects scoring under CN1.1(i) will be excluded from scoring under CN 1.1(ii)(a)* • *Refer to WLC Technical Guide for list of software tools for computation of WLC assessment*	**(i)** **Non Residential:** 3 points **Residential:** 3 points	**(i)** **Non Residential:** N.A **Residential:** N.A
(ii) **Embodied Carbon Computation** a) Calculation of embodied carbon of the development Using the Building Embodied Carbon Calculator (BECC) or Singapore Building Carbon Calculator (SBCC) hosted at the SGBC website. (*Also refer to SGBC Embodied Carbon in Buildings Calculation Guidance*) b) >10% Reduction from the reference embodied carbon (for Concrete, Glass and Steel) c) >30% Reduction from the reference embodied carbon (for Concrete, Glass and Steel)	**(ii)** **Non Residential:** 0.5 point for (a) 1 point for (b) OR 2 points for (c) **Residential:** 0.5 point for (a); 1 point for (b) OR 2 points for (c)	**(ii)** **Non Residential:** 1 point for (a) N.A for (b) OR N.A for (c) **Residential:** 1 point for (a) N.A for (b) OR N.A for (c)

WHOLE LIFE CARBON

<table>
<tr><th colspan="2">CN1 CARBON</th><th colspan="2">Green Mark Points</th></tr>
<tr><td colspan="2">CN1.1 Whole Life Carbon</td><td>New</td><td>Existing</td></tr>
<tr><td colspan="2">
<table>
<tr><th></th><th>Reference values

(kgCO2e/m2)</th></tr>
<tr><td>Non-Residential</td><td>1000</td></tr>
<tr><td>Residential</td><td>1300</td></tr>
<tr><td>Industrial</td><td>2500</td></tr>
</table>
(Reference values based on A1-5 emissions for superstructure only) A5 Construction Phase embodied carbon emissions has been included in the Reference value for all building typologies
</td><td></td><td>(ii) is applicable only to Existing Buildings with Addition and Alteration (A&A) works involving additional gross floor area (GFA) with new construction, addition of floors with independent substructures</td></tr>
<tr><td colspan="2">CN1.2 2030 Transition Plan</td><td>New</td><td>Existing</td></tr>
<tr><td colspan="2">(i) Develop and publish as 2030 Transition Plan that delineates steps to deliver a net zero carbon building from 2030 for the asset under assessment, based on Scope 1 and 2 emissions

[Note: Timelines and strategies shall be clearly articulated with tracking mechanisms, covers the areas under the building owner's control. See WGBC Net zero Carbon commitment https://www.worldgbc.org/thecommitment]

(ii) At least 50% offset of Scope 2 emissions offset at verification stage</td><td><u>(i)
Non Residential:</u>

1 point

<u>Residential</u>

1 point

(ii)
N.A</td><td><u>(i)
Non Residential:</u>

3 points

<u>Residential:</u>

1 point

(ii)
<u>Non Residential:</u>

2 points

<u>Residential:</u>
N.A</td></tr>
<tr><td colspan="2">CN1 Carbon</td><td colspan="2">5 Points total</td></tr>
</table>

WHOLE LIFE CARBON

CN2 Construction

Green Mark Points

CN2.1 Sustainable Construction

New

Existing Buildings

Use of sustainable construction materials and methods to reduce environmental impacts of the construction phase.

(i) Design with Low CUI

Building Type	CUI
Non Residential	≤ 0.35
Residential	≤ 0.45
Industrial	≤ 0.45

(ii) Adoption of sustainable building systems and Design for Manufacturing and Assembly (DfMA) that minimise resource use and waste, with a view to a greater integration of components and systems. The following can be considered jointly and severally based on % coverage over constructed floor area (CFA).

a) Advanced precast concrete system (APCS)

b) Structural Steel

c) Mass Engineered Timber (MET)

d) Prefabricated Prefinished Volumetric Construction (PPVC)

e) Hybrid structural system of:

i) Structural Steel and Precast Concrete; or

ii) MET and Structural Steel/ Precast Concrete

Building Type	Adoption of Sustainable Building System
Non-Residential	≥ 50% of CFA
Residential	≥ 55% of CFA

(iii) Use of Low Carbon Concrete certified by SGBC or equivalent local certification bodies (using CEM II – V cements under SS EN 197-1) for ≥ 80% of applicable superstructure works by volume

New

Non Residential:

1 point for (i)

1 point for (ii)

0.5/0.75/1 point for (iii)

0.5point for fine/coarse agg. replacement; 1point for both coarse and fine agg. replacement for (iv)

Residential:

2 points for (i)

1 point for (ii),

1.0/1.5/2.0 point for (iii)

0.5point for fine/coarse agg. replacement; 1point for both coarse and fine agg. replacement for (iv)

Existing Buildings

(*Applicable only to Existing Buildings with Addition and Alteration (A&A) works involving additional gross floor area (GFA) with new construction, addition of floors with independent substructures*)

Non Residential:

1 point for (i)

1 point for (ii)

0.5/0.75/1 point for (iii)

0.5point for fine/coarse agg. replacement; 1point for both coarse and fine agg. replacement for (iv)

Residential:

2 points for (i)

1 point for (ii),

1.0/1.5/2.0 point for (iii)

0.5point for fine/coarse agg. replacement; 1point for both coarse and fine agg. replacement for (iv)

WHOLE LIFE CARBON

CN2 Construction

Green Mark Points

Concrete categories	Points
Concrete products that achieve at least SGBP 2 ticks or equivalent administered by local certification bodies	0.5 (NR) 1.0 (R)
Concrete products that achieve at least SGBP 3 ticks or equivalent administered by local certification bodies	0.75 (NR) 1.5 (R)
Concrete products that achieve at least SGBP 4 ticks or equivalent administered by local certification bodies	1.0 (NR) 2.0 (R)

(iv) Replacement of coarse and fine aggregates for structural concrete applications [by mass of Crushed Concrete Aggregate (CCA), Wash Copper Slag (WCS), granite fines (GF)] must meet both minimum requirements in terms of extent of usage and replacement levels as shown in the table below:

Minimum Requirement	**CCA***	**WCS**	**GF**
Extent of usage	≥ 1.5% x GFA	≥ 0.75% x GFA	≥ 1.5% x GFA
Replacement amount (%)	≥ 20%	≤ 10%	≥ 50%

*Crushed concrete aggregate (CCA), referred to in current standards, was previously called recycled concrete aggregate (RCA)

CN2.2 Sustainable Products & Finishes

(i) **≥ 60%* (by cost) or ≥ 80%* (by areas)** of the Architectural and applicable landscaping works are at least SGBP 2 ticks or equivalent administered by local certification bodies

(ii) **≥ 60%* (by cost)** of Mechanical, Electrical and Plumbing (MEP) systems are SGBP certified or equivalent administered by local certification bodies

Non Residential:

1 point for (i)

1 point for (ii)

(Applicable to existing buildings with retrofitting works or change of MEP systems)

Non Residential:

2 points for (i)

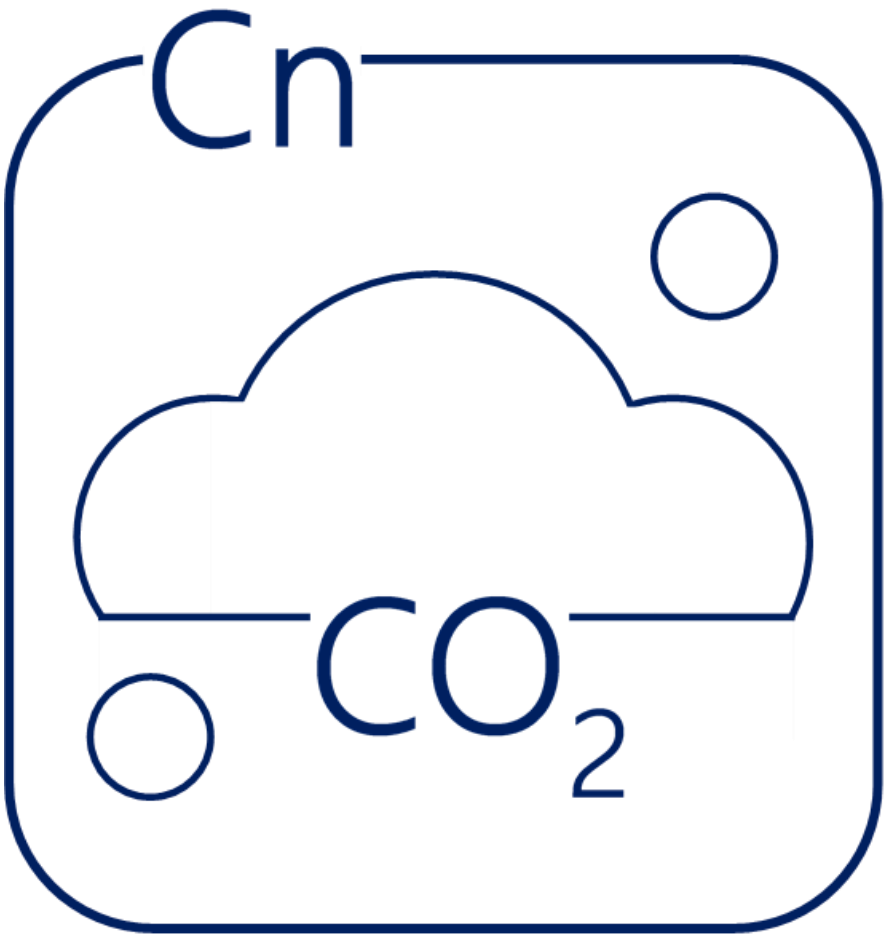
3 points for (ii)

WHOLE LIFE CARBON		
CN2 Construction	**Green Mark Points**	
* The coverage of ≥ 60% (by cost) or 80% (by areas) should include minimally **at least 3 building Products/Finishes.**	**Residential:** 2 point for (i) 1 point for (ii)	**Residential:** 2 points for (i) 3 points for (ii)
CN2.3 Conservation, Resource Recovery and Waste Management	**New**	**Existing**
(i) To encourage conservation of existing building structure, recovery of demolished building materials for reuse and/or recycling and waste management. Existing structures are conserved and not demolished. (ii) Existing structures are demolished with an enhanced demolition protocol, where a recovery rate of ≥ 40% crushed concrete waste from the demolished building is sent to approved recyclers with proper facilities. (iii) Appointment of environmental specialists during construction stage – The main builder is a BCA Green and Gracious Builder with Merit or above rating and has ISO14001 certification.	**Non Residential:** 1 point for (i) 1 point for (ii) 1 point for (iii) **Residential:** 1 point for (i) 1 point for (ii) 1 point for (iii)	*(Applicable to existing buildings undergoing major retrofitting work and > 30 years old)* **Non Residential:** 1 point for (i) 1 point for (ii) 1 point for (iii) **Residential:** 1 point for (i) 1 point for (ii) 1 point for (iii)
CN2 Construction	**5 Points total**	

WHOLE LIFE CARBON		
CN3 Fit Out	**Green Mark Points**	
CN3.1 Green Lease	**New**	**Existing**
A comprehensive Green Lease* (or equivalent) to be incorporated into the tenancy agreement, that establishes agreed levels of environmental performance between the landlord and the tenant for (i) ≥ 50% of the net lettable area (ii) ≥ 70% of the net lettable area (iii) Every tenant **The Green Lease should include at a minimum: principles relating to energy, water, waste, environmental management and procurement including materials, fit-out as well as facility management practices.* *Example template is available:* *BCA Green Lease Toolkit: Office/Retail/Industrial Green Schedule: https://www1.bca.gov.sg/docs/default-source/docs-corp-buildsg/sustainability/green-lease-toolkit.docx?sfvrsn=3c597a12_4*	**Non Residential:** 1 point for (i) 2 points for (ii) 3 points for (iii) **Residential:** N.A	**Non Residential:** 1 point for (i) 2 points for (ii) 3 points for (iii) **Residential:** N.A
CN3.2 Fit Out Products		
(i) ≥ 80% (by cost or area) of the fit-out materials used (construction and finishes) for **common areas** (i.e. non-tenanted spaces) shall be conserved or at least SGBP 2 ticks or equivalent administered by local certification bodies (ii) ≥ 80% (by cost or area) of the fit-out materials used (construction and finishes) for **tenanted spaces/ dwelling units** shall be conserved or at least SGBP 2 ticks or equivalent administered by local certification bodies *Fit out products with EPD certification can score additional points at Innovation section*	**Non Residential:** 1 point for (i) 1 point for (ii) **Residential:** 1 point for (i) 2 points for (ii)	**Non Residential:** 1 point for (i) 1 point for (ii) **Residential:** 2 points for (i) N.A for (ii)

WHOLE LIFE CARBON		
CN3 Fit Out	**Green Mark Points**	
CN3.3 Tenancy Offsets	**New**	**Existing**
Non Residential: The building owner requires and actively assists the tenants to offset their operational energy through the procurement of renewables, or through the ongoing purchase of certified carbon offsets. (i) ≥ 30% of tenants (by NLA) (ii) ≥ 60% of tenants (by NLA) (iii) ≥ 90% of tenants (by NLA)	**Non Residential:** N.A	**Non Residential:** 1 point for (i) 2 points for (ii) 3 points for (iii)
Residential: The building owner (e.g. MCST) offset their common areas operational energy through the procurement of renewables, or through the ongoing purchase of certified carbon offsets. (i) ≥ 30% of common areas consumption (ii) ≥ 60% of common areas consumption (iii) ≥ 90% of common areas consumption	**Residential:** 1 point for (i) 2 points for (ii) 3 points for (iii)	**Residential:** 1 point for (i) 2 points for (ii) 3 points for (iii)
CN3 Fit Out	**5 Points total**	

CN - INNOVATION		
	Green Mark Points	
	New	**Existing**
Where projects can demonstrate substantial performance to a specific Carbon indicator or outcome innovation points can be awarded on a case by case basis. Points shall be awarded based on the strength of evidence of benefits and potential impact. <u>Process:</u> **At Design / Pre-retrofit stage** The project team is to submit a concise summary that articulates: • The nature of the environmental benefit of their intervention • Justify the impact of the intervention through detailed calculations and comparisons with industry norms • Substantiate the calculations and comparisons with evidence and data. **At Verification (As Built/ In Operation):** Details of the implemented intervention including measurements and monitoring of the environmental performance including lessons learnt if the intervention does not perform as expected. *Examples:* • *Full scope of Whole Life Carbon (WLC) Assessment* • *Use of NEWSand in non-structural applications* • *Use of carbon mineralisation technologies* • *Use of 100% granite fines as aggregate replacement* • *Recognising products with EPDs* • *Recognising the use of low carbon technologies and solutions as part of sustainable construction practices (e.g. use of low carbon construction site generators, energy storage solutions, electric construction equipment, etc.)* • *Recognising design for Disassembly/Future adaptability - to facilitate future changes and dismantlement (in part or whole) for recovery of systems, components and materials.*	Up to 2 points	Up to 2 points
CN INNOVATION	**2 Points total**	


Cn
CO_2

Developed by:

Building and Construction Authority

In collaboration with:

SINGAPORE GREEN BUILDING COUNCIL

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PUB SINGAPORE'S NATIONAL WATER AGENCY

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