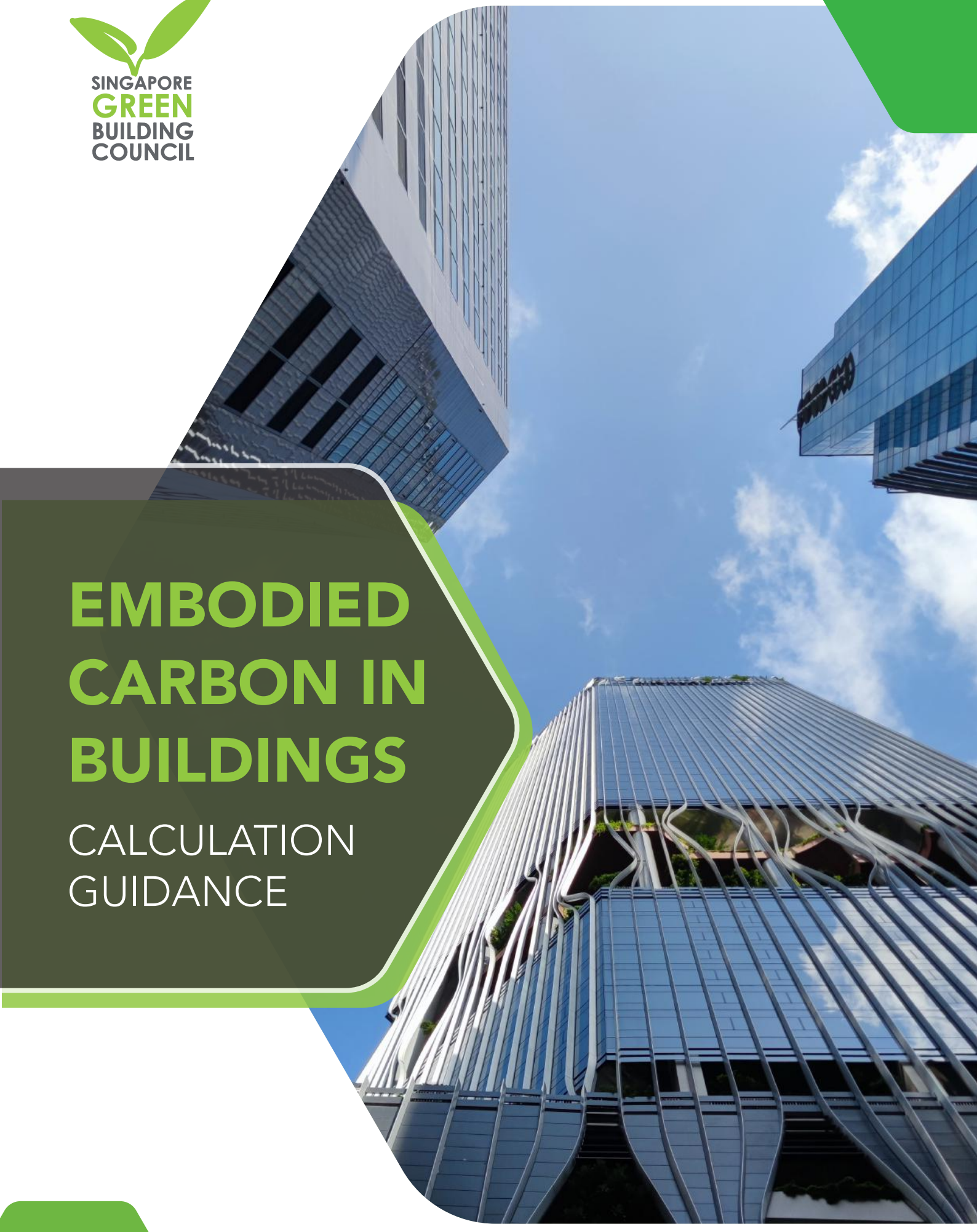
SINGAPORE GREEN BUILDING COUNCIL



EMBODIED CARBON IN BUILDINGS

CALCULATION GUIDANCE

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FOREWORD

Climate Change is the greatest threat to the natural environment and humanity. Atmospheric carbon has been rising annually to historical highs, leading to global increases in temperatures. The built environment sector has a crucial role to play in responding to the climate crisis and with a highly connected value chain, this presents opportunity for the sector to address carbon holistically from a whole life perspective and to address both operational and embodied carbon emissions in design, construction and operations.

The Singapore Green Building Council (SGBC) champions the decarbonisation of Singapore's built environment and has launched a series of programmes and activities to galvanise and support industry efforts. This includes the Singapore Built Environment Embodied Carbon Pledge as well as the Singapore Building Carbon Calculator, in collaboration with the Building and Construction Authority (BCA), JTC Corporation (JTC) and the Energy Studies Institute at National University of Singapore (NUS-ESI).

The Embodied Carbon in Buildings Calculation Guide supports Singapore's decarbonisation efforts by providing guidance on defining the scope and methodology for measuring and reporting the embodied carbon emissions of building and construction activities. It is particularly useful for understanding the upfront carbon of building and infrastructure projects, where upfront carbon is the emissions resulting from the materials production and construction phases of an asset's lifecycle, before the building or infrastructure asset begins to be used. In contrast to other categories of emissions, these emissions have already been released into the atmosphere before the building is occupied or the infrastructure begins operation.

This Guide is intended to serve as an informative resource to harmonise carbon emissions data collection efforts during the design and construction phases of projects, and to provide a standardised framework for the reporting of embodied carbon emissions. This will facilitate the aggregation of embodied carbon emissions information of Singapore's buildings and construction activities, and allow for national averages and benchmarks to be determined.

CONTENTS

1. PURPOSE OF THIS GUIDE

1.1 STANDARDISED REPORTING FRAMEWORK FOR SINGAPORE BUILT ENVIRONMENT SECTOR

Project teams from across the industry have embarked on embodied carbon emissions measurement and reporting; with the approach to reporting boundaries, inventory of materials, source of carbon emissions factors etc differing across the industry. This Guide provides a standardised framework and approach to understand, calculate and report the embodied carbon emissions of a building or infrastructure project. It facilitates a minimum level of reporting that will allow project owners and teams across Singapore's built environment sector to communicate and compare embodied carbon impact across projects in a consistent manner. This will support the development of common baselines and performance benchmarks, from which future decarbonisation efforts and emissions reduction targets can be set against.

Explanations are provided in a simplified manner to assist project teams to track and record the information required to calculate the embodied carbon emissions of building and infrastructure projects. Project teams may contact SGBC for deeper engagement on the Guide.

2. SCOPE

2.1 UNIT OF MEASUREMENT

Carbon emissions are commonly measured by quantifying the carbon dioxide emission equivalent ($kgCO_2e$). In addition to carbon dioxide, $kgCO_2e$ includes other greenhouse gas (GHG), such as methane, nitrous oxide and other emissions already expressed in terms of carbon dioxide. This unit is adopted to calculate carbon emissions associated with the life cycle assessment (LCA) of buildings.

2.2 BUILDING LIFE CYCLE ASSESSMENT (LCA) STAGES

This Guide draws reference from EN 15978: Sustainability of Construction Works - Assessment of Environmental Performance of Buildings – Calculation Method for the definition of building life cycle which is divided into stages as expressed in Figure 2-1.

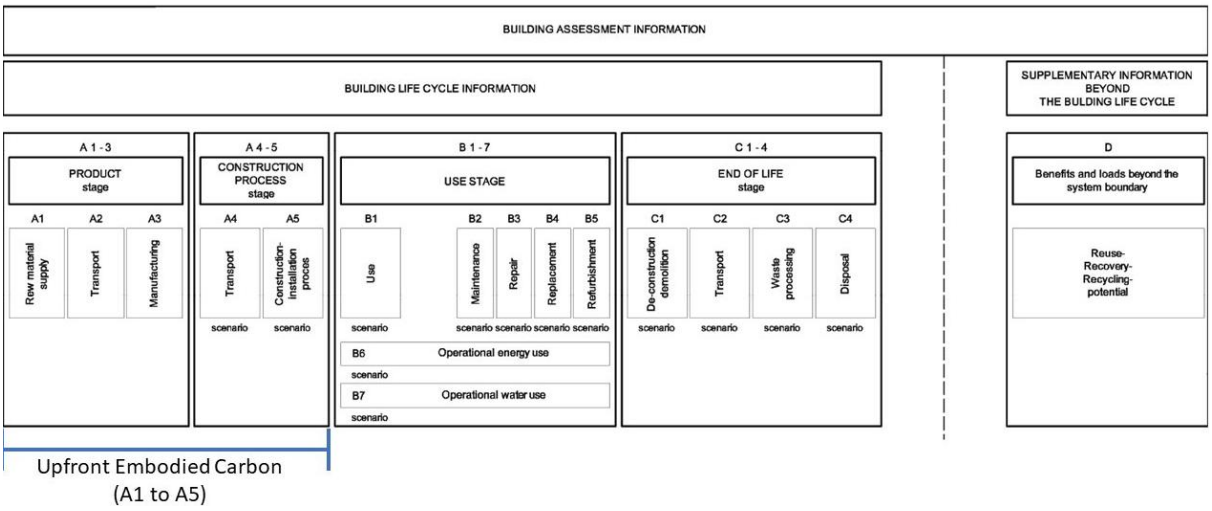


Figure 2-1: EN 15978 Building Life Cycle Assessment (LCA) Stages

The scope of this Guide covers stages A1 to A5 as defined by EN 15978 and is summarised in Figure 2-2. It covers the production of building materials, transportation and construction of a building project. This Guide will provide more details on the required information to standardise the measurement and reporting of associated carbon emissions from the respective life cycle stages.

Stage	Module	Section to Refer to
Product Stage	A1: Extraction of Raw Materials A2: Transportation of Raw Materials to Manufacturing Plant A3: Manufacturing Plant Processes	3.1 A1 to A3 – Product Stage Carbon Emissions
Construction Process Stage	A4: Transportation of Building Materials to Construction Site	3.2 A4 – Transportation to Site Carbon Emissions
	A5: On-site Construction Processes	3.3 A5 – Construction Activity Carbon Emissions

Figure 2-2: Scope of LCA Stages Covered in Guide

3. CARBON CALCULATION GUIDANCE

3.1 A1 TO A3 - PRODUCT STAGE CARBON EMISSIONS

3.1.1 WHAT IS PRODUCT STAGE CARBON EMISSIONS

Product stage carbon emissions are associated with building materials and products used in construction. Each material has a unique carbon emissions factor that represents the emissions associated with its entire manufacturing process. It captures the activities of extraction of raw materials (A1), transportation of raw materials to manufacturing plant (A2) and the manufacturing process itself (A3).

A building's product stage carbon emissions is the summation of all building materials used. As such, project teams should keep track of the quantities of individual building materials used.

BUILDING MATERIAL CARBON EMISSIONS = MATERIAL'S CARBON EMISSIONS FACTOR X MATERIAL QUANTITY

3.1.2 HOW TO DETERMINE A MATERIAL'S CARBON EMISSIONS FACTOR

To determine a material's carbon emissions factor, Environmental Product Declarations (EPD) should be used. These are third party verified reports developed in accordance to prevailing International Organization for Standardization (ISO) and European Standard (EN) that provide information on the carbon emissions of products, amongst other environmental impact indicators.

This Guide draws reference from the BCA Green Mark 2021 Whole Life Carbon Technical Guide and the Royal Institution of Chartered Surveyors (RICS) Whole Life Carbon Assessment for the Built Environment guidance document to recognize EPDs in the following preferred order: EN 15804, ISO 21930, ISO 14067, ISO 14025, ISO 14040, ISO 14044, and PAS 2050.

Figure 3-1 is an example of an EPD showing the performance of various environmental indicators in accordance to EN 15978 building life cycle assessment stages.

Impact Category	Unit	A1	A2	A3	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	D
Global Warming Potential	kg CO_2e	6.26E+01	3.92E+00	4.10E+00	7.06E+01	4.97E+00	MND	MND	1.60E+00	3.09E+00	2.42E+00	5.07E-01	-1.28E+01
Depletion of Stratospheric Ozone	kg CFC-11	1.56E-06	7.15E-07	4.92E-07	2.77E-06	9.07E-07	MND	MND	2.73E-07	5.65E-07	4.13E-07	1.65E-07	-7.56E-07
Photochemical Ozone Formation	kg C_2H_4e	8.04E-03	5.16E-04	1.03E-03	9.59E-03	6.55E-04	MND	MND	2.43E-04	4.07E-04	3.67E-04	1.47E-04	-6.71E-03
Acidification	kg SO_2e	1.24E-01	7.98E-03	2.04E-02	1.52E-01	1.01E-02	MND	MND	2.36E-03	6.30E-03	3.57E-03	2.01E-03	-4.68E-02
Eutrophication	kg $(PO_4)^3$e	3.75E-02	1.66E-03	4.32E-03	4.35E-02	2.11E-03	MND	MND	4.16E-04	1.31E-03	6.28E-04	3.88E-04	-2.71E-02
Abiotic Depletion of Non-Fossil	kg Sbe	2.30E-05	9.78E-05	9.21E-06	1.30E-04	1.24E-04	MND	MND	2.44E-06	7.11E-05	3.69E-06	4.63E-06	-4.29E-04
Abiotic Depletion of Fossil	MJ	2.07E+02	5.91E+01	4.43E+01	3.10E+02	7.50E+01	MND	MND	2.17E+01	4.66E+01	3.29E+01	1.41E+01	-1.78E+02

Figure 3-1: Example EPD and Carbon Emissions Reference Value
Source: Environmental Impact Data, One Click LCA
https://www.oneclicklca.com/getting-ready-for-en-15804-a2-whats-changed-and-how-to-prepare-for-it/

Project teams should use the value for total Global Warming Potential (GWP) for Product Stage (A1 to A3), reported in terms of $kgCO_2e$.

Some EPDs report A1, A2 and A3 separately. In such cases, project teams should sum up the Global Warming Potential for A1, A2 and A3 modules, and use the summed-up value for carbon emissions calculations.

EPDs are increasingly becoming more available and project teams may request for EPDs from building material suppliers. SGBC also maintains a list of environmentally-preferred building materials administered under the Singapore Green Building Product certification scheme. The scheme will progressively incorporate carbon emission performance into its framework with EPDs as the basis of assessment.

3.1.2.1 HOW TO DETERMINE A MATERIAL'S CARBON EMISSIONS FACTOR IF EPDs ARE NOT AVAILABLE

If a building material does not have an EPD, project teams may use the average carbon emissions value of individual building materials. This value can be found in the Singapore Building Carbon Calculator that is available publicly at SGBC's website. It contains carbon emissions factors for the standardised list of materials covered in this Guide, and can support embodied carbon emissions reporting for A1 to A5 stages.

The Singapore Building Carbon Calculator is co-developed by JTC and NUS-ESI with support from BCA and SGBC.

3.1.3 HOW TO DETERMINE MATERIAL QUANTITY

Project teams should keep track of the quantity of materials used. This information can be retrieved from sources such as:

Design Stage

- Past project experiences
- Drawings
- BIM models

Construction Stage

- Purchase Orders (PO) & Delivery Orders (DO)
- Bill of Quantities (BQ)

The quantity of materials wasted should be reported separately from quantity of materials used in construction where possible.

3.1.4 WHICH MATERIALS TO INCLUDE IN STANDARDISED REPORTING

The following building materials in Figure 3-2 are essential building materials that should be included within the scope for embodied carbon emissions reporting. Project teams should include these materials if they are used in projects for the building elements specified in Figure 3-3.

Category	Materials Required for Standardized Reporting if Used in Project
Concrete Category	• Eco-concrete with Fly Ash Replacement • Eco-concrete with Ground Granulated Blast-Furnace Slag (GGBFS) Replacement • Natural Concrete • Natural Precast Concrete • Precast Eco-concrete with Fly Ash Replacement • Precast Eco-concrete with GGBFS Replacement • Product-specific Concrete Mix (e.g. mixture of coarse or fine aggregates, water, cement, and admixture)
Metal Category	• Aluminium • Copper • Reinforcement Bars and Rods • Steel and Structural Steel
Glass Category	• Coated Glass • Double Glazed Glass • Fiberglass • Float Glass • Laminated Glass • Skylight Glass • Tempered/ Annealed Glass • Triple Glazed Glass
Timber Category	• Cross Laminated Timber • Glue Laminated Timber
Internal Products Category	• Insulation (Mineral Wool) • Paint • Plaster • Screed* • Tiles • Waterproofing

**Screed can be calculated based on the composition of cement and water quantities.*

Figure 3-2: Materials Required for Standardised Reporting

Level 1 Element Group	Level 2 Building Element	Level 3 Sub-elements
Substructure	Substructure	Basements, including excavation and retaining walls
		Standard foundations and specialist foundation systems
Superstructure (Main)	Frame	Beams, columns and support systems
		Frames
	Roof	Roof lights, skylights and openings
		Structure, coverings, specialist roof systems and drainages
	Stairs and Ramps	Balustrades and handrails
		Ladders, chutes and slides
		Structures and finishes of stairs and ramps
	Upper Floors	Balconies
		Floors
Superstructure (External/ Façade)	External Walls	Curtain walls
		External walls above and below ground level
	Windows and External Doors	External doors
		External windows
Superstructure (Internal)	Internal Walls and Partitions	Balustrades and handrails
		Dry and lightweight walls
		Fixed cubicles
		Fixed dividers
		Partitions
	Internal Doors	Internal doors
**Fitout works are excluded*		

Figure 3-3: Building Elements Required for Standardised Reporting

3.1.5 WORKED EXAMPLE (1) TOTAL CARBON EMISSIONS FOR A1 TO A3

Element Group	Building Element	Building Materials	Carbon Emissions Factor A1-A3 ($kgCO_2e/kg$)	Material Quantity (kg)	Carbon Emissions A1-A3 ($kgCO_2e$)
Substructure	Piling	Concrete (50 MPa)	0.18	9,600,000	1,728,000
		Rebar (recycled)	0.86	200,000	172,000
Superstructure (Main)	Frame	Concrete (40 MPa)	0.16	240,000	38,400
		Rebar (recycled)	0.86	14,000	12,040
		Structural Steel	1.06	20,000	21,200
	Roof	Concrete (40 MPa)	0.16	168,000	26,880
		Rebar	0.86	10,000	8,600
	Stair Core and Lift Core	Concrete (50 MPa)	0.18	1,100	198
		Rebar (recycled)	0.86	200,000	172,000
Superstructure (External)	Wall	Concrete (40 MPa)	0.16	3,120,000	499,200
		Rebar (recycled)	0.86	200,000	172,000
		Structural Steel	1.06	4,000	4,240
		Glass	1.55	5,000	7,750
Total A1 to A3 Carbon Emissions ($kgCO_2e$)					**2,862,508**

**This example is not exhaustive.*
Please refer to Figure 3-2 and Figure 3-3 for the comprehensive list of materials and building elements respectively.

3.1.6 WORKED EXAMPLE (2) CONCRETE CARBON EMISSIONS BASED ON CONCRETE COMPOSITION

$1m^3$ of Grade 30 Concrete Material Breakdown	Carbon Emissions Factor A1-A3 ($kgCO_2e/kg$)	Material Quantity (kg)	Material Quantity (%)	Carbon Emissions A1-A3 ($kgCO_2e$)
Cement	0.92	288.00	16%	294.96
Water	0.0013	160.00	9%	0.208
Coarse Aggregates	0.005	670.00	38%	3.35
Fine Aggregates	0.004	639.00	36%	2.56
Admixture	2.67	4.50	<1%	12.02
Total Carbon Emissions ($kgCO_2e$)				**313.098**

3.2 A4 - TRANSPORTATION TO SITE CARBON EMISSIONS

3.2.1 WHAT IS TRANSPORTATION TO SITE CARBON EMISSIONS

Transportation to site carbon emissions are associated with the transportation of materials from the manufacturing plant to the construction site. This includes factors such as distance of transport from point of origin, type of transport vehicle, and vehicle carbon emissions factor.

A4 CARBON EMISSIONS = MATERIAL QUANTITY X TRANSPORT DISTANCE X VEHICLE'S CARBON EMISSIONS FACTOR

3.2.2 HOW TO DETERMINE MATERIAL QUANTITY

Similar to product stage modules A1 to A3, A4 is also reported for each individual building material's transportation to construction site. As such, the materials quantity value should be the same as the value reported in the product stage calculations. It should be measured in mass (kg or tonnes).

3.2.3 HOW TO DETERMINE TRANSPORT DISTANCES

Transport distance includes all stages of the journey of the product from the manufacturing plant to the project site, including any interim stops at storage facilities or distribution centers in between. As such, land transport distances and sea transport distances of the route taken by each mode of transportation should be measured.

Land Transport	Sea Transport
• Transport Vendor's Data • Google Maps Distances	• Transport Vendor's Data • Port to Port Distances based on Point of Origin

Figure 3-4: Data Sources of Distance Values used in A4

3.2.3.1 HOW TO DETERMINE TRANSPORT DISTANCES IF DISTANCES ARE NOT AVAILABLE

However, the transport routes taken by the product to project site is often not documented in sufficient detail. In such cases, Figure 3-5 may be used to normalise the distance covered by the transportation of materials if the point of origin and port to port distance is not available.

Material's Point of Origin	Normalised Distances to be used in Calculations
Category 1 From ASEAN Region	3,000 km
Category 2 From Beyond ASEAN Region	6,000 km

Figure 3-5: Normalised Distances if Point of Origin is Unavailable

In this situation, a single transportation type may be used as reference for the transport carbon emissions factor.

- If majority of the transport distance is by marine transport, the carbon emissions factor for General Cargo may be used.
- If majority of the transport distance is by land transport, the carbon emissions factor for Average Goods Vehicle may be used.

The carbon emissions factors for general marine cargo and average land goods vehicle are given in Figure 3-6.

3.2.4 HOW TO DETERMINE TRANSPORT VEHICLE'S CARBON EMISSIONS FACTOR

The type of vehicle for each segment of the transport determines the carbon emissions factor to be used. This value already considers the vehicle's fuel consumption rate and the type of fuel used.

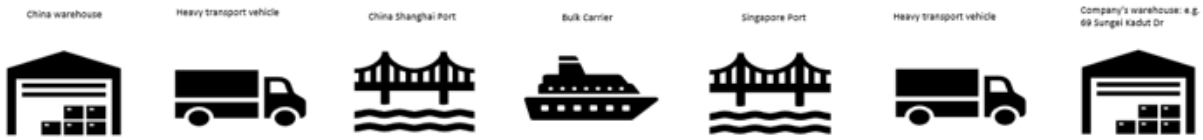
Figure 3-6 describes the vessel types and their respective carbon emissions factors. Sea Transport values are in reference to the International Maritime Organization's 4th Greenhouse Gas Study conducted in 2020, and land transport values are in reference to Land Transport Authority definitions, and results from LCA modelling based on industry-accepted LCA databases. These values can be found in the Singapore Building Carbon Calculator that is available publicly at SGBC's website.

Vehicle Type	Description	Carbon Emissions Factor ($kgCO_2e$ / kg / km)
Sea Transport *Based on International Maritime Organization's 4th Greenhouse Gas Study conducted in 2020*		
Container Vessel	Most common for long distance international sea transportation for most materials *e.g. plastic, glass, tiles*	0.000007343
General Cargo	Common for international sea transportation for both long and short distance *e.g. plastic, glass, tiles*	0.000017171
Barge	Common for short distance sea transportation *e.g. plastic, glass, tiles*	0.000024244
Bulk Carrier	Common for large bulk materials *e.g. steel, cement*	0.000004212
Land Transport *Vehicle categories based on LTA's definition* *Carbon emissions values based on LCA modelling based on industry-accepted LCA database*		
Light Goods Vehicle	Light commercial vehicle with maximum laden weight of 3,500kg	0.000178
Heavy Goods Vehicle	Trucks with laden weight between 3,501kg to 16,000kg	0.000106
Very Heavy Goods Vehicle	Large trucks or trailers with maximum laden weight more than 16,000kg	0.000052
Goods Vehicle (Average)	To be used when type of vehicle is unknown	0.000112

Figure 3-6: Carbon Emissions Factor for Identified Vehicle Types

3.2.5 WORKED EXAMPLE (3) FOR TRANSPORTATION TO SITE CARBON EMISSIONS

Transport Route Used:



Parameters	Material (kg)	Transport Distance (km)	Carbon Emissions Factor ($kgCO_2/kg/km$)	Source of Distance	Source of Carbon Emissions Factor	Carbon Emissions ($kgCO_2e$)
Heavy Goods Transport Vehicle (China warehouse to Shanghai Port)	3,000,000	20	0.000106	Google Maps	Carbon Emissions Factor from Figure 3-6	6,360
Bulk Carrier (Shanghai to Singapore Port)	3,000,000	4,986	0.000004212	Port to Port Distance	Carbon Emissions Factor from Figure 3-6	63,003
Heavy Goods Transport Vehicle (Singapore Port to Company's warehouse)	3,000,000	15	0.000106	Google Maps	Carbon Emissions Factor from Figure 3-6	4,770
Total A4 Distance (km)	-	**5,021**		-		
Total A4 Carbon Emissions ($kgCO_2e$)						**74,133**

3.2.6 WORKED EXAMPLE (4) FOR TRANSPORTATION TO SITE CARBON EMISSIONS

Parameters	Material (kg)	Transport Distance (km)	Carbon Emissions Factor ($kgCO_2/kg/km$)	Source of Distance	Source of Carbon Emissions Factor	Carbon Emissions ($kgCO_2e$)
Same material as worked example (3). However, the material's point of origin is unknown and therefore normalised distances are used	3,000,000	6,000	0.000017171	Predefined Distance from Figure 3-5	Predefined General Cargo Carbon Emissions Factor from Figure 3-6	309,078
Total A4 Distance (km)	-	**6,000**		-		
Total A4 Carbon Emissions ($kgCO^2e$)						**309,078**

3.3 A5 - CONSTRUCTION SITE PROCESSES CARBON EMISSIONS

3.3.1 WHAT IS CONSTRUCTION SITE PROCESSES CARBON EMISSIONS

Construction site processes carbon emissions refers to the utilities used in any on-site construction related activities, such as energy for machinery use, operating on-site generators, vehicle fuel, and water consumption for dust suppression, equipment cooling and other uses. Demolition works on the previous building is excluded from this scope.

CONSTRUCTION SITE PROCESSES CARBON EMISSIONS
=
UTILITIES QUANTITY
X
UTILITIES' CARBON EMISSIONS FACTOR

3.3.2 HOW TO DETERMINE UTILITIES QUANTITY

The quantity of each utility used should be tracked and recorded throughout the construction process. Documents such as purchase orders (PO), delivery orders (DO), utility bills, and bill of quantities (BQ) may be used to determine the quantities of utilities used.

3.3.3 HOW TO DETERMINE UTILITIES' CARBON EMISSIONS FACTOR

Figure 3-7 describes the types of utilities and their respective carbon emissions.

The values used are based on LCA models developed using industry-accepted LCA databases. These values can be found in the Singapore Building Carbon Calculator that is available publicly at SGBC's website or from Authorities such as Energy Market Authority (EMA). Alternative power systems or fuel sources utilised by project teams should be included along with documentation to verify its emission factor.

Utility	Units	Emission Factor ($kgCO_2e$/unit)
Emissions factors are based on Energy Market Authority Data for electricity, and LCA models developed using industry-accepted LCA database for the other utilities		
Electricity from National Grid	kWh	0.44
Diesel	m^3	3,331.19
Petrol	m^3	2,763.66
Tap Water	m^3	1.3
Industrial Water	m^3	1.3
Liquefied Petroleum Gas (LPG)	Tonne	3,595.21
Town Gas	kWh	0.22
Alternative Power System or Fuel Source *(if applicable)*	*Dependent on power system or fuel source*	*Provide documentation for its emission factor*

Figure 3-7: Carbon Emissions Factor for Utilities

3.3.4 WORKED EXAMPLE (5) FOR CONSTRUCTION SITE PROCESSES CARBON EMISSIONS

Utilities	Utilities Quantity	Units	Carbon Emissions Factor ($kgCO_2e$/unit)	Carbon Emissions ($kgCO_2e$)
Water	100,000	m^3	1.3	130,000
Grid Electricity	40,000	kWh	0.44	17,600
Generator Diesel	200	m^3	3,331.19	666,238
Total A5 Carbon Emissions ($kgCO_2e$)				**813,838**

4. STANDARDISED REPORTING

4.1 RECOMMENDED CARBON REPORTING FORMAT

The standardised format for the reporting of embodied carbon emissions is to include project details, a summary of A1 to A3 emissions, A4 and A5 carbon emissions

Project Details:

Project Name	
Project Address	
Project Description	
Building Type	
Building Height	
Number of Storeys and Basement Levels	
Gross Floor Area (GFA), m^2	
Constructed Floor Area (CFA), m^2	
Date of Assessment	
Current Stage of Project *(Preliminary Design, Concept Design,Construction etc.*	

Summary of Total Carbon Emissions ($kgCO_2e$)			
	Total	Super-structure	Sub-structure
A1-A3	0.00	0.00	0.00
A4	0.00	0.00	0.00
A5	0.00		
Total	0.00		

Embodied Carbon Emissions of A1-A3 ($kgCO_2e$)			
	Total	Superstructure	Substructure
Concrete Category			
Eco-concrete	0.00	0.00	0.00
Natural Concrete	0.00	0.00	0.00
Precast Concrete	0.00	0.00	0.00
Precast Eco-concrete	0.00	0.00	0.00
Admixture	0.00	0.00	0.00
Aggregates	0.00	0.00	0.00
Cement	0.00	0.00	0.00
Water	0.00	0.00	0.00
Metal Category			
Aluminium	0.00	0.00	0.00
Copper	0.00	0.00	0.00
Reinforcement Bars and Rods	0.00	0.00	0.00
Steel and Structural Steel	0.00	0.00	0.00
Glass Category			
Coated Glass	0.00	0.00	0.00
Double Glazed Glass	0.00	0.00	0.00
Fiberglass	0.00	0.00	0.00
Float Glass	0.00	0.00	0.00
Laminated Glass	0.00	0.00	0.00
Skylight Glass	0.00	0.00	0.00
Tempered/ Annealed Glass	0.00	0.00	0.00
Triple Glazed Glass	0.00	0.00	0.00
Timber Category			
Cross Laminated Timber	0.00	0.00	0.00
Glue Laminated Timber	0.00	0.00	0.00
Internal Products Category			
Screed *(Composition of cement & water quantities)*	0.00	0.00	0.00
Plaster	0.00	0.00	0.00
Waterproofing	0.00	0.00	0.00
Insulation (Mineral Wool)	0.00	0.00	0.00
Paint	0.00	0.00	0.00
Tiles	0.00	0.00	0.00

Embodied Carbon Emissions of A4 ($kgCO_2e$)			
	Total	Superstructure	Substructure
Concrete Category			
Eco-concrete	0.00	0.00	0.00
Natural Concrete	0.00	0.00	0.00
Precast Concrete	0.00	0.00	0.00
Precast Eco-concrete	0.00	0.00	0.00
Admixture	0.00	0.00	0.00
Aggregates	0.00	0.00	0.00
Cement	0.00	0.00	0.00
Water	0.00	0.00	0.00
Metal Category			
Aluminium	0.00	0.00	0.00
Copper	0.00	0.00	0.00
Reinforcement Bars and Rods	0.00	0.00	0.00
Steel and Structural Steel	0.00	0.00	0.00
Glass Category			
Coated Glass	0.00	0.00	0.00
Double Glazed Glass	0.00	0.00	0.00
Fiberglass	0.00	0.00	0.00
Float Glass	0.00	0.00	0.00
Laminated Glass	0.00	0.00	0.00
Skylight Glass	0.00	0.00	0.00
Tempered/ Annealed Glass	0.00	0.00	0.00
Triple Glazed Glass	0.00	0.00	0.00
Timber Category			
Cross Laminated Timber	0.00	0.00	0.00
Glue Laminated Timber	0.00	0.00	0.00
Internal Products Category			
Screed *(Composition of cement & water quantities)*	0.00	0.00	0.00
Plaster	0.00	0.00	0.00
Waterproofing	0.00	0.00	0.00
Insulation (Mineral Wool)	0.00	0.00	0.00
Paint	0.00	0.00	0.00
Tiles	0.00	0.00	0.00

Embodied Carbon Emissions of A4 ($kgCO_2e$) *Transport Emissions Breakdown based on Vehicle Types*			
	Total	**Super-structure**	**Sub-structure**
International Marine Transportation			
International Marine (Container)	0.00	0.00	0.00
International Marine Transport (General Cargo)	0.00	0.00	0.00
International Marine Transport (Barge)	0.00	0.00	0.00
International Marine Transport (Bulk Carrier)	0.00	0.00	0.00
International Land Transportation			
International Road Transport (Light goods vehicle)	0.00	0.00	0.00
International Road Transport (Heavy goods vehicle)	0.00	0.00	0.00
International Road Transport (Very heavy goods vehicle)	0.00	0.00	0.00
International Road Transport (Goods vehicle (avg))	0.00	0.00	0.00
Local Land Transportation			
Local Road Transport (Light goods vehicle)	0.00	0.00	0.00
Local Road Transport (Heavy goods vehicle)	0.00	0.00	0.00
Local Road Transport (Very heavy goods vehicle)	0.00	0.00	0.00
Local Road Transport (Goods vehicle (avg))	0.00	0.00	0.00

Embodied Carbon Emissions of A5 ($kgCO_2e$)	
	Total
Electricity Usage (Grid)	0.00
Alternative Power System or Fuel Source	0.00
Diesel	0.00
Petrol	0.00
Water (Tap)	0.00
Water (Industrial)	0.00
Liquefied Petroleum Gas (LPG)	0.00
Town Gas	0.00

References:
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EN 15978: Sustainability of Construction Works - Assessment of Environmental Performance of Buildings – Calculation Method

International Maritime Organization's 4th Greenhouse Gas Study conducted in 2020

Land Transport Authority Driving Goods Vehicles

One Click LCA Environmental Impact Data

Royal Institution of Chartered Surveyors (RICS) Whole Life Carbon Assessment for the Built Environment

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