PAM Northern Chapter

The Impact of EECA and BCX in Architecture

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15 March 25

BGREEN
RIVERSTONE
ELITE

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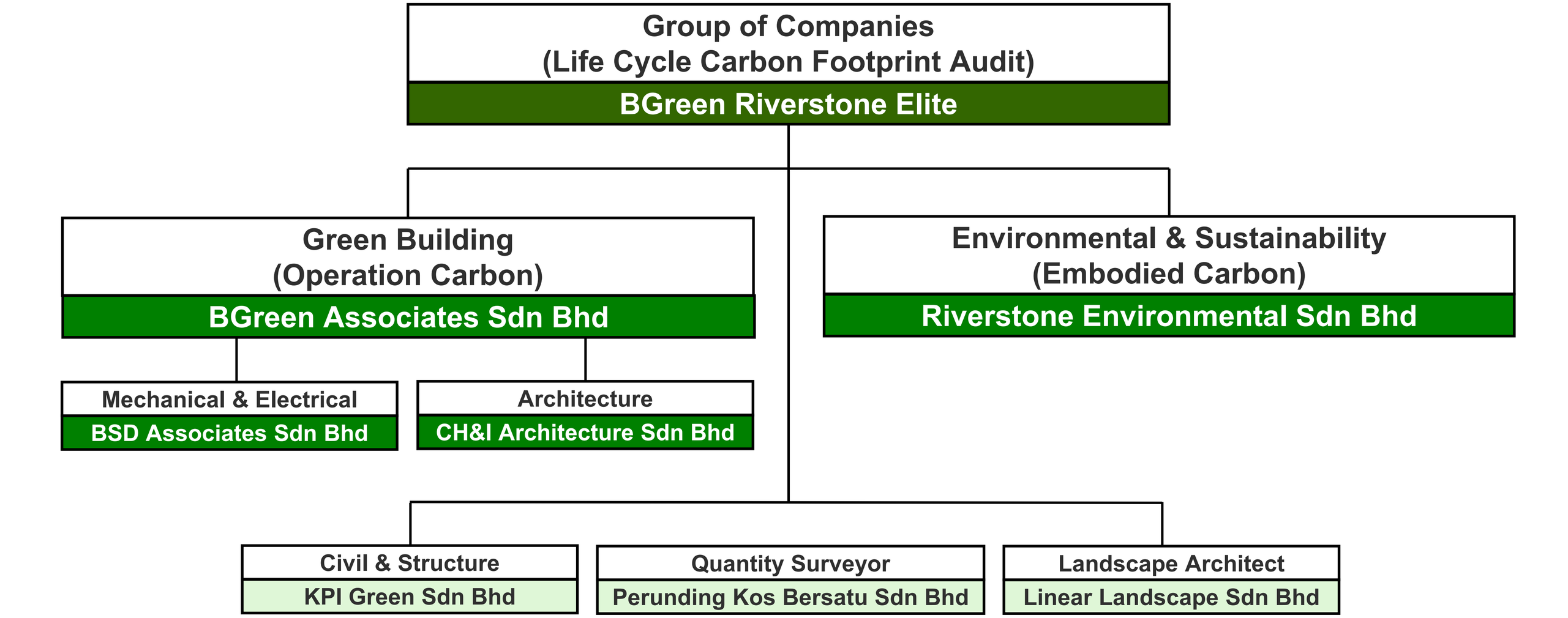
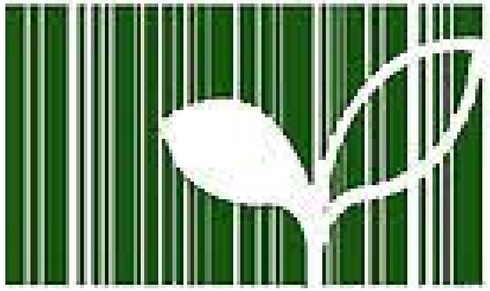
Introduction


Group of Companies
(Life Cycle Carbon Footprint Audit)
BGreen Riverstone Elite
Green Building
(Operation Carbon)
BGreen Associates Sdn Bhd
Environmental & Sustainability
(Embodied Carbon)
Riverstone Environmental Sdn Bhd
Mechanical & Electrical
BSD Associates Sdn Bhd
Architecture
CH&I Architecture Sdn Bhd
Civil & Structure
KPI Green Sdn Bhd
Quantity Surveyor
Perunding Kos Bersatu Sdn Bhd
Landscape Architect
Linear Landscape Sdn Bhd



BGREEN
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ELITE

2024 Awards

World Green Building Council Asia Pacific Network
Leadership in Sustainable Design and Performance Award 2024
Best New Green Residential Building – Winner

2024 Awards

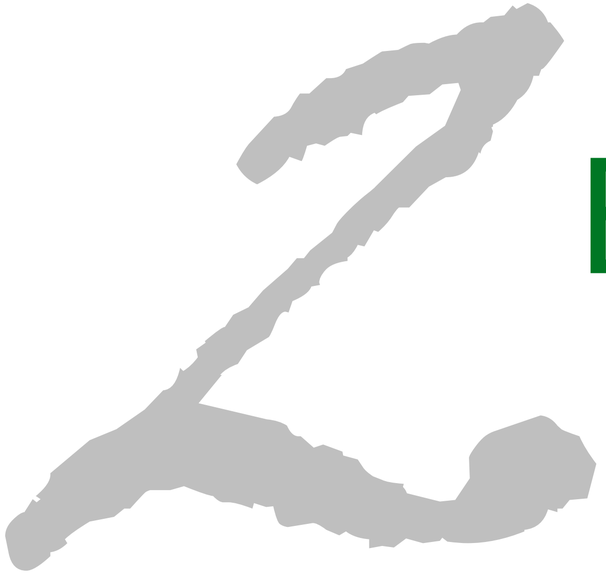
malaysiaGBC	**Malaysia Green Building Council** **Leadership in Sustainability Award 2024** Best New Green Commercial Building – Winner Best New Green Residential Building (Highrise) – Winner Best New Green Residential Building (Landed) – Winner Best New Green Institutional Building – Runner Up
nea NATIONAL ENERGY AWARDS	**Malaysia Ministry of Energy and Natural Resources** **National Energy Awards 2024** Energy Efficient Green Building – Runner Up Green Building (Large) – Winner Green Residential – Winner
ASEAN ENERGY AWARDS	**ASEAN Centre for Energy** **ASEAN Energy Efficiency and Conservation Best Practices Awards 2024** Green Building (Large)(2nos) Green Resident

2023 Awards

	**Malaysia Ministry of Energy and Natural Resources** **National Energy Awards 2023** Green Building (Large) – Winner Green Building (Large) – Merit Energy Efficient Green Building (Large) – Runner Up (2nos)
	**ASEAN Centre for Energy** **ASEAN Energy Efficiency and Conservation Best Practices Awards 2023** Green Building (Large) – Winner

2022 Awards

malaysiaGBC	**Malaysia Green Building Council** **Leadership in Sustainability Award 2022** Best New Green Institutional Building – Winner Best Sustainability Leadership for Consultant – Honorary Mention
nea NATIONAL ENERGY AWARDS 2022	**Malaysia Ministry of Energy and Natural Resources** **National Energy Awards 2022** Energy Efficient Green Building (Large) – Winner Energy Efficient Green Building (Large) – Runner Up
	**ASEAN Centre for Energy** **ASEAN Energy Efficiency and Conservation Best Practices Awards 2022** Green Building (Large) – Winner Green Building (Large) – 2nd Runner Up



EECA

Energy Efficient and Conservation Act

Achieving net zero emissions by 2050 involves implementing initiatives outlined under the National Energy Transition Roadmap (NETR) that includes *energy efficiency, renewable energy, hydrogen, green infrastructure, carbon capture, utilization and storage* to enhance Malaysia's resilience

Dato Seri Anwar Ibrahim, The Honorable Prime Minister of Malaysia @ Nikkei Forum on the Future of Asia, 23 May, 2024

LAWS OF MALAYSIA

Act 861

ENERGY EFFICIENCY AND CONSERVATION ACT 2024

Royal Assent Date 14 Nov 2024
Publication Date in Gazzate 26 Nov 2024
Commencement 01 Jan 2025

EECA Technical Expert Working Group Members

1. **Ar Michael, Ching Chee Hong** - Malaysia Green Building Council
2. **Mr Tan Tze Meng** - Malaysia Digital Economy Corporation Sdn. Bhd
3. **Ir Chen Thiam Leong** - PRIMETECH Engineers Sdn. Bhd.Malaysia
4. **Mr Gregers Rehman** - IEN Consultants Sdn. Bhd.
5. **Ts. Steve Anthony Lojuntin** - Sustainable Energy Development Authority (SEDA)
6. **Assoc. Prof. Ir. Dr Nofri Yenita Dahlan** - Universiti Teknologi MARA (UiTM)
7. **Ir. Lum Youk Lee** - Persatuan Pengurusan Kompleks Malaysia (PPKM)

EECA Introduction

The Act regulates the efficient consumption of energy and conservation of energy with the aim to improve and **increase energy efficiency and to avoid waste of energy**, and to provide for related matters.

EECA Application

1. Any **Energy Consumer** whose energy consumption for a period of 12 consecutives months ***≥ 6,000,000 kWh*** *or 21,600 gigajoule (GJ), which is approximately RM2.4 million in annual electricity bill (RM 200,000 monthly) or RM1 million in natural gas bill.*
2. Any **Building** as describe in the 3rd Schedule: ie **Office Building GFA > 8000 m²**
3. Any energy-using product as specified in the guidelines.

Office
GFA > 8000 m²

Education Institute

Healthcare

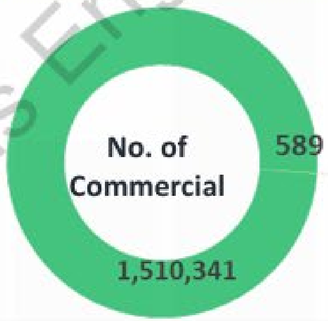
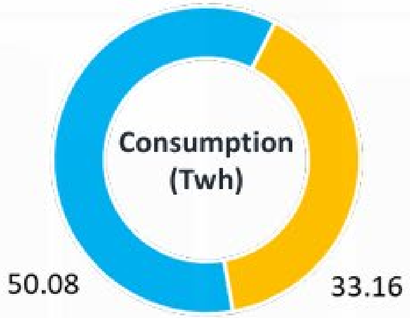
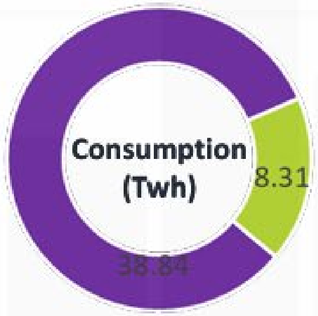
Hotel

Retail

Data Center

EECA Application

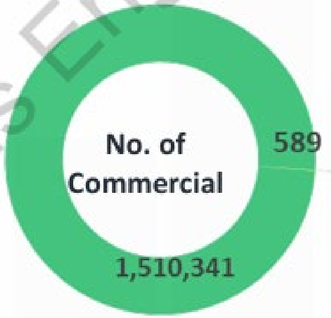
1. Any **energy consumer** whose energy consumption for a period of 12 consecutives months ***≥ 6,000,000 kWh*** *or 21,600 gigajoule (GJ), which is approximately RM2.4 million in annual electricity bill or RM1 million in natural gas bill.*

INDUSTRIAL	COMMERCIAL
	
4.3% Industrial installations are subjected to EECA from a total of 28,687 Industrial Consumer (data from TNB).	**0.04%** Commercial installation are subjected to EECA from a total of 1.5 million Commercial consumer (data from TNB).
	
66% of total industrial consumption.	**21%** of total Commercial consumption.

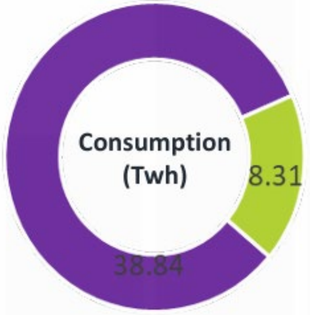
EECA Application

2. Any building as describe in the 3rd Schedule: ie **Office Building GFA > 8000 m²**

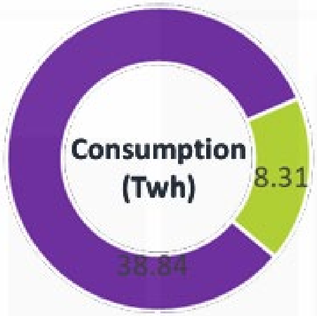
COMMERCIAL



0.04% Commercial installation are subjected to EECA from a total of 1.5 million Commercial consumer (data from TNB).



The remaining **79%** of the commercial or buildings consumption will be regulated via building energy efficiency requirements known as Building Energy Intensity Labelling (BEI Label).



21% of total Commercial consumption.

EECA Implementation

The **Energy Commission (EC)** is responsible for overseeing the implementation of the Act, including:

1. setting energy efficiency policies and targets
2. exercising regulations
3. **impose penalties**

EECA Energy Consumer - Duties

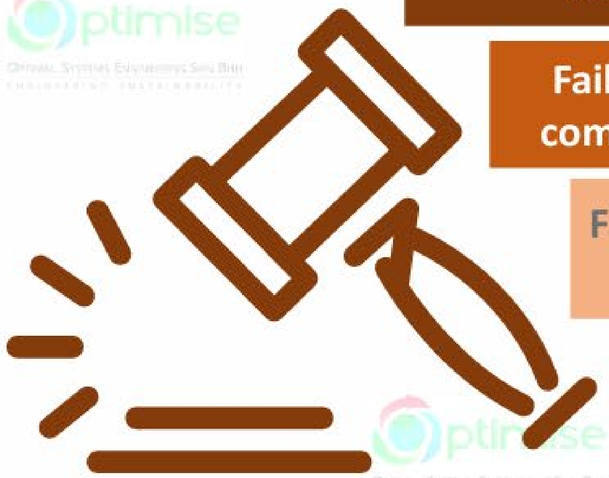
1. Appoint a **Registered Energy Manager (REM)**
   The REM is responsible for implementing and monitoring energy management systems, preparing energy efficiency reports, and advising on energy-saving measures.

2. Develop and Implement an **Energy Management System (EMS)**
   Energy Consumers must develop an EnMS within a prescribed period and in accordance with the guidelines provided by the Commission.

3. Submit **Energy Efficiency and Conservation (EEC) Annual Reports**
   The REM must prepare and submit these reports, detailing energy consumption, management systems, and proposed improvements.

4. Conduct **Periodic Energy Audits:**
   Energy audits must be conducted every 5 years by a Registered Energy Auditor (REA), and the resulting audit report must be submitted to the Commission.

EECA Energy Consumer - Penalty



Energy Efficiency and Conservation Regulation 2024

Failure by the Energy Consumer to appoint REM	FINE NOT EXCEEDING RM50,000.
Failure by the Energy Consumer to comply with the EnMS requirement	FINE NOT EXCEEDING RM20,000
Failure by the Energy Consumer to comply with the EE&C Report requirement	FINE NOT EXCEEDING RM50,000
Failure by the Energy Consumer to comply with the Energy Audit requirement	FINE NOT EXCEEDING RM50,000
Failure of REM to comply with REM duties	FINE NOT EXCEEDING RM20,000

EECA Building - Duties

1. **Building Energy Intensity Label (BEL):**
   Comply with BEL within 30 days after expiry of 1 year period from the date the person-in-charge received the notice from EC. If Building Energy Intensity (BEI) < 2 Stars, the building need to appoint a Register Energy Auditor (REA) to perform a mandatory Energy Audit.

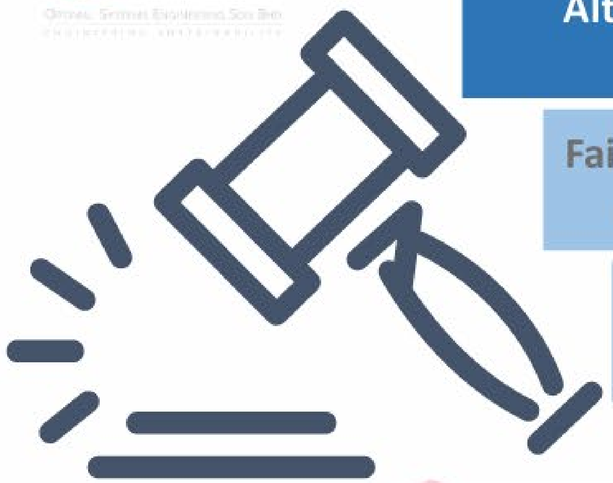
2. Prepare and Implement an **Energy Efficiency Improvement Plan:**
   Based on the energy audit, the person-in-charge must prepare a plan to improve energy efficiency, submit it for approval, and implement the approved plan.

3. Conduct **Periodic Energy Audits:**
   Energy audits must be conducted every 5 years by a Registered Energy Auditor (REA), and the resulting audit report must be submitted to the Commission.

Note:
A Person-in-charge of a building denotes the owner of a building or any other person having the charge, management or control of a building.

Shall not apply in respect of a building where the person-in-charge is also an energy consumer.

EECA Building - Penalty



Energy Efficiency and Conservation Regulation 2024

Failure to display building energy intensity label (BEL)	FINE NOT EXCEEDING RM50,000
Alteration or forgery of BEL information	FINE NOT EXCEEDING RM50,000 OR IMPRISONMENT NOT MORE THAN 2 YEARS OR BOTH
Failure to conduct energy audit and appoint registered energy auditor (<2 Star BEI)	FINE NOT EXCEEDING RM50,000
Failure to rectify energy audit report request by EC	FINE NOT EXCEEDING RM50,000
Failure to implement energy improvement plan	FINE NOT EXCEEDING RM50,000
Failure to submit energy improvement plan	FINE NOT EXCEEDING RM50,000

EECA Energy Consumer & Building - Penalty

Failure to furnish any information required by the EC	FINE NOT EXCEEDING RM100,000 OR IMPRISONMENT NOT MORE THAT 2 YEARS OR BOTH
Internationally alters information which required by the EC	FINE NOT EXCEEDING RM100,000 OR IMPRISONMENT NOT MORE THAT 2 YEARS OR BOTH
Refuse to assist to facilitate the EC in carrying out the review or audit	FINE NOT EXCEEDING RM100,000 OR IMPRISONMENT NOT MORE THAT 2 YEARS OR BOTH

EECA Building – Building Energy Intensity Label (BEL)

EECA Building – Building Energy Intensity Label (BEL)

Star Rating	EIP Range (GJ/m²/year)	EIP Range (kWh/m²/year) 1 GJ = 277.778 kWh	Indication
5-Star	EIP ≤ 0.324	EIP ≤ 90	Very efficient
4-Star	0.324 < EIP ≤ 0.396	90 < EIP ≤ 110	Efficient
3-Star	0.396 < EIP ≤ 0.576	110 < EIP ≤ 160	Moderate efficient
2-Star	0.576 < EIP ≤ 0.720	160 < EIP ≤ 200	Slightly efficient
1-Star	EIP > 0.720	EIP > 200	Least efficient

Table 1: The EER for an office building.

Star Rating	EIP Range (GJ/m²/year)	EIP Range (kWh/m²/year) 1 GJ = 277.778 kWh	Indication
5-Star	EIP ≤ 0.684	EIP ≤ 190	Very efficient
4-Star	0.684 < EIP ≤ 0.864	190 < EIP ≤ 240	Efficient
3-Star	0.864 < EIP ≤ 1.224	240 < EIP ≤ 340	Moderate efficient
2-Star	1.224 < EIP ≤ 1.512	340 < EIP ≤ 420	Slightly efficient
1-Star	EIP > 1.512	EIP > 420	Least efficient

Table 2: The EER for an office building with chilled water supply

EECA Building – Building Energy Intensity Label (BEL)

$$BEI\ office\ building = \frac{Energy\ Consumption\ (GJ)}{\text{GFA}\ (m^2)}$$

- The energy consumption refers to the total amount of energy used by the building within a period of twelve consecutive months which includes electricity, natural gas and any other energy or energy resources consumed for heating, cooling, lighting and other building operations (including from renewable energy sources).

- GFA – Gross Floor Area

The Gross Floor Area (GFA) for an office building refers to the total area of floor space within a building, as measured between the external sides of wall or, in the case of party walls, between the centres of such walls but it excludes the following areas:

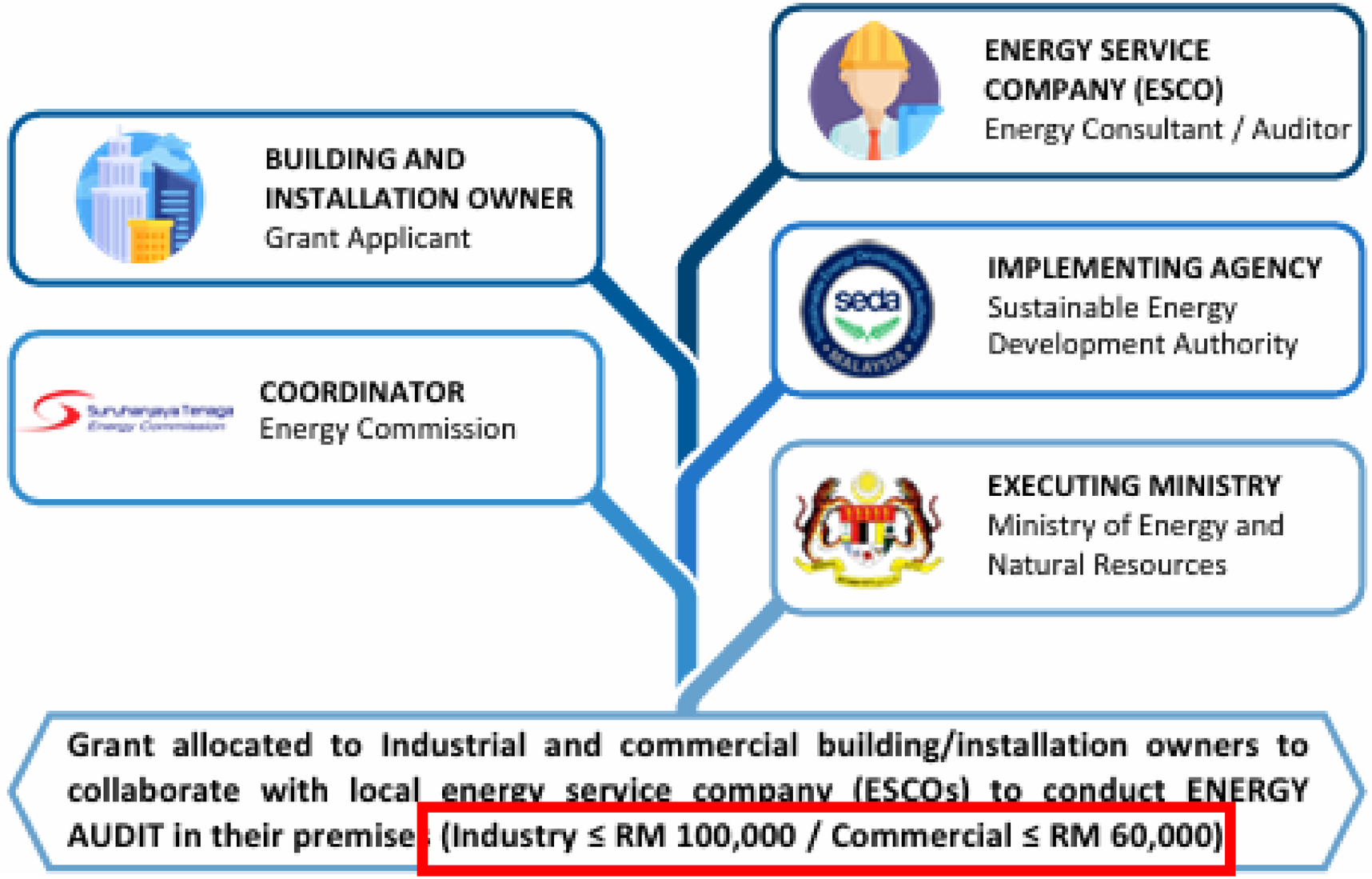
a) parking spaces and circulation areas, including any mechanical or electrical spaces within the parking area of the building;
b) open or covered parking area outside the building;
c) staircases and lift shafts on floors other than the ground floor or lobby;
d) waiting area for commercial vehicles unloading goods;
e) gardens or recreational facilities for residents provided on the rooftop or podium in open or semi-open spaces;
f) pedestrian pathway connected to the building or transit station, including any supporting activities; and
g) pedestrian pathways within buildings functioning as public walkways.

EACG

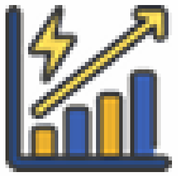
Energy Audit Conditional Grant

ENERGY AUDIT CONDITIONAL GRANT RMK-12 FOR INDUSTRIAL AND COMMERCIAL SECTOR (GENERAL INFORMATION)

EACG Introduction



EACG Eligibility



ELECTRICITY USAGE

Open to any commercial and industrial installation with minimum monthly consumption **100,000 kWh/month**

Approximately RM40,000 in monthly electricity bill

NON EACG RMK11 APPLICANT

Not eligible for any installation which has **received a grant from the previous Energy Audit Conditional Grant RMk-11**

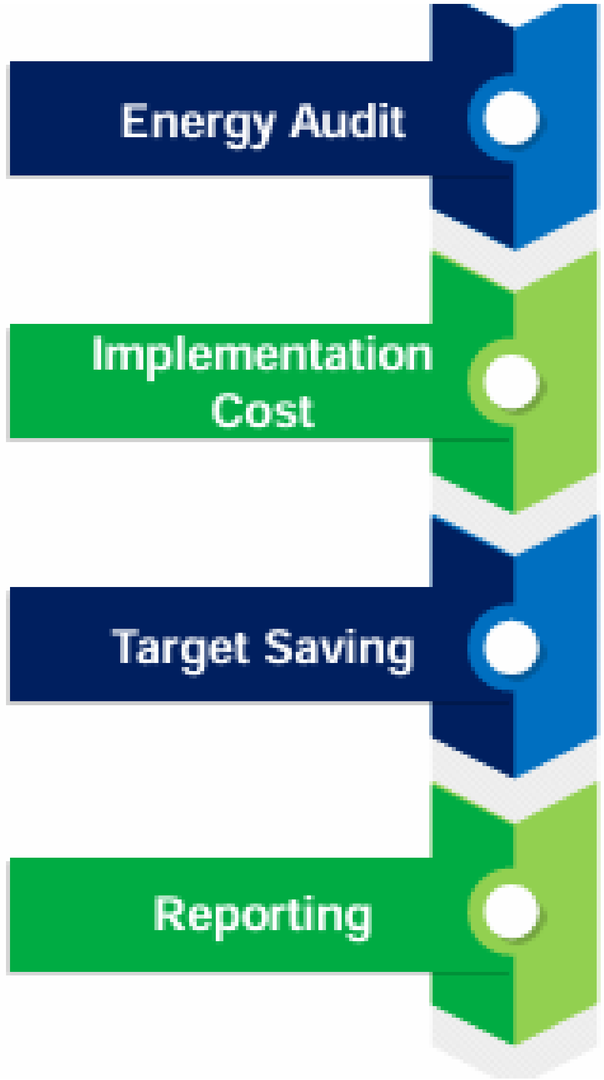
APPOINT REEM

– Must appoint Registered Electrical Energy Manager (REEM)

EACG Benefit

Grant Provided by Government	• Grant amount up to RM100,000 for industrial and RM60,000 for commercial sector
Platform and Facilitation	• Facilitation from the energy expert throughout 3 years contract period • Option for No-Cost energy saving implementation
Capacity Development	• Staff trained in Energy Management and Energy Audit (Competency) - Free for Grant Applicant • Able to upgrade to Registered Electrical Energy Manager (REEM)
Recognition and Award	• Establish energy baseline and potential energy saving • Voluntary sustainable energy low carbon building assessment such GreenPASS, BEI Labelling and National Energy Award
Reduce Operating Cost	• Saving from Energy Saving Measures (ESM) Implementation

EACG Term and Condition



2 month of allocation for Energy Audit exercise

Minimum investment must be equal or greater than total grant applied within 3 years

Percentage savings are based on Energy Audit Report

- Every 3 months to SEDA
- Every 6 months to EMIS System

a. Implement the Energy Saving Measures (ESMs)
b. Attend the Energy Audit & Energy Management Training

Case Study

Selected Clients (Green Building & Energy Audit)

Project Introduction

GROSS FLOOR AREA (GFA)

43, 648 m2

37 (since 1987)

BUILDING AGE'S

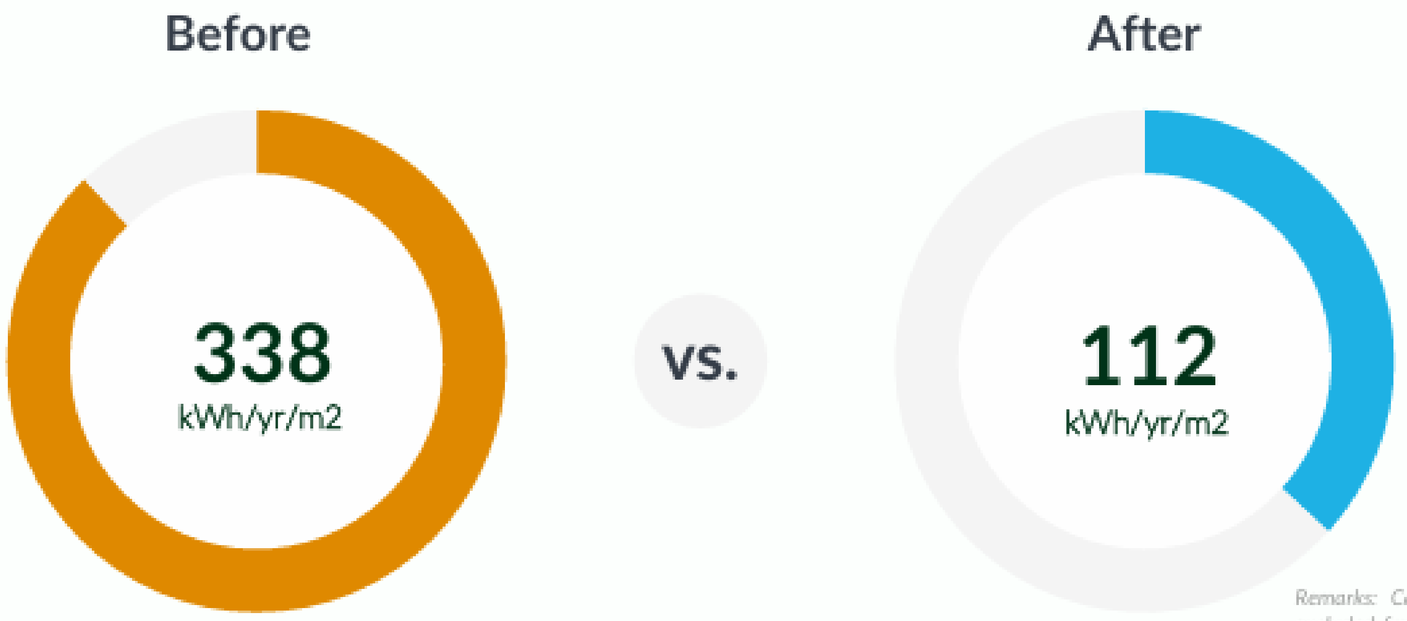
CURRENT OCCUPANCY RATE (%)

70%

CERTIFIED

GREEN BUILDING INDEX RATING

Building Energy Intensity



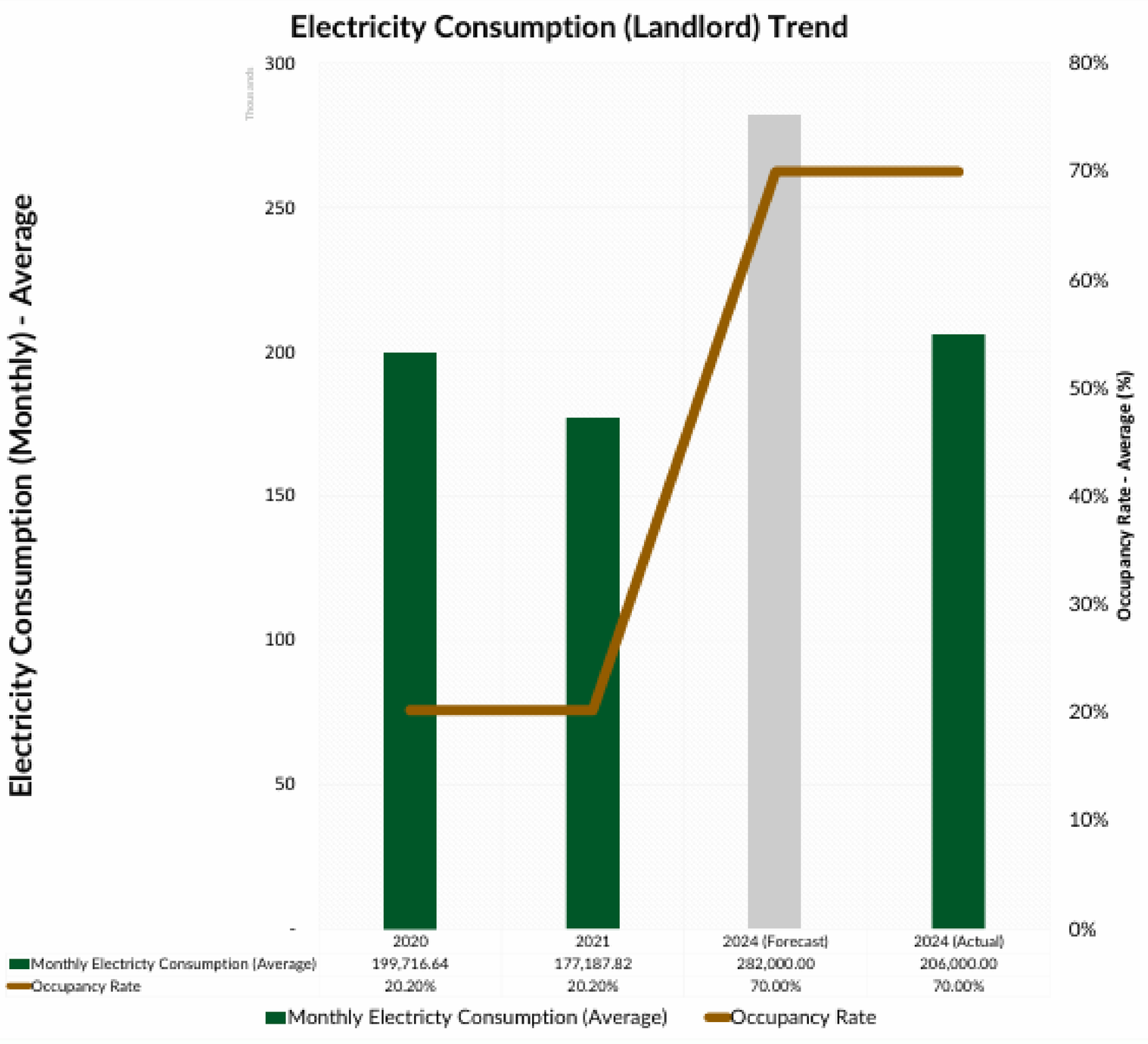
Remarks: Car Parks & Data Center Electricity Usage has been excluded from the BEI Calculation. The BEI also normalised to the common operation hours of office building (52 WOH –average actual WOH is 63 hours per week)

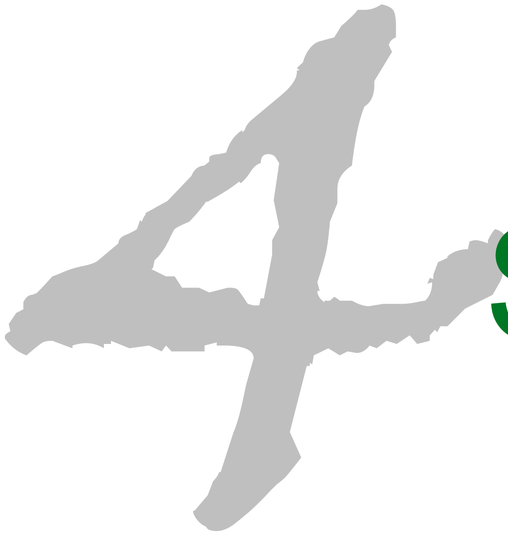
• 1.6 kW/RT (The overall existed chiller plant system)	CHILLER PLANT EFFICIENCY	• 0.76 kW/RT (The overall upgraded chiller plant system)
• 2 nos. x 600 RT + 1nos. x 750 RT – average chiller performance 0.934 kW/rt	CHILLER CONFIGURATION	• Replaced 750RT with high efficient 450RT chiller with performance efficiency of 0.63 kW/RT
	NEW ADDED FEATURES	• High efficient pumps + motor c/w Variable Speed Drive. • Carbon Dioxide Sensor

- There is often significant relationship between the electricity consumption of a building and its occupancy rate.
- The relationship between **occupancy rate and electricity consumption** is typically linear (positive correlation), meaning that as the occupancy rate increases, the electricity consumption also tends to increase as shown in the next graph.
- **Forecast** is made based on the Business As Usual (BAU) data (2020 to 2021), shows that the electricity consumption (landlord) could achieve 282,000 kWh/mth (when the occupancy rate hit 70%) if no upgrading work being imposed or introduced to the building system *(refer to bar chart in grey color).*
- From the graph, it shows that the building **save** about 75,000 kWh/mth or 900,000 kWh/yr (702,000 kgCO2e) through the upgrading works that have been carried out to the building.

4.0 Years

Return of Investment (ROI)



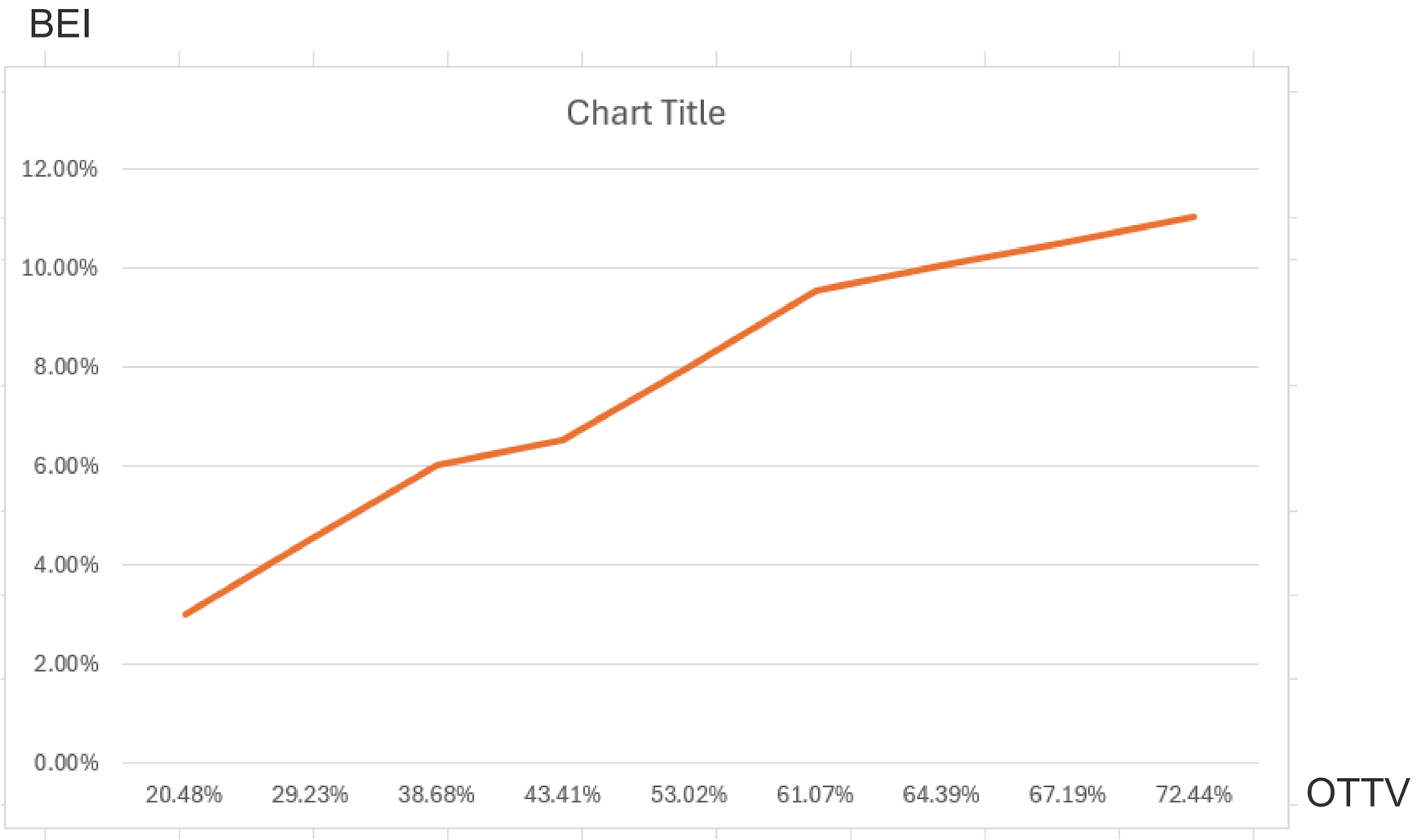


Sustainability by Design

Mixed-Mode

Passive Design

1. Orientate
2. Insulate
3. Shade
4. Daylit
5. Ventilate
   (Mixed-Mode Cooling)



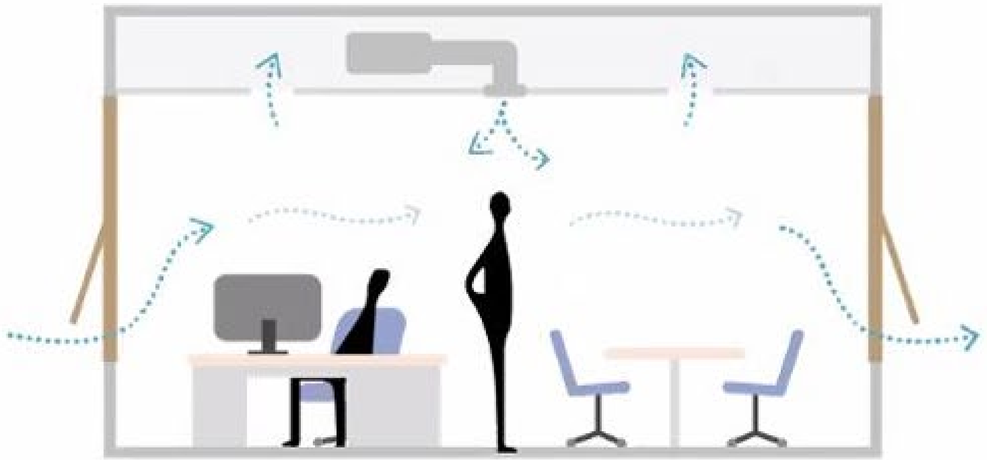
Mixed Mode

Mixed-mode refers to a hybrid approach to space conditioning that uses a **combination of natural ventilation** from **operable windows (either manually or automatically controlled) or other passive inlet vents,** and **mechanical systems** that provide air distribution and some form of cooling.

- Brager, G. (2006) Mixed-mode cooling. ASHRAE

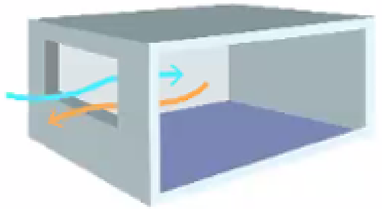
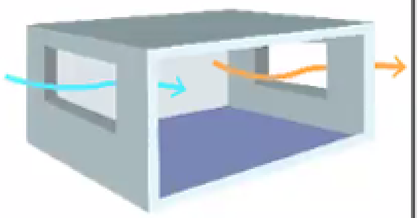
OPERATING MODE OF INTEREST

Concurrent
(Same space, same time)



Change-over
(Same space, different times)

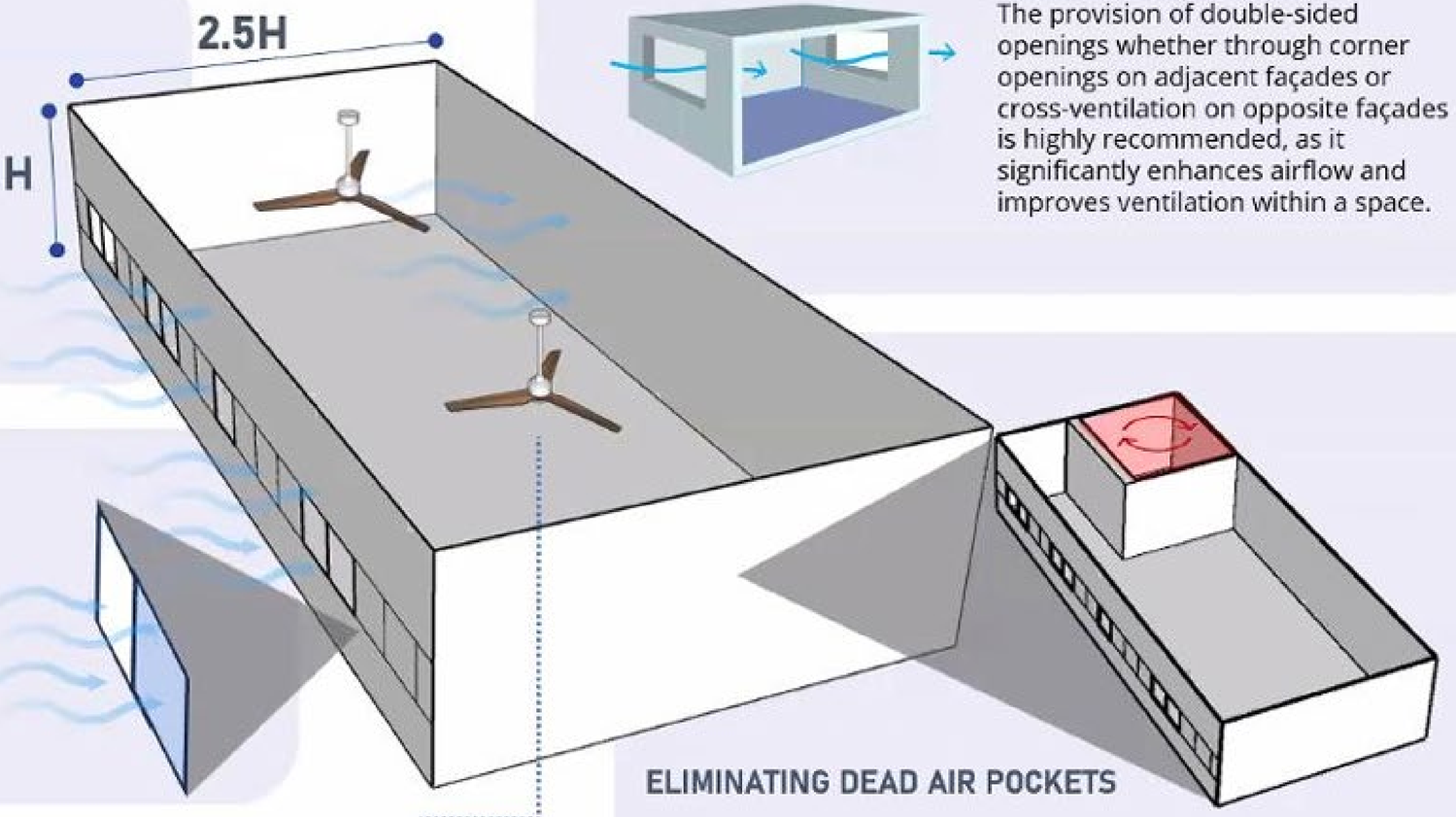
Mixed Mode

TYPE OF VENTILATION	CIBSE (AM10)	ASHRAE 62.1-2022
Single Side Ventilation 	• The limiting depth for effective ventilation is about **twice the floor-to-ceiling height**. • The limiting depth for effective ventilation is about **2.5x the floor-to-ceiling height** for single sided double opening ventilation	• The limiting depth (W) for effective ventilation is twice the floor-to-ceiling height (H) **[W≤2H]** • Limiting depth for effective single sided ventilation is **no more than 8m**. • This can be **extended to 12m with use of air movement technologies** such as ceiling fans.
Cross Ventilation 	• The maximum distance between the two facades is **5x times the floor-to-ceiling height**.	• The limiting depth(W) for effective ventilation is five times the floor-to-ceiling height (H) **[W≤5H]** • Limiting depth for effective **cross ventilation** is **15m**. This can be extended to **24m with use of air movement technologies** such as ceiling fans.

Mixed Mode

DEPTH (W) TO HEIGHT LIMIT FOR EFFECTIVE VENTILATION

To optimize ventilation efficiency, the limiting depth (W) should not exceed 2.5 times the floor-to-ceiling height (H). This helps to proper airflow distribution and improves natural ventilation effectiveness.



CROSS VENTILATION

The provision of double-sided openings whether through corner openings on adjacent façades or cross-ventilation on opposite façades is highly recommended, as it significantly enhances airflow and improves ventilation within a space.

OPERABLE WINDOWS

Incorporate operable windows, even if typically closed, to enable the building to adapt to epidemic conditions and provide additional ventilation when needed.

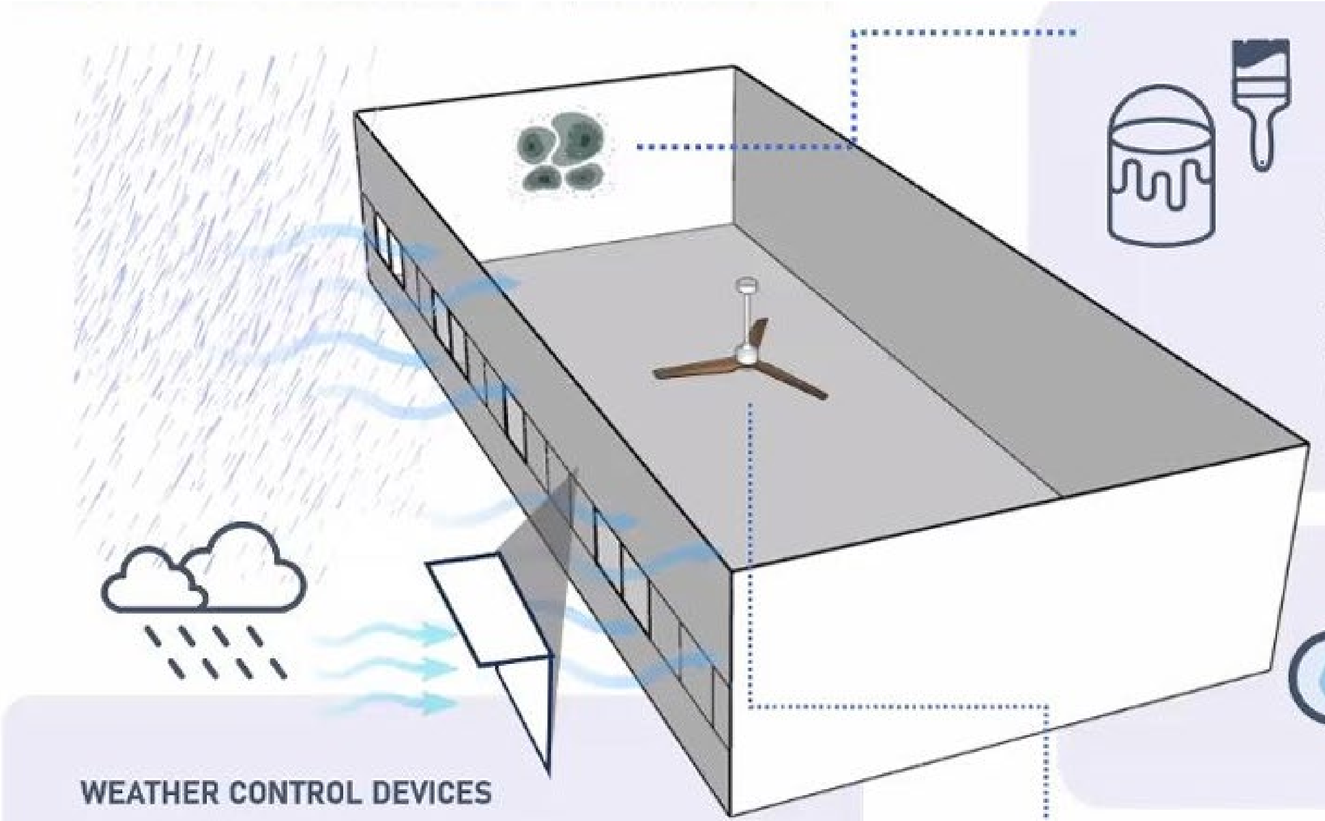
ELIMINATING DEAD AIR POCKETS

These poorly ventilated zones can cause discomfort, humidity buildup, mold growth, and increased concentrations of viruses and pollutants.
Optimize Airflow Design by strategically placing windows in different locations throughout the room to enhance natural ventilation and ensure even air distribution.

MAXIMISE MIXING IF SUFFICIENT VENTILATION PROVIDED

The use of air mixing devices such as ceiling fans can improve air distribution and enhance thermal comfort throughout the space.

Mixed Mode



SPECIFY WALL FINISHES WITH AN ANTI-MOLD TOPCOAT TO PREVENT MOLD GROWTH

Use paint with excellent water resistance to mitigate the risk of mold and moisture in naturally ventilated rooms.

Ensure material surfaces are resistant to mold growth according to standardized test methods such as UL 181, ASTM C1338, or ASTM D3273.

INSPECTIONS

Regularly check for condensation and wet spots, addressing moisture problems promptly to prevent potential issues

WEATHER CONTROL DEVICES

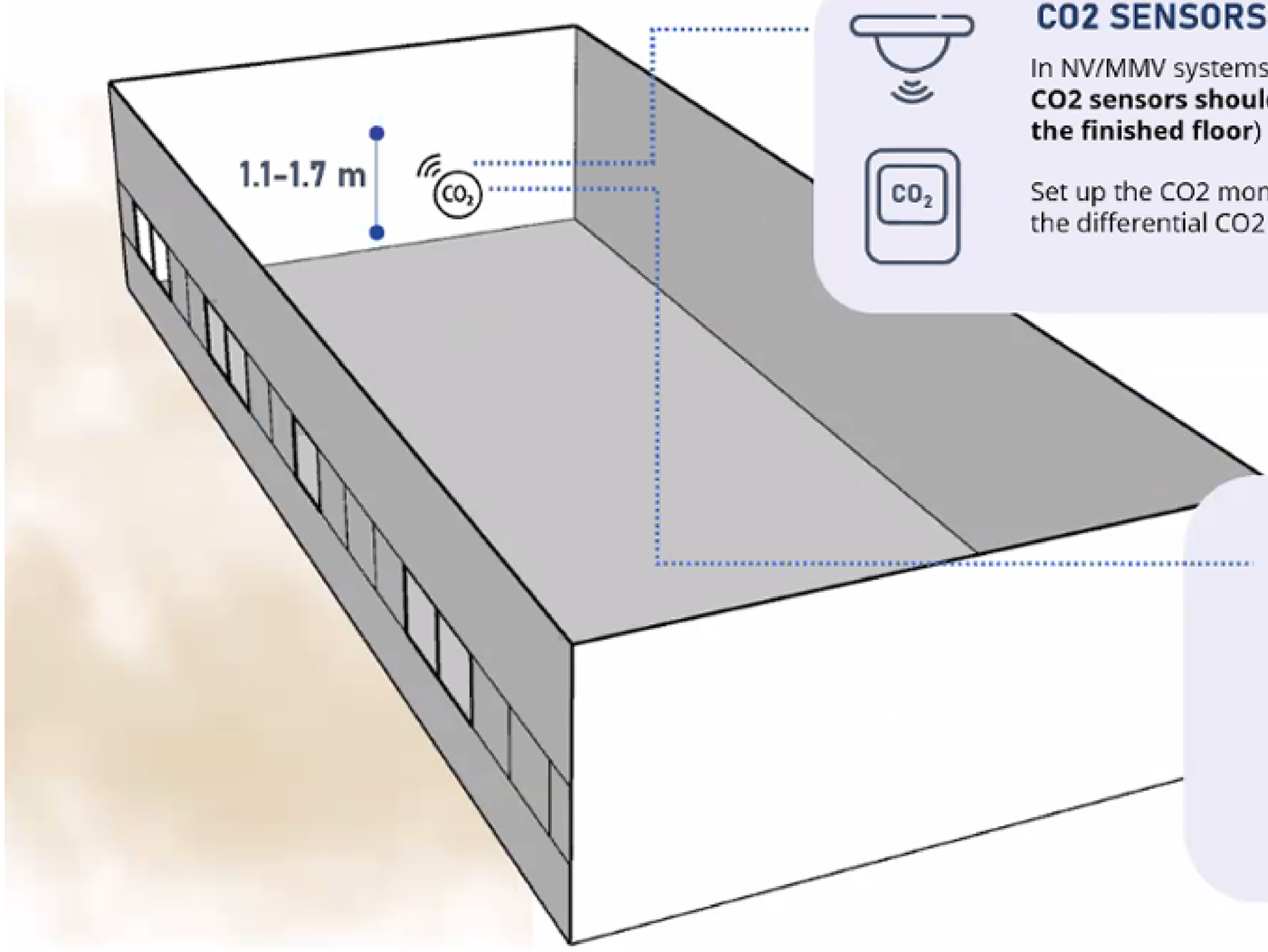
Overhangs and rain screens at external openings help protect against rain ingress through operable windows. Installing a waterproofing membrane on adjacent walls further prevents water damage.

Performance-based simulations should be conducted to ensure these devices do not obstruct ventilation.

HUMIDITY CONTROL

Ensure proper air movement to reduce humidity build-up by incorporating ceiling fans and exhaust fans in moisture-prone areas such as kitchens and bathrooms.

Mixed Mode



CO2 SENSORS

In NV/MMV systems, a CO2 level below **800ppm indicates good ventilation. CO2 sensors should be installed at the breathing zone (1.1 - 1.7m above the finished floor)** in each ventilation zone to ensure effective monitoring.

Set up the CO2 monitoring system to trigger an audible or visual alarm when the differential CO2 concentration surpasses the recommended levels.

PM2.5 SENSORS

Avoid opening windows when outdoor air quality is **below the acceptable level (PSI > 100).** During unfavorable air quality conditions, operate the building with full air conditioning to maintain a controlled indoor environment.

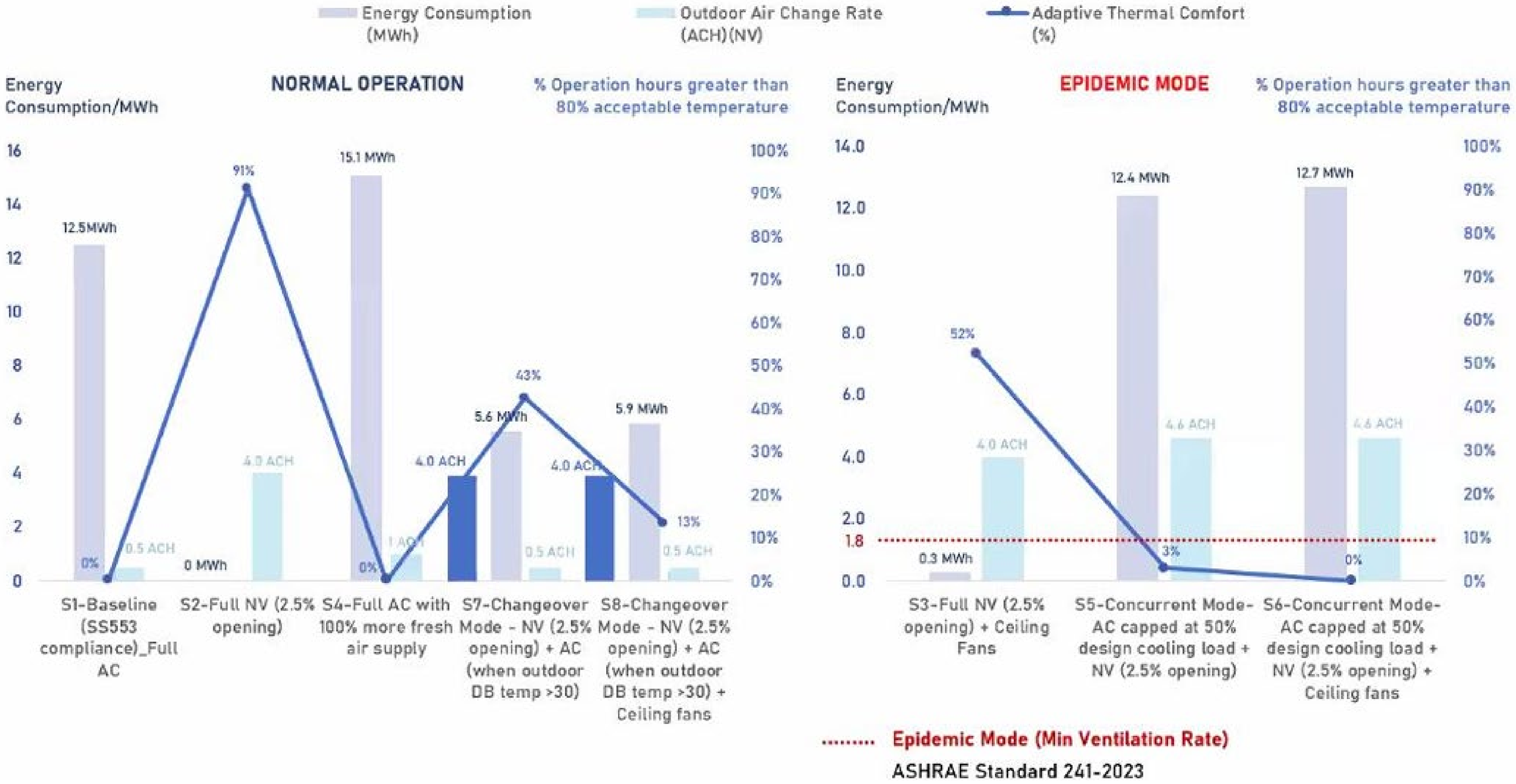
Monitor PM2.5 levels to determine instances when **natural ventilation should be avoided due to poor outdoor air quality**, and the opening of windows avoided.

Mixed Mode

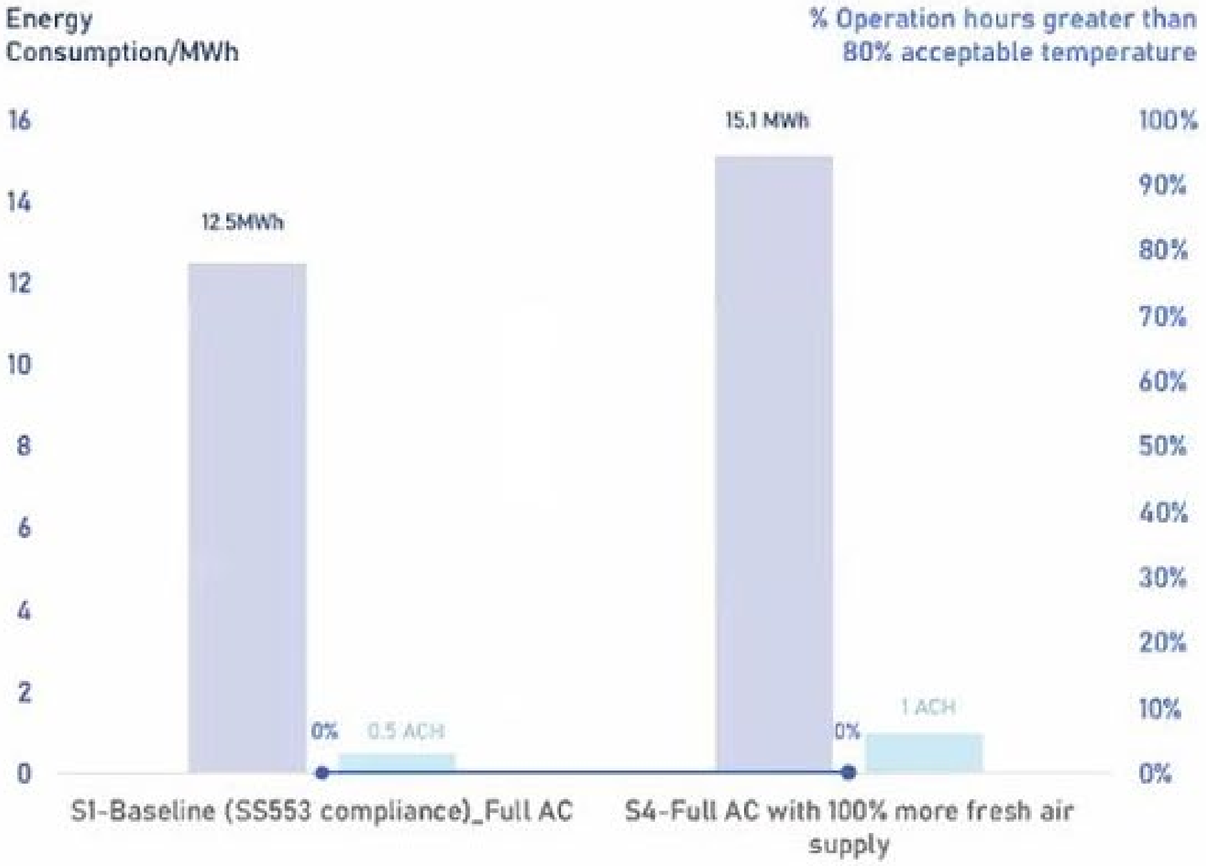
Operation Mode	Scenario	Description	Simulation Results		
			Outdoor Air Change Rate (ACH)	Energy Consumption (MWh)	Adaptive Thermal Comfort (%)
Full Operation NV/AC	Scenario 1	Full AC - Baseline (SS553 Compliance)			
	Scenario 2	Full NV (2.5% opening)			
	Scenario 3	Full NV (2.5% opening) + Ceiling Fans			
	Scenario 4	Full AC with 100% more fresh air supply compared to minimum code requirement			
Concurrent Mode	Scenario 5	Part Load AC capped at 50% design cooling load + NV (2.5% opening)			
	Scenario 6	Part Load AC capped at 50% design cooling load + NV (2.5% opening) + Ceiling fans			
Changeover Mode	Scenario 7	NV (2.5% opening) + AC (when outdoor DB temp >30)			
	Scenario 8	NV (2.5% opening) + AC (when outdoor DB temp >30) + Ceiling fans			

Mixed Mode

Adaptive Thermal Comfort denotes people's perceptions of their environment change based on climatic temperature and humidity as well as their capacity to control the conditions in a space.



Mixed Mode



SCENARIO 4

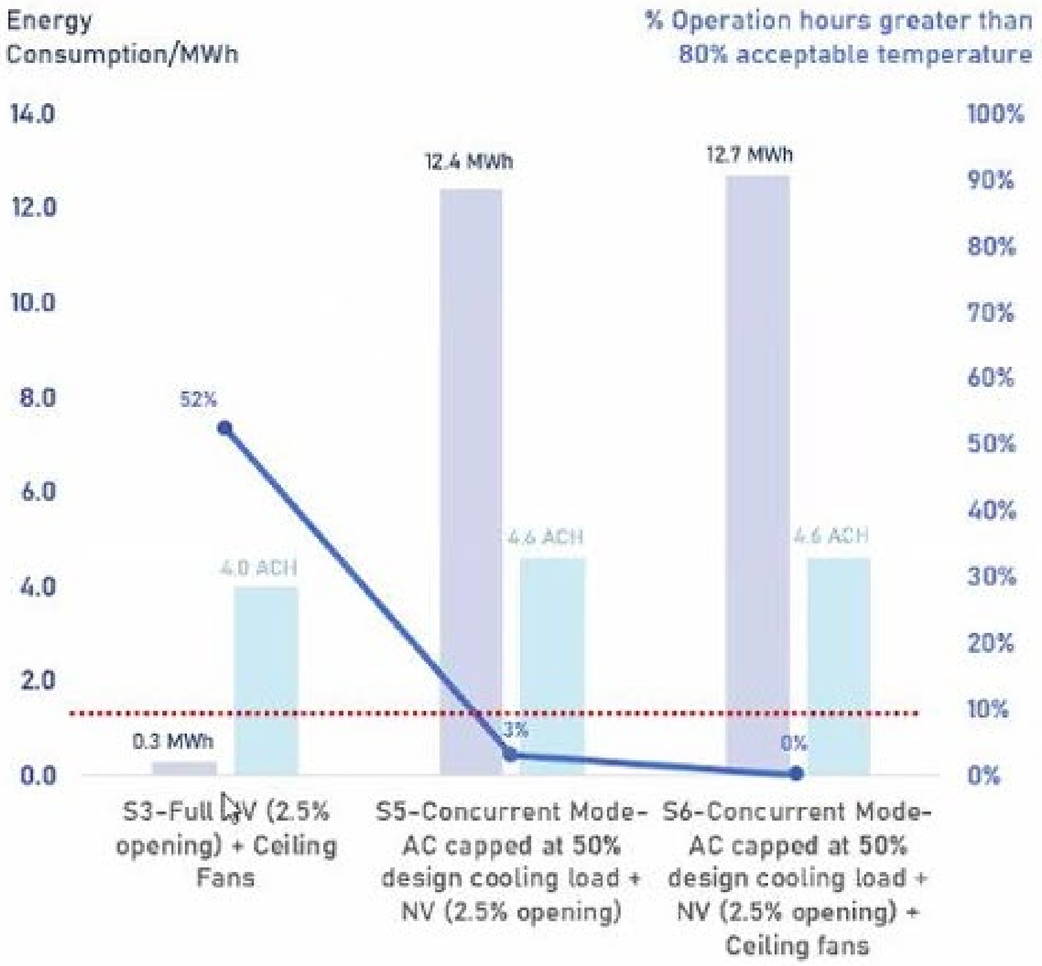
Full AC with 100% more fresh air supply (Epidemic-Control)

Scenario 4 highlights the challenge of attaining higher outdoor air rates solely with the existing ACMV system.

The achieved ACH only increases to 1 ACH, **falling short of meeting the minimum ventilation rate for epidemic mode** operation.

Furthermore, this has a significant impact on energy consumption to achieve the same thermal comfort.

Mixed Mode



SCENARIO 5

Part Load AC capped at 50% design cooling load + NV (2.5% opening)

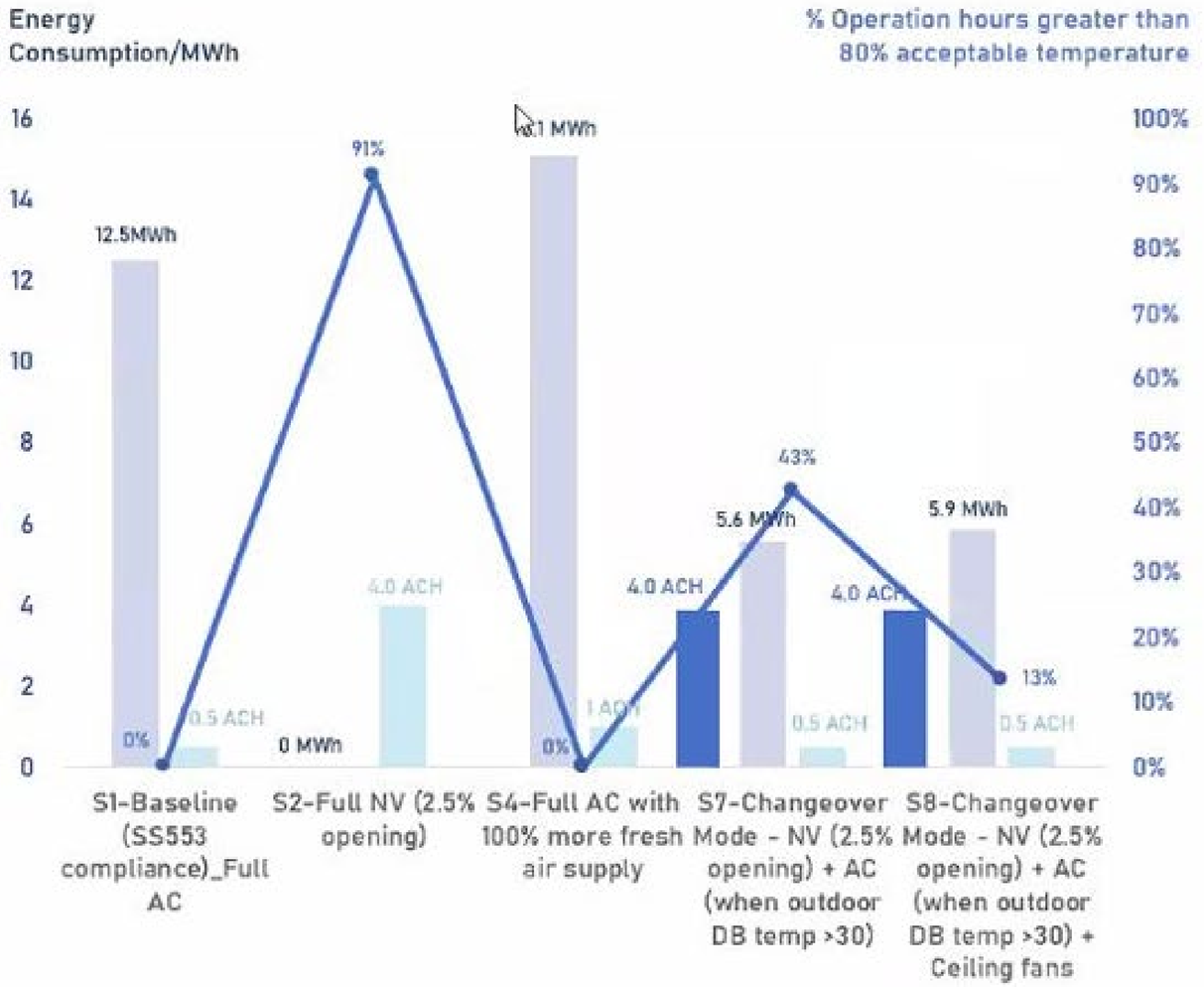
SCENARIO 6

Part Load AC capped at 50% design cooling load + NV (2.5% opening) + Ceiling fans

Operating in concurrent mode with a cooling capacity cap of 50% presents an option to **increase the ventilation rates without significantly impacting thermal comfort and energy efficiency.**

In scenarios 5 and 6 , the supply of outdoor air required for epidemic mode operation is maintained while utilizing nearly the same energy as in the full AC baseline scenario.

Mixed Mode



SCENARIO 7

NV (2.5% opening) + AC (when outdoor DB temp >30)

SCENARIO 8

NV (2.5% opening) + AC (when outdoor DB temp >30) + Ceiling fans

Changeover mode operation offers the chance to improve outdoor air provision while **cutting energy consumption by 56%** compared to full AC operation.

In these scenarios, outdoor air change rates exceed epidemic mode requirements **only** when the windows are open, however the **thermal comfort is negatively impacted.**

Nevertheless, the inclusion of fans can reduce the percentage of hours exceeding acceptability limits for adaptive thermal comfort from 43% (Scenario 7) to 13% (Scenario 8).

Case Study


吉隆坡慈济国际学校
TZU CHI INTERNATIONAL SCHOOL K.L
PRIMARY
SECONDARY

OTTV & BEI

NATIONAL ENERGY AWARDS 2023

ASEAN ENERGY AWARDS

OTTV

DA – 47 Wm²

CVA – 47 Wm²

BEI

DA – 58.2 kWh/m²/yr

CVA – 27.41 kWh/m²/yr

(82% lower than national benchmark)

Passive Design

OTTV
Window-to-Wall (WWR) – 21%
Light Grey Tinted Glass
3m Roof Overhang (SC2)
3m width perimeter Corridor (SC2)
Shading Device – Sunscreen/Vertical Green (SC2)
Self-shade Façade (Advanced OTTV)

Daylight
Courtyards
Daylight (1.0% to 3.5% DF) – 54.79% of NLA
– 84.29% of GFA
Visible Light Transmission (VLT) – 89%

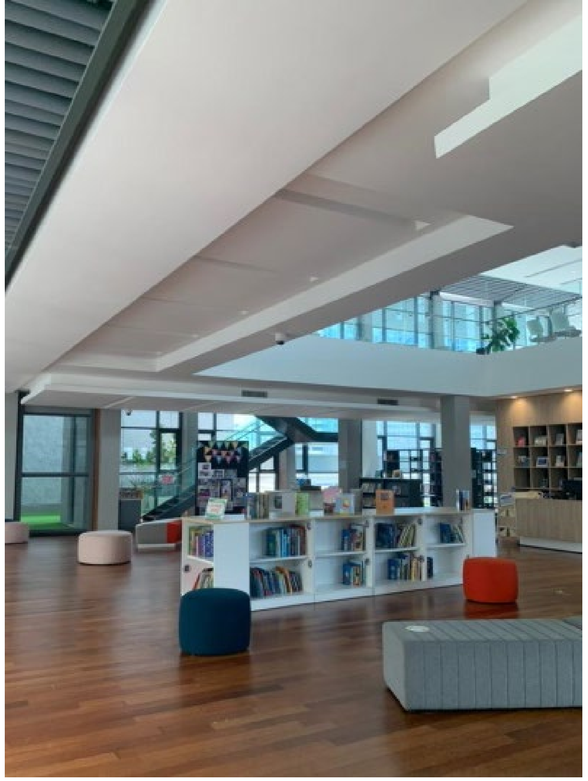
Ventilation
Courtyards
4-6m Floor-to-Floor Height
9m Slim Building with 2 Sides Opening

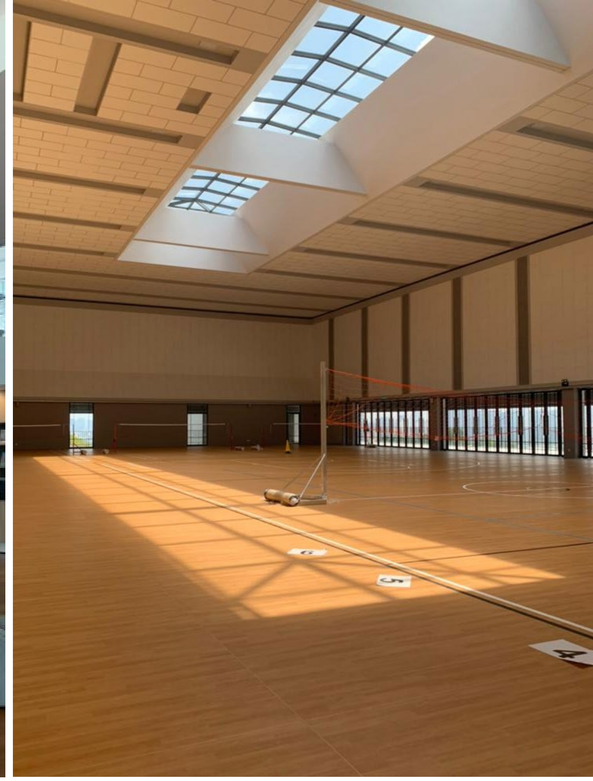
Passive Design

OTTV
Window-to-Wall (WWR) – 21%
Light Grey Tinted Glass
3m Roof Overhang (SC2)
3m width perimeter Corridor (SC2)
Shading Device – Sunscreen/Vertical Green (SC2)
Self-shade Façade (Advanced OTTV)

Daylight
Courtyards
Daylight (1.0% to 3.5% DF) – 54.79% of NLA
– 84.29% of GFA
Visible Light Transmission (VLT) – 89%

Ventilation
Courtyards
4-6m Floor-to-Floor Height
9m Slim Building with 2 Sides Opening





Passive Design

OTTV
Window-to-Wall (WWR) – 21%
Light Grey Tinted Glass
3m Roof Overhang (SC2)
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Shading Device – Sunscreen/Vertical Green (SC2)
Self-shade Façade (Advanced OTTV)

Daylight
Courtyards
Daylight (1.0% to 3.5% DF) – 54.79% of NLA
– 84.29% of GFA
Visible Light Transmission (VLT) – 89%

Ventilation
Courtyards
4-6m Floor-to-Floor Height
9m Slim Building with 2 Sides Opening

Mixed-Mode

Mixed Mode Ventilation

- **NV 77% of NLA**
- **< 26ºC** temperature in the classroom - **Ceiling Fan**
- **> 26ºC** temperature in the classroom - **A/C**

Mixed-Mode

A/C System Efficiency

- High EE (Hi-COP) VRV = 0.71 kW/ ton (COP = 3.68)
- Cooling Load – 66.06 W/m²
- Refrigerant – R410A

Mechanical Ventilation (MV) System

- High Velocity Low Speed (HVLS) Fan at Canteen

BCX

Bursa Carbon Exchange

We hope that it can contribute to Malaysia's ambition to achieve our target of net zero emissions by 2050, and assist Corporate Malaysia's pivot towards a green economy and meet global standards for a sustainable supply chain.

Nik Nazmi Nik Ahmad, Malaysia's Minister of Natural Resources, Environment and Climate Change
@ launched of Bursa Carbon Exchange (BCX),
9 Dec 2022

BCX Introduction

Bursa Carbon Exchange (BCX) is the world's first Shariah-compliant multi-environmental product exchange that facilitates the **trading of carbon credits and renewable energy certificates (RECs)** via standardised contracts, from projects registered with Verra.

Note: A standardized contract refers to a pre-defined contract for trading carbon credits, where all the key parameters like project type, emission reduction methodology, and quality standards are set, ensuring consistency and transparency for buyers and sellers in the carbon market; essentially, it means all carbon credits traded on BCX meet specific criteria, making it easier to compare and assess their value.

Note: Verra is a widely recognised standard in the voluntary carbon market, and accounts for nearly 70% of voluntary carbon credit issuances globally.

BCX Carbon Mechanism

Voluntary Carbon Markets (VCM)

Companies purchase and “retire”, voluntarily, carbon offsets/credits, to fulfil either voluntary emissions reduction targets or to create “Carbon neutral” products for their customers.

Emissions Trading System (ETS)

The regulator sets a fixed limit for the amount of CO_2 to be emitted, sometimes called 'cap. They then issue the respective amount of emission allowances (or permits) to firms either directly or through auctions. One allowance typically grants the right to emit one ton of CO_2

Carbon Tax

The regulator sets a fixed limit for the amount of CO_2 to be emitted and then taxes every ton of CO_2 emitted in excess of the defined limit at fixed rates. Depending on design, carbon credits may be acceptable, to a limit, to offset an organization’s exposure to tax

BCX Carbon Mechanism

The BCX enables companies and other entities to trade **voluntary** carbon credits from projects that remove, reduce or avoid greenhouse gas (GHG) emissions, via **The Voluntary Carbon Market Exchange (VCM)**

The state of Sarawak passed the **Environment (Reduce of Greenhouse Gases Emission) Ordinance** in 22 Dec 23 that includes provisions to introduce **mandatory emissions thresholds for certain industrial emitters**.

The government has announced plans to implement a **carbon tax for the iron, steel, and energy industry by 2026**.

BXC Implementation

The Voluntary Carbon Market Exchange (VCM) is a joint initiative between **the Minister of Natural Resources and Environmental Sustainability (NRES)** and **Ministry of Finance (MOF).**

Bursa is tasked with operating the VCM.

Corporate buyers will be able to purchase carbon credits from the BCX to offset their emissions, demonstrating progress in their voluntary climate commitments while creating carbon-neutral products.

BXC Application

Technology-based

Renewable Energy

Biomass, geothermal, hydro (e.g., run of river hydro-electricity), solar, wind

Energy efficiency

Waste heat recovery, process efficiencies, insulation/weatherization of buildings

Waste Disposal

Waste management, landfill gas (e.g., landfill methane), wastewater, biogas

Industrial Gases

N_2O from nitric acid and adipic acid plants, ozone-depleting substances (HFCs)

Household Devices

Clean cookstoves, water purification devices

Transport

Electrification, lower fuel use (e.g., biofuels)

Tech-based Removals

Direct Air Carbon Capture and Storage, Bio Energy Carbon Capture and Storage

Nature-based

Agriculture / Soil Carbon

Rice methane, improved fertilizer management, no- and low-till agriculture, cover crops

Forestry

Afforestation, reforestation, improved forest management (IFM), conservation (REDD+)

Other Land Use

Grassland management, restoring or avoiding conversion of peatlands

Blue Carbon

Restoration or avoiding conversion of mangroves, wetlands, seagrass

BXC Application

Emission mitigation project

A **developer sets up a project.**

Developer obtains validation and registers on a certification standard.

Developer operates and monitors results.

3rd party verifies results.

Project verified by standards and credit issuance

A carbon credit is “issued” i.e. a certificate is issued and a unique serial number on the registry is created for each ton of CO_2e

The first credit issuance can be 2 - 3 years after the start of the project

Trading and carbon markets

Issued credits belong to project developers.

These can be bought and sold, and their ownership on the registry changes, until a buyer “redeems” (retires), at which point the credit ceases to exist (it is marked as “retired” in the registry)

Credits retired toward company targets

The carbon credits are “retired”, by companies, to fulfill either voluntary emissions reduction targets or to create “Carbon neutral” products for their customers.

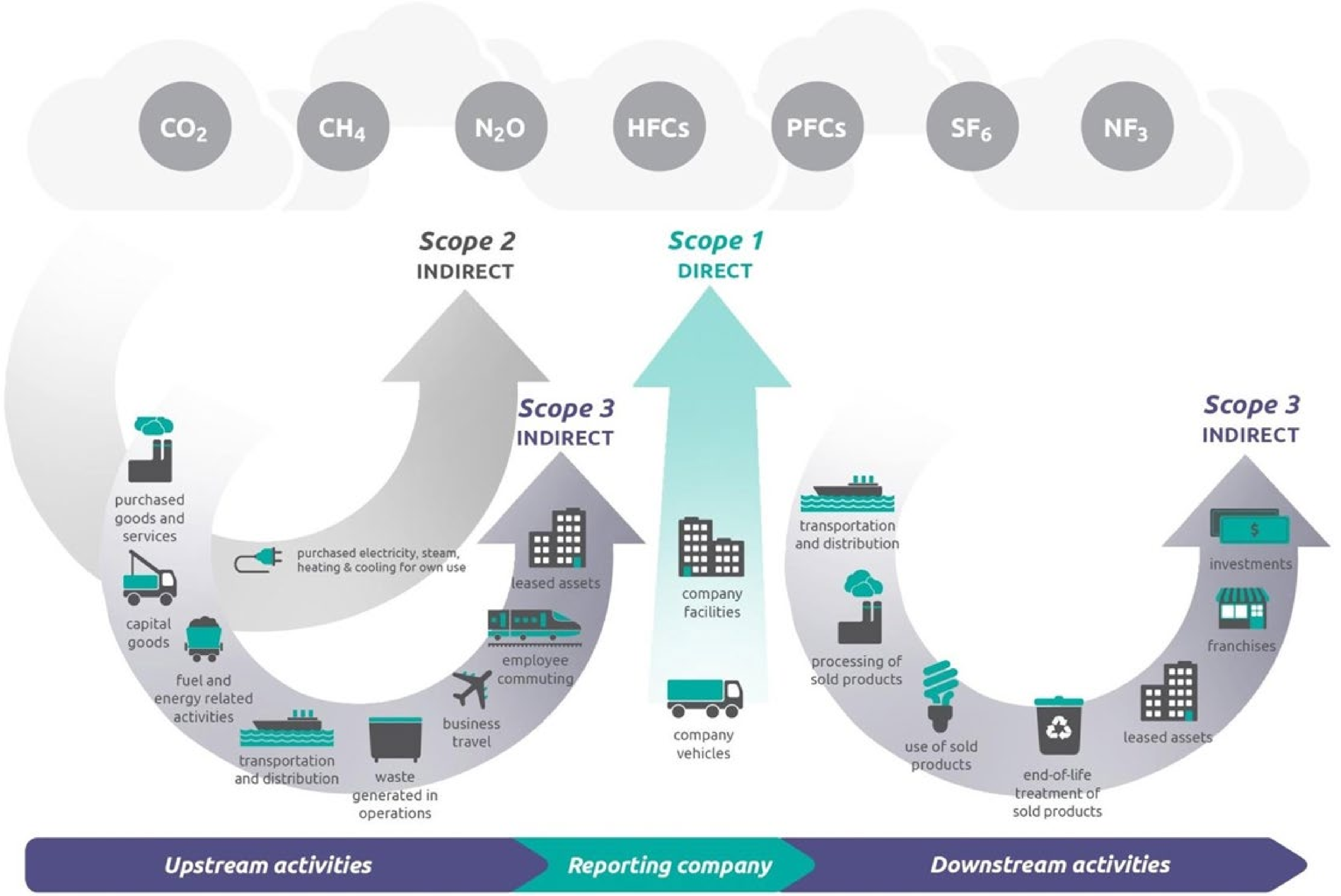
Today, companies tend to buy a credit, and retire it shortly after, to use in meeting their emissions targets. However, transactions when a company buys credits for future use, or intermediaries buy credits to sell onwards / to benefit from price appreciation can also occur

6

Embodied Carbon

Upfront Carbon

GHG Emission



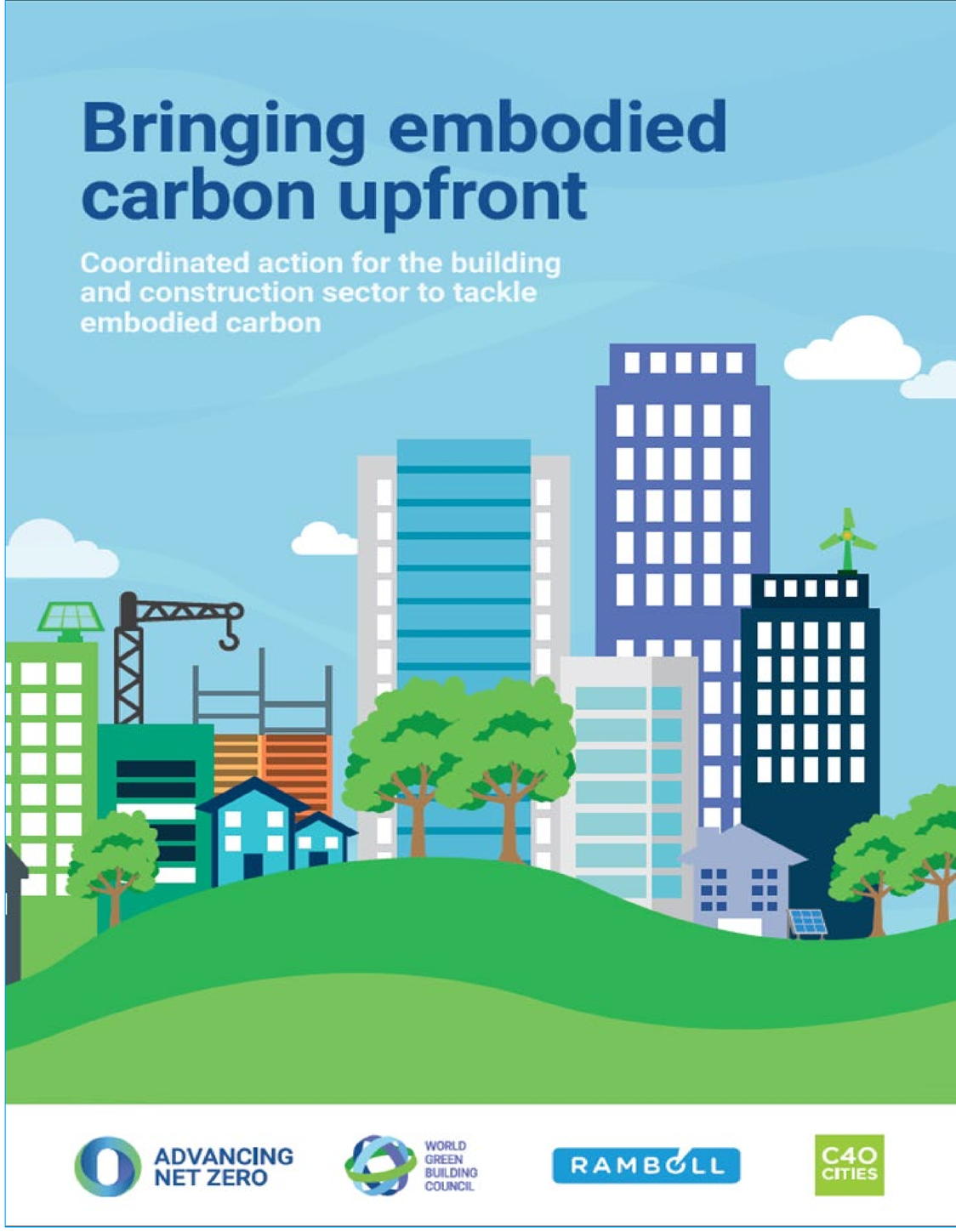
Life Cycle Carbon Emission (LCCE)

Building & Construction sector is responsible for **39% of global carbon emissions**:

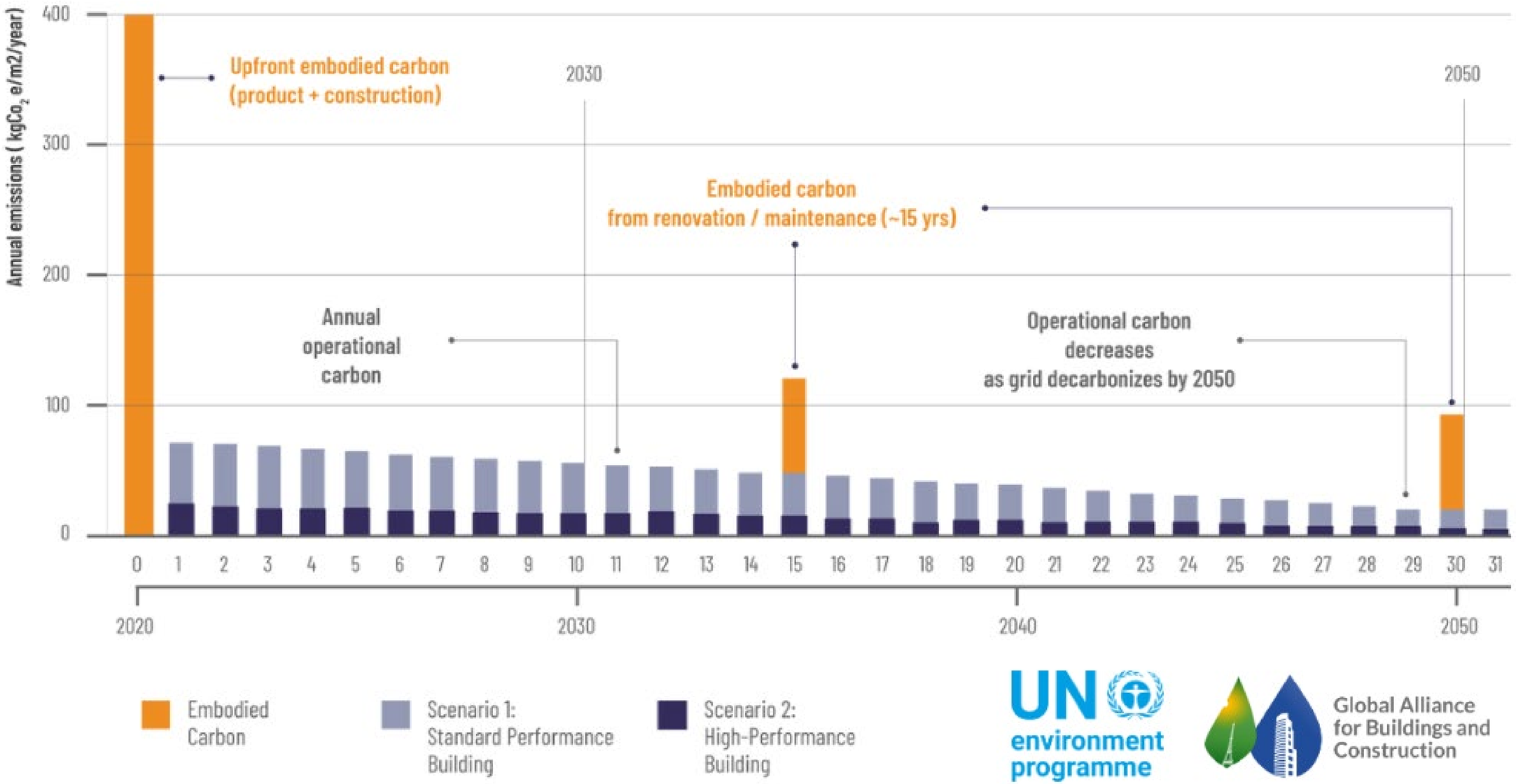
28% comes from **Operational Carbon (OC)**
11% comes from **Embodied Carbon (EC)**

In 2018, WorldGBC has launched the Net Zero Carbon Buildings, targeting to reduce Total Carbon for all new buildings, infrastructure and renovation by

2030: 40% less Embodied Carbon (EC) with significant upfront carbon & **Net Zero Operation Carbon**
2050: Net Zero Embodied Carbon (EC) & **Net Zero Operation Carbon (including existing building)**



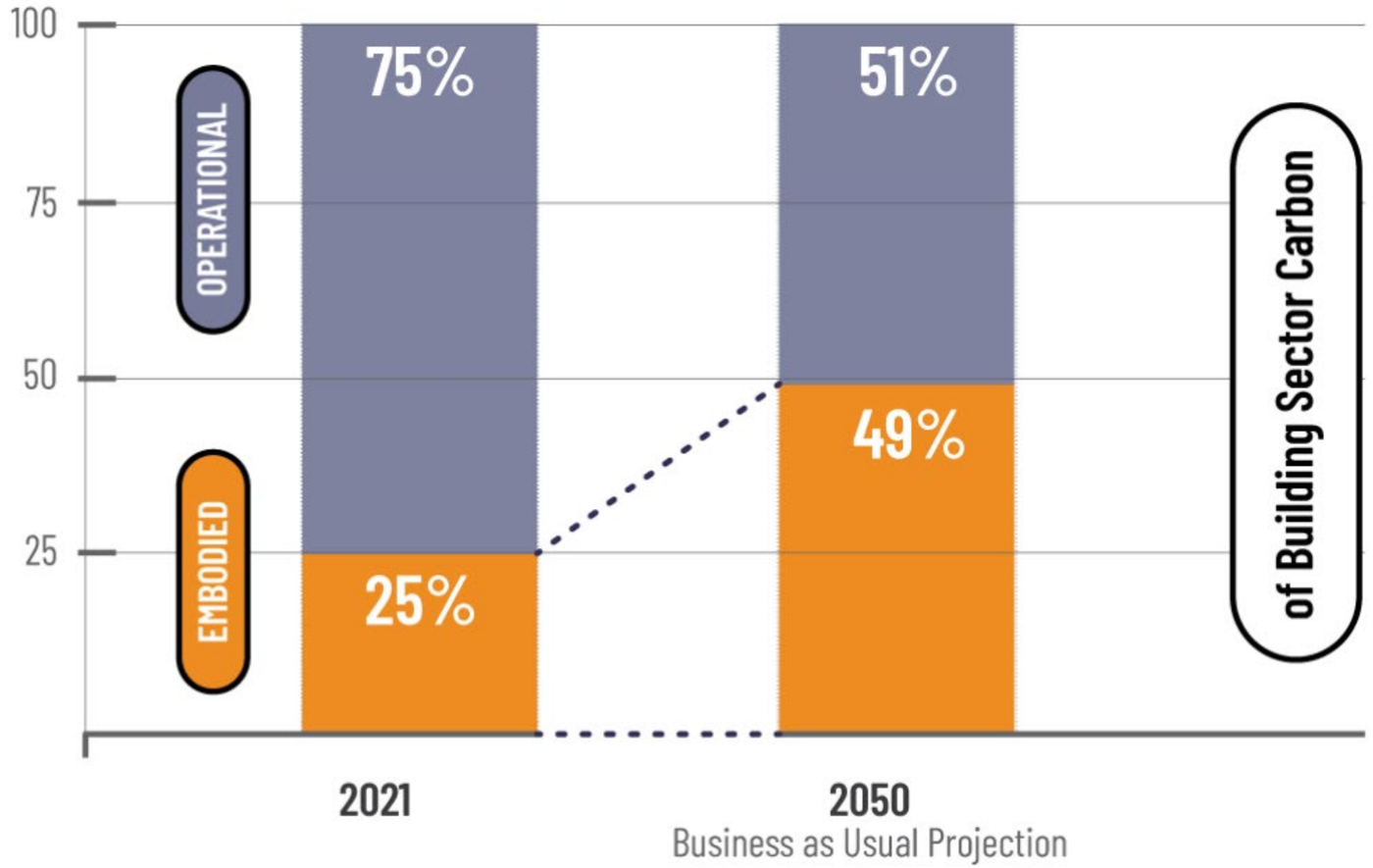
Lift Cycle Carbon Emission (LCCE)



UN environment programme

Global Alliance for Buildings and Construction

Life Cycle Carbon Emission (LCCE)



UN environment programme

Global Alliance for Buildings and Construction

LCCE Embodied Carbon

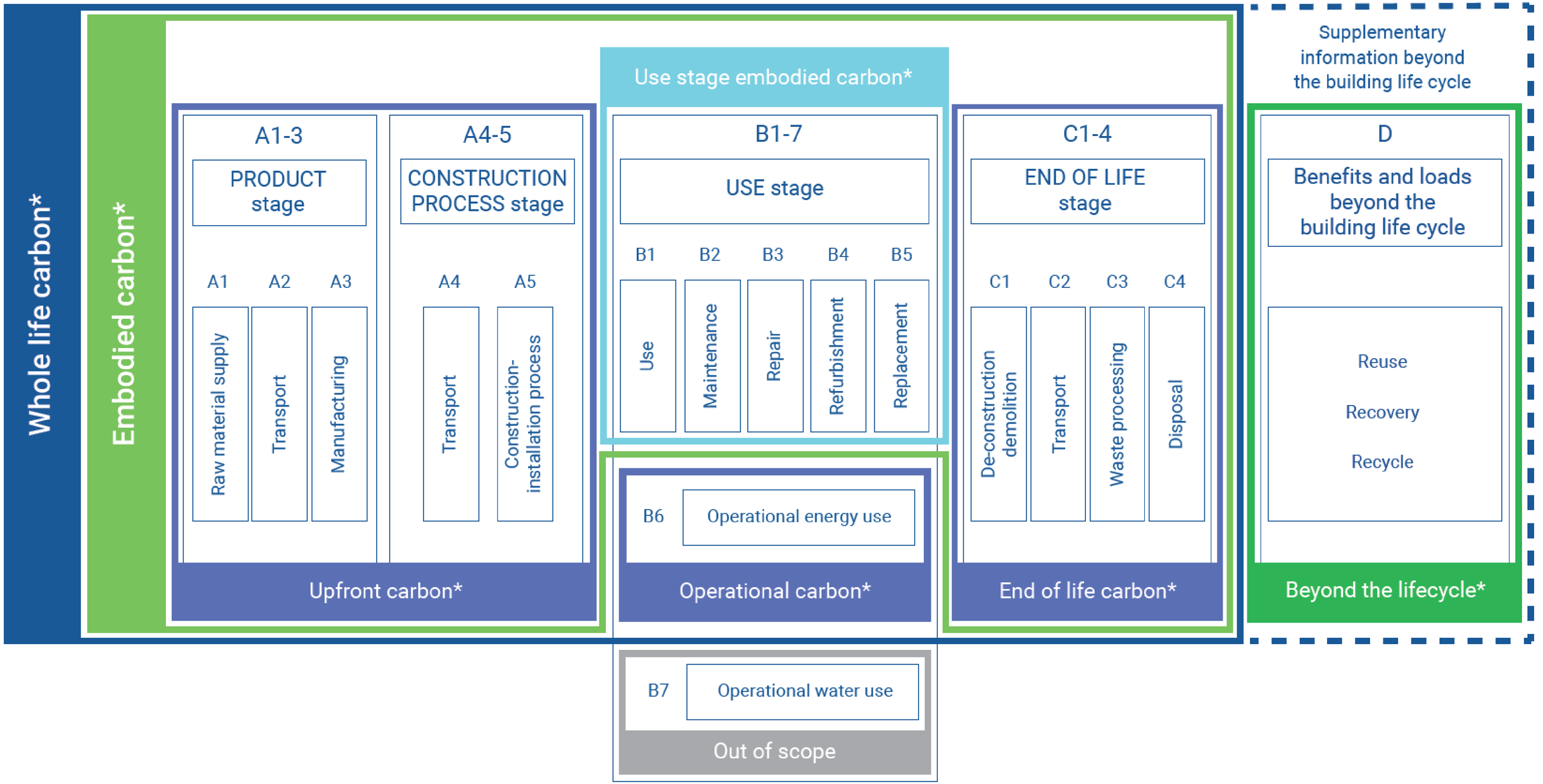
Embodied Card (EC) is the carbon emissions associated with **materials & construction processes throughout the whole lifecycle** of a building or infrastructure.

EC includes:

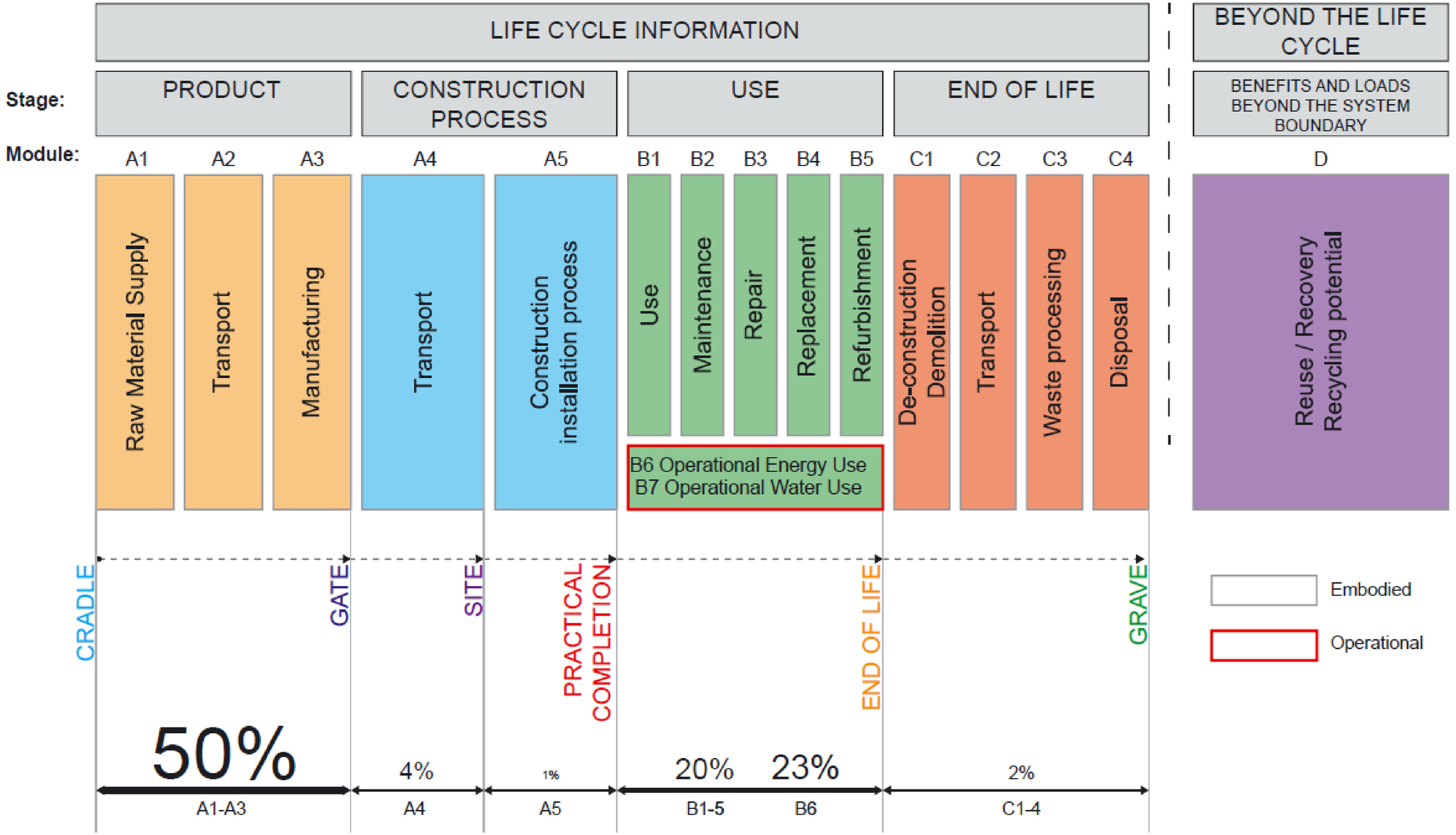
1. **Upfront Carbon** (A1-A5)
2. **Use Stage** (B1-B7)
3. **End of Life Stage** (C1-C4)
4. **Benefits & Loads beyond the building life cycle** (D)

Operational Carbon (OC) is the emissions associated with Energy Used (B6) to operate the building or in the operation of infrastructure.

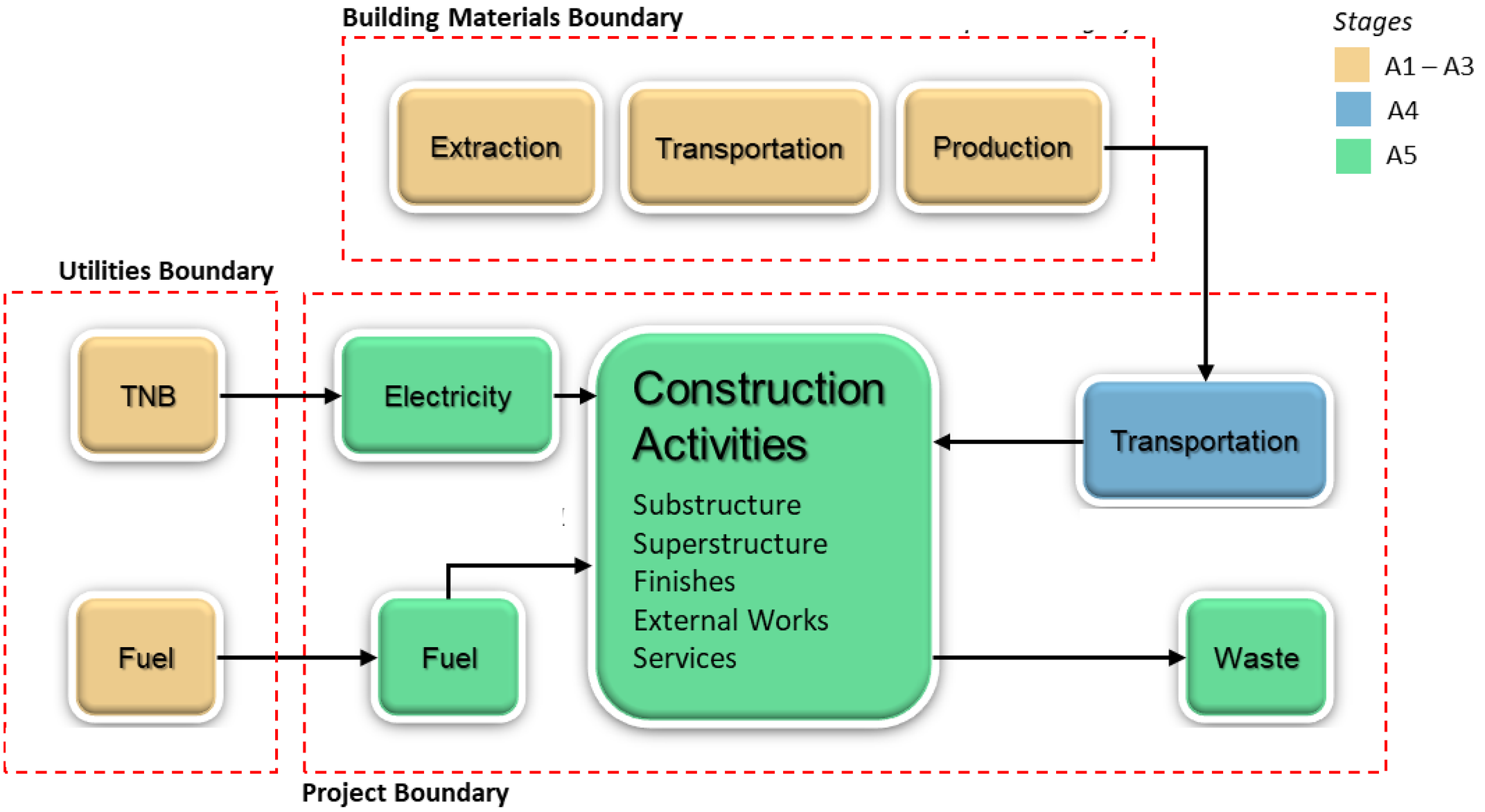
LCCE Embodied Carbon



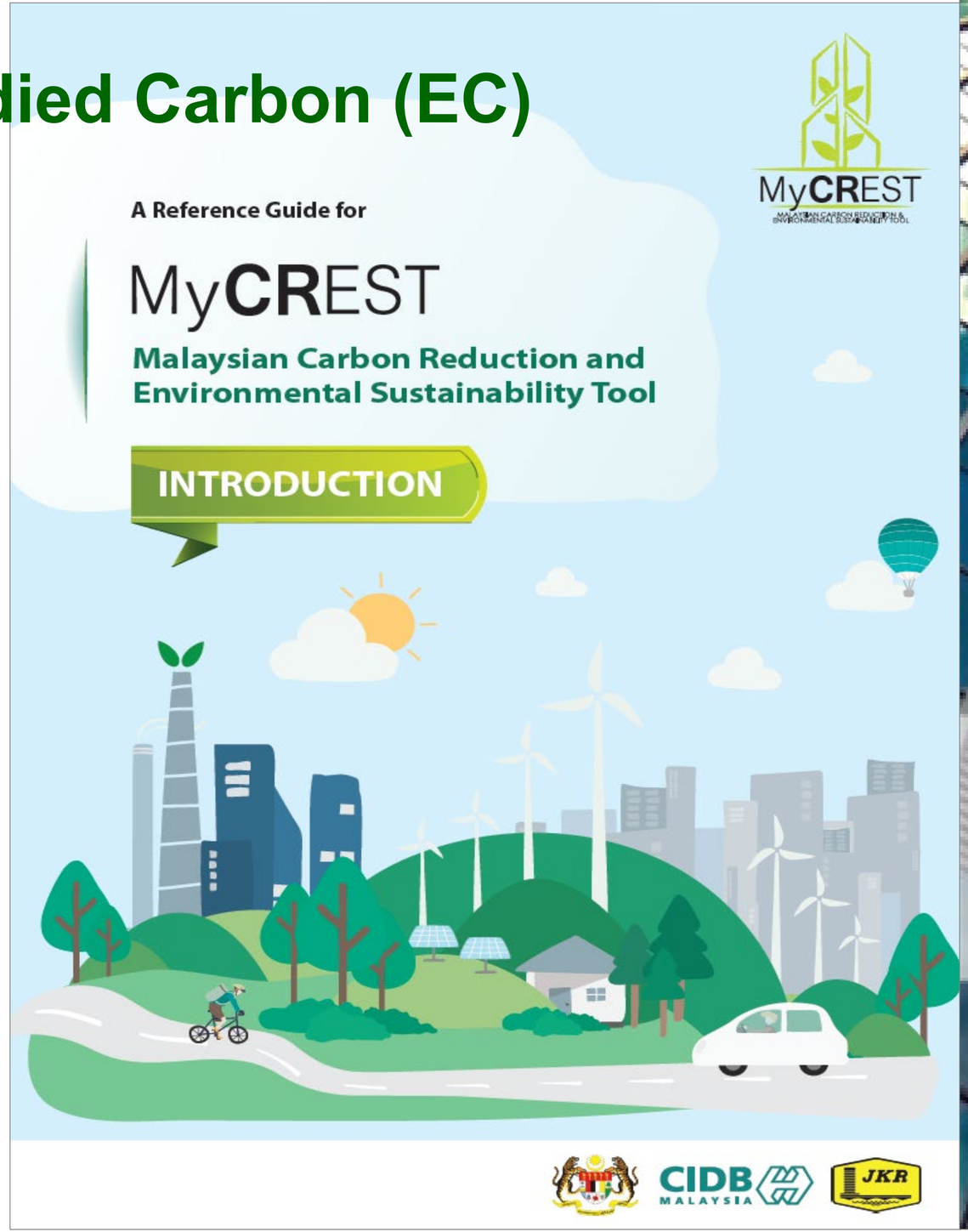
LCCE Upfront Carbon

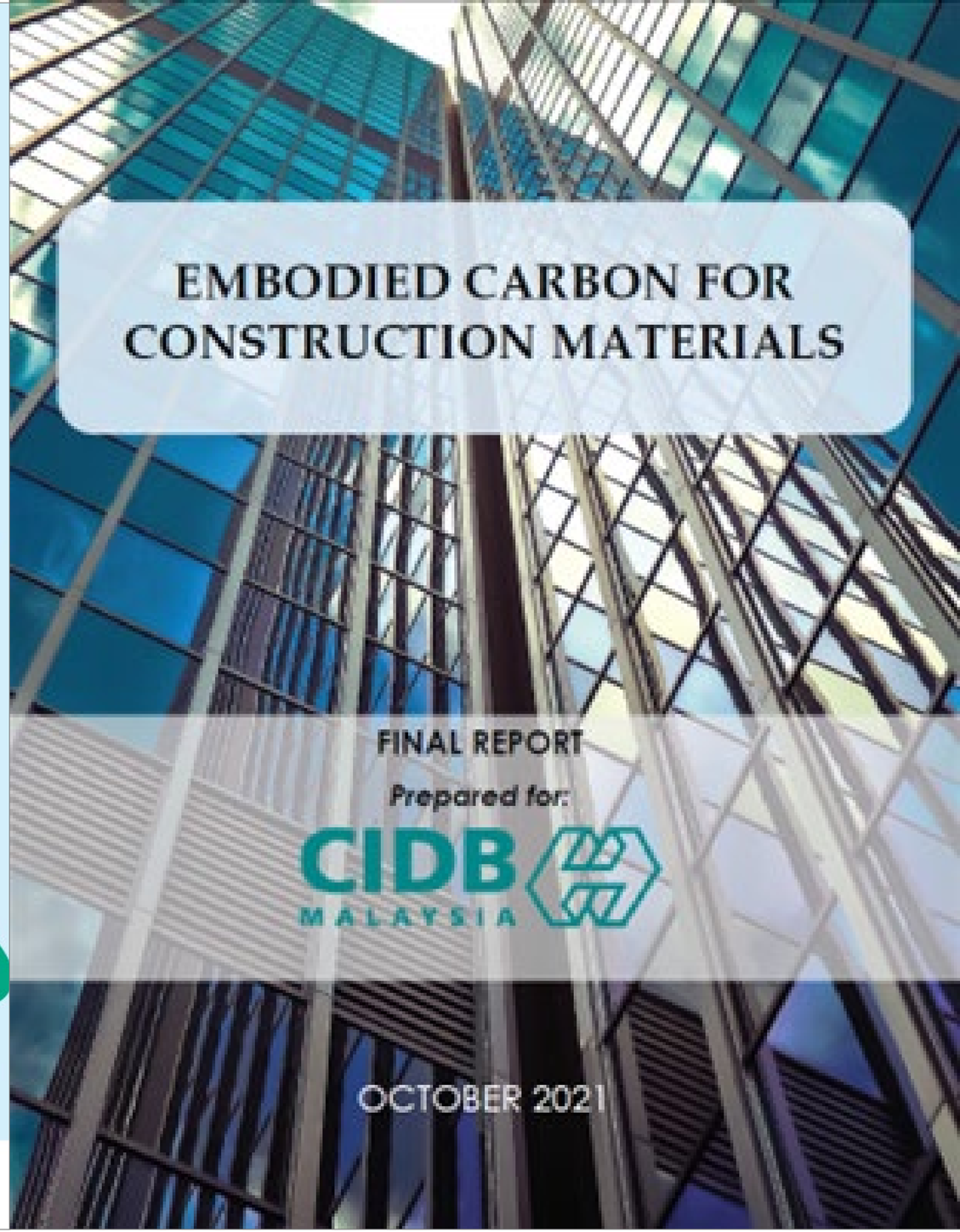


LCCE Upfront Carbon

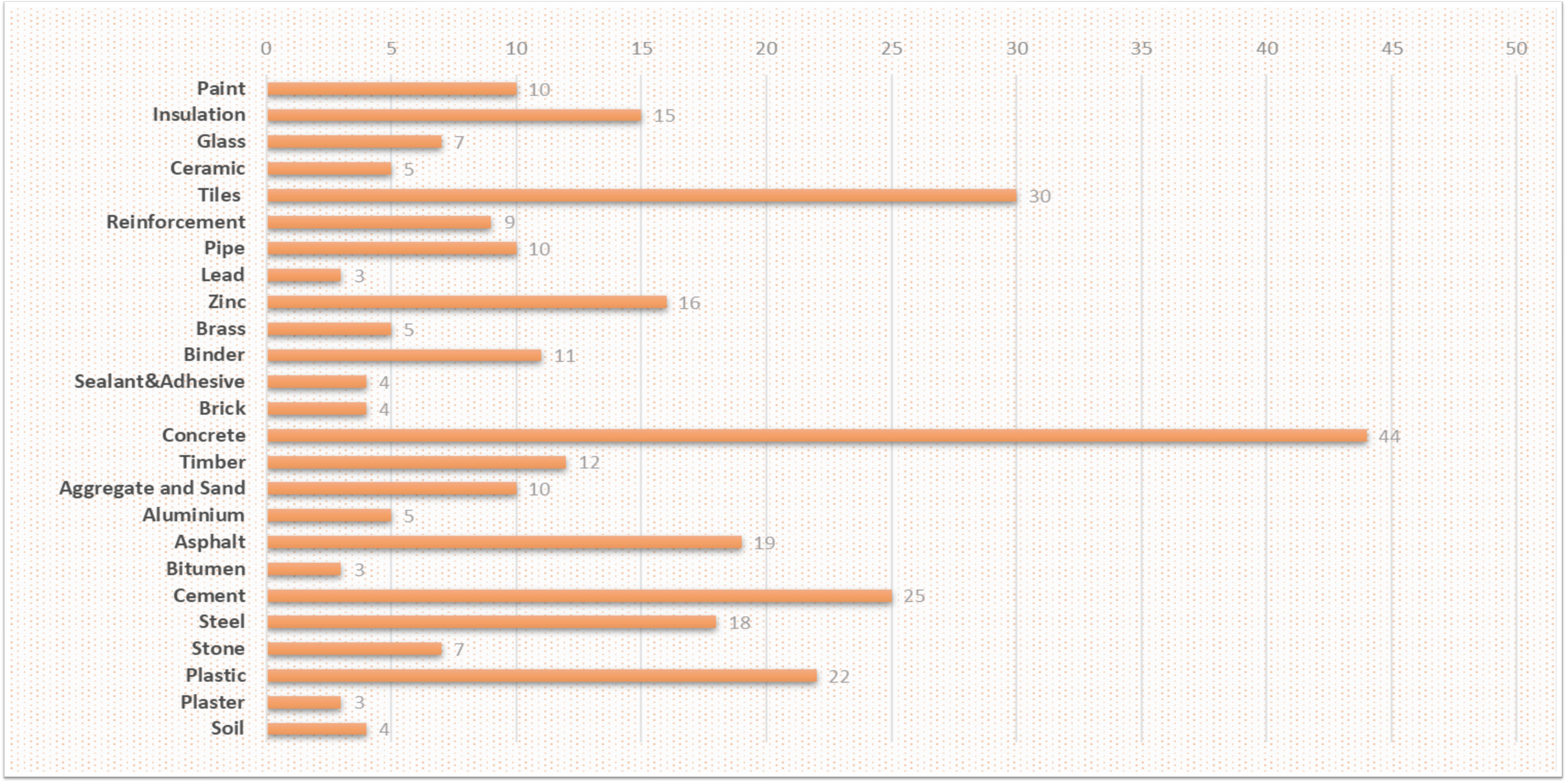


Embodied Carbon (EC)





Embodied Carbon (EC)



Embodied Carbon (EC)

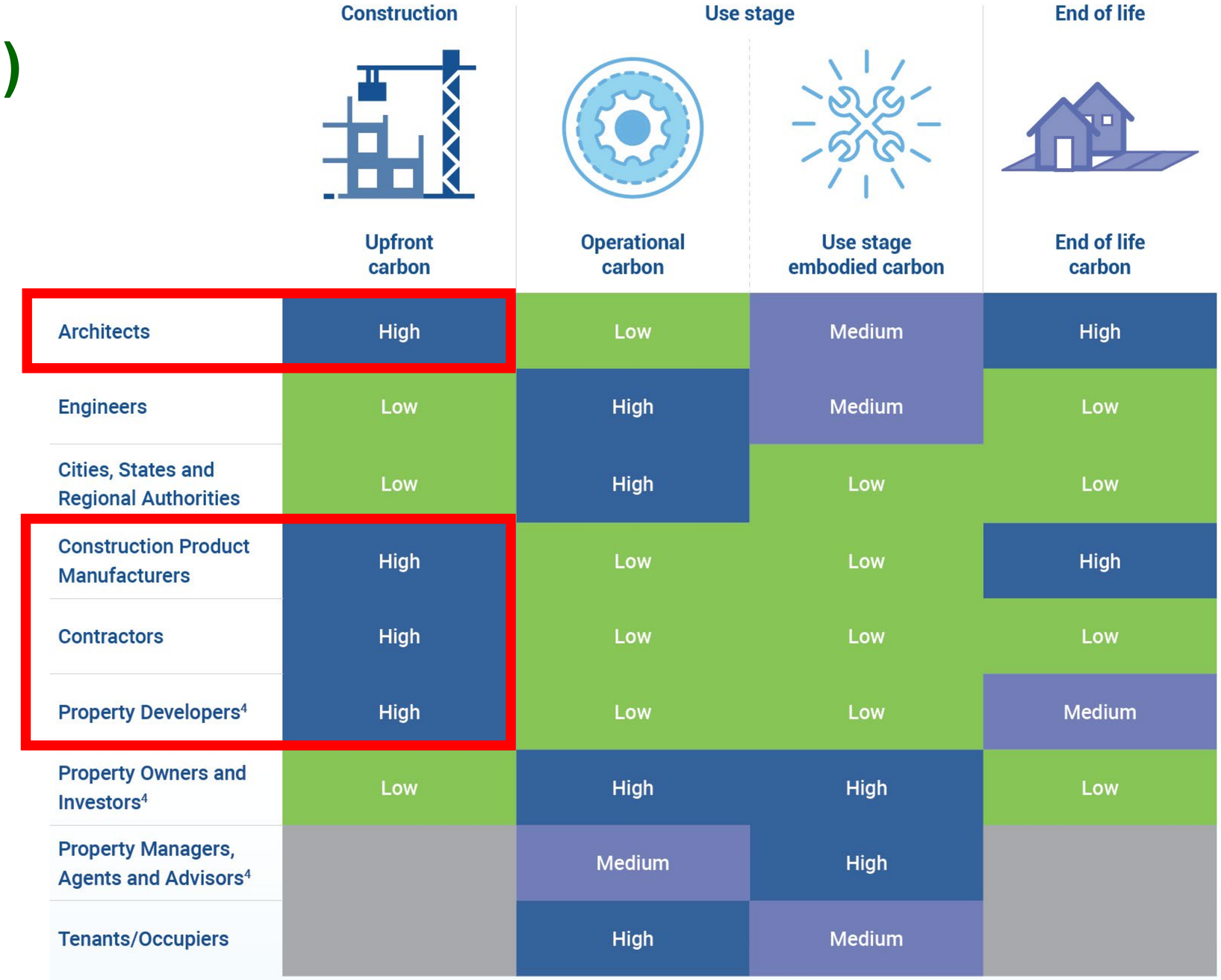


Figure 5 - Influence of stakeholders across the building lifecycle (new construction and renovation)

Case Study

IJM Construction Sdn Bhd

Selected Clients (Embodied Carbon)

EC GHG Emission

IJM Annual Report 2023

126 sites

Covered in FY2023 GHG emissions profile

9 locations

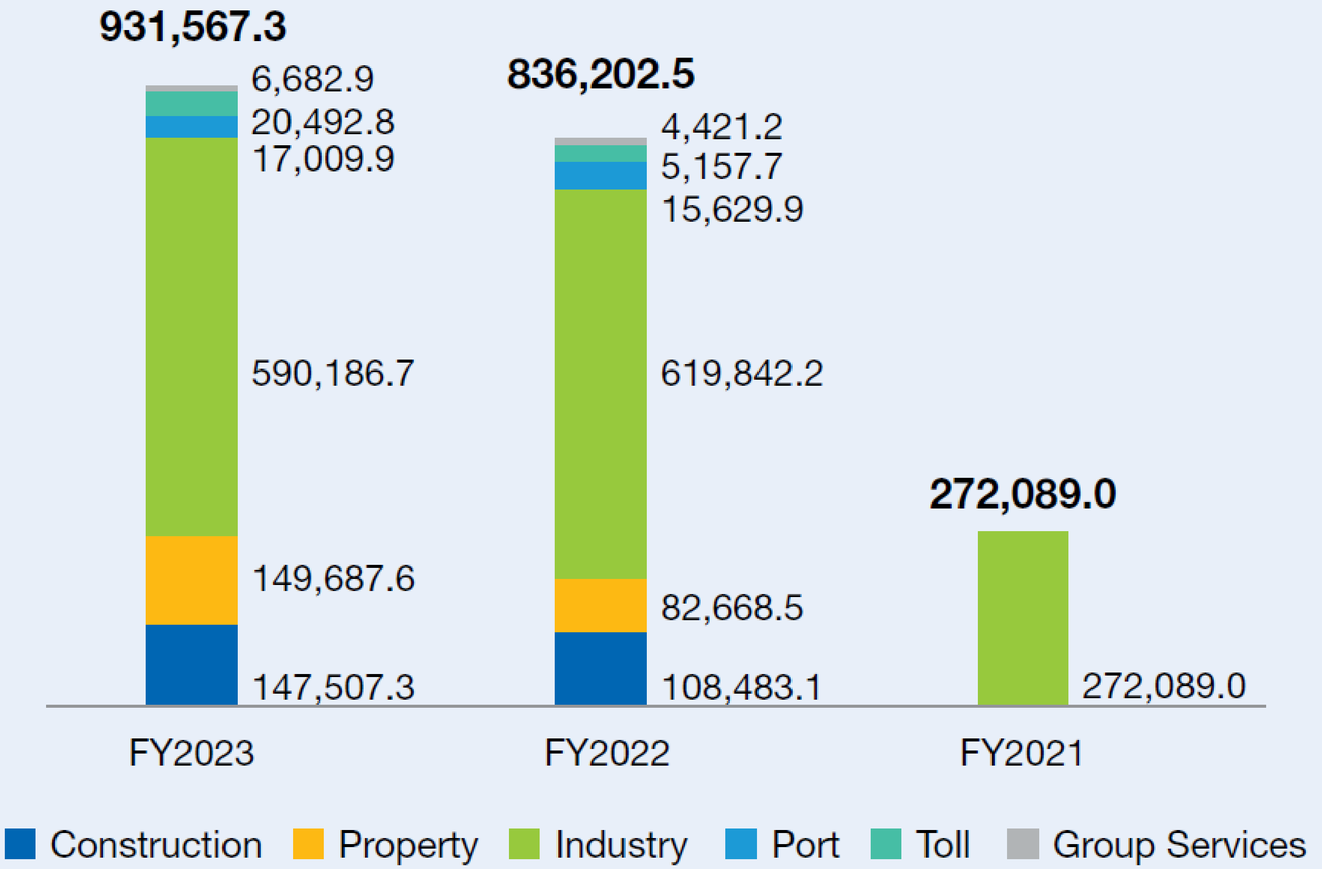
Assessed for physical climate risks

All divisions

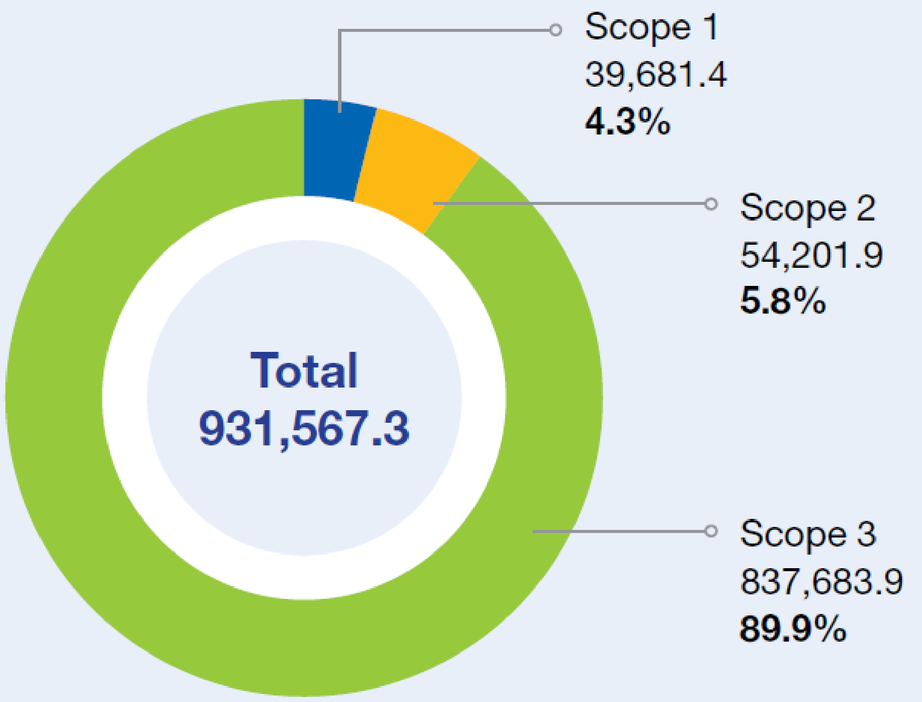
Assessed for transition risks

EC GHG Emission

Total GHG Emissions by Division (tCO_2e)



Total GHG Emissions by Scope in FY2023 (tCO_2e)

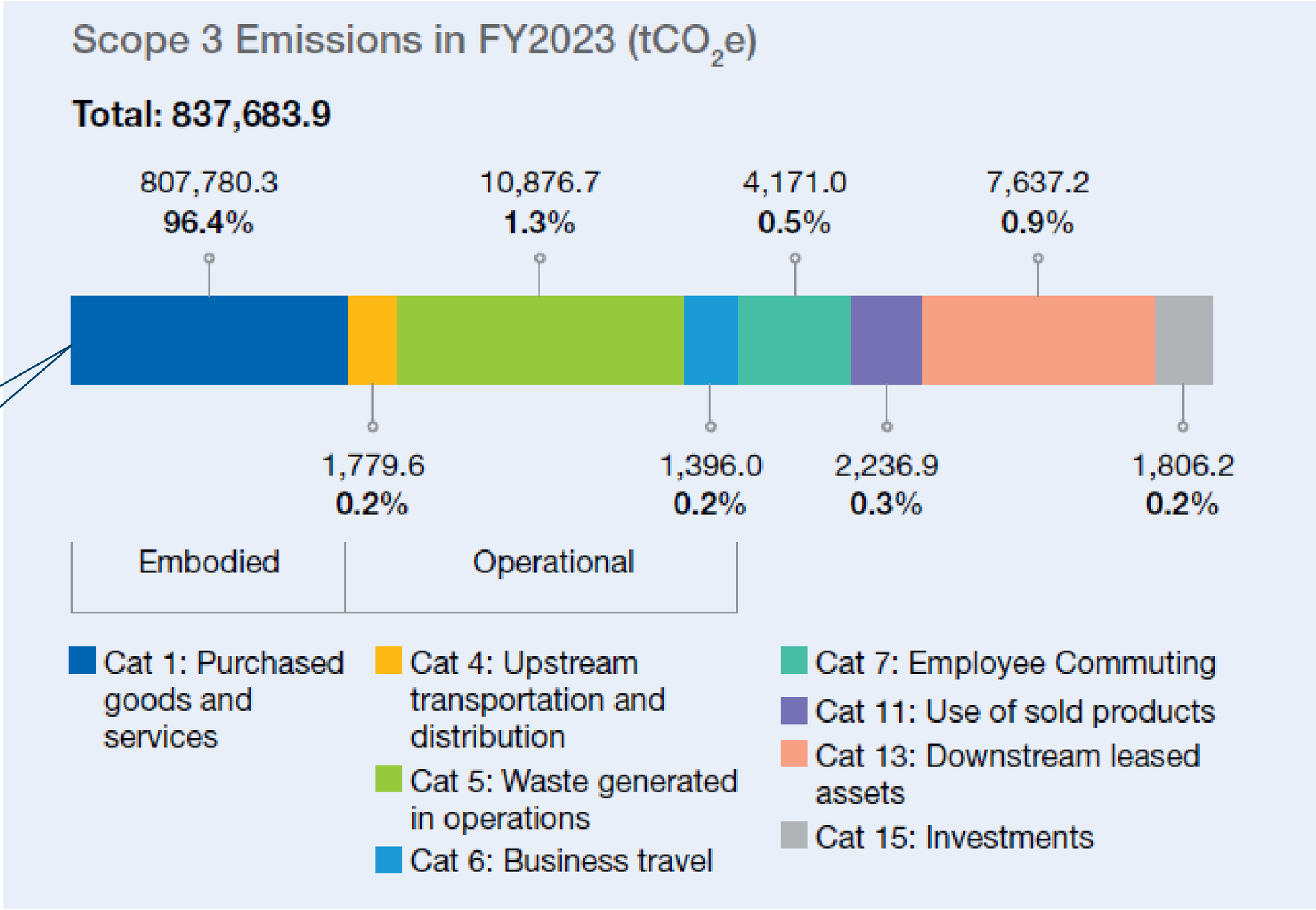


Notes:

- FY2023 represents our baseline emissions, which has undergone independent verification by BSI Malaysia in accordance with ISO 14064-1:2018
- Intra-Group emissions between the Construction, Property and Industry Divisions have been eliminated to avoid double counting

EC GHG Emission

Upfront Embodied Carbon of projects are reported in Scope 3, Cat. 1, 4 & 5



EC GHG Emission

Scope 1: Direct Emissions

- Mobile combustion by On-Road Vehicles
- Stationary combustion by Gensets, Cranes, pumps etc

Scope 2: Indirect Emissions

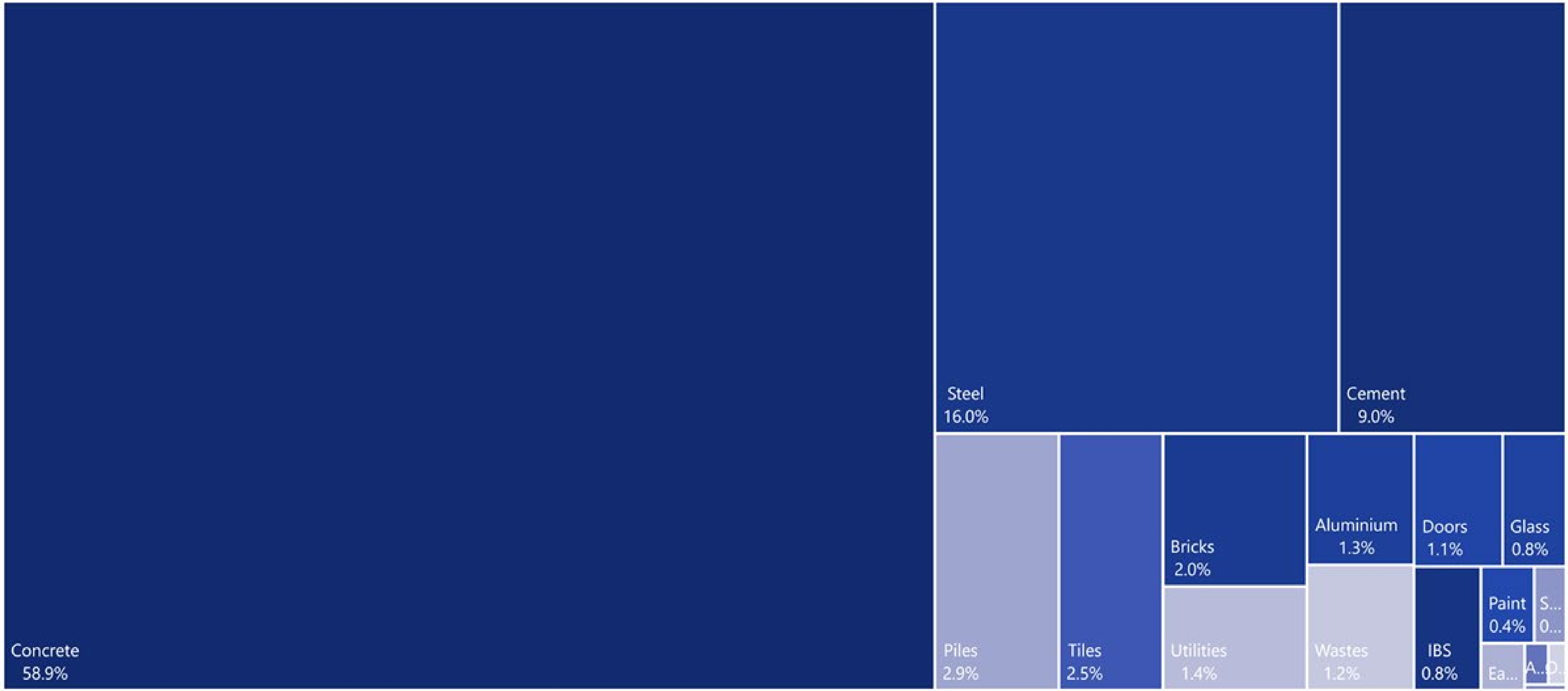
- Purchased Electricity

Scope 3: Other Indirect Emissions

- **Purchased Goods & Services**
- Capital Goods
- Upstream Transportation & Distribution
- Waste Generation
- Business Travel
- Employee Commuting

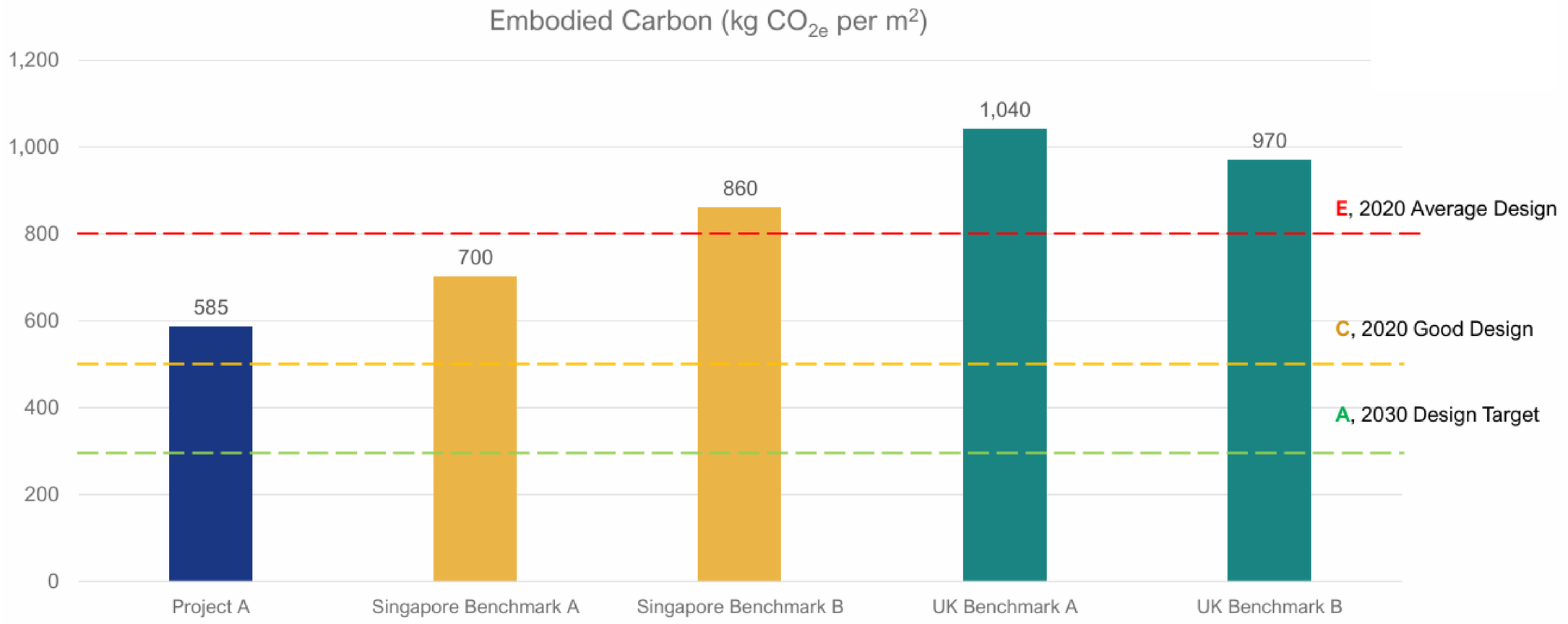
EC Upfront Carbon

High-rise Residential



EC Upfront Carbon

High-rise Residential – Upfront Embodied Carbon

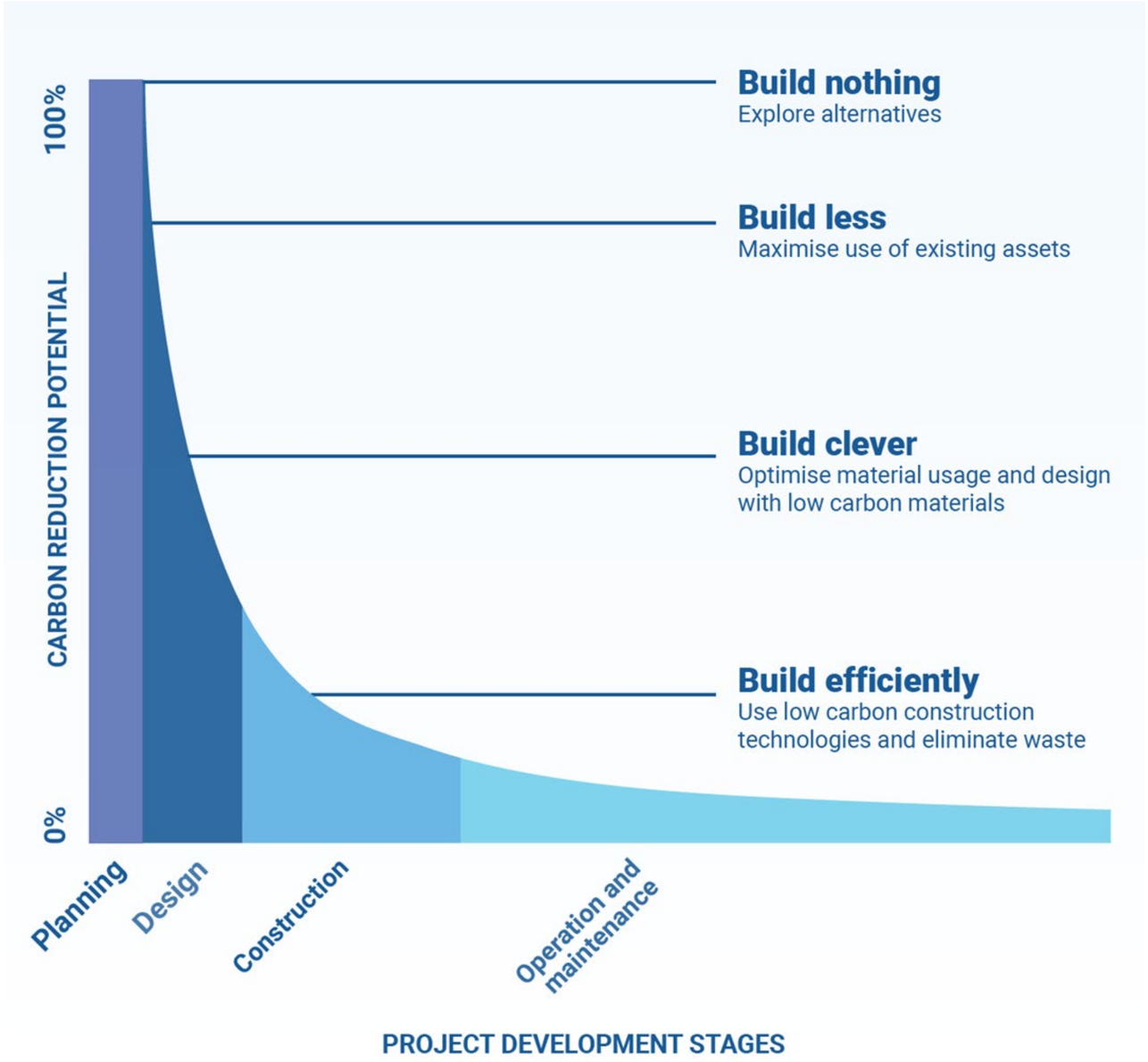


7

Sustainability in Specification

Environmental Product Declarations (EPDs)

EC Reduction

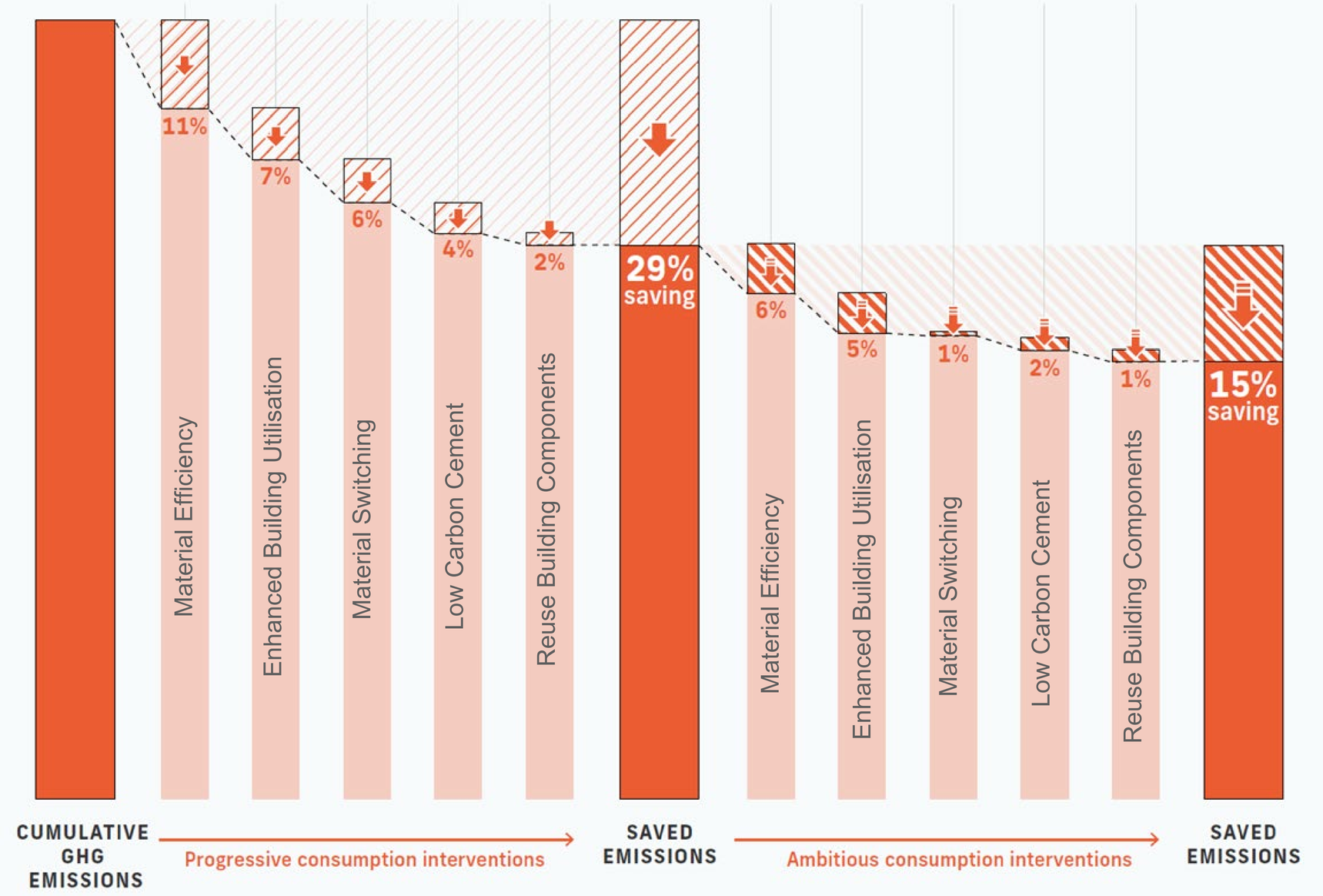


Aims and Approach:

1. **Build less**: Refurb and re-use
2. **Build light**: Consider the building structure
3. **Build wise**: Longevity and local context
4. **Build low carbon**: Review material specifications
5. **Build for the future**: Assess end of life and adaptability
6. **Build collaboratively**: Involve the whole team

Including Maintenance

EC Reduction



EPD Types of Environmental Declarations

	TYPE I Third Party Environmental Labelling	TYPE II Self-declared Environmental Claims	TYPE III Environmental Product Declarations (EPDs)
Declaration Created By:	Third party certified environmental labelling programmes with pre-determined performance requirements	Product manufacturers, importers or distributors	Product manufacturers in accordance with Product Category Rules (PCR) and independently verified by a third party
ISO Compliance	**ISO 14024**	**ISO 14021**	**ISO 14025**

EPD Overview

Type III Label, **3rd party verified, and international recognised.**

A single transparent disclosure of a product's impact throughout its **life cycle**.

EPDs are an evaluation tool to help manufacturers, purchasers, suppliers and distributors from government to institution facilities evaluate a product characteristics. Further, they enhance awareness of the overall impact of a product.

EPDs can represent one product, a group of similar products from or more manaufacturer's site, or multiple manufacturers (eg an industry average EPD)

EPD Process

▪ kickstarts the EPD execution process for selected products	▪ Select relevant PCR for product system ▪ Formulate plan if suitable PCR unavailable	▪ Conduct LCA study according to PCR parameters and methodology	▪ Formally verify LCA study upon which EPD will be based ▪ Address comments raised in verification	▪ Using LCA results, create EPD ▪ Provide record of compliance with referenced standards	▪ Verify EPD against relevant PCR	▪ Secured EPDs are added to the . EPD Registry and Sustainable Products Database

EPD 3rd Part Verification

Verification of an EPD is carried out by approved individual verifiers or accredited certification bodies. According to a recent international survey the cost of EPDs was around $15,000 per EPD and is valid for 5 years.

EPD Product Category Rules (PCR)

General information

Life cycle process flowchart

Inflow/outflow Material

Inflow/outflow Non material

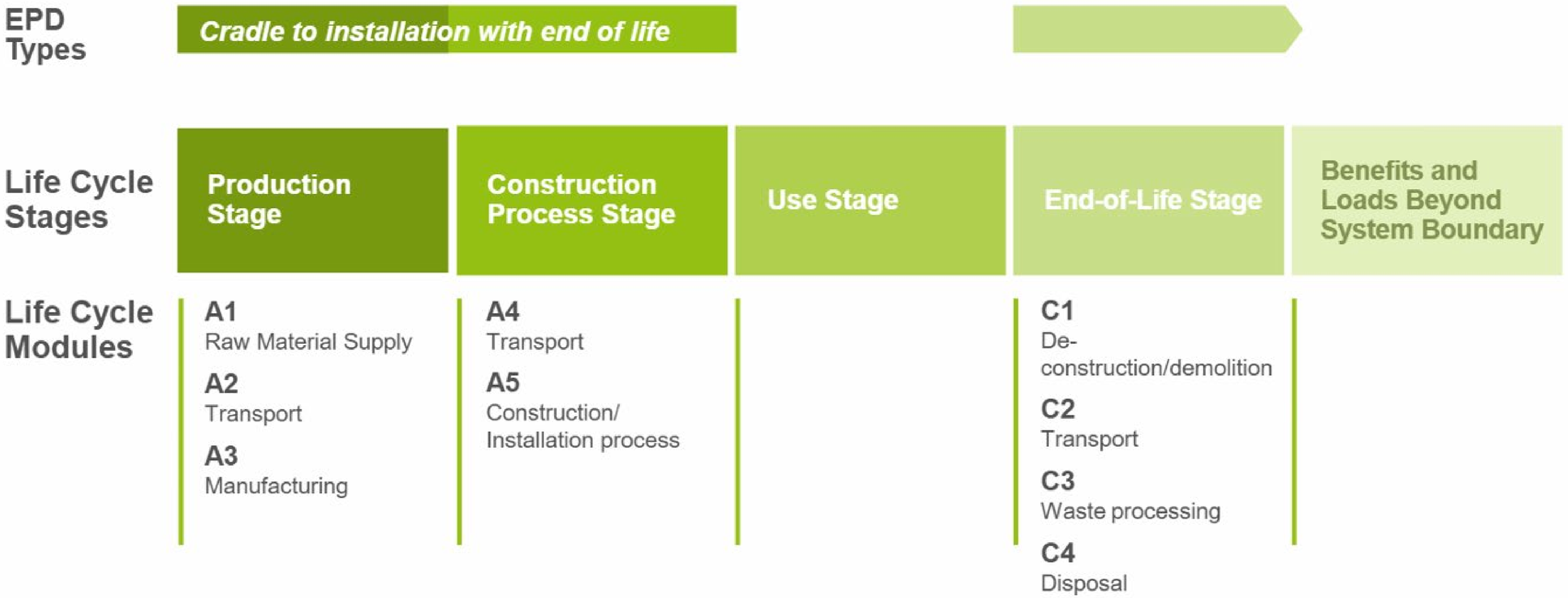
Transport of product

Installation and maintenance

Other information

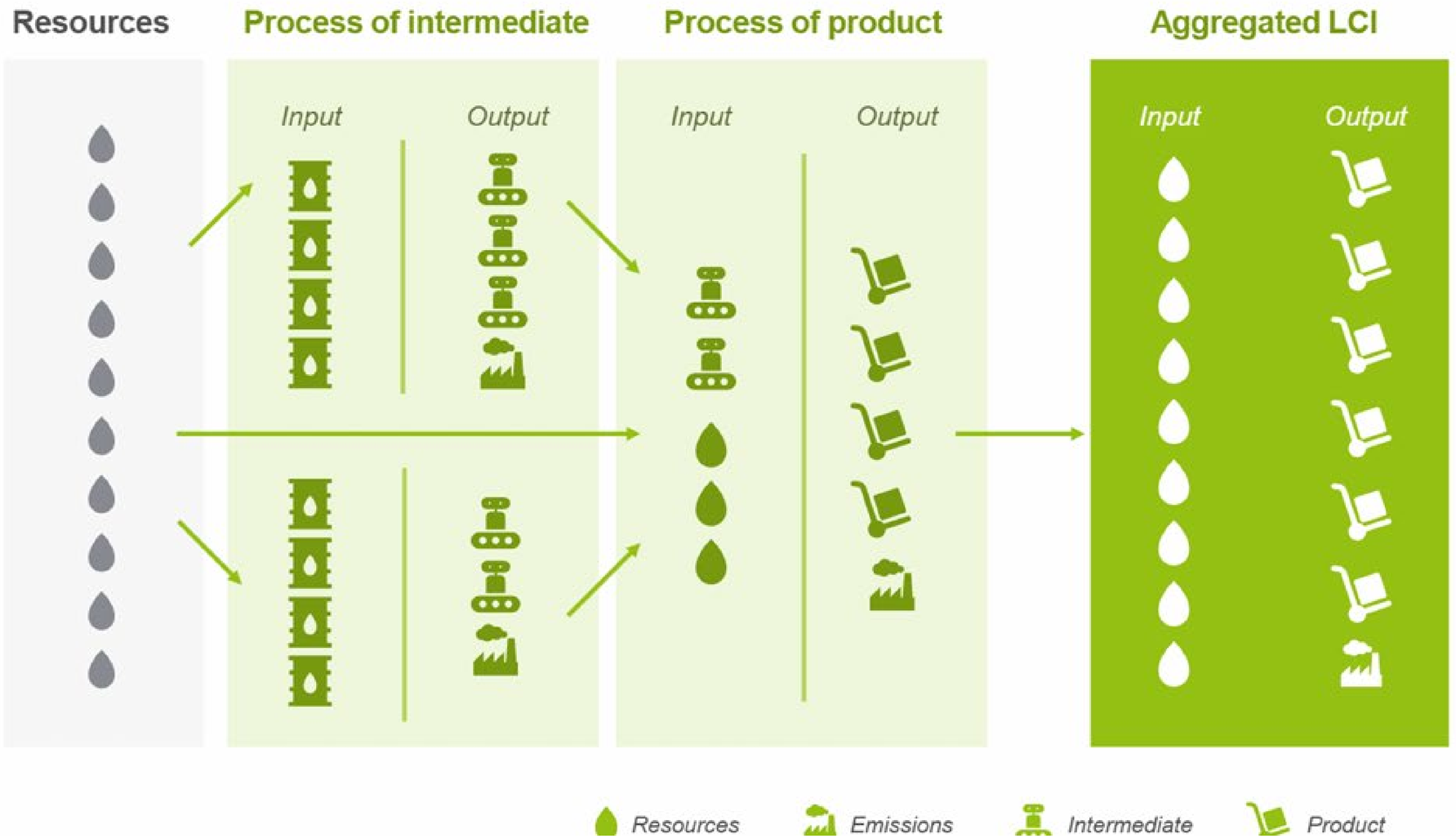
EPD Life Cycle Analysis (LCA)

Cradle to Installation with End of Life



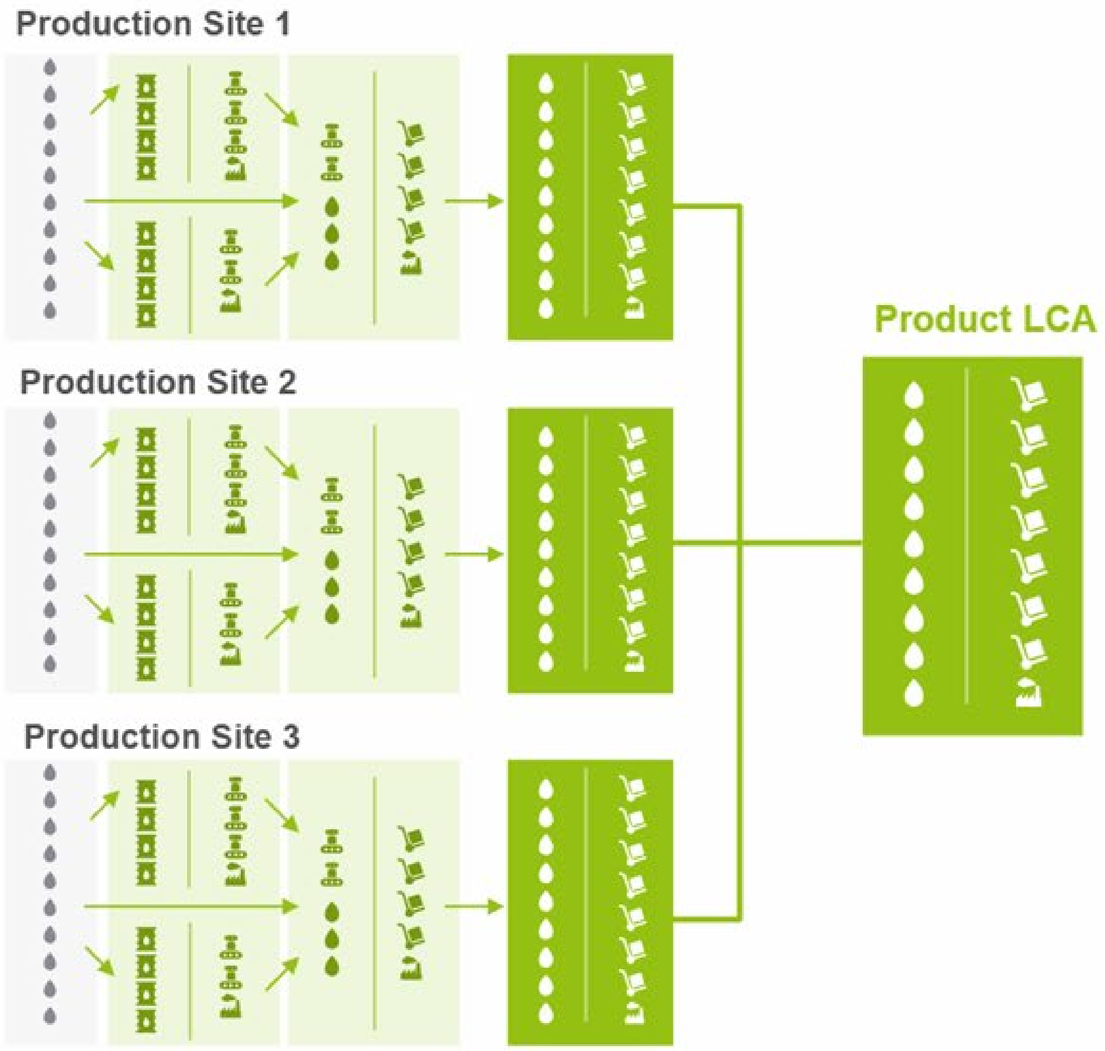
EPD Life Cycle Inventory (LCI) Aggregation

The environmental impact relating to production process of each product is analyzed and aggregated to for each factory



EPD Life Cycle Inventory (LCI) Aggregation

The results of analysis from different production sites are averaged to provide an overall result per product



LCA is conducted on averaged results to provide assessment on environmental impact including:

- **Global Warming Potential**
- **Ozone layer depletion**
- **Photochemical oxidation**
- **Acidification**
- **Eutrophication**

EPD Report

ENVIRONMENTAL PRODUCT DECLARATION

ASPHALT SHINGLE ROOFING SYSTEM

INSTALLATION: FASTENED

Steep-slope roofing system installed with fasteners and consisting of asphalt shingles, underlayment, leak barrier, starter strip, and hip and ridge components.

ASPHALT ROADING MANUFACTURERS ASSOCIATION

ATLAS · BP · CertainTeed · IKO · Malarkey Roofing Products · GAF · Owens Corning · PABCO · TAMKO BUILDING PRODUCTS

ENVIRONMENTAL PRODUCT DECLARATION

INDOOR RUBBER ATHLETIC FLOORING 8-10 mm THICKNESSES (ADVANCE NEW GENERATION, ADVANCE VULCANIZED, RAMFLEX, SPORT IMPACT, ZONE-IT)

MONDO SPORT&FLOORING

Resilient Rubber sport flooring for multisport facilities.

MONDO

SAFE FOR ATHLETES, SAFE FOR THE ENVIRONMENT.

We design, manufacture and supply sports solutions that are safe for the athletes who use them each day, and the structures and environment where they are installed. Our commitment starts with how we design our products, and it continues in how we select our raw materials, choose the energy sources that power our plants, all the way through to how our flooring is disposed of or recycled.

Because indoor air pollution can have a negative effect on athletes' performance and put their health at risk, MONDO has been providing low-emitting products for years, all certified by independent external laboratories, such as UL Environment.

By publishing this EPD, we are demonstrating our commitment to better processes, products and performance for a reduced environmental impact.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION

ENVIRONMENTAL PRODUCT DECLARATION

MINERAL WOOL BOARD

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION

using energy, reducing pollution, and more.

NAIMA

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION

The North American Insulation Manufacturers Association (NAIMA) is the association for North American manufacturers of fiber glass, rock wool, and slag wool insulation products. The Association seeks to promote energy efficiency and environmental preservation through the use of fiber glass, rock wool, and slag wool insulation, and to encourage the safe production and use of these materials. NAIMA advocates for improved energy efficiency in homes and buildings as the quickest and most cost-effective way to reduce energy use and lower greenhouse gas emissions.

Insulation saves 12 times as much energy per pound in its first year of use as the energy used to produce it. In fact, insulation in place in U.S. buildings reduces the amount of carbon dioxide emissions by 780 million tons per year.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION

ENVIRONMENTAL PRODUCT DECLARATION

GLACIER™ BASIC, FROST™ BASIC AND "F" FISSURED™ BASIC ACOUSTICAL PANELS

A perfect choice for noisy environments, these durable, panels possess excellent sound control and noise reduction qualities. Glacier™ Basic, Frost™ Basic and "F" Fissured™ Basic Acoustical Ceiling Panels combine a high noise reduction coefficient and ceiling attenuation class that make them an ideal choice for environments where noise reduction is important. Perfect for conference and lobby areas, executive offices, hospitality environments, retail stores and transportation terminals.

USG

For over a century, sustainable practices have naturally been an inherent part of our business at USG. Today, they help shape the innovative products that become the homes where we live, the buildings where we work and the arenas where we play. From the product formulations we choose, to the processes we employ, USG is committed to designing, manufacturing, and distributing products that minimize overall environmental impacts and contribute toward a healthier living space. We believe that transparency of product information is essential for our stakeholders and EPDs are the next step toward an even more transparent USG.

For additional information, visit usg.com, ogpac.com and usgdesignstudio.com

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION

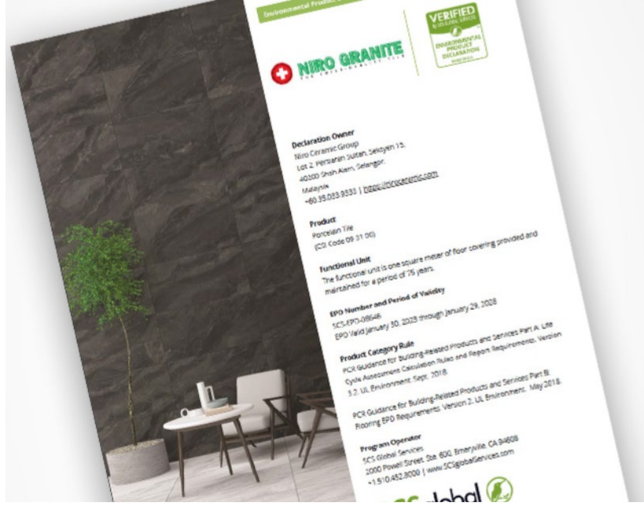
EPD Report

Parameters (Weighted Average)	Units	Modules Included in LCA							
		A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
Global Warming Potential (GWP)	kg CO2 eq	2.13E+02	2.12E+01	3.93E+01	0	2.1E+00	3.2E+00	1.6E+00	0
Ozone depletion (ODP)	kg CFC 11 eq	6.47E-06	1.16E-05	3.81E-06	0	2.6E-07	2.2E-06	1.1E-06	0
Acidification potential (AP)	kg SO2 eq	8.13E-01	1.29E-01	1.13E-01	0	1.6E-02	1.9E-02	1.2E-02	0
Eutrophication potential (EP)	kg N - eq	1.68E-01	2.62E-02	3.27E-02	0	3.7E-03	4.8E-03	2.5E-03	2.1E-02
Photochemical ozone creation (POCP) -	kg O3 - eq	7.66E-02	9.30E-03	1.24E-02	0	4.7E-03	1.4E-03	8.9E-04	0
Abiotic depletion potential for fossil resources (ADP-fossil fuels)	MJ	3.00E+02	1.87E+01	6.88E+02	0	2.9E+01	4.0E+01	2.0E+01	0

EPD Product in Malaysia

Some products from Malaysia that have Environmental Product Declarations (EPDs) include:

- **Niro Granite**: Niro Ceramic Group announced an EPD for its porcelain tiles
- **Keraflex Extra S1 White Zero**: Has an EPD that is valid until 2030 and covers South and East Asia
- **Hardtop Optima**: A coating from Jotun Paints Malaysia that has an EPD
- **EEW Malaysia Line and Process Pipes**: Has an EPD and are pre-fabricated single pipes
- **UAC Fibre Cement Board**: Has an EPD



Conclusion

Key Challenges

Achieving Net Zero Emission by 2050

- More expensive to construct
- Slow in adopting automation in construction sector (high dependency on manual labour)
- Not enough green technologies
- No driving force
- No market demand
- No alternative low-carbon materials
- Technical knowledge limitation and scale
- Complexity to retrofit existing development
- Lack of Environmental Product Declaration (EPD)

Acknowledgement

- Suruhanjaya Tenaga (ST)
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- Surbana Jurong (SJ)
- Tzu Chi International School
- Bursa Malaysia
- World Green Building Council (WorldGBC)
- United Nation Environmental Program (UNEP)
- Global Alliance for Building and Construction (GlobalABC)
- Construction Industry Development Board (CIDB)
- IJM Construction Sdn Bhd
- Armacell
- International EPD System

Thank You

BGREEN
RIVERSTONE
ELITE