Sustainability & the Built Environment

CPG CORPORATION

Gavin Chan,
Head of Sustainability, CPG Corporation
Senior Vice President, CPG Consultants

Geotechnical Engineer by training
Community Volunteer
Butterfly Enthusiast
Cycles Everywhere
Adjunct Lecturer

Engineers

What my friends think I do

What my customer thinks I do

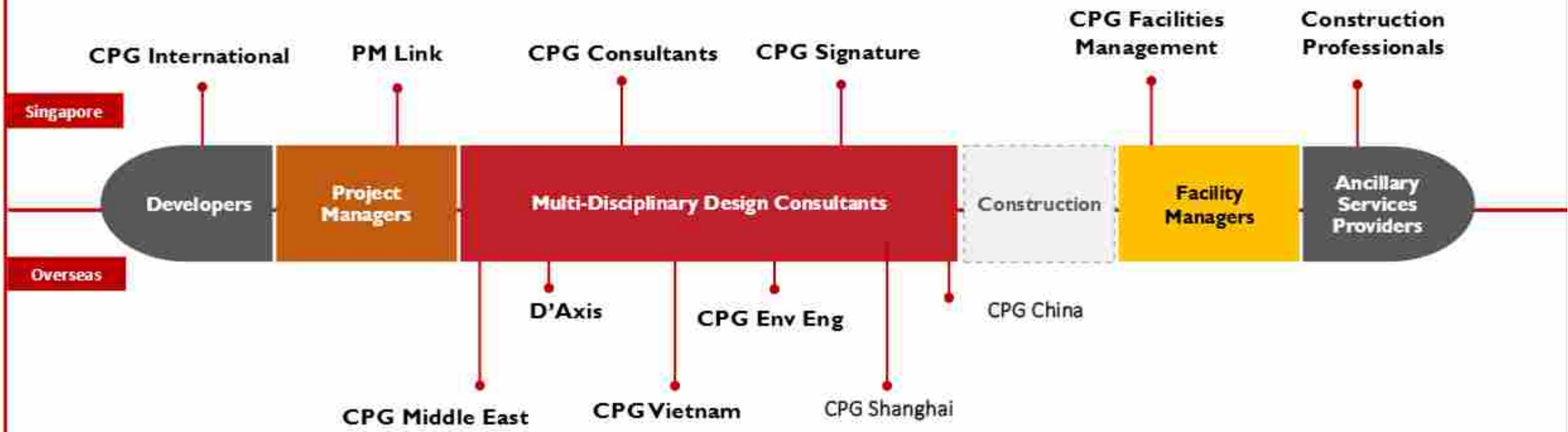
What society thinks I do

What my parents think I do

What I think I do

What I really do

CPG Group of Companies



CPG Corporation is a member of the China Construction Technology Consulting Co. Ltd

HQ in Singapore **12** overseas offices,

1,500 employees worldwide

Completed projects in more

than **30** countries

CPG Corporation is one of the leading providers of infrastructure and building management and consultancy services in Asia Pacific.

We design integrated solutions covering multi-disciplinary architecture and engineering consultancy to project and construction management.

Talent Statistics

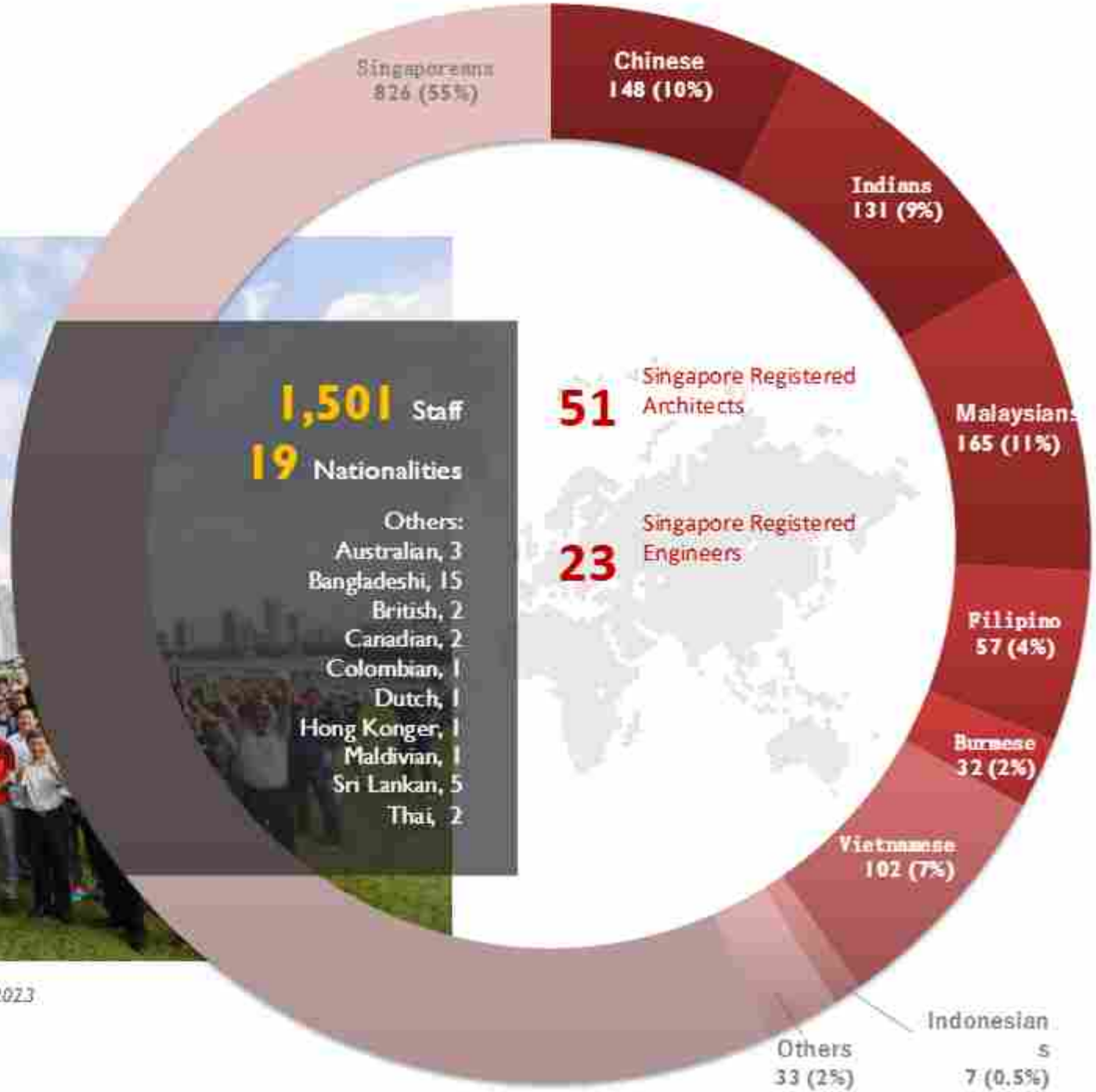
1,501 Staff

19 Nationalities

Others:
Australian, 3
Bangladeshi, 15
British, 2
Canadian, 2
Colombian, 1
Dutch, 1
Hong Konger, 1
Maldivian, 1
Sri Lankan, 5
Thai, 2

51 Singapore Registered Architects

23 Singapore Registered Engineers



As of 30 Jun 2023

President*s Design Award, Design of the Year

PRESIDENT*S DESIGN AWARD SINGAPORE

CPG CORPORATION


Changi Airport Terminal 3, Singapore


Khoo Teck Puat Hospital, Singapore


Gardens by the Bay, Singapore

LOCALLY RECOGNISED. GLOBALLY ACCLAIMED.

OVER 500 AWARDS IN OUR PORTFOLIO AND COUNTING

President's Design Award
National Gallery Singapore, Singapore (Design of the Year)

Gardens by the Bay, Singapore (Design of the Year)

Khoo Teck Puat Hospital, Singapore (Design of the Year)

National Museum of Singapore, Singapore (Design of the Year)

UNESCO World Heritage Site
Singapore Botanic Gardens, Singapore

Royal Institute of British Architects (RIBA) International Design Award
Solaris, Singapore
Gardens by the Bay, Singapore

Thea Award
Gardens by the Bay, Singapore (Outstanding Achievement)

Stephen R. Kellert Biophilic Design Award
Khoo Teck Puat Hospital, Singapore

World Architecture Festival
Gardens by the Bay, Singapore (World Building of the Year)

British Expertise International Awards
Gardens by the Bay, Singapore (Outstanding International Design Project)

International Society of City and Regional Planners Awards
Kallang Riverside Development, Singapore (Second Prize)

URA Architectural Heritage Awards
National Gallery Singapore, Singapore

Chek Jawa Visitor Centre, Singapore

BCA Green Mark Awards (Platinum)
National Centre for Infectious Diseases, Singapore

Singapore Polytechnic School of Business and Aerospace Hub, Singapore

Interpol Global Complex for Innovation, Singapore

NTU The Hive, Singapore
Solaris, Singapore

State Courts (Building & Data Centre), Singapore

Design & Health International Academy Awards
Khoo Teck Puat Hospital, Singapore (International Health Project Above 40,000sqm)

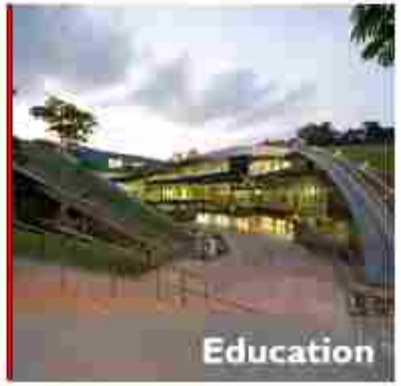
National Centre for Infectious Diseases, Singapore (International Health Project Over 40,000 sqm)

Our Works

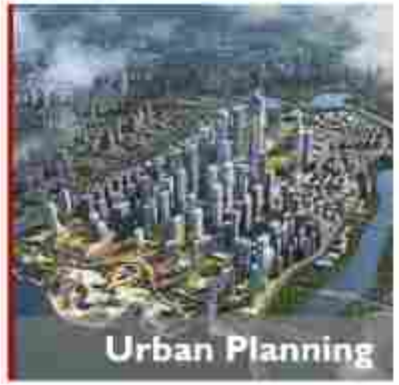

Cultural


Airports


Institutional


Education


Healthcare


Urban Planning


Security


Residential


Commercial


Leisure

CHANGI AIRPORT T1,2,3

One of the most widely acclaimed airports in the world, the airport is easily Singapore's pride and joy development, gaining international recognition across the globe.

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GARDENS BY THE BAY

2013 President's Design Award Winner

In collaboration with Grant Associates & Wilkinson Eyre Architects

The fantasy land evoked by the giant Supertrees, Cloud Forest and Flower Dome Conservatories has been transformed into reality, realising Singapore's vision of having a full fledged waterfront garden right in the heart of the city.

CPG CORPORATION

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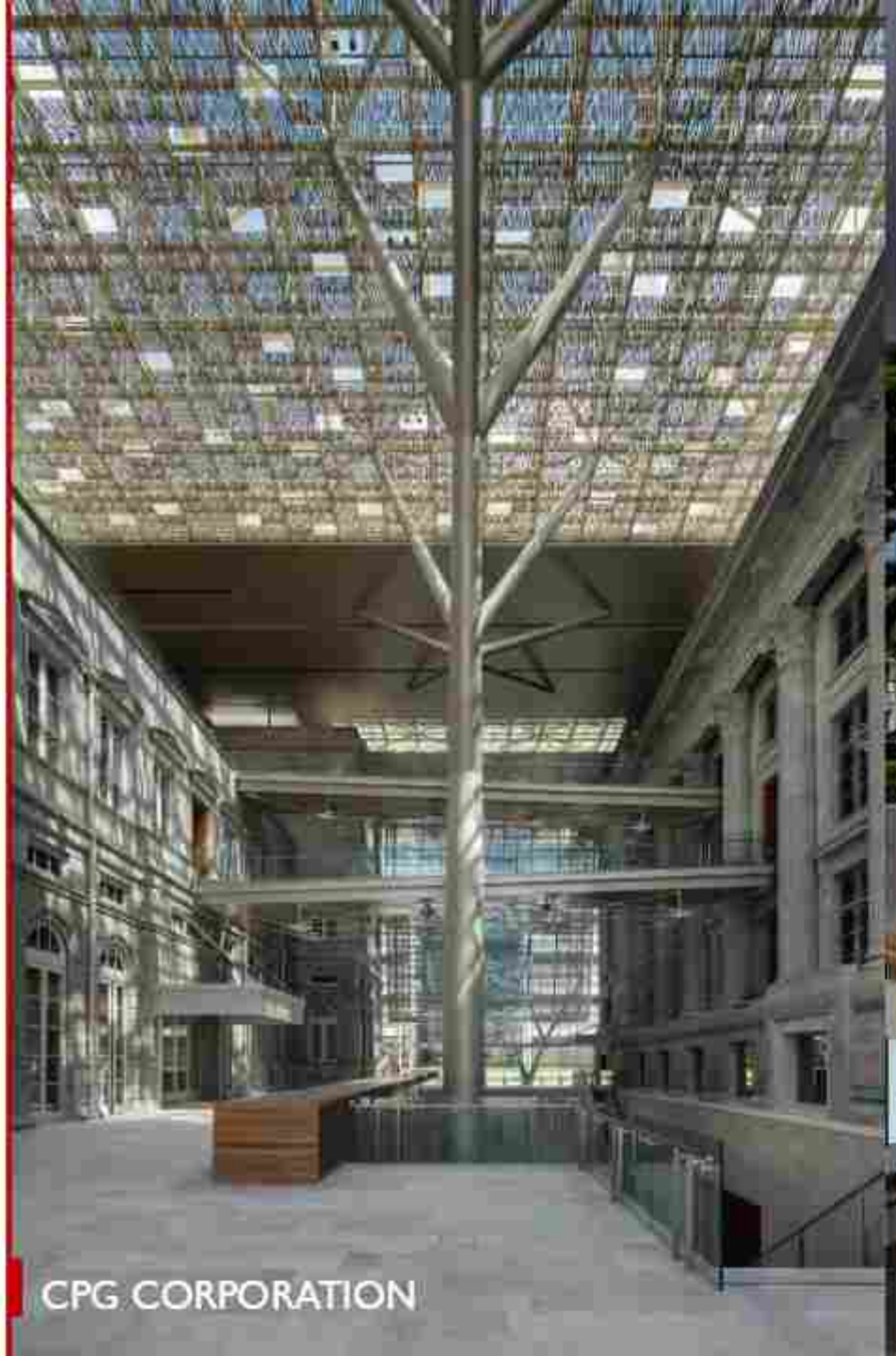
KHOO TECK PUAT HOSPITAL

2011 President's Design Award Winner

The design harmoniously brings together the elements of accessibility, comfort and convenience. Believing that patients would recover in a healing environment, KTPH was built with the vision of being a hospital in a garden and a garden in a hospital and this has influenced every aspect of the hospital planning.



NATIONAL GALLERY SINGAPORE

2015 President's Design Award Winner

In collaboration with Studio Milou

Preserving the historic character of two of Singapore's national monuments, the former Supreme Court and City Hall Buildings. The new visual arts institution represents a spectacular and respectful adaptive reuse and conservation project, an amalgamation of heritage and innovation.

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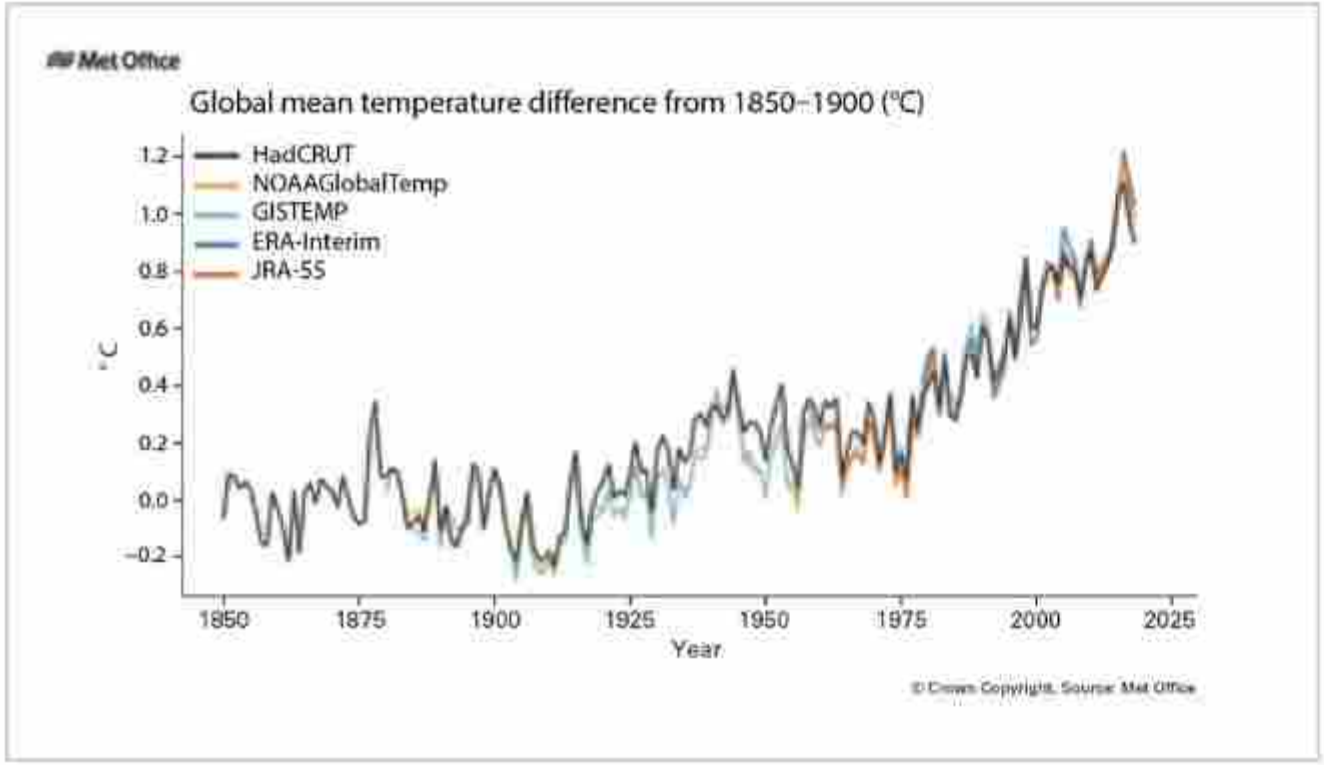
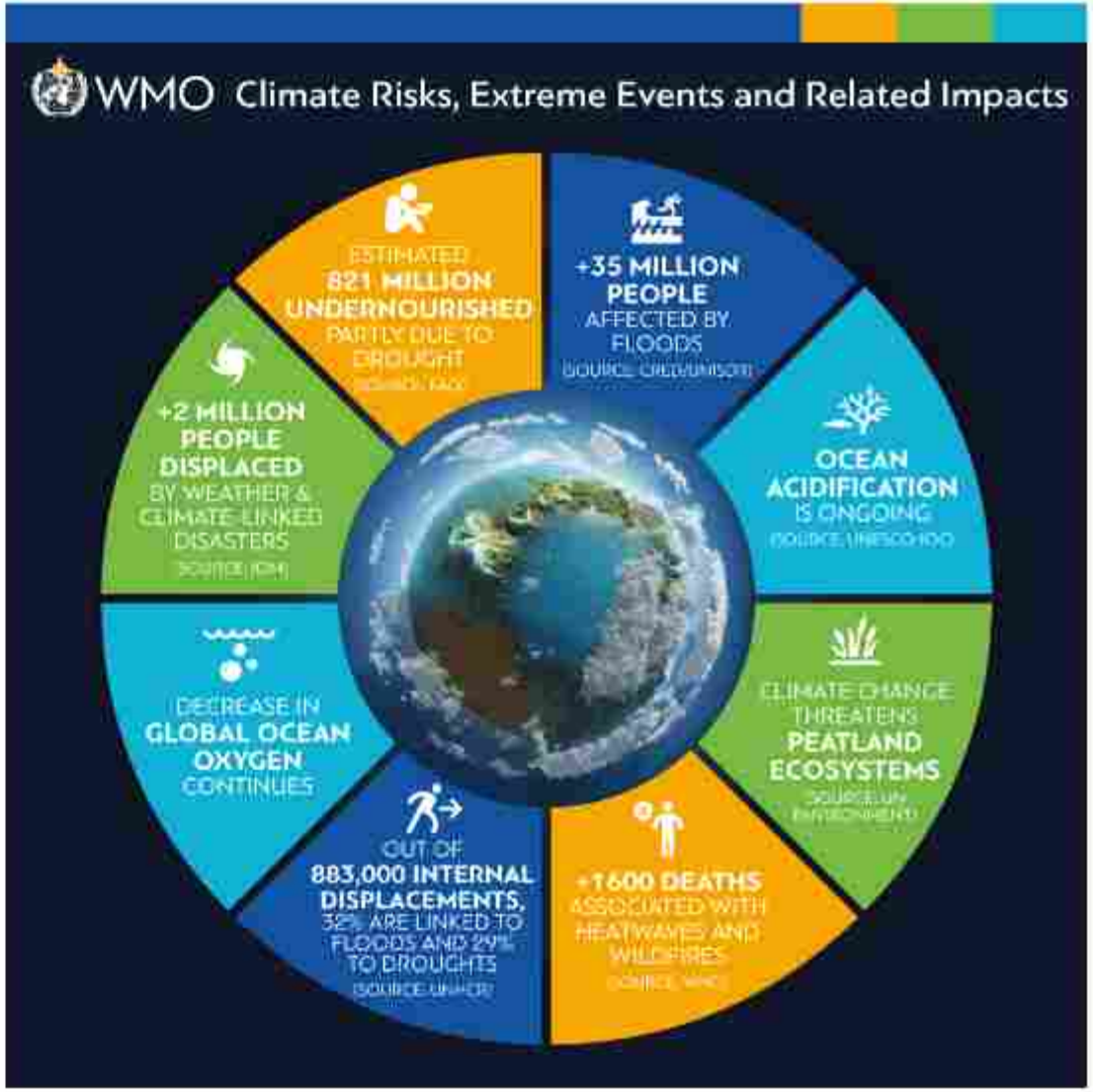
THE ROCHESTER SINGAPORE

33-Storey mixed use development comprising hotel, condominiums, retail, and other facilities.

Climate Change?





CO_2
concentration

Highest

in at least

2 million years

Sea level
rise

Fastest rates

in at least

3000 years

Arctic sea ice
area

Lowest level

in at least

1000 years

Glaciers
retreat

Unprecedented

in at least

2000 years


Singapore is a low-lying island and about 30 per cent of Singapore's land is less than 5m above sea level. If extreme sea-level scenarios reach 4m to 5m in 2100, our coastlines are at risk.
© The Straits Times

The Paris Agreement

- A **legally binding international treaty** on climate change.
- Adopted by 196 parties, including Singapore, at UN Climate change conference (COP21) in Paris, 2015.
- The parties agree to set committed goals, known as **Nationally Determined Contributions (NDCs)** to reduce greenhouse gas emissions.

Singapore's Commitment

- **2009**: Reduce carbon emission by 16% from business-as-usual by 2020.
- **2015**: Reduce emission intensity (GHG/GDP$) by 36% from 2005 level by 2030, and peaking by 2030.
- **2015**: Singapore's 2030 Pledge (Climate Action Plan: Take Action Today)
- **2016**: Signed Paris Accord at COP21
- **2020**: Enhanced NDC and committed Long-term Low Emissions Development Strategies towards net zero emissions:
  1. **Peak emissions at 65MtCO_2e around 2030**
  2. **Halve emissions from the peak to 33MtCO_2e by 2050, achieving net zero emissions by second half of 2100s**.
- **2022**: revised NDC known as second update to NDC.
- **2024**: revised NDC known as third update to NDC.

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Source: NCCS Singapore

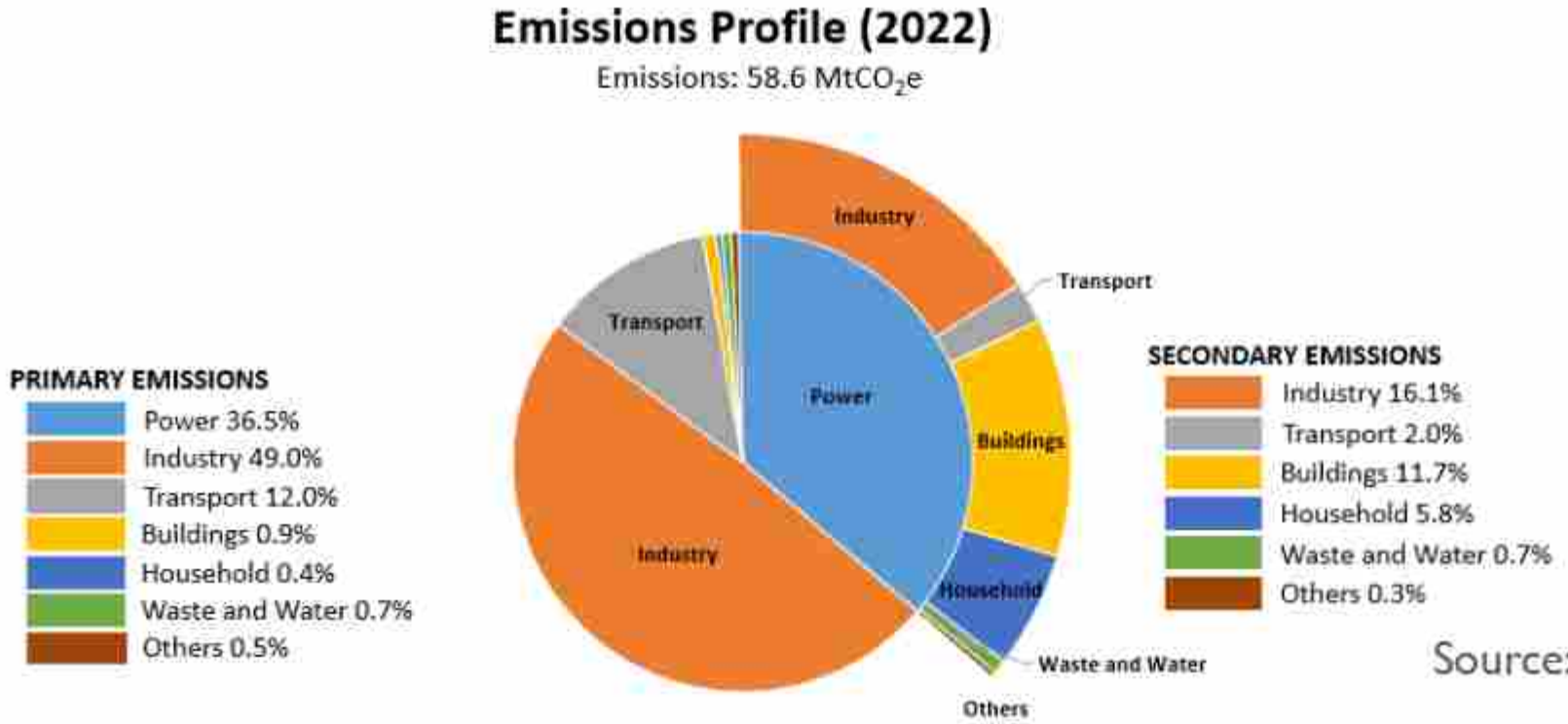
Singapore's revised NDC updated in 2024:

Singapore's emission level in 2035 will be 45 - 50 million tonne CO_2e, after peaking earlier.

Achieve net zero emission by 2050.

Source: National Climate Change Secretariat, Singapore

Singapore's Current Emission (2022): 58.6MtCO2e



Source: NCCS, Singapore

Primary emissions refer to direct emissions from the sector's owned or controlled sources.
Secondary emissions refer to the sector's share of Power sector's emissions based on its share of electricity consumption.

After 2030:

- **GDP is still expected to grow;**
- **population is still expected to grow;**
- **but carbon emission will have to reduce after peaking at 60MtCO2e, and until it achieves net zero by 2050.**

Singapore's Long Term Low Emissions Strategy

CHARTING SINGAPORE'S LOW-CARBON AND CLIMATE RESILIENT FUTURE

CPG CORPORATION

Charting Singapore's Net Zero Future

Committed Goals

- **Achieve net zero emissions by 2050**
  Long-Term Low-Emissions Development Strategy (LEDS)
- **Reduce 2030 emissions to 60 $MtCO_2e$ after peaking emissions earlier**
  2030 Nationally Determined Contribution (NDC)

How to Get There?

Accelerating Low-Carbon Transition in Industry, Economy and Society

Catalyse business transformation
- Sustainable energy and chemicals hub in conjunction with industry
- Grants for energy efficiency and emissions reduction

Invest in low-carbon technologies
- Carbon Capture Utilisation and Storage
- Low-carbon hydrogen
- Solar and energy storage systems

Pursue effective international cooperation
- International carbon markets with high quality carbon credits
- Regional power grids for green energy

Adopt low-carbon practices
- Green commutes via public transport, Walk-Cycle-Ride & cleaner energy vehicles

Financial Drivers

KEY ENABLER — Right-pricing carbon to shape business decisions and consumer behaviour

Carbon tax S$50-80/$tCO_2e$ by 2030

Who?

EVERYONE CAN PLAY A PART

- **Public sector**
  Achieve net zero emissions across public sector around 2045 as part of GreenGov.Sg
- **Private sector**
  Develop and adopt low-carbon solutions, and pursue green growth opportunities
- **Individuals**
  Contribute to climate friendly initiatives

NCCS

SG GREEN PLAN

SG Green Plan (2021)

Multi-ministry led, whole-of-Singapore movement towards low carbon living and economy

Source: www.greenplan.gov.sg

4th Green Building Masterplan (2021)

Part of SG Green Plan and contribute towards SG's low term low emissions strategy

Vision

"A leading green Built Environment sector mitigating climate change and providing a healthy, liveable and sustainable Built Environment for all"

80% of buildings to be green by 2030:

- Raising mandatory Environmental Sustainability Standards
- Publication of building energy performance data
- Green Mark 2021
- Nudging Poor Performers

Support Scheme:

Green Mark Incentive Scheme for Existing Buildings 2.0 (GMIS-EB 2.0)

80% of new developments to be SLE from 2030:

- GreenGov.SG
- Raise Environmental Sustainability Standard (including EE requirements) for projects under GLS programme
- Develop SLE standards for residential buildings

Support Scheme:

BE Transformation GFA Incentive Scheme

80% EE improvement (from 2005 levels) by 2030:

- GBIC Research and Development (GBIC R&D)
- GBIC Prototyping
- GBIC Demonstration (GBIC Demo)
- SLE Buildings (SLEB) Smart Hub

Support Scheme:

Enhanced GBIC funding (GBIC 2.0)

Supported by Integrated FM and Aggregated FM (IFM & AFM) grant for buildings to operate and maintain optimal building performances, to improve buildings' energy efficiency and cultivate a sustainable Built Environment in Singapore.

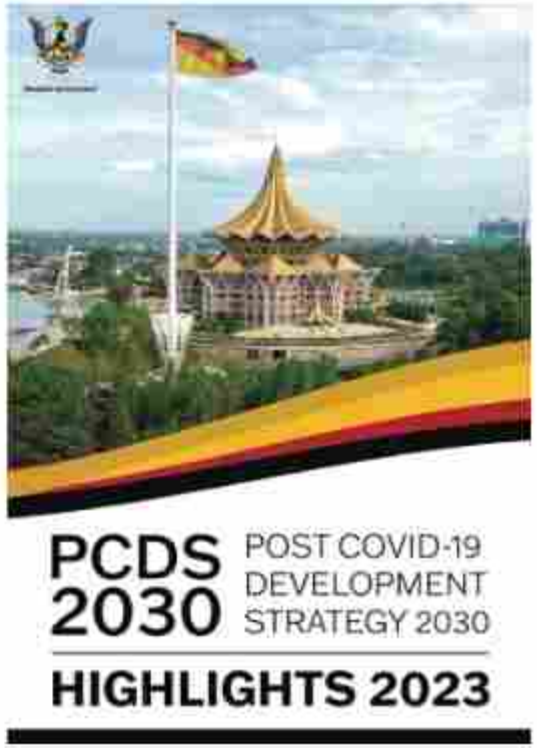
Source: Building and Construction Authority, Singapore

Post-COVID Development Strategy (PCDS) 2030

Strategic Context: Why Sarawak, Why Now

Sarawak stands at an inflection point in its economic transformation. The Post-COVID Development Strategy (PCDS) 2030 sets a clear ambition for Sarawak to become a high-income, innovation-driven, and environmentally sustainable economy, targeting 8% annual GDP growth.

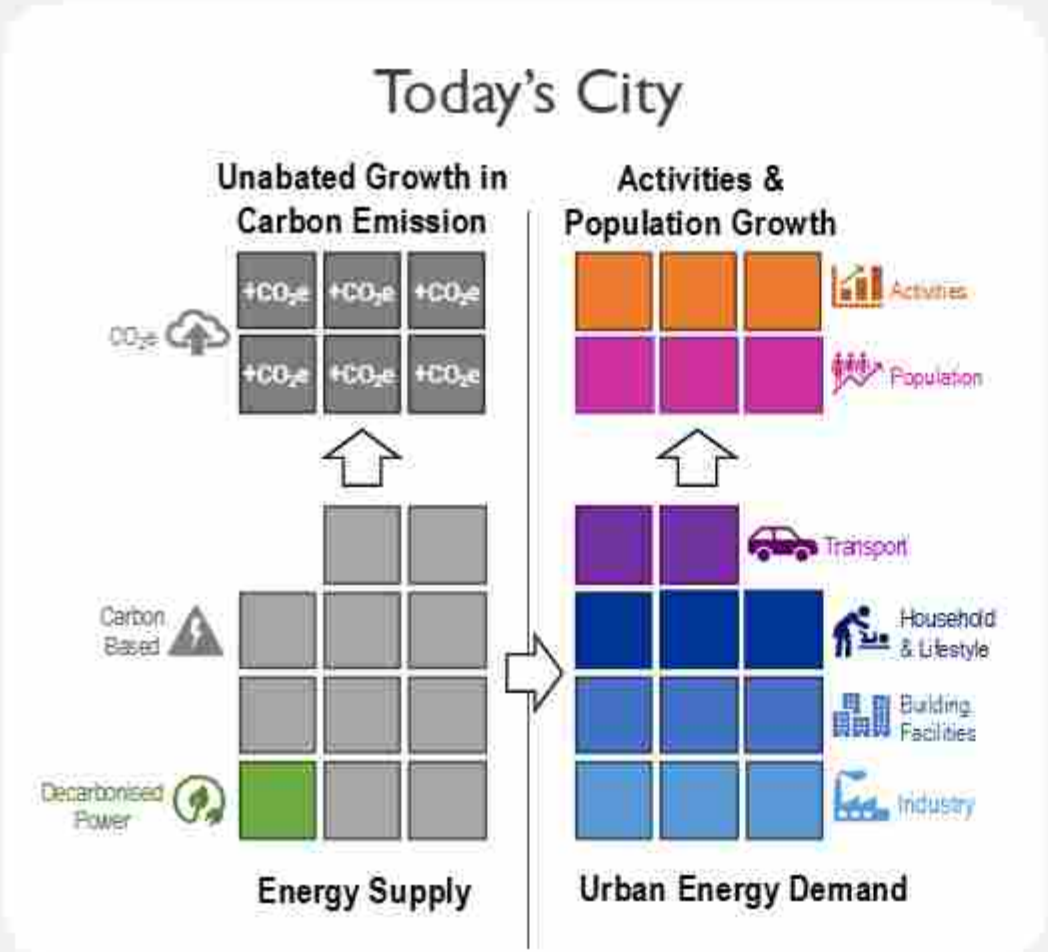
To align with Sarawak's Green Economy Policy and strong renewable energy ambitions, the built facilities must be conceived from the outset as a green, bankable, and revenue-generating infrastructure asset. This means integrating sustainability, ESG, and financial viability into the core planning and delivery framework to attract institutional capital and reduce long-term operational risk.

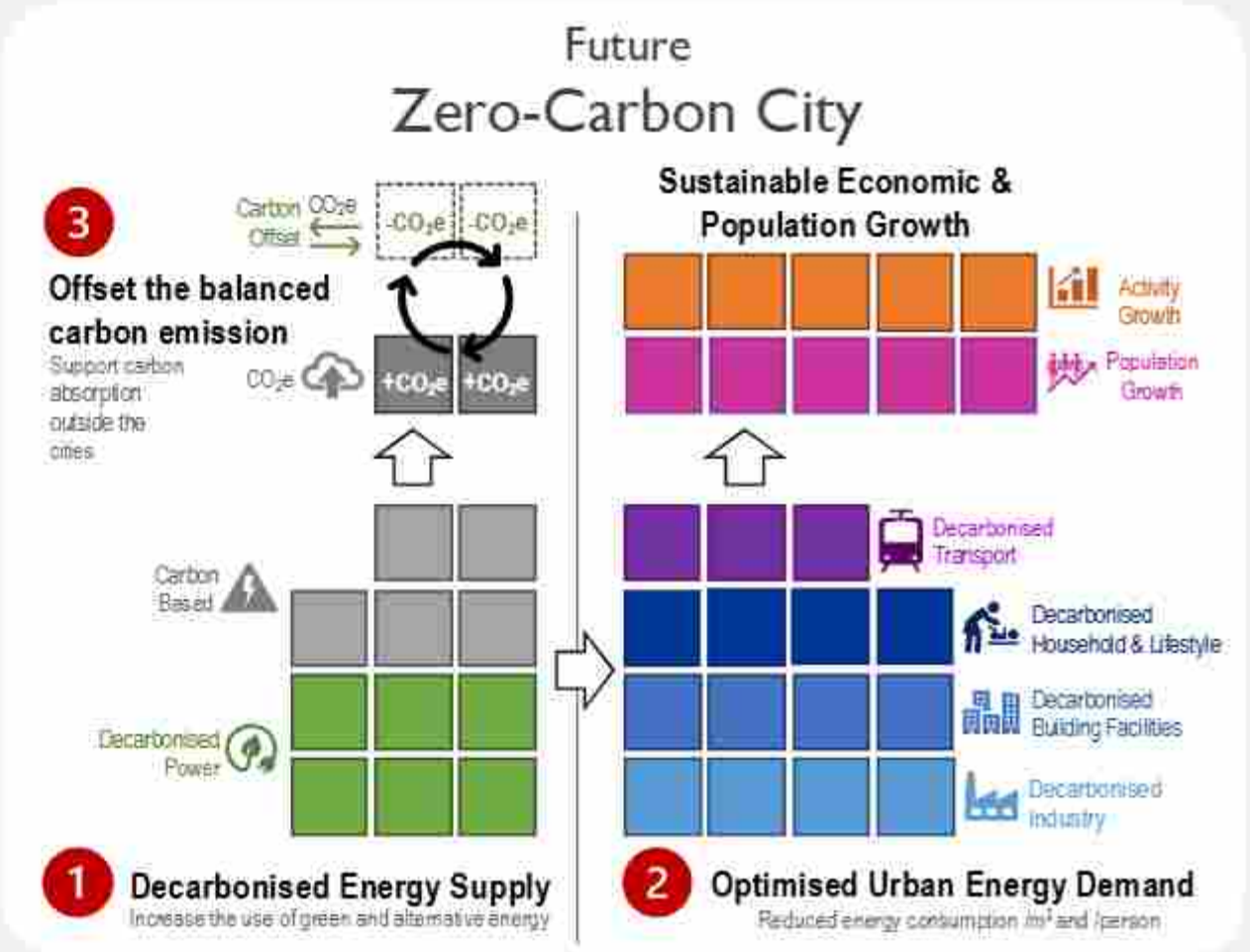


SARAWAK 60% RENEWABLE ENERGY ALIGNMENT

- Hydropower integration
- Floating solar arrays
- BESS energy storage
- Green hydrogen pathway

Challenge of the Future





Source: CPG Sustainability Office

Built Environment Needs to Decarbonise

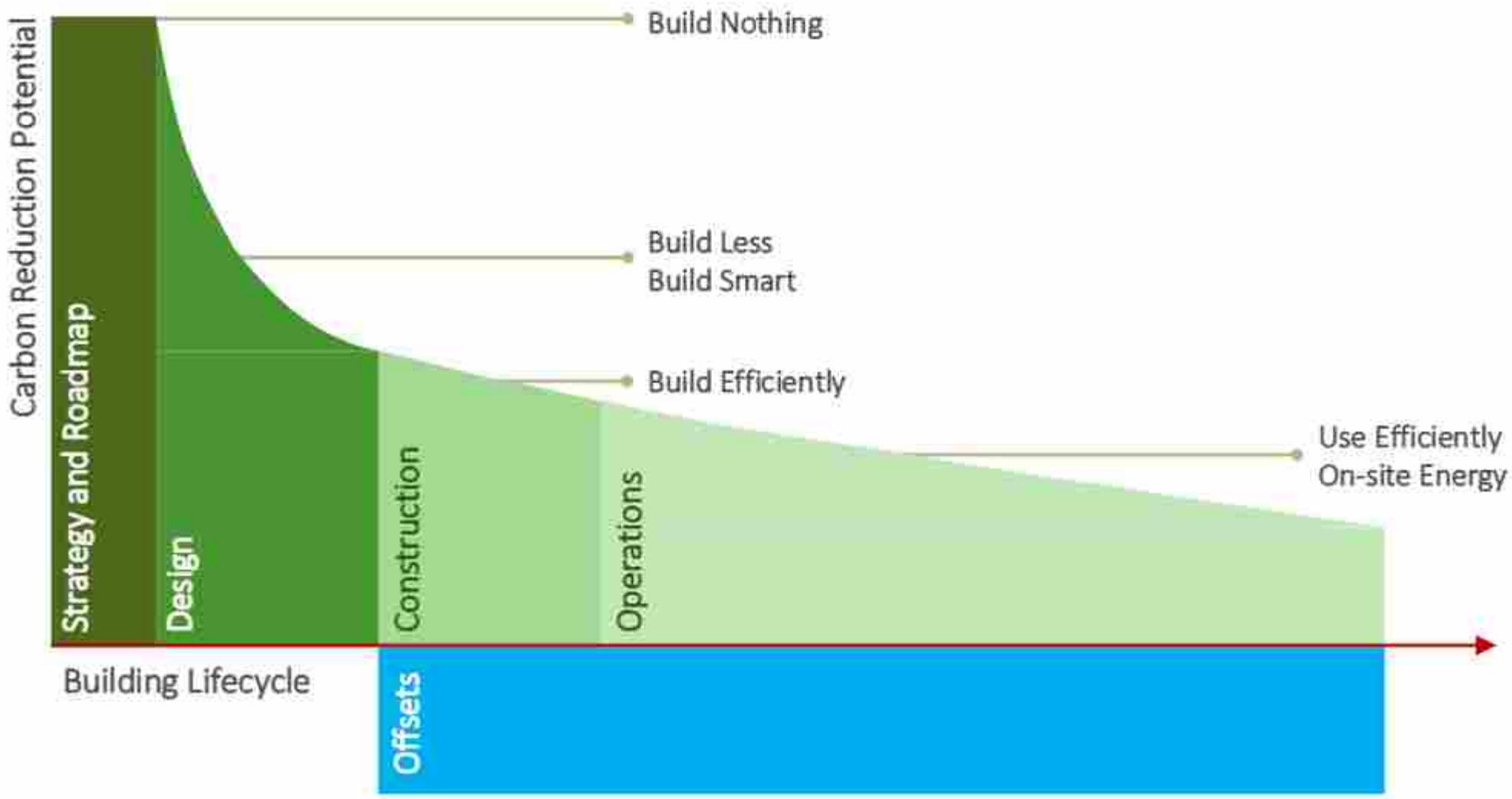
Buildings are currently responsible for 37% of global energy related carbon emissions:

- 28% from operational emissions
- 9% from materials and construction

Source: United Nations

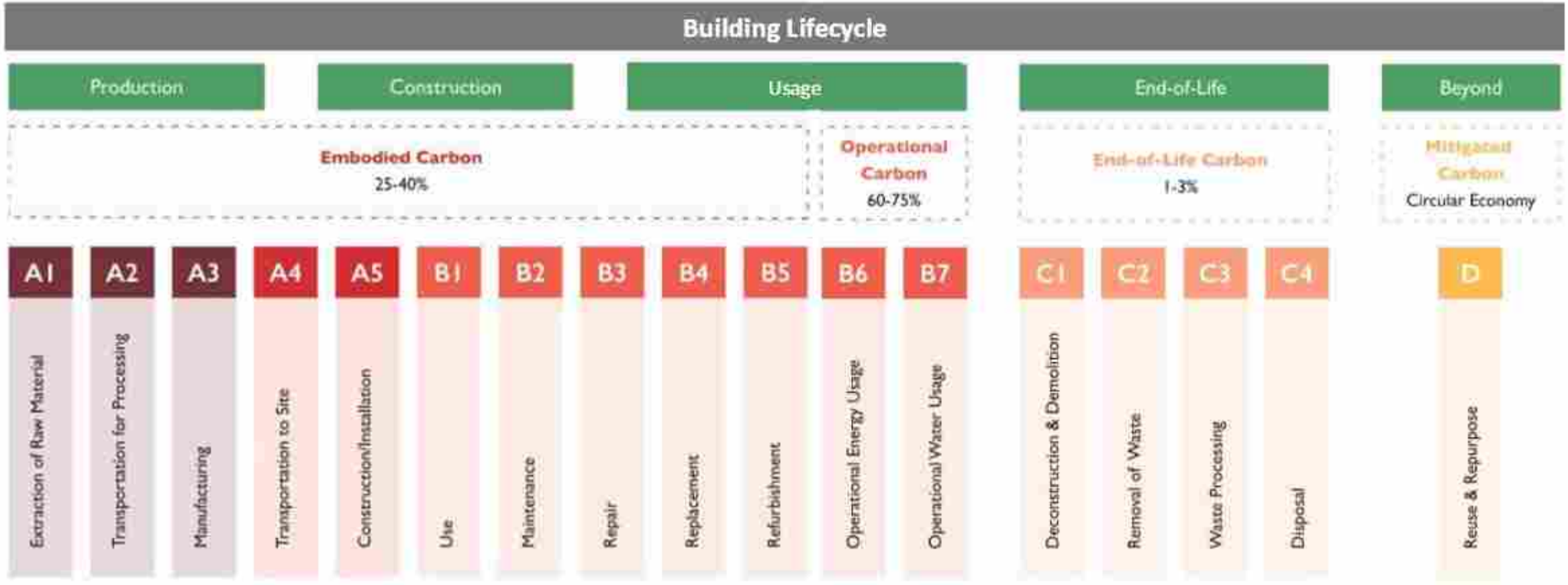
There are methods, tools, and pathways to reduce carbon emissions associated with buildings.

Path to Net Zero

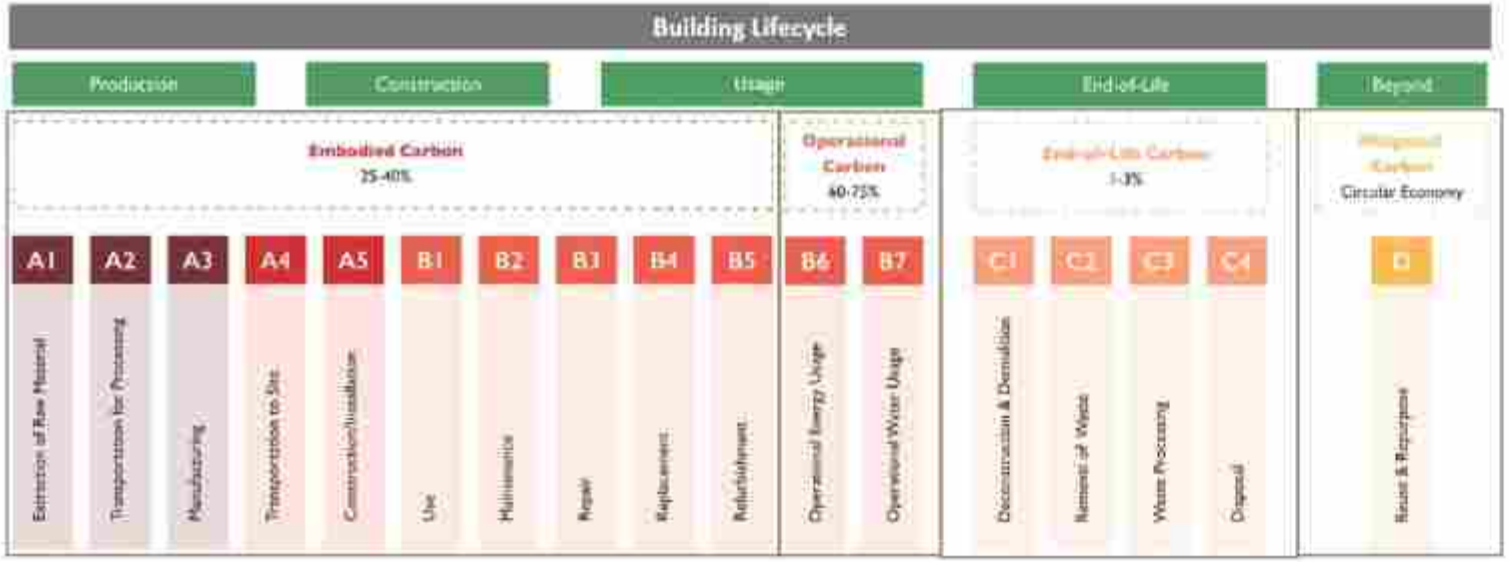


Lifecycle Carbon Approach

CPG Adopts the EN15804 and EN15978 frameworks to organise the methodology and tools for performing lifecycle carbon assessment



Our Current Decarbonisation Focus



A1-A5 = 25%-40%

SG: 40%
Next frontier for decarbonisation efforts

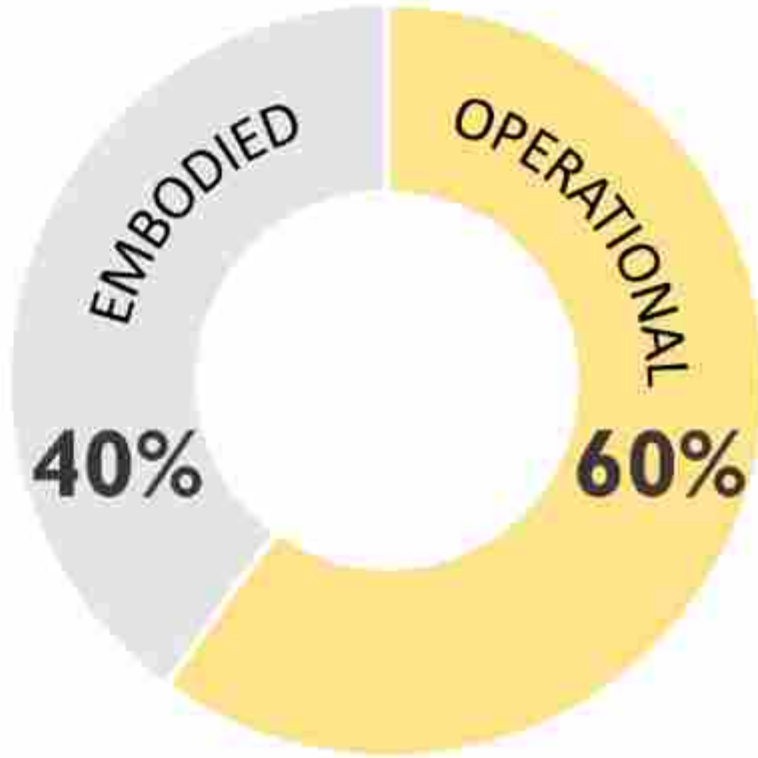
B6-B7 = 60%-75%

SG: 60%
Primary focus for decarbonisation efforts

C1-C4 = 1%-3%

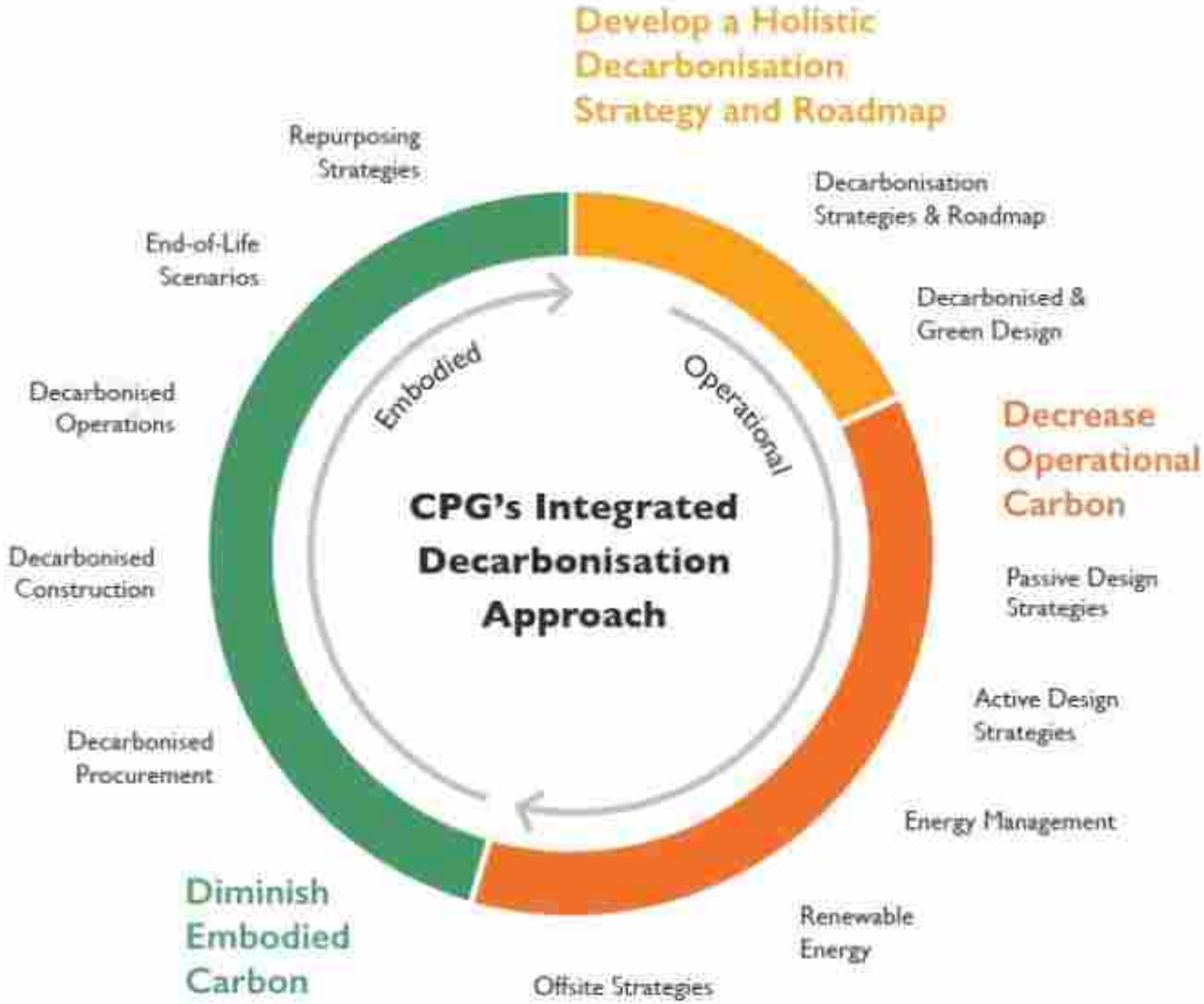
D = Future Opportunities

Reuse of building materials after end-of-life may contribute to decarbonisation in future, but current focus should be on Operational and Embodied Carbon



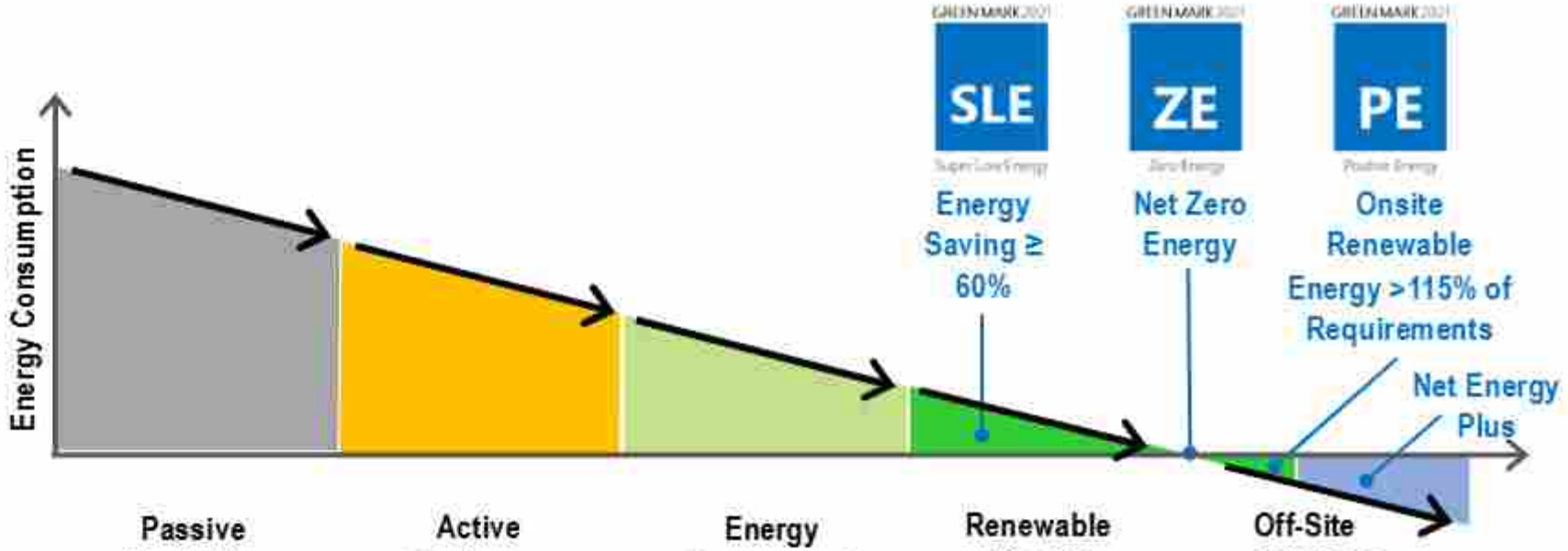
In Singapore, the ratio between operational to embodied carbon is approximately 60% : 40%, based on Singapore Green Building Council's estimation.

CPG's Integrated Approach to Decarbonise Built Facilities



Operational Carbon: Design and Operation Methodologies

There are clear strategies and methodologies that require bespoke adaptation to each project.



Passive Strategies

- Site orientation
- Env assessment
- Massing orientation
- Solar shading
- Daylighting
- Façade modeling
- Double skin facade
- Natural ventilation
- CFD simulation
- Thermal comfort
- Visual comfort
- Glare simulation

Active Strategies

- Energy modeling
- Air-conditioning
- Mech ventilation
- Hybrid ventilation
- Artificial lighting
- Thermal comfort
- Thermal stratification
- Chill beam
- Underfloor cooling

Energy Management

- Plug load management
- Smart control
- Demand control Building automation
- IoT sensors
- Data analytics
- Smart FM platform
- Digital twins
- Machine learning
- AI automation

Renewable Energy

- Roof optimisation
- Façade optimisation
- Site optimisation
- PV technologies
- BIPV integration

Off-Site Strategies

- Off-site renewable energy sources
- Carbon offset
- Carbon credits

KEY TAKE AWAY !

Existing development must look into ways to upgrade energy efficiency of building operation.

FM: Measuring What Matters

01 | Defining boundaries is the first step in credible carbon accounting.

Organisational boundaries: We adopt the operational control approach, which captures emissions from assets and facilities under CPG FM's direct management.

Operational boundaries: These define the emissions sources to be included — energy use, refrigerants, water treatment, waste, logistics, and more.

02 | Scope 1 and 2 Emissions: Direct FM Controls

Scope 1: Direct emissions such as fuel use in FM fleets and fugitive emissions from refrigerants.

Scope 2: Indirect emissions from purchased electricity that powers building operations — lighting, cooling, pumps, and other essential systems.
Through energy efficiency programmes, chiller plant optimisation, and refrigerant management, these are the areas where quick and measurable reductions can be achieved.

03 | Scope 3 Emissions: The Hidden Majority

Scope 3 emissions, though outside direct control, often represent the largest share of a facility's carbon footprint. These include:

- Tenant activities and waste generation.
- Contractor commuting and logistics.
- Procurement of equipment and building materials.
- End-of-life treatment and disposal.

Addressing Scope 3 requires partnership and transparency. By engaging tenants, contractors, and vendors with sustainability scorecards and awareness programmes, CPG FM ensures these emissions are not ignored but actively managed as part of the decarbonisation journey.

04 | Science-Based Targets & MACC Curves

Measurement must translate into prioritised action. CPG FM uses:

Science-Based Targets (SBTs): Emissions reduction pathways aligned with climate science, ensuring our operations and client engagements are consistent with a 1.5°C future.

Marginal Abatement Cost Curves (MACC): A decision-making tool that compares the cost of interventions against their carbon reduction potential. This allows us to:

- Prioritise low-cost, high-impact measures (e.g., LED retrofits, waste segregation).
- Plan for longer-term investments (e.g., system rejuvenations, renewable energy integration).

This dual approach balances financial prudence with climate ambition, ensuring both immediate progress and long-term resilience.

Case Study: Limbang Shopping Centre

Source: CPG Decarbonisation Playbook

Deputy Prime Minister Lawrence Wong waving to the hawkers during his tour at the wet market during the opening ceremony of Limbang Shopping Centre on Feb 3.

Deputy Prime Minister and Finance Minister Lawrence Wong officially reopened Limbang Shopping Centre on Feb 3.

Case Study: Limbang Shopping Centre

QUICK FACTS

GENERAL
Location:
533 Choa Chu Kang Street 51, Singapore 680534

Client:
Housing Development Board

Project Size:
17,243.88 sqm

Project Duration:
2018 to 2024

Awards:
Certificate of Merit
To-Be-Built Rejuvenation Category
(HDB Design Award, 2020)

GREENERY
Old Limbang SC planting area: **796.0sqm**
New Limbang SC planting area: **809.0sqm**

RAIN GARDENS (ABC WATERS FEATURE)
Total Rain Gardens: **8 nos**
Catchment area: **11.4% (1,630 sqm) of total site area**
Design Feature: **7% (108 sqm) of total catchment area**

Case Study: Limbang Shopping Centre

4 key Pillars

1. Architectural Renewal

Retaining original structure to reduce carbon emissions and shorten construction period. Use of natural daylight and ventilation to reduce energy usage

2. Heritage & Nature Integration

Integrating Nature and History to imbued a strong connection with community

3. Wellness & Biodiversity

Use of biophilic and nature based design to reduce heat gain, whilst introducing biodiversity

4. Operational Integration with FM

Embedded with smart FM, energy efficient practices, circular waste management and sustainability reporting

Case Study: Limbang Shopping Centre

Case Study: Limbang Shopping Centre - Concept

Case Study: Limbang Shopping Centre

Case Study: Limbang Shopping Centre

Case Study: NUS SDE 1 & 3

NUS SDE 1 & 3 – Super-Low energy design

This building reduces both embodied and operational carbon. The structural core is retained and designed for adaptive reuse to mitigate embodied carbon. In addition, passive and active design strategies are deployed to achieve super-low energy operations. This includes facade optimisation that screens the building from heat during the day while allowing for aesthetic expression, passive tropical design utilizing a network of smart sensors to optimize building electrical consumption and a hybrid cooling system that replaces air-conditioning with pre-cooled air that is circulated by ceiling fans

EXISTING ENVELOPE AND STRUCTURAL FRAME

The original aluminum envelope blocked the view and created a heavy perimeter facade that reflected the industrial transformation of Singapore's economy in the 1960s and 1970s.


NUS
Architecture
NOTES

Image Credit: CPG Consultants Pte Ltd and Finbarr Fallon

Retained Elements

Roof

L3 Floor

L2 Floor

Structural Columns

L1 Floor

Image Credit: CPG Consultants Pte Ltd and Finbarr Fallon

THANK YOU

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