GREEN COUNCIL
環保促進會

Webinar:
Climate Change Mitigation:
What can you do right now?

Cutting Carbon in Construction

Ms Emma Harvey
Group Sustainability Manager
Gammon Construction Limited

Remarks: This material/event is funded by the Professional Services Advancement Support Scheme of the Government of the Hong Kong Special Administrative Region. Any opinions, findings, conclusions or recommendations expressed in this material/any event organised under this project do not reflect the views of the Government of the Hong Kong Special Administrative Region or the Vetting Committee of the Professional Services Advancement Support Scheme.

Gammon

Cutting carbon in construction

Green Council webinar - Climate Change Mitigation: What can you do right now?

22nd February 2022

Emma Harvey – Group Sustainability Manager

25 by 25

Introduction to Gammon

Integrated award-winning building contractor

Headquartered in Hong Kong since 1958

Around 7,000 staff in HK, Singapore and Guangdong

Annual turnover US$2.5Bn

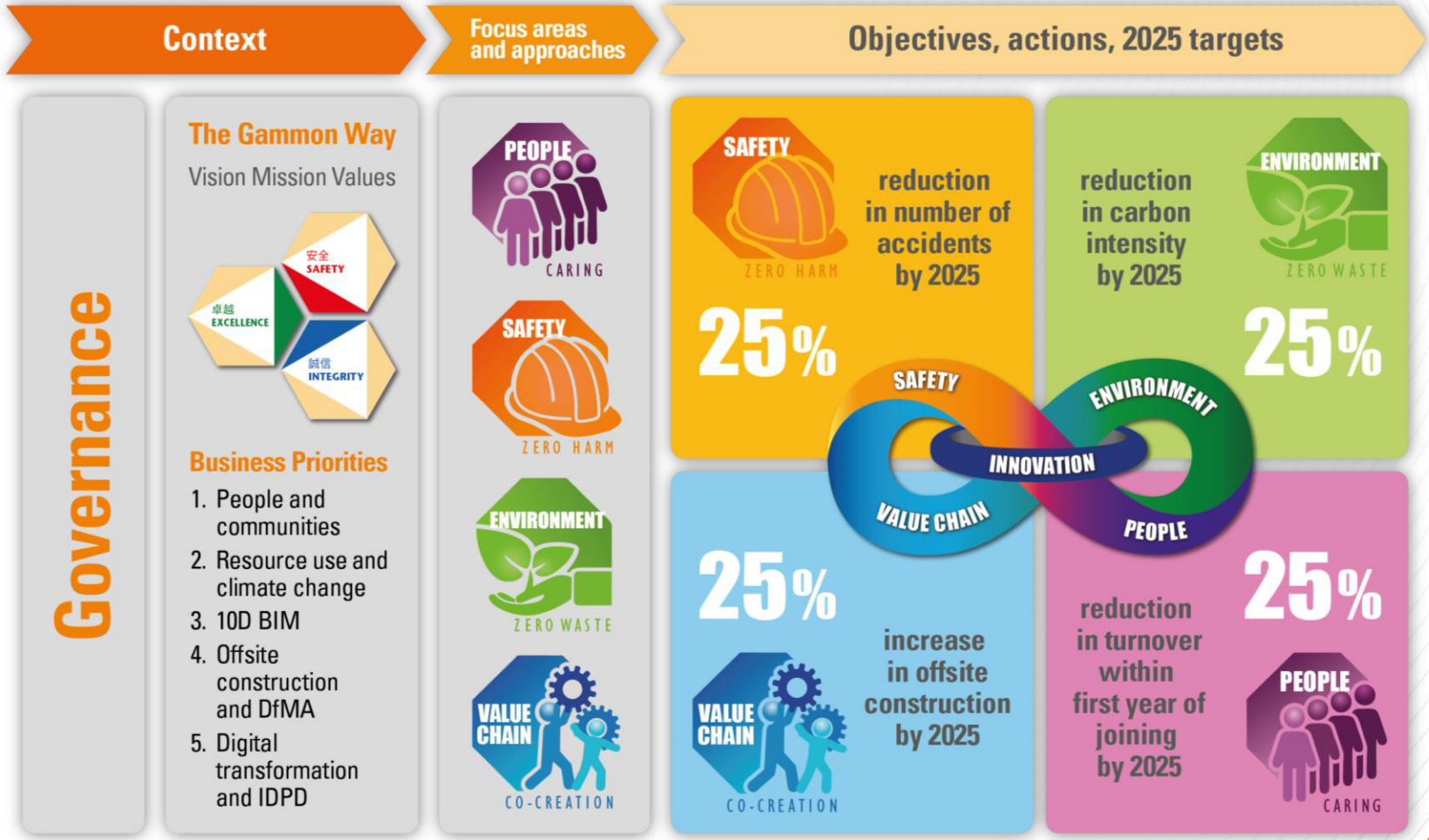
Jointly owned by Jardines & Balfour Beatty

Over 160 green building projects

www.gammonconstruction.com

Responsible Growth – 25 *by* 25

We focus our efforts on four areas and our approach is to target mainly 25% improvements by 2025 across a range of issues that are crucial for the industry – our **people** (and the **community**), **safety**, the **environment** and our **value chain**



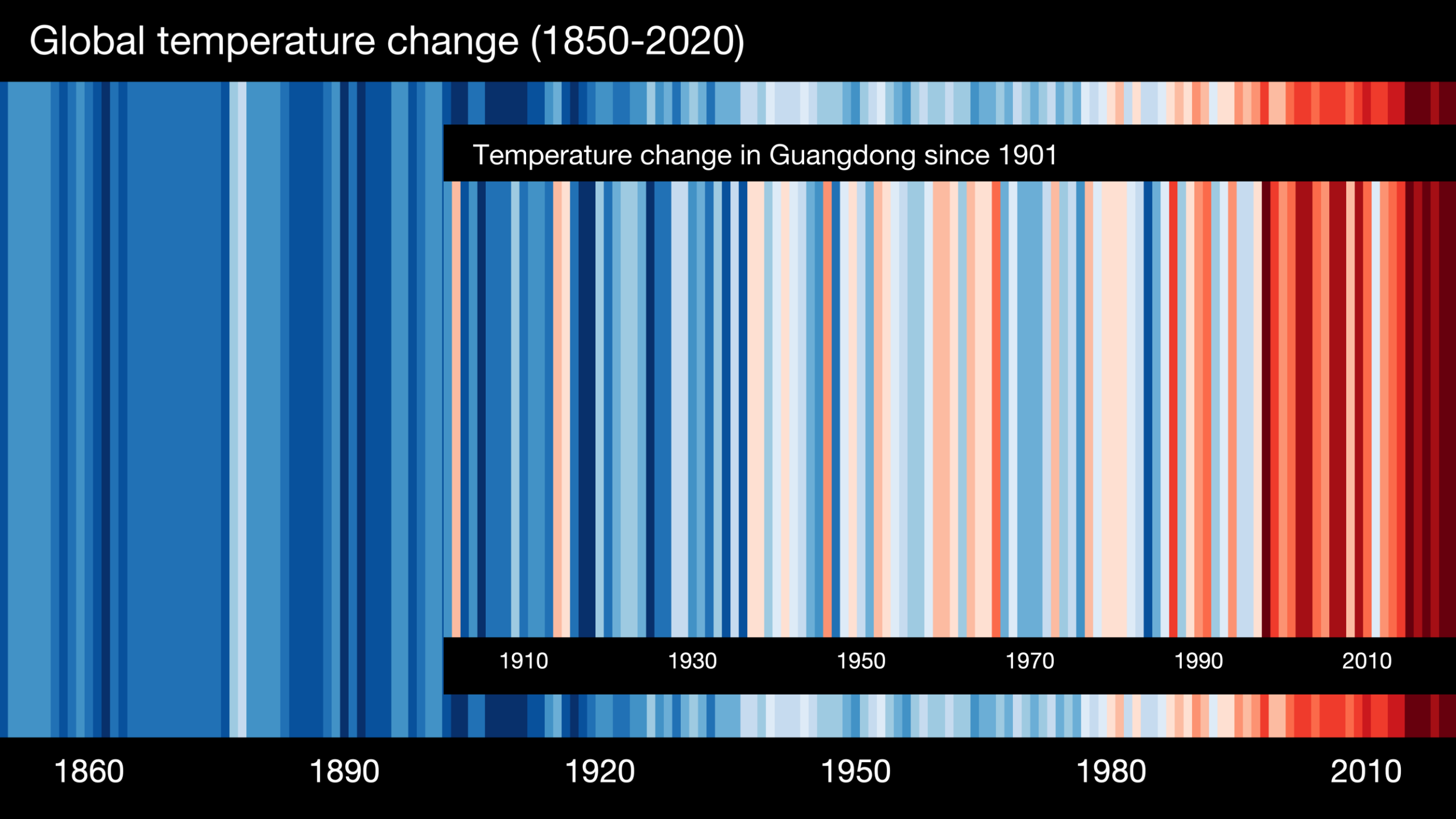
Sustainability Reporting and Engagement

https://www.gammonconstruction.com/en/sustainability-report.php

Climate change mitigation

What does it mean for us in the construction sector?

Gammon

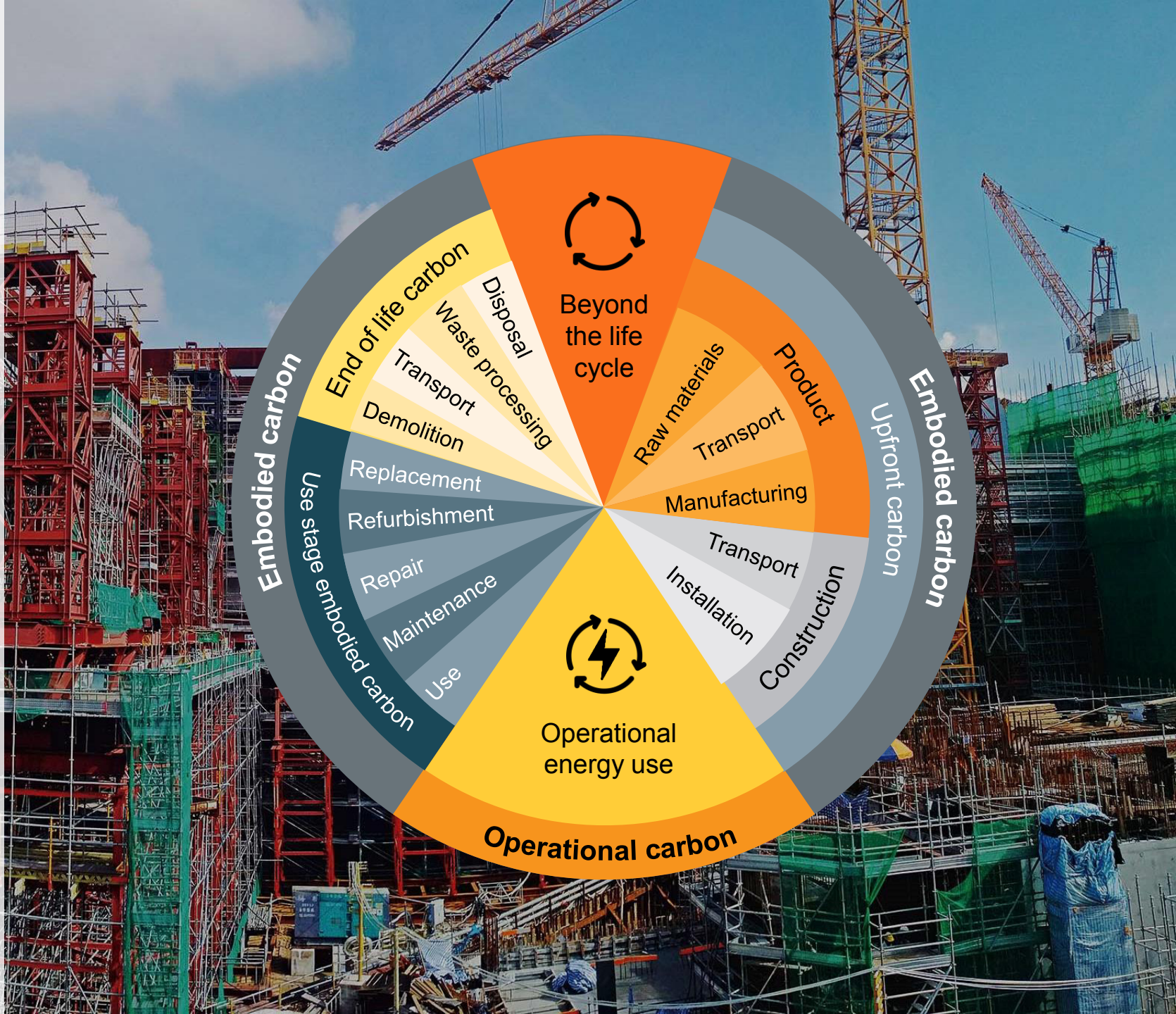

Global temperature change (1850-2020)
Temperature change in Guangdong since 1901
1910
1930
1950
1970
1990
2010
1860
1890
1920
1950
1980
2010

Types of carbon in construction

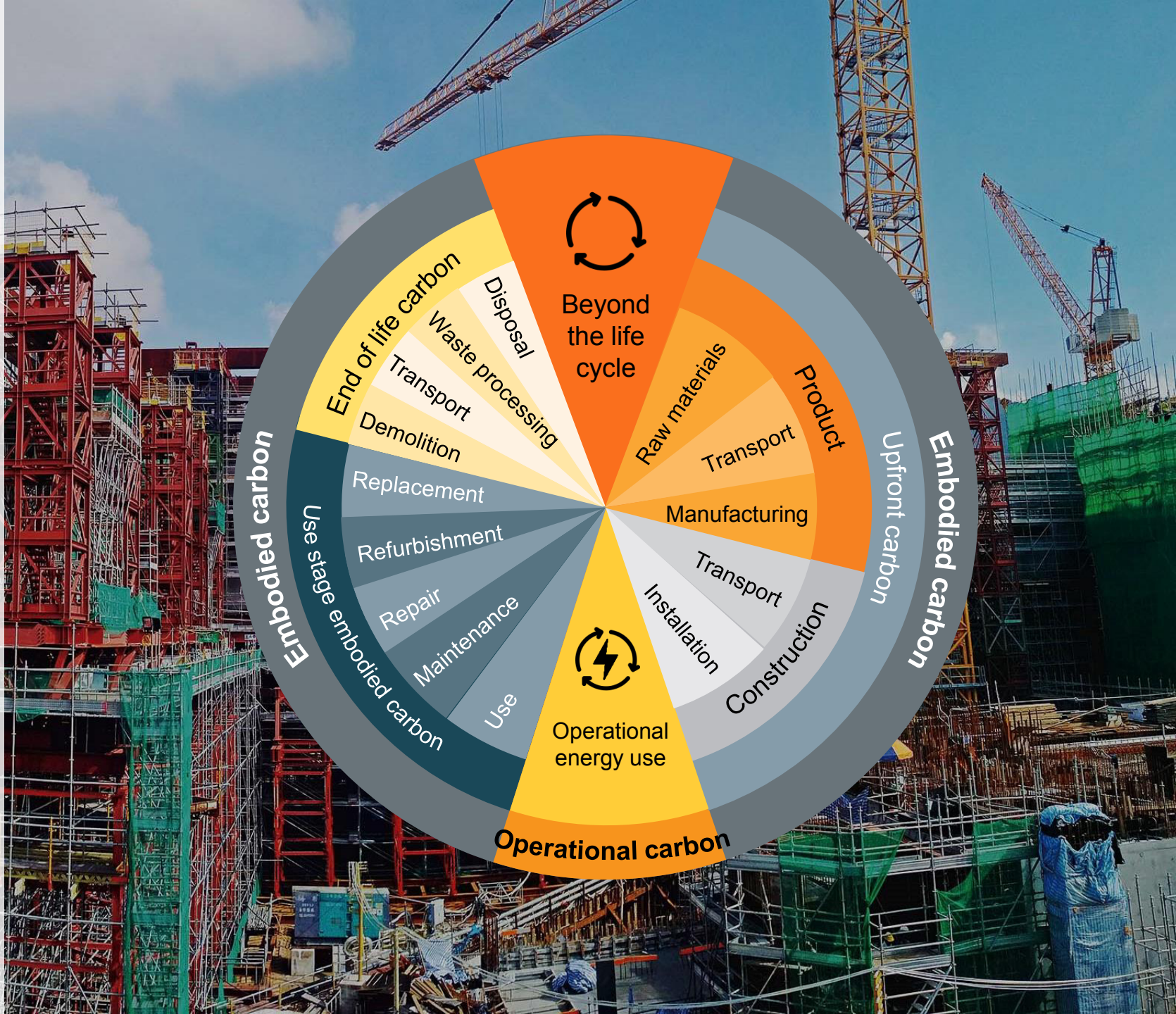
Embodied Carbon
The emissions from manufacturing, transportation, and installation of building materials.

Operational Carbon
The emissions from a building's energy consumption.

Whole-life carbon approach



Whole-life carbon approach

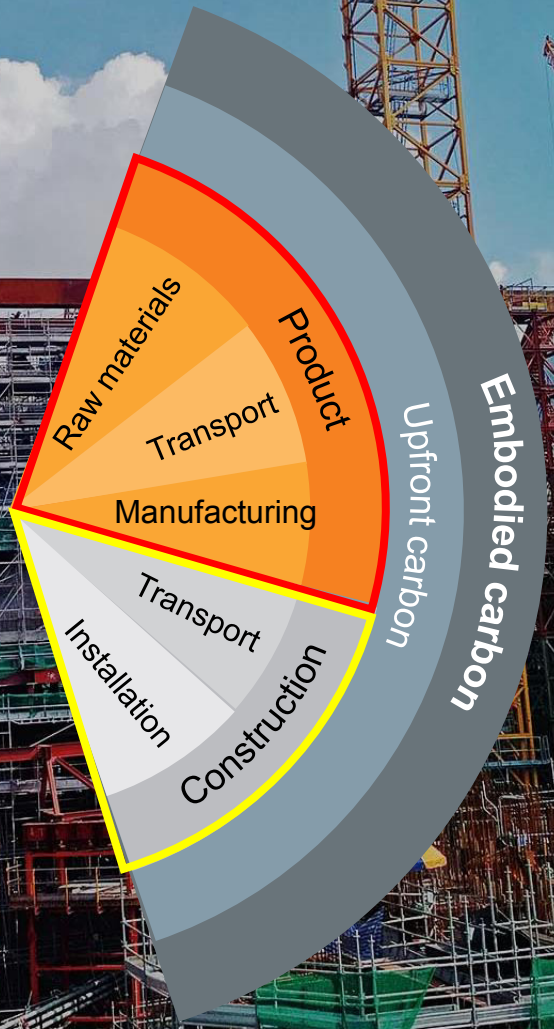


Upfront carbon mitigation focus

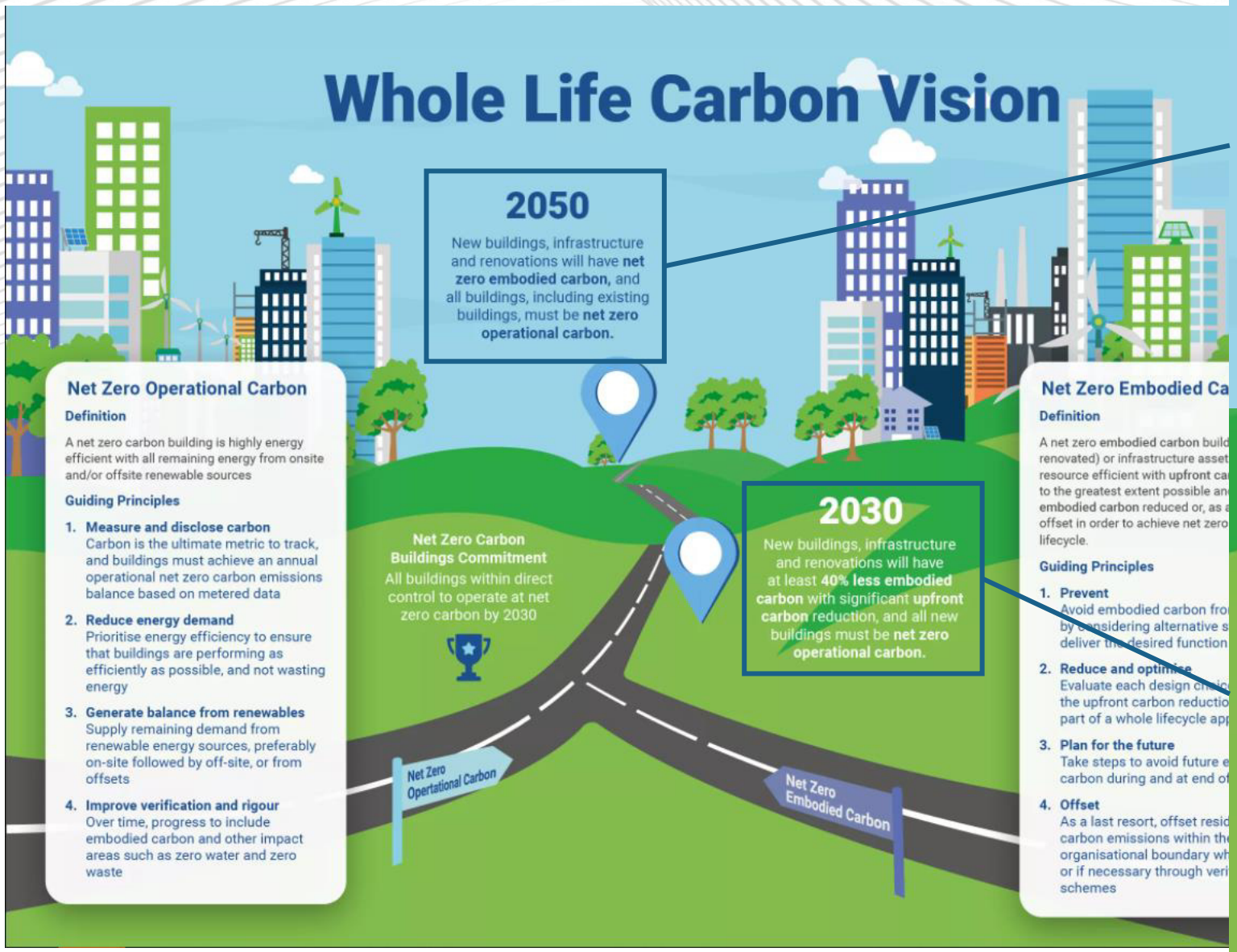
Materials embodied carbon

Upfront carbon

Carbon from construction activities



World Green Building Council Vision



2050

New buildings, infrastructure and renovations will have **net zero embodied carbon,** and all buildings, including existing buildings, must be **net zero operational carbon.**

2030

New buildings, infrastructure and renovations will have at least **40% less embodied carbon** with significant **upfront carbon** reduction, and all new buildings must be **net zero operational carbon.**

SUPPLIER

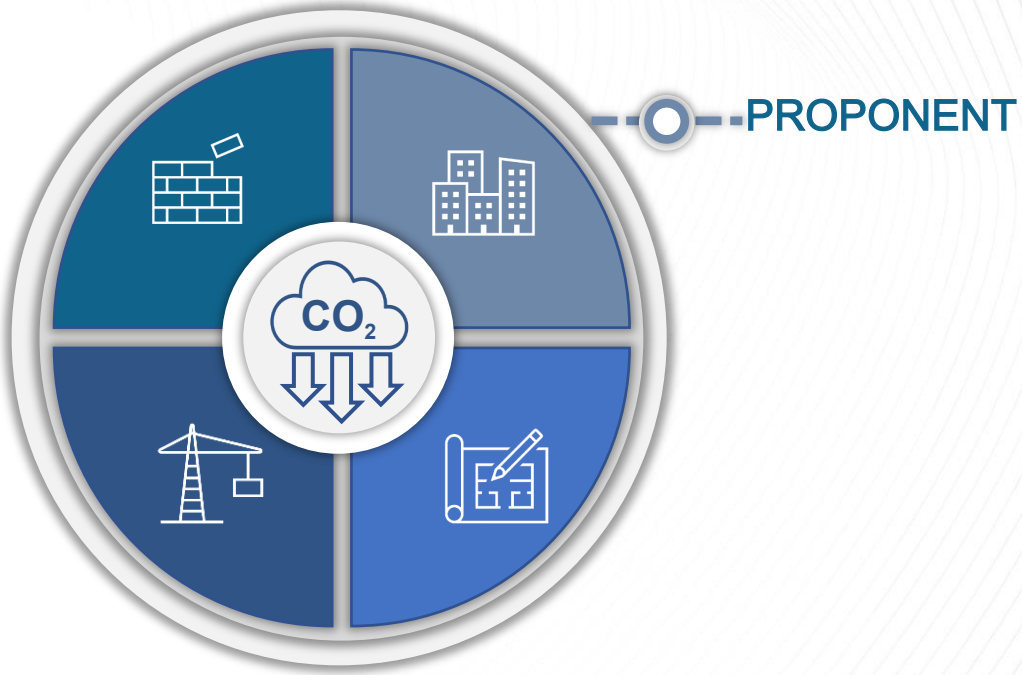
PROJECT PROPONENT

CONTRACTOR

DESIGNER

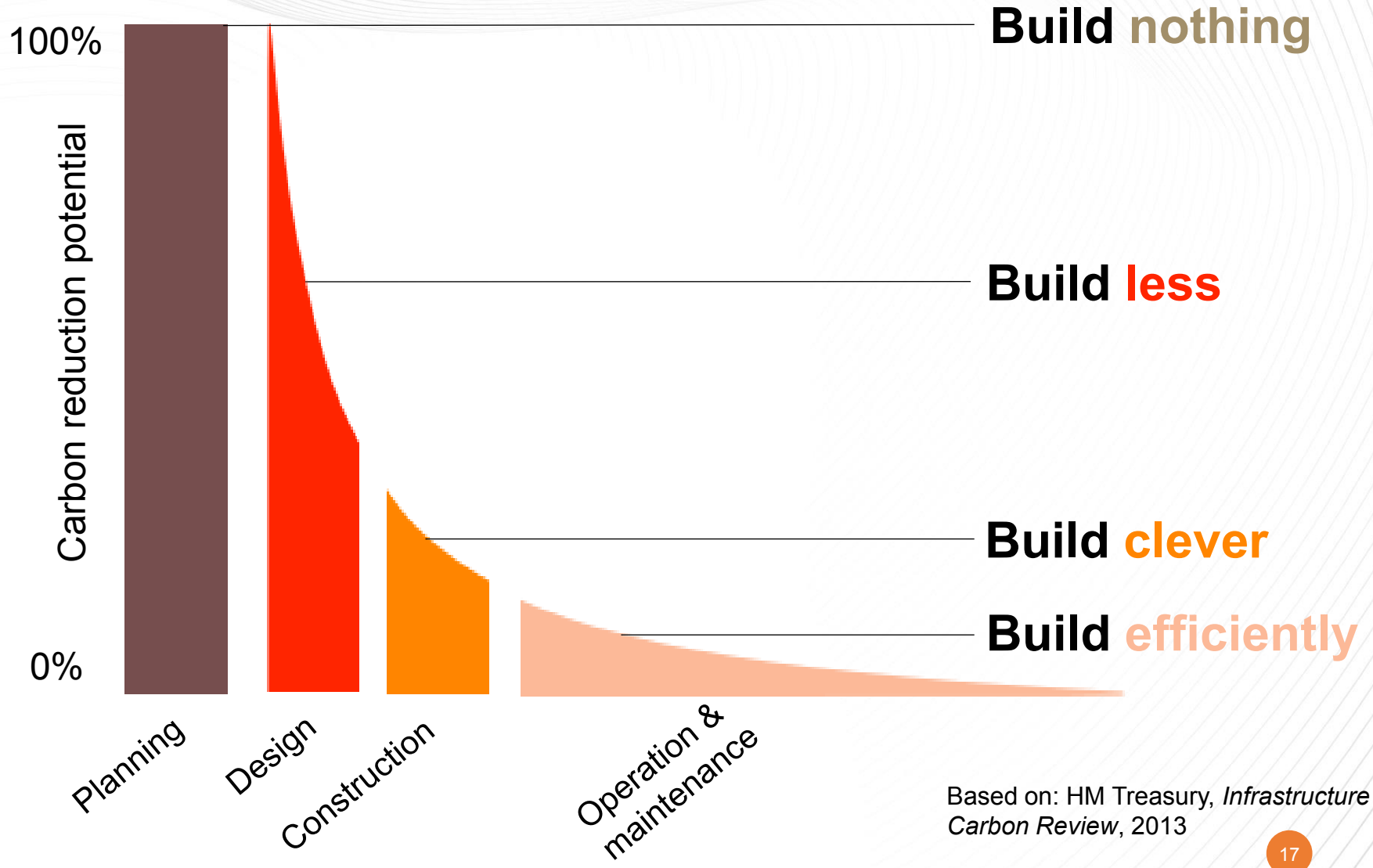
Climate change mitigation

Proponent's role



The pathway to net zero carbon starts early

- Carbon reduction potential is greatest at the concept, planning and design stages
- Carbon should be viewed as a critical success factor and decision-making criteria together with budget and programme, not in isolation.
- Set targets during design phase for embodied carbon



Based on: HM Treasury, *Infrastructure Carbon Review*, 2013

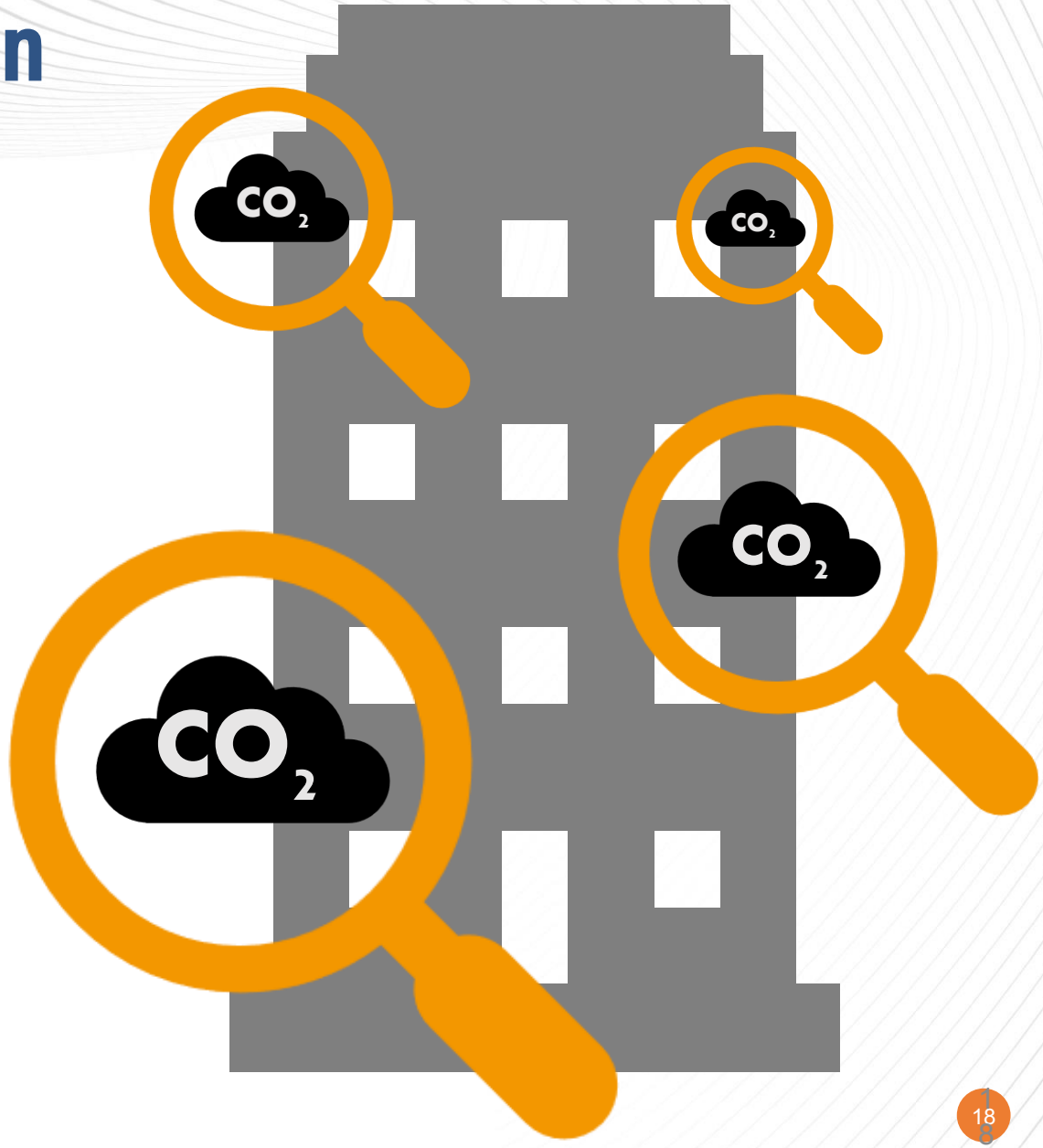
Whole life and embodied carbon thinking

Life-cycle carbon assessment (LCA): assess and target reductions – carbon can be considered a proxy for cost

Integrate low carbon specifications into contract procurement

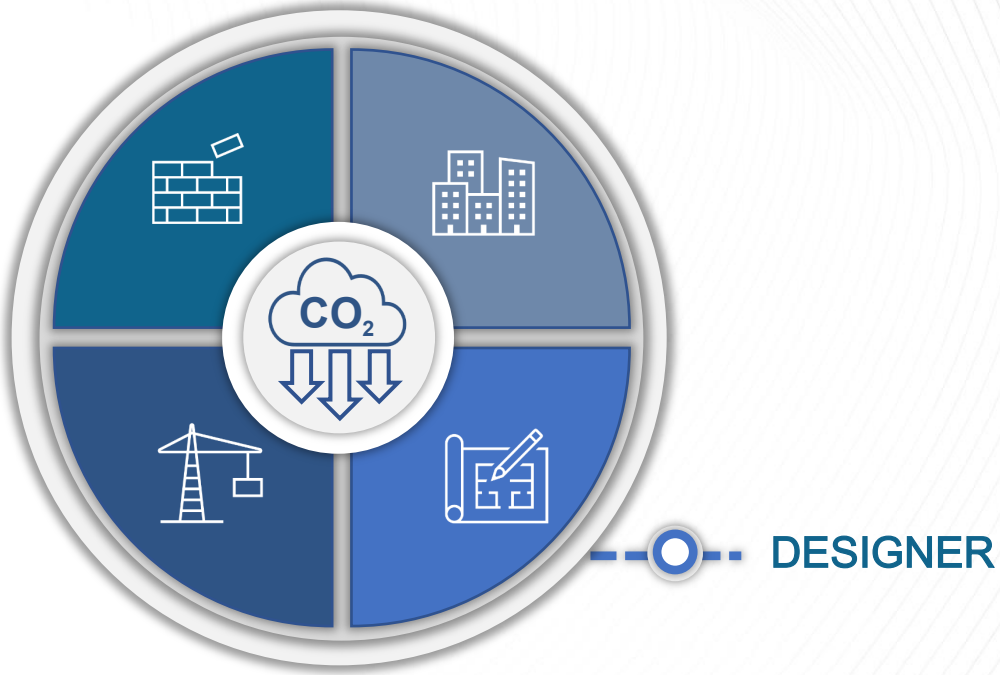
Consider early contractor involvement or design and build contracts

Longer design life, flexibility for adaptation, and disassembly for reuse and material recovery



Climate change mitigation

Designer's role



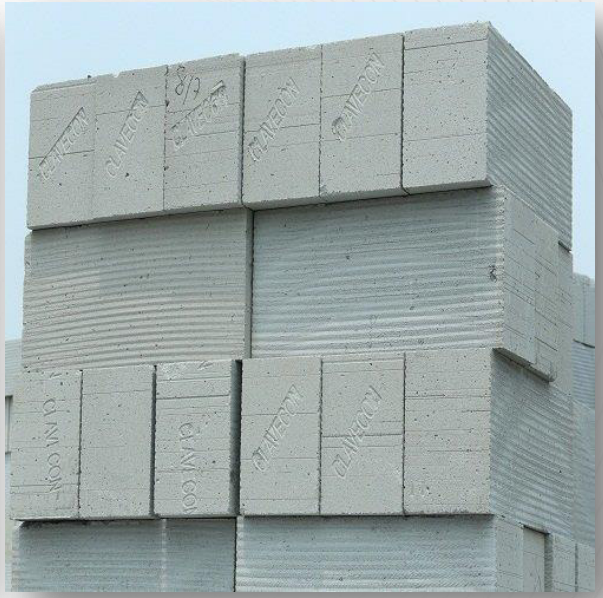
Gammon

Designer's role

Lean design - enough time to optimise design, lighter structure = reduced foundations, especially steel and concrete (majority of CO_2e footprint)

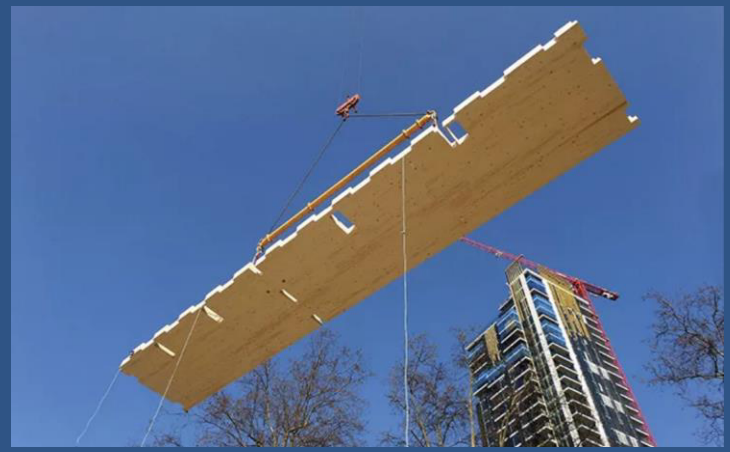
Lower carbon materials and LCA to drive down embodied carbon

Programme for offsite construction



Sustainably managed engineered timber, suitable for offsite

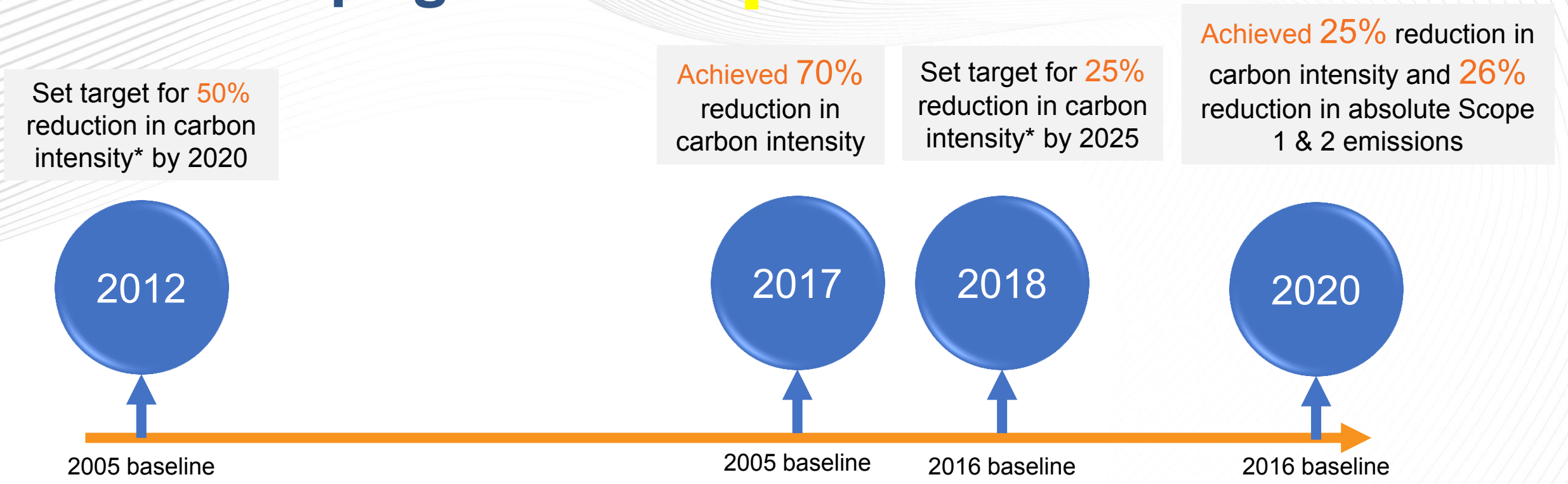
Glu-lam & cross laminated timber, composite buildings



Climate change mitigation

Contractors' role

Our carbon progress so far...



The Hong Kong Construction Association set a carbon intensity target of 25% reduction by 2020 based on a 2010 baseline. We achieved **over 50%** carbon intensity reduction for the Group over the same period

** = Carbon intensity is Scope 1 and 2 CO_2e emissions / $ turnover*

Our energy related carbon footprint

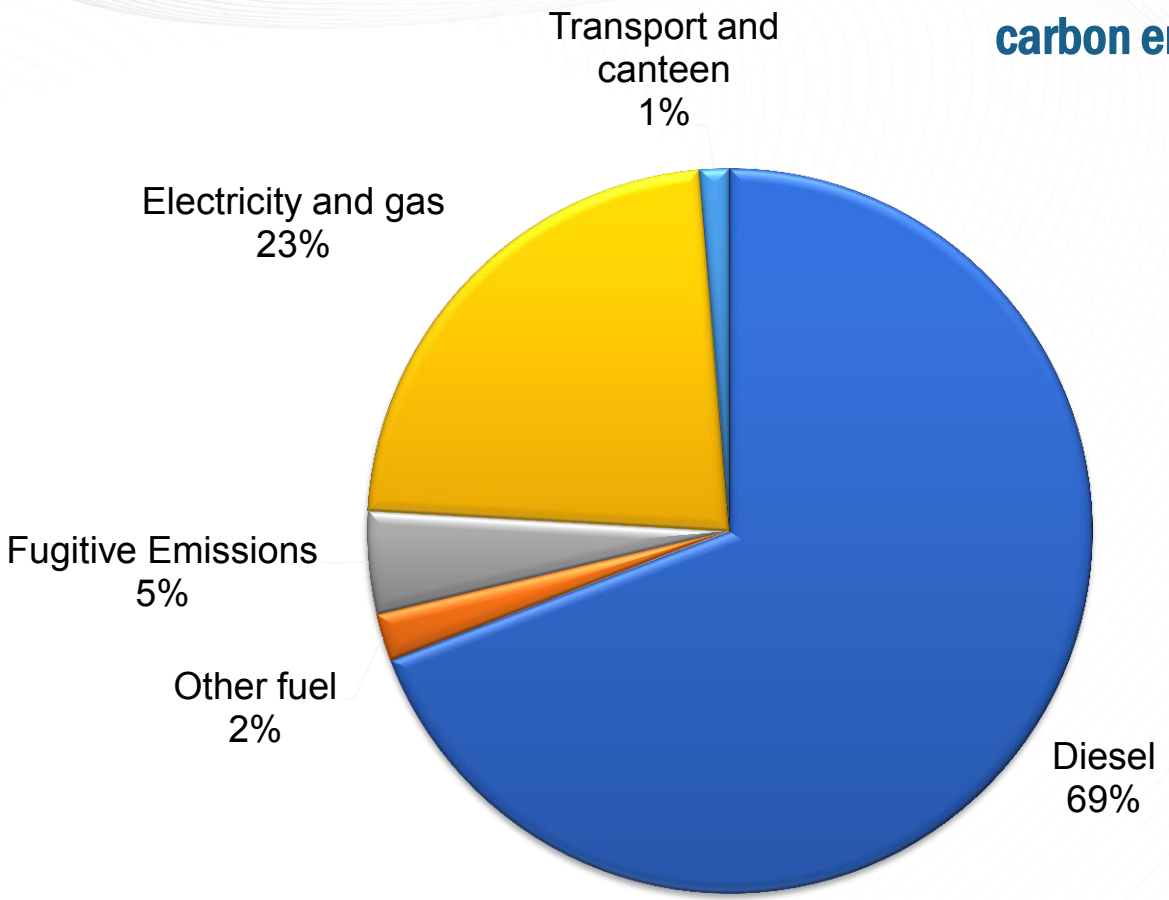
Our scope 1 and 2 (direct and indirect energy) carbon footprint is dominated by B5 / diesel use

Total CO_2e emissions (2020):

Scope 1 and 2 ~66,000 tonnes

But Scope 1 and 2 will no longer be sufficient, we must reduce scope 3 emissions also

Our 2020 Scope 1 and 2 construction related carbon emissions



Others includes canteen wastewater, tankered water, food waste incineration

Carbon footprint under our control

Our carbon footprint is typically dominated by:

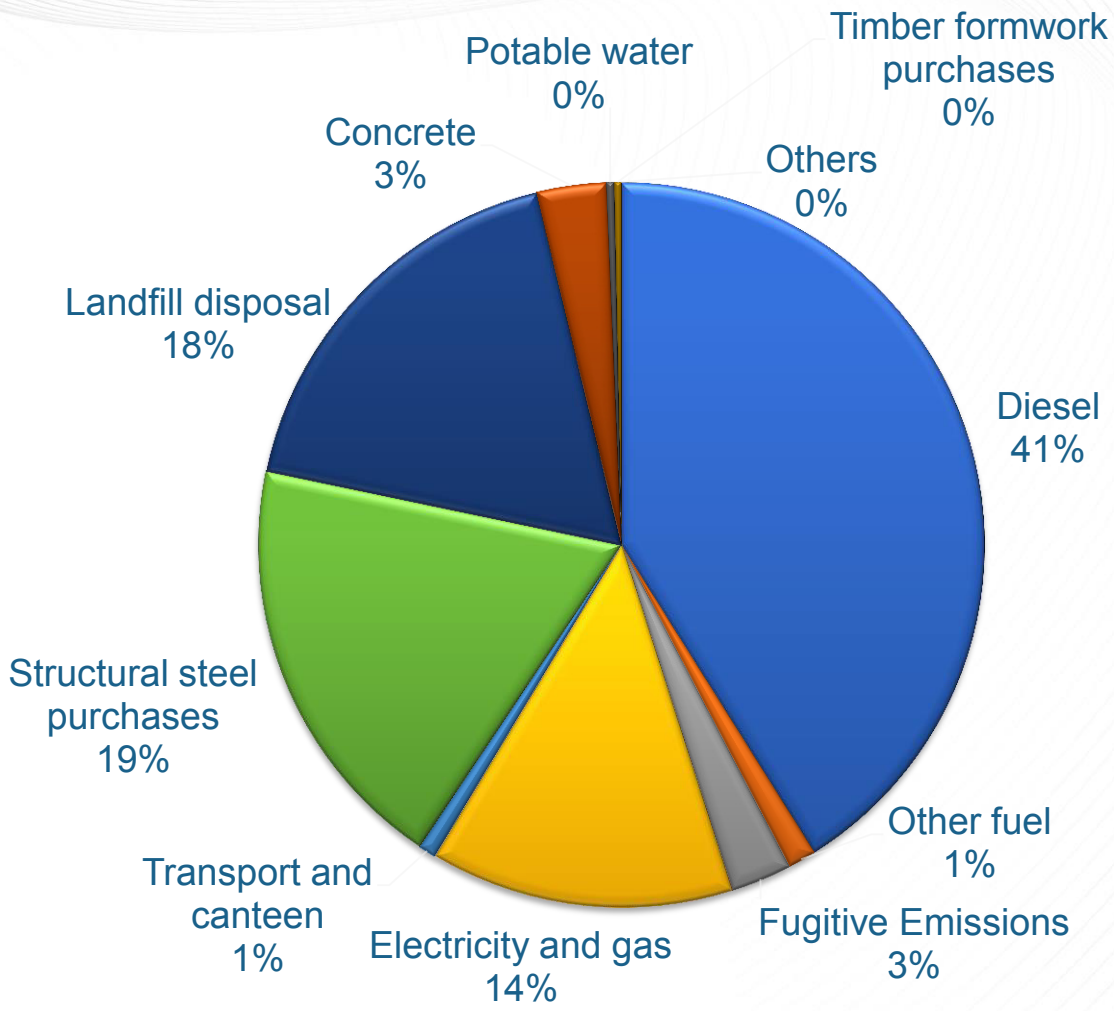
- Diesel for Scope 1 and 2 (direct and indirect energy)
- Embodied carbon for temporary works purchases and waste for Scope 3 (indirect)

Total CO_2e emissions (2020)

Scope 1 and 2 ~66,000 tonnes

Scope 1, 2 and 3 ~ 112,500 tonnes

Our 2020 construction related carbon emissions
(including temporary works material purchases)

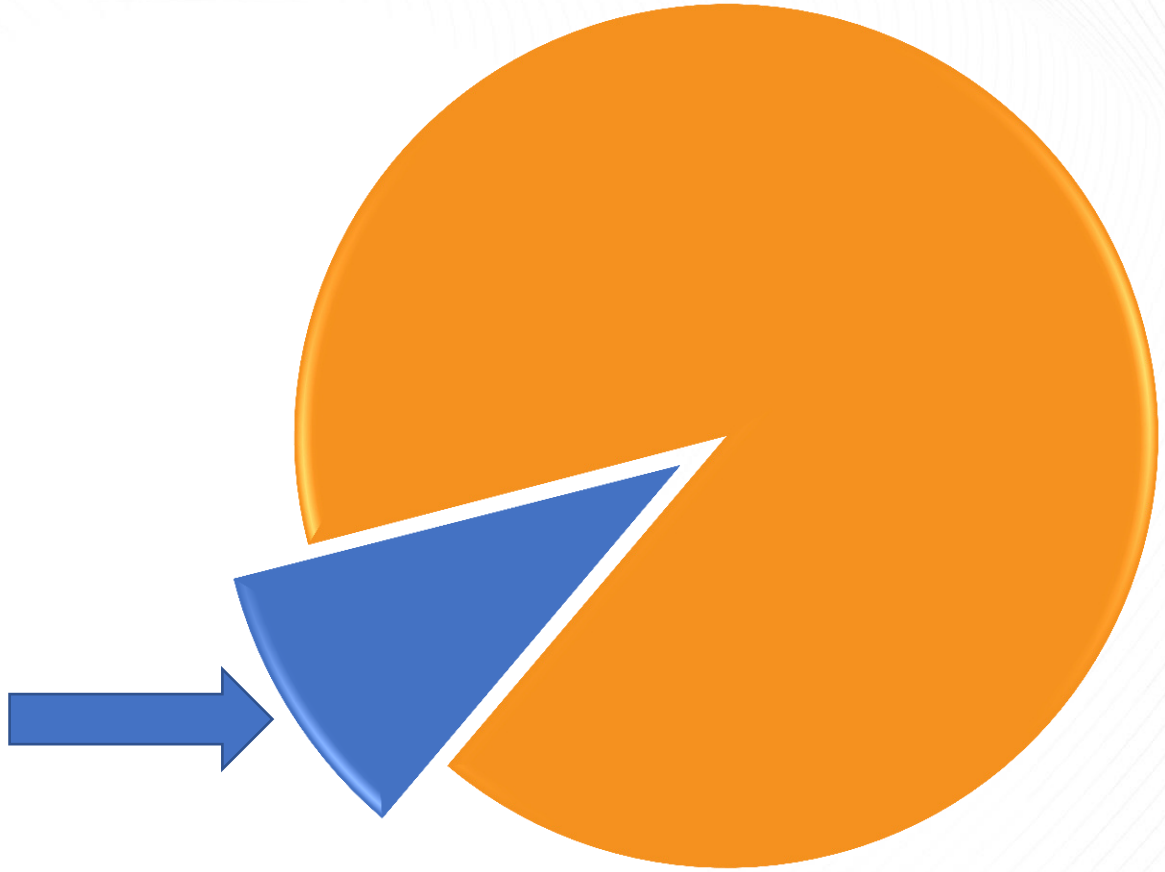


Others includes canteen wastewater, tankered water, food waste incineration

Carbon footprint related to Gammon

Around 90% of upfront carbon is embodied carbon in permanent works materials – Gammon can only influence

Around 10% of upfront carbon is temporary works and construction activities (Scope 1, 2 and 3) – Gammon can potentially control



Influence value chain and deliver projects efficiently

Influence and collaborate with project proponents and designers

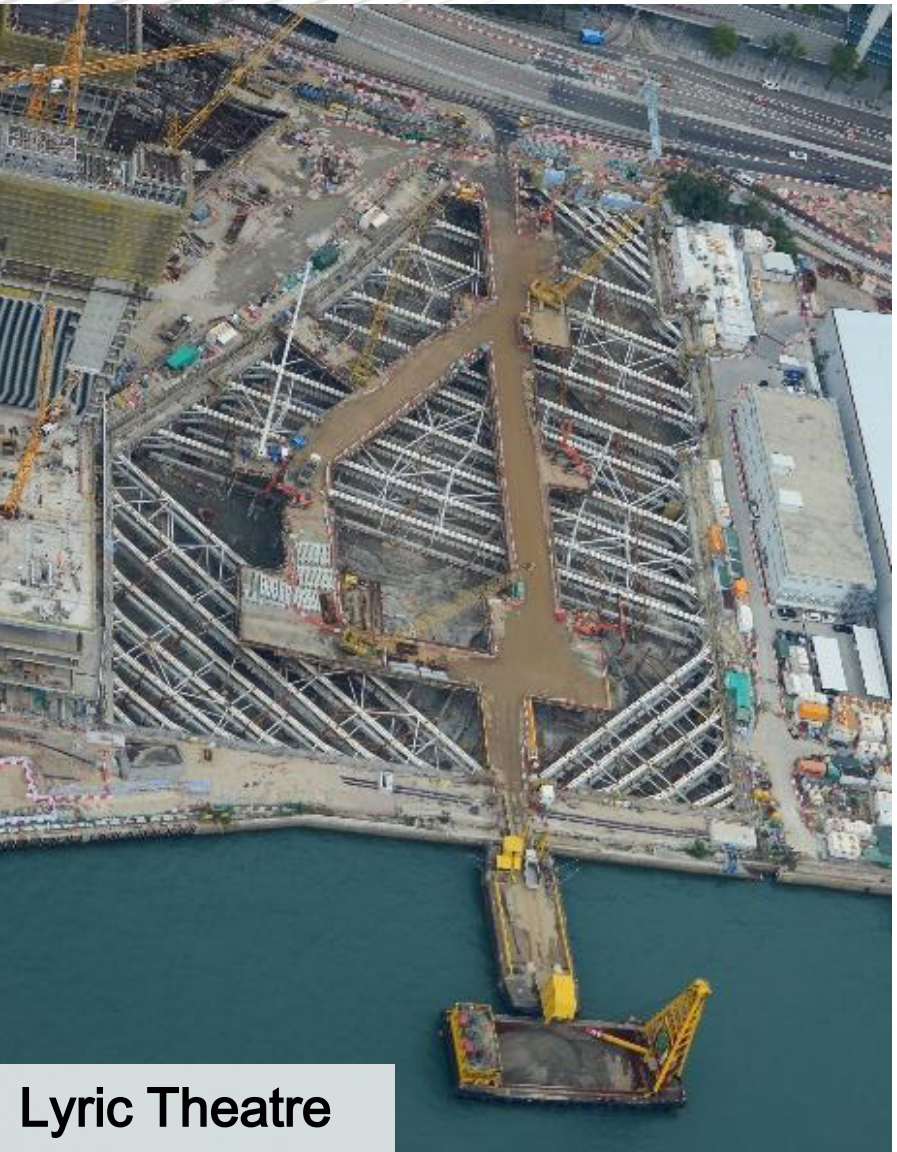
Influence supply chain – by raising awareness, specific contract requirements and incentives

Use less / low carbon energy sources

Deliver efficiently - examples:

- Digital twins (BIM) with full co-ordination and rehearse sequence of works
- DfMA / offsite construction and optimise design for lean permanent works where possible
- Select construction methods / temporary works design with lower carbon intensity (e.g. structural steel reuse, system formwork, sustainably certified timber etc.)
- Waste management to avoid / reduce waste to landfill and surplus
- Water efficiency by minimising, recycling and reusing potable water supplies
- Ensure similar good environmental management at offsite partner factories

Reusing struts for excavation and lateral support



Lyric Theatre

Central Kowloon Route – Kai Tak West

Modular Steel towers

M+ Museum

Foundation Design - Bored piling for commercial project

Use of higher strength concrete (C60 vs C45) to reduce rebar in foundations

Carbon saving from switching concrete mix and rebar quantity needed = **2,402 tonnes CO2e**

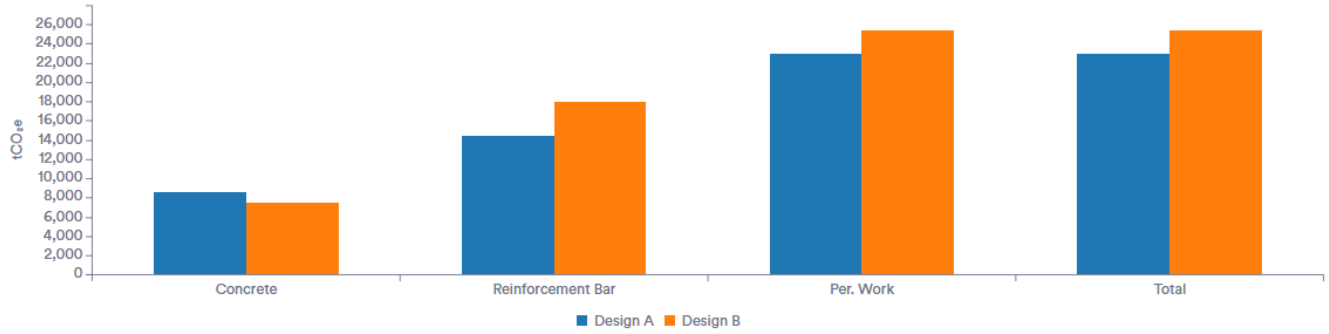
Total Carbon Emission tCO_2e

Design A: Permanent Works

Reinforcement Bar	14,409 tCO_2e
Concrete	8,580 tCO_2e
	0 tCO_2e
	0 tCO_2e
	0 tCO_2e

Design B: Permanent Works

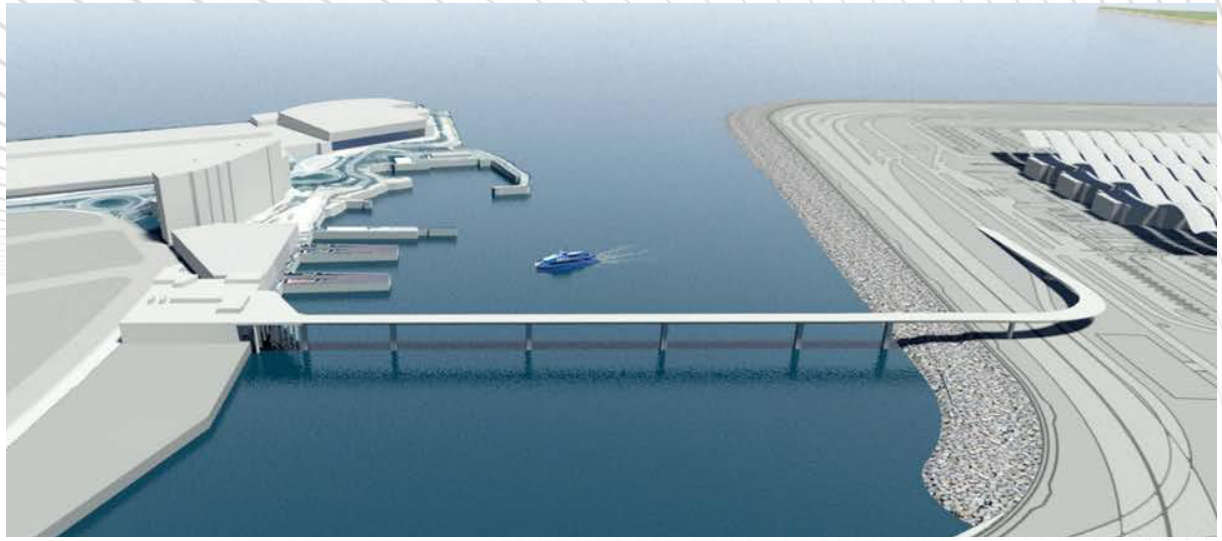
Reinforcement Bar	17,929 tCO_2e
Concrete	7,462 tCO_2e
	0 tCO_2e
	0 tCO_2e
	0 tCO_2e



Performance

	Design A	Design B	Difference
Total Carbon of the Project (tCO_2e)	22,989 tCO_2e	25,391 tCO_2e	2,402 tCO_2e
Normalised Carbon of the Project ($tCO_2e/(m^2)$)	0 tCO_2e	0 tCO_2e	0 tCO_2e

Intermodal Transfer Terminal Bonded Bridge - Cement reduction for marine sediment stabilisation



Excavated marine sediment stabilisation and solidification

To reduce carbon footprint and maximize the cost benefit, testing was undertaken to determine the optimum mixing ratio for sediment treatment is of:

- Minimum content of Portland cement, which is **carbon intensive**
- Adequate content of granular material
- Maximum content of sediment

Cement used:

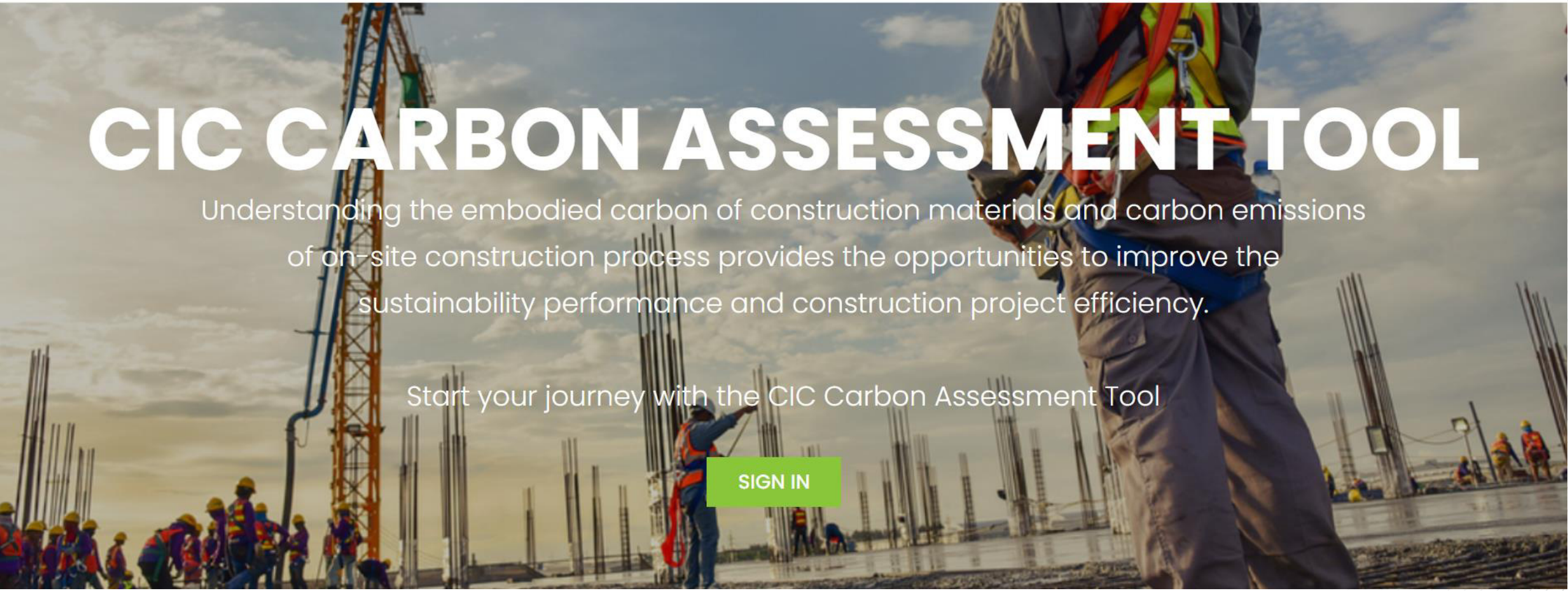
- Typically 5-20% cement use
- **Reduced to 0.5%**

1,964t of cement reduction

Avoided 1,993 tonnes CO_2e emissions

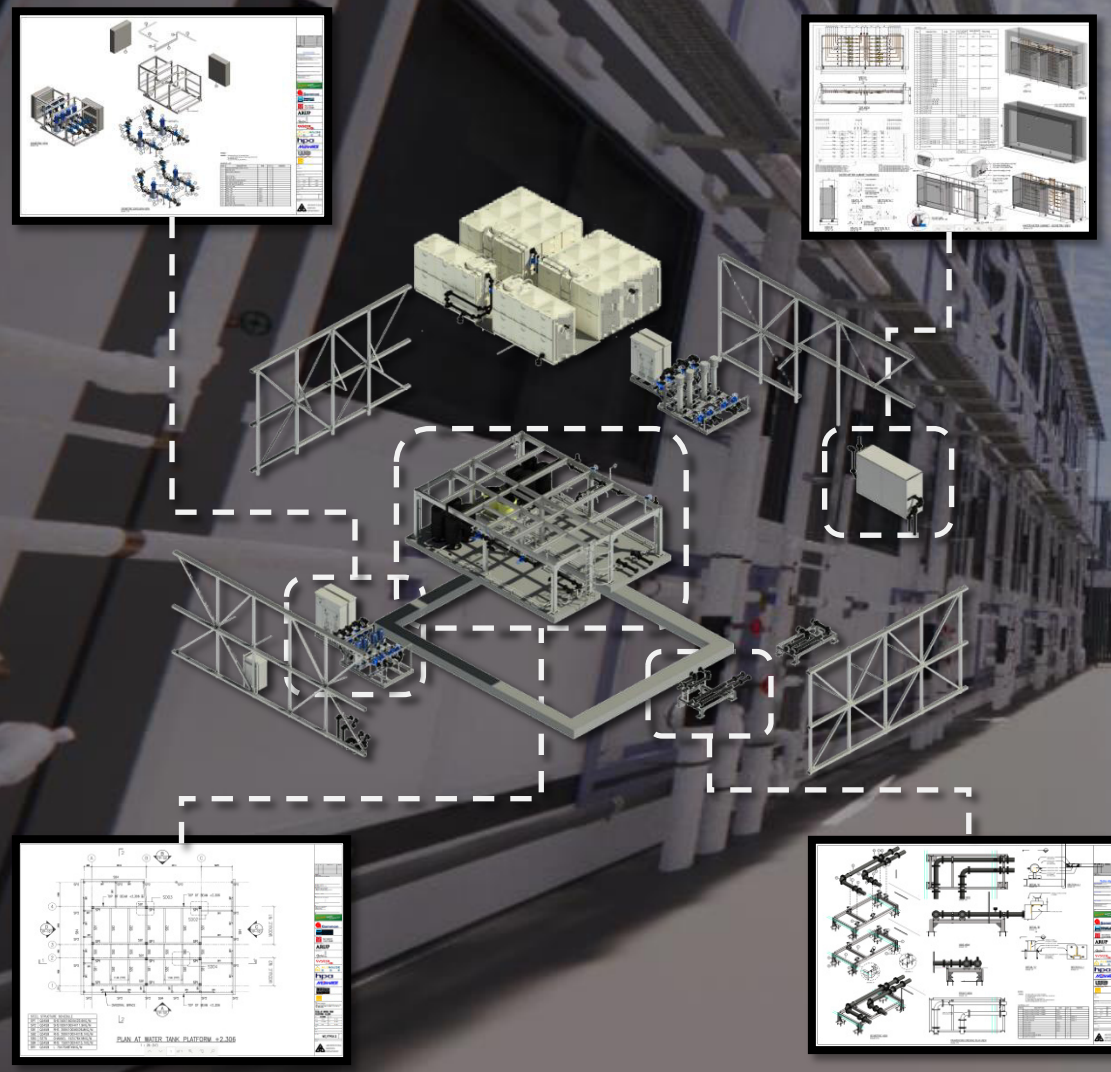
100% FSC / PEFC certified timber

for formwork and door purchases



https://cat.cic.hk/

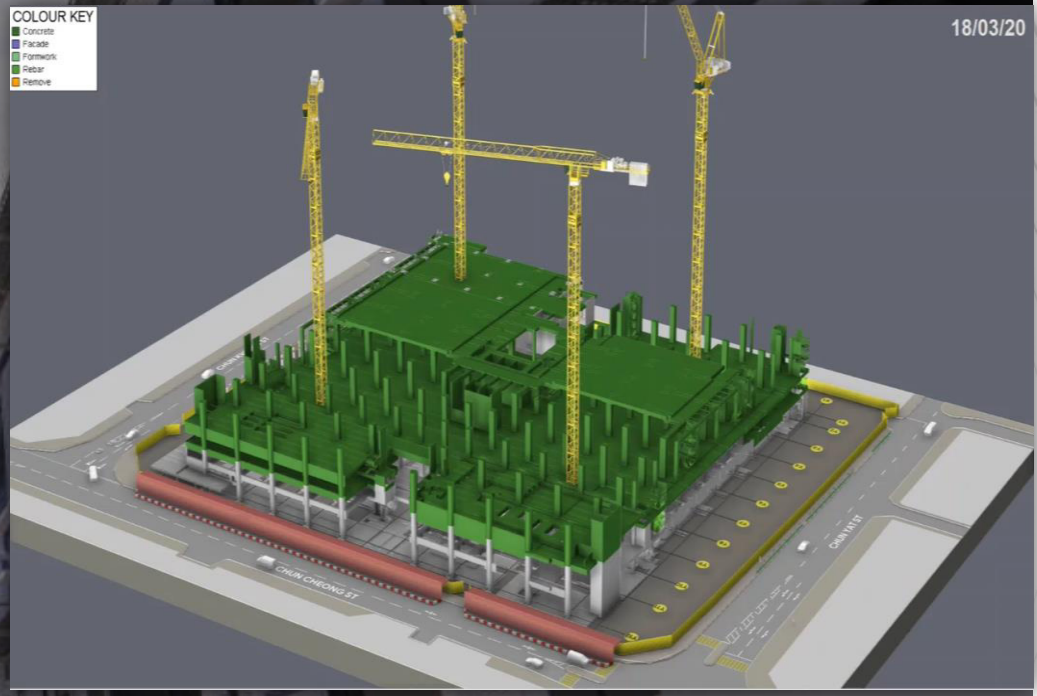
BIM and offsite



BIM and offsite

E&M modules

Precast



Pods

MiC

Offsite construction

- **Standardisation** and **repetition** to enable manufacturing approaches to increase efficiency and reduce energy intensive lifting on site
- Reduction in carbon from material efficiency, energy, fuel and waste
- Enabled through early fully co-ordinated fixed design in BIM (BIM use in Korea case studies shown to reduce waste by 4-15%)

Carbon reduction potential	At site only	Net including factory related
Reduced energy used	Up to 80%	30%
Reduced waste	Up to 90%	50%
Reduced traffic movements	Up to 60%	20%

Sources: *Won, J., Cheng, J.C.P., Lee, G., 2016. Quantification of construction waste prevented by BIM-based design validation: Case studies in South Korea. Waste Management 49, 170-180 and Offsite Construction: Sustainability Characteristics*, 2013 by Buildoffsite (based on 20 case studies)

Case study: Penny's Bay Phase 2 Quarantine facilities

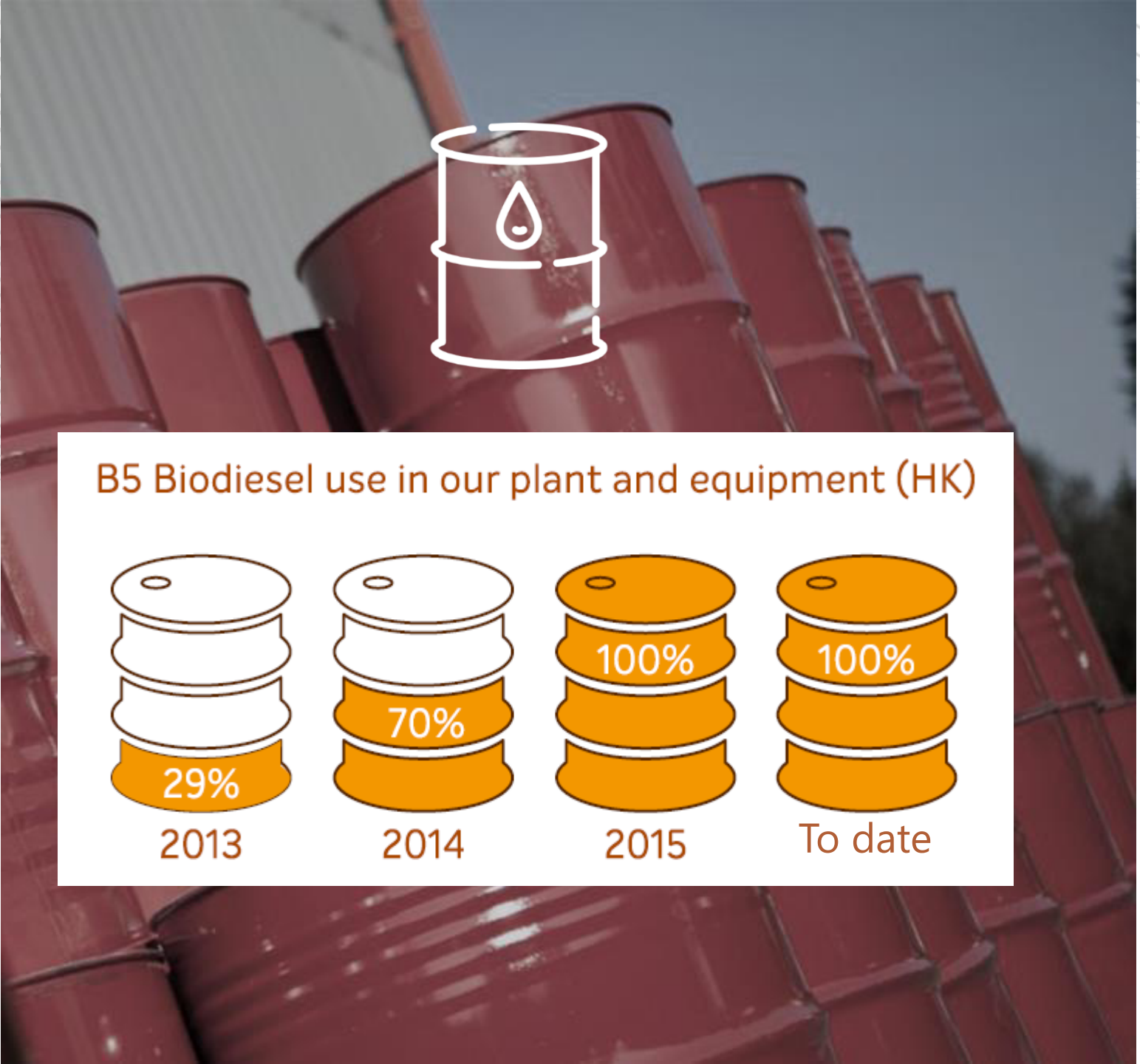
Designed and fabricated 700 temporary quarantine units in just 87 days

~95% of all works used MiC methods,

Significant reductions achieved compared to traditional construction methods for residential projects*:

- **68% reduction in waste sent to landfill**
- **38% reduction in carbon intensity**
- **76% reduction in water intensity**

** Average of 12 recently completed Gammon residential projects normalised against construction floor area (CFA)*



Use less / low carbon energy

Limitations for use of **biodiesel** – engines, feedstock, sustainability confidence and cost (hydro treated vegetable oil), residual impacts and risks

Blend of solutions needed for transition to zero carbon

Vision for transition to zero carbon

1. Low carbon power supply
2. Grid connection, possibly with temporary transformer
3. Battery energy storage system
4. Electric powered machinery and equipment
5. Charging for electric vehicles and plant
6. Renewable energy for Feed-in Tariff or to power site offices
7. Mobile electric plant on charge while stationary
8. Electric / non-fossil fuel foundations equipment
9. Hydrogen / other fuel cell technology

10. Non-fossil fuel heavy vehicles
11. Offsite construction to reduce onsite energy use

Optimising electricity use – current opportunities

1. Low carbon power supply
2. Grid connection, possibly with temporary transformer
3. Battery energy storage system
4. Electric powered machinery and equipment
5. Charging for electric vehicles and plant

Battery Energy Storage System – The Enertainer

78%

lower OPEX

(vs a 350/400kVA generator)

81%

less CO_2 footprint

(vs a 350/400 kVA generator)

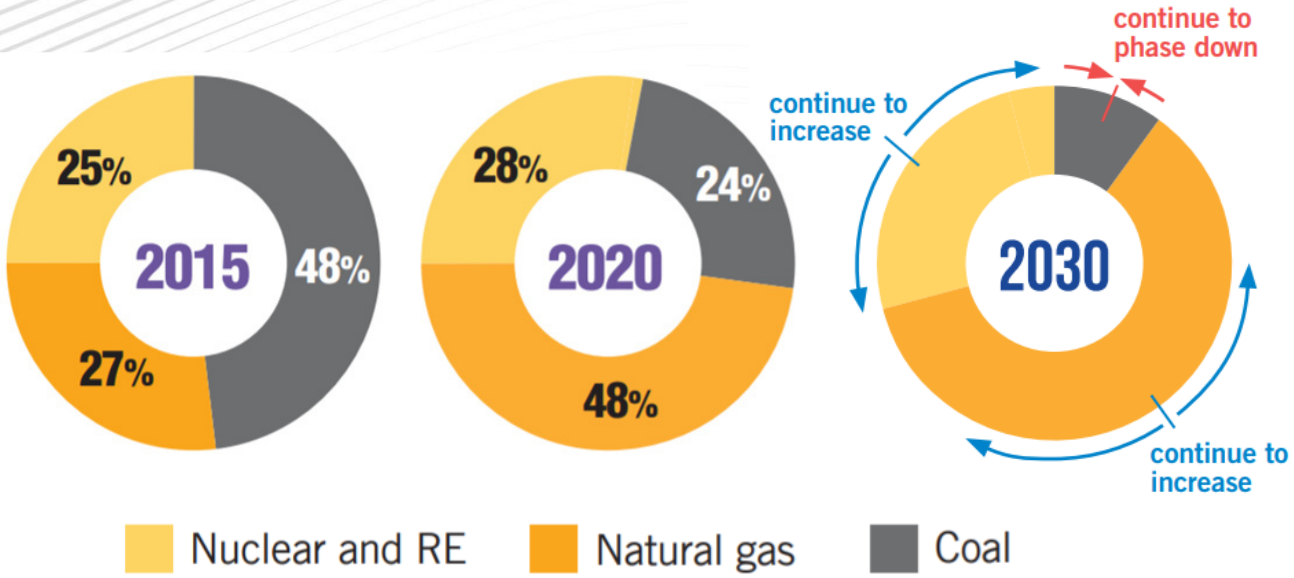
15

decibels* quieter than quietest type of generators used

(*in terms of sound power level)

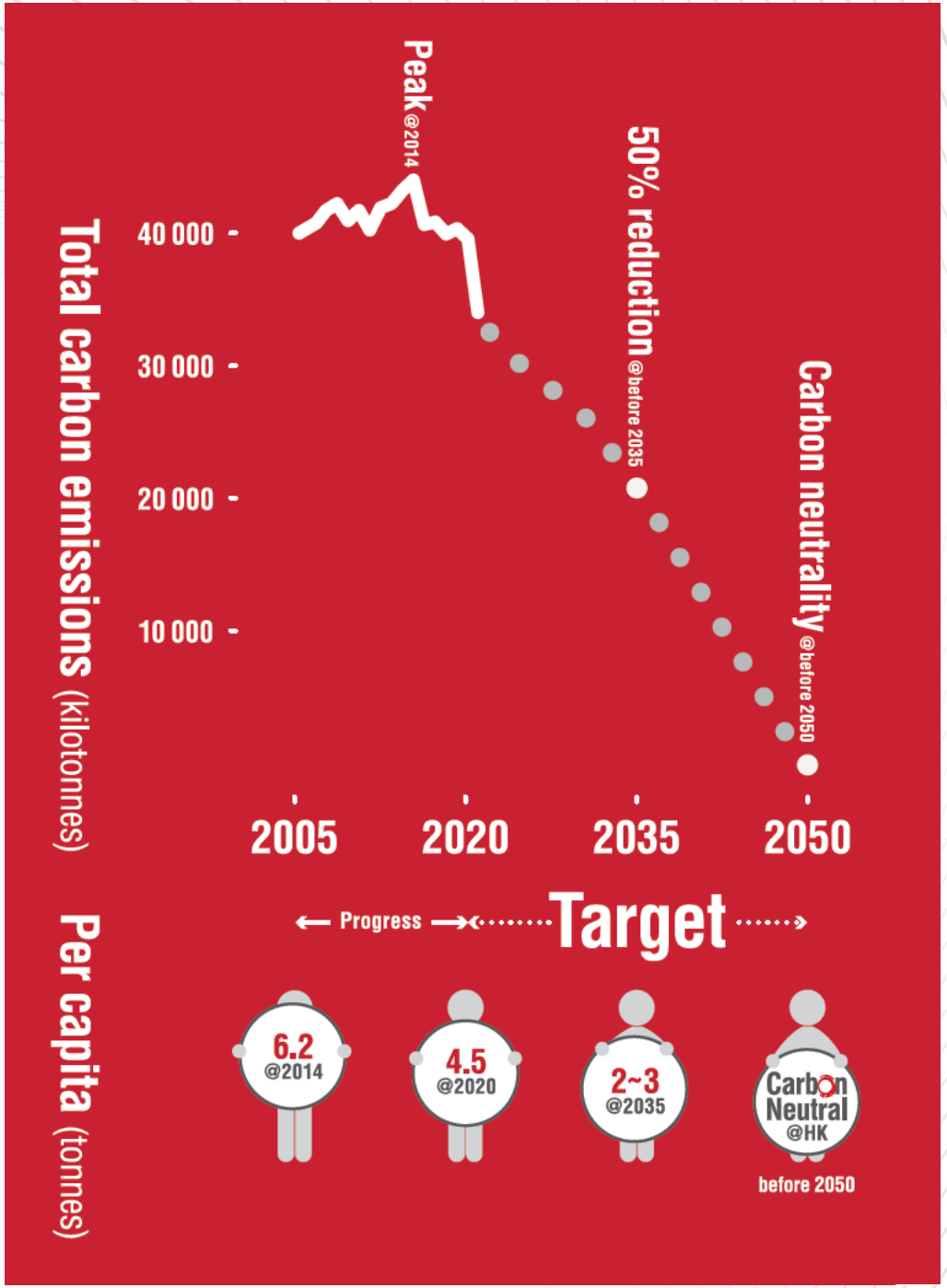
Diagram of the connection between the utility mains, Enertainer and the load.

Why electrify?



- Allows for more energy efficient operation compared to diesel generators
- Take advantage of planned decarbonisation of the electricity grid - phase out coal, more natural gas, more non-fossil fuels (e.g. FiT, offshore wind)

Sources: HKSARG Climate Action Plans 2030+ and 2050

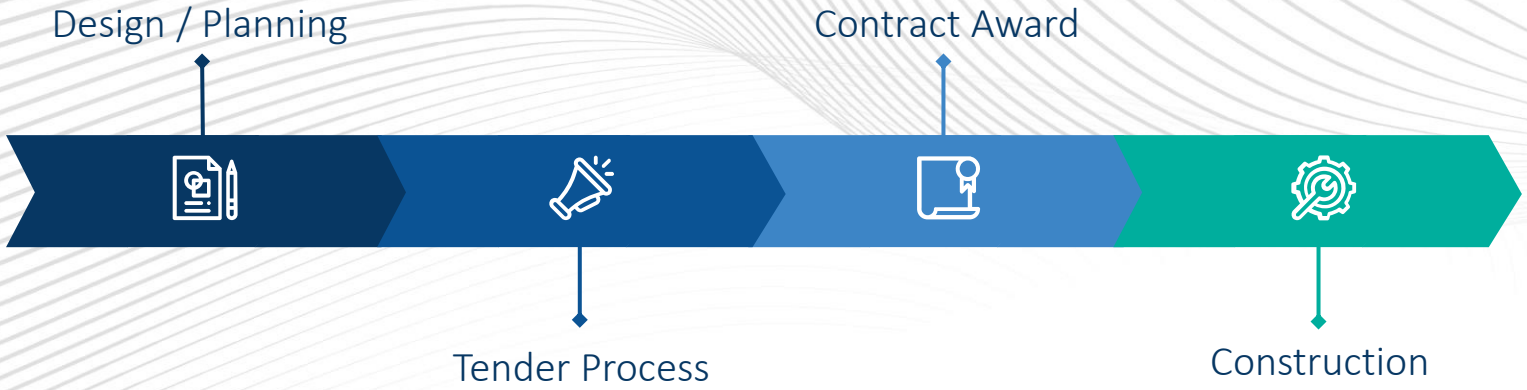


Why electrify? Decarbonisation + health + +

People regularly exposed to diesel exhaust fumes at work can be up to **40%** more likely to develop lung cancer*

* From International Agency for Research on Cancer (IARC). IARC treats diesel emissions as Group 1 carcinogen - definite cause of cancer in humans

Current workflow



Temp Power Estimation	Application to Power Company	Site Works

Typically waiting around 6 months before power connection

Normally insufficient power on site

Cannot adopt electric plant efficiently until sufficient electricity supply available

Early electrification on Government projects

In September 2020, the Development Bureau announced that all public work contracts must apply for temporary electricity and water supply for tenders issued after February 2021 to facilitate the use of electric plant, equipment and vehicles.

Application during detailed design with pre-construction for connection before construction starts (only up to 400 Amps)

發展局
Development Bureau

Technical Circular (Works) No. 13/2020
Timely Application of Temporary Electricity and Water Supply for Public Works Contracts and Wider Use of Electric Vehicles in Public Works Contracts

What about private sector?

https://www.devb.gov.hk/filemanager/technicalcirculars/en/upload/378/1/TCW%2013-2020.pdf

Engaging the private sector in early electrification

Supporting BEC to deliver a two-year **Power Up Coalition** programme of activities:

- The **Power Up Coalition** would encourage and facilitate timely electrification of construction sites to non-public works projects in Hong Kong, reduce use of diesel generators & diesel equipment, and promote zero-emission construction sites in the long term.
- Gammon recognised as ‘Founding Member’
- Guideline and peak electricity forecasting tool developed and under review

All companies are welcome! *Please approach BEC for more details Information can be found under Low Carbon Charter:* https://bec.org.hk/en/bec-low-carbon-charter

Current workflow

Design / Planning

Tender Process

Contract Award

Construction

Temp Power Estimation	Application to Power Company	Site Works

Proposed workflow

Design / Planning

Typically waiting around 6 months before power connection

Normally insufficient power on site

Cannot adopt electric plant efficiently until sufficient electricity supply available

Construction

Temp Power Estimation	Application to Power Company	Construction starts


Jeg er elektrisk
VEIDEKKE
ZLINE


ELECTRIC
JCB


LIEBHERR


ENERGYA
CIFA

Vision for transition to zero carbon

1. Low carbon power supply
2. Grid connection, possibly with temporary transformer
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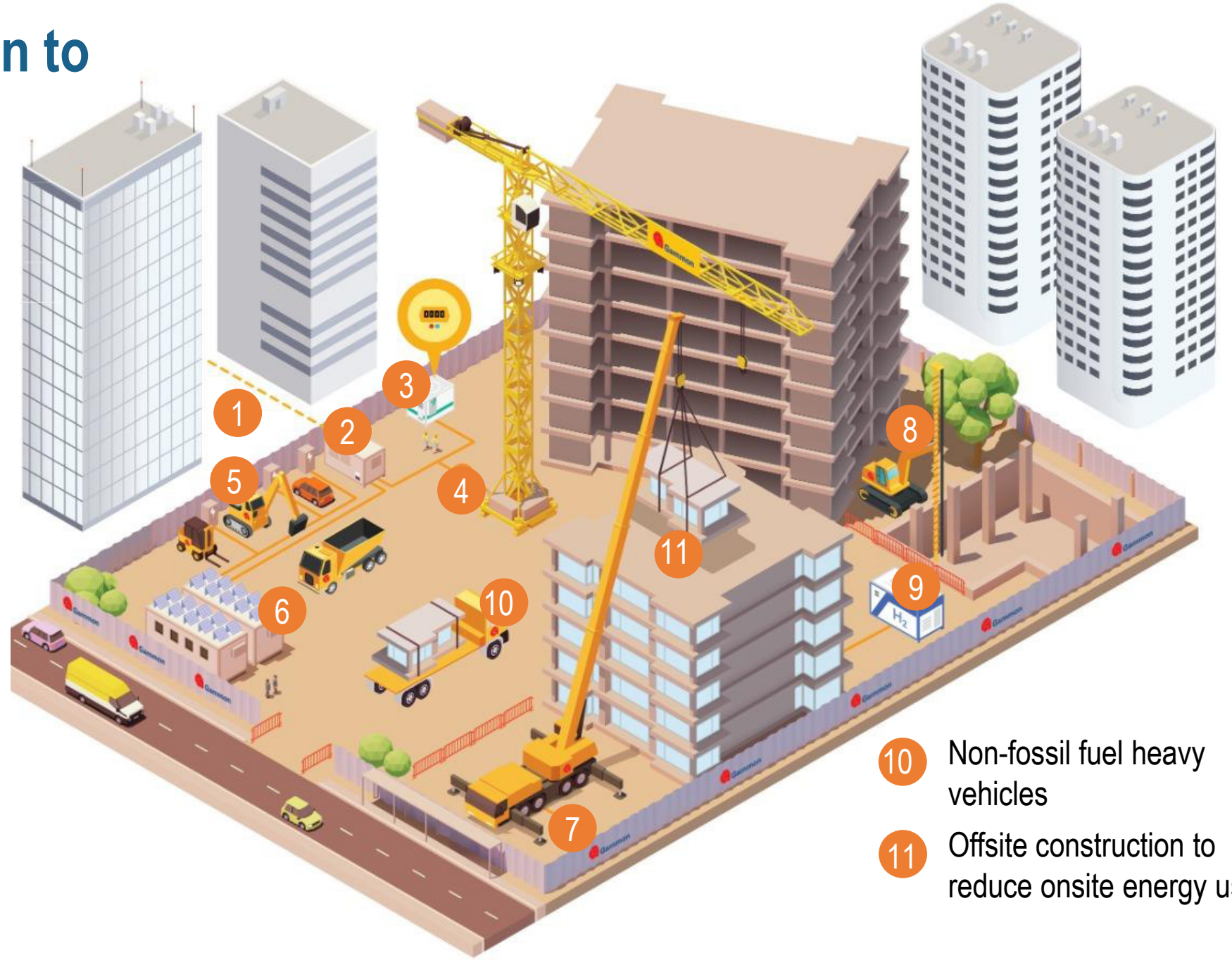
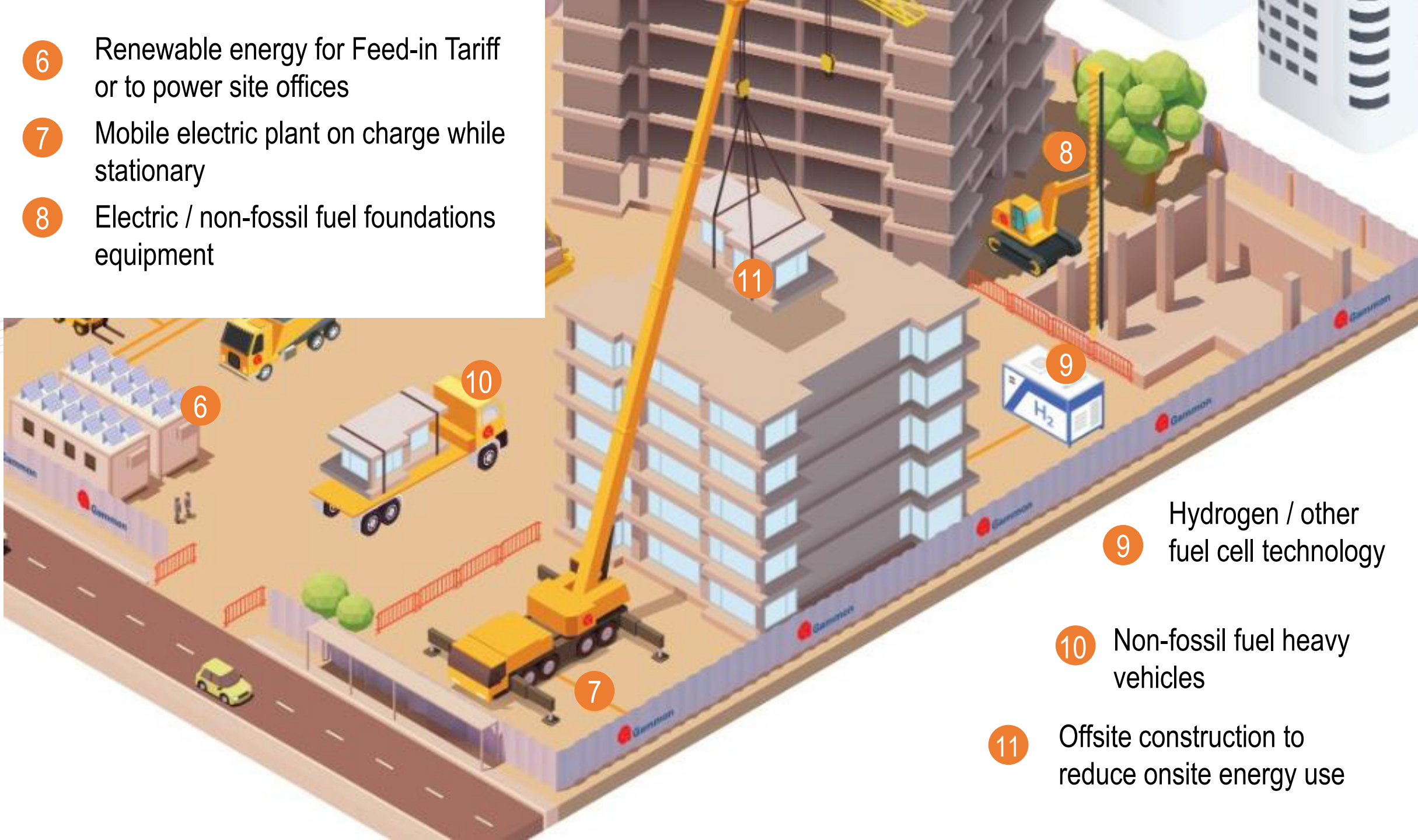


10. Non-fossil fuel heavy vehicles
11. Offsite construction to reduce onsite energy use

6 Renewable energy for Feed-in Tariff or to power site offices

7 Mobile electric plant on charge while stationary

8 Electric / non-fossil fuel foundations equipment



9 Hydrogen / other fuel cell technology

10 Non-fossil fuel heavy vehicles

11 Offsite construction to reduce onsite energy use

Wider renewables adoption possible

- Potential for renewable energy on major multi-year projects
- Take advantage of Feed-in-Tariff
- Connection to the power grid is prerequisite

Sai Sha Road Widening Work – 2019 CLP Smart Energy Award "Renewable Energy Category" Excellent Award

Gammon Technology Park

CLP Smart Energy Award

Renewable Energy

Category

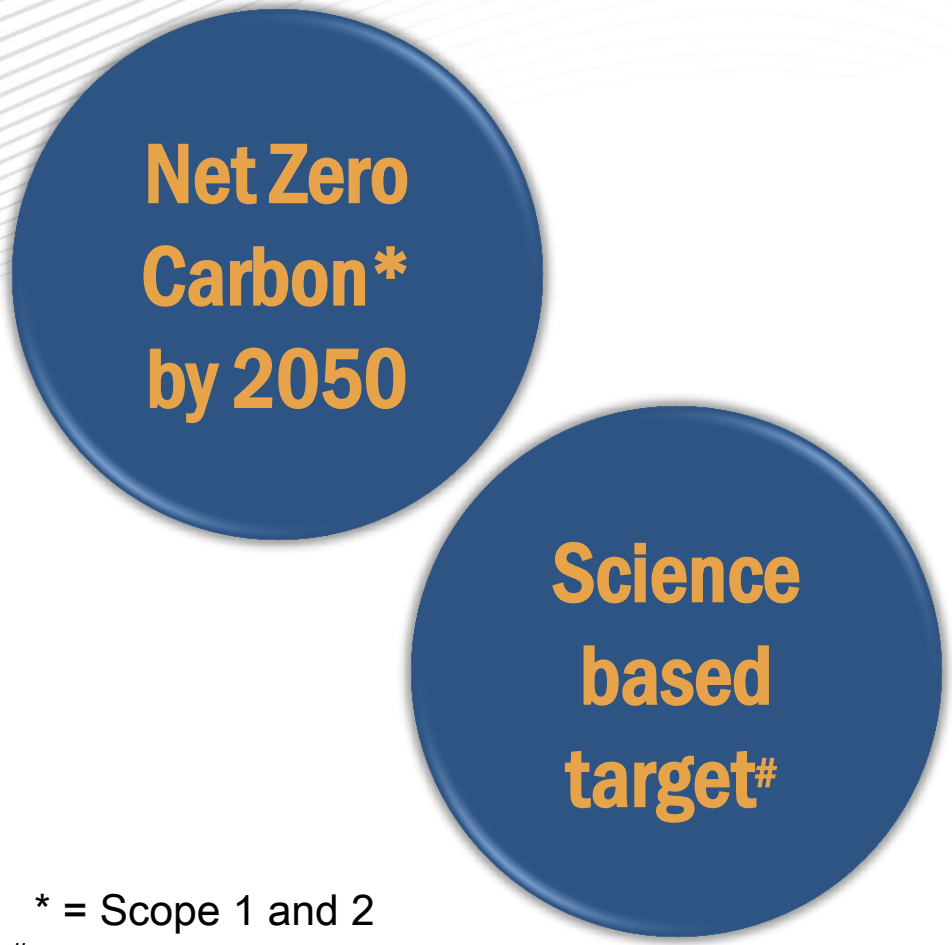
Grand Award

&

BEAM Plus

Existing Building
(Selective Scheme):
Energy - Excellent)

Gammon Climate Action Plan

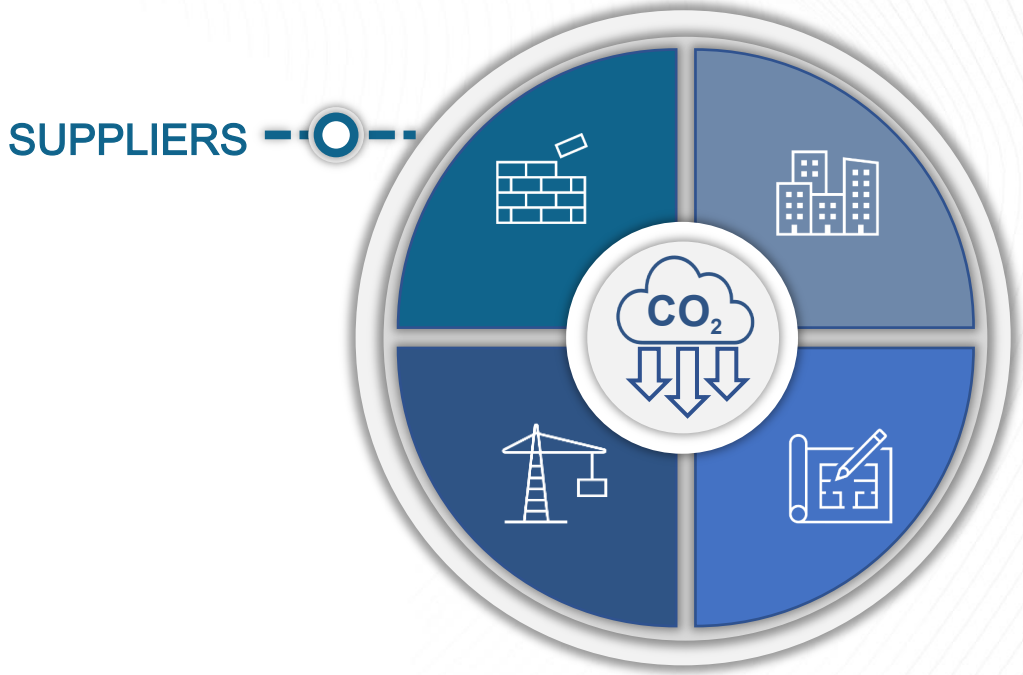


* = Scope 1 and 2
# = Scope 1, 2 and 3

- Reporting against recommendations of **Taskforce on Climate-related Financial Disclosures** in 2021 Sustainability Report
- Developing climate action plan to enable commitment to **Science Based Targets Initiative** during 2022 and seek approval in 2023
- Minimum 50% reduction by 2035 (Scope 1 and 2) and net zero by 2050 in line with HKSARG ambition for climate neutrality

Climate change mitigation

Role of suppliers / manufacturers



Suppliers

Low carbon materials

Global Cement and Concrete Association

Roadmap to net-zero in 2050

worldsteel ASSOCIATION

Responsible Steel standards & certification

Low Carbon Concrete Mixes

PLATINUM

CIC GREEN
PRODUCT CERTIFICATION
CARBON LABELLING SCHEME

384 mixes assessed,

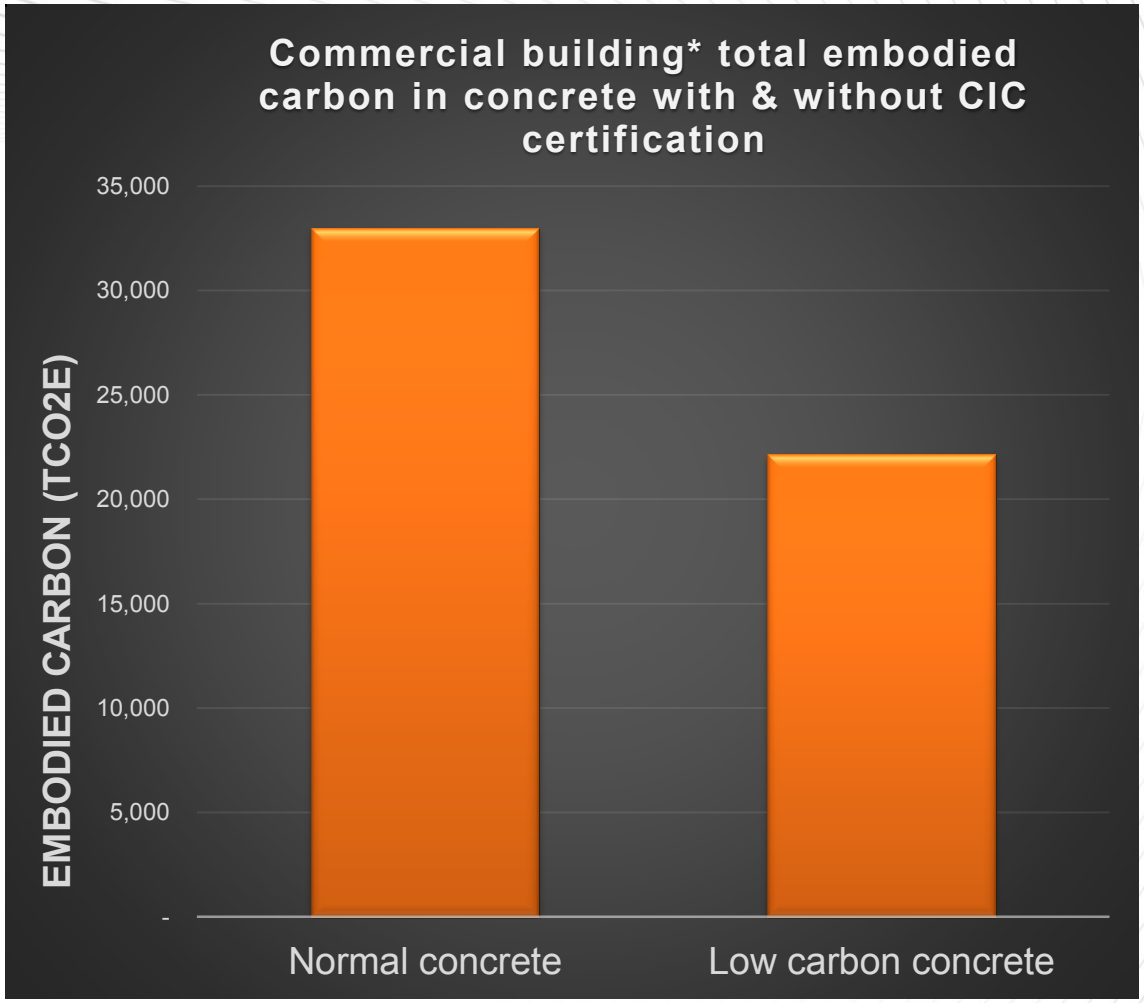
82% Platinum

11% Gold

CIC Green Product Certification

High performance lower carbon concretes

- Lifecycle green house gas emission assessment verified against ISO 14067 Greenhouse gases — *Carbon footprint of products — Requirements and guidelines for quantification*
- The first concrete mixes in HK with CIC Carbon Labels
- Typically 15-30% carbon reductions
- Carbon curing technology adoption in 2022
- Potential GGBS cement replacement up to 50%

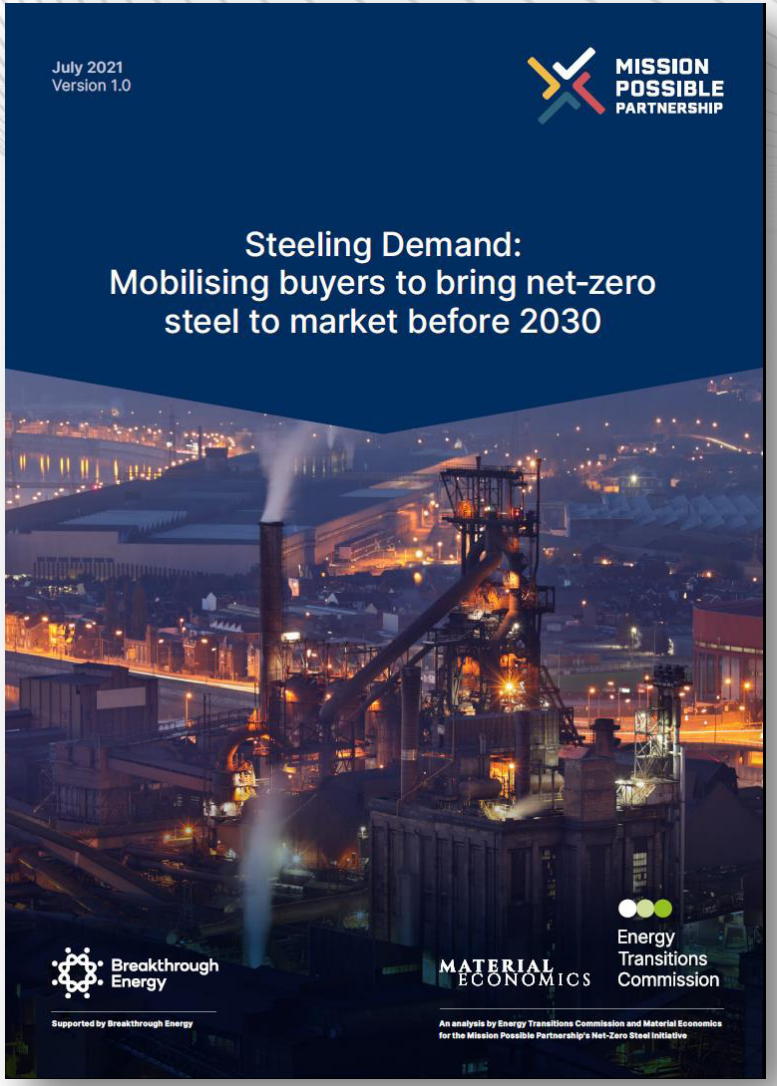


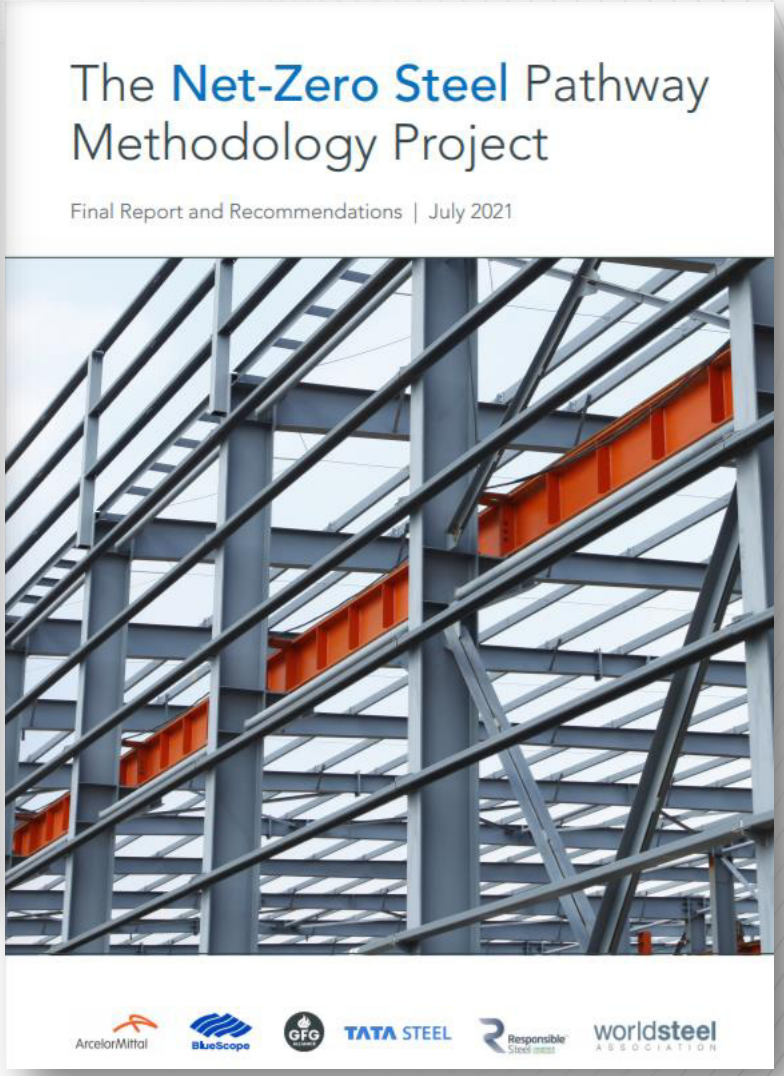
** Completed commercial building with actual concrete quantities / mix types used with indicative carbon footprints from CIC CAT*

Steel

Limited supplies with certified high recycled content or low carbon production – externally assured carbon footprint or Environmental Product Declaration

Demand will increase - cost premiums likely





worldsteel ASSOCIATION

Responsible Steel™ standards & certification

CARES SUSTAINABILITY

UKAS PRODUCT CERTIFICATION 002

Conclusion

Climate Change Mitigation: What can you do right now?

Gammon

SUPPLIER
Source / produce low carbon intensity products

PROPONENT
Life-cycle carbon assessment and low carbon specifications

CONTRACTOR
Deliver efficiently, offsite using low carbon energy

DESIGNER
Lean design and programme offsite construction

Thank you

Gammon