BUSINESS ENVIRONMENT COUNCIL
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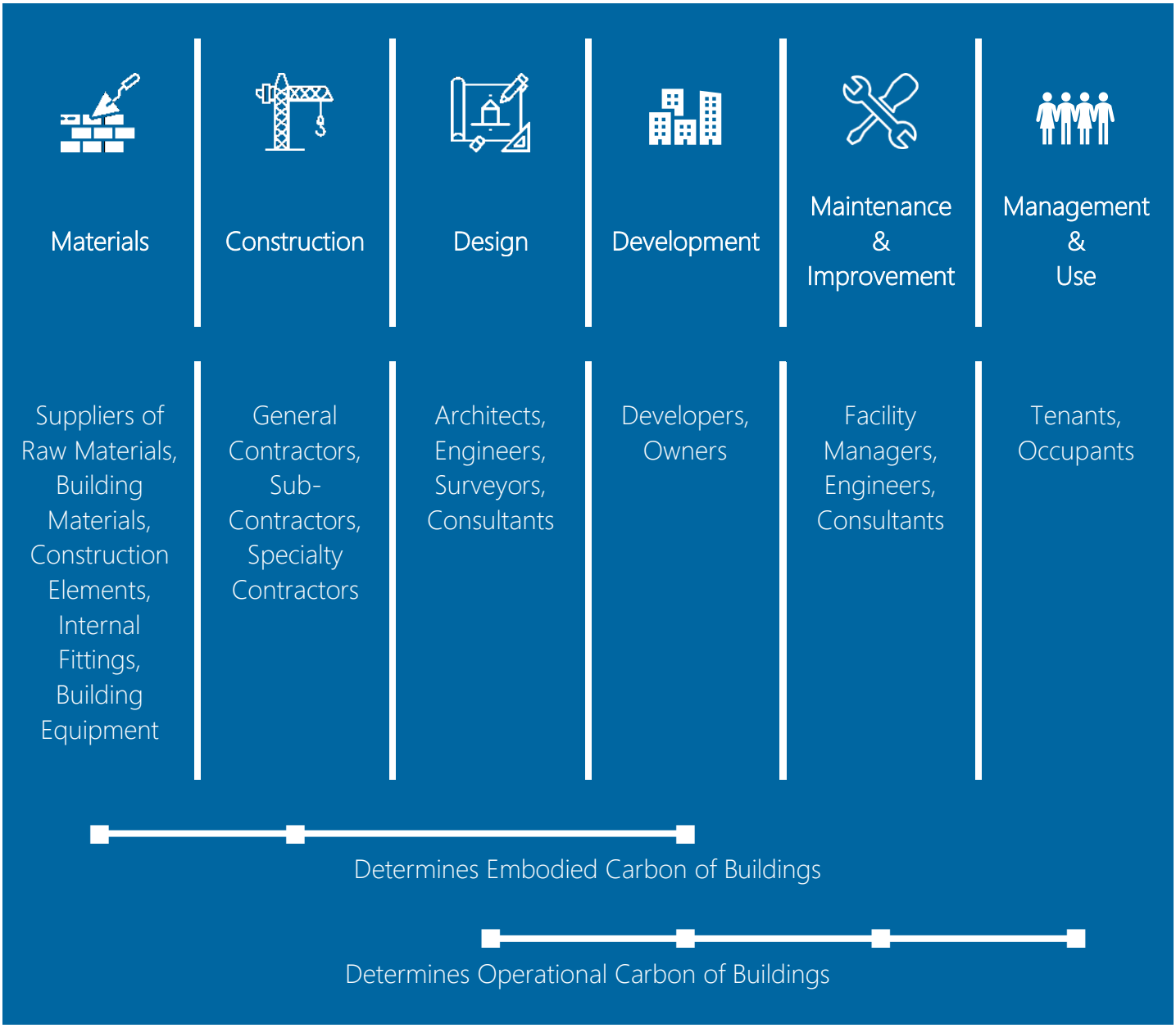
# Achieving Significant Decarbonisation in the Property & Construction Sector

## Executive Briefing

June 2019

# Mapping the Property & Construction Value Chain




In this Executive Briefing, for simplicity, materials and construction are defined as contributing to buildings' embodied carbon. Design is scoped as applied to new buildings and defined as design approaches which influence the operational performance of buildings. Development is scoped as the interaction of the materials, construction and design processes and defined as influencing both embodied and operational carbon of buildings. Maintenance, improvement, management and use are scoped as applied to existing buildings and influencing the operational carbon of buildings. Maintenance and improvement are defined as improving buildings through "hard" approaches such as upgrading building equipment. Management and use are defined as using "soft" approaches such as smart management to drive behaviour change to improve buildings carbon performance. These processes are presented in the order of carbon flow. This conceptualisation draws upon World Business Council for Sustainable Development's SBT4buildings discussion paper.[1]

[1] https://www.wbcsd.org/Programs/Cities-and-Mobility/Sustainable-Cities/Science-based-targets/Resources/framework-carbon-emissions-management-building-construction-value-chain

# Decarbonisation of Materials & Construction

The contribution of construction and materials towards buildings' lifecycle carbon footprint can vary significantly depending on project-specific conditions, but on average account for 15-20%, and as much as 40% of buildings' total lifetime carbon footprint.

## Materials

There are two principles for reducing buildings embodied carbon from materials: use less materials and use lower-carbon alternative materials. The below figures are drawn from research by Waste and Resources Action Programme.[2]

| Initiative | Impact |
|---|---|
| Adopt more efficient building design, e.g. employing compact building form. | Up to 5% carbon reduction depending on building type. |
| Adjust specifications for major building elements, e.g. using lower-weight roof design. | Up to 20% carbon reduction depending on specifications. |
| Design for less waste on site, e.g. planning efficient work sequences. | Up to 10% carbon reduction depending on material specified and extent of off-site construction. |
| Select materials with lower-carbon intensities, e.g. applying cement substitutes such as pulverised fuel ash. | Up to 20% carbon reduction depending on building type and specification. |
| Reuse materials or use materials with higher recycled content, e.g. reclaimed bricks, aggregates for foundation works and filling materials. | Up to 10% carbon reduction depending on reusable materials type and availability. |

Planning buildings for deconstruction and disassembly at the end of life is a key enabler for effectively gathering materials for reuse and recycling.[3]

## Construction

Key factors contributing to construction process emissions include the transportation of materials and equipment to construction sites, the use of heavy construction machinery, and waste generated.

| Initiative | Impact |
|---|---|
| Use clean energy, e.g. using biofuels or grid electricity in construction equipment and transportation. | Carbon reduction varies depending on extent and type of energy use. |

[2] http://www.wrap.org.uk/sites/files/wrap/FINAL%20PRO095-009%20Embodied%20Carbon%20Annex.pdf
[3] http://rpe.hkqbc.org.hk/download/Green_Design_Guide_Eng.pdf

| | |
|---|---|
| Adopt offsite construction, e.g. through fabrication and assembly of building elements offsite. | Up to 10% carbon reduction depending on extent. Reduces material waste, achieves 30% shorter construction time, improves quality control, and enhances safety.[4] |

### Green Procurement

Green procurement incorporates sustainability criteria in the process of identifying and purchasing products or services. Green procurement can be readily practiced by developers when sourcing materials and services.

#### Green Procurement Tips for Project Proponents

**Communicate Expectations Clearly**

- Sustainability specifications should be consistent, have no information gaps, and set out in prominent and easy-to-understand forms across all contract documents.
- Procurement requirements should be communicated to all stakeholders – suppliers, contractors, architects, and even your own staff.
- Early engagement with suppliers is important to understand what can be provided and achieved.

**Set a Challenge**

- Project proponents should request high standards. Suppliers and architects will innovate to meet and even exceed requirements.

## Decarbonisation Through Design & Development

Buildings account for 90% of electricity consumption in Hong Kong and more than 60% of the city's carbon emissions. As such, for all new buildings, it is important to design and develop them so that they operate in a low carbon manner. The figures below draw from a BEC Institute of Environmental Education course.[5]

### Design Approaches

| Initiative | Impact |
|---|---|
| Ensure the building is well insulated to minimise unwanted heat transfer, e.g. through using spray-on materials, prefabricated buildings components with built-in insulation layers, higher wall-to-window ratio, and double-glazing windows. | Up to 35% carbon reduction depending on extent and type of insulation. Also reduces noise pollution entering the indoor environment. |
| Utilise natural ventilation to reduce cooling demand, e.g. through building shape and design, openable windows, chimney-type features. | Up to 25% carbon reduction depending on design and natural environment conditions. In favourable climate zones, cooling energy demand can be reduced by up to 78%. |

[4] https://www.gammonconstruction.com/en/html/press/press-921ffc3b60b54255a9322bc5119d8f8a.html
[5] https://www.beamsociety.org.hk/files/BEC/20161123_BEAM%20Plus%20EU_Session3_MKL.pdf

| | |
|---|---|
| Minimise unwanted solar gain that heats up buildings, e.g. through shading, building orientation, using overhangs and balconies for shading, recessed windows, and low-e glass. | Up to 20% of carbon reduction depending on extent and natural environment conditions. Can also reduce noise pollution entering the indoor environment. |
| Make use of natural lighting, e.g. using light tubes and through smart layout of building. | Up to 5% of carbon reduction depending on extent and building design. Using daylighting systems can achieve 50% more energy saving compared to using LEDs. |
| Use onsite renewable energy systems and energy efficient systems. e.g. using solar PV system. | Carbon reduction varies depending on extent and type of systems used. |
| Create cool neighbourhoods, e.g. capture and utilise waste heat generated, using light-coloured surfaces, planting vegetation. | Carbon reduction varies depending on design and local environment. Green roof systems can achieve up to 10% carbon reduction.<br><br>This avoids the feedback loop of buildings needing more cooling, releasing more heat, which heats up the environment and buildings requiring more cooling, and so on. |

## Tools for Smart Development

Integrated Design Process (IDP) is a collaborative method that involves the full participation of stakeholders including building elements suppliers, contractors, architects, engineers, owners, developers and facility managers at an early stage and with a transparent flow of information. IDP will facilitate the understanding of sustainability objectives across all parties and enable stakeholders to jointly and optimally plan for buildings to be low carbon throughout their entire lifecycle. IDP can lead to reduced construction waste, reduced design mistakes, and avoid the need for major repairs and alterations in the future.

Building Information Modelling (BIM) is a model-based architectural drawing tool that can visualise, plan, and analyse building performance across its lifecycle. BIM enables more efficient planning, design, construction and management of buildings by optimising the construction schedule, revealing potential design faults, simulating building performance, and enabling detailed and accurate information exchange. BIM can help ensure buildings are designed to be low carbon and operate as intended.

# Decarbonisation Through Maintenance & Management

Given buildings' prominence in Hong Kong's carbon emissions profile and that buildings typically have a lifespan of well over half a century, buildings need to be maintained – and in some cases improved – to ensure they continue to operate in a low carbon manner throughout their lifetime. Smart management approaches are also key to encourage low carbon behaviour in the usage of buildings.

## Retrofitting

Retrofitting is the modifications of existing buildings to improve their energy efficiency and overall carbon performance.

BEC's Energy Efficient Retrofits Guide found that for an average 20-storey office building, implementing upgrade options with payback periods of 10 years or less can already achieve more than 50% operational carbon emissions reduction cumulatively. The initiatives are described below.

| Initiative | Impact |
|---|---|
| Adjust the chilled water supply setpoint of chiller plants based on seasonal outdoor temperatures. | Up to 2% carbon reduction, with payback period of 0.1 year. |
| Reduce illuminance to 300 lux from 500 lux. 300 lux is sufficient for modern offices where occupants primarily use computers. | Up to 11% carbon reduction, with near-immediate payback. |
| Install variable speed drives for chilled water pumps, providing chilled water according to demand. | Up to 3% carbon reduction, with payback period of 0.4 year. |
| Install air pollutant sensors in carpark exhaust fans, operating only when ventilation is needed rather than running nonstop. | Up to 2% carbon reduction, with payback period of 1 year. |
| Install solar photovoltaic panels to generate and/or utilise renewable energy. | Up to 1% carbon reduction, with payback period of 7 years. The payback period may be less now with the feed-in tariff schemes. |
| Install regenerative braking in elevators. | Up to 1% carbon reduction, with payback period of 3 years. |
| Replace lights with LEDs in landlord areas. | Up to 3% carbon reduction, with payback period of 1 year. |
| Install daylight and occupancy sensors for lighting control. | Up to 4% carbon reduction, with payback period of 2 years. |
| Replace air handling unit fans with electrically commutated plug fans arranged in fan walls. | Up to 2% carbon reduction, with payback period of 10 years. |

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|---|---|
| Install intelligent building management systems. | Up to 3% carbon reduction, with payback period of 10 years. |
| Replace chillers with oil-free water-cooled chillers. | Up to 8% carbon reduction, with payback period of 4 years. |
| Install fresh air demand-controlled ventilation to modulate ventilation rates. | Up to 11% carbon reduction, with payback period of 4 years. |

## Retro-Commissioning

Most buildings lose up to 30% of their energy efficiency in the first three years of operation.[6] This can be due to changes induced by alteration works, drift off from control set points, or substandard maintenance.

Retro-commissioning is a systematic process to evaluate an existing building's performance, identify opportunities for operational improvements, and bring the building stock up to the designed performance standard. This typically involves checking whether equipment and systems are functioning properly and fine-tuning of building equipment and control systems. On average, retro-commissioning can reduce a building's energy use and hence carbon emissions by 7-22%, depending on the building's original conditions.

## Management & Occupant Behaviour

While hardware is important for low carbon buildings, people, processes and the tools that empower them are just as important. This is about behaviour change on the part of buildings managers and occupants.

Good management practices typically involve collecting and analysing data to increase visibility and for more precise control of systems and behaviour. This in turn leads to improved operations, planning, and reporting. Good management has been shown to reduce buildings operational carbon by up to 20%.[7] A few individual initiatives are described below.

| Initiative | Impact |
|---|---|
| Switch off all appliances fully when not in use. | Up to 12% carbon reduction, depending on initial pattern of appliance use.[8] |
| Set air conditioner thermostat at 25.5°C. | Up to 2% carbon reduction for every 3°C increased.[9, 10] |
| Use clean air conditioner filters or replace clogged air filters with clean ones. | Up to 4% carbon reduction, depending on the initial state of filters.[11] |

[6] https://ashraeny.org/images/meeting/102516/buildingeq_ase___ny_chapter.pdf
[7] http://bec.org.hk/files/images/BEC_Topical_Digest/Issue_38/BEC_TD_38_LCHK_6_June_2018_Workshop_Highlights.pdf
[8] http://www.hkia.net/UserFiles/Image/forum%20on%20Carbon%20Emission/Forum%20on%20Carbon%20Emission%20Reduction%20(WWF)_r.pdf
[9] https://www.enb.gov.hk/sites/default/files/susdev/html/en/council/ccc_ird_e.pdf
[10] https://www.emsd.gov.hk/filemanager/en/content_762/HKEEUD2018.pdf
[11] https://www.energy.gov/energysaver/maintaining-your-air-conditioner

## Significant Decarbonisation is Possible

This Executive Briefing presents a succinct overview of the property & construction sector, and the various decarbonisation initiatives that can be pursued at each stage of the value chain. The initiatives described here are by no means the sole options for decarbonising in this sector. The objective of this Executive Briefing is to show that significant decarbonisation is possible. You are encouraged to use this, along with other available resources, as reference to support your decarbonisation process.

# Background: The Low Carbon Hong Kong Initiative

Low Carbon Hong Kong is an initiative of BEC which aims to support businesses develop strategies and targets aligned with the goals of the Paris Agreement. Since 2016, milestones under the initiative include the publication of an introductory report, a series of workshops for different business sectors backed up by research, and engagement activities with C-Suite. All the early works culminated to the BEC Low Carbon Charter, launched in 2019, under which companies pledge to step up their decarbonisation endeavours and commit to set and achieve decarbonisation targets. This Executive Briefing is part of a suite of tools designed to support signatories of the Charter, and businesses more generally, to set and achieve decarbonisation targets.


### Acknowledgments

BEC would like to thank the Steering Committee Members of BEC Climate Change Business Forum Advisory Group for their contributions and financial support to the Low Carbon Hong Kong initiative and the development of this Executive Briefing. BEC staff Mr Simon Ng and Mr Jonathan Ho led the Low Carbon Hong Kong initiative and the development of related materials.


### About BEC & BEC CCBF AG

Business Environment Council Limited ("BEC") is an independent, charitable membership organisation, established by the business sector in Hong Kong. Since its establishment in 1992, BEC has been at the forefront of promoting environmental excellence by advocating the uptake of clean technologies and practices which reduce waste, conserve resources, prevent pollution and improve corporate environmental and social responsibility. BEC offers sustainable solutions and professional services covering advisory, research, assessment, training and award programs for government, business and the community, thus enabling environmental protection and contributing to the transition to a low carbon economy.

BEC Climate Change Business Forum Advisory Group ("BEC CCBF AG") promotes the awareness of, and builds capacity in relation to, climate change mitigation, adaptation and resilience activities amongst BEC's membership and the business community in Hong Kong. It also aims to provide a platform for BEC to engage relevant regulatory bodies on climate change-related matters, and forge collaboration between local and global experts on climate change.


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