



Decarbonising the Built Environment

December 2023



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Executive Summary

Decarbonisation as the next business opportunity. Businesses who incorporate sustainability into their operations can open doors into new business areas with better access to green financing. For example, green projects may only pre-qualify project developers who possess building development track records.

There are evidences supporting the investment viability for buildings to go green. The benefits of a green building includes (i) allowing landlords to command a rental premium; and (ii) lower vacancy rate with tenants wanting to lease space at green buildings.

Building owners need to assume an active role when they want to greenify their assets. Tackling an asset's carbon footprint will require building owners to identify areas for improvement and having a commercially viable execution plan that minimises disruption to the asset's daily operations.

Embodied and operational carbon are intimately connected. Building owners will need to adopt a whole life carbon assessment in order to make an informed decision that will effectively reduce an asset's overall carbon footprint. There will be instances where building owners will need to balance the trade-off of incurring more embodied carbon upfront to reduce operational carbon over the asset's life cycle.

Building owners will need to be properly advised in order to mitigate the risk of greenwashing. This will involve working with the ecosystem stakeholders, from financial institutions, real estate advisory firms to their supply chains, in identifying unambiguous principles delineating the boundaries of what can be considered green.

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Decarbonising the built environment

The built environment ecosystem comprises real estate and infrastructure as well as service providers essential to keep these assets running smoothly. The smooth operation of the built environment is essential for society that it is almost impossible to function if there are any prolonged disruption. Unfortunately, the built environment is also a major contributor to greenhouse gas emission – accounting for close to 40 per cent of global carbon emission.

Decarbonisation as the next business opportunity. Businesses who incorporate sustainability into their operations can open doors into new business areas with better access to green financing. For example, green projects may only pre-qualify project developers who possess building development track records.

Decarbonisation of the built environment does not necessarily have to start from the top (i.e. the regulators and building owners). A frequent pain point cited by downstream ecosystem players is the absence of “technical requirements in order for the asset to be certified as green”. While this may have been cited in the past, it is increasingly unlikely that this reason will continue to hold water in the near future. The introduction and continued revision to Green Mark certification is testament on how the built industry attempts to address ambiguities related to green building classification.

Reduction in carbon emission is not the only outcome of decarbonisation. Some benefits, both tangible and intangible are shared below.

Figure 1: Benefits of decarbonising



Lower operating cost leads to increase in asset valuations



Reduce stress on shared resources through improvements in efficiency



Improvement to quality of life



Reduce strain on resource through wastage reduction

Source: UOB Analysis

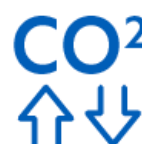
Three key themes for building owners



The investment economics of green buildings: why building owners should own / develop them



Tackling embodied carbon through implementation of sustainable building materials



The role of banks in financing the decarbonise efforts of the built environment

US\$24.7 trillion market opportunity for green buildings. World Green Building Council estimates that green buildings will represent an investment opportunity of US\$24.7 trillion by 2030, outlining a clear direction for building owners on what they should be thinking for the future. Bain estimates Southeast Asia's green building market size to be within US\$34 billion to US\$48 billion by 2030 with majority of the opportunity within the construction and operation stages.

Its time to address embodied carbon. With 70 per cent of an asset's carbon footprint being operational carbon, it stands to reason that regulators and forward-looking building owners have started or already complete address this aspect. This inevitably implies that an asset can only reduce its carbon footprint by addressing embodied carbon.

Financial institutions heavily influence the built environment through transactions and financing covenants. Financing cost is one of the key cost drivers in a building development therefore securing of financing is a crucial component for building owners. They also need to manage the risk of greenwashing when they obtain green/sustainability-linked financing hence working with financial institutions that have industry know-hows can minimise risk of being labelled as greenwashing.

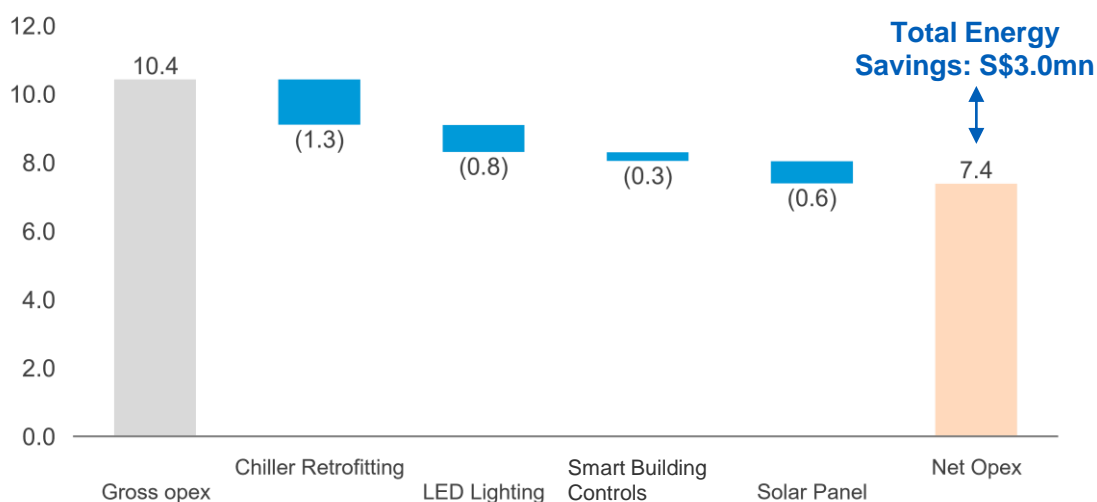
Investment economics of green buildings

Retrofitting a building to a green-certified building offers a shorter go-to-market option versus a greenfield and refurbishment project that may take 3 to 5 years depending on the size of the development. Hence, the value-add approach may improve investment returns for investors and building owners given the shorter time horizon under retrofitting.

By retrofitting existing buildings, building owners and tenants can look forward to improving their energy efficiency, cutting down their operating expenses and increasing the capital value of their properties. This is supported by findings from a study by Building and Construction Authority (BCA) and the National University of Singapore, which showed that the retrofitting of commercial buildings can lead to average expected savings in operating expenses of up to 13.5 per cent and up to 2.7 per cent increase in capital value, with an average payback period of about 6.3 years after the retrofit.

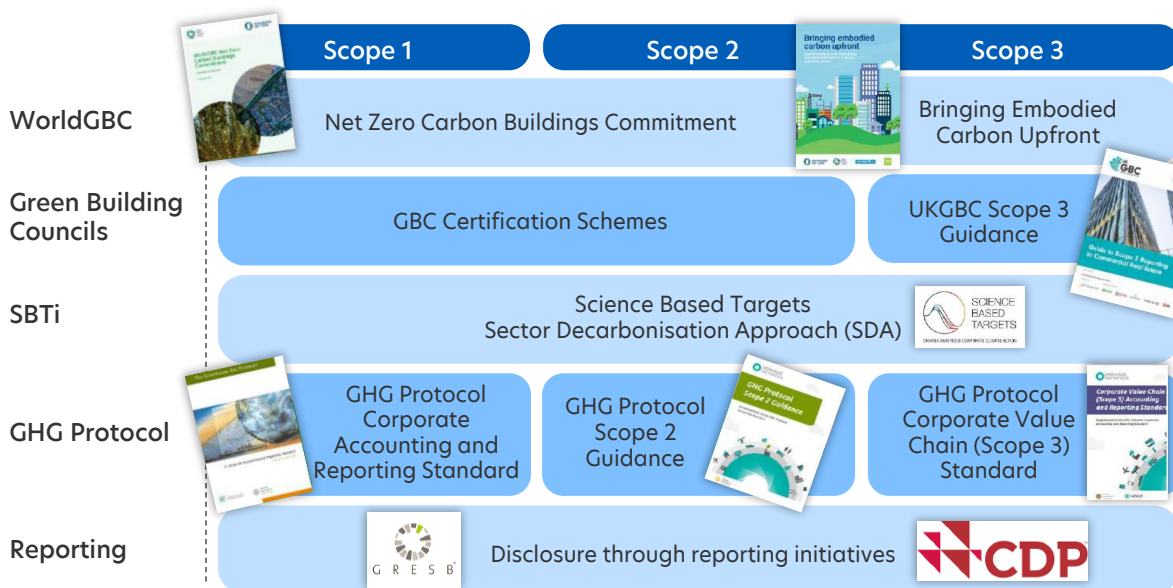
In fact, in 2013, BCA conducted a study on 40 existing commercial buildings comprising hotels, office and retail buildings, and mixed developments which had undergone retrofitting to achieve the Green Mark Gold, GoldPlus or Platinum rating. Results showed that owners of these 40 buildings saved a total of 90 GWh in energy, amounting to S\$24 million each year after retrofitting.

Figure 2: Case study of energy savings from retrofitting a retail mall



Source: UOB analysis

Figure 3: Scope 1, 2 and 3 Coverage Across Disclosure/Reporting Standards

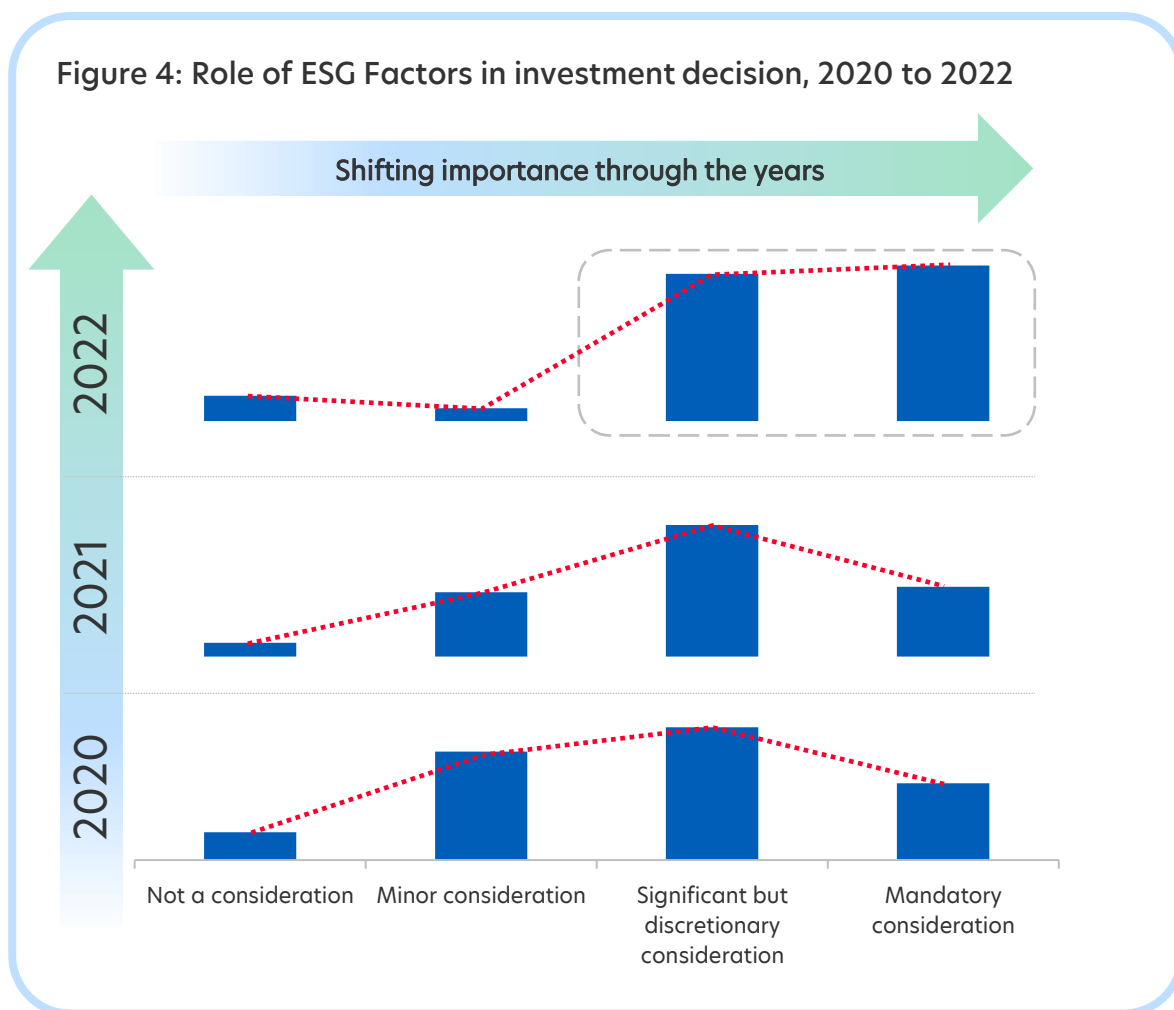


Source: City Developments Limited

How then should we think about embodied carbon relative to operational carbon towards the decarbonisation pathway? Borrowing the agricultural concept of “we reap what we sow”, **tackling embodied carbon upfront is of critical importance as it sets the trajectory of the decarbonisation pathway from day one.** It is important enough that embodied carbon (for new buildings) are captured under Scope 3 of all the definitions ranging from WorldGBC, Green Building Councils, SBTi, GHG Protocol and more.

Coupled with the implementation of stricter government regulations and increasing investor-activism in the ESG space, banks have also aligned themselves such that access to financing may be limited and costly. **Financing may be de-prioritised for development projects that are non green-building-certified** to a high standard as green certified buildings would have incorporated embodied carbon into its calculation methodology. Financing cost is one of the largest cost item in a building development as these assets are financially leveraged. Debt financing for projects without the “green” considerations may be viewed by financiers as having increased business risk.

Figure 4: Role of ESG Factors in investment decision, 2020 to 2022



Source: PwC, Urban Land Institute

This **perceived increase in risk would be translated into higher interest rates or more stringent loan terms**. Also, quality tenants, especially multi-national corporations (MNCs), will look towards having green buildings as a key criteria for the selection of their corporate locations across geographies, partly driven by corporate policy and partly driven by shareholder / investor activism in their home countries.

With the push from tenants, landlords and investors will need to embrace ESG considerations going forward. In fact, in a May 2022 report by Savills Research, ESG considerations are becoming increasingly mandatory as part of investment decisions and rental premium of offices for green certificates have been noted across markets in Asia Pacific.

Figure 5: Rental Premium of offices with Green certificates across markets, April 2022



Source: Savills Research & Consultancy, UOB analysis

The preceding rental premiums for office buildings with green certificates will encourage more landlords / investors to aspire and achieve green certifications going forward and therein lies the business opportunities. Quality tenants shifting their attention towards taking an active role in carbon tracking and monitoring of their leased premises especially with some taking on green leases is a trend that will evolve over time.

We see a **growing trend where landlords and tenants work together to address the tenant's carbon inventory**. Reducing tenant's carbon inventory is a win for both the tenant and landlord. From the landlord's perspective, this reduces their scope 3 carbon inventory and enhance asset valuation with improving net operating margins. From the tenant's perspective, a reduction in their carbon inventory can translate into reduction in operating cost, originating from the reduction in waste generated or electricity consumed. In fact, a 2021 survey of 60 corporate real estate occupiers from JLL found:

Figure 6: Survey results of 60 corporate real estate occupiers



1 in 2

occupiers agree that **sustainability is part of their corporate strategy**



7 in 10

occupiers are **willing to pay a rental premium to lease green buildings in the future**



8 in 10

occupiers agree that **real estate is a game-changer in achieving the net zero carbon agenda**



7 in 10

occupiers in **Singapore either have committed or plan to net zero carbon by 2025**

Source: "Road to 2030: Greening Singapore's real estate (Jan 2022)" - JLL

The survey results reinforces 2 notions. **Firstly, there are incentives for building owners to obtain industry recognized green-certifications for their assets. Secondly, the performance gap between green and non-green buildings is likely to widen in the coming years, transforming the real estate landscape.** To remain relevant, building owners can start by being aware and dealing with embodied carbon upfront for new developments and managing the impact of operational carbon. More information on how building owners can address their asset's carbon footprint will be covered in the subsequent section.

Case study: Unlocking asset value with sustainability

Key points

1. Singapore's first commercial building with BCA's Green Mark Platinum Zero Energy certification in 2020
2. Showcase of
 - How an existing building can adopt new energy efficient technologies while overcoming challenges with existing infrastructure
 - Effective implementation that minimises disruptions to ongoing operations

Energy Use Index (EUI) of <math><115\text{kWh}/\text{m}^2</math> per year

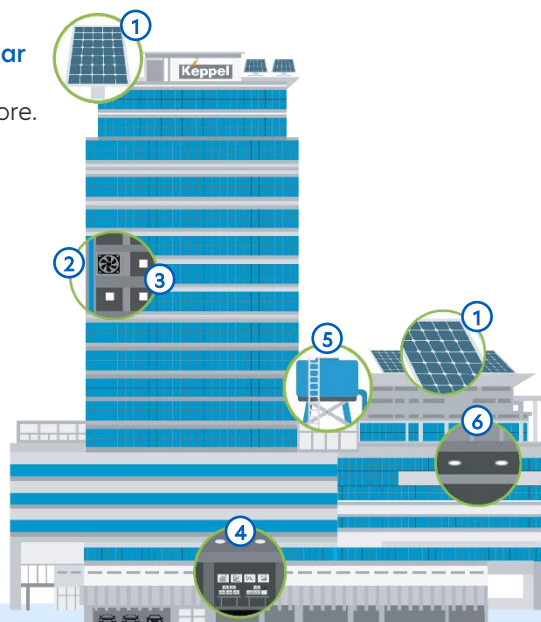
Almost 40 per cent more energy-efficient compared to typical office buildings in Singapore.

Overall energy savings of over 30% or 2.0 million kWh/year

Equivalent to the amount of energy required to power more than 400 five-room HDB flats in Singapore for a year.

Reduction of over 2,400 tonnes of carbon emissions per annum

The purchase of renewable energy certificates together with the installation of onsite PV panels at Keppel Bay Tower, result in a reduction of over 2,400 tonnes of carbon emissions per annum. This amount would otherwise require about 12,000 trees to absorb over approximately 50 years.




Smart Eco-Features of Keppel Bay Tower


- ① **PV Panel System** will generate about 100,000 kWh of energy per annum
- ② **Energy-Efficient Air Distribution System** with air handling unit fans that are about 45% more energy-efficient than other best-in-class technologies
- ③ **Demand Control Fresh Air Intake System** utilises integrated sensors to regulate fresh air intake according to indoor activities, optimising energy usage for better thermal comfort and indoor environmental quality
- ④ **Intelligent Building Control System** employs a high precision physics-based simulation engine to improve data analytics and control
- ⑤ **Cooling Tower Water Management System** utilises a patented solution that reduces cooling tower water usage and eliminates the need for chemical water treatment
- ⑥ **Smart Lighting System** utilises occupancy sensors which allow seamless transition in lighting levels according to building occupancy

Source: Keppel

Tackling embodied carbon through implementation of sustainable building materials

“Green building” targets and expectations across SEA

 **80%** of buildings (by gross floor area) by 2030

 Estimated **30%** of buildings by 2025

 Estimated **20-25%** of buildings by 2025

 Estimated **20-25%** of buildings by 2025

Sustainable building materials represents a \$20 billion to \$25 billion market in Southeast Asia with Singapore expected to lead in SEA for the adoption of sustainable building materials. Multiple decarbonisation initiatives were announced in June 2023 at the International Green Building Conference which includes the launch of embodied carbon calculator.

Second Minister for National Development Ms Indranee Rajah also commented on how private investors for real estate and infrastructure projects are more sensitive towards project green requirements – an indication of how the entire sector is aligning itself towards meeting the net-zero targets.

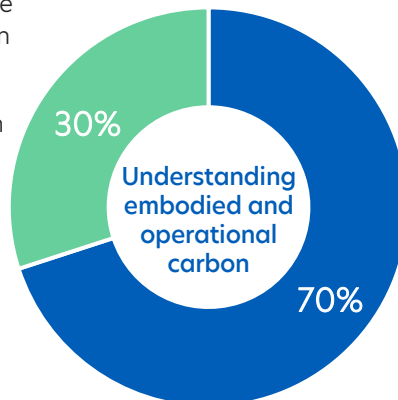
Embodied and Operational Carbon

The split for an asset's embodied and operational carbon is typically 30 per cent and 70 per cent respectively. In countries where redevelopment occurs more frequently (such as Singapore) due to shorter asset lifespan, the ratio for embodied and operational carbon can lean towards 40 per cent and 60 per cent respectively.

Figure 7: Understanding embodied and operational carbon



Embodied carbon refers to the carbon generated during the construction and / or redevelopment phase for the assembly of materials in an asset. The carbon is “locked-in” into the materials used for the asset construction throughout the asset life or when it undergoes an asset enhancement initiative.

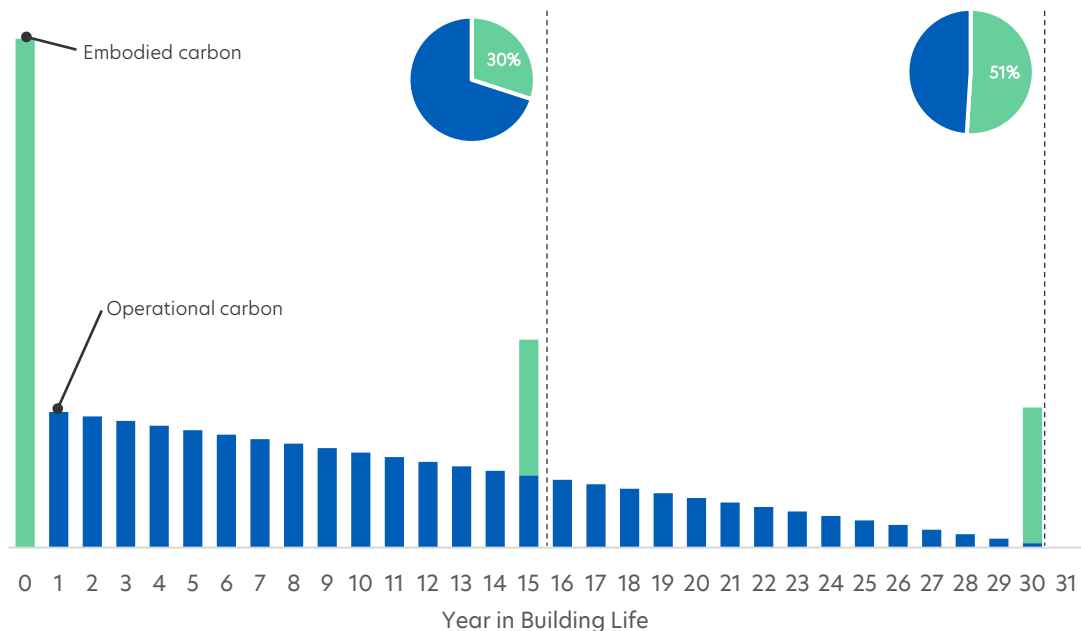


Operational carbon refers to carbon generated from the building's operations such as electricity, heating and cooling, and lighting.

Unlike operational carbon, embodied carbon cannot be reduced over an asset's lifetime. Embodied carbon aggregates the entire supply chain carbon footprint from raw materials, transportation and final assembly. Without deliberate and early intervention at the design or planning stage, it is almost impossible to improve an asset's embodied carbon.

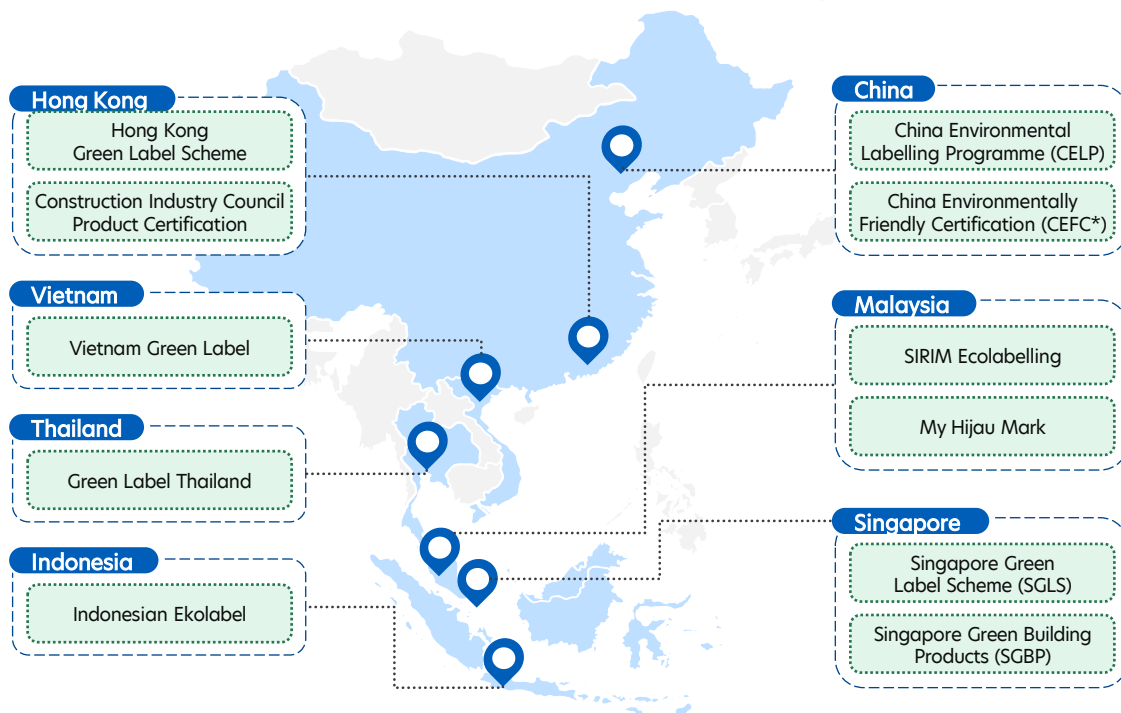
Embodied carbon - the growing elephant in the room. According to UN Environment Global Status Report 2017, embodied carbon is forecast to take up 41 per cent of new buildings by 2050, an increase from the current 30 per cent on the back of improving building efficiency. An illustration of how carbon is generated in an asset is presented below.

Figure 8: Operational versus Embodied Carbon



This feature is not unexpected due to the combination of improvement to operational efficiency as well as decarbonization of the grid which reduces the annual operational carbon footprint. Compared to operational carbon, tackling embodied carbon requires a more active intervention. It begins with adoption of sustainable building materials.

Figure 9: Certifications/labels in selected countries



Sustainable building material

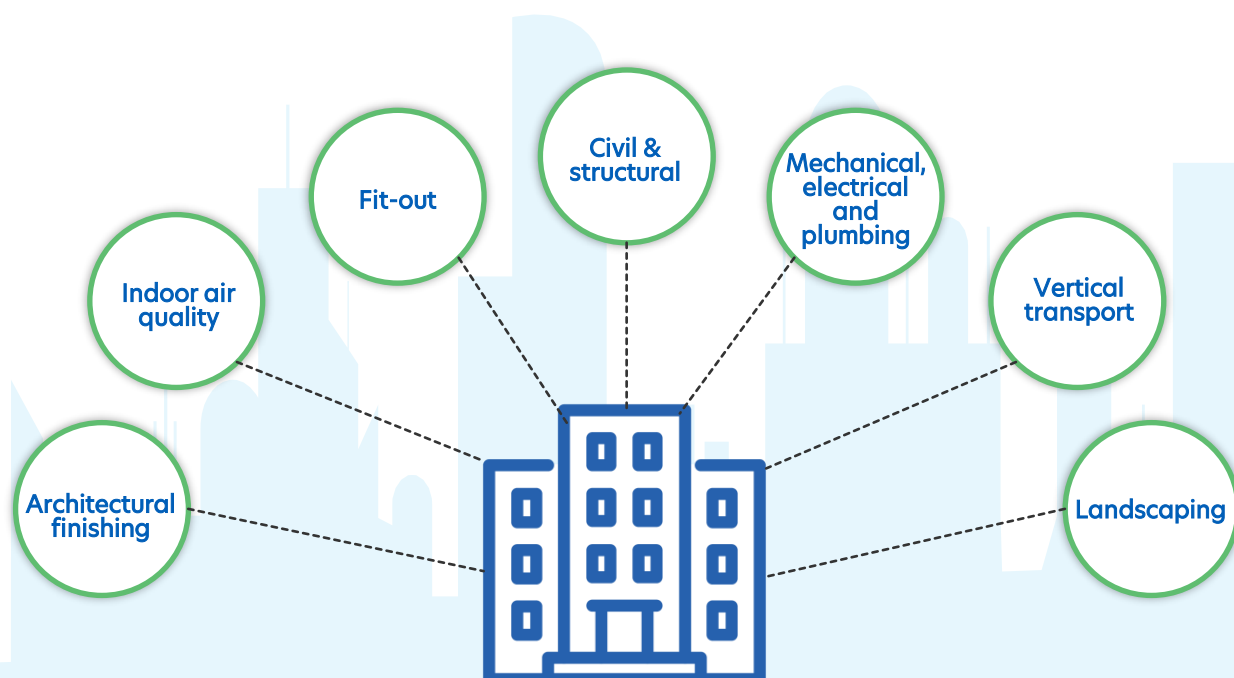
At its core, a building material can be considered sustainable where the carbon generated in its lifetime is lower than the conventional. To minimise the risk of greenwashing, manufacturers or distributors have started registering their products with certifications / labels. A building material can claim to be sustainable when they receive a label or certification from the registry within each country. However, there is still a need for the industry to converge towards a common verification standard for a construction material to be label as sustainable.

Sustainable building material cost more?

Sustainable building material commands a unit price premium but not necessarily for total cost. In Singapore, sustainable building material is 2 to 10 per cent more expensive compared to conventional building materials. As a consequence, this may deter developers or architects in specifying for these building materials. While this is true on a unit price basis, the total cost may not necessarily be true.

One of the steel manufacturer whose product received a sustainable label / certificate shared that while sustainable steel is 12 per cent more costly compared to conventional steel, the volume of sustainable steel used is 20 per cent less - which more than offsets the 12 per cent unit price increase.

Figure 10: Application of Sustainable Building Materials



Here are some areas that building owners can consider looking into for sustainable building materials use. In addition, building owners can be opportunistic in identifying little pockets of areas where they can reduce an asset's embodied carbon. But to "move the needle" in an asset's embodied carbon will require building owners to look more closely at the asset's use of cement and steel.

Cement and steel were singled out as the most pollutive industrial carbon emitters in COP27. Cement is the second most widely consumed material after potable water. It is also the largest contributor to a building's embodied carbon at 33 per cent. The second largest contributor is steel at 30 per cent. Steel is an important construction and engineering material, accounting for 7 to 9 per cent of global carbon emission.

The challenge in decarbonising of both these materials is the lack of commercially viable alternatives / technologies. While the industry continues to explore technology to reduce carbon intensity required along the production process, there are strong strides made in reducing the demand of them through innovation and technology. With proper verification and certifications, these cement and steel end products can be considered as sustainable building materials.

Chinese government construction material selected targets

- i. Lower energy consumption per million ton of steel by 2 percent;
- ii. Lower energy consumption per unit of clinker for cement by 3.7 percent; and
- iii. Reduce carbon emission of aluminum by 5 percent

Positive observations from the Chinese construction material industry – a major global manufacturer

Despite the challenges in decarbonising the construction materials, **notable progress has been observed from the Chinese government on the construction materials front.** The Chinese government introduced targets in their 5-year development plan for the construction materials industry on 29 Dec 2019. Relevant targets includes (i) lower energy consumption per million ton of steel by 2 percent; (ii) lower energy consumption per unit of clinker for cement by 3.7 percent; and (iii) reduce carbon emission of aluminum by 5 percent. This is a positive note as it suggests an increased emphasis and commitment from the government to achieving their carbon neutrality targets.

Another healthy sign that the construction materials industry is decarbonising is reflected with Europe's 1st commercial green steel plant expected to be operational in 2025. Closer to the Southeast Asia region, the 1st commercial green steel plant in 2027. However, it should be noted that while these are encouraging signs, the questions on bankability of these green steel plants remains.

Far reach of Europe's Carbon Border Adjustment Mechanism (CBAM)

Another trend that can spur the decarbonisation of the construction materials industry is the implementation of CBAM in Europe. The objective of CBAM is to address carbon leakage into Europe by preventing corporates shifting production into countries with less stringent carbon standards to avoid carbon taxation and flooding the European market with carbon-intensive products. The second order effects from CBAM includes (i) spurring greener production of products outside of Europe; and (ii) accelerating implementation of carbon tax outside of the European market.

Although CBAM is effective from 2026, **materials manufacturers need to start rethink their strategy for their exports to Europe to remain competitive.** According to Southeast Asia Iron and Steel Institute, Indonesia is expected to be hit the hardest amongst ASEAN countries with the largest export of steel into Europe at 3,510 thousand tonnes registered in 2022.

Figure 11: Benefits of Sustainable Building Materials

- ✓ Lower embodied carbon

✓ Lowers operational carbon

✓ More durable than conventional
- ✓ Toxin-free

✓ Use of sustainable / eco-friendly materials

✓ Reduce construction wastage



Use of sustainable building materials has to be deliberate and upfront as once the materials are installed, the carbon footprint is “locked-in” by the asset for the material’s useful life. **Opportunities usually present itself during the initial design or during retrofit.** This means building owners will need to work closely with their real estate advisors and architects in order to address their asset’s embodied carbon.

It is also interesting to note that the **use of sustainable building materials does not necessary equate to reducing embodied carbon.** There are instances where embodied carbon increases but offset by a decrease in operational carbon - an example is the use of double-glazed window. Compared to single glazed window, a double-glazed window has more embodied carbon.

However, a double-glazed window helps reduce heating and cooling required by the asset thereby reducing the asset’s operational carbon. This highlights the importance of deliberate design and planning when addressing an asset embodied carbon – an increase in embodied carbon can lead to a reduction in an asset total lifecycle carbon footprint. **This evaluation framework is commonly known as Whole Life Carbon Assessment.**

Case studies: Sustainable building materials adoption

The following section lists 2 use cases of assets that have taken strides in addressing their carbon footprint. Noticeably the second asset has started its journey since 2009.

PARKROYAL COLLECTION Pickering

Asset type: Hotel

Operating since 2013

Sustainability features

- ✓ Green plot ratio of 240% to lower building temperature thereby reducing cooling energy needs
- ✓ High performance glass to reduce solar heat while providing natural lighting
- ✓ Use of cutting-edge green construction technology to reduce concrete usage
- ✓ Optimise energy use through demand-based control for ventilation



Source: UOL Group



Source: City Developments Limited

11 Tampines Concourse

Asset type: Commercial

Operation period: 2009 to 2023

Sustainability features

- ✓ Singapore and Asia's first CarbonNeutral development
- ✓ Use of "green concrete" for structural building components
- ✓ Designed building envelope with energy efficient features
- ✓ Use of natural day-light to reduce lighting needs

The role of banks to decarbonise the built environment

The role banks play in decarbonising the built environment

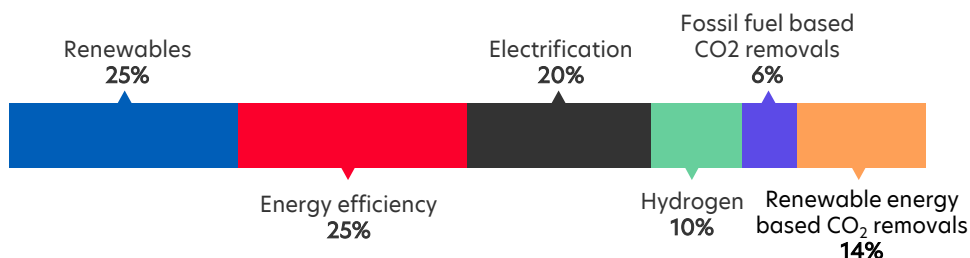
Banks can play a key role in helping green projects obtain financing by bridging financing gaps with the appropriate investors or financiers. Providing access to capital is crucial for both project developers and investors. Acting as an intermediary or even providing direct financing into the projects, banks can help connect project developers with financing stakeholders

Banks are responsible for ensuring that financing is directed towards projects that help ensure a just transition towards net zero. Financing cost is a material cost component for a building development. Hence banks, through their financing covenants, have a sway in how the building can be developed. Against the backdrop of sustainability megatrend, there is also a risk that the type of financing provided (green VS sustainability-linked) has implications on the risk of the bank and building owner of being called out for green washing.

Building owners can look to banks in bridging their financing gaps

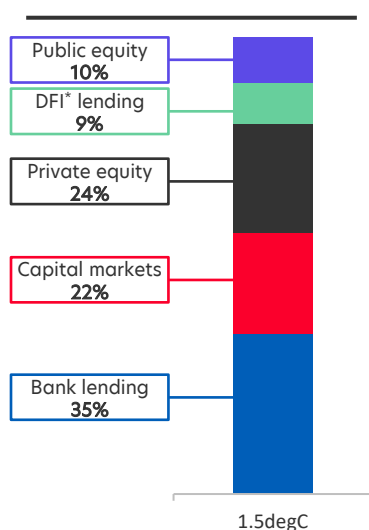
Reduction of 37 giga tonne of CO₂ annually between 2021 to 2030 is required to meet 1.5degC climate target according to International Renewable Energy Agency (IRENA) World Energy Transition Outlook 2022. 70% of this reduction will come from renewable, energy efficiency and electrification, a strong indication that commercially viable technologies are already available in these 3 categories. To support economies in meeting this climate target, banks need to familiarise themselves with technologies in these 3 areas.

Figure 12: Energy transition solutions need to reduce an annual 37Gt of CO₂ annual carbon reduction to meet 1.5degC climate targets



Source: IRENA World Energy Transition Outlook 2022

Cumulative US\$57 trillion required between 2021 to 2030 to meet 1.5degC scenario



*DFI = Development Financial Institutions

Banks need to understand energy transition technologies and how it contributes towards building owners' decarbonization journey.

This understanding will enable banks to structure a suitable financing solution that fit the risk profile of the building owner and energy transition technology. In addition, banks can also help facilitate the connection between building owners and other green technology solution providers to further accelerate towards a low carbon economy.

Bank's role will only continue to grow. The latest IRENA World Energy Transitions Outlook 2023 estimates an additional US\$47 trillion into energy transition is required between 2023 to 2050 to meet the 1.5degC scenario. Risk of failing to meet the 1.5degC scenario will increase in the absence of the steward guiding funds where it is needed most.

Close collaboration amongst built environment stakeholders required for a just economic transition. Building owners, banks and real estate advisory firms will need to work together in ensuring that genuine project that enables a green economic transition are funded for execution.

Impact of greenwashing is applicable to both building owners and banks

Green or sustainability-linked financing, at its core, is to enable society to make a green economic transition that is aligned to the Paris Agreement. **Greenwashing is an example of organisational failure as resources are misallocated and confidence in the organisation is dented due to misrepresentation and lack of effective corporate governance.**

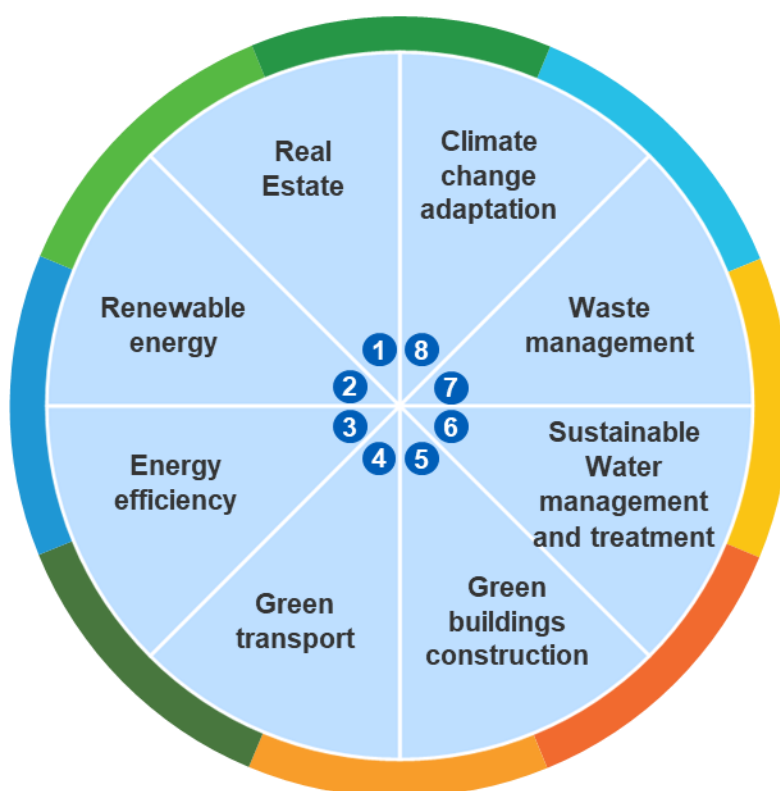
Banks may require building owners to provide third-party verified data as they tighten green financing requirements. To mitigate risk of greenwashing, banks are increasing the disclosure requirements from building owners. For instance, banks are beginning to require building owners to provide energy usage information coupled with third party verification as part of the green or sustainability-linked financing extended.



UOB is committed to a sustainable future and has a framework aligned with the UN Sustainable Development Goals

Building owners can either create and obtain second-party opinion for their own green frameworks or leverage on bank's second-party verified frameworks to mitigate the risk of greenwashing. For the latter, building owners will need to determine the framework's robustness and relevance to their business operations.

At UOB, we recognise that every asset is unique in its operational requirements. We also recognise the importance of a sustainable future and is committed to driving the change for smarter cities. This initiative is supported by UOB's Smart City Sustainable Financing Model that revolves around 8 key areas which are deemed essential for smart cities to be effective and efficient.



Building owners who are keen to embark on their sustainability journey can tap on opportunities available from the development of smart cities can contact UOB to see how we can facilitate your journey through UOB's Sustainable City Solutions.

Conclusion

It makes good investment sense for building to go green.

Unhedged physical climate risk as well as tightening government regulations translates into higher financing cost for non-green buildings. In addition, green buildings are able to command rental premiums thereby enhancing asset valuations.

Symbiotic relationship for landlords and tenants in working together to address tenant's carbon emissions.

An example of a benefit that a green building enables is to lower tenant's scope 2 emissions with improved operational efficiency. This also translates into lower operating costs.

Building owners should assess the cost of ownership over the asset useful life for sustainable building materials instead of looking only at the unit price tag.

Sustainable building materials can have lower total cost of ownership despite higher unit prices due to lower usage volumes.

Unlike operational carbon, embodied carbon cannot be reduced over an asset's lifetime.

Deliberate and early intervention from the design or planning phase has to be present to reduce an asset's embodied carbon. Implementation of sustainable building materials can help in reducing embodied carbon.

Adopting a whole life carbon approach allows building owners to identify the overall best combined opportunities for reducing / optimising the carbon emission of an asset throughout its life.

This is achieved by presenting the trade-offs on the available options instead of focusing only on a single factor.

The risk of being labelled as greenwashing is real.

Building owners will need to be cognizant of the risk associated with loosely labelling their assets as green or sustainable. Banks, real estate advisory firms and material suppliers have the responsibility in helping building owners as they decarbonize their assets.

Building owners need to either create and obtain second-party opinion for their own green frameworks or leverage on bank's second-party verified frameworks.

This can help to mitigate the risk of greenwashing.

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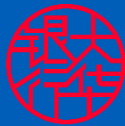
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