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Net Zero Construction

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Construction | Construction & Engineering

Construction

Net Zero Construction

"We are at the verge of the abyss. We must make sure the next step is in the right direction. Leaders everywhere must take action. First, by building a global coalition for net zero emissions by 2050 in every country, every region, every city, every company, and every industry."

Antonio Guterres, United Nations Secretary General

- **Cutting emissions is imperative for the construction sector.** This report pinpoints key enablers in achieving the net zero carbon emissions target by 2050 across Malaysia, Indonesia, Singapore and Thailand. This report is timely, as the building and construction sector saw operational carbon dioxide (CO2) emissions hitting a new high in 2021 – 2% and 5% more than the peaks of 2019 (pre-pandemic) and 2020. Therefore, it is vital that we identify the way construction players are doing their part to cut emissions – these firms have to have higher-than-average ESG scores as per our proprietary methodology, which now puts greater emphasis on emissions.
- **Malaysia's construction emission cuts are underpinned by technology.** Malaysia's Construction 4.0 Strategic Plan 2021-2025 emphasises technology usage, namely industrialised building systems (IBS) amongst others to facilitate sustainability. Overall, IBS implementation in both government and private projects has increased to 84% (2020: 79.5%) and 60% (2020: 41%) in 2021. This indicates there is still room for growth in IBS implementation, which is able to reduce CO2 emissions/sqm. Sustainable rating tools by the Construction Industry Development Board (CIDB) play a role in promoting environmentally friendly projects.
- **Thailand's Green Building Energy Code (GBEC) is the first compulsory energy consumption standard** to have universal applications in Thailand. Prior to it, developers had to obtain "green building" certifications from four different authorities. Overall, cement accounts for the highest construction-related CO2 emissions in Thailand. Therefore, Thai cement-related industry players have collaborated to reduce 1m tonnes of CO2 emitted in 2023 by encouraging all sectors to use hydraulic cement, which is an environmentally friendly building material.
- **Indonesia's pathway is slightly different – it is committing to reach net zero emissions by 2060 (instead of 2050)**. In 2021, the Ministry of Public Works and Housing promulgated national mandatory regulations for the efficient use of energy and water, management of building sites, waste and indoor air quality. These regulations imposed for most residential, mixed-use, office and hospital buildings are tied to the minimum performance standards of building envelopes, cooling equipment, lighting and other building systems**.**
- **Singapore's high rate of urbanisation is evidenced by the building and household sector's** c.20% contribution towards the nation's carbon emissions. The Singapore Green Building Masterplan is in place to accelerate a low carbon environment via an 80-80-80 rule, ie 80% of gross floor area is to be green by 2030, 80% of new developments are to be super-low energy buildings from 2030, and there should be an 80% improvement in energy efficiency (vs 2005 levels) for green buildings by 2030.
- **Net zero emissions stock ideas:** Sunway Construction, Kerjaya Prospek, Gamuda, Siam Cement, CH Karnchang and ISOTeam. Gamuda has its own Gamuda Green Plan 2025, which aims to reduce its corporate greenhouse gas (GHG) emissions intensity by 30% by 2025, and by 45% by 2030 as compared to 2022. Meanwhile, we highlight Total Bangun Persada and Wijaya Karya Bangunan Gedung as non-rated ideas from Indonesia.

Company Name	Rating	Target	% Upside (Downside)	P/E (x) Dec-24F	P/B (x) Dec-24F	ROAE (%) Dec-24F	Yield (%) Dec-24F
CH Karnchang	Buy	THB26.10	22.5	19.9	1.5	7.8	2.2
Gamuda	Buy	MYR5.27	15.3	12.9	1.1	8.6	2.6
ISOTeam	Buy	SGD0.12	97.9	4.1	0.6	15.4	-
Kerjaya Prospek	Buy	MYR1.55	41.0	8.4	1.0	12.2	4.7
Siam Cement	Buy	THB400.00	25.4	8.7	0.9	10.9	5.5
Sunway Construction	Buy	MYR2.05	19.6	13.5	2.6	19.7	4.5

Source: Company data, RHB

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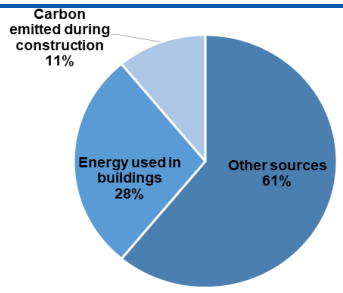
Global CO2 emissions by sub-sector



Source: Global Alliance for Buildings and Construction

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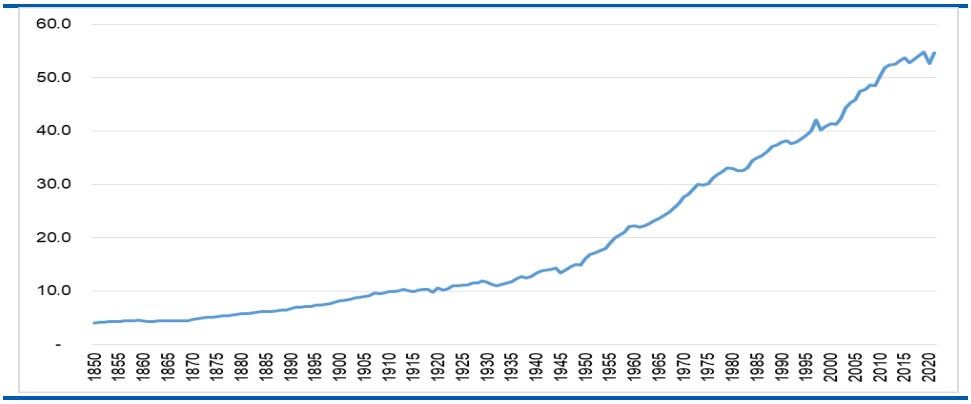
Net Zero 2050

Net zero refers to a state in which GHG – all gases covered under the Kyoto Protocol such as CO2, methane, nitrous oxide and hydrofluorocarbons going into the atmosphere – are balanced by their removal from the atmosphere. The term net zero is important because – for CO2, at least – this is the state at which global warming stops. In 2015, 196 Parties to the Paris Agreement pledged their commitment to transform their development trajectories towards sustainability and called for limiting global warming to well below 2°C – ideally 1.5°C – above pre-industrial levels.

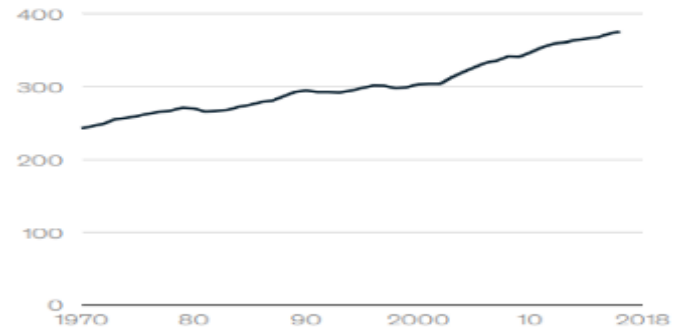
To meet these goals, global CO2 emissions need to be cut by 45% by 2030 from 2010 levels, and reach net zero emissions by 2050. GHG concentrations soared to new highs in 2020, with globally averaged mole fractions of CO2 exceeding 410 parts per million (ppm) vs the 340-350ppm range in the 1980s according to the United Nations (UN) and the United States Environmental Protection Agency. A mole fraction is the proportion of molecules of one component in a gas. For example, if the mole fraction of methane in gas is 0.9, this indicates that 90% of the molecules are methane. Meanwhile, ppm essentially denotes how many parts a certain molecule make up within one million parts of a gas (GHG in this case) – or in other words, multiplying the mole fraction by a million.

Figure 1: Annual global GHG emissions (bn tonnes)



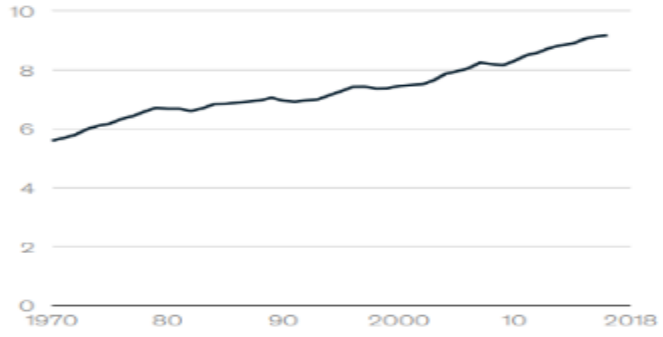
Source: Our World In Data

Figure 2: Annual global methane emissions (m metric tonnes per year)



Source: McKinsey

Figure 3: Annual global nitrous oxide emissions (m metric per year)



Source: McKinsey

Within the private sector there are differences in emission types. Generally, emissions are bounded following the Greenhouse Gas Protocol's "scoped" approach, and net zero-aligned actors should attempt to cover all three scopes. The three scopes are:

i. Scope 1 – direct company-owned or -controlled emissions occurring at the source;

ii. Scope 2 – emissions associated with the production of energy consumed by a company;

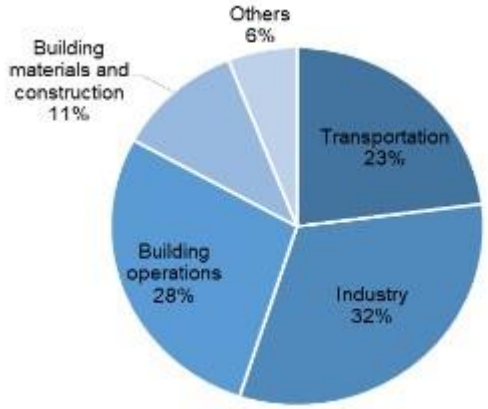
iii. Scope 3 – indirect emissions associated with company activities from sources not owned or controlled by a company.

More than 70 countries, comprising the heaviest polluters such as China, the US, and the EU have fixed a net zero target, to cover about 76% of global emissions. The number of businesses working with the Science-Based Targets Initiative (SBTI) to reduce their emissions in line with climate science are more than 3,000. Also, more than 1,000 cities, over 1,000 educational institutions, and over 400 financial institutions have joined the "Race to Zero", pledging to take rigorous, immediate action to halve global emissions by 2030.

The construction sector's part in global GHG emissions

Released at the 27th Conference of the Parties (COP27), the 2022 Global Status Report for Buildings and Construction highlighted that the building and construction sector accounted for more than 30% of energy and process-related CO2 emissions in 2021. In the same vein, the World Green Building Council (WorldGBC) cited that buildings currently contribute 39% of global energy-related carbon emissions: 28% from operational emissions from energy needed to heat, cool and power them, and the remaining 11% from embodied emissions such as materials and construction activities.

Figure 4: The part the building and construction industry contributes in global CO2 emissions



Source: Global Alliance for Buildings and Construction

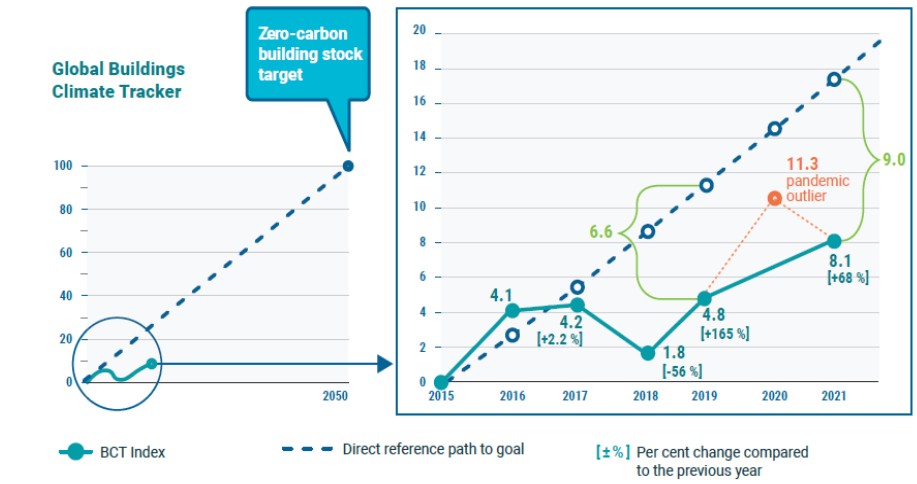
On further scrutiny, the building and construction sector's operational energy-related CO2 emissions hit 10 gigatonnes of CO2 equivalent (CO2e) – 5% over 2020 levels and 2% over the pre-pandemic peak in 2019. This means that the gap between the climate performance of the sector and the 2050 decarbonisation pathway is widening.

In 2021, the Global Buildings Climate Tracker (GBCT) indicated that the decarbonisation level (a higher level indicates better decarbonisation) decreased to 8.1 pts from the 2020 pre-pandemic outlier of 11.3 pts, which indicates lower decarbonisation progress – driven mainly by the return of the sector to pre-pandemic operational levels (refer to the right side of Figure 5 for more details). This is due to the exceptional slowdown of large parts of the economy including the construction sector, and the limited use of non-residential buildings such as offices during the COVID-19 pandemic. As this may give a false positive message of decarbonisation moving towards being "on track", the 2020 observation is treated as an outlier.

Despite the 68% improvement shown in the GBCT index to 8.1 in 2021 from 4.8pts in 2019, the index has fallen further away from the path to a zero-carbon building stock (the broken line in Figure 5) with the distance between the broken line and the solid line (representing the GBCT index) having increased from 6.6pts in 2019 to 9pts in 2021 (depicted in the chart on the right in Figure 5). The numbers confirm the slowing down of decarbonisation and provide evidence that the reduction of emissions in 2020 was temporary, and no lasting progress was achieved.

In short, Figure 5 shows the direct path to the goal of the Paris Agreement on the left. The blue dot illustrates the target of a zero-carbon building stock by 2050 as defined by the GBCT. The direct path to the goal connects the starting point of 0 in the base year 2015, with the target point of 100 in 2050.

Figure 5: Direct reference path to a zero-carbon building stock target by 2050 (left); zoom into the period between 2015 and 2021, comparing the observed GBCT to the reference path (right)



Source: Global Alliance for Buildings and Construction

Below shows how Scope 1, 2 and 3 emissions apply to the construction sector:

i. Scope 1 – emissions caused by burning diesel fuel in trucks and machineries;

ii. Scope 2 – purchase of electricity, steam, heating or cooling systems;

iii. Scope 3 – transportation of raw materials, machinery manufacturing and production of raw materials such as steel and concrete.

The path to net zero for the construction sector

As buildings head towards net zero operational GHG emissions, embodied GHG emissions and embodied carbon (CO2 emitted during the construction phase) will become even more significant. In response to this, the WorldGBC has called for a 40% reduction in construction-related embodied GHG emissions by 2030. Meanwhile, by 2050, new buildings, infrastructure and renovations will have net zero embodied carbon, and all buildings, including existing buildings must be net zero operational carbon. This takes into account the value of offsets as a medium to compensate for and neutralise the effects on the sector, and the call to further knowledge on the social and environmental impact in efforts to reach net zero emissions. These calls to action are encapsulated under the Net Zero Carbon Buildings Commitment.

Figure 6: Components in the Net Zero Carbon Buildings Commitment

Commitment stage	Operational Carbon	Embodied Carbon
Commit	Commit assets under direct control to reduce (and compensate where necessary) all operational carbon emissions by 2030	Commit new developments and major renovations under direct control to reduce and compensate (for residual emissions) embodied carbon emissions by 2030
Disclose	Disclose and assess annual asset and portfolio operational energy demand and carbon emissions	Disclose whole life carbon emissions according to EN 15978 or other accepted national standards
Act	Act to achieve maximum emission reductions with key actions and milestones towards energy efficiency and renewable energy	Act to achieve maximum emission reductions in upfront, in-use and end-of-life embodied carbon
Verify	Verify enhanced energy performance, reduced carbon emissions and progress towards net zero carbon assets and portfolio	Verify prevention strategies, WLCA calculations, offsets and progress towards net zero embodied carbon assets and portfolio
Advocate	Advocate for wider emissions reduction by acting as a catalyst through core organisation activities for further action within respective supply chains	

Source: WorldGBC

According to the 2022 Global Status Report For Buildings and Construction, buildings and construction policies underwent a big step forward in 2021 as 23 countries revised and updated their nationally determined contributions (NDCs), with a greater level of commitment towards building efficiency and adaptation. To date, 158 out of 196 countries (80% of the total) now refer buildings as part of their NDC action plans compared to c.69% in 2020. Meanwhile, 79 out of 196 countries (ie 40%) already have building energy codes, despite only 26% of countries having mandatory codes for all buildings. In essence, building codes are vital for addressing building sector emissions and providing clear guidelines on their features. As such, this is a positive sign, as more governments recognise and make commitments to recognise the role buildings play in their decarbonisation actions.

As a priority, more jurisdictions need to align their building codes to meet the goals of the Paris Agreement. In 2021, several organisations and jurisdictions made the move to align their new building energy codes towards being zero-carbon. For example, the new voluntary appendix to the 2021 International Energy Conservation Code (IECC) provides a pathway to develop a standard for achieving zero-carbon buildings, and Washington DC's 2020 energy code includes a net zero energy appendix for new buildings.

Aside from policies, key enablers or methods in relation to construction and buildings to achieve net zero emissions include solar panels, phantom load reduction, heating and cooling systems, air sealing, and lighting control, among others.

Key enabler #1: Solar energy

It is common for construction sites to need their own power supply. When it comes to off-grid energy sources, solar panels (that may be in the form of solar mobile power units) are one way to generate renewable electricity (RE) on construction sites. The solar panels absorb sunlight during the day and convert it into electricity that can be used to power lights, tools, heating systems and other equipment as well as a backup emergency power source. Moreover, such power sources requires minimal maintenance and can provide reliable power even when the sun is not out. This kind of RE is also becoming increasingly affordable, making it a viable option for reducing energy costs on construction projects.

In a real-life scenario, a Dubai-based solar photovoltaic (PV) developer, Enerwhere, came up with a business model for solar projects at construction sites. Its approach is based on short-duration power purchase agreements (PPAs) – involving mobile PV installations from one building site to another. In general, contractors may save 10-20% of electricity costs depending on the site, while CO2 emissions could be reduced by 30%. The systems are dismantled and brought to other construction sites after building projects are completed.

Figure 7: Carpark-mounted solar panels at Besix's 340m skyscraper construction site

Source: Enerwhere

Figure 8: Solar panel at Remraam residential development project site

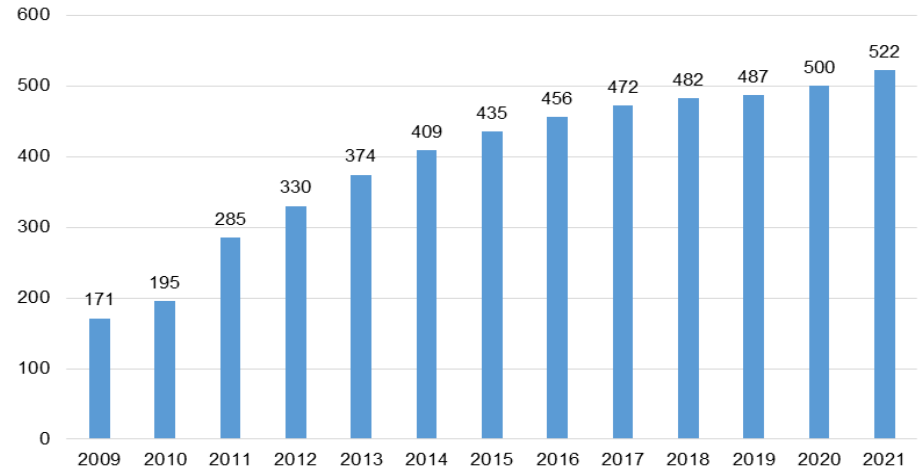
Source: Enerwhere

Enerwhere has built a 540kW off-grid rooftop PV installation on top of a parking lot at a skyscraper construction site in Dubai for a Belgian contractor. The carpark-mounted solar panels serving 180 carpark spots – the largest solar carpark installed on a construction site – serves the dual purpose of providing shade as well as generating RE, while also freeing up areas on-site which would have been used to install solar panels for other purposes. Other projects include the installation of RE generation facilities at a construction site for phase 2 of the Remraam residential development in Dubai.

To illustrate the integration of solar energy into buildings being constructed to reduce carbon emissions – solar water heater systems in buildings, for example, can provide a very high percentage (50-75%) of domestic hot water energy according to the UN. Solar water heaters are devices that capture sunlight to heat water. It collects heat with the help of a solar collector, and the heat is passed to the water tank with the help of a circulating pump. This helps in energy consumption, as solar power is free in contrast to natural resources such as natural gas or fossil fuels.

As water heating accounts for around 30% of a home's CO2 emissions on average, a solar water heater can reduce its total emissions by more than 20%. Over the longer term, one solar water heater can prevent over 50 tonnes of CO2 emissions that would have been emitted by an electric or natural gas water heater over a 20-year period. Many countries are encouraging the increased use of solar hot water technology. The capacity of solar water heating systems worldwide reached 522 gigawatts thermal (GWt) in 2021 vs just 171 GWt in 2009, representing a 12-year CAGR of 9.7% according to Statista (Figure 9).

Figure 9: Capacity of solar water heating systems worldwide (GWt)



Source: Statista

Key enabler #2: Carbon offsets

Carbon offsets occur when a polluting company buys a carbon credit to make up for the greenhouse gas it has emitted. The money should be used to fund action somewhere in the world that removes the same amount of carbon out of the air, or to prevent carbon emissions.

The need for offsetting can be justified by the fact that, in a majority of scenarios compliant with the goals of the Paris Agreement, the world does not reach zero absolute GHG emissions in the next few decades – with some residual emissions being balanced out by natural or artificial "carbon sinks" (for instance tree planting). As such, companies or countries that are unable to reduce their emissions organically may require some accounting mechanism through which they can compensate those actors that are contributing negative emissions, in order for the global system to reach net zero.

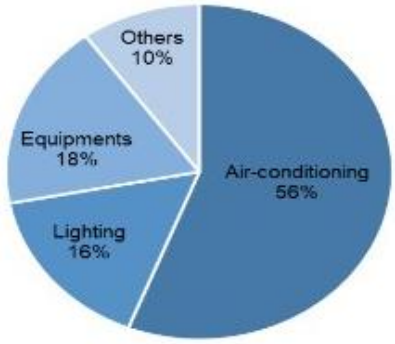
However, there are substantial challenges around offsetting, because this market comprises both voluntary and regulated aspects, with uneven levels of transparency and scientific rigour. Part of the challenge stems from the counterfactual nature of offsetting and the risk of claiming credits for emission reductions that would have happened anyway, even if a given offset was not purchased (for example, compensating an owner to maintain a forest when the owner had no intention of cutting it down in the first place), or that has not happened yet (ie netting present emissions against the future carbon sequestered by a newly planted tree over its lifetime). Additional complexities stem from how to account for carbon credits across jurisdictions and over time (ie should overachievement in the past allow actors to reduce their emission targets in the future?)

Key enabler #3: Shading systems

According to the International Energy Agency (IEA), the usage of air conditioners and electric fans to stay cool accounts for nearly 20% of the total electricity used in buildings around the world today, or 10% of all global electricity consumption. The increasing demand for space cooling is also exerting pressure on electricity systems in many countries, as well as driving up carbon emissions.

The issue is particularly sensitive in the fastest-growing nations, with the biggest increase happening in hot countries like India – where the share of air-conditioners in peak electricity load could reach 45% in 2050, up from 10% today, without action. This comes as no surprise, as air-conditioning makes up 56% of the typical building energy consumption in tropical countries.

Figure 10: Typical energy consumption breakdown in tropical countries



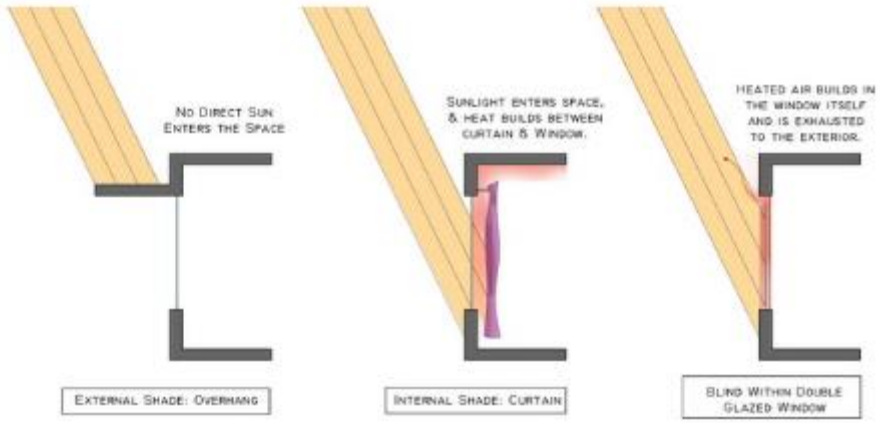
Source: International Conference on Sustainable Energy Technologies

Therefore, solar shading systems play an important role in sustainable architectural practices in subtropical climates, where the demand for cooling and the reduction in unwanted direct sunlight is high. Building energy modelling conducted by the National Energy Foundation shows that total energy savings can be as high as 48% when external shading is used, and up to 14% with internal shading – resulting in carbon emission reduction.

Meanwhile, solar shading systems designed and configured according to the sun's peak seasonal angles can reduce solar gains in summer (reducing heat gain by as much as 80%) but still permit heat gains from the low-angle sun in cooler months – contributing to a reduction in space cooling and heating loads.

In summer conditions, solar radiation can be prevented effectively from reaching glazed surfaces via external solar shading which also reduces the fraction of solar radiation in the short wave infrared range (780-2500 nanometers) that is absorbed and re-irradiated as thermal (long-wave infrared) radiation. This may eliminate the requirement for artificial, mechanical-driven interior cooling, if coupled with cross-ventilation strategies.

Figure 11: Shading systems



Source: International Conference on Sustainable Energy Technologies

Key enabler #4: Air sealing

Air leakage introduces moisture, mould, pollen, pests, and sound into the living environment in addition to higher cooling energy consumption by buildings. According to Greenspec, air leakage is a major cause of energy loss – accounting typically for around 40% of the energy loss in modern houses. Through the reduction of the amount of air that leaks in and out of a building via air sealing, heating and cooling systems can operate more efficiently, leading to lesser energy consumption and fewer GHG emissions.

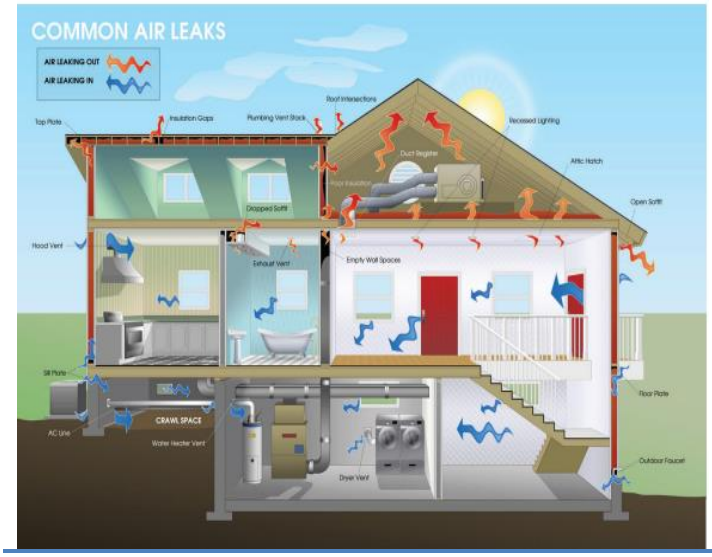
The Spray Polyurethane Foam Alliance (SPFA) found – through a study involving typical new 2,512 sq ft homes in Houston, Texas which has hot-humid weather – that spray polyurethane foam (SPF) insulated homes reduced air infiltration and additional annual energy savings compared to the same home insulated with only fibreglass. These additional energy savings are then converted to annual environmental impact reduction, cumulative energy savings and global warming reduction.

Figure 12: Environmental benefits of insulation from households using SPF compared to fibreglass in Houston, Texas

	SPF on attic floor	SPF under roof deck
	Annual Energy Savings	
Additional gas savings (kWh/year) compared to fiberglass insulation	1,143	1,699
Electricity savings (kWh/year) compared to fiberglass insulation	139	857
Total energy savings (kWh/year) compared to fiberglass insulation	1,282	2,556
	Annual Environmental Impact Reduction	
Global warming potential (GWP) (kg CO2/year)	349	950
Cumulative energy (megajoules (MJ)/year)	4,433	13,855

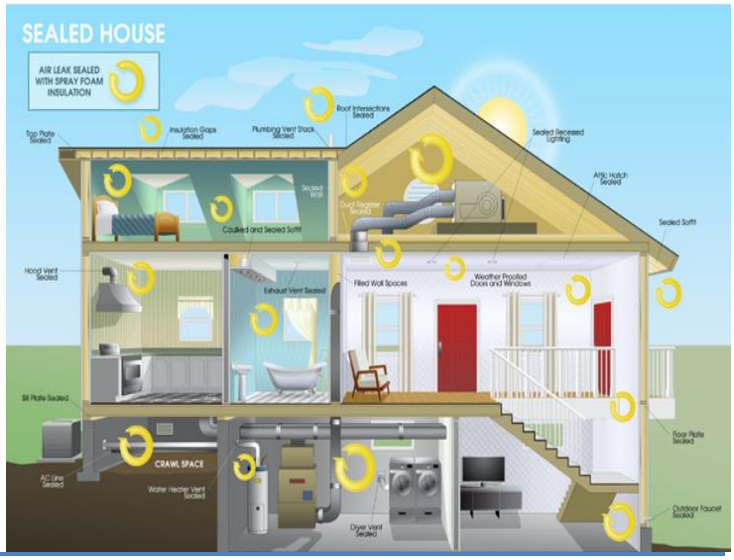
Source: Spray Polyurethane Foam Alliance

Figure 13: Common air leaks



Source: American Chemistry Council

Figure 14: A house using SPF for air sealing



Source: American Chemistry Council

Key enabler #5: Phantom load reduction

Phantom loads, also known as standby power or vampire electrical charges, is the electricity consumed by equipment when they are turned off but still plugged in. In general, the US Department of Energy reports that 20% of electricity used goes to phantom loads.

Phantom loads at construction sites can be managed via the deployment of energy-efficient equipment that utilise solar energy or even ones powered by lithium-ion batteries. It is now possible to purchase equipment with electric drives, in which the engine drives a generator to turn mechanical power into electricity. Some companies such as Bobcat, Volvo CE and Caterpillar are developing and releasing electric construction equipment powered by lithium-ion batteries that are capable of operating all day on a single charge – minimising phantom load reduction while reducing emissions at construction sites. For instance, Pon Equipment, with input and support from Caterpillar, converted a 28-tone CAT 323F excavator from diesel to electric. The diesel engine was replaced with a 122kW electric motor and a 300kWh lithium-ion battery pack that weighs 3.4 tonnes. Known as the Z-Line, the modified excavator can work for 5-7 hours before it needs to be recharged, which can be done in 1-2 hours.

Figure 15: Pon Equipment's (in collaboration with Caterpillar) Z-Line excavator

Source: Pon Equipment and Caterpillar

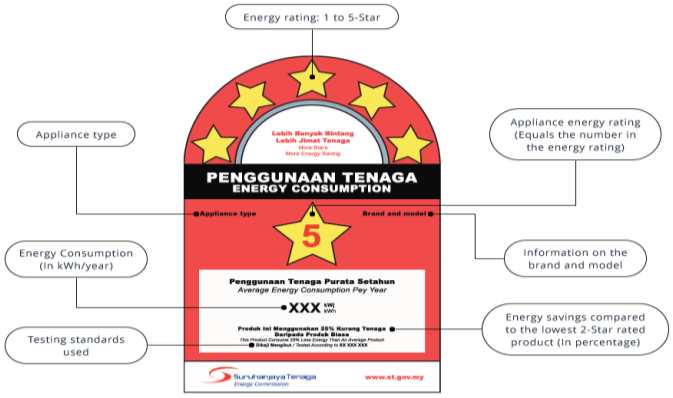
Figure 16: Pon Equipment's (in collaboration with Caterpillar) Z-Line excavator

Source: Pon Equipment and Caterpillar

As for buildings, phantom loads could account for up to 10% of an average home's electricity cost. Having a desktop computer constantly plugged in will cost an average of USD241 annually, of which USD41 will be the vampire cost if your desktop is in sleep mode when unutilised. Assuming that there are 300 staff in the office building with desktops in sleep mode – the total vampire cost per year from desktops is USD12,300. The typical American household contributes an average of 10% of their electrical bill to vampire power – thereby costing the American economy an estimated USD10bn a year. Such wasted energy is enough to shut down 30 coal plants!

Using appliances such as power strips that allow unplugging several electronics by flipping a single switch is a way to reduce the phantom load. Alternatively, the phantom load can be minimised via the purchase of equipment with good energy ratings – ENERGY STAR or energy ratings from respective energy commissions.

Figure 17: Energy efficiency label for appliances by Malaysia's Energy Commission



Source: Energy Commission

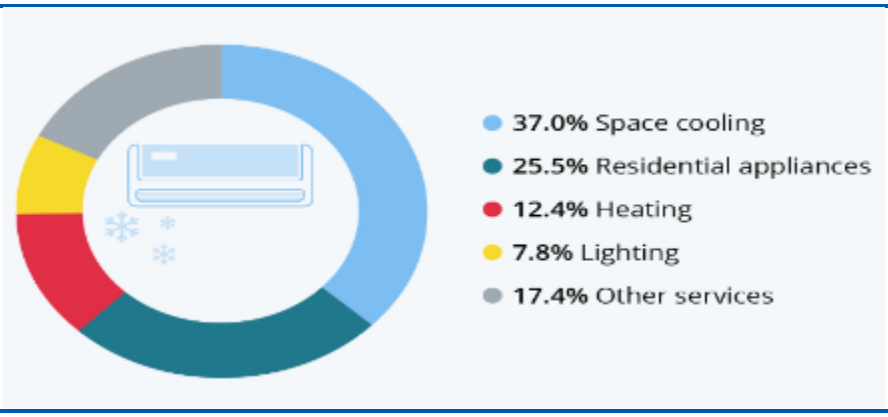
Figure 18: ENERGY STAR rating on appliances

Source: ENERGY STAR

Key enabler #6: Cooling systems

Apart from shading systems, built-in cooling systems such as district cooling systems play a part in controlling the heat in buildings. On further scrutiny, district cooling systems provide cooling services through a network of pipes and distribution systems, unlike traditional building cooling systems that are typically standalone units in each building. According to the IEA, the energy demand for space cooling globally will more than triple from 2020 to 2050, and account for about 37% of global electricity demand growth by 2050.

Figure 19: Breakdown of global electricity demand by 2050



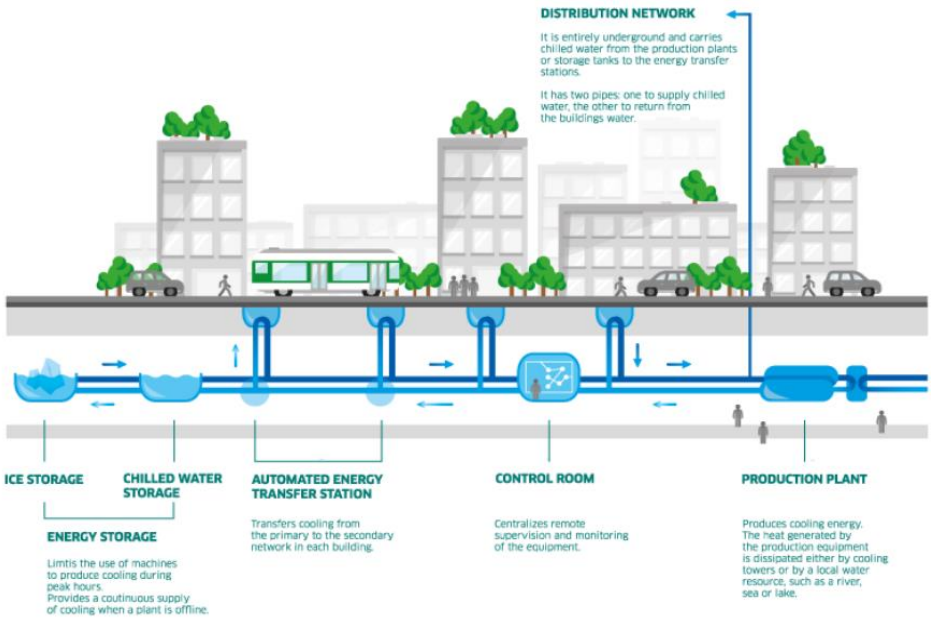
Source: IEA, Statista

In a district cooling system – a central plant generates chilled water or other cooling fluids using large-scale cooling technologies such as absorption chillers, electric chillers or thermal energy storage systems. The chilled water is then distributed to individual buildings through a network of underground pipes where it is used to cool the buildings' air conditioning systems, ventilation systems and other cooling applications.

Compared with traditional air conditioning systems, district cooling systems in general:

i. Consume 35% less electricity;
ii. Emit 50% less CO2;
iii. Greater than 50% energy efficiency;
iv. Have 65% less water consumption.

Figure 20: Typical energy consumption breakdown in tropical countries



Source: ENGIE

Key enabler #7: Implementation of building technologies

Digital technologies like building information modelling (BIM) and IBS provide an opportunity for the construction industry to improve resource and energy efficiency for more sustainable development. Whether it involves refurbishment or new buildings, BIM facilitates improved decision-making for both buildings and infrastructure assets across the entire asset life cycle. Sustainability-wise, better decisions would lead to the optimal usage of materials, less wastage, improved asset utilisation and a lower consumption of resources during the construction phase.

Prefabrication and modular construction relies heavily on BIM with the help of automated production processes used. This eliminates uncertainties or interpretation errors during construction that could lead to higher emissions and wasted materials through delays.

In research conducted by IBM, it was estimated that bad data cost the US economy USD3.1trn, which represented 16.5% of the US' GDP in 2016. When applying the ratio of bad data to the global economy in 2020 – implying a GDP of USD84.5trn – it may have had a global impact of nearly USD13.9trn. Taking into consideration the 13.2% construction sector share of global GDP in 2020, the total cost on the construction sector's bad data may have cost USD1.8trn (Figure 21).

When considering a contractor that carries out USD1bn in work annually, a report by Auto Desk and FMI cited that an upwards of USD165m of their revenue could have been impacted by bad data. Additionally, the value of avoidable rework from bad data stands at c.USD7.1m for every USD1bn's worth of work done recognised annually. Henceforth, applying more information systems in construction processes would facilitate in reducing the carbon emissions caused from demand for excessive building materials.

Figure 21: Calculating the cost of bad data in construction

The % of bad data's impact to the US GDP in 2016 (A)	16.5%
2020 Global GDP (B)	USD84.5trn
2020 global cost of bad data (A x B) = (C)	USD13.9trn
2020 construction sector share of global GDP (D)	13.2%
Total cost of construction sector's bad data in 2020 (C x D) = (E)	**USD1.8trn**

Source: AutoDesk, FMI

Figure 22: Cost of bad data for every USD1bn in construction works done

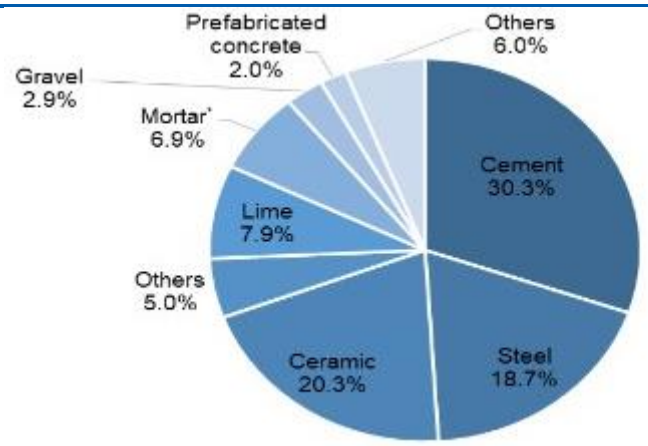
Value of work done recognised and claimed by a general contractor (A)	USD1bn
Cost of bad data (B)	16.5%
Cost of bad data for every USD1bn construction work done recognised and claimed (A x B) = (C)	**USD165m**

Source: AutoDesk, FMI

Key enabler #8: Sustainable building materials

Another way technology is aiding in sustainable construction is through the use of green building materials, due to the carbon emissions coming from the manufacturing of construction materials. Green building materials are designed to minimise emissions from factories that produce them, as well as cut waste during and after use at a construction site. For example, new wood can be replaced with recycled lumber to conserve natural resources while CO2 emissions decreased by as much as 50% with steel beams made with recycled aluminium.

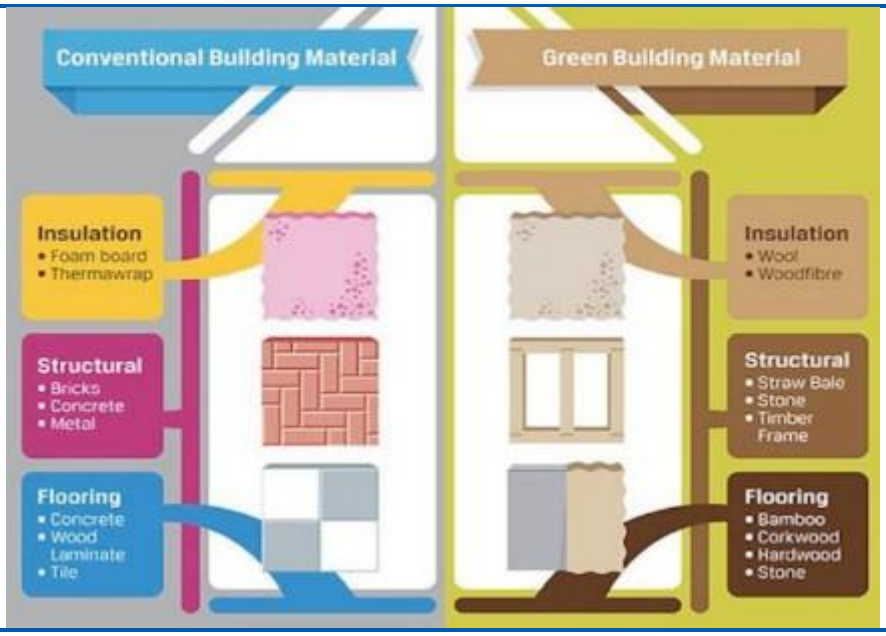
Figure 23: CO2 emissions from the manufacturing of construction materials per sqm of floor



Source: IOP Conference Series: Materials Science and Engineering

Biodegradable materials (bamboo, timber, mycelium or organic paints) in lieu of traditional materials that are hard to decompose offer an eco-friendly solution to promote sustainability in construction. Such materials can decay naturally without releasing toxins, while forming part of modern building structures such as foundations and insulation during construction activities. In fact, precast concrete is also a sustainable form of concrete as it undergoes an exact-batch technology during production, which leads to less waste. Furthermore, green building materials often have longer lifespans than traditional building materials, which results in less frequent replacement or repair costs over time.

Figure 24: Conventional vs green building materials



Source: International Conference on Sustainable Energy Technologies

Risks and challenges in achieving net zero for the construction industry

The lack of standardised and recognised carbon reduction metrics has been identified as a major obstacle to deliver ESG promises in Asia. This is because many of the ESG standards remain voluntary and regulations in some countries are ambiguous, making these difficult to follow. The diverse steps adopted by different governments on mandating sustainable construction is one of the reasons as to why there is a lack of a standardised practice in carbon reduction measures.

Contractors – especially the ones operating in multiple geographic locations – face difficulties in applying systematic and consistent metrics to evaluate their operations and projects from an ESG angle. Henceforth, such contractors would have to resort to mixing and matching varying standards and requirements to address ESG-related issues. Subsequently, a practice that fits the nature of cross-border businesses would be something hard to be implemented.

Another significant economic barrier is the difficulty in finding low or net zero materials, especially for SMEs. The cost of low or net zero building materials, particularly in Asia, remains high. Sourcing these materials remains a global hurdle. Many Asian construction companies are also still navigating and dealing with supply chain issues brought about by COVID-19 and the Russia-Ukraine conflict, making it even more difficult for them to find and use low-carbon alternative building materials.

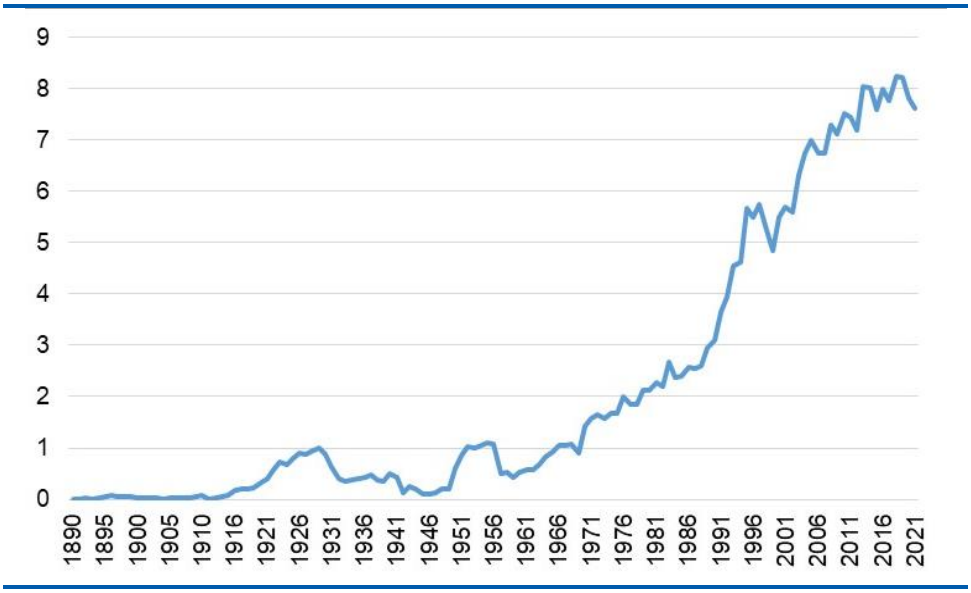
Therefore, project awarders need to be more attentive in pricing their projects realistically and reviewing the price fluctuation mechanisms, to avoid contractors from walking away from their green commitments.

MALAYSIA

Carbon emissions from Malaysia's construction industry

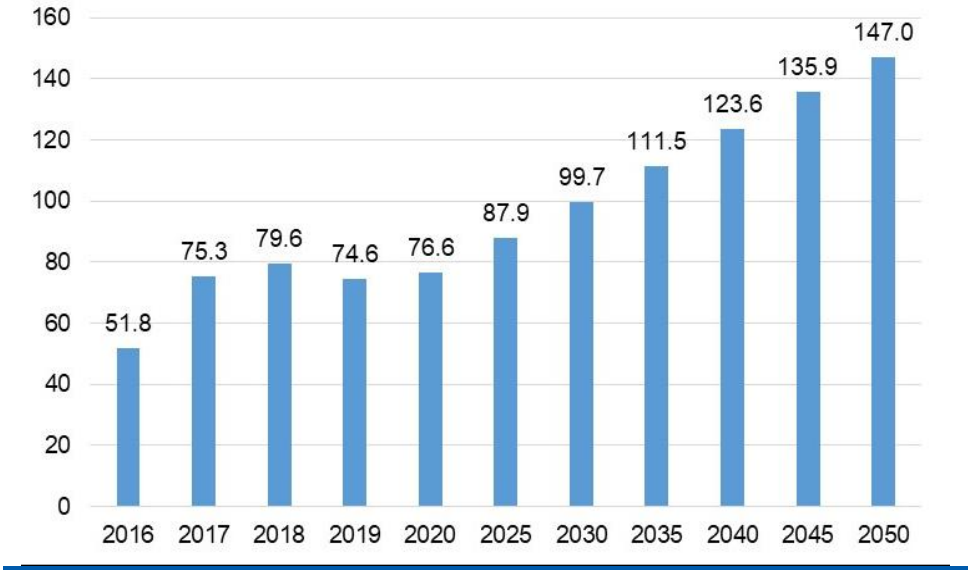
Malaysia's CO2 emissions per capita stood at 7.6trn tonnes in 2021, showing a reduction from the all-time high of 8.2trn tonnes recorded in 2018, according to Our World In Data. Nevertheless, the CO2 emissions per capita has more than doubled since 1990. According to a study conducted by the CIDB, it was projected that 147m tonnes of CO2 equivalent (MtCO2e) will be emitted from the construction sector by 2050 if no efforts are implemented for net zero emissions. This represents a 92% increase from the 76.6m tonnes of CO2 equivalent in 2020.

Figure 25: CO2 emissions per capita in Malaysia (trn tonnes)



Source: Our World In Data

Figure 26: Historical and projected GHG emissions from the construction industry in Malaysia (m tonnes of CO2 equivalent (MtCO2e))



Source: CIDB

Malaysia construction industry's path to net zero by 2050

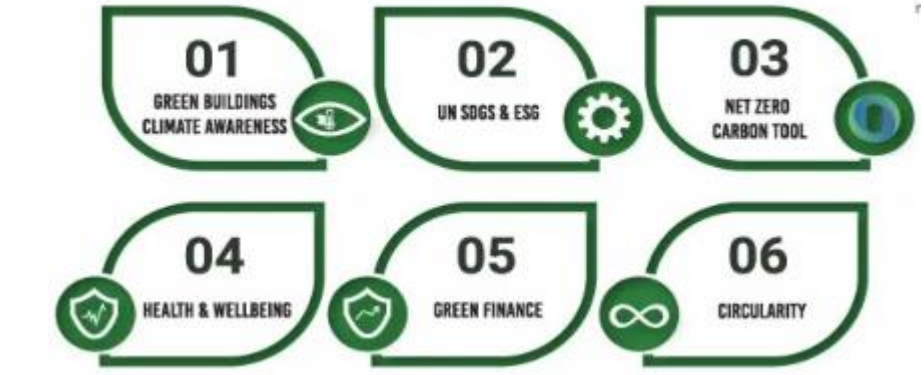
On a national scale, former Prime Minister Dato' Sri Ismail Sabri Yaakob announced the goal for the country to become carbon-neutral as early as 2050, while reiterating the country's pledge to cut GHG emissions intensity per unit of GDP by 45% by 2030, relative to 2005 levels, during the tabling of the 12th Malaysia Plan in Sep 2021. In the nation's commitment to achieve net zero GHG emissions by 2050, there exists a cost factor of MYR350-400bn – as the total investment needed to achieve this.

The current unity government remains committed to this pledge. According to the Natural Resources, Environment and Climate Change Minister Nik Nazmi Nik Ahmad, the Government is preparing a long-term, low-emissions development strategy via the Energy Transition Roadmap and an act on energy efficiency and conservation. Both of these will be adopted this year to meet these commitments, while a much-delayed climate change bill will be passed by 2025.

Malaysia Green Building Council

As for Malaysia's buildings and construction sector – the Malaysia Green Building Council (MalaysiaGBC) is advancing the built environment in the country to achieving 100% net zero carbon by 2050. Moreover, MalaysiaGBC has officially joined the WorldGBC's global climate action programme, Advancing Net Zero – which is a global initiative working towards total sector decarbonisation by 2050 in the buildings space. MalaysiaGBC's roadmap for 2021-2025 highlights six elements, as shown below.

Figure 27: MalaysiaGBC's roadmap initiatives for 2021-2025



Source: CIDB

Green Building Index (GBI)

Green buildings in Malaysia are rated through the GBI – introduced in 2009 as the country's first comprehensive rating system for evaluating the environmental design and performance of buildings, towns and factories. As at 31 Oct 2022, GBI has certified 627 out 1,100 buildings that account for 285.9m sq ft of gross floor area – compared to when it hit the 150m sqft of GFA mark in 2016.

The GBI rating tool provides an opportunity for building owners to design and construct green, sustainable buildings that can provide a healthier indoor environment, better connectivity to public transportation, and engender the adoption of recycling to help reduce the construction and building sector's impact on the environment. There are six criteria that projects need to adhere to for the GBI certification – energy efficiency, indoor environment quality, material resources, sustainable site planning and management, water efficiency, and innovation (Figure 29).

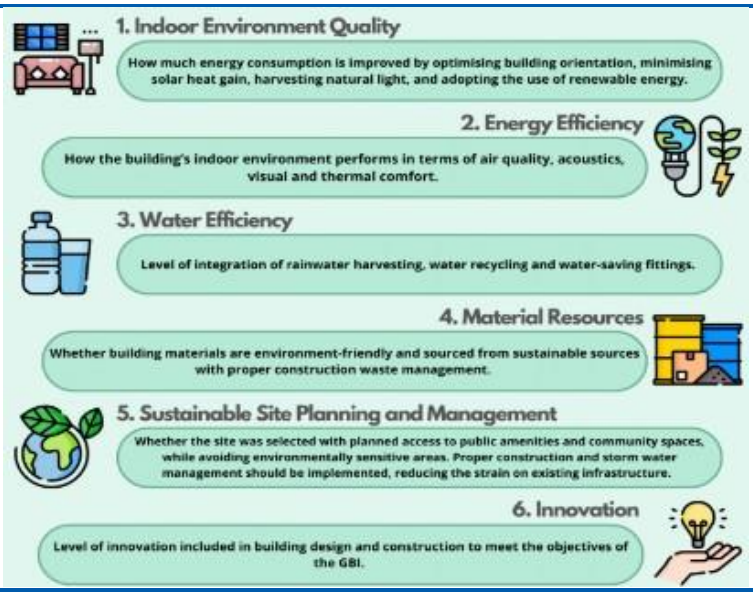
Besides being a great marketing tool, a property with GBI certification indicates that the developer has not only built an energy- and water-efficient building but has also upheld the adoption of sustainable building practices starting from the design phase of the development. As developers aspire to get the GBI certification and considering the certification has to be renewed every three years, the Malaysian construction and building industry will benefit as we see more innovation in sustainable practices.

Figure 28: GBI ratings

GBI rating	Points
Platinum	86 - 100
Gold	76 - 85
Silver	66 - 75
Certified	50 - 65

Source: GBI

Figure 29: Six pillars of Malaysia's GBI



Source: GBI

Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST)

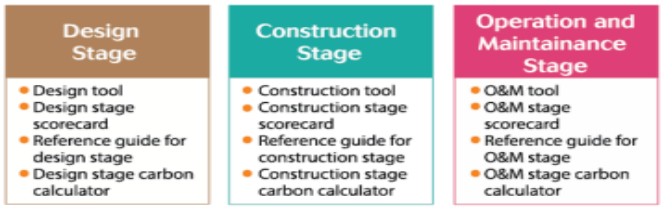
In 2016, CIDB launched MyCREST – a green rating tool that aims to measure and reduce carbon emissions and environmental implications, from the pre-design phase to sustainable waste management. Also, the MyCREST certification was made compulsory for all government projects valued at MYR50m and above. Some of MyCREST awarded projects are Menara KKR 2, Wisma REHDA, SP Setia's headquarters and G Tower Hotel.

MyCREST combines basic tools comprising scorecards, carbon calculators and reference guides for three stages – design, construction and operation & maintenance in order to develop a scoring plan, which is then used to assess a building for certification. Projects with a score of 40-49% will be given a 1-star MyCREST rating. The highest rating – five stars, for an 80-100% score.

Figure 30: MyCREST assessment criteria

Source: CIDB

Figure 31: Basic stages for MyCREST assessment and tools



Source: CIDB

Figure 32: MyCREST star ratings

MYCREST RATING	Percentage SCORE (%)
★★★★★	80 - 100
★★★★	70 - 79
★★★	60 - 69
★★	50 - 59
★	40 - 49

Source: CIDB

Sustainable Infrastructure Rating Tool (INFRASTAR)

CIDB has also developed a sustainable infrastructure rating tool for Malaysia to assess the extent of sustainability measures adopted by infrastructure projects in Malaysia primarily at both the design and construction stages. Sustainable INFRASTAR serves as a design and measurement tool to ensure consideration and sustainable elements are adopted early in the development of the project.

It is rated via two elements: i) Design, and ii) design & construction. The design stage gauges the sustainability of a project during the pre-construction phase, where planning and design is concerned. Meanwhile, the design & construction assessment stage emphasises the pre-commissioning and sustainability of the project's execution in relation to suitable worker amenities, monitoring plan for noise, and vibration. Similar to MyCREST, projects that get an >40% finalised assessment point will be given a 1-star score, while a 80-100% finalised assessment will be given a 5-star score (highest score).

Figure 33: Sustainable INFRASTAR assessment classification

Certification Award	Assessment point	Assessment details
Design certification (provisional)	At pre-construction stage	Credit points will be awarded based on the policy and targets set in planning, as well as documented evidence to validate their definite execution in the project design. This is only an interim assessment and award.
Design and construction certification	Between pre-commissioning to Certificate of Practical Completion (CPC) stage	Credit points will be awarded based on policy and targets addressed in the detailed design, as well as documented evidence to verify their definite execution in actual construction.

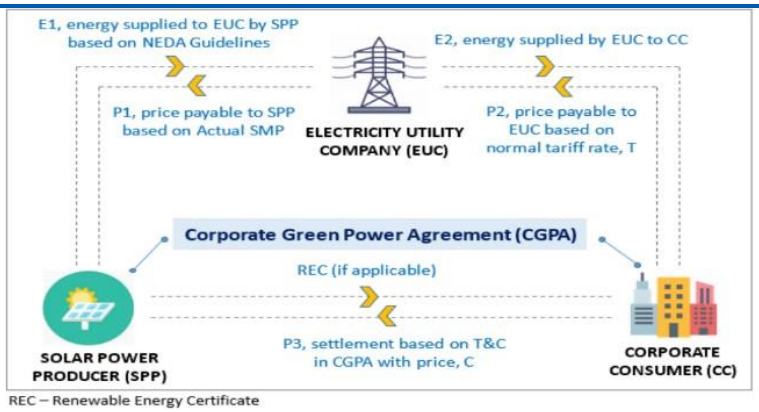
Source: CIDB

Notable infrastructure projects such as the Light Rail Transit 3 and the Mass Rapid Transit Putrajaya Line received a 5-star rating under the Sustainable INFRASTAR certification for the design phase.

Corporate Green Power Programme

The Government launched the Corporate Green Power Programme (CGPP) in Nov 2022, a RE initiative that allows corporate consumers to virtually purchase solar energy from solar developers for business operations. This is achieved through the use of virtual power purchase agreements (VPPA), or the corporate green power agreement (CGPA), under which there is no physical transfer of electricity. The available quota under CGPP is 800MW (maximum quota of 30MW for each solar project) and the deadline for applications is either 31 Dec 2023 or until the quota has been fully taken up, whichever comes earlier.

Figure 34: Overview of the CGPP framework



Source: Energy Commission

The three parties involved in the energy delivery and transaction process under the CGPP are:

i. The solar power producer (SPP);

ii. The corporate consumer (CC);

iii. The electricity utility company (EUC).

The SPP will develop, own, and operate the solar power plant. The energy produced by the solar power plant is exported through the electricity supply system of the EUC based on the rules of New Enhanced Dispatch Arrangement (NEDA).

The EUC provides electricity supply to the CC (which may include building owners). Notwithstanding this, the CC can have a VPPA with the SPP for the virtual supply of solar energy. The EUC pays the SPP the electricity exported to the electricity supply system based on the actual system marginal price (SMP) in adherence to NEDA rules. An SMP is the energy price of the most expensive thermal generator dispatched to meet demand of the CC.

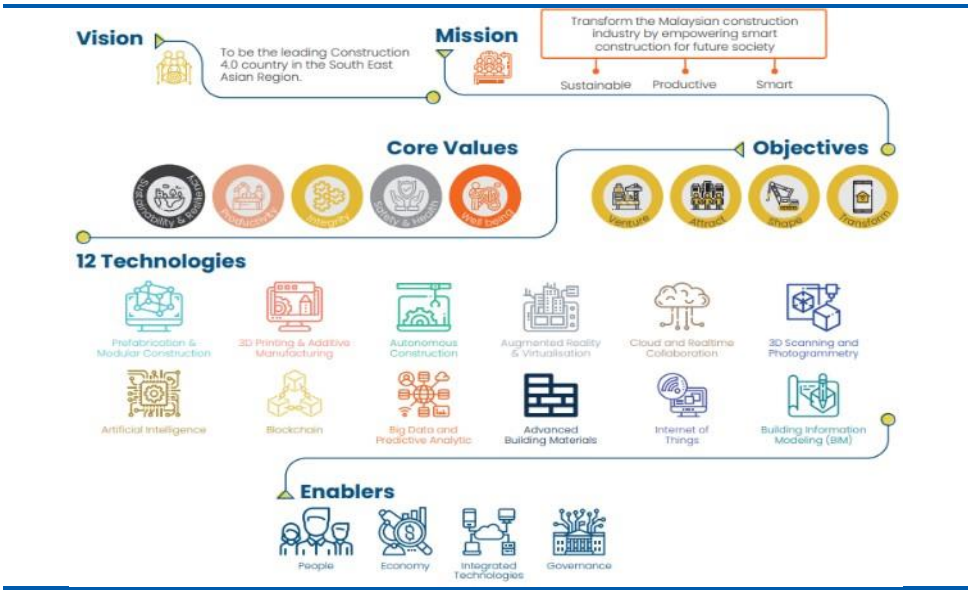
In fact, the CC's source of electricity supply is not directly from the solar power plant, but from a pool of generation sources connected to the electricity supply system. When no electricity is produced or electricity generated by the solar power plant is insufficient, other sources of electricity generation will have to top up the supply to meet the CC's demand. The EUC will have to provide electricity supply and services to the CC of similar quality and charges to other normal consumers

All in, the CC will purchase the energy produced by the SPP, based on an agreed price or price structure under the CGPA. If the SMP is higher than the price under the CGPA – the SPP will pay the CC the difference between the actual SMP and CGPA and vice versa. Gamuda (GAM MK, NEUTRAL, TP: MYR5.27) is the contractor, via the purchase of ERS Energy, which has secured the early quota to develop a power plant under the NEDA framework that will form the base for the CGPP.

Construction 4.0 Strategic Plan 2021-2025

The Construction 4.0 Strategic Plan 2021-2025 (CSP) was introduced to enhance current and future technologies for the construction industry to achieve higher productivity, better safety and lead the industry towards a more sustainable approach – incorporating whole lifecycle analysis using various technologies such as BIM, prefabrication and predictive analytics. A more sustainable approach would, in turn, lead to better-managed carbon emissions from the construction industry.

Figure 35: An overview of the Construction 4.0 Strategic Plan 2021-2025



Source: CIDB

Developments in carbon emission reduction efforts in Malaysia's construction sector

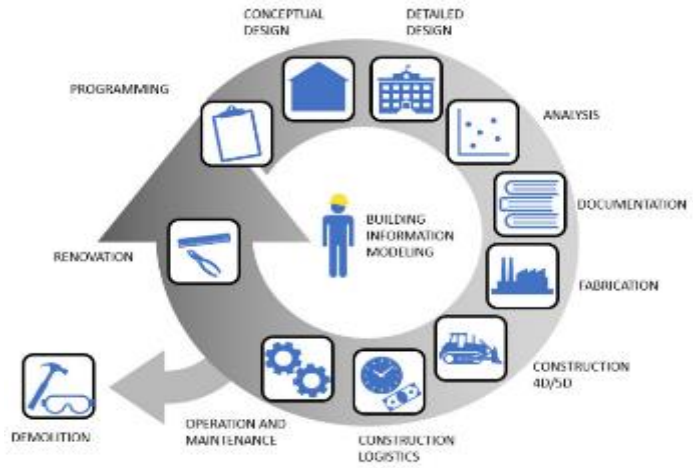
In realising the core values of the CSP through various technologies depicted in Figure 35, it is worthwhile studying the progress of certain technologies in the construction industry, namely BIM, and prefabrications mainly operated via IBS. Implementation of such technologies is also in line with the first strategic thrust of the National Construction Policy 2030 which is to improve the quality of construction through technology as a game changer.

BIM implementation in Malaysia

As mentioned in earlier sections, BIM allows contractors or owners to create accurate estimates before they start working on a project. Aside from having an amount of investment needed upfront compared to conventional methods, BIM helps with reducing carbon emissions by 20%.

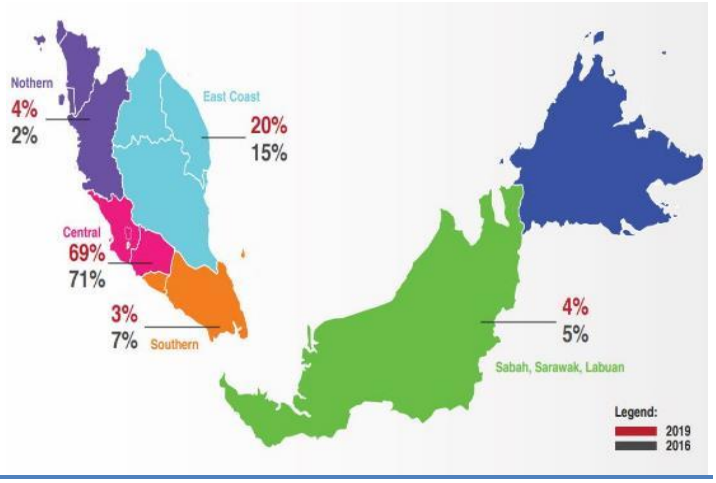
According to the Malaysia BIM Report published in 2019, the level of BIM adoption in Malaysia stood at 49% vs 17% in 2016. On further scrutiny, a high number of BIM implementors are located in the central region, which consists of five states based on a survey carried out by CIDB in 2019. The five states are the Federal Territory of Kuala Lumpur, Federal Territory of Putrajaya, Selangor, Melaka, and Negeri Sembilan – which have a 69% BIM adoption rate in total. Selangor recorded the highest number of BIM implementors (35%), followed by the Federal Territory of Kuala Lumpur (28%), Melaka (3%), the Federal Territory of Putrajaya (2%), and Negeri Sembilan (1%). Since most mega projects are ongoing in the Klang Valley region, there are many BIM implementors in this region. The rate of respondents' BIM adoption broken down by region is important in lifting the low percentage of BIM adoption in certain targeted regions, as well as driving BIM advancement further for the others.

Figure 36: BIM applications across buildings' lifecycles.



Source: Energies Journal

Figure 37: BIM adoption by region



Source: CIDB

IBS developments in Malaysia

The official definition of IBS in Malaysia by CIDB is a construction system through which components are manufactured in a factory, on- or off-site, and positioned/assembled into structures with minimal additional sitework. The mandate for IBS took effect for government projects and private projects in 2008 and 2018, when the Ministry of Housing and Local Government at that time required projects worth MYR50m and above to have a minimum IBS score of 50.

CIDB cited that IBS implementation in Malaysian Government projects has increased to 84% in 2021, from 79.5% in 2020. Meanwhile for private projects, IBS adoption has surged to 60% in 2021 compared with 41% in 2020.

Incentives were offered by the Government in the previous Budget 2021 whereby companies producing at least three basic components of IBS or IBS systems that use at least three basic IBS components are eligible for the incentive tax allowance of 60% on qualifying capital expenditure incurred within five years, which can be set off against 70% of statutory income for each year of assessment. These incentives took effect from 1 Jan 2021 and will end in 31 Dec 2025, via the Malaysian Investment Development Authority (MIDA).

Figure 38: Precast facade

Source: Sunway Construction

Figure 39: Volumetric staircase wall

Source: Sunway Construction

IBS adoption not only improved construction quality and cost and reduced the reliance on foreign labour but also accelerated construction timelines, simplifying on-site management and safety and reducing the construction industry's environmental impact. A case study, mentioned in the Journal of Advanced Research in Fluid Mechanics and Thermal Sciences involving the quantification of carbon footprint in Malaysia, was done by evaluating the selected case studies in Kuching, Sarawak using IBS vs conventional methods. In general, there are 3-storey administration blocks that adopted IBS as a construction method, while another 3-storey administration blocks applied the conventional system. The IBS and conventional system projects have three similar type of construction materials that can be compared which are steel bars, Portland cement and ready mix concrete.

Results showed that the total emissions from the IBS project were lower than that of the conventional system project – but one may argue that this is due to a lower gross floor area. Looking into further detail, the IBS project has a lower carbon emission intensity of 25.36 CO2e per sqm compared to the conventional system project, which has 39.58 CO2e per sqm.

Figure 40: Conversion of construction materials to CO2e for an IBS project in Kuching Malaysia

IBS Building Component	Total volume (m^3)	Construction material	Density (tonne/ m^3)	Quantity (tonne)	Carbon emission of material/tonne	Total CO2e emissions (tonnes CO2e)
Precast concrete column	25	Ready mixed concrete	1.90	7,905.90	0.14	1,106.83
Precast concrete beam	119	Portland cement	1.50	6,241.50	0.75	4,681.13
Precast concrete half slab	187	Aggregate	2.00	8,322.00	0.005	41.61
Precast concrete Wall	3,830	Steel wire mesh and steel bar	7.70	32,039.70	1.46	46,777.96
Panel		Steel bar	7.80	32,455.80	1.46	47.385.47
Total	**4,161**					**94,163.43**

Source: Journal of Advanced Research in Fluid Mechanics and Thermal Sciences

Figure 41: Conversion of construction materials to CO2e for a conventional project in Malaysia

Conventional Building Component	Total volume (m^3)	Construction material	Density (tonne/ m^3)	Quantity (tonne)	Carbon emission of material/tonne	Total CO2e emissions (tonnes CO2e)
Reinforced concrete column	206	Clay brick	1.90	27,774.20	0.24	6,665.81
Reinforced concrete beam	1,560	Damp proof membrane	0.0009	13.16	4.45	58.56
Reinforced concrete slab	1,652	Portland cement	1.50	21,927	0.75	16,445.25
Brickwall	11,200	Steel bar	7.80	114,020.40	1.46	166,469.78
		Ready mixed concrete	1.90	27,774.20	0.14	3,888.39
Total	**14,618**					**193,527.79**

Source: Journal of Advanced Research in Fluid Mechanics and Thermal Sciences

Figure 42: Conversion of construction materials to CO2e for a conventional project vs IBS project in Malaysia

Project	Total CO2e	Gross Floor Area (m^3)	CO2e per sqm (CO2e/sqm)
IBS	**94,163.43**	3,713	25.36
Conventional	**193,527.79**	4,890	39.58

Source: Journal of Advanced Research in Fluid Mechanics and Thermal Sciences

Initiatives by cement players in Malaysia

In Malaysia, CO2 emissions from cement production have exceeded 10m tonnes annually since 2016, which makes up 4-5% of total CO2 emissions from the production of coal, gas, oil and flaring activities. Cement players in Malaysia have already practiced substituting Portland cement fully or partially with supplementary cementitious materials such as fly ash to reduce embodied carbon. Partial replacement of Portland cement with fly ash can result in a considerable reduction in the embodied carbon of concrete, with reductions as high as 7% achievable at 15% replacement ,and 17% achievable at 30% replacement.

Other alternatives include cement manufacturers such as Malayan Cement (LMC MK, NEUTRAL, TP: MYR3) which offers its range of low-carbon cement, ECOCem. The ECOCem range contains at least 25% recovered materials and made with 20-50% lower CO2 emissions intensity compared to ordinary Portland cement. In this product range, its various products are certified with green labels, such as Mascrete LH (SIRIM Eco-Label) and Castle (Singapore Green Label).

On a wider scale, the Construction Research Institute of Malaysia (CREAM, a subsidiary of CIDB) and YTL Cement signed an MoU in Apr 2023 to support the transition of Malaysia's construction industry to sustainable construction. The MoU marks the beginning of a meaningful collaboration between the Government and industry players to achieve construction excellence and promote sustainable practices, in line with the nation's 2050 carbon-neutral aspiration. YTL Cement will be supporting CIDB's initiatives in developing: i) The construction industry's workforce, ii) research and innovation, and iii) in enhancing the understanding of sustainable construction practices among industry players.

Under this MoU, YTL Cement will be offering access to its laboratory and testing facilities. CREAM will work together with YTL Cement's team of experts to conduct R&D on lower embodied carbon alternatives in materials and construction methods. Both parties will also work together to increase awareness on embodied carbon, by providing channels for discussions and knowledge transfer among industry practitioners and experts. This is very crucial, as the local market still prefers the ordinary Portland cement despite the introduction of alternative constituents in cement.

In Thailand, cement manufacturers are taking a more collective approach. Cement manufacturers have formed alliances with the public and academics to push forward carbon-neutrality efforts by launching MISSION 2023, to reduce 1m tonnes of CO2 in 2023, by encouraging all sectors to use environmentally friendly hydraulic cement in all types of construction projects in Thailand. Such a collaboration is further enhanced by construction standard and production standard improvements, capacity building and product research and development.

Figure 43: MoU between CREAM and YTL Cement to promote sustainable construction

Source: Business Today

Figure 44: Low-carbon cement product range under Malayan Cement certified as a Singapore Green Label Cement

Source: Malayan Cement

Featured Stock Ideas – Malaysia

Investment ideas in Malaysia's construction sector are related with contractors that have a sizeable footprint in implementing IBS systems. Other important criteria covers efforts in managing their carbon intensity emissions, whether it is through solar energy or the usage of energy-efficient equipment. We highlight three companies are making good progress in realising the nation's aim to reach net zero carbon by 2050.

Gamuda (GAM MK, BUY, TP: MYR5.27) – the green champion among Malaysian contractors

Under the Gamuda Green Plan 2025, the group aims to reduce its corporate GHG emissions intensity by 30% by 2025 and by 45% by 2030, as compared to 2022. To achieve this, Gamuda is intensifying its investments in RE, specifically solar and hydropower. The group aims to grow its RE asset portfolio to a capacity exceeding 800MW, which would position it as Malaysia's largest private RE producer.

So far, Gamuda has embarked on the construction of its inaugural 39MWp solar power plant in Pekan, Pahang (expected completion in 4Q23) via a 49:51 JV between Gamuda and ERS Energy (known as NEDA Pekan). The solar power plant in Pekan will operate under the NEDA framework, which allows power producers such as RE companies to supply energy to a single buyer, Tenaga Nasional (TNB), without entering into PPAs. Gamuda's participation in NEDA Pekan should make it and ERS Energy frontrunners in the CGPP, which uses the virtual VPPA mechanism to allow corporate consumers to purchase RE virtually.

As for its operations or ongoing construction projects – Gamuda's RE adoption has mostly been in the form of solar PVs as well as via a subscription to the Green Electricity Tariff. The group is slowly phasing out the use of non-RE by installing solar panels, and incorporating efficient cooling systems into ongoing and future developments, such as Gamuda Cove

To enhance continuous efforts in Scope 3 traceability, Gamuda has also started monitoring its construction emissions and begun training over 3,000 partners in its supply chain ecosystem, on the group's expectations in doing business in a sustainable measure to reduce Scope 3 emissions. Supply chain partners comprise financiers, government agencies and regulators, builders, suppliers and consultants.

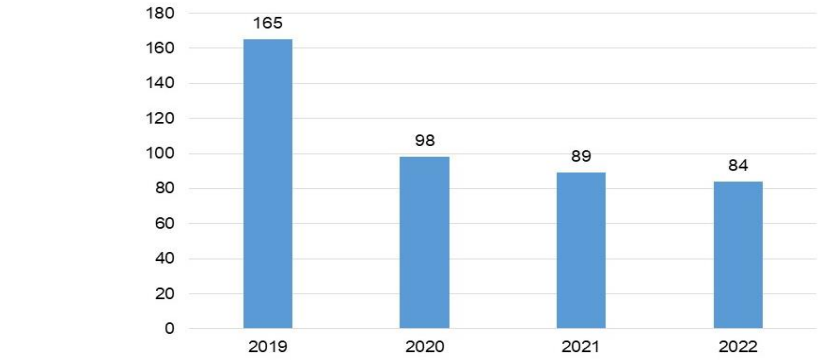
Figure 45: Gamuda's energy and cost savings from RE adoption

Source: Gamuda

Sunway Construction (SCGB MK, BUY, TP: MYR2.05) – the "cooler" one

Sunway Construction's (SCGB) focus is consistent with the ultimate environmental goal of its parent – which is achieving net zero carbon emissions by 2050. For its own operations, SCGB has installed rooftop solar panels at its Sunway Precast Industries plant at Senai, Sunway Enterprise Park in Puchong and a solar investment project in its parent's project in Kuala Lumpur. With this, a total of 245MWh of solar energy is generated per year from the said facilities – avoiding 143 tonnes of CO2e which is equivalent to carbon sequestrated from 6,810 trees in a year. In terms of emissions performance, SCGB's carbon emissions intensity stood at 84 tonnes CO2e per MYRm in FY22. SCGB recorded a 6% YoY decrease in its carbon emissions intensity (CEI) for FY22, reaching 89 tonnes CO2e/MYRm. In fact, the CEI in FY19 was almost double than what was seen in FY22.

Figure 46: Annual carbon emissions intensity of SCGB (tonnes CO2e/MYRm)



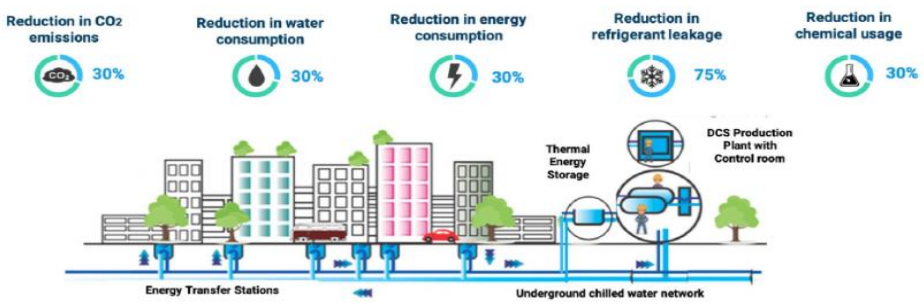
Source: Sunway Construction

Another key aspect of SCGB's approach is its contribution as a RE solutions provider – in particular as a builder/installer of solar energy-generating facilities. Under SCGB's construction orderbook as at end FY22, c.8% comes from projects related to sustainable energy. For instance, the group has commenced the construction of two of its Large Scale Solar 4 (LSS4) EPCC projects in Kampar, Perak and Klang, Selangor capable of producing 50MWac of clean energy each. The group has also completed the installation of solar PV panels at the Universiti Sains Malaysia campus in Penang – with a PPA duration of 20 years and an energy generating capacity of 4,325 kilowatt peak (kWp). In total, SCGB has completed 18 solar projects with a cumulative clean energy-generating capacity of 17,866kWp.

Aside from sustainable energy like solar, SCGB also commenced the construction of the MYR40m District Cooling System (DCS) at the mixed development project in South Quay Square, Sunway City, in collaboration with ENGIE Southeast Asia in Jul 2022. The project is on track for completion in FY24 and marks SCGB's maiden foray in jointly operating a DCS system. The project will provide an energy-efficient cooling solution and is aligned with the parent's continued focus on reducing its carbon footprint and developing more sustainable townships.

We foresee manageable execution risks, as ENGIE already has an established footprint in Malaysia under its previous JV with Cyberview that has more than 40 buildings connected through a DCS. To date, SCGB has installed 44,250 refrigeration tonnes (RT) of DCS under three projects in Putrajaya.

Figure 47: Sustainability benefits of DCS



Source: ENGIE Southeast Asia

The use of digital construction methodologies is one effective means of realising leaner construction – which ultimately reduces construction waste generation, the carbon footprint and the environmental impact. In FY22, mandatory BIM and digitalisation for all new projects was implemented for SCGB. This expedited the transition towards ultimately achieving 100% 3D and 4D utilisation for all new SunCon projects by FY23. Moving forward, the company has earmarked the usage of Autodesk Construction Cloud for the data centre project in Sedenak Technology Park to enhance design management processes.

Kerjaya Prospek (KPG MK, BUY, TP: MYR1.55) – cutting emissions via a aluminium formworks system

Kerjaya Prospek (KPG) uses fuel in vehicles and heavy machinery such as cranes, excavators, generation sets and others. While the consumption of fuel is inevitable in its operations, the group regularly performs maintenance on its machinery and equipment to keep them in good condition, thereby maintaining their energy efficiency. From time to time, KPG also invests in new machinery and equipment to boost energy efficiency.

Based on electricity bills, in relation to KPG's construction projects, the electricity intensity in FY22 stood at 3.30kWh/MYR1,000 construction revenue vs the 3.56kWh/MYR1,000 construction revenue recorded in FY21. This indicates the group's effort to enhance energy efficiency is gradually progressing along.

As for KPG's operations, the group has installed solar power generation systems at its premises to support or offset energy needs. As of 31 Dec 2022, KPG has two solar panel systems installed and in operation at its headquarters and the Rawang factory. In FY22, 24,900 kWh of electricity was generated from solar panels at its Petaling Jaya headquarters (for a 3-month period, between Sep to Dec 2022) while the Rawang factory (operating since March 2022 generated 53,900 kWh of electricity.

Figure 48: Electricity generated from solar panel systems

Electricity generated from solar panel systems	'000kWh
Petaling Jaya headquarters (in operation since Sep 2022)	24.9*
Rawang factory (in operation since Mar 2022	53.9**

**calculated based on system meter*
***estimated based on power-generation capacity*
Source: Kerjaya Prospek

Meanwhile, KPG has sold 28,085 kWh of excess solar-generated power to TNB in FY22. Meanwhile, based on the 78,800 kWh of RE generated, the emissions avoidance is estimated at 43.4 tonnes of CO2e. Looking ahead, KPG is studying the feasibility of installing solar panel systems on its cabin at project sites to reduce its dependency on diesel-based electricity power via generator sets.

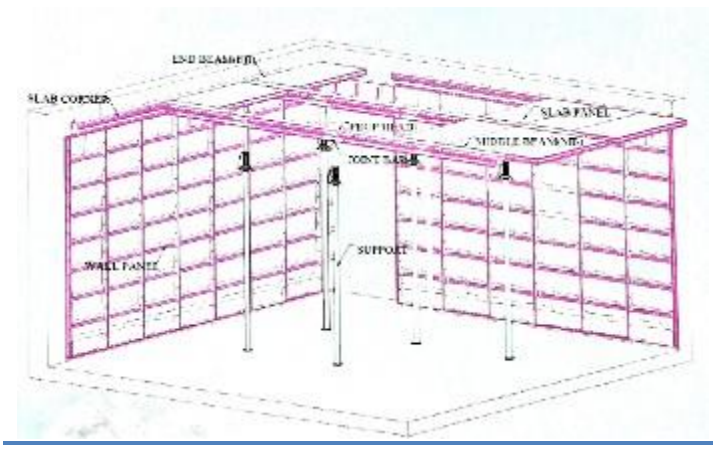
Instead of using conventional timber formwork which can be used only once, KPG has also fully adopted the use of aluminium formwork, a type of IBS component, at its construction sites (initial investment of MYR88m) which can be repeatedly used. This technology enabled KPG to reduce building material waste (especially timber) and maintain a cleaner project site while being more efficient. Using such systems, KPG is able to build one storey per week of high-rise buildings, and this system can be reused for a period of five years. Moreover, the aluminium formwork which is repeatedly used indirectly leads to lower carbon emissions from procuring new aluminium formwork at their sites. As a result, none of the non-hazardous waste (such as iron or steel) was directed to disposal – but instead diverted to disposal via recovery, reuse or recycling activities – from FY20 to FY22.

Figure 49: Aluminium formwork vs conventional timber formwork

Characteristics	Aluminium Formwork	Conventional Formwork
Speed of construction	7 days cycle per floor	Minimum cycle time of 21 days
Quality of surface finish	Excellent – plastering is not required	Bad – plastering is required
Wastage of formwork material	Very little	High
Pre-planning of formwork system	Can be done in advance and fabrication of formwork can done offsite	To be done onsite and time consuming with modifications required throughout the process
Re-usage value of formwork system	250-300 times	Maximum 50 times

Source: Kerjaya Prospek

Figure 50: Layout of aluminium formworks system



Source: Kerjaya Prospek

Figure 51: Aluminium formworks usage at Serviced Residences Tower at Bukit Bintang City Centre (BBCC) project

Source: RHB

Figure 52: Post dismantlement of an aluminium formworks system at Serviced Residences Tower, BBCC

Source: RHB

Figure 53: Finished product after using aluminium formworks at Serviced Residences Tower, BBCC

Source: RHB

INDONESIA

Indonesia's carbon reduction target

In order to achieve the net zero emission (NZE) target by 2060, Indonesia raised its Enhanced National Determined Contribution target (E-NDC) for 2030 in Sep 2022 to 32% from 29% – equivalent to a reduction of 912MtCO2e. Steps to be taken by the Indonesian Government consist of converting fossil fuel consumption to that of LNG and biofuel, while ramping up electric stove and rooftop solar panel usage. The Ministry of Public Works and Housing also regulates the implementation of sustainable construction by using green materials, which waters down the environmental impact compared to conventional materials.

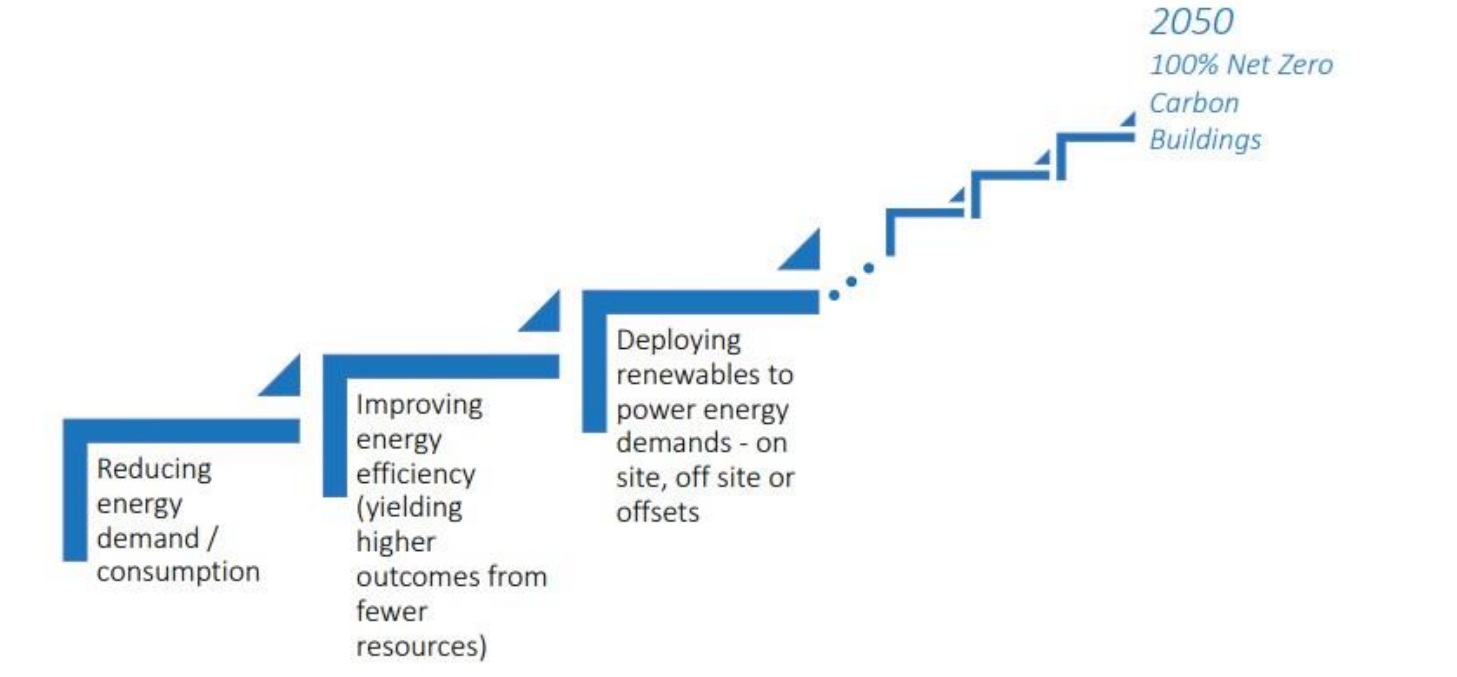
Figure 54: Indonesia's commitment in reducing GHGs

No	Sector	GHG Emissions 2010 (MtCO2e)	GHG Emissions by 2030 (MtCO2e)			Reduction (MtCO2e)	
			Business as usual	National effort	International Support	National effort	International Support
1	Energy	453.2	1,669.0	1,335.3	1,271.0	333.72	398.0
2	Waste	88.0	296.0	66.9	270.0	229.15	26.0
3	Industrial Processes and Product Use	36.0	69.6	110.4	66.4	(40.79)	3.3
4	Agriculture	110.5	119.7	217.0	115.9	(97.34)	3.8
5	Forest	647.0	714.0	217.0	64.0	497.00	650.0
	Total	**1,334.7**	**2,868.3**	**1,946.5**	**1,787.2**	**921.74**	**1,081.1**

Source: Ministry of Energy and Mineral Resources, RHB

According to the Ministry of Environment and Forestry, GHG emissions from the industrial processes and produce use (IPPU) sector reached nearly 60m tonnes in 2019, of which 52% was from cement production. Some of green materials which can replace conventional cement are non-ordinary Portland cement (NOPC), recycled timber, recycled bricks, bamboo, seaweed roof, and low volatile-organic-compound paint. However, the main constraints lie in the availability of green materials, which are produced far less than conventional materials.

Figure 55: The path to net zero carbon buildings



Source: World Green Building Council, RHB

Green Building Council Indonesia

Green Building Council Indonesia (GBC Indonesia) is an independent organisation. Its four main activities are related to green construction: Market transformation, education & training, green building certification, and also collaborative programmes. The main goal is to encourage the industry to apply green building principles via public education and facilitating the sustainable building industry. It has collaborated with construction professionals, building material players, property developers, the Government (via state-owned enterprises), research institutions, associations and environmental organisations.

GBC Indonesia issues green building certifications, GREENSHIP, for different purposes:

i. GREENSHIP Net Zero (NZ) – design optimisation to reduce energy consumption per year with the usage of a RE system. Tropical countries such as Indonesia only have two seasons, ie dry and rainy, without extreme temperature changes. The natural ventilation is considered suitable for human comfort and an environment with good air quality.

ii. GREENSHIP New Building (NB) – certification for a new building on vacant land, renovation projects with 90% mechanical, electrical, and structural renovations. This also applies to new buildings within integrated areas.

iii. GREENSHIP Existing Building (EB) – certifications related to operational management and building maintenance, intended for buildings that have been operating for at least one year after it was built.

iv. GREENSHIP Interior Space (IS) – certification for building owners to provide proper comfort, health and productivity for occupants. The assessment scope includes fit-out activities and facilitated management policies.

v. GREENSHIP Homes – certification for landed homes that meets the basic requirements (safety, minimum area, and health), and also considered eco-friendly with the efficient usage of land, water, energy, materials and other resources. This involves the concept of a green home that does not require high maintenance costs, or a home with a lot of green space.

vi. GREENSHIP Neighbourhood – certification to create sustainable and environmentally friendly areas for users, having larger scope that oversees the interaction between building, nature and people. It can be used for residential areas, central business districts and industrial estates.

Figure 56: GREENSHIP certification and requirements

Certification	Project type	Requirement	Note
Net Zero Healthy	New and existing building	1. Fulfillment of the quantity of comfort in the building 2. Energy usage intensity (EUI) of the building is efficient 3. Action to reduce carbon emissions beyond RE application	Net Zero Ready: 1. Fulfillment of EUI and comfort standards 2. RE on-site fulfills one of three schemes 3. Building monitoring system 4. Delivering a carbon balance implementation plan Net Zero Certified: Same as above, with an additional carbon balance equal to or less than zero.
New Building	1. New building on vacant land 2. Renovation project with 90% activities that are mechanical electrical and structural 3. New building within an integrated area	1. Minimum building area of 2,500sqm 2. Green building certified data for assessment 3. Building function in accordance with land designation 4. Ownership of Environmental Impact Report (AMDAL) 5. Compliance with building safety standards for fire protection 6. Conformity with the earthquake resistance standard 7. Conformity with disabled accessibility standard	Design Recognition stage (DR) with a maximum score of 77pts Final Assessment stage (FA) with a maximum score of 101pts
Existing Building	Operating building for at least one year	1. Minimum building area of 2,500sqm 2. Green building-certified data for assessment 3. Has environmental management implementation report (UKL/UPL) 4. Has Certificate of Acceptability to Function (SLF), which is issued by the local government	Six assessment categories: Appropriate Site Development (ASD), Energy Efficiency and Conservation (EEC), Water Conservation (WAC), Material Resources and Cycle (MRC), Indoor Health and Comfort (IHC), Building and Environmental Management (BEM). Maximum score of 117pts
Interior Space	Interior for building users/tenants	1. Fit-out activity 2. Uses minimum area of 25sqm 3. All area used in one building must be included in the certification process 4. Minimum of one employee working full-time for one year 5. Minimum 3-year lease of the area used 6. A copy of land allocation permit for the building used 7. SLF	Six assessment categories: Appropriate Site Development (ASD), Energy Efficiency and Conservation (EEC), Water Conservation (WAC), Material Resources and Cycle (MRC), Indoor Health and Comfort (IHC), Building and Environmental Management (BEM). Maximum score of 93pts
Homes	1. Landed home with a single residential unit attached to the ground 2. New house, existing house, and redeveloped house	1. Less than four floors (excluding basement/semi-basement) with a minimum of 70% of the area used as a residence 2. Occupied by at least one permanent resident 3. Has IMB documents 4. No change in function for the 3-year certification period 5. Meeting the basic requirements (safety, minimum area, and healthy) 6. Agreement letter that allows building data to be studied by GBC Indonesia	Six assessment categories: Appropriate Site Development (ASD), Energy Efficiency and Conservation (EEC), Water Conservation (WAC), Material Resources and Cycle (MRC), Indoor Health and Comfort (IHC), Building and Environmental Management (BEM). Maximum score of 77 pts
Neighborhood	Residential, central business district, and industrial estate	1. Has a masterplan for the area 2. Has environmental management implementation report (UKL/UPL) 3. Permit from the National Land Agency 4. Function permit from the local government 5. Minimum area of 5,000sqm and maximum of 60ha 6. Minimum of two buildings 7. One management team 8. Data availability to be studied by GBC Indonesia	7 assessment categories: Land Ecological Enhancement (LEE), Movement and Connectivity (MAC), Water Management and Conservation (WMC), Solid Waste and Material (SWM), Community Wellbeing Strategy (CWS), Building and Energy (BAE), Innovation and Future Development (IFD) Maximum score of 124 pts

Source: Green Building Council Indonesia, RHB

Net Zero Programme

Realising that buildings consume 36% of energy produced and contributes 39% of global carbon emissions, GBC Indonesia is committed to craft the net zero certification programme, in order to achieve its decarbonisation target by 2050. The basic principle is to optimise building designs that reduce energy consumption as efficiently as possible, and support these by using RE systems.

Indonesia, being a tropical country, does not have drastic changes in seasons. The ample natural ventilation and lighting can be used to reduce energy consumption. To facilitate the path towards having net zero buildings, a few steps can be taken:

i. Use natural ventilation and lighting;

ii. Optimise air conditioning systems, lighting and other equipment;

iii. Create healthy and comfortable air quality;

iv. Utilising RE sources.

Figure 57 details the framework used for GREENSHIP Net Zero certification.

Figure 57: GREENSHIP Net Zero certification framework

Source: GBC Indonesia

Featured Stock Ideas – Indonesia

Stock picks for this theme centre on contractors that have made a mark in implementing modular construction systems. Other important criteria cover efforts like efficiently managing waste materials which, in turn, reduce indirect carbon emissions that stem from using more building materials for construction. We highlight two companies that promote sustainable construction practices in Indonesia – Total Bangun Persada and Wijaya Karya Bangunan Gedung.

Total Bangun Persada (TOTL IJ, NR) – a known "green" builder

TOTL consistently applies green construction principles to its projects. These principles are taken into consideration during the phases of site planning, creating accessibility, boosting circulation and traffic, as well as improving project surroundings and also operations. At the same time, the company also educates the public on the benefits of green buildings, to encourage the further adoption of green design and construction methods – including passive design, modular, prefab systems and reusing materials. Moreover, TOTL implements a dewatering system for water absorption, which can include features like recharging wells and retention ponds.

TOTL uses recycled concrete piles for retaining walls, where it reuses rubble from bored piles. The idea to utilise recycled concrete piles came from the increased cutting of bored piles as connectors to the main structure of the building (Figure 58).

Figure 58: Process of using recycled concrete pile

Source: Company

TOTL has also improved its liquid waste management from using septic tanks to employing the extended aeration method. It has also built hazardous waste warehouses, cartesian wells and biopores to reduce water flow. The company is also a corporate founder of the Green Building Council Indonesia.

Figure 59: Total Bangun Persada projects with GREENSHIP certification

Building	Rating	Point	Note
Menara Bank Danamon	Platinum	92	Menara Bank Danamon, in South Jakarta, has successfully achieved GREENSHIP Existing Building Certification. It accomplished a PLATINUM rank with a 92-pt score.
Trinity Tower	Gold	66	Trinity Tower has successfully achieved GREENSHIP New Building Certification. It accomplished a GOLD rank with 66pts. This building is located in South Jakarta.
RDTX Place	Platinum	78	RDTX Place has successfully achieved GREENSHIP New Building Certification. It accomplished a PLATINUM rank with 78pts. This building is in Karet Kuningan, South Jakarta.
Wisma Barito Pacific II	Gold	64	Wisma Barito Pacific II has successfully achieved GREENSHIP New Building Certification. It accomplished a GOLD rank with a total point of 64. This building is located in West Java.

Source: Company data, RHB

Wijaya Karya Bangunan Gedung (WEGE IJ, NOT RATED) – mitigating emissions via modular construction

WEGE contributes to the green construction principal via its modular products, which consists of flatpack, prefabrication, volumetric and stacking. The production process starts with prefabrication at the manufacturing plant, then delivery to the project site, while foundation works are done at the site. Thereafter, the modular components can be assembled after the foundation is completed.

Figure 60: Modular products – flatpack and stacking

Source: WEGE, RHB

Figure 61: Modular products – prefab and volumetric

Source: WEGE, RHB

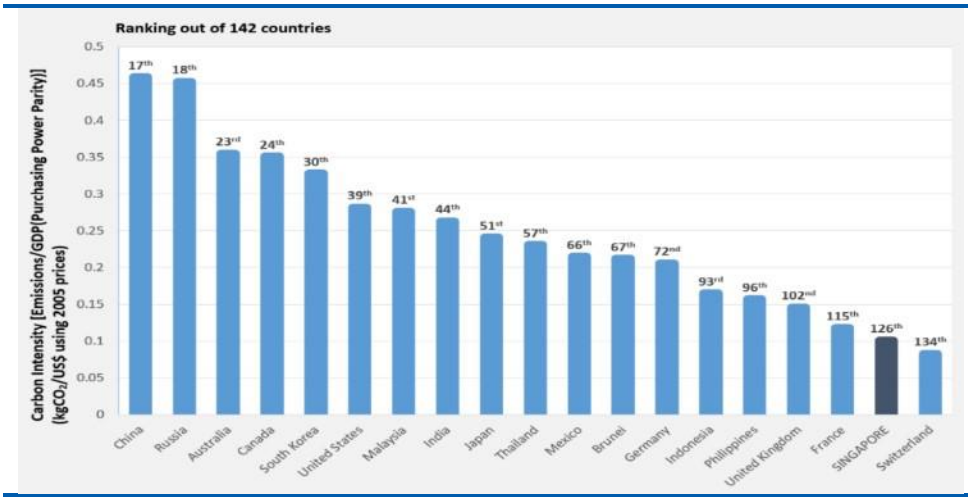
WEGE is able to build mid-rise buildings with modular material – this means buildings up to 12 floors – and it is targeting to widen its usage to include high-rise buildings by 2025. Its latest modular project is at Nusantara (Indonesia's new capital) where it is building housing quarters for construction workers. Minimum on-site construction could reduce materials wastage, decrease noise levels (from works), improve safety and lead to a cleaner working area. Modular projects are also time-efficient and require less heavy equipment – which may cut down GHG emissions by 17-30%. Most importantly, modular products can be reused. The company also continuously improving BIM implementation, and has used BIM level 3 for two of its projects.

SINGAPORE

One of the top carbon intensity performers globally

Singapore is one of the top performers for carbon intensity globally. It is amongst the 20 best-performing countries in terms of emissions intensity, according to the International Energy Agency (IEA) World CO2 Indicators 2022 – despite its small share of the global GDP, ie 0.4%. Out of 142 countries, Singapore ranks 126th in terms of CO2 emissions per dollar GDP.

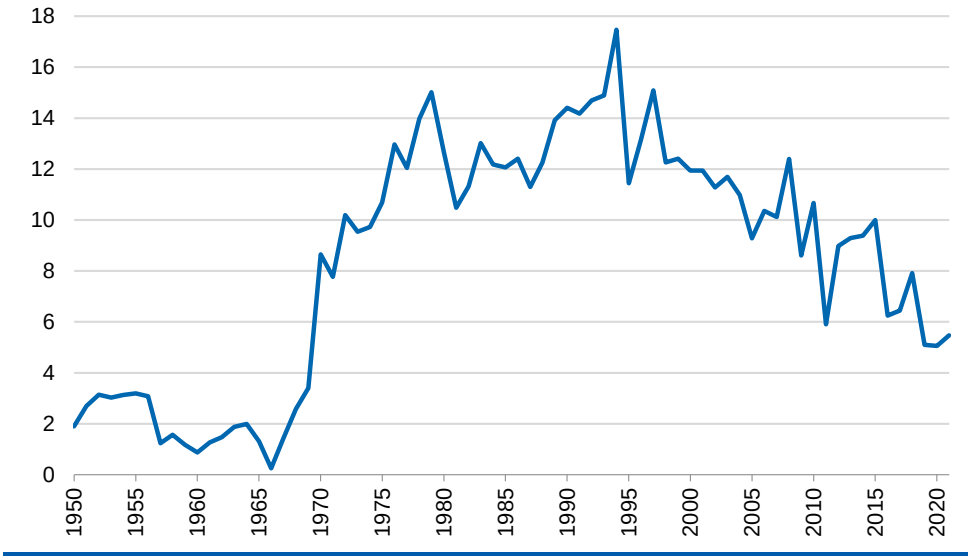
Figure 62: Carbon intensity (emissions per dollar GDP) – Singapore ranks 126th of 142 countries in terms of CO2 emissions per dollar GDP



Source: National Climate Change Secretariat (NCCS), CO2 Emissions from Fuel Combustion - 2018 Highlights © OECD/International Energy Agency, 2018

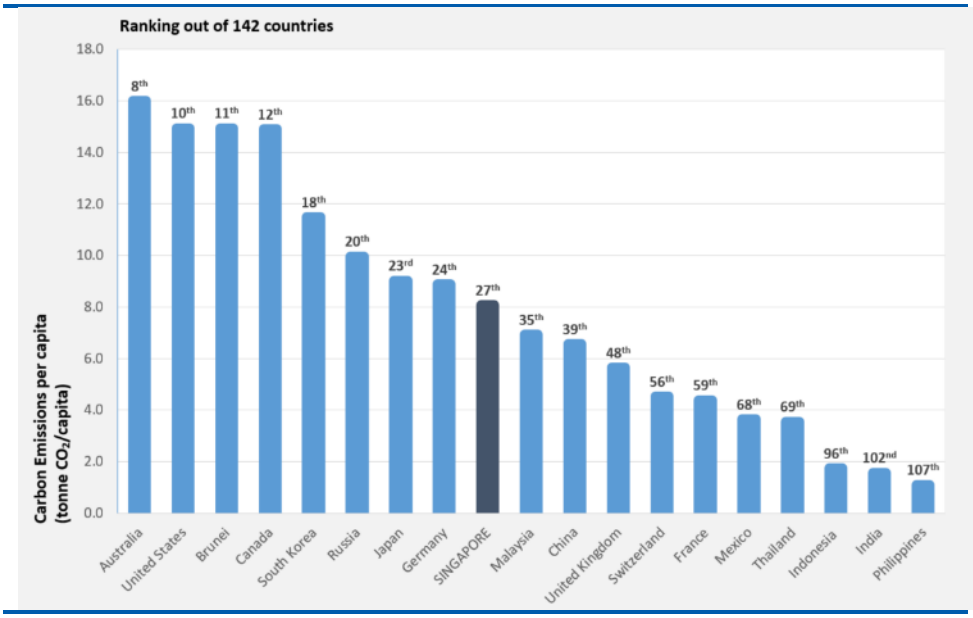
CO2 emissions per capita soared, as Singapore has undergone industrialisation since its independence, and peaked in 1994 at 17.5trn tonnes. Then, the metric declined by more than twofold to 5.4trn tonnes in 2021, after the UN Framework Convention on Climate Change was adopted by the UN, which required governments to develop policies and strategies to reduce GHG emissions in 1992. In terms of global ranking, Singapore ranks 27th out of 142 countries in CO2 emissions per capita.

Figure 63: CO2 emissions per capita in Singapore (trn tonnes)



Source: Our World In Data

Figure 64: Per capita emissions – Singapore ranks 27th out of 142 countries in terms of emissions per capita

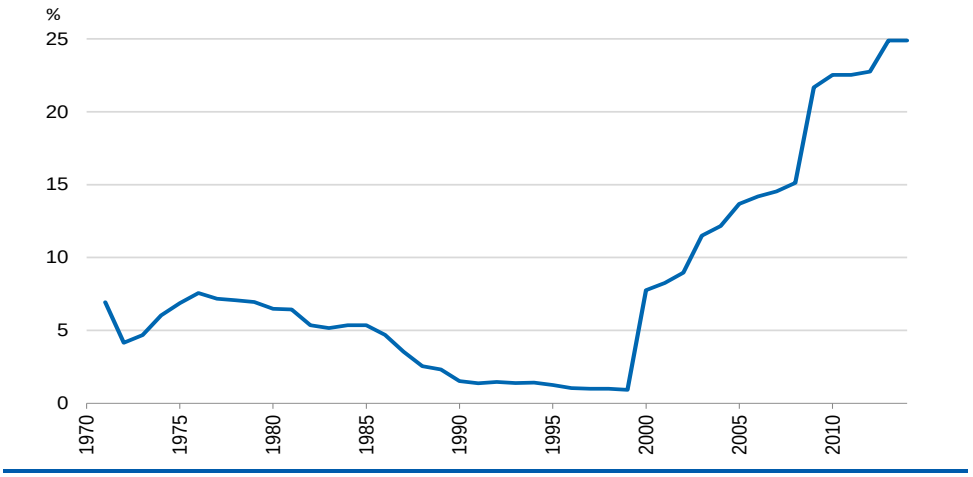


Source: NCCS, CO2 Emissions from Fuel Combustion - 2018 Highlights © OECD/International Energy Agency, 2018

Net zero target by 2050

Despite reducing CO2 emissions per capita and ranking favourably in recent years, Singapore now aims to achieve net zero emissions by 2050, targeting emissions at around 60m tonnes of CO2 equivalent (MtCO2e) in 2030 after peaking earlier, and from 52.8 MtCO2e in 2020, based on the addendum to the long-term Low-Emissions Development Strategy (LEDS) 2022.

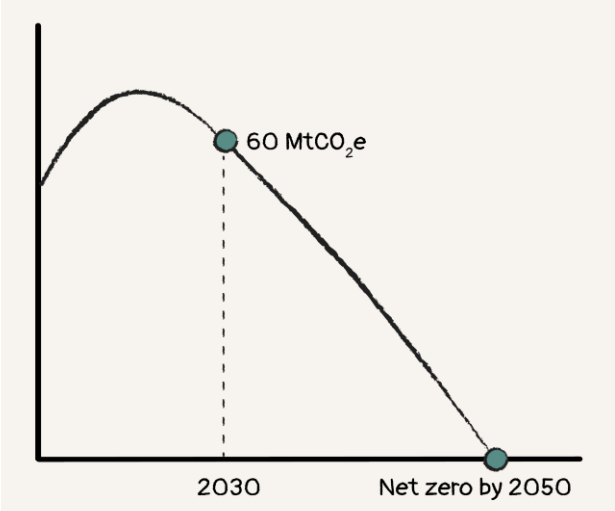
Figure 65: Singapore's CO2 emissions from manufacturing industries and construction (% of total fuel combustion)



Source: Worldbank, IEA

A key strategy to reduce emissions is energy efficiency, since Singapore is also an advanced manufacturing hub. The objective is to be energy- and carbon-efficient through the adoption of energy efficiency and emissions reduction technologies. This will be aided by grants and other policy tools, which help to subsidise high upfront capital investments and other non-market barriers. Currently, energy is not subsidised – this incentivises companies to use energy prudently and to adopt more energy-efficient methods. Strong pollution laws are in place to move industries to cleaner fuel sources, including natural gas. Singapore is proactive in targeting "net zero emissions by 2050", and has outlined its plans under the long-term LEDS 2022.

Figure 66: Singapore's net zero emissions trajectory



Source: Addendum to Singapore's Long-Term Low-Emissions Development Strategy 2022

The use of alternative energy in Singapore is limited due to its small land area, high population density, low-lying and relatively flat land, low wind speeds and lack of high-quality hydrothermal resources. These characteristics make alternative energy – such as wind, hydro, and nuclear energy – challenging. Even with high average annual solar irradiation, solar PV is limited by the availability of land to deploy solar panels on a large scale, and high cloud cover. Some of these circumstances are recognised in the UN's Framework Convention on Climate Change, which recognises the circumstances of countries with "serious difficulties in switching to alternatives". Despite being unable to generate sufficient baseload electricity from renewable sources reliably, Singapore aims to deploy at least 2 gigawatt-peak (GWp) of solar energy by 2030, which is capable of powering about 350,000 households for a year.

As part of its LEDS, to achieve "net zero emissions by 2050", Singapore will be accelerating the low-carbon transition for industry, economy and society through four key thrusts (Figure 67).

Figure 67: Four key thrusts to accelerate low-carbon transition for industry, economy and society to reach net zero by 2050

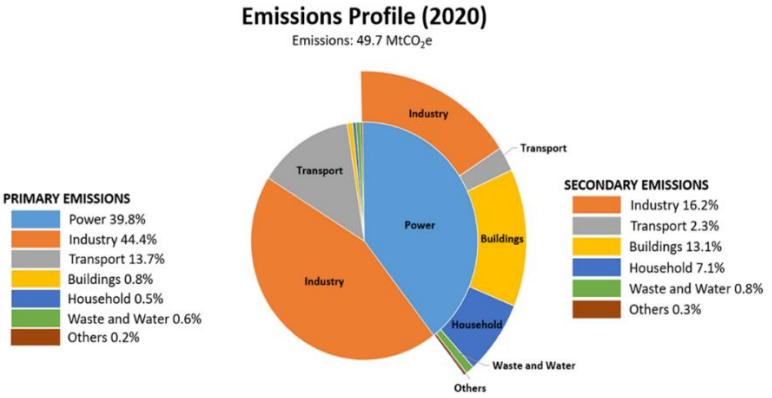
Plans and policies	Remarks
Catalysing business transformation	Improving energy efficiency, shifting towards a more sustainable Energy and Chemicals sector
Investing in low-carbon technologies	CCUS and use of low-carbon fuels
Pursuing effective international cooperation	International climate action, regional power grids, market-based mechanisms
Adopting low-carbon practices	Greener commutes with cleaner vehicles and Walk-Cycle-Ride

Source: NCCS, Addendum to Singapore's Long-Term Low-Emissions Development Strategy 2022

Reducing carbon through Singapore Green Building Masterplan (SGBMP)

As Singapore is highly urbanised, the building and household sectors account for about 20% of its carbon emissions, based on Singapore's emissions profile. A sizeable portion would have been for air-conditioning. Green buildings have, as such, become crucial for Singapore's climate change strategy, since buildings have long life cycles.

Figure 68: Emissions profile



Source: National Climate Change Secretariat

Under the LEDS's key thrust of adopting low-carbon practices, the construction sector is helping to accelerate Singapore's transition towards a low-carbon built environment via three targets by 2030. This falls under the SGBMP launched by the Building and Construction Authority (BCA) Singapore and the Singapore Green Building Council (SGBC), developed in conjunction with industry stakeholders and the community in Mar 2021. The three key targets of "80-80-80 by 2030" are:

i. **80% of buildings by gross floor area (GFA) to be green by 2030**, which seeks to reduce the carbon footprint of day-to-day building operations by raising mandatory environmental sustainability standards, mandatory energy audits, the publication of building energy performance data, Green Mark (GM) building certification and incentives.

   Standards are in place to improve the environmental sustainability of buildings. Buildings that meet minimum energy performance standards or have been certified GM will be considered "green". Higher-tiered GM Platinum buildings have to achieve at least 55% energy efficiency improvement compared to 2005 levels and demonstrate best practices in sustainability, while minimum energy performance standards for new and existing buildings were also raised by the BCA in 2021-2022. Standards including energy improvement performance, periodic Energy Audits (PEA), and energy usage data submission, can all be raised or calibrated to help Singapore move towards 80% of GFA to be green by 2030 in buildings.

ii. **80% of new developments (by GFA) to be Super Low Energy (SLE) buildings from 2030 onwards**, to achieve best-in-class building energy performance cost-effectively, with the government leading in driving SLE buildings along with measures to improve private sector adoption of SLE buildings.

   The SLE Programme goes beyond the existing GM Platinum standards. Its standards require buildings to achieve at least a 60% energy efficiency improvement over 2005 building codes. The Government is leading the wider adoption of SLE buildings under the GreenGov.SG initiative, with new and existing public sector buildings required to achieve GM Platinum SLE standards or equivalent. The Government also requires new private developments on strategic government land sales sites to deliver energy performance equivalent to SLE.

iii. **80% improvement in energy efficiency (compared to 2005 levels) for best-in-class green buildings by 2030** which is currently at 65-70% through the Green Buildings Innovation Cluster (GBIC) programme – a 1-stop research, development and demonstration platform for technologies and innovations that help to improve energy efficiency in buildings – along with funding.

The enhanced the GBIC programme in 2022, focuses on three key areas that are deemed to have high potential for significant energy savings and wide industry adoption:

- Alternative cooling technologies (ACTs) that yield improved energy performance;
- Data-driven smart building solutions to better integrate across various smart building systems, and manage its energy demand;
- Advanced ventilation technologies to improve energy efficiency.

Featured Stock Idea – Singapore

Given Singapore's unique situation of having a highly urbanised small land size and limitations for RE developments, the Government's plan to reduce emissions and achieve net zero emissions by 2050 in the building and construction sector is by having more green and energy-efficient buildings. As buildings typically outlast their construction phase, the reduction of carbon emissions through more energy-efficient buildings presents a more permanent means of contributing to a more sustainable environment over focusing on carbon reduction in the construction phase itself.

Our Top Pick according to these criteria is ISOTeam, which has implemented industry-leading practices in developing environmentally sustainable buildings in Singapore – mainly for existing buildings via maintenance and upgrading works.

ISOTeam (ISO SP, BUY, TP: SGD0.12) – green procurement practices

ISOTeam is a leading facilities maintenance specialist with expertise in repairs & redecoration (R&R), addition & alteration (A&A), specialised coating & painting (C&P), and other services such as mechanical & electrical engineering, architectural & engineering solutions, interior decoration & retrofitting, landscaping & horticultural services, home painting services, reroofing & waterproofing, and handyman services. It mainly services public sector buildings, but has more customers from the private sector.

ISOTeam also plays its part to help Singapore develop eco-friendly buildings. As such, it is committed to green procurement and supports eco-retrofitting. It practices the 3Rs – reuse, reduce and recycle – and adopts best practices for procurement and waste prevention. Under its green procurement policy, it strives to use green products and methods while supporting the purchase of recycled and environmentally preferred products, systems and practices. Products are sourced globally to meet its green procurement guidelines, with appointed vendors and outsourced partners evaluated for their sustainability approach as well. Some other examples of ISOTeam's sustainability efforts are:

i. Recognition by BCA for the BCA Green Mark Award and the BCA Green and Gracious Builder Award (Excellent).

ii. Registered corporate member of the SGBC, which forms part of the World Green Building Council.

iii. Using green and sustainable products including eco-friendly paints from Nippon Paint that can lower the temperature in a building by 2°C to 3°C, a chemical-free plant-based pesticide ie Cockroach and Odour RemoverTM, etc.

iv. Participating in green projects that include a 5MW floating solar farm in the Straits of Johor for Sunseap Group – one of the world's largest – comprising 13,312 panels, 40 inverters and more than 30,000 floats.

v. Installed 386 solar panels on the roof of its headquarters, which has helped to power 77% of its FY22 electricity consumed.

vi. Implemented sustainable measures to monitor water consumption to improve water efficiency.

While revenue was largely flat between FY21 and FY22, ISOTeam's fuel and water consumption increased. However, it has successfully reduced non-renewable electricity usage and moved electricity consumption from renewable sources (Figure 69).

An overview of the group's energy consumption is in the diagram in the next page.

Figure 69: ISO Team's consumption of energy in FY21-22

Consumption	FY21	FY22	YoY Change
Diesel fuel (litres)	229,066	381,813	+66%
Petrol fuel (litres)	141,543	128,739	-9%
Renewable electricity (kWh)	156,567	157,365	+1%
Non-renewable electricity (kWh)	50,857	46,574	-8%
Water (litres)	22,551,000	25,672,100	+14%

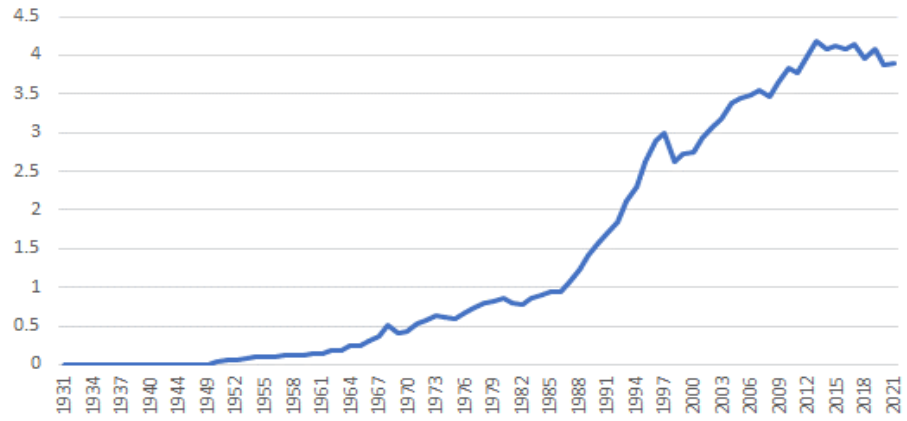
Note:
1 Available data on solar energy is quoted in kWp. The typical solar panel yield ranges from 1,000kWh/kWp to 2,000kWh/kWp, and is affected by a multitude of factors. We have opted to use the lowest range for our estimate.
2 Data covered the period from September 2019 to June 2020
Source: ISOTeam Annual Report 2022

THAILAND

Carbon emissions from Thailand's construction industry

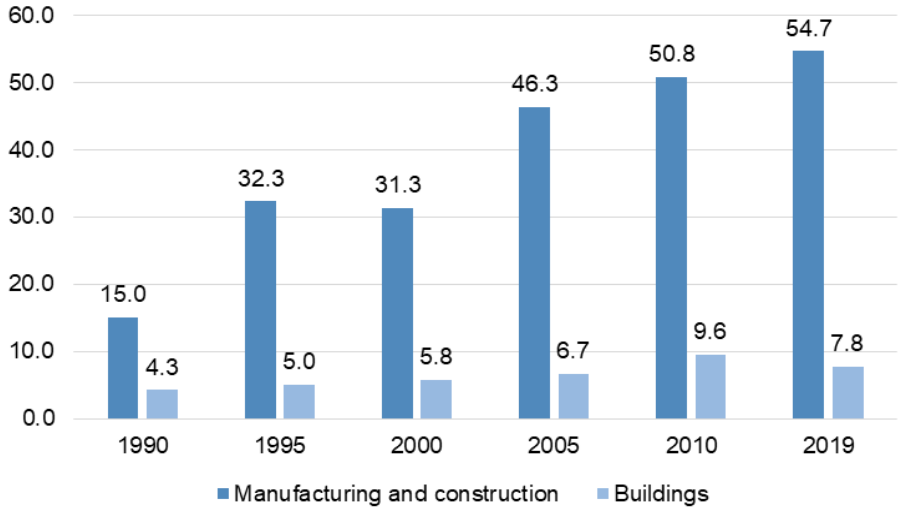
In 2021, Thailand recorded 3.9 tonnes of CO2 emissions per capita – which pointed to an overall decline since 2013. Meanwhile, Thailand's time-series data from Our World In Data shows that its CO2 emissions per capita in 2021 has increased by >9 times from Industrial Revolution 3.0 in 1969. Cement production has been recognised as one of major causes of carbon emissions in Thailand, as the country has been a long-time net cement exporter. In 2021, cement production accounted for 7.6% of CO2 emissions in Thailand. More broadly, GHG emissions from manufacturing & construction have almost quadrupled to 54.7m tonnes in 2019 from 15m tonnes in 1990. Meanwhile, the buildings sector saw its GHG emissions almost doubling to 7.8m tonnes in 2019 from 4.3m tonnes in 1990.

Figure 70: CO2 emissions per capita in Thailand (tonnes)



Source: Our World In Data

Figure 71: GHG emissions from manufacturing & construction, as well as the buildings sector, almost quadrupled ad doubled from 1990 to 2019 (m tonnes)



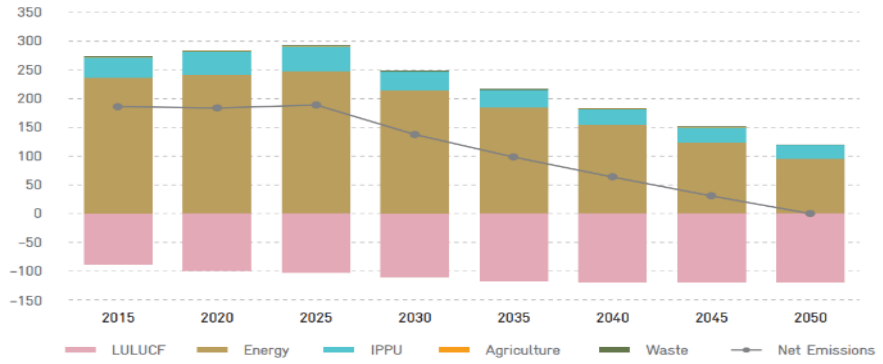
Source: Our World in Data

The Thai construction industry's path to net zero

To attain carbon neutrality by 2050 and net zero GHG emissions by 2065, Thailand has focused its attention on minimising CO2 emissions in the energy sector, which contributes the most towards GHG emissions in the country. As outlined under Thailand's Long-Term Low GHG Emission Development Strategy published by Ministry of Natural Resources and Environment, Thailand has drafted National Energy Plan 2022 to guide related agencies in their transition towards clean energy systems. The share of RE in new power generation capacity will be at least 50% by 2050, and EVs are expected to account for 69% of new vehicles by 2035. Most of CO2 emissions are expected to come from the industrial processes and product use (IPPU) sector, particularly the cement industry, with CCUS being used to reduce emissions. Meanwhile, the land use, land-use change and forestry (LULUCF) sector is expected to remove carbon emissions by as much as 120 MtCO2e by 2037. Further ahead, the net nationwide CO2 emissions in Thailand are expected to be at 137.3m tonnes of CO2 (MtCO2) in 2030 and 63.1 MtCO2 in 2040 (Figure 72).

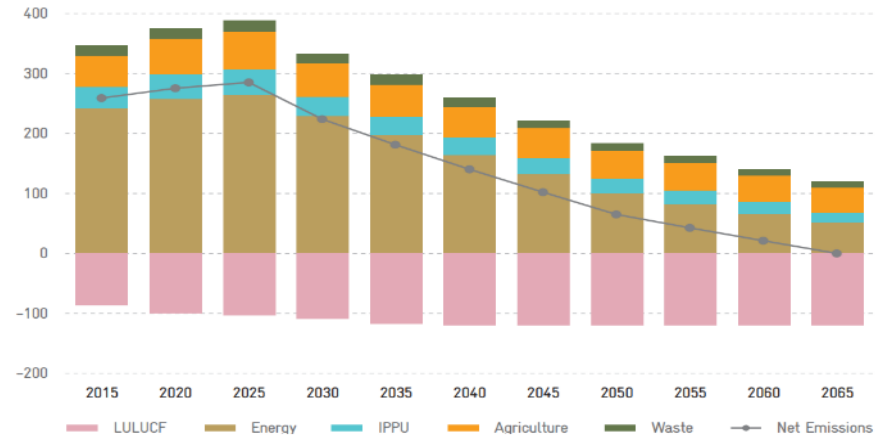
From the 2065 net zero GHG emissions scenario (Figure 73), Thailand is expected to record net GHG emissions of 64.1 MtCO2e in 2050. Total GHG emissions from sources (waste, agriculture, LULUCF, etc.) are expected to peak at 388 MtCO2e by 2025, with the energy sector being a key player in mitigating GHG emissions after 2025. Coal phase-out and negative emission technologies in the energy sector, eg bioenergy with carbon capture and storage (BECCS) or direct air capture and storage, will be essential in facilitating the journey to net zero.

Figure 72: Thailand's 2050 carbon neutrality pathway (MtCO2)



Source: Ministry of Natural Resources and Environment

Figure 73: Thailand's 2065 net zero GHG emission pathway (m tonnes of CO2 equivalent (MtCO2e))



Source: Ministry of Natural Resources and Environment

Green Building Energy Code (GBEC)

In Jul 2017, the Department of Alternative Energy Development and Efficiency (DEDE) started to closely monitor the energy consumption levels of large buildings across Thailand, ahead of a push to enforce the most recent efficiency standards on newly constructed projects going forward.

The GBEC is contained within the Ministerial Regulations Prescribing the Type and Size of Buildings and Standards, Rules and Procedures for Designing Energy Conservation Buildings B.E. 2552 (2009). It was issued by the Minister of Energy under Section 19 of the Energy Conservation Promotion Act and is based on international power consumption standards for large structures. While the GBEC has been a feature of the Thai regulatory framework, it only became binding on state agency buildings from 2013 onwards.

The GBEC sets certain standards and specifications that a building's design and construction must adhere to: its building envelope (ie separation of the air-conditioned and non-air-conditioned space), electrical lighting system, air-conditioning system, water heating, overall energy consumption and RE outfitting within the building.

Following DEDE's move in Jul 2017, the purview of GBEC is expanded to cover all "large buildings", which are defined as buildings with the following criteria:

i. Total usage area exceeding 10,000sqm;

ii. Power meter capacity exceeding 1,175 kilovolt-amperes;

iii. Energy consumption levels exceeding 20m megajoules per year.

Based on the application of stricter standards on energy consumption within larger buildings, there will be an estimated reduction of 74m units of electricity (valued at THB260m) in addition to 43k tonnes of annual reduction of CO2 emissions.

The GBEC is the first compulsory energy consumption standards to be universally applied in Thailand. Prior to the GBEC, building developers were required to obtain "green building" certification form four different authorities:

i. Energy and Environmental Assessment Method (an initiative spearheaded by the Ministry of Energy in conjunction with Chulalongkorn University);

ii. Thailand Rating Energy and Environment System (TREES), an initiative launched by professional engineers and architects under the auspices of the Thai Green Building Institute;

iii. Thailand Association for Sustainable Construction (developed in conjunction with the German Sustainable Building Council);

iv. Leadership of Energy Efficiency Design (LEED) system (the most popular universally recognised green building certification system developed by the US Green Building Council).

Based on the German-Thai Chamber of Commerce, a total of 214 buildings in Thailand so far have been certified according to LEED, 75 buildings according to TREES and five buildings according to the Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) or German Sustainable Building Council as well as one project according to the WELL Building Standards and three buildings according to the Excellence in Design For Greater Efficiencies (EDGE) standards. Many more projects are currently in the certification process. The establishment of a lively market for energy efficiency technologies, green products and services was made possible thanks to the green building movement.

Figure 74: Different emphasis among third-party green building rating systems

Source: Thai Green Building Institute

Collaboration in Thailand's cement industry players

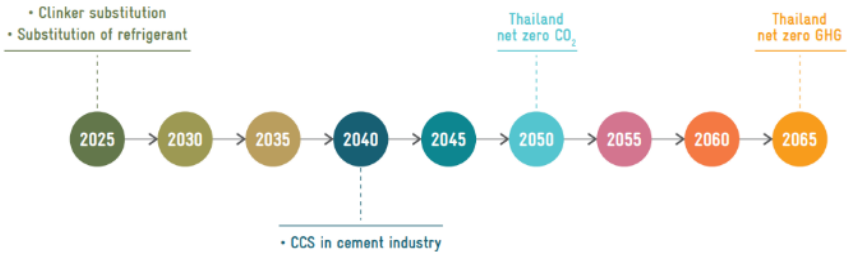
As highlighted under Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy, the IPPU sector accounted for 8.7% and 10.8% of Thailand's total GHG emissions in 2000 and 2018. With Thailand's cement industry accounting for 51.3% of GHG emissions in 2018 – the cement industry is a major source of GHG emissions in the IPPU sector. GHG emissions from the chemical industry and product uses – such as substitutes for ozone depleting substances – were estimated at 33.2% and 13.3% GHG emissions from metal production, non-energy products from fuels, and other product manufacture and use accounted for 2% of total GHG emissions from the IPPU sector.

Key mitigation measures in the IPPU sector to tackle GHG emissions focus mainly on clinker substitution and the substitution of high-GWP (global warming potential) refrigerants. These mitigation measures were included in the National Action Plan for the GHG Mitigation from the IPPU Sector and Industrial Wastewater Measure (2021-2030) drafted by the Department of Industrial Works, Ministry of Industry and are currently being implemented.

In light of this, the Thai Cement Manufacturers Association (TCMA) in collaboration with the Council of Engineers of Thailand, the Engineering Institute of Thailand and the Thai Concrete Association, with the support of the Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment joined forces with 31 alliances from public, professional, industry and academic sectors to promote carbon neutrality efforts by launching "MISSION 2023" in 2022. MISSION 2023 aims to reduce 1m tonnes of CO2 in 2023 by encouraging all sectors to use environmentally friendly hydraulic cement in all types of construction projects in Thailand – replacing the Ordinary Portland Cement Type I.

Nonetheless, further technologies are required to shift towards more climate-friendly industrial processes, such as the reduction of nitrous oxide emissions from nitric acid, caprolactam and other relevant industries. Negative emission technologies including CCUS will be needed to achieve up to 90% of GHG emission cuts from the cement industry.

Figure 75: Net zero GHG emissions pathway for the IPPU sector – the cement industry is the major source of GHG emissions



Source: Ministry of Natural Resources and Environment

Figure 76: TCMA launch of hydraulic cement

Source: Bangkok Post

Figure 77: Example of hydraulic cement brands in Thailand

Source: Thai Cement Manufacturers Association

Board Of Investment (BOI) supports efforts to cut down GHG emissions

During the World Leaders Summit which is part of COP26, then-prime minister General Prayuth Chan-Ocha had announced Thailand's commitment to focusing on achieving net zero GHG emissions by 2065.

Nevertheless, Thailand submitted its Nationally Appropriate Mitigation Actions in 2014 with a pledge to reduce GHG in the energy and transport sectors by 7-20% by 2020. As a result, the country managed to decrease its GHG emissions by 17% from its projected business-as-usual levels.

In addition, the BOI has driven the goal of GHG reductions and promoted investments with a clear policy to promote environmentally-friendly businesses and energy-saving by using RE. In the case of large investment projects, an environmental impact assessment (EIA) report must be submitted, as specified by the law.

At present, BOI has policies that aim to support the reduction of GHG emissions through additional measures and benefits. A few measures can be adopted by construction companies – and these would benefit their tax schemes. A majority of government measures, in fact, are meant to benefit the industrial manufacturing and agricultural industries.

One such measure that construction businesses can adopt is to save energy by using RE, under the following conditions:

i. Invest in modern technology to reduce energy consumption ;

ii. Modifying machinery to increase the proportion of RE used in its total energy consumed;

iii. Modifying machinery to reduce the impact on the environment, by reducing waste, wastewater, air pollution, etc.

Tax benefits from this measure include exemptions in duties imposed on machinery imported, and corporate tax exemptions for three years based on 50% of the investment cost.

Featured Stock Ideas – Thailand

For Thailand, within the construction materials industry, the bigger players have been emphasising on net zero GHG emissions for a long time, and have played a key role in developing new initiatives and committing much capex towards achieving this. In contrast, the key construction companies may be lagging in this regard, as most of these are small-to-mid-sized companies that have limited budgets to achieve net zero emission targets.

Our Top Picks as per this theme are: i) Siam Cement, which holds the standard of good practices the construction materials sector should implement to help reach the net zero emissions target; and ii) CH Karnchang, known for delivering projects on time while minimising the impact of its construction activities on the environment.

Siam Cement (SCC TB, BUY, TP: THB400) – the green choice

In 2020, Siam Cement's GHG emissions decreased by 2.86m tonnes of CO2 compared with a business-as-usual (BAU) scenario with 2007 as the base year, vs only 1.46m tonnes of CO2 being reduced in 2015 relative to 2007 (Figure 78). All business units have integrated the task force on climate-related financial disclosure (TCFD) framework in their medium-term plan (MTP) formulation processes. These include identifying: Key drivers towards net zero, physical risks from climate change that may arise in all operations, the financial impact of these key drivers and the strategic response to those material risks and opportunities. The company has integrated the TCFD framework in its MTP as a tool to measure the effects of its policy, technology, and the market. The results of such data would help it make better decisions to smoothen the path to net zero.

Siam Cement has set target of net zero GHG emissions by 2050 and the reduction of net GHG emissions of scope 1 and 2 by at least 20% by 2030 compared to the base year of 2020 – these targets are inclusive of its business activities in and outside Thailand. The company has been working actively to increase the use of all forms of clean energy and expand the use of alternative energy in its energy mix. Also, it has adopted principles of the circular economy, digital technology, AI and automation to enhance production capacity and energy efficiency. In addition, it is working towards using less resources to ensure competitiveness for long-term growth, while minimising the climate's impact on people at all levels, and creating equality of access to clean energy sources and security of livelihoods.

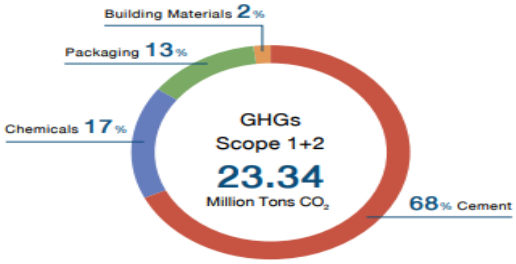
Furthermore, the company has undertaken initiatives to rehabilitate forest resources, and boost biodiversity and ecosystems through Natural Climate Solutions (NCSs) in tandem with R&D efforts to realize advanced CCUS technology. Siam Cement has also invested in clean energy businesses through Siam Cement Group (SCG) Cleanergy and EV-related businesses and various eco-friendly products, such as hybrid cement (low-carbon cement) and SCG solar rooftop solutions, which support consumers in a collective action towards emissions reduction and energy conservation.

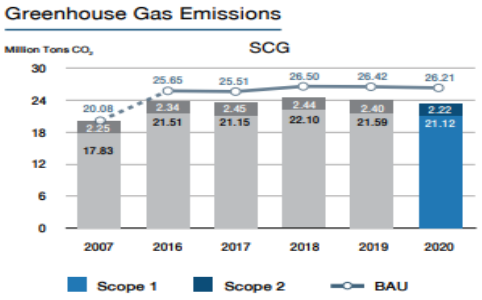
Key success factors include the development and application of innovation and digital technology to every step of its processes. For its cement & building materials business, the highlight in 2021 was CPAC Green Solution, in which BIM is used to elevate construction standards and ensure eco-friendliness in construction. There has been an innovation applied to the development of products, services, and solutions across all business units – and these are certified with the "SCG Green Choice" eco label. This is to offer options to eco-conscious consumers and the assurance that these certified items have the least impact on the environment.

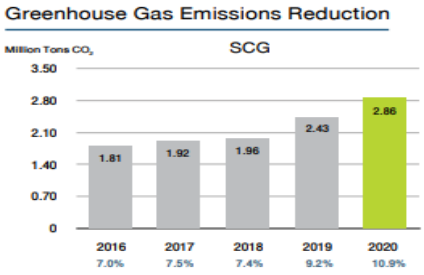
Figure 78: Siam Cement's GHG emissions track record

Performance Data	2007	2015	2016	2017	2018	2019	2020	GRI Standards	DJSI*	SASB
GHGs Scope 1 and 2 (Million Tons CO_2)	20.08	24.98	23.85	23.60	24.54	23.99	23.34			
GHG Scope 1 (Million Tons CO_2)**	17.83	22.51	21.51	21.15	22.10	21.59	21.12	GRI 305-1	2.3.1	EM-CM-110a.1
GHG Scope 2 (Million Tons CO_2)**	2.25	2.47	2.34	2.45	2.44	2.40	2.22	GRI 305-2	2.3.2	
GHG Emission Reduction compare with business as usual (BAU) at base year of 2007 (Million Tons CO_2)	0	1.46	1.81	1.92	1.96	2.43	2.86	GRI 305-5		
(%)	0	5.5	7.0	7.5	7.4	9.2	10.9			
GHG Emission Reduction compare with base year of 2015 according to Paris Agreement (Million Tons CO_2)	-	0	1.13	1.38	0.44	0.99	1.64	GRI 305-5		

Base year
* Reference based on DJSI 2020 Questionnaire
** Within KPMG's limited assurance scope (page 136-137)







Source: Siam Cement

Below are Siam Cement's actions on controlling GHG emissions:

i. Build sustainable suppliers by enhancing ESG practices among them. Steps include selecting and assessing suppliers with the capability for sustainable business, conducting risk assessments and supplier segmentation to formulate strategy and a supplier development plan corresponding with the risk. Climate-related mitigations are integrated in supplier assessments and the Green Procurement List to promote reduction of scope 3 GHG emissions.

ii. Ensure green transportation by setting standards for logistics providers according to ISO 14001, and embed environmental concerns in their practices. Energy conservation is integrated through route optimisation, loss minimisation, the eco-drive to save the planet and people, deployment of digitalisation for automated control as well as tracking and monitoring GHG generated from logistics.

iii. Enhance energy efficiency by using best-in-class technologies. This includes the deployment of digital technology to automate a measurement and control system, resulting in higher production efficiency, as well as enabling process optimisation and energy efficiency.

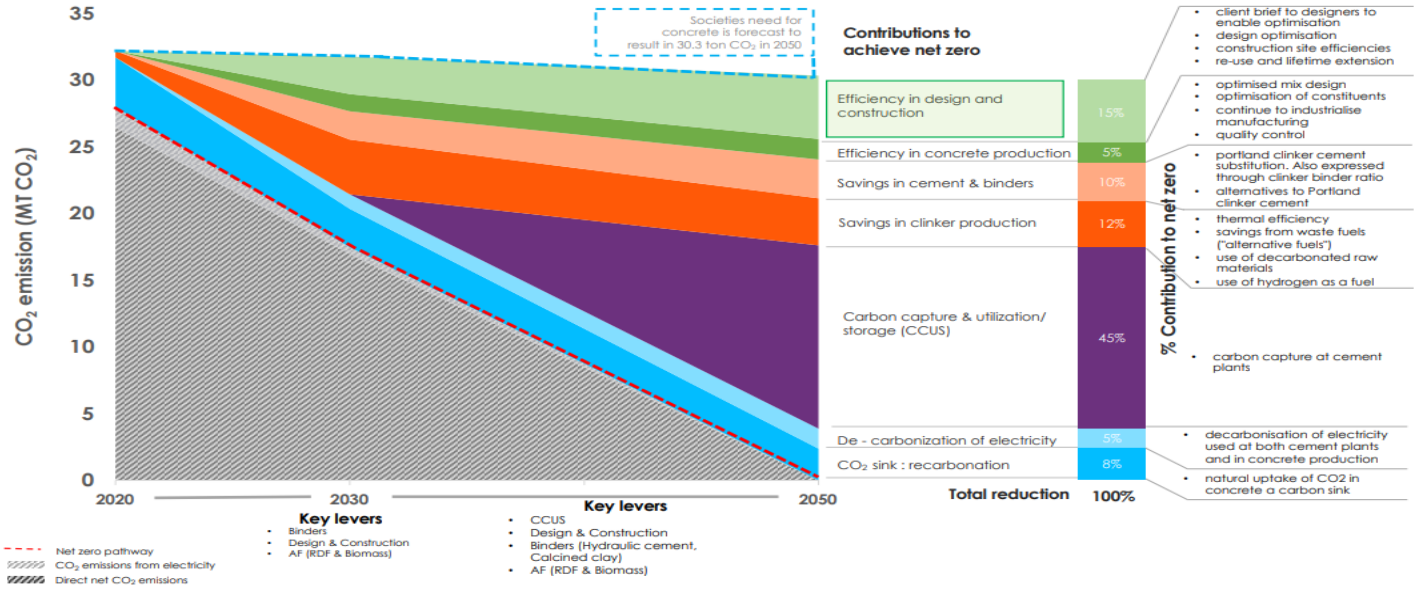
iv. Transition to clean and green energy by increasing the share of biomass and RE such as solar rooftop, solar farm, floating solar, and hydrogen. All forms of alternative fuel such as agricultural waste including oil-palm shell, rice husk, straw, sugarcane leaf, refuse-derived fuel (RDF), waste heat power generation (WHG) in the production process, and biogas production from wastewater treatment is utilised to reduce fossil fuel consumption.

v. Promote low-carbon products by innovating low carbon products, services and solutions based on the circular economy, across the value chain. All of its business units have been pursuing the development and design of products under the SCG "Green Choice" label which is given to products that meet its criteria for safety, environmental friendliness, less resource use, and with value-adding features. Revenue from Green Choice products accounted for 51% of SCG's total revenue in 1Q22. SCG targets revenue from Green Choice products to comprise 67% of total revenue by FY30.

vi. Grow the green construction business by applying BIM technology, which can precisely determine the amount of materials required in a construction project. BIM enables it to reduce construction waste by 10-20% compared to conventional construction methods.

vii. Ensure green transportation by setting standards for logistics providers according to ISO 14001, and embed environmental concerns in its practices. Energy conservation is integrated through route optimisation, loss minimisation, the eco-drive to save the planet and people, deployment of digitalisation for automated control as well as tracking and monitoring GHG generated from logistics.

Figure 79: Net zero emission pathway for the cement and concrete industry in Thailand



Source: Siam Cement

CH Karnchang (CK TB, BUY, TP: THB26.10) – a determined adopter

In FY23, CH Karnchang aims to be able to report complete carbon emissions at all project offices, as a guideline to reduce carbon emissions effectively in the following years to promote the transition to being carbon-neutral.

In addition, its Community Technician Innovation Promotion Project – where it collaborated with the National Innovation Agency (NIA) and the ChangeFusion Institute – aims to develop the potential of "technicians," which are the heart of the construction business. It has been in operation since Oct 2019 and FY23 will be considered the third year of operation. Actually, this project may enhance the skills of community technicians and enable them to bring knowledge to further improve and develop innovations for maximum efficiency. In 2022, CH Karnchang was considered by Thaipat Institute to receive the ESG 100 award for the seventh consecutive year.

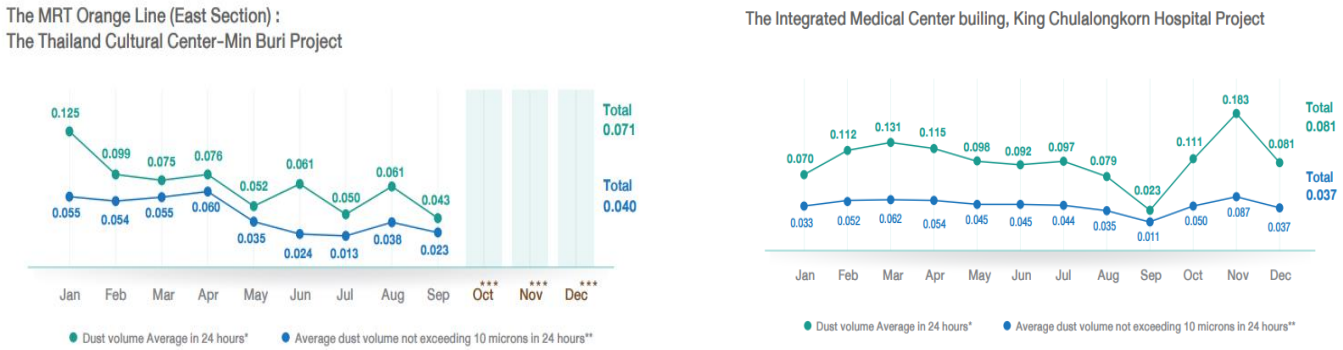
In large construction projects, the major issue at hand is the air quality from dust particles within construction sites. Various building materials used in construction have caused the dust diffusion during construction activities and may affect workers and the communities surrounding the construction area. CH Karnchang has implemented measures to control dust under the conditions of construction work (according to regulations). Guidelines for dust control during construction process are also supervised by the Pollution Control Department and National Environment Board.

Figure 80: Benchmarks for controlling dust diffusion announced by the National Environment Board

Source: CH Karnchang

In FY22, CH Karnchang inspected the air quality within the neighbourhood area of the MRT Orange Line project (East Section: Thailand Cultural Center-Min Buri) and the construction area of King Chulalongkorn Hospital's Integrated Medical Centre building on a 24-hour basis. Average dust particles (<10 microns) during Jan–Dec 2022 was found to be at the normal level of the air quality index. CH Karnchang will continue to maintain the standard of air quality control and the protection measures from dust diffusion in future construction projects.

Figure 81: Examples of dust level measurements in two major construction projects

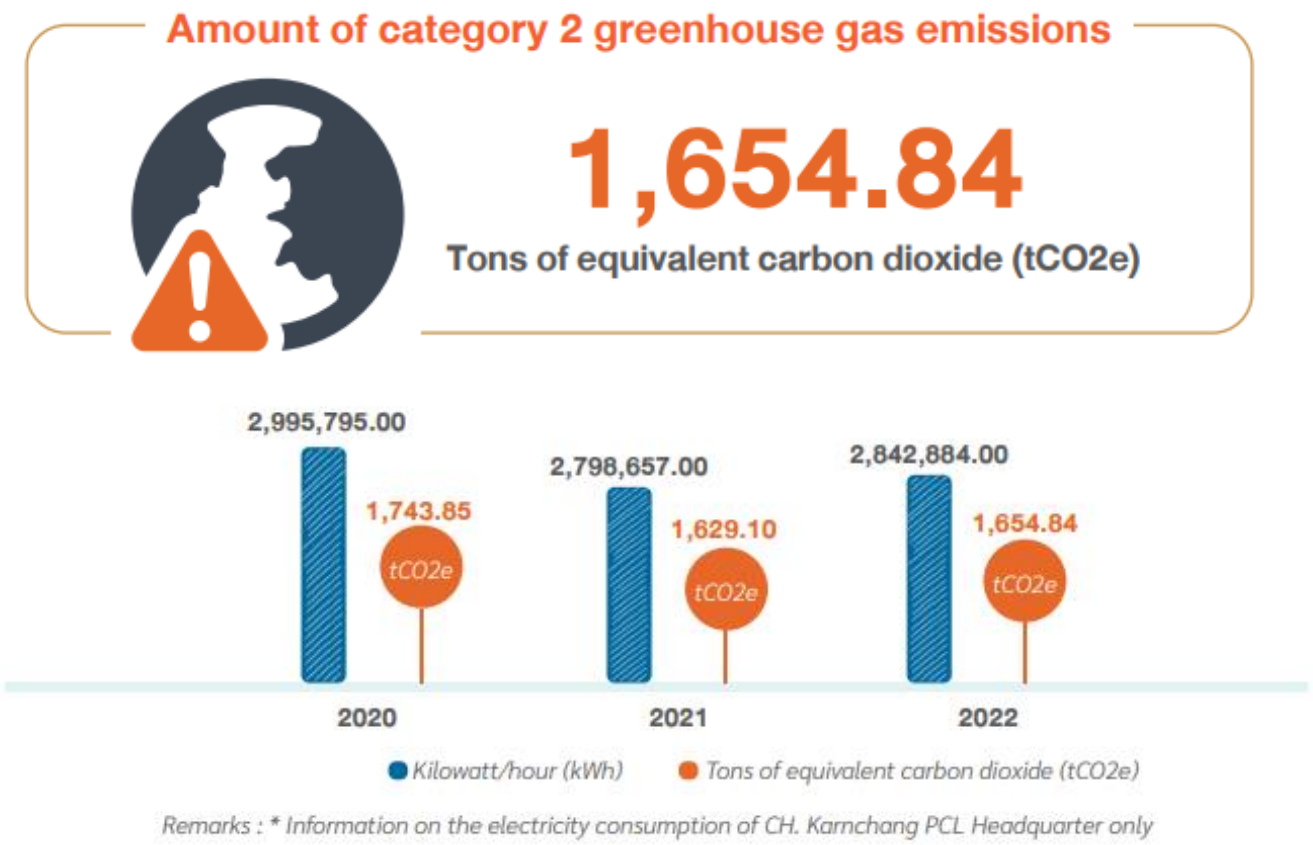


Source: CH Karnchang

For GHG emissions, the company has managed its business activities in line with the goals of the Paris Agreement. Its move towards having net zero carbon emissions by 2050 may be executed via the sustainable use of natural resources, energy and water (based on eco-efficiency and circular economy principles), reducing emissions, improving its waste management, disclosing its GHG emissions, appraising climate change risks along with the impact on related businesses, and setting and maintaining guidelines for managing risks caused by climate change.

Based on the electricity it consumed in FY22, GHG emissions data 2 (Scope 2) or GHG emissions resulting from energy consumption (indirect energy emissions) from the purchase of electricity for consumption within the group stood at 1,654.8 tonnes of CO2e during the year – up 1.6% YoY, but 5.1% lower than FY20 levels.

Figure 82: CH Karnchang's category-2 GHG emissions in FY20-22



Source: CH Karnchang

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