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Advancing Built Environment Sustainability

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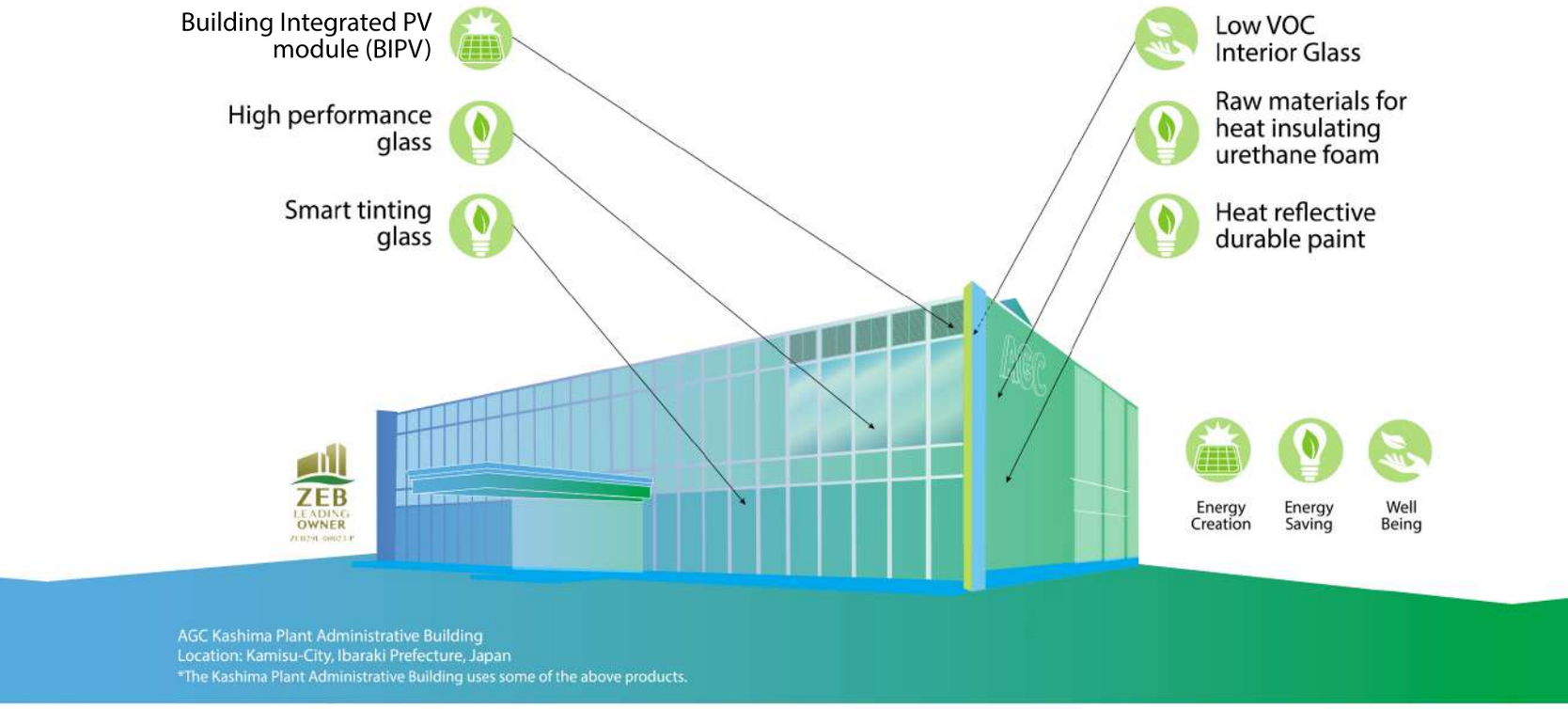

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FOREWORD

2020 has been challenging, to say the least. The global pandemic has essentially turned the world we once knew upside down, with air travel grounded to a halt, face masks becoming a necessary part of daily apparel and working-from-home becoming the norm rather than the exception. Indeed, 2020 has been a trying year for everyone, everywhere.

If there can be a silver lining to one of the greatest crises' humanity has ever faced in recent times, it is the fact that sustainability has been propelled to the forefront of business consciousness. Businesses can now see the dire importance of meaningfully incorporating sustainability into the very core of their operations, not just simply as an afterthought or to check a box. Successfully weaving sustainability into business practices not only helps to cushion the impact from global shocks, but also showcases the organisation in a positive light to its stakeholders.

The nature of the pandemic also casts a spotlight on health and wellbeing. More so than ever before, people around the globe are actively taking measures to keep themselves and their loved ones safe and healthy. This is a prime opportunity to communicate to the entire world the importance of the built environment in keeping our families healthy and safe, to help our businesses identify new opportunities and for our communities to adapt to changes. Green buildings' emphasis on human health and wellbeing is now brought to the fore, and this must be included within a broader systemic review of our buildings that also covers net zero energy and low-carbon building principles.

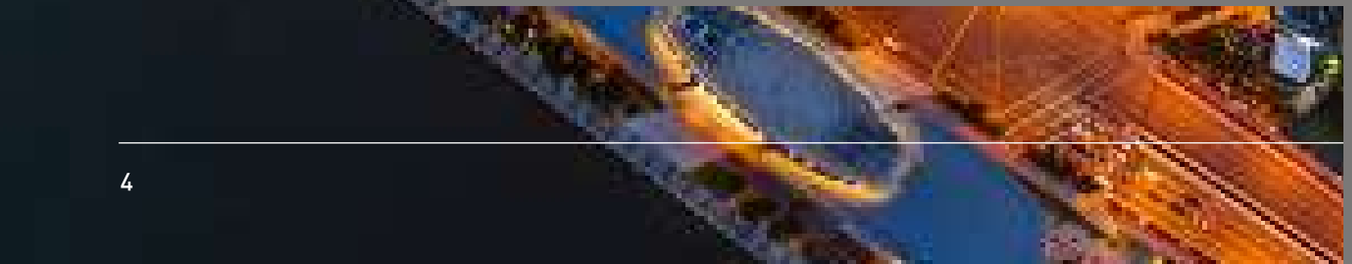
In the 11th issue of SG Green, we take a look at how sustainability in the built environment is being advanced. In collaboration with SGBC Member KPMG Services Pte Ltd, an extensive report on Advancing Net Zero in the Asia Pacific has been produced, providing a wide overview of decarbonisation efforts in the region as well as an actionable roadmap for organisations to take that important first step. This issue also profiles Singapore's representatives to the WorldGBC Asia Pacific Awards in Green Building 2020, the shining exemplars of sustainability in the built environment and beyond.

As the world undergoes a paradigm shift in the way we design, construct and operate our buildings, we hope that the SG Green magazine will continue to raise awareness of novel green building solutions and inspire you to advance built environment sustainability.

Yours Sincerely,
SG Green Editorial Team

ADVANCING NET ZERO & CLIMATE RESILIENCE IN THE BUILT ENVIRONMENT

The built environment, responsible for more than a third of global carbon emissions, is in a prime position to address climate challenges through low-carbon and net-zero building principles. To remain resilient, the sector must take climate mitigation and adaptation actions to alleviate the physical and transition risks posed by climate change. In this special report presented by the Singapore Green Building Council (SGBC) in collaboration with SGBC Member KPMG Singapore, better understand the climate action landscape in the Asia Pacific and find out what you can do to advance net zero and build resilience against climate change in your organisation.



INTRODUCTION

In 2015, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) signed The Paris Agreement with the aim to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius (°C) above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C. Limiting warming to 1.5°C requires global net anthropogenic carbon dioxide emissions to reach net zero around 2050. There is an urgent need for coordinated action by all stakeholders including governments and private sectors to achieve this ambitious target.

Whilst the severe economic and business disruptions caused by the COVID-19 pandemic has directed focus to more immediate challenges, climate change and the associated risks for businesses remain and will continue to significantly shape the business landscape going forward. The emerging signs of a post-pandemic new normal also implies that businesses must set their sights on the long-term to ensure they remain viable. The ability of businesses in the built environment sector to adapt to the new normal and effectively advance decarbonisation has direct implications to their access to capital, improved credit ratings and preservation of business value. Besides commitments to reduce their own carbon footprint, real estate players will need to critically assess physical and transition risks arising from climate change and take the necessary mitigation and adaptation actions to safeguard their business and properties.

"By 2030, all new buildings, infrastructure and renovations will have at least 40% less **embodied carbon** with significant **upfront carbon** reduction, and all new buildings must be net zero **operational carbon**.

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"**

- World Green Building Council

Aligned with the Paris Agreement, the WorldGBC's vision aims for net zero in terms of both operational and embodied carbon. This is by no means an easy journey. Climate change is an evolving science and technological advancements need to keep up with climate change to provide palatable solutions for the built environment sector. Significant investments need to be made and more importantly, the ecosystem needs to work together to collectively pursue net zero carbon goals along the value chain.

SINGAPORE'S NATIONAL COMMITMENTS

Singapore's commitment in supporting international climate action is demonstrated in the Enhanced Nationally Determined Contribution which aims to peak emissions at 65 million tonnes (Mt) carbon dioxide equivalent (CO2e) around 2030. Singapore's Long-Term Low-Emissions Development Strategy aims to halve emissions from its peak to 33MtCO2e by 2050, with a view to achieve net zero emissions as soon as viable in the second half of the century. Given that buildings account for more than 20 percent of Singapore's carbon emissions, green buildings are a key needle mover to address Singapore's higher climate change ambitions.

ENABLERS TOWARDS CLIMATE ACTION - SUSTAINABLE FINANCE

As observed in the Sustainable Finance Moves into the Regulatory Mainstream report published in June 2018, sustainable finance has become a regulatory imperative. Initiatives relating to environmental, social and governance (ESG) factors and socially responsible investing (SRI) have received regulatory support in several countries. The Monetary Authority of Singapore (MAS) has devised an action plan aiming to turn Singapore into a leading centre for green finance in Asia and Globally, which includes developing grant schemes to mainstream green and sustainability linked loans.

ENABLERS TOWARDS CLIMATE ACTION - TECHNOLOGY AND INNOVATION

According to the Global PropTech Survey 2019 conducted by KPMG, real estate companies are increasingly embracing digitalisation, with 95 percent of real estate companies having a role responsible for leading digital transformation and innovation. With almost a quarter of total mobile connections estimated to run on the fifth generation of wireless networks (5G) by 2025, Asia Pacific is home to countries such as Australia, China, Japan, Malaysia, Singapore and South Korea that are aiming to be global leaders in 5G. The 5G attributes of high speed, low latency, low energy consumption and ability to execute a high number of connections simultaneously are particularly significant for the built environment's transition towards smart buildings and cities.

ENABLERS TOWARDS CLIMATE ACTION - INNOVATIVE SERVICE MODELS

Globally, there has been a paradigm shift in business models of the built environment sector including the move from product to product-as-a-service. Conventionally purchased as capital, equipment such as cooling, lighting, solar panels, BMS and sensors are increasingly offered on a subscription or pay-per-use basis. This is aligned with the transition towards a circular economy, as producers are incentivised to improve the efficiency,

quality and lifespan of their products. Remote facility management services are also on the rise, where remote data collection, monitoring and diagnosis of systems are performed using remote monitoring technology. This minimises the need for on-site visits by technicians and saves on the carbon emissions from travelling.

DRIVERS TOWARDS CLIMATE ACTION - REGULATORY SHIFTS

According to the World Economic Forum, environmental risks have surpassed that of economic risks in recent years, with climate change action failure, biodiversity loss and extreme weather being included in the top five risks in 2020. In June 2020, the MAS launched a public consultation on guidelines for financial institutions to manage environmental risks with the aim to enhance the financial sector's resilience to these risks. This has a potentially significant impact on various sectors including real estate as lenders, insurers and asset managers are called to integrate environmental risks assessments into their financing, underwriting and investment decisions. Businesses and organisations have begun to recognise the impacts of climate change on their financials and long-term viability and thus the need to mitigate and adapt to such risks with the increased resilience of buildings and energy systems.

DRIVERS TOWARDS CLIMATE ACTION - INVESTOR SENTIMENT

There is mounting investor pressure to manage climate-related risks. BlackRock, the world's largest asset manager, has committed to making sustainability integral to portfolio construction and risk management and exiting investments that present a high sustainability-related risk. It has also asked the companies it invests in to disclose climate-related risks in line with the Task Force on Climate-related Disclosures (TCFD) recommendations. In Singapore, state investment firm Temasek Holdings is working towards carbon neutrality for its portfolio by investing in carbon solutions and working with existing and new portfolio companies to support their transition to a carbon neutral world.

DRIVERS TOWARDS CLIMATE ACTION - MARKET DEMAND

Based on a global study, the top triggers to increased levels of green buildings are client demands and environmental regulations, demonstrating that the green building market is influenced by both the pull of the market and the push of regulations. In addition, net zero buildings enable lower operational and maintenance costs, increased asset value and desirability. This presents an opportunity for the built environment sector to capture the environmental, social and economic benefits that arise from green buildings and prepare for future regulations as governments respond to their obligations under the Paris Agreement. Further, there is an increased emphasis on social impacts of buildings such as occupant health and well-being, employee productivity and satisfaction and a sense of community that can be addressed by green buildings which offer improved thermal comfort, increased quality of building stock and reduced air pollution.

DRIVERS TOWARDS CLIMATE ACTION - THE NEW NORMAL POST COVID-19

The COVID-19 pandemic has elevated health concerns, drawing attention to the need for improved design of buildings, air-conditioning and ventilation systems to reduce the risk of virus transmissions. As a result of the pandemic, 6 million jobs across the energy sector, energy efficiency and vehicle manufacturing could be permanently lost in 2020. Conversely, the International Energy Agency's (IEA) sustainable recovery plan is estimated to create nearly 9 million new energy-related jobs in construction and manufacturing on average every year between 2021 and 2023. The jobs created would be in areas of energy efficiency projects in the buildings and industry sectors, electricity, transport, fuels, renewables, recycling and innovation. As such, the built environment sector plays a vital role in economic stimulus and recovery plans to emerge stronger from this crisis. Further, transformation of the built environment sector is necessary for it to remain viable for the new norm of work, especially as studies illuminate the significance of remote work in carbon reduction. Property technology can be an enabler in this

transition, such as the use of sensors for building systems to respond to factors such as occupancy and temperature.

DRIVERS TOWARDS CLIMATE ACTION - COST EFFICIENCY

There is a strong business case for green buildings especially when a long-term view is taken. Singapore's Green Mark certified buildings reap net positive savings throughout their lifecycle, with energy savings outweighing the upfront investment cost.

NBR	Green Cost Premium	Simple Pay Back (yrs)	NPV Savings per GFA (median $/GFA)
Gold	0.12% - 1.80%	0.81 - 2.45	48
Gold^{Plus}	0.70% - 1.87%	1.89 - 3.56	117
Platinum	1.00% - 4.40%	2.30 - 5.80	225
SLEB	1.00% - 4.60%	2.11 - 5.77	284

Figure 1 Net present value savings from Green Mark Buildings. Cost data taken from 25 and 5 SLE (new) projects.

DRIVERS TOWARDS CLIMATE ACTION - REVENUE AND FINANCING POTENTIAL OF CARBON CREDITS

Carbon credits are a source of revenue to emission reduction projects and they are generally used to increase a project's internal rate of return and return on investment. Project developers can also raise finance by generating equity for an emission reduction project through the forward sale of carbon credits.

CHALLENGES OF CLIMATE ACTION - RISE IN ENERGY DEMAND

The key challenge is to bring green building best practices into the mainstream, while demand for floor area and energy services continue to rise.

In Southeast Asia, the number of cooling degree days is expected to increase between 2018 and 2040 due to rise in temperature and humidity. Coupled with a rise in gross domestic product (GDP) per capita, this corresponds to a sharp projected increase in the share of households with air conditioning in the region.

CHALLENGES OF CLIMATE ACTION - OVERCOMING INTERMITTENCY OF RENEWABLE ENERGY

Renewable capacity in the ASEAN region is expected to expand by over one-third from 2018 to 2024, led by solar PV and hydropower, followed by wind, bioenergy and geothermal. The expansion of electrification, distributed generation and variable renewable sources will create the need for flexibility options in power systems to be able to tackle the intermittency of renewable sources such as solar and wind.

KEY ACTIONS TO ACHIEVE NET ZERO CARBON

While buildings contribute to more than a third of global GHG emissions, a large portion is attributed to embodied carbon - the carbon footprint of building materials and construction - which accounts for about 11 percent of global emissions.

Further, embodied carbon is projected to be responsible for almost half of total new construction emissions between now and 2050. It is therefore crucial to focus efforts on reducing embodied carbon right from the design stage as these emissions will be locked in the materials and construction of the building.

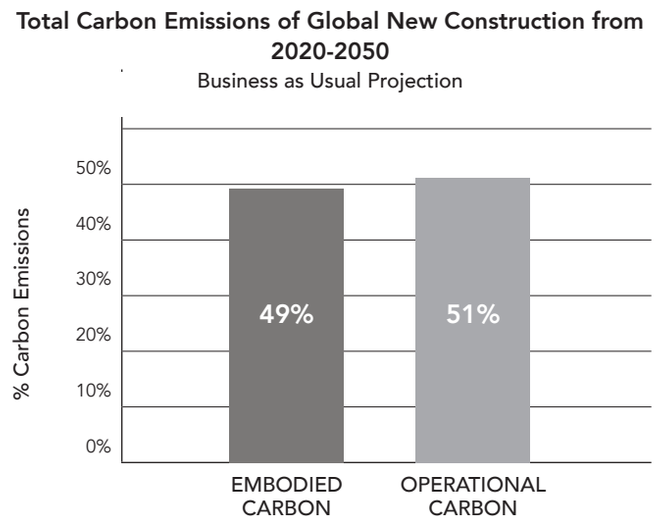


Figure 2 Total Carbon Emissions of Global New Construction from 2020-2050

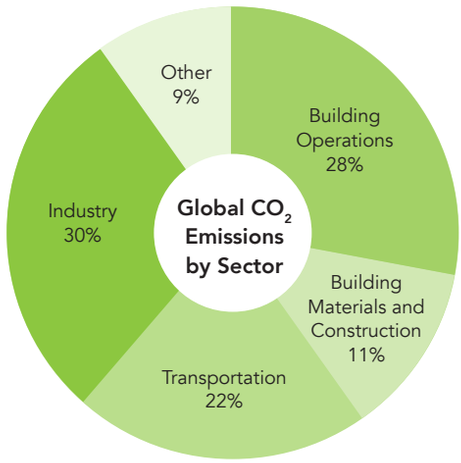


Figure 3 Global CO2 Emissions by Sector

REDUCING EMBODIED CARBON

To reduce embodied carbon in building materials and construction, a whole life cycle approach leveraging life cycle assessments (LCA) should be used to specify low carbon materials and optimise the building design.

There may be challenges in obtaining the Environmental Product Declarations (EPDs) or quantitative carbon footprint data to make comparisons of carbon footprint between different materials such as the reluctance of suppliers in providing the data. Where such data are unavailable, there are qualitative factors to specify building materials with low carbon footprint. Architecture 2030's Carbon Smart Materials Palette, as summarised below, serves as a guide:

5 impactful ways to reduce embodied carbon	
Concrete	Using less cement is the most effective way to reduce the carbon footprint of concrete
Steel	Using steel from electric arc furnaces is the best way to reduce embodied emissions in steel because EAFs use high levels of recycled material and can be powered by renewable energy sources
Drywall	Choosing lightweight drywall products and eliminating waste material are the most impactful ways to reduce the carbon footprint of drywall
Wood	Using reclaimed wood and wood from sustainably managed forests are the best ways to reduce embodied carbon emissions from wood
Carpets	Specifying carbon neutral carpet tile products with solution-dyed recycled content yarn is the most impactful way to reduce the embodied carbon emissions of carpet

Figure 4 5 impactful ways to reduce embodied carbon

As a rule of thumb, always look at labels, material ingredients, country of origin, creating a list of high- and low-carbon materials and paying attention to construction techniques.

The SGBC maintains the Singapore Green Building Product (SGBP) certification scheme dedicated to assessing and evaluating the environmental performance of green building products, and the industry-developed criteria takes into account a product's carbon footprint, a critical requirement for a high certification rating. SGBC also organises a Carbon Footprint Course since 2015 to equip companies with the know-how to assess the Carbon Footprint of their building products.

REDUCING OPERATIONAL CARBON

To reduce operational carbon, the strategies are categorised broadly into two categories: reducing operational energy demand through effective design and efficiency in building and equipment and decarbonising power.

Reducing Operational Energy Demand - Passive Strategies

Passive strategies are integrated into the design of a building to work with natural elements on a site, including sun and wind patterns, to provide natural heating and cooling of spaces. This takes advantage of the local climate to keep buildings comfortable without the need for purchased energy.

Reducing the need for cooling in the design stage, which includes building design and material choices, is the most cost effective as it has a huge potential to influence the need for cooling and hence the costs incurred during operations, where 80-85 percent of all costs occur.

Reducing Operational Energy Demand - Active Strategies

Active strategies use purchased energy to keep buildings comfortable. These strategies include mechanical system components such as air conditioning, mechanical ventilation, heaters and electric lighting. Private sector innovations can extend beyond improving the efficiency of individual technologies such as air conditioning. This can include utilising assisted ventilation, hybrid cooling systems which combine the use of fans and air conditioning, alternative systems such as

highly efficient district cooling systems, as well as optimising operations such as by operating at a set-point temperature.

Reducing Operational Energy Demand - Smart Energy Management

Smart energy management can include the Internet of Things (IoT), smart controls, Intelligent Building Management Systems (BMS) and motion sensors for energy use optimisation and monitoring purposes. Smart controls can enable load shifting to avoid the usage of energy by different parties concurrently which can have severe implications for the power system. Advanced analytics and artificial intelligence can also be used for critical energy savings. Companies in Singapore can leverage the Automation Support Package under the Enterprise Development Grant (Innovation and Productivity category) by Enterprise Singapore. This grant is designed to support companies in their automation, productivity and scale-up efforts.

DECARBONISING POWER - SOLAR ENERGY: A BALANCED APPROACH

A balanced approach is required in the deployment of solar PV, considering greenery and the environment, public acceptance and safety. Solar PV deployment on buildings in residential and commercial areas or infrastructure will need to be harmonised with Singapore's plans to deploy greenery on buildings which address the urban heat island effect and stormwater management.

Decarbonising Power - 3D Modelling And Simulation

In formulating the Solar PV Roadmap for Singapore, SERIS utilised 3D modelling and simulation on the buildings in Singapore to determine the building surfaces usable for PV and sum up the true potential for PV on buildings. A potential investor can leverage such technologies to identify qualified and usable building surfaces which are suitable and viable for PV deployment. One facet of such modelling tools is the ability to perform complex shading analysis, which enables efficient analysis of the solar deployment potential taking into account the shadows cast on the existing and new buildings in high-density Singapore.

Decarbonising Power - Types Of Solar PV Deployment

The table below shows the usable area for the different types of solar PV. As evident in the large proportion of usable area in existing building facades, retrofitting existing buildings present a huge opportunity for solar energy generation in Singapore.

Deployment Type	Sub-category	Total Net Usable Area ('000 m^2)	Remarks
Roof-top [1)]	HDB	2,225	
	Industrial	8,056	
	Commercial	1,656	
	Others	1,284	Including (amongst others): Non-HDB residential and educational institutions.
		13,221	
Facades	Retrofit [1)]	7,877	Using irradiation >750 kWh/m^2/yr; would be 56 km^2 for >500 kWh/m^2/yr
	New buildings	1,950	Until 2050, based on 100 new buildings per year
		9,827	
Mobile-/land-based PV		5,000	Conservatively using only 70% of the available land areas on Jurong Island (5 km^2), Pulau Semakau (0.85+0.85 km^2) and the main island (0.38 km^2)
		5,000	
Floating PV		4,616	Inland reservoirs and "dead sea" spaces
		4,616	
Infrastructure PV	Existing land	4,150	Potential areas for PV noise barriers and for over-building existing land, canals and roads.
		4,150	
TOTAL		**36.8k**	

1) Based on the existing building stock in 2014, and 3D model assessment

Figure 5 Net usable area for solar PV deployment

Decarbonising Power - Novel "Urban Solar" Applications

To unleash the full potential of solar PV deployment in Singapore, there is expansive opportunity for private-public sector partnerships to push research and development in the following areas.

- Co-location of PV with greenery:
  - Solar PV deployment on buildings can be optimised in combination with greenery, which helps to reduce urban heat island effect and reduce energy demand.
- Building-integrated photovoltaics (BIPV)
  - BIPV are photovoltaic materials that are used to replace conventional building materials in parts of the building envelope such as the roof, skylights, or facades. Examples include coloured BIPV modules, "transparent" PV windows, ultra-light BIPV elements and PV-powered media walls. Integration of BIPV during pre-fabrication of buildings renders implementation easier as compared to an existing building.
- Other innovative applications include mobile, floating and infrastructure PV.

Decarbonising Power - Enabling Flexibility In The Power System

Flexibility options to counter the intermittency of renewable energy include smart grid infrastructure, smart meters, demand response method to match the power demand with supply, batteries, interconnection, flexible generation and smart charging for power storage especially with the rise in electric vehicles.

Decarbonising Power - Renewable Energy Certificates (REC)

The uptake of RECs for off-site renewable energy generation is driven by RE100 companies, who are committed to 100 percent renewable power, such as data centre operators as well as SGX-listed companies due to mandatory sustainability reporting that incentivises them to purchase RECs. However, this option should only come into play after consideration of energy-saving or on-site renewable energy generation initiatives. The current operators and registries can be found in Figure 6.

S/N	Name	Reference
1	APX TIGRs	https://apx.com/tigrs-overview/
2	I-REC Registry	https://registry.irecservices.com/
3	Reneum	http://www.reneum.com/
4	Sembcorp RECs	www.sembcorprec.com
5	Singapore Power REC Marketplace	https://rec.spdigital.io
6	T-RECs.ai	https://www/trecs.ai/

Figure 6 Operators and registries of RECs

ROADMAP TOWARDS NET ZERO CARBON & CLIMATE RESILIENCE

Real estate investors, owners, developers and building product manufacturers are faced with a multitude of challenges, from the current COVID-19 crisis to the physical and transition risks of climate change, resource scarcity and urbanisation.

A holistic approach is therefore essential for these players in the built environment sector embarking on their journeys towards net zero carbon and climate resilience. The proposed approach consists of the strategy, implementation and disclosure phases as shown below.

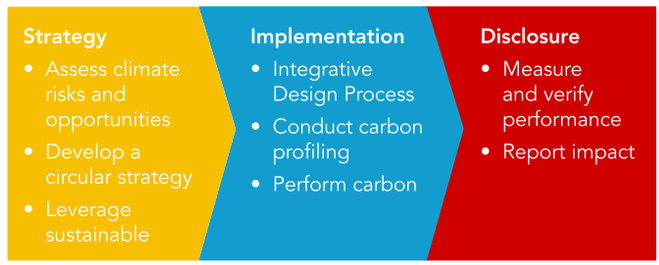


Figure 7 Roadmap towards net zero carbon

STRATEGY - ASSESS CLIMATE RISKS AND OPPORTUNITIES

Climate change has a potential financial impact on the built environment sector through physical and transition risk types. Physical risks emerge from the impact of weather events and long-term or widespread environmental changes. This can impair property assets, while insurance premiums may be hefty or unavailable for high-risk locations. Transition risks arise from the process of adjustment to a low-carbon economy, including changes in public policies, disruptive technological

developments, shifts in consumer and investor preferences and reputational impact.

Assessing the physical and transition risks based on time horizon, potential financial impacts, geographical spread and location of impact on the organisation's value chain, as well as prioritising them based on the likelihood and impact of occurrence will enable the organisation to devise strategies to mitigate and adapt to the critical risks.

STRATEGY - DEVELOP A CIRCULAR STRATEGY

Whilst devising a climate change mitigation and adaptation plan, an organisation in the built environment sector must also consider the needs and demands of the stakeholders in its value chain. To achieve a low carbon, healthy, regenerative and resilient built environment that creates shared value, the only way to succeed is by embracing the principles of the circular economy.

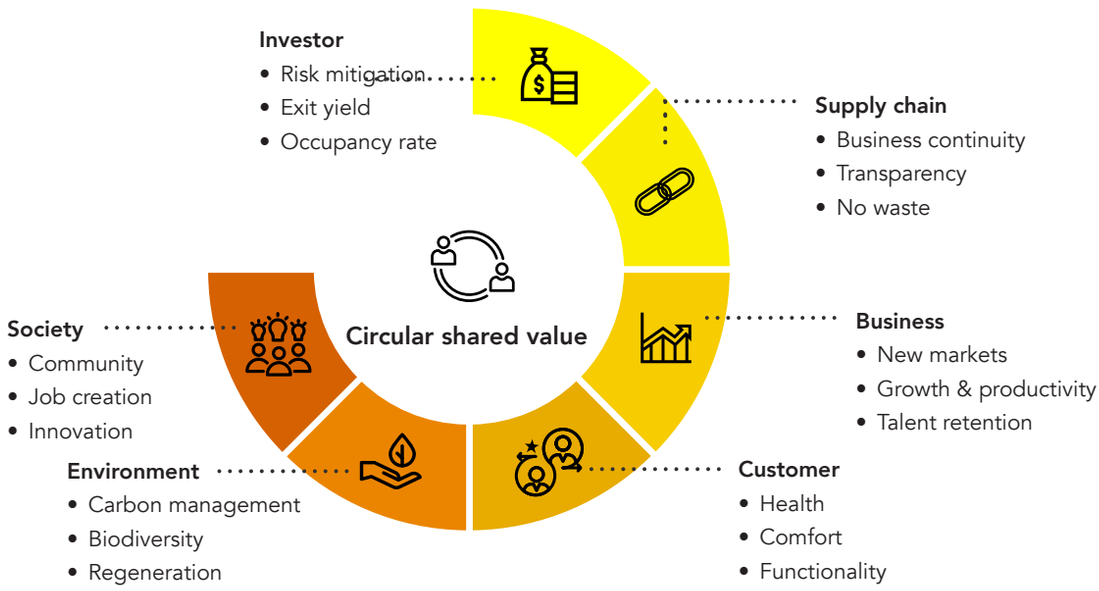


Figure 8 Value map showing examples of circular shared value creation for different stakeholders - values that should be taken into account in order to stay or become successful in the short and long term (KPMG, 2020)

The core principles laid out below are mainly inspired by the principles of Lean Management, the Cradle to Cradle philosophy and KPMG's True Value methodology.

Lean management

Maximize value, mimimise waste

- Identify value
- Map the value stream
- Create flow
- Establish pull
- Seek perfection

Cradle to cradle

Eco-effectiveness instead of efficiency

- Everything is a resource for something else
- Use clean and renewable energy
- Celebrate diversity

True Value

Connecting corporate and societal value creation

- Asses the company's true' earnings
- Understand future earnings at risk
- Create corporate and societal value

5 Core principles

1. Have a thorough understanding of circular shared value creation for all stakeholders
2. Create organization-wide insight in core processes and critical functions
3. Measure performance on a regular basis with timely feedback loops
4. Develop an effective prioritization method for improvement possibilities
5. Put safeguards in place for continuous improvement

Figure 9 The five core principles to create circular shared value, distilled from lean management, the Cradle to Cradle philosophy and KPMG's True Value methodology (KPMG, 2020).

STRATEGY - LEVERAGE SUSTAINABLE FINANCE

Organisations can leverage the preferential rates or reputational gains of financing their green projects with sustainable financing instruments such as green bonds, sustainability-linked loans or green loans. Developing a sustainability strategy and putting in place a data management system to effectively measure and verify performance will build a foundation for organisations to fulfil the conditions to qualify for sustainable finance such as criteria listed in the Green Bond Principles, Sustainability Linked Loan Principles and Green Loan Principles.

IMPLEMENTATION - INTEGRATIVE DESIGN PROCESS (IDP)

A high-performance design requires a holistic systems-thinking approach that considers complex and inter-related issues and a multi-disciplinary and collaborative team to execute. IDP encompasses these requirements and is the most effective and iterative process for exploring and implementing sustainable design principles on a project while staying within budget and program schedule constraints. The process is essential to achieve high performance sustainable buildings while avoiding or minimising incremental costs. It follows the design through the entire project life, from pre-design through occupancy and into operation and can be used for both new and existing buildings.

Integrative Design Process	Conventional Design Process
Inclusive from the outset	Involves team members only when essential
Front-loaded — time and energy invested early	Less time, energy, and collaboration in early stages
Decisions influenced by broad team	More decisions made by fewer people
Iterative process	Linear process
Whole-systems thinking	Systems often considered in isolation
Allows for full optimization	Limited to constrained optimization
Seeks synergies	Diminished opportunity for synergies
Life-cycle costing	Emphasis on up-front costs
Process continues through post-occupancy	Typically finished when construction is complete

Figure 10 Differences between Integrative Design Process and Conventional Design Process

IMPLEMENTATION - CONDUCT CARBON PROFILING

A comprehensive study of Scope 1, 2 and 3 direct and indirect emissions should be conducted to measure current performance and identify areas for improvement.

Scope 1 - Direct emissions	Scope 2 - Indirect emissions	Scope 3 - Other indirect emissions
• Burning of fossil fuels on-site • On-site leakages • Other gaseous emissions (e.g. SF6) • Use of organisation vehicles burning fossil fuels	• Electricity consumption • Heating consumption • Cooling consumption • Steam consumption	• Supply chain emissions • Waste management • Business commute

Figure 11 Examples of Scope 1, 2 and 3 emissions

IMPLEMENTATION - PERFORM CARBON SIMULATION

Carbon simulation software can be used to perform LCA and assist in the carbon computation of a project. One such tool is the One Click LCA which can model both baseline and proposed low-carbon buildings for comparison, including life cycle stages such as construction materials, transportation to site, maintenance and material replacements and deconstruction.

IMPLEMENTATION - ANALYSE COSTS

To better inform decision-making, Life cycle costing (LCC) and Marginal Abatement Cost Curve (MACC) methods can be used to analyse the costs of carbon reduction strategies. LCC is the process of compiling all costs that the owner or producer of an asset will incur over its lifespan. These costs include the costs incurred in initial investment, operation and maintenance of the asset. MACC, which shows the marginal cost of additional reductions in pollution, can be produced to define opportunities in net present value per ton of CO_2e.

IMPLEMENTATION - INTEGRATE CARBON PRICING

To factor in environmental costs in decision-making, a shadow price on carbon can be set within an organisation and incorporated into the investment

costs of a project. This will allow organisations to better understand the potential impact of external carbon pricing on the profitability of a project or investment and incentivise efficiencies, low-carbon innovations and reduction in energy usage.

IMPLEMENTATION - OFFSET REMAINING CARBON

As a last resort, an organisation can offset its carbon footprint using RECs which are units of electricity generated from renewable energy resources. Carbon can also be offset using carbon credits such as Certified Emission Reductions (CERs), Verified Carbon Units (VCUs), or Gold Standard (GS) generated from sustainable development projects such as renewable energy generation.

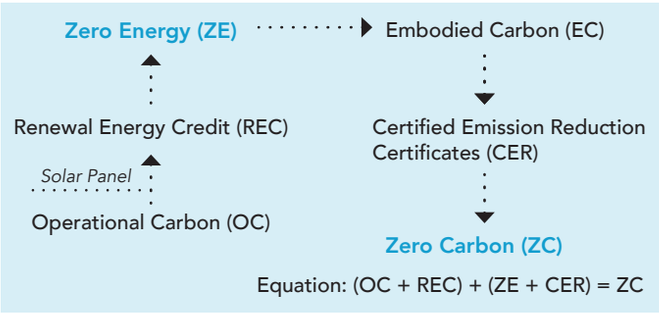


Figure 12 Process of carbon offsetting

DISCLOSURES - MEASURE & VERIFY PERFORMANCE

The measurement and monitoring of carbon footprint performance for both operational and embodied carbon is crucial for tracking performance against targets, which enable real estate players to improve performance against international sustainability ratings such as Global Real Estate Sustainability Benchmark (GRESB), the environmental, social and governance performance benchmark for real assets.

DISCLOSURES - REPORT IMPACT

Furthermore, comprehensive carbon footprint data is needed for the assessment of climate-related transition risks as we transit to a low carbon economy, the disclosure of which is increasingly demanded from stakeholders such as the MAS as they translate to financial impacts.

The societal impact and value of the green development can be measured and monetised using methodologies such as SROI to effectively communicate the organisations efforts and connect with investors by using a common language of dollars.

CONCLUSION

The built environment sector has as much a crucial role to play in the COVID-19 economic recovery as it does in the global efforts towards climate change mitigation. Moving towards low- or zero-carbon will enable the sector to make a mark on both fronts as climate change risks are transformed into opportunities in the form of job creation.

Whilst being nudged along by tightening regulations, heightening scrutiny from investors and market demands for green and healthy buildings, real estate players can take leadership in decarbonisation by leveraging the concise regional and national roadmaps and plans being developed, rise in technology, as-a-service models and sustainable finance. Despite the initial costs, businesses will reap the benefits of green buildings over their life cycle through cost and resource efficiencies, revenue potential of carbon credits, as well as invaluable societal value.

As the sector is particularly exposed to the physical risks of climate change, climate mitigation will have to go hand in hand with adaptation strategies. Furthermore, the built environment sector is compelled to reinvent itself to remain viable and adapt to the new normal of remote work. Coupled with resource scarcity and urbanisation, the sector is faced with a multitude of challenges that necessitate a holistic systems-thinking approach to rise above such complex challenges and turn them into opportunities.

All stakeholders in the built environment sector - governmental and non-governmental organisations, property developers, investors and owners, building professionals such as designers, architects and engineers and building product manufacturers - must work conjointly in the journey towards net zero carbon. The above key steps in establishing strategy, implementation and disclosure are paramount in neutralising the operational and embodied carbon of buildings, while staying relevant amidst a dynamic environment.

The full report can be found on the SGBC website.

GREEN PROCUREMENT FOR GREEN BUILDINGS

In order to achieve the vision of a low-carbon and energy-efficient future, the environmental performance of each and everyday building product cannot be left to chance, as buildings are permanent structures in place for decades at a time. As such, the materials used in its construction play important roles in ensuring that the building's footprint and impact on its surrounding environment is as small as possible. Green building materials certified for their environmental performance, coupled with sound green building design and technology along with an emphasis on sustainability, will definitely go towards creating buildings which are greener and healthier for both occupants and the environment.

ASSESSING ENVIRONMENTAL PERFORMANCE

So how does one determine if a particular green building product is indeed *green*? As a dedicated certification scheme for green building products and materials, the Singapore Green Building Product (SGBP) certification scheme – managed by the Singapore Green Building Council (SGBC) - provides a one-stop solution for the certification and subsequent selection of sustainable building materials. While the Building and Construction Authority's (BCA) Green Mark Scheme certifies the complete building for its environmental performance, the SGBP does the same for the building materials that go into a building, helping to ensure that the final structure will be green, healthy and sustainable from inside-out.

Embracing a holistic assessment philosophy that closely mirrors the requirements outlined in the national Green Mark Scheme, products and materials certified by the SGBP can help green building projects obtain higher Green Mark ratings while also ensuring that the building is sustainable and healthy throughout its lifespan and beyond.

Certified green building products and materials are also good news for building occupants. No one would want to live, work or play in buildings that are "sick", with their harmful and detrimental effects on human health and productivity. For employers, having workers operate out of a sick building essentially translates to higher absenteeism rates, greater medical costs and needless work hours lost, which ultimately go towards diminishing the company's bottom line. Therefore, green and healthy buildings make business sense as well.

A FRAMEWORK OF SUSTAINABILITY

The SGBP is structured on a holistic framework that covers energy efficiency, water efficiency, resource efficiency, health & environment protection as well as any other green features present in the product. In addition, the SGBP assesses products across the entire life cycle: from manufacturing to installation/ operation and all the way to its end of life. Based on assessment of the product's documentation and testing reports, it will be awarded a rating ranging from 1-tick to 4-ticks (Good to Leader), depending on the verified environmental qualities of the product. To date, more than 4000 building products across almost every conceivable category have been certified by the SGBP.

SGBP certification covers a broad range of building products and materials, classified into six main categories. Individual product types are further classified into more than 80 sub-categories within these main categories, meaning that almost any building product can be certified for environmental performance. All certified products are contained in an easily-accessible online directory, where designers and consultants can easily source for and identify required green building products. For example, a consultant looking for certified paints can either type in a keyword or browse through all certified products of that particular category to locate a suitable choice.

Additionally, SGBC also maintains a directory of green building service providers who have a proven track record to work on green building projects through the Singapore Green Building Services (SGBS) certification scheme. These organisations are accredited based on their track record and emphasis on sustainability, allowing the industry a meaningful point of reference for their building projects.

Completing the value chain, SGBC has since April 2019 taken over the administration of Singapore's Green Mark Accredited Professionals (SGBC-GMAPs), the men and women behind the nation's high-performance green buildings (previously known as Green Mark Managers and Professionals).

The SGBC Green Mark Professional Qualification Scheme not only provides the green building community with a continuing education and development framework to stay abreast of key green building trends and developments, but will also allow for the meaningful sharing and transfer of knowledge with regional and international counterparts. In light of the current situation that restricts the organisation of in-person events, SGBC has organised more than 15 industry-focused webinars since April 2020 for SGBC-GMAPs to continue their professional development.

GREEN PROCUREMENT FOR GREEN BUILDINGS

Covering the full spectrum of the green building ecosystem, SGBC's certification programmes complement the Green Mark Scheme, with certified products and services helping green building projects to secure higher ratings by accruing bonus points. The accredited professionals also help to ensure that green buildings are designed and constructed to qualified standards, imparting their knowledge and expertise to continually push the envelope for energy efficiency and built environment sustainability.

SGBC regularly engages with building owners, designers and consultants to spread awareness of SGBC certifications, through purpose-organised seminars, sharing at partner events or during green building conferences and trade shows and exhibitions such as the annual Build Eco Xpo Asia event held virtually for the first time in September 2020.

AS COOLING SHOULD BE

Air-conditioning has become a regular part of daily lives, with most of our places and spaces equipped with air-conditioning systems to help cool the buildings. Air-conditioning alone can account for more than 50 percent of a building's total energy consumption and with rising global temperatures, this figure may increase further. Striking a delicate balance between cooling requirements and energy efficiency will be key as the built environment strives to move into a low-carbon future.

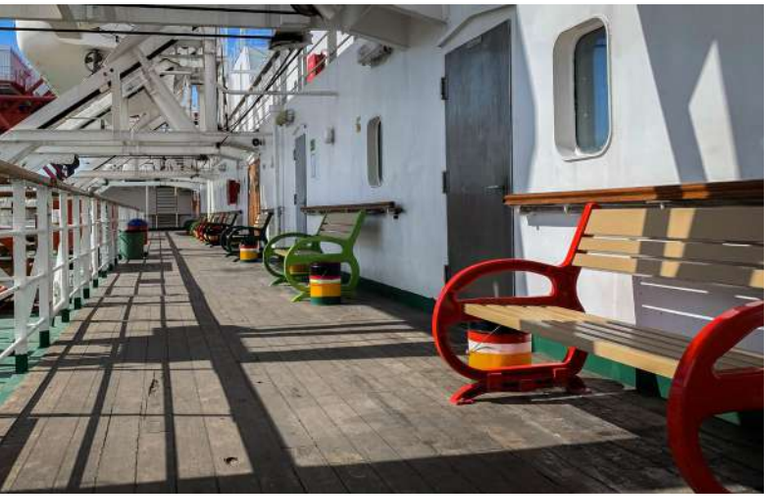
Homegrown enterprise and SGBC Member Ecoline Solar Pte Ltd has developed a solar-thermal hybrid air-conditioning system that leverages harnessing sustainable solar and ambient thermal heat energy to reduce the energy required to for cooling. The Therm-Aire system (SGBP ✓✓) is essentially a conventional air-conditioning system paired with an evacuated-tube thermal collector filled with a novel medium designed by a team from the National University of Singapore (NUS). To ensure long-term sustainability of this system, the thermal collector uses biodegradable materials and medium. When in operation, the collectors absorb solar energy and ambient heat to heat up the refrigerant in the system, reducing reliance on the air-conditioning unit's compressor to pump refrigerant through the system which drastically lowers energy consumption and heat emitted. This hybrid cooling system has consistently helped to reduce energy consumption by 30-50 percent. The return on investment is typically two years, making it a very attractive option for many who are passionate about reducing their carbon footprint.

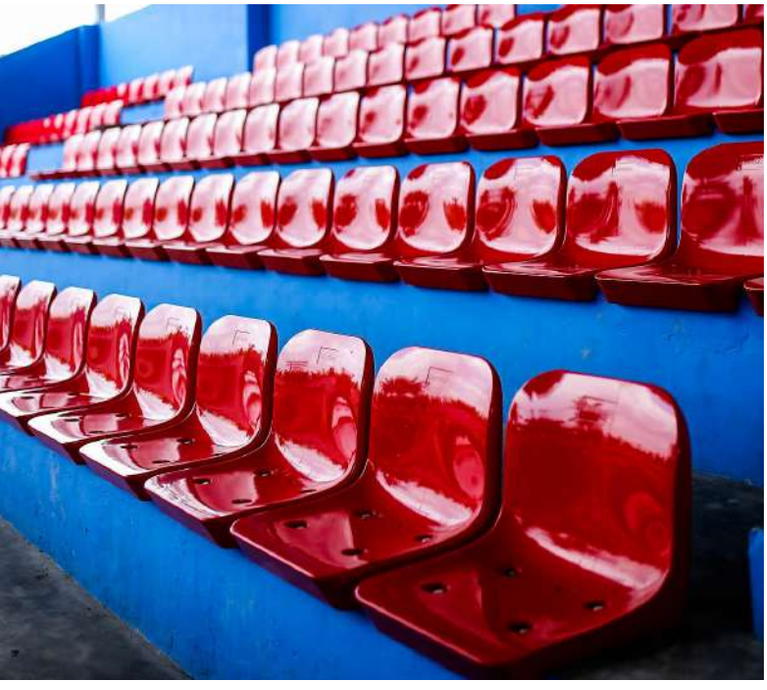
By harnessing surrounding heat, this system also helps reduce Urban Heat Island effect and potentially resulting in a lower outdoor temperature if more of such systems are deployed. Ecoline is also seeking experts in this area to help study the impact of this and have reached out to some research institutes for collaboration discussions.

As with common inverter systems, Ecoline Solar's technology can be applied to commercial, industrial and residential buildings, with a number of local buildings already making use of the system to generate cost savings. The JOULES Smart Lab @ Bukit View Secondary School – a community-industry cross collaboration project catalysed by

SGBC – has a Therm-Aire system in place to not only help to sustainably cool the one-of-a-kind green classroom but also to serve as a learning feature for the students.

In line with global paradigm shifts towards greater environmental sustainability, greener and more sustainable cooling systems will help to bolster the energy efficiency of the built environment and lower global carbon footprint, just as cooling should be.





CREATING BETTER LIVING SPACES

Over the past decade or so, the building and construction landscape has undergone a shift towards greener, more climate-resilient building materials to address the challenges of global warming and climate change. More recently in the wake of the global pandemic, the emphasis on health and wellbeing has never been greater, and the built environment is in a prime position to deliver healthy, equitable, resilient spaces and places for people to live, work and play in the new normal.

The industry has been responding to the call for better ways to design, construct and maintain a growing number of buildings. With materials continuing to play key roles in any type of building, organisations have been fervently developing new products and solutions to create better living spaces.

One such company is SGBC Member Tasblock Composite Pte LTd. With over 30 years of experience in composite material manufacturing, Tasblock pioneered the innovation, engineering and development of next-generation renewable composite urban furniture and infrastructure products. With a wide range of solutions that can be deployed to almost every building type from residential apartments to disaster relief facilities, Tasblock's products are stronger, lighter, healthier and more resistant to impact, weathering, termites and fungi.

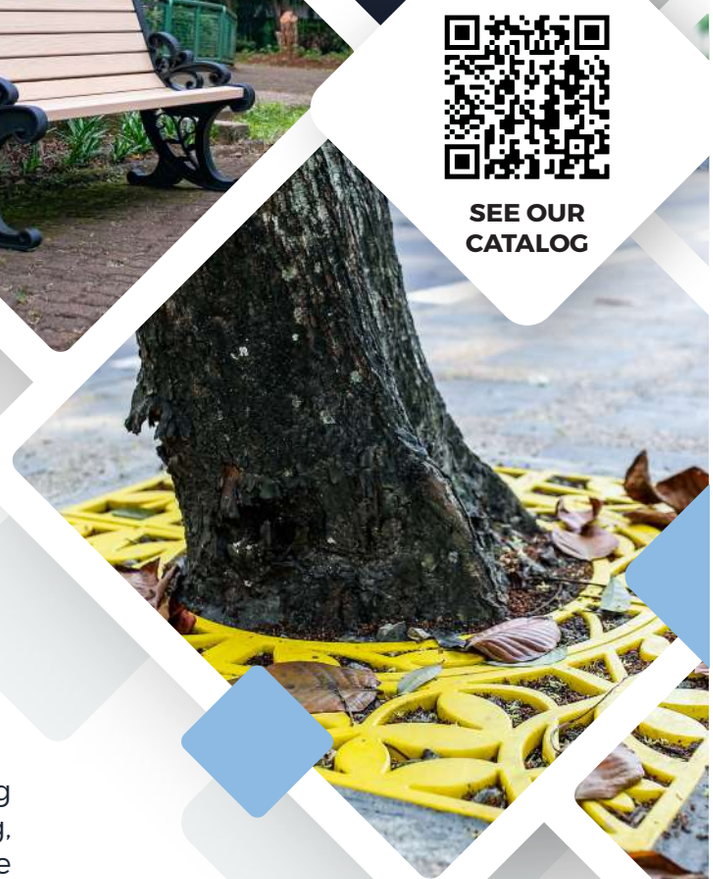
In fact, the TAS SC001 Stadium Chair is the first-ever building product in its object category to achieve the highest-possible SGBP Leader 4-tick rating, a sound testament to the emphasis on sustainability that went into such a common and humble product. The chair has almost no volatile organic compound (TVOC) and formaldehyde emissions and incorporates recycled materials in its manufacture. When used in the thousands in sports stadiums or other similar facilities, these chairs will be able to help keep emissions low and create a better indoor environment for occupants and patrons.

As the world moves into a new business as normal, companies such as Tasblock will continue to develop cutting-edge solutions to help create a greener, healthier and more resilient built environment.

tasblock

SINGAPORE GREEN BUILDING PRODUCT
SGBC
LEADER

CERTIFICATE NUMBER: SGBP 3577



SEE OUR CATALOG

Tasblock is the leading composite manufacturing company specialized in compression moulding, providing high quality and unique street furniture and infrastructure products to worldwide.

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+65 9759 0066

OPTIMISING THE THERMAL ZONE

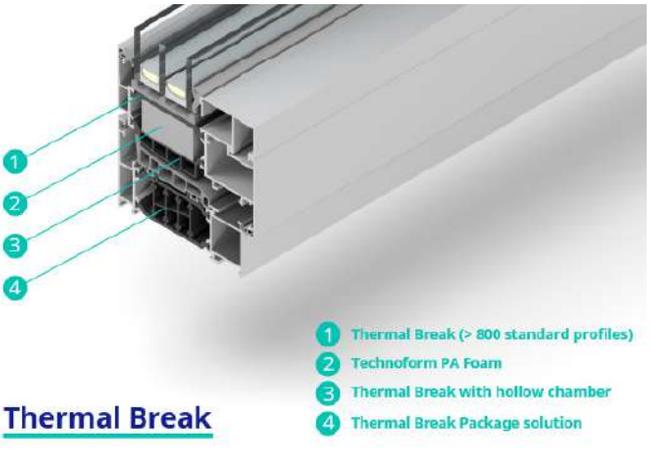
Insulation is one of the most important building features for comfort and energy efficiency. Proper insulation helps the building to remain comfortable and energy efficient without the need for extremely costly heating and/or cooling machinery that excessively consume energy. In the modern built environment where aluminium windows, doors and facades are commonplace, ensuring adequate and appropriate insulation can lead to tremendous energy – and cost – savings.

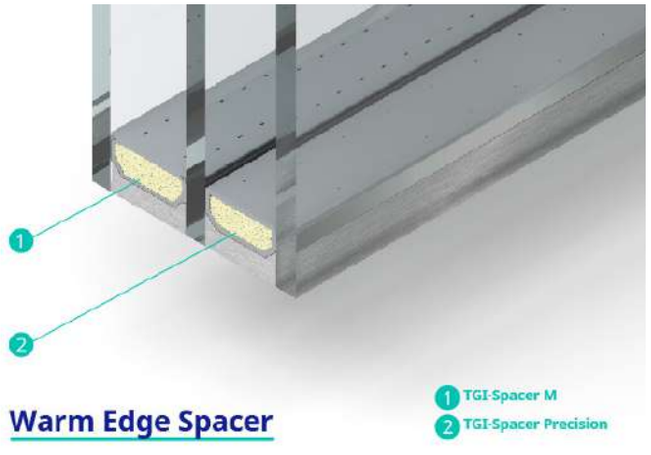
A market leader in multiple industries with a suite of innovative and market-oriented solutions, Technoform specialises in the optimisation of the thermal zone in windows/ doors/ facades, creating a comfortable indoor environment and keeping energy costs low. This results in improved thermal performance of the building envelope, a better energy footprint and a considerable reduction in carbon emissions.

One of its core solutions, the Thermal Break (SGBP ✓✓✓), improves the thermal performance of windows, doors and facades. Connecting the exterior and interior aluminium profiles, while keeping mechanical performance at the highest level, the solution prevents direct exchange of heat and cold – and create what is known as the "thermal break". The result: minimised thermal conductivity, optimised building efficiency, and a better energy footprint.

Technoform's solutions have shown to be able to reduce energy consumption due to façade heat gain by more than 25 percent, considerably reducing carbon emissions. All these translate to energy and cost savings which can then be spent on other areas of the building, knowing that the building's insulation is well taken care of.

With more than 50 years in the industry, Technoform works closely with its partners to develop thermal insulation solutions for the building façade. From consultation on design and optimisation of the thermal zone in facade systems to the support and documentation for the specification of Thermal break and Warm Edge Spacer solutions, Technoform stands ready to optimise your thermal zone.



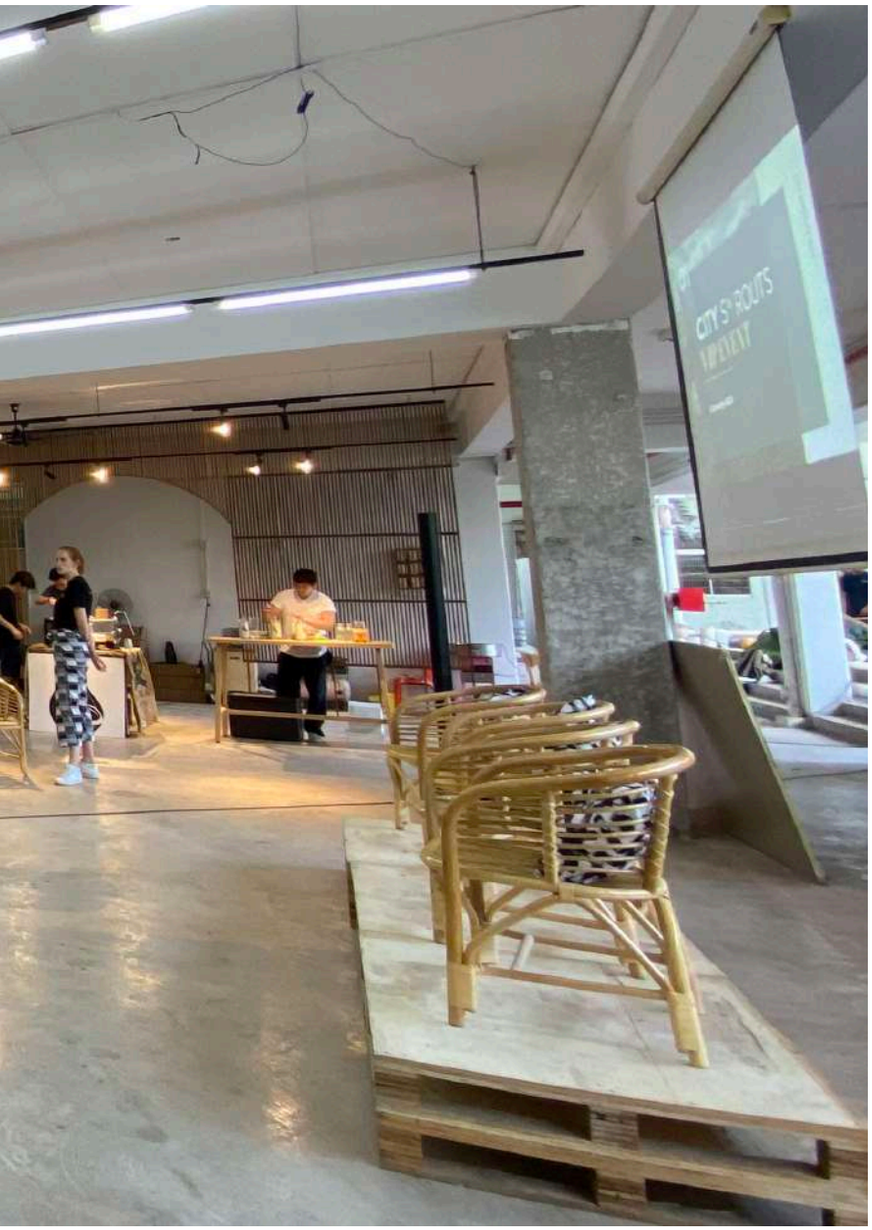


SPROUTING A COMMUNITY SPIRIT

Sprout Hub is fast becoming a focal point for community sustainability

According to a Channel News Asia report in 2018, only 1 percent (compared to 20 percent in 1961) of Singapore's total land space is occupied by farmland and the nation imports 90 percent of its food. These staggering numbers reflect the profundity of Singapore's transformation since its independence; migrating from an agrarian society in the 1960s to a knowledge-based, information technology-driven economy, outsourcing most of its food production in the process.

While this shift has already significantly remodeled the country's food landscape, we can only expect the stability of our food supply, both current and in future, to be further threatened by climate change, cross border supply shocks and increases in food prices due to global food crises. Unfortunately, the general masses have been mostly shielded from these issues – primarily due to the lack of exposure to food shortages, easy access to food and advanced logistics in Singapore. The issue of food self-sufficiency was only highlighted when the government called for more initiatives and campaigns to bolster the nation's food security. The approach is to develop local production capabilities - through increases in Agrotechnology Parks and



supporting technologically-advanced indoor vertical farms - to achieve greater self-sufficiency. This is apparent through the 30by30 goal – to produce 30 percent of Singapore's nutritional needs locally by 2030.

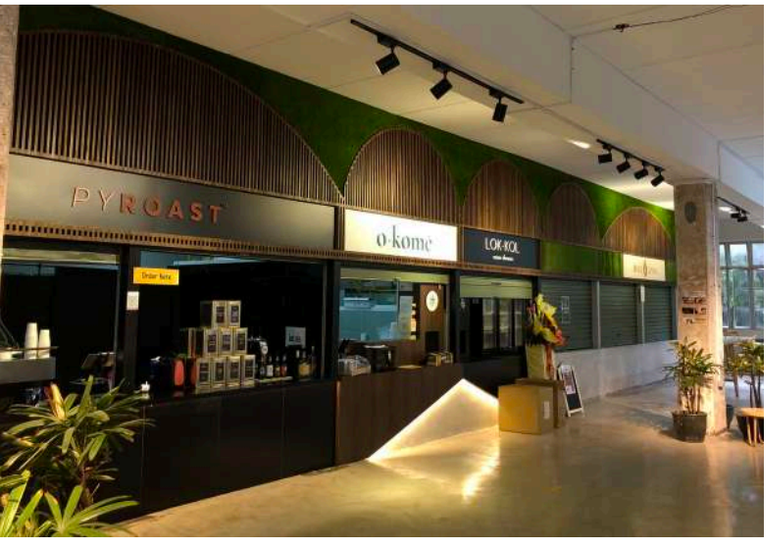
City Sprouts is a social enterprise founded in 2018, whose core mission is to rejuvenate urban spaces and communities through the development of robust solutions for modern agriculture. One of the key problem statements that they set out to resolve is the divide between people and food production. Although there was a great nationwide push towards being food independent, the founders believed that more effort is needed from the ground up to complement this movement; through raising awareness about the current food system and empowering people to take ownership over growing their own food. In May 2019, City Sprouts was awarded a tender to redevelop a part of the former Henderson Secondary School into a food and social hub concept – now called Sprout Hub. Co-located with a nursing home and childcare center, Sprout Hub is an ecosystem that revolves around the concept of subsistent farming in the city, food, education and community.

A SPROUTING COMMUNITY

Using the old school field, City Sprouts created a community farm in Sprout Hub that runs on an allotment model, where hobbyist and entrepreneurs alike can rent a greenhouse to grow their own food or pilot their innovations. By detaching the masses from production-based agriculture, this model inspires users to take on an active ground-up role in tackling food security. Inasmuch as Singapore lacks space for experimental farms, this model also welcomes aspiring pre-commercialised farmers to pilot or testbed their cultivation systems and methods. Ultimately, by incorporating inclusivity and community-centeredness into this model, City Sprouts hopes to bring the experience of urban farming to the people, giving them a glimpse into how food was and should be grown: with the community and for the community. To reinforce the sense of community and preserve the history of the space, City Sprouts erected a traditional wayang structure as an open classroom for workshops and community storytelling.

As a complement to the allotment model, City Sprouts developed an integrated farming platform called Singapore Indoor Agriculture Platform in the old school hall. This platform serves as a knowledge center and testbed for indoor farms to pilot and formulate solutions in a safe environment with minimum risks. The first indoor farm partner is Singrow Pte. Ltd., a developer of innovative agritechnology solutions for producing premium-quality and tropic-resistant strawberries. In their pilot 500m2 facility, Singrow will be deploying their proprietary hydroponics rack and cultivation method to grow more than 10,000 strawberry plants with an expected annual harvest of 8-10 tons. Growing in a controlled environment means production will not be disrupted by seasonal changes thus ensuring consistent harvest all year round. This will enable them to deliver freshly harvested premium grade strawberries to local clients quickly and at affordable prices. Adjacent to the platform, City Sprouts has preserved the design and structure of the remaining hall space for community activations and events such as movie screening, agritech conferences, exhibitions etc.

Sprouting a Community Spirit

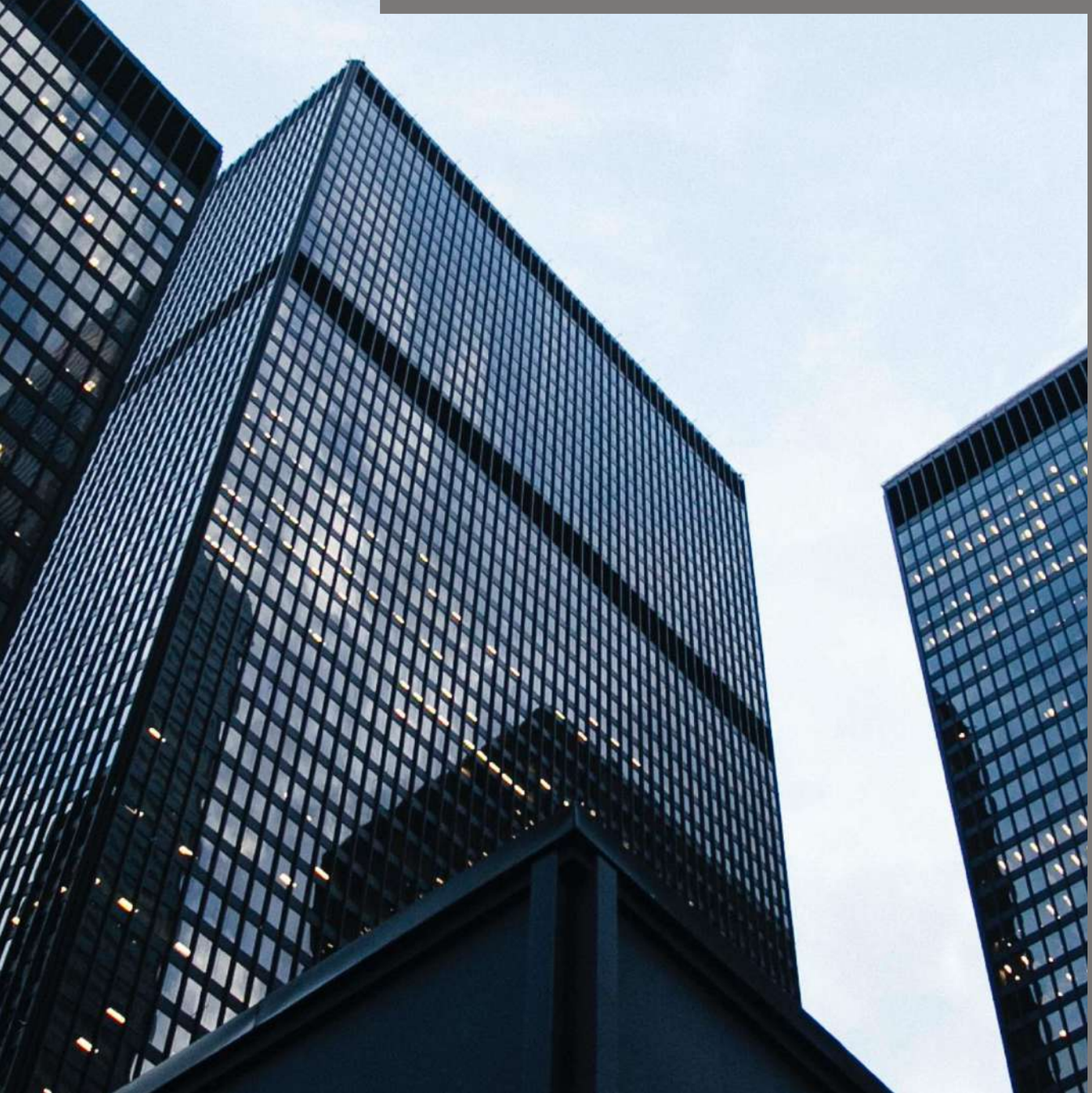


City Sprouts overhauled the former canteen into an open air multi-purpose community space, with the canteen stalls redesigned into a unique food concept. This versatile space will enable City Sprouts and its partners to host community events such as educational seminars, farmers' markets, and knowledge sharing workshops. These events and outreach programs are selectively curated to not only increase public awareness and foster empowerment about environmental and social issues, they seek to equip participants with relevant skills to take measurable actions. In view of the pandemic situation, City Sprouts' plan is to resume their events and programs in phases starting from August 2020 onwards. They plan to begin with their weekly farm tours, monthly Farm Day Out (both family and junior versions). Furthermore, the food outlets operate with the overarching theme of fresh, local produce and sustainability. On top of exploring farm-to-fork initiatives, these outlets have been adopting eco-friendly packaging and contributing their food waste to City Sprouts' in house compost pile, which will then go back to our farmers for cultivation.

Additionally, City Sprouts' sister company SGBC Member GWS Living Art, a specialist in vertical greenery is also housed in Sprout Hub. Having established its foundations in green roofs and green walls, GWS Living Art will be focusing on refining its technologies and products in its new headquarters. Through such a relationship, City Sprouts has and will continue to benefit from cross-collaborations in events and sustainable activations.

CELEBRATING BUILT ENVIRONMENT SUSTAINABILITY

The WorldGBC Asia Pacific Leadership in Green Building Awards celebrate iconic green buildings pushing the envelope in sustainability, inspiring companies that have integrated sustainability into the core of their operations, and women leadership in the green building space.



Celebrating Built Environment Sustainability

The biennial Awards, first held in 2014, showcase and celebrate the achievements of businesses and innovators leading on sustainability in buildings across the Asia Pacific region. Presented by the World Green Building Council and its Asia Pacific Regional Network of Green Building Councils, the Awards programme will recognise five winners across three award categories:

- The **Business Leadership in Sustainability Award** rewards companies that push boundaries, integrate sustainability into their business models and make an outstanding contribution to a sustainable built environment.

- The **Leadership in Sustainable Design and Performance Award** is presented to pioneering green building projects that set new benchmarks for sustainability. There are three sub-category winners for **commercial**, **institutional** and **residential** buildings.

- The **Women in Green Building Leadership Award**, was presented for the first time in 2018 to an inspiring female leader. In a traditionally male-dominated industry, the Award recognises the pivotal role that women play in nurturing and activating their communities, and delivering change.

Additionally, to reflect the growing momentum of WorldGBC's global projects – namely the Better Places for People and Advancing Net Zero projects – the Awards confer special recognitions for businesses and projects that have gone above and beyond. The Better Places for People Special Recognition will be awarded to companies that have truly embraced health and wellbeing practices; and the Advancing Net Zero Special Recognition will be awarded to projects that have demonstrated an ambitious and holistic solution to achieving net zero operational carbon emissions.

The winners of the Asia Pacific Leadership in Green Building Awards 2020 will be determined by an independent jury committee composed of prominent international experts in the fields of green buildings, architecture, engineering design, energy, economics and sustainability.

FLYING THE SINGAPORE FLAG HIGH

Jointly conferred by the Singapore Green Building Council (SGBC) and the Building and Construction Authority (BCA), the annual SGBC-BCA Sustainability Leadership Awards recognise outstanding green building professionals, organisations and building projects for their significant achievements and consistent contribution to the development of a green and sustainable built environment. In keeping with the theme of the Awards since its inception in 2016, the 2019 edition was modelled as a platform to recognise and acknowledge individuals, organisations and building projects that have demonstrated sustainability leadership in the green building industry.

The Winners of selected award categories of the SGBC-BCA Sustainability Leadership Awards 2019 will represent Singapore in this year's WorldGBC Asia Pacific Leadership Awards in Green Building. Read on to find out more about the organisations and projects that are flying the SInngapore flag high on the regional stage.

BUSINESS LEADERSHIP IN SUSTAINABILITY

A household name in Singapore, DBS is a leading financial services group in Asia with a presence in 18 markets. As a bank born and bred in Asia, DBS understands the intricacies of doing business in the region's most dynamic markets. DBS is committed to building lasting relationships with customers, and positively impacting communities through supporting social enterprises.

DBS has established a SGD50 million foundation to strengthen its corporate social responsibility efforts across Asia. Leading at the forefront, DBS has achieved many firsts in its commitment towards sustainability. It is the first Asian bank and Singapore company to join global renewable energy initiative RE100. It has also pledged to power 100 percent of its operations in Singapore using renewable energy by 2030. DBS launched Asia's first real estate sustainability-linked loan with CapitaLand, is the first financial institution in Singapore to issue a green bond with the Marina Bay Financial Centre Tower 3 as one of the first green assets, and is also the sole bookrunner for Singapore's first green bond with City Developments Limited.

Celebrating Built Environment Sustainability

As of 2019, 14 percent of DBS' operational energy consumption is sourced from renewable sources. The bank's total electricity consumption also fell by more than 1,600 MWh despite an increase in real estate footprint. All of DBS' office premises and retail branches in Singapore are certified to Building and Construction Authority Green Mark standards, with two premises awarded the Green Mark for Healthier Workplaces certification – and were the two largest such projects certified at that time by nett lettable area.

As a significant financer of renewable energy, the bank had 17 deals of loan size of over SGD 1.3 billion in 2018. In 2019, DBS financed about SGD 1.7 billion of renewable and clean energy-related loans.

DBS reinforced its commitment to grow its sustainable financing business by launching Asia's first real estate sustainability-linked loan of SGD 300 million with CapitaLand. DBS is the first financial institution in Singapore to issue a green bond, with the Marina Bay Financial Centre Tower 3 as one of the first green assets. DBS is also the sole bookrunner for Singapore's first green bond with City Developments Limited and the sole lead manager and bookrunner in Asia's first green bond issuance by National University of Singapore.

DBS is the first Singapore bank to adopt circular procurement in its own procurement practices. Some of its key initiatives include eliminating the use of single-use plastic bottles and reducing packaging for laptop delivery. Globally, DBS has been formally recognised for its sustainability efforts. DBS is included as an index constituent of the Dow Jones Sustainability Index (Asia Pacific), FTSE4Good Global Index and is just one of two Singapore-based companies named in the Bloomberg Gender Equality Index for two years running.

Amid the global pandemic, DBS partnered The Food Bank Singapore to launch Singapore's first virtual food banking app to enhance support for individuals and families affected by the crisis. In April 2020, DBS launched its SGD 10.5 million DBS Stronger Together Fund to help communities hard hit by Covid-19 across the region. Through the fund,

the bank provided about 4.5 million meals and care packs to affected individuals across its six key markets, namely Singapore, Hong Kong, China, India, Indonesia and Taiwan.

Over the years, DBS has organised and sponsored sustainability-related innovation hackathons, such as Unleash (2018) and NUS-DBS Social Venture Challenge (2014- 2018). In August 2018, DBS started a countrywide RecycleMoreWasteLess public awareness campaign in Singapore to educate the public on the importance of responsible consumption and correct recycling habits. The campaign was multi-faceted, and included working with various celebrities, media, NGOs, businesses and social enterprises. The campaign saw more than 53,000 people take the pledge to Recycle More, Waste Less.

Engagement with key stakeholders helps DBS define its strategic priorities. The bank holds regular conversations with institutional investors, employees, industry associations such as ABS, customers, communities, NGOs and regulators. DBS also participates in sustainability-related forums organised by policy makers, banking associations, academic institutions and share our thoughts on specific ESG matters.

In 2019, DBS was one of the pioneer founders of Singapore's first industry workgroup to promote sustainable procurement – the National Sustainable Procurement Roundtable (NSPR). The NSPR is committed to promoting sustainable procurement in Singapore, with the aim of building a sustainable supply chain that efficiently meets sustainability objectives.

DBS also co-chaired the working group in consultation with the Monetary Authority of Singapore (MAS) on the development of Environmental Risk Management Guidelines which would outline expectations on governance, risk management and disclosure. The bank continues to engage corporate customers on green financing instruments, with sessions held to raise awareness on good ESG practices and making positive impact.

LEADERSHIP IN SUSTAINABLE PERFORMANCE & DESIGN – COMMERCIAL

PARKROYAL COLLECTION Pickering by UOL Group Limited was built with the aim to be the city's greenest hotel. Its hotel-in-a-garden concept features over 15,000 sqm of lush gardens, waterfalls and planter walls that constitute more than twice the hotel's total land area. Other innovative sustainability features include the zero-energy sky gardens, the use of rainwater or NEWater for landscape irrigation, motion and rain sensors, recycling bins in every hotel room, as well as the use of natural materials such as wood and glass in the hotel design. Living up to its green promise, PARKROYAL COLLECTION Pickering has been winning prestigious accolades across the globe, placing the hotel and Singapore as world leaders of green high-rise buildings.

Designed as an urban resort, PARKROYAL COLLECTION Pickering is filled with lush green sky gardens and living facades that changes with the seasons. In the spirit of giving back to the city, it was in the hotel's vision to perform an added civic duty by serving as public architecture in the way it monumentally opens up its porte-cochere as an axis

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and ceremonial gateway that physically and visually links Singapore's business and historical districts, while extending the horizontal green of the adjacent park vertically into the building as one continuous sweep of urban parkland.

The vertical landscaping and elevated gardens effectively serve as multiple levels of new city parks in the sky that can be enjoyed both up close and afar. These elevated gardens are not only visually attractive; they also present many environmental and social benefits, forming spaces for interaction and for building of communities in dense urban high-rise developments.

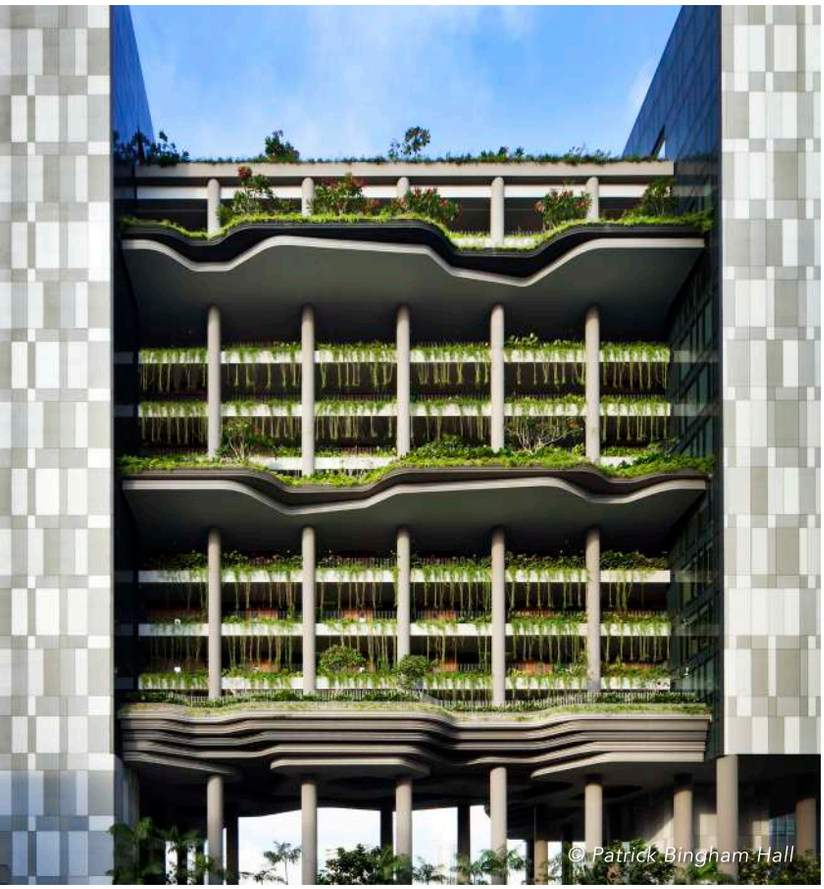
***"We were honoured to receive the SGBC-BCA Sustainability Leadership Awards 2019. UOL adopts a holistic approach towards greening the urban habitat and endeavours to contribute our part as a developer to improve urban lives and the planet. Since its opening in 2013, PARKROYAL COLLECTION Pickering has become an iconic green landmark within the existing urban landscape,"* said Mr Liam Wee Sin, UOL Group Chief Executive**

To retain a sense of human scale, the building's massing and details were calibrated to the intricacies of the city by mirroring the density and height of the surrounding shop houses, taking visual references from the height of the ubiquitous tree canopies, and responding to the site's context in terms of the size and orientation of its tower blocks. The historic streetscape proportions were also further reinforced by the way the building is horizontally segmented by the great open veranda on the 5th storey and by the projecting shelves of the sky gardens above at 4-storey intervals.

The property is designed to relate to the existing Hong Lim Park, extending the greenery from Hong Lim Park to the sky gardens in the hotel. This also improves biodiversity in the city centre. Keeping the hotel-in-a-garden design concept in mind, PARKROYAL COLLECTION Pickering introduced extensive amounts of landscaping into the building estimated to be 215 percent of the site area or equivalent to the footprint of the neighbouring Hong Lim Park.

Dense layered and large-leaf exotic planting like Monsteras, Alocasias and Calatheas combined with ferns and palm varieties were selected for the sky gardens, attracting birds, dragonflies and butterflies to the garden spaces. Apart from wildlife, humans are drawn to the building evidently seen with people whipping up their phones to snap pictures of the iconic building.

Taking regional climate into consideration and designs, the building works for the tropics, with ample shading from the sky gardens and large voids for good cross ventilation. The hotel has 50 percent of the hotel corridors and 100 percent of the office



common toilets naturally ventilated. The building is orientated such that it receives minimal heat gain from the western sun. The unique contours are inspired from regional geological formations like the tropical paddy fields and cave formations.

PARKROYAL COLLECTION Pickering also broke new ground by being the first development in Singapore built using Cobiaz technology, a system that reduces concrete usage by placing 'void formers' made of environmentally friendly recycled plastic. The Cobiax Void Formers were installed within the non-structural loading areas of the slab to reduce concrete usage, and a downstream effect of reducing the weight of the building, therefore requiring smaller structural members. Reducing concrete usage equates to lesser carbon footprint to produce and deliver concrete for construction. The hotel is also one of the first commercial buildings to adopt this system in Singapore, and serves as a good case study.

The property also innovates by using plants as building material instead of architectural materials such as concrete:

- Green walls and sky garden act as insulation against heat gain to walls and ceiling, greenery with large foliage for shading and screening at the podium.
- Overflowing creepers along the hotel corridor act as a shading curtain, as well as a living light chandelier at the sky gardens oculus

For all its efforts in sustainability, PARKROYAL COLLECTION Pickering has been awarded with the Building and Construction Authority Green Mark Platinum rating, the nation's highest certification level for green buildings.

Developer: UOL Group Limited

Architect: WOHA Architects Pte Ltd

Façade Consultant: Meinhardt Façade Technology (S) Pte Ltd

Lighting Consultant: LPA Lighting Planners Associates Inc.

Green Mark Consultant: LJ Energy Pte Ltd

Landscape Consultant: Tierra Design (Singapore) Pte Ltd

LEADERSHIP IN SUSTAINABLE PERFORMANCE & DESIGN – INSTITUTIONAL

Kampung Admiralty is Singapore's first one-stop integrated complex that maximises land use and the benefits of co-locating a mix of public housing for senior citizens and other facilities and services under one roof. The compact site prompted a layered 'club sandwich' approach. The result is a "Vertical Kampung (village)", with a Community Plaza sheltered by a Medical Centre supporting a rooftop Community Park overlooked by apartments for seniors. These three distinct layers juxtapose the various building uses to foster diversity of cross-programming and frees up the ground level for activity generators. The proximity to healthcare, social, commercial and other amenities support inter-generational bonding and promote active ageing in place.

Kampung Admiralty demonstrates innovation in intensifying land uses with a varied mix of public spaces and social facilities and healthcare and private homes, creating new ground levels of useable and accessible greenery in a built-up environment. The different layers in Kampung Admiralty create new ground levels of useable landscape spaces within the development. Passive Environmental Strategies are used to create comfortable tropical public spaces. All public spaces and apartments are designed for natural ventilation and hence not reliant on air-conditioning. The pre-cast façade has deep sunshading and all the roof surfaces are landscaped to reduce thermal load.

The extensive rooftop green space, with green plot ration of 4.5 provide a natural and bio-diversified environment for wildlife habitats. A community farm and herb garden are allocated within the development to allow residents to enjoy gardening. Fruit trees such as Limau Purut are planted to evoke kampung (village) livelihood memories. Overall, 110 percent landscape replacement and 150 percent community space in relation to site area have been achieved. With a planting palette that encourages bio-diversity, significant numbers of species of insects, birds and fruit bats have been observed. A biodiversity survey was commissioned a year after completion and the species are found to be performing better when compared to an existing ground level public park.

Kampung Admiralty is located next to the train station – a prime location in terms of real estate value. Kampung Admiralty and its public spaces are connected to this public transport network and have become a natural urban focal point. The overarching theme of this project is "connection and integration", a new prototype mixed-use development which combines social housing for the elderly with public space and park, medical health and recreational amenities, retail shops, food centre and an urban farm. This integrated project makes intergenerational activities and social interaction possible and ensures that elderly residents are not pushed to the periphery of the community.

Kampung Admiralty is designed to be porous so that natural daylight and ventilation is introduced to all common spaces. The view, easy access to nature and landscape promotes a biophilic environment and helps to create a sense of well-being to residents, users and visitors. Indoor operative temperature is maintained at 24 to 26 degrees Celsius. Relative humidity is less than 65 percent for

consistent indoor thermal comfort. Indoor fresh air is regulated with built-in demand control algorithm in the Building Management System (BMS).

The building's design provides good insulation against noise and air pollution by:

- Locating the podium block of enclosed spaces strategically in order to shield the apartments from road and train noise
- Locating the kitchen exhaust to roof top to bring the food fumes and smell away from apartments and users' space
- High uncluttered ceiling spaces to Community Plaza and Hawker Centre promote effective cross ventilation and channel air upwards through a daylight opening
- Landscape Courtyard brings natural light to circulation and waiting areas of the Medical Centre

Kampung Admiralty is steered by multi-agencies with a singular vision to integrate their programmes both in design and in post occupancy programming. Each agency brings their best practices and yet resolve to integrate them in a coherent framework. For its efforts in sustainability, Kampung Admiralty has been awarded with the Building and Construction Authority Green Mark Platinum rating, the nation's highest certification rating for green building.

Developer: Housing & Development Board
Architect: WOHA Architects Pte. Ltd.
C&S Consultant: Ronnie & Koh Consultants Pte. Ltd.
M&E Consultant: AECOM Pte. Ltd.
Quantity Surveyor: Davis Langdon KPK (Singapore) Pte. Ltd.
Landscape Consultant: Ramboll Studio Dreiseitl Singapore Pte. Ltd.
Green Mark Consultant: AECOM Pte. Ltd.
Contractor: Lum Chang Building Contractors Pte Ltd

LEADERSHIP IN SUSTAINABLE PERFORMANCE & DESIGN – RESIDENTIAL

Completed in 2018, the 944-unit Coco Palms condominium is nestled in the neighbourhood of Pasir Ris, surrounded by lush tropical greenery and extensive water area. The project consists of 12 12-16 storey blocks set within a resort atmosphere with an emphasis on clean, sleek and modern architectural form balanced with wide open spaces and natural landscaping.

Coco Palms was sensitively designed and sustainably built throughout its entire lifecycle – from using innovative design and eco-friendly materials during design and construction, to embracing expansive lush landscaping and multiple green spaces, to its myriad energy- and water efficient features.

The central open space is a tree-lined boulevard with elements of water that creates abstraction of a "lagoon" in the development. There is an organic shaped pool with islands vegetated with plants that gives a resort-like atmosphere. Pedestrian networks are interspersed with gardens & plazas, giving residents an opportunity to enjoy the outdoors. An abundance of greenery – trees, shrubs and groundcovers – not only beautifies the environment but importantly, contributes to a high Green Plot Ratio.

Being in a tropical country, the heat generated from the West Sun can be quite unbearable at times. The project adopted a passive design approach with all blocks oriented along the North-South direction to minimise direct West facing units. In addition, sun shading canopies, extensive planters and sun-shading ledges coupled with the use of double glazed low-E glass are provided to reduce direct sunlight penetration into unit interior. Cool paints are used on all external walls to further cut solar heat gain.

In terms of site planning, the buildings are positioned and oriented in such a way that most of the 944 apartment units are able to take advantage of the prevailing wind directions, ensuring good natural ventilation for the better part of the day.

The bathrooms in most apartments were prefabricated to improve productivity and reduce waste. The project's energy-efficient features include energy-efficient air conditioning system in all apartments, motion sensors in common areas, and solar powered LED bollards at landscaped areas. Its energy-efficient lifts with VVVF drive and sleep function mode help conserve electricity.

For water efficiency, the Coco Palms project features include innovative rainwater harvesting and recycling system, which helped Coco Palms garner the ABC Waters Certification from PUB. Amongst its myriad green spaces, the solar gardens at Coco Palms help generate electricity. To encourage greener modes of transport, residents can use electric vehicle charging points and sheltered bicycle parking lots.

The condominium clubhouse "Club Cocomo" is a 3-level facility space kept within the parameters of the building, offering both generosity of communal-use facilities and vast visuals of the central lagoon-like swimming pool.

Coco Palms has attained Building and Construction Authority's Universal Design GoldPlus rating with the following unique features among others:

a. Main location map (way finding) at 1st Storey drop-off area

b. Accessible Ecocube farm

c. Smart storage in apartment units

Celebrating Built Environment Sustainability

Housed in an enviable neighbourhood with myriad amenities, good transport networks and leisure options, Coco Palms is ideal for individuals, couples and families. There is excellent accessibility to the city via MRT, buses and expressways such as ECP, PIE and TPE. Coco Palms is also a short drive to shopping and lifestyle attraction Jewel Changi Airport, IKEA Tampines, Giant and Courts, which are one-stop stores for home essentials. Leisure and recreational options abound at the nearby Pasir Ris Park, Tampines Biking Trail and Downtown East.

Testament to its sustainable design, Coco Palms has received a string of accolades including the BCA Green Mark GoldPLUS Award.

Developer: Hong Realty (Private) Limited
Project Manager: City Developments Limited
Quantity Surveyor: Arcadis Singapore Pte Ltd
Architect: AXIS Architects Planners Pte Ltd
C&S Consultant: Parsons Brinckerhoff Pte Ltd
M&E Consultant: Meinhardt (Singapore) Pte Ltd
Landscape Consultant: Tinderbox Landscape Studio Pte Ltd
Project Interior Designer: AXIS ID Pte Ltd
Main Contractor: Woh Hup (Private) Limited

SCORING GREEN MARKS WITH SUSTAINABLE CONCRETE INNOVATION

Pan-United forges the way ahead with an onus on sustainability

Scoring Green Marks with Sustainable Concrete Innovation

Sustainability is a concept that has been gaining momentum in Singapore in recent years as more people realise that nature's resources are becoming increasingly scarce and finite.

Under the Paris Agreement, Singapore has pledged to reduce its carbon dioxide emissions intensity by 36 per cent from 2005 levels and simultaneously cap its emissions by 2030. As a result, significant efforts have been made to decrease emissions, including the greening of the country's transport systems and buildings.[1]

It is no surprise that sustainability in Singapore's built environment is being taken very seriously. The country is aiming for at least 80 percent of buildings to achieve the Green Mark Certification[2] – a testament to environmentally-friendly living.

The role of concrete in reducing environmental carbon emissions is a notion that is beginning to reach new levels of awareness in the built industry. In fact, the built environment is in a prime position to address the emergency of climate change through the reduction of embodied carbon emissions from our buildings and infrastructure assets, according to the Bringing Embodied Carbon Upfront report published by the World Green Building Council (WorldGBC) in September 2019.

The built environment is responsible for 40 percent of global carbon emissions, with embodied carbon emissions being especially critical. Unlike operational carbon that can be saved over the lifetime of a building, embodied carbon emissions are produced during the development works before a building project is completed. These embodied emissions are produced throughout the supply chain of materials and systems used in the project. If embodied carbon emissions are not addressed before the building project moves past the design stage, there is no way for building owners to reclaim lost carbon savings once the building is constructed and subsequently used.

The breakdown of carbon emissions for buildings is typically 30 percent embodied carbon emissions versus 70 percent for carbon emissions due to building operations. In Singapore, where the lifespans of buildings tend to be shorter due to urban renewal, the embodied carbon emissions of buildings can constitute up to 40 percent of the total carbon emissions over the lifespan of the building.

Research and development work done by scientists at Pan-United's Innovation Centre has created more than 300 specialised concrete products. Among them is PanU Shield which reduces the thickness of concrete walls in hospital proton therapy rooms for cancer treatment (pictured below) from 6 metres to just 1.6 metres.

The upfront emissions from materials and products used to construct buildings and infrastructure, and those installed later during maintenance and renovation, usually represent a significantly greater source of embodied carbon than all other stages in the lifecycle. Globally, cement and steel are two of the most important sources of material-related emissions in construction. Cement manufacture is responsible for around 7 percent of global carbon emissions, with steel also contributing 7-9 percent of the global total, of which around half can be attributed to buildings and construction.

For one industry player, however, embedding sustainability in ready-mix concrete is a long-time passion that began way back in 2001. That was when Pan-United Corporation Ltd (Pan-United) – a SGBC Founding Member – started an in-

house research arm to develop high-performance concrete products that were commercially viable with sustainability at the core of its innovations. Since then, quite a few of the specialised concrete products were custom-developed in partnership with property developers and construction companies owners to achieve their green targets.

Pan-United has developed a suite of over 300 specialised concrete products, of which over a hundred satisfy its criteria of using either recycled or reused materials, or production processes that are sustainable. In 2017, it was the first concrete company to be awarded the highest "Leader" certification for at least 150 of its green building products under the Singapore Green Building Council's (SGBC) Singapore Green Building Product (SGBP) certification scheme. In 2019, Pan-United was also conferred the Leadership in Green

Scoring Green Marks with Sustainable Concrete Innovation

Building Product accolade under the SGBC-BCA Sustainability Leadership Awards 2019 for its onus on building a greener built environment.

Today, Pan-United continues to develop more concrete products that will upcycle waste and reduce CO2 emissions. For instance, Pan-United collaborated with the National Environment Agency (NEA) to design and produce a 3D-printed concrete bench using NEWSand, a material made from repurposed municipal solid waste slag. The bench was unveiled at NEA's Year Towards Zero Waste event in November 2019. NEWSand is undergoing trials for future road construction projects.

Pan-United's game-changing concrete technologies crossed a milestone in July 2020 when it signed on a collaboration deal with leaders from other industries – Chevron, Keppel Data Centres and Surbana Jurong – to combine resources to develop Singapore's first end-to-end decarbonisation process. With the support of the National Research Foundation, the four partners aim to accelerate the development of a carbon capture, utilisation and sequestration (CCUS) system that can contribute to a low-carbon economy. Since then, Pan-United has signed on more deals with other industry partners to develop cleantech solutions for urban infrastructure projects.

The NEWSand Bench sponsored by Pan-United was unveiled at the Year Towards Zero Waste event in November 2019. Seated on the bench from left are Mr Masagos Zulkifli and Dr Amy Khor, then the Minister and Senior Minister of State for the Environment and Water Resources, respectively.

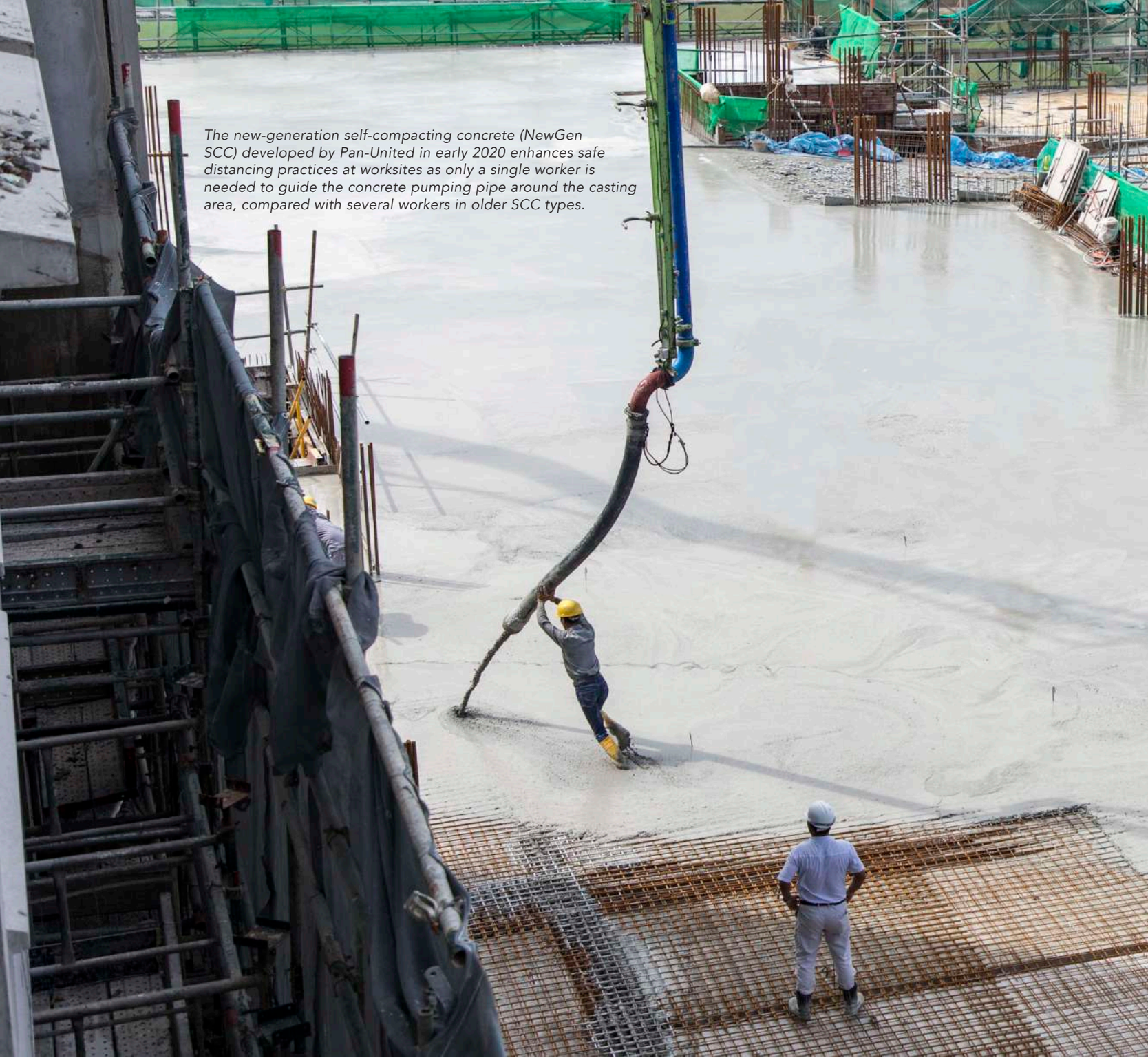
CAPTURING CARBON

Pan-United uses a carbon sequestration technology to trap CO2 in its concrete forever. This also increases the compressive strength of the concrete and enables less cement to be used. By partnering with Canada-based clean technology company CarbonCure Technologies to introduce this technology to Asia, Pan-United estimates that it can potentially reduce carbon emissions at each of its concrete plants by over 4,000 tonnes annually.

Such a breakthrough technology will go a long way to reduce the embodied carbon in the built environment. This refers to the carbon emissions released during the manufacturing, transportation, and construction phases of a building. As posited by the WorldGBC report on embodied carbon, these emissions are expected to be responsible for half of the entire carbon footprint of new construction.

Aiming to introduce this technology to other ready-mix concrete producers locally and regionally, Pan-United can spearhead an industry-wide movement towards decreasing carbon emissions from the manufacture of concrete.

Pan-United inked a strategic partnership with CarbonCure Technologies in November 2018 to use the Canadian cleantech company's carbon sequestration technology to produce sustainable concrete that is stronger and uses less cement.



The new-generation self-compacting concrete (NewGen SCC) developed by Pan-United in early 2020 enhances safe distancing practices at worksites as only a single worker is needed to guide the concrete pumping pipe around the casting area, compared with several workers in older SCC types.

BUILDING FOR THE NEW NORMAL

Pan-United developed a new type of self-compacting concrete called PanU NewGen SCC in early 2020 when the COVID-19 crisis brought the construction industry to a virtual halt. Compared with the original self-compacting concrete it developed in 2008, Pan-United's 2020 version is a specialised rheologic concrete that improves productivity by 75 percent while reducing casting time by 40 percent. Thus, construction is made faster even with better safe distancing of workers.

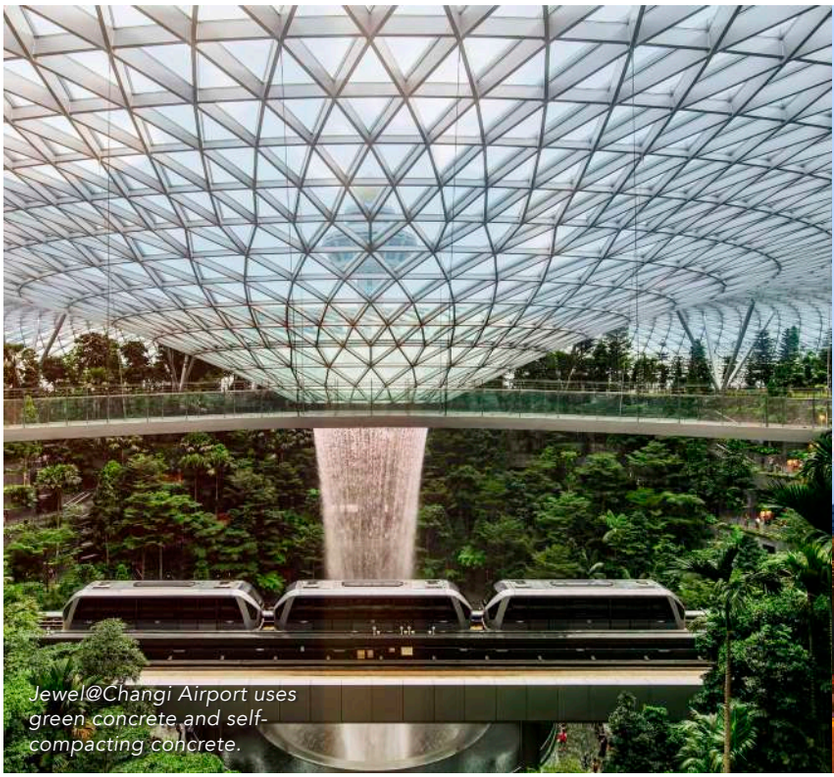
SCC behaves like a liquid, flowing easily and naturally on its own weight. It reaches and fills any position or formwork completely and uniformly. The concrete self-compacts and removes all air voids in the placed concrete. Noise-pollutive mechanical compactors are no longer needed, making it ideal for high-density residential or commercial locations where noise levels must be minimised.

The multi-purpose properties of SCC meet exacting demands for high strength and durability. This supports load-bearing structures such as skyscrapers. It also allows construction workers to work more efficiently: only a single worker is required to guide the concrete pumping pipe around the slab area, instead of many more concreting workers manually compacting the concrete into place.

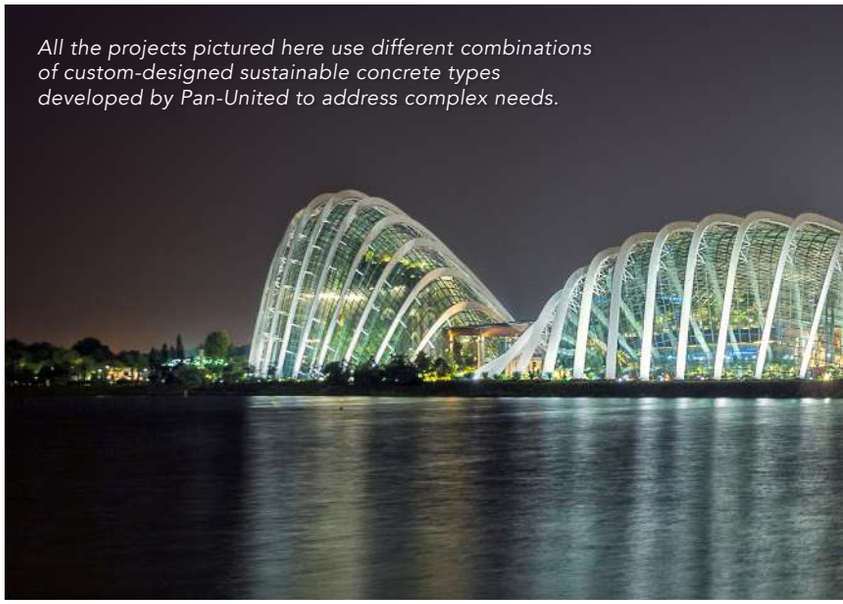
SCC has been used in many notable projects in Singapore, including the iconic Jewel Changi Airport, Gardens by the Bay and Tanjong Pagar Centre, the tallest building in Singapore. It has also shaped other towering skyscrapers such as Landmark 81 in Ho Chi Minh City, the tallest building in Vietnam standing at 462 metres high. These are by no means small developments, and casting any formwork for these developments must be done in a single continuous pour of multiple batches of consistent quality concrete.

The raft foundation for the Tanjong Pagar Centre, the tallest building in Singapore, has 13,500m³ of self-compacting concrete, enough to fill 5 Olympic swimming pools.

During casting, batches of wet concrete mix must be delivered to the worksite continuously and successively, and in a just-in-time manner. To achieve this delivery precision, Pan-United leverages its operations optimisation platform called AiR, Artificial Intelligence for Ready-Mix Concrete, the only one of its kind in Singapore's concrete industry.



Jewel@Changi Airport uses green concrete and self-compacting concrete.



All the projects pictured here use different combinations of custom-designed sustainable concrete types developed by Pan-United to address complex needs.

For instance, during the construction of Tanjong Pagar Centre, the AiR platform optimised the entire supply chain from end to end, ensuring an uninterrupted convoy of one truck every 90 seconds to deliver the wet mix. The single continuous mass pour was achieved in less than two days what would normally have taken over six days to complete.

The lightweight concrete roof of Changi Airport Terminal 3 allows the use of slim pillars, maximising indoor space.

Landmark 81, the tallest building in Vietnam, uses temperature-controlled concrete, early-strength concrete and self-compacting concrete.

The iconic Gardens by the Bay uses green concrete for its two superdomes.

THE WAY FORWARD

Pan-United firmly believes that industry transformation and disruption are inevitable. Using its twin strengths of an innovation culture and strong technology capabilities since its early days, the company is building on its sustainability initiatives to catalyse a national impact in the built environment industry, both Singapore and globally.

Going green is clearly the way forward.

Resources:

1 https://www.straitstimes.com/forum/letters-in-print/spore-taking-range-of-actions-to-cut-carbon-emissions

2 https://www.visitsingapore.com/mice/en/bulletin-board/leading-the-way-singapores-sustainable-future/overview/


PLQ
Hello
everywhere

KNOWLEDGE-SHARING IS THE KEY TO ADVANCING SUSTAINABILITY PRACTICES

By facilitating the sharing of our sustainability and placemaking approach with industry peers and students alike, the launch of the "People Places Planet" experience portal acts as a catalyst for wider community debate, dialogue and action.

The road to embedding sustainability in the building and construction industry's future is paved with knowledge.

In conjunction with World Environment Day in June 2020 SGBC Member Lendlease launched an interactive knowledge-sharing platform, the 'People Places Planet' experience portal, to showcase the placemaking and sustainability best practices behind our landmark urban regeneration development, Paya Lebar Quarter (PLQ).

Central to this online learning tool is how Lendlease's vision of revitalising urban spaces and creating vibrant, sustainable spaces comes to life at PLQ. Through the portal, students and industry peers will have the opportunity to observe PLQ's role as a key catalyst in the transformation of Paya Lebar into a bustling, pedestrian-friendly, new city precinct with a distinctive sense of place and cultural identity.

CREATING THE BEST PLACES FOR PEOPLE TODAY AND THE GENERATIONS TO COME

A mixed-use development, PLQ seeks to transform the Paya Lebar district into a bustling, pedestrian friendly precinct and business hub. Combining workplaces, commercial and retail outlets with lush green residences, PLQ seamlessly melds each component within the greater vision but still allows for their respective characteristics to effortlessly shine through.

As a development certified to the highest-possible Platinum rating of the Singapore Building and Construction Authority's Green Mark Scheme, PLQ's onus on sustainability can be felt throughout the property. Numerous green building features and innovations can be found in PLQ, such as the usage of super high efficiency chiller systems that make use of artificial intelligence and real-time data to optimise performance, high performance facades that reduce heat gain while improving air conditioning efficiency as well as boosts thermal comfort for occupants as well as specifying only LED energy efficient lighting for the entire precinct. Paints, sealants and adhesives with low volatile organic compound (VOC) levels are used in the development to keep the indoors healthy for all occupants, and exhaust ducts installed with filters clean the air from PLQ before being released into the environment.

Green leases are also offered by Lendlease to help tenants ensure that their office fit-outs reduce waste as well as energy and water consumption. PLQ's generous cascading rain gardens and drainage cells filter and purify stormwater runoff, and the development is Singapore's first mixed-used private development to receive the Active, Beautiful, Clean Waters Certification by the Public Utilities Board.

PEOPLE FRIENDLY SP
We have spacious pub
with accessible walkw
generous seating.

LOW-ENERGY COMFORT
Our giant fans provide a welcome, light breeze at PLQ Plaza and Park Place Residence.

MEETING PLACE
Many community activities take place at this large canopy.

SOLAR POWER
In 2020, we'll install PV cells on our retail rooftop!

ORGANIC WASTE DIGESTER
Diverts food waste from landfill and incineration.

ABC WATERS CERTIFIED
- Terraced rain gardens
- Green roofs
- Sky gardens
- Vertical greenery

INNOVATIVE SOLUTIONS
Cascading rain gardens and drainage cells slow down the stormwater discharge rate to mitigate floods and help purify the water.

FIRST IN SINGAPORE

TO ACHIEVE PLATINUM RATING FOR BCA GREEN MARK FOR NON-RESIDENTIAL BUILDINGS (2015 CRITERIA)

TO RECEIVE PUBLIC UTILITIES BOARD'S ABC WATERS CERTIFICATION (PRIVATE MIXED USE DEVELOPMENT)

TO REGISTER FOR THE IWBI WELL CORE AND SHELL CERTIFICATION

SUPPORTING LOCAL TALENTS

WORKING WITH LOCAL DESIGNERS AND SERVICE PROVIDERS

WORKPLACE APP

CAN FACILITATE FORMING OF SOCIAL GROUPS FOR EXERCISE, LEISURE AND MORE

KNOWLEDGE SHARING

WE'RE COMMITTED TO BE A LEARNING PARTNER TO EDUCATIONAL INSTITUTIONS

43,000+

TRAINED ON ENVIRONMENT, HEALTH & SAFETY AS PLQ WAS BUILT

OVER 300%

MORE TREES PLANTED THAN WERE ORIGINALLY ON SITE

OVER 30%

ENERGY SAVINGS ACROSS THE PRECINCT


PACES
lic areas
ays and
SUPER HIGH EFFICIENCY PLANT ROOM
Our chiller plant room utilises AI and real time data to stay highly efficient.
ACTIVE COMMUTE
End-of-trip facilities and to-the-door bike paths encourage active and carbon free commutes.
EXPLORE NATURE
With seamless links to the park connector network.
SHELTERED WALKWAY
This elevated pedestrian network connects the whole of PLQ!
FLEXIBLE WORKSPACES
We cut fitout wastage by dedicating 14% of our office space to flexible, pre-fitted workspaces.
NEW BEGINNINGS
From a Banyan tree originally on site, we cultivated over 40 saplings, donated 30 to Jurong Lake Gardens and replanted 5 in PLQ.
FLOOD PREVENTION
We expanded this canal that runs through PLQ, increasing its capacity to handle peak water levels.

PLAYING OUR PART THROUGH ACTIVE KNOWLEDGE-SHARING

Seeking to give back to the community by sharing knowledge around the considerations behind placemaking and the role that sustainability plays, it is in the spirit of education that Lendlease launched the free-to-use "People Places Planet" experience portal.

The People Places Planet experience portal was designed with the understanding that schools in Singapore are interested in applied learning opportunities that offer hands-on, experiential learning for students to situate and apply their knowledge in a real-world context. As an interactive website resource, the portal also offers students an engaging technology-enabled learning experience complemented by the use of animations, videos, and interactive components.

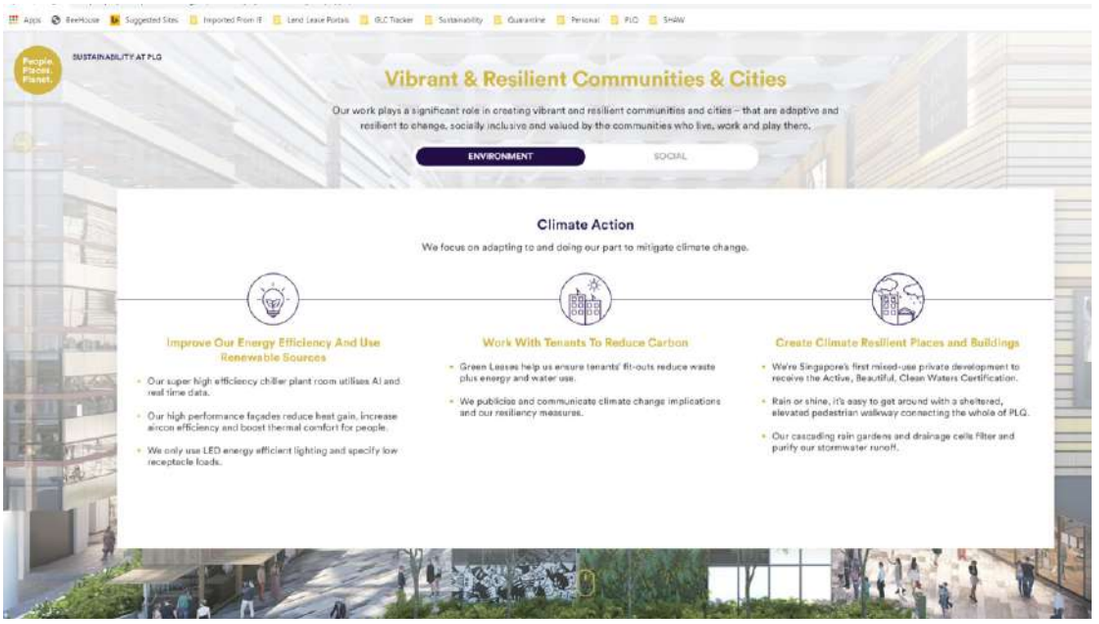
Through the online platform, Lendlease seeks to spark industry peers' interest in sustainable solutions for their future projects. By taking them through the design-thinking process, the portal serves to precipitate industry discussions on place creation with a people-first thinking and on improvements in urban planning.

By cultivating students' and industry peers' interest in sustainability through active knowledge-sharing, society as a whole comes one step closer to securing the future for generations to come.

Some of PLQ's consultants including DP Architects, Meinhardt, Kaer, Grant Associates and Web Structures, also contributed to this learning offering.

Visit https://www.peopleplacesplanet.com.sg/ to access the People Places Planet experience portal. Individuals can register their interest for a site tour to continue their learning journey at PLQ.*

**Tours are temporarily suspended in view of social distancing guidelines arising from the COVID-19 pandemic. Register your interest and be notified on a later date when the tours are up and running!*



People. Places. Planet.

Case Study Worksheet

Cultivating and Enabling a Sustainability-Conscious Community

1. Why did Lendlease rally its stakeholders to play a part in its Sustainability Vision?
2. What initiatives did Lendlease embark on with its tenants as part of this sustainability journey?
3. How is food waste treated in PLQ? Why is it important for PLQ to do this? What impact will this food digesting system have on Singapore's waste situation if many more building managers implement them?
4. How can food waste processing be implemented in your school? Make a few suggestions. Do you think it is better to first discourage food wastage? Why?
5. PLQ has an education corner to encourage people to take immediate action in adopting zero-waste lifestyles. What do you think you can do at home with your family and friends to lead a zero-waste lifestyle?
6. What did PLQ do to reduce its energy consumption in the precinct? (Hint: explore the portal's Sustainability section too.)

Join the Green Building movement

SINGAPORE GREEN BUILDING COUNCIL

- Connect with Green Building leaders
- Access industry trends and developments
- Gain exposure to the Green Building marketplace
- Exclusive discounts for events and SGBC certification

+65 6732 5518 membership@sgbc.sg www.sgbc.sg

Established Member of WORLD GREEN BUILDING COUNCIL

ENSURING A SAFE RESTART

Potential issues in the workplace post Circuit Breaker may be detrimental to reoccupying occupants.

As Circuit Breaker restrictions ease and businesses reopen in Singapore, there is another series of problems apart from the risk of COVID-19 cross infection that need to be addressed.

During preliminary checks carried out in workplaces scheduled to reopen following the 2-month period of closure, some problems of significant concern have been discovered within the working environment:

1. **Disinfection Methods** - Antimicrobial Protection Chemicals – Leaching vs non-leaching, which is better?
2. **Mould Issues** - Growing prolifically on hard and soft fabric surfaces
3. **Odour/ Smell** - Chemical/residual odour/musty smell due to mould presence
4. **Air Quality** - Suspended particles in the air which includes a high presence of mould spores and residual chemicals used during disinfection.
5. **Stains** - Visible stains on carpets, furniture, walls and fabric panels

Although facilities are planning a phased re-opening and occupancy, the challenge is to maintain the facility to an appropriate standard of hygiene and occupational health & safety until the entire space is fully re-occupied.

Here are some guidelines and suggestions to address these issues.

DISINFECTION CHEMICALS AND METHODS

Back in February 2020, during the onset of COVID 19, it was imperative to carry out the disinfection with the effective and approved chemicals. With urgency and fear lurking present in the initial days, it was confusing for many to grasp which chemicals were effective and which were not.

Obviously, the last thing on anyone's mind at that time was if these chemicals would have any long-term impact on their buildings. Now, when it is time to re-occupy the spaces, the question has become: what happens to the compound we spray in our office for disinfection? Where does it go? What impact does it have on assets? Furthermore, in enclosed air-conditioned spaces, some of the impacts now being noticed are due to the spraying of chemicals causing the bleaching of fabrics, the etching of leather and varnish as well as corrosion on metal finishes. These are all drawbacks from the inappropriate use of disinfectant which have been overlooked during the initial period of this pandemic. To understand the reasons for this oversight, it is important to be aware of the list of disinfectant chemicals approved by the Centre for Disease Control (CDC). Based on this information and years of experience, we have also listed the chemicals that can be used appropriately in office, schools, hospitals or common areas.

List of CDC approved disinfectants

- **Alcohol**
- **Chlorine and chlorine compounds**
- **Quaternary ammonium compounds**
- **Hydrogen peroxide**
- **Phenolics**
- Formaldehyde
- Glutaraldehyde
- Iodophors
- Ortho-phthalaldehyde (OPA)
- Peracetic acid
- Peracetic acid and hydrogen peroxide

In some countries, the use of **hydrogen peroxide** or chlorine-based chemicals is popular for both indoor and outdoor applications. Both chemicals react fast, are effective but if used inappropriately can be highly corrosive. Others are using **Quaternary Ammonium chloride** (QAC) compounds, again these are fast, effective and non-corrosive which is a very favourable for many applications. **Alcohol** (although comes with the issue of fire safety) is still being commonly used for hand sanitising and the disinfection of materials because of its low cost, ready availability and comparative safety in use on hands and articles. Fewer are using **phenolic** compounds which is a good disinfectant but leaves a very high level of residual odour. The remaining chemicals in the above list are less popular for several reasons like availability, safety in handling and their complexity of use. Some of them are very effective when appropriately used in the healthcare industry under strict guidance.

Returning our attention to the important aspect of the post disinfection environment and what happens to the compounds we spray in our offices for disinfection. After the initial period of microbicidal activity we need to be aware of the **'residual properties'** of the disinfectant compound. It may evaporate, convert to other compounds or remain in the treated space either suspended in the air or stuck to the surface to which it was applied. For example:

Alcohol based disinfectants - react (coagulation of microbes) quickly with microbes and after destroying them the residual compound evaporates leaving only destroyed microbes and dust on the surface. This is a clean method with virtually zero residual activity within minutes of application. Hence, best for hand sanitising or the quick sanitation of personal articles like phones, wallets or bags.

Chlorine based disinfectants - react quickly with microbes and oxidises them. They leave oxides behind which are not harmful but when they react with other compounds in the workplace, they leave unwanted oxides of corrosion. These oxides may also become suspended particulates in the air and compromise the overall air quality.

Quaternary Ammonium Compounds (QACs) – react slightly slower to microbes as compared to chlorine-based chemicals, but they react only with the microbes and destroy them by physically damaging the cell membrane, inhibiting the growth of any microbes. The residual QAC molecules that do not actually react with any organic material or microbes may remain free in in the environment. These free residual molecules can continue to kill microbes for as long as they remain intact on the surface.

QAC compounds are sold in two varieties. They are either **Leaching** (meaning they do not bond with any surface) or they are **Non-leaching** which means they can bond chemically with the surface being treated. Therefore, we have to ensure that the correct variety is appropriately applied.

Leaching compounds: compounds that when sprayed onto any surface will remain on the surface or suspended in the air for some time. They do not have any bonding properties. With simple dusting or light agitation due to wiping they can be dislodged from the surface and become airborne. Although they are active even when they are airborne or lying on a surface, leaching compounds are less popular because there is a risk of them being inhaled by building occupants whilst they are suspended in the air.

Non-leaching compounds: QAC compounds blended with (Silane) molecules that provides the QAC with a unique bonding property, so that it sticks to the surface intended to be disinfected and can remain active without being dislodged. These compounds are becoming very popular, in office spaces, childcare centres, schools, ATM machines and especially for medical devices and healthcare institutions as they remain bonded with their antimicrobial properties intact on the intended surface. Non-leaching compounds (nowadays popularly known 'Self-disinfecting coatings') are one of the recommended disinfectants for offices, schools and highly populated spaces. It is therefore recommended to look for non-leaching antimicrobial compounds for your disinfection and protection.

MOULD GROWTH

During the Circuit Breaker period, there were several measures taken to save energy from air conditioning and mechanical ventilation (ACMV) equipment. Some companies reduced the number of air changes per hour in their workplaces, some increased the chilled water temperatures, some reduced the air-conditioning operating hours. While all these measures may have saved energy, some also compromised the overall safety and wellbeing of the indoor environment.

For example, stale air coupled with higher humidity is a conducive environment for mould growth. In such environments, the residual mould spores in the air will settle on a moist surface and proliferate extensively. Many premises visited following a few weeks of lockdown were found with bad odour, mould growth and stains.

It is important to understand that in any working space, a human touch usually leaves behind an organic residue that is extremely conducive for the reproduction of settled mould spores. This can be seen on walls, behind wallpaper, on leather couches, upholstery, cabinets, coats, clothing and inside of wardrobes. Even leather bags, purses or shoes left in an office have been seen covered with extensive mould growth.

Although some species of mould may not be very harmful, there are many varieties that produce

toxins which can pose serious threats to the wellbeing of the occupants. Where extensive mould growth has occurred, it is strongly recommended not to simply wipe down the affected surfaces and start using the offices again. It is better to have the damage assessed by a professional and have the necessary remediation carried out using the proper tools and protocol. A post remediation test is usually suggested to ascertain any residual levels of contamination on the affected surfaces.

AIR QUALITY - SUSPENDED PARTICLES IN THE AIR

One positive environmental outcome observed during the pandemic lockdown was that the air quality became pristine again from March to the end of May 2020. The global air quality index (AQI) was in the green! This is a remarkable testimony of what can be achieved in a very short duration if governments and corporations decide to implement strict air pollution control measures. However, while the outdoor air quality was becoming pristine, the IAQ (indoor air quality) of building spaces that had been closed for long periods had deteriorated significantly. The primary reason for this poor air quality was the inability of the installed ACMV systems to cater to the reduced loading levels of air conditioning required coupled with the inability to run the systems with additional fresh air and ventilation. This resulted in **higher humidity** levels being retained in buildings **and an excessive amount of chemicals/ disinfectants being sprayed**.

To ensure that indoor hygiene was maintained, most buildings continued to run air conditioning either partially or intermittently. While this strategy was partially correct, ACMV operational parameters were not set properly in a few places, which resulted in high Rh (relative humidity) of the stagnant air. With the high humidity levels remaining trapped within buildings, the proliferation of mould growth followed with increasing spore counts and its associated risks.

In some instances where frequent and inappropriate disinfection was carried out, the residual chemicals and products of corrosion have remained suspended in the air. These particles will continue to circulate in the workplace because the normal AHU and FCU filtration are not able to arrest this size of suspended matter in the air. These additional particles suspended in the air can be inhaled by the building's occupants, creating a further risk to their safety. It is highly recommended for indoor air quality to be checked and that suitable measures for purging, filtering and cleaning of indoor air is carried out before the buildings are re-occupied.

ODOUR MANAGEMENT

Most unwanted unhealthy odours in an enclosed space or building may be taken as an indication of organic decomposition within that space. Perhaps from the decay of discarded food debris or from dead vermin. The increase of microbial growth,

including mould on the surface of decomposing organic materials, causes unpleasant odours. High humidity levels in rooms can also cause fabrics such as carpets and upholstery to support microbial growth and create foul smells.

Conditions that exacerbate the process include:

1. **Stale air** - stale air has fewer negative ions and encourages microbial growth resulting in the formation of toxins and odours.

2. **Organic residues on surfaces** - in the absence of fresh air and ultraviolet light from the sun, organic residues will begin to decompose resulting in foul odours.

3. **Mould growth** - high humidity levels, a lack of sunlight and the absence of air circulation encourages mould proliferation. When mould is active and multiplying, large quantities of toxins are creating exposure risks to the occupants.

The solution to address such presence of odour involves a 3-Step process: **Audit > Remediate > Test**.

Audit is recommended to identify the source of the odour. Remediation including the removal of the source followed by air purification as well as sanitising all ACMV ducts is suggested. Sometimes, the odours can be absorbed by porous building materials and a proper remediation protocol is required to ensure the source of the odour is completely eliminated. It is highly recommended that professionally qualified IAQ Consultants are employed to assess the situation and propose a suitable remediation plan.

STAINS ON FABRICS, CARPETS, FURNITURE, SIDE PANELS

High touch areas like sofas, chairs, table-tops, cabinets, curtains and side panels are usually full of microbes that are transferred from our hands to the surface. In normal conditions, these microbes are removed during routine cleaning. In the absence of this cleaning and due to the creation of a conducive environment caused by the lack of ACMV operations, these microbes start to multiply exponentially. This growth causes decolourisation and staining. While some of the stains may be able to be removed by remediation companies, it should be noted that often the material has been compromised and will remain permanently stained. However, professional restoration companies may be in a position to restore some of these fabrics or surfaces to their original condition based on the intensity of the stain.

Therefore, it is highly recommended that during periods of inactivity, all 'at risk' items of furniture are to be cleaned, completely dried and packed within airtight coverings. However, if there is the possibility for the space to be lightly ventilated while allowing for sunlight, the furnishings can be simply covered with normal sheets after thorough cleaning and drying. Running a dehumidifier periodically can also reduce the risk of mould growth and any stain formation on upholstery. Lastly, use of antimicrobial coating on such surfaces also prevents growth of mould.

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The SGBC Green Mark Professional Qualification Scheme succeeds the BCA Green Mark Specialist programme and aims to uplift, upskill and recognise green building competencies of professionals in the built environment sector.

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The Green Mark AP certification qualifies industry professionals with the knowledge and expertise needed for the development of Green Mark projects.

- **Green Mark Accredited Professional** *(Green Mark AP)*
- Green Mark Advanced Accredited Professional *(Green Mark AAP)*

Green Mark AP (FM)

The Green Mark AP (FM) certification qualifies industry professionals with the knowledge and expertise needed to maintain and operate green buildings.

- Green Mark Accredited Professional (Facilities Management) *[Green Mark AP(FM)]*
- Green Mark Advanced Accredited Professional (Facilities Management) *[Green Mark AAP(FM)]*

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Renewal requirements **for Green Mark AAP and Green Mark AAP (FM)**	**18** SGBC-GMAP CPD Points

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Frequently Asked Questions

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