Whitepaper on Green Building Adoption in Singapore

Accelerating Adoption of Green Building Solutions through Public-Private Partnerships

Executive Summary

This whitepaper aims to put forth public-private partnerships as a vital tool to accelerate the procurement and adoption of green building solutions in Singapore. The proposals focus on common priorities and leverage stakeholders' strengths to co-develop solutions and industry best practice stowards the common 80-80-80 target of the Green Building Masterplan. By pulling capabilities together through partnerships, the industry can maximise resources and reduce duplication of effort. The following opportunities have been identified as possible first steps towards even greater collaboration in the future.

(1) Partnership opportunity:

Pair government grants to Proof of Concept (POC) projects to enable building owners to test and validate green building solutions for retrofit projects before full implementation.

(2) Partnership opportunity:

Co-develop a central portal as a common repository for products, solutions, training programmes, grants and financing options for the building industry to meet prevailing environmental sustainability standards.

(3) Partnership opportunity:

Co-develop awareness campaigns on common priorities, such as the impact of carbon tax for building owners, updates on government initiatives, available training programs, and certification process for the Green Mark 2021 standard.

The public sector can take a leading role and include representatives from building owners, operators, developers, technology companies, system integrators, consultants, Institutes of Higher Learning, certification bodies and industry associations. By co-developing projects like a central portal and awareness campaign through this partnership, expertise can be amalgamated to meet specific needs effectively while minimising abortive work.

The Singapore Green Building Masterplan has set a course for the built environment in Singapore, guiding the industry onto a common journey, which can form the basis of the public-private partnership. The proposals in this whitepaper suggest opportunities to formalise partnerships and take actionable steps towards common targets. Together, we can unite the industry's diversity for a stronger effort on greening the built environment in Singapore – the choice is not "if" but "when" to take the first steps in establishing these partnerships.


SINGAPORE
GREEN
BUILDING
COUNCIL

Singapore Green Building Council Introduction and Background

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 World Green Building Council, decarbonisation of the built environment is one of the most cost-effective ways to mitigate climate change. With the global building stock expected to double in order to accommodate the world's projected population of 10 billion, this growth will contribute to an expected doubling of the global consumption of raw materials by around the middle of the century, significantly increasing the building and construction sector's emissions and climate impact.

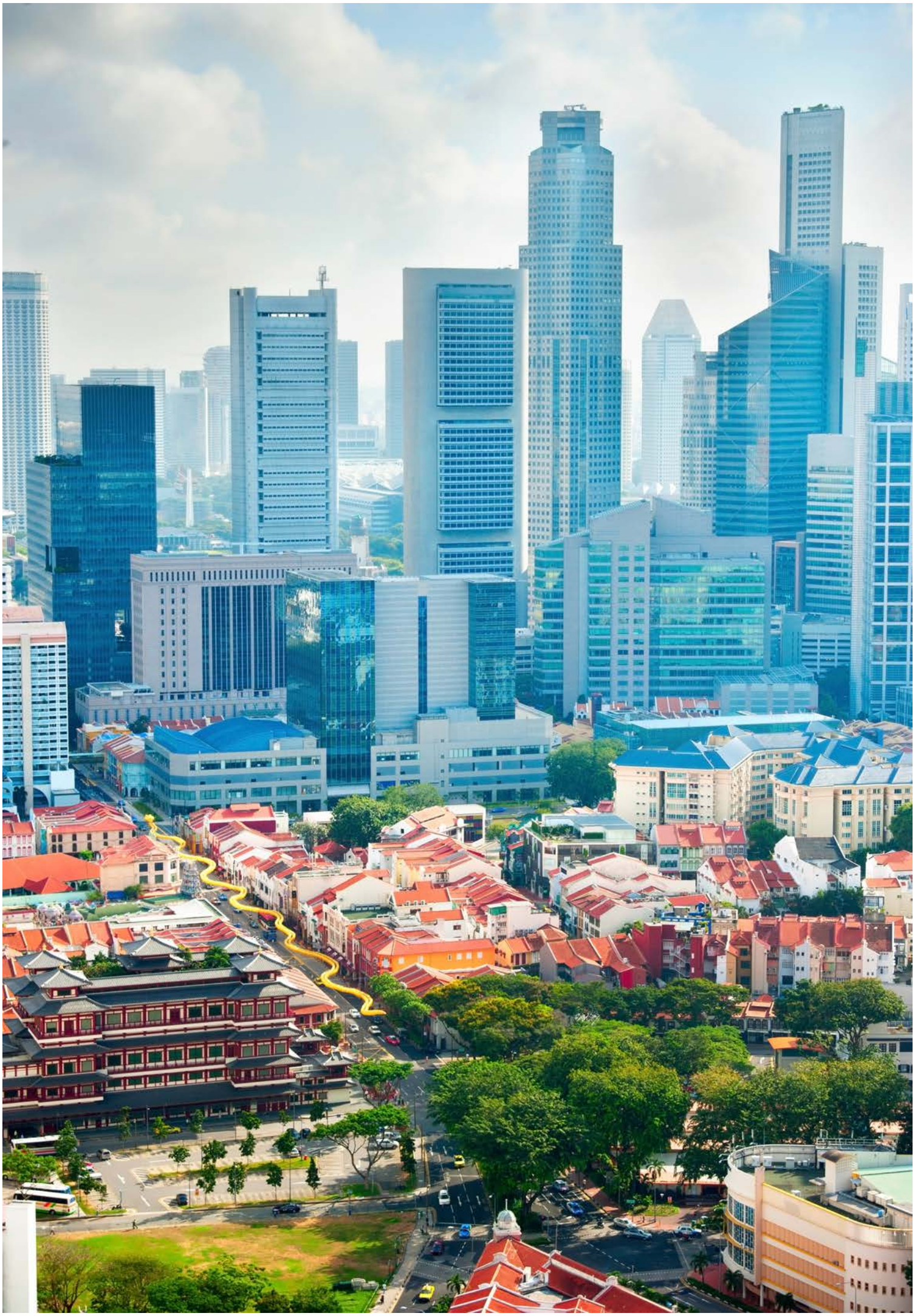
The latest report from the Intergovernmental Panel on Climate Change (IPCC) has warned that current national pledges are not ambitious enough to stop global warming from exceeding 1.5°C. This is a clear reminder that the industry must act, and must act now. While there is a small window of opportunity to stabilise global temperatures below 2 degrees by implementing stringent emissions cuts this decade to result in net-zero emissions by 2050, the urgency is on as this window will become smaller and smaller for each year without concrete climate action.

In 2019, Prime Minister Lee Hsien Loong specifically spoke about sustainability in his National Day Rally speech, where he likened the importance of climate change adaptation to national defence. This now rings true more so than ever before. On 31 March 2020, Singapore submitted our Long-Term Low Emissions Development Strategy (LEDS) to the United Nations Framework Convention on Climate Change, building on existing aspirations to halve our emissions from its peak to 33MtCO2e by 2050, with a view to achieving net zero emissions as soon as viable in the second half of the century. Having greener, more efficient buildings will help Singapore achieve its climate ambitions. This also ties in with Singapore's Inter-Ministerial Committee on Sustainable Development's (BCA) target of having at least 80% of the buildings' gross floor area (GFA) in Singapore to be green by 2030. As of end 2021, Singapore has greened 49% of the built environment.

More recently in February 2022, Singapore has raised its climate ambitions to reach net zero emissions by 2050 (NCCS, Singapore will raise climate ambition, 2022), a major step up from the previous long-term goal to achieve net zero in the second half of the century. As the built environment is responsible for more than 20% of the country's carbon emissions, the built environment must urgently accelerate sustainability principles - enabled by green building technology - to make a net zero impact on the nation's carbon aspirations.

Co-created by the Building and Construction Authority (BCA) and SGBC, the Singapore Green Building Masterplan is part of the Singapore Green Plan 2030, the national's collective effort to advance the agenda on sustainable development. The SGBMP aims to deliver three key targets of "80-80-80 in 2030":

1. Stepping up the pace to green 80% of our buildings by 2030
2. 80% of new developments by GFA to be Super Low Energy (SLE) buildings from 2030
3. Achieving 80% improvement in energy efficiency for best-in-class green buildings by 2030



Enabling Sustainable Procurement

The public sector is supported by industry associations, such as the Singapore Green Building Council (SGBC), to raise awareness of green building. Since 2009, SGBC has advocated for greener, healthier products, solutions, practices and operations, amalgamating sustainability expertise across the building and construction value chain.

One of the most important programmes is the Singapore Green Building Product (SGBP) Certification Scheme. The only industry-centric certification scheme for green building products and materials, the Singapore Green Building Product (SGBP) certification scheme aims to aggregate and amass a wide selection of green building materials for the industry through a comprehensive and holistic methodology. Working in collaboration with both the public and private sectors, each product's sustainability criteria is drafted by professionals and experts for the industry, by the industry.

The SGBP Certification Scheme covers a wide range of products and assesses them based on their sustainability performance. Environmental and health impacts can occur across a product's lifecycle, from raw material extraction or cultivation, through manufacturing, use and end-of-use management. The SGBP Certification Scheme looks at the whole lifecycle of products to account for the full impact.

The SGBP assesses products and materials on their sustainability performance. The assessment criteria is categorised into common criteria which apply to most products and specific criteria which apply only to relevant products. For some products, the assessment against criteria covers the whole product lifecycle, while for other products, the assessment criteria focuses on a select few lifecycle stages across raw material extraction or cultivation, manufacturing, distribution, use, and end-of-use. This grounded methodology enables building products to be impartially evaluated for their relevant, noteworthy qualities, benchmarked against similar products in its category.

For some products, the applicant will need to show proof of laboratory test results or other documentation to verify the product's alignment with some criteria. After the assessment, the certified product will be awarded a rating between 1 and 4 ticks, based on its performance. 1 tick indicates good performance, while 4 ticks indicates leading industry performance.

Enabling Sustainable Procurement

This rating level differentiates the environmental and sustainability impact of the certified product, a testament of the product's environmental performance. SGBC maintains a list of Lab Partners on its website that can help companies obtain the necessary test reports as required by the criteria.

The SGBP is one of the key standards and benchmarks for green building products in the building and construction industry. Products and materials certified by the SGBP are highly recognised under the Green Mark Scheme, Singapore's national green building rating tool administered by the Building and Construction Authority (BCA), which allows certified products to accrue points that count towards a project's Green Mark rating. The more highly rated a product is under the SGBP Scheme (i.e., the more ticks it has achieved), the more points are awarded towards the Green Mark rating.

SGBP Certification Scheme is also widely accepted by regional green building rating tools for its coverage of product's sustainability performance. Examples include GreenRE, a rating tool set up by the Real Estate & Housing Developments' Association (REHDA) of Malaysia, and LOTUS, Vietnam Green Building Council's rating tool. The SGBP complies with the requirements in ISO 14024 Environmental labels and declarations — Type I environmental labelling.

The SGBP Certification Scheme is similar to internationally leading eco-labels, such as Cradle2Cradle, DECLARE, Global Green Tag, Good Environmental Choice Australia, Korea Environmental Industry and Technology Institute. Future versions of the SGBP may provide additional recognition for products that excel in addressing social issues, circular economy, and low embodied carbon, and reorganise the Scheme's governance to allow for products certified under our Scheme to be recognised under other eco-labels.

Easing into Green Retrofits

Energy performance contracting (EPC) is a proven way to ease the financial pressures of building energy retrofits. EPC is a method for retrofitting existing buildings by using guaranteed operational energy savings to pay for the upgrades. For EPC retrofits, building owners are assured that the retrofits are effective and generate enough cost savings to pay for itself. Savings can be generated from reduction in use of electricity, fuels, water and/or wastewater. Building owners can focus on other aspects of the business while leaving building energy efficiency and performance to the professionals.

Turnkey services offered by EPC firms include helping owners design retrofit solutions to achieve the desired level of Green Mark certification (e.g. to meet requirements for aircon system efficiency, Singapore Standards 554 Indoor Air Quality standards, etc), as well as to apply for applicable government incentives /grants. In addition, EPC firms can advise owners on the latest technological advancements for higher sustainability targets.

For EPC projects where the building owner takes on a bank loan, the loan amount is usually capped at up to 90 percent, with an upfront payment of 10 percent or above. However, for EPC projects with zero capital partnership arrangements, no capital outlay is required by the building owner, as the EPC firm will arrange for and bear the financing needed (i.e. any loans will not be on the balance sheets of the building owner). This ensures that building upgrades are not deferred due to competition of capital against other allocations, and hence avoid incurring higher operating costs over time. Should utility costs rise, EPC projects will also provide additional cost savings. There is the option to include maintenance works in the EPC contract to sustain long term operational savings, where most EPC firms are able to offer such services as well.

SGBC accredits energy performance contracting firms under the Singapore Green Building Services (SGBS) certification scheme to facilitate energy efficiency retrofits with confidence. Evaluated and assessed based on track record, financial net worth, EPC project amount and bizSAFE accreditation levels, these EPC firms will be able to help building owners implement sound and fruitful building retrofit arrangements.

Additionally, SGBS-certified EPC firms can help green building projects gain bonus points if the firm has been engaged to implement suitable projects that guarantee operational system efficiency over a minimum of 3 years (Green Mark 2021, Section RE 2.1b).

Easing into Green Retrofits

Owners of smaller building developments may not have the capital and technical expertise necessary to implement energy efficient retrofit projects on their own, deterring them from greening their buildings for greater efficiency and reaping substantial cost savings. The SGBC-BCA Zero Capital Partnership Scheme addresses these critical concerns by providing the building owner with the expertise of an SGBS-accredited energy performance contracting (EPC) firm. The EPC firm serves as a one-stop solution for both minor and major retrofit options, provide financing options and also facilitate the application of relevant grants or incentive schemes to fund the retrofit works.

Through the Scheme, the building owner can work with a proven EPC firm achieve greater energy efficiency with zero capital outlay. In May 2016, the Scheme was launched to cover chiller plant retrofits. In September 2017, the Scheme was expanded to also cover lighting retrofits, lighting being the second heaviest consumer of energy in buildings. The Scheme first identifies and accredits lighting retrofit firms that are able to provide lighting-related energy efficiency retrofit solutions with financing options, including leveraging on BCA incentive schemes, for zero capital outlay. Essentially, building owners and occupants do not have to pay for the retrofit works. Similar to the Chiller Plant Retrofits category, the Scheme will help building owners, tenants and occupiers to tap on the proven technical expertise of such accredited lighting retrofit firms to carry out lighting-related energy efficiency works without any upfront financial expenditure.

Through the Scheme, buildings and premises will be able to ease into lighting retrofit arrangements for greater energy efficiency towards Singapore's green targets.

Lowering Embodied Carbon

The built environment is responsible for 40 percent of global carbon emissions, with embodied carbon emissions often being overlooked. Embodied carbon emissions are associated with the full supply chain of all materials and systems put into any built environment project and cannot be improved over the lifetime of a building, unlike operational carbon emissions. If embodied carbon emissions are not addressed before the building project moves past the design stage, there is no way 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. 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.

To bring attention to this important issue and the built environment sector's influence on embodied carbon emissions, SGBC launched the Singapore Built Environment Embodied Carbon Pledge in August 2021 to help unify and amplify industry action.

Organisations with ambitions, intentions and solutions to address built environment embodied carbon emissions can pledge their commitment and then take broad-based actions anchored on the Pledge's 3 key principles:

1. Opting for building materials with lower embodied carbon

2. Minimising materials usage and wastage through collaborative design and optimisation

3. Transforming construction site processes to utilise electricity and renewable sources of energy

Lowering Embodied Carbon

SGBC is supporting Pledge signatories through the following:

1. Enable access to carbon-centric knowledge and expertise from SGBC Member companies and WorldGBC resources.

2. The Singapore Green Building Product (SGBP) certification scheme will transit towards carbon emissions data in assessment criteria, beginning with high impact materials such as concrete and steel.

3. Developing an Embodied Carbon Calculator and Embodied Carbon Baseline for the local context

Close to 100 organisations across the building and construction sector have signed the Singapore Built Environment Embodied Carbon Pledge, signalling strong industry impetus to address built environment embodied carbon emissions. The signatories of the Pledge include the Singapore Ministry of National Development, government agencies, building developers and owners, consultants and specifiers, builders and contractors as well as manufacturers and solution providers.

The revised Green Mark scheme (GM: 2021) implemented on 1 November 2021, aims to mitigate the effects of climate change through driving energy efficiency and carbon reduction, as well as other measures that address key sustainability drivers.

In collaboration with BCA and SGBC, JTC worked with the National University of Singapore - Energy Studies Institute (NUS-ESI) to launch a unified Embodied Carbon Calculator which will replace the current BCA carbon calculator. It is customised for local industry use and includes key features such as accounting for upfront carbon of materials used with adapted carbon emission factors to reflect the carbon footprint of projects within the local context. The Building Embodied Carbon Calculator, accessed from the SGBC website (SGBC, embodied carbon calculator), provides the industry with a unified tool to make informed decisions on material and product selections to reduce the carbon footprint of projects for use under the Sustainable Construction section of the Code for Environmental Sustainability of Buildings (Edition 4.0) and the Green Mark 2021 Whole Life Carbon section.

The Embodied Carbon Calculator is aligned with the SGBC's growing emphasis on reducing and optimising carbon emissions through upskilling of industry professionals' carbon capabilities and developing an ecosystem to raise the adoption rate of environmental product declarations (EPD) to support the built environment's transformation to one that is greener, healthier and low-carbon.

Danfoss Introduction and Background

The world is warming at an increasingly rapid pace and we are already seeing the effects of climate change in the form of sea level rise and extreme weather events. Enhanced energy efficiency can provide one third of the emission reduction needed for net zero[1]. It is time to accelerate the green transition. The good news: we have the solutions available today.

"Many of the changes observed in the climate are unprecedented in thousands, if not hundreds of thousands of years, and some of the changes already set in motion—such as continued sea level rise—are irreversible over hundreds to thousands of years[2]."

The cost to reverse climate change far exceeds the cost to prevent it. The more we wait, the more expensive it becomes. Further irreversible changes will happen if we do not limit global warming to 1.5°C.

The world's cities occupy just 3% of the Earth's land, but account for 60-80% of energy consumption and 75% of carbon emissions[3].

Modern HVAC systems alone can reduce energy consumption by 30%, translating to substantial savings over a buildings lifetime and relatively short payback times[4]. Buildings and their construction account for over 1/3 of global final energy consumption and nearly 40% of global energy-related CO2 emissions[5]. This must – and can – change.

In addition, the economic benefits of focusing on buildings are enormous. **We can create around 9-30 jobs for every SGD1.6M invested in energy efficiency in buildings[6],** making it the most labor-intensive means of ensuring a green recovery from the COVID-19 pandemic.

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1 IEA (2022). The value of urgent action on energy efficiency. P. 7.
2 IPCC Report 2021
3 https://www.un.org/sustainabledevelopment/cities/
4 Ecofys, Optimising the energy use of technical building systems, 2017
5 IEA (2021). Tracking Buildings 2021
6 IEA (2020). Sustainable Recovery

Challenges

Urgency and availability of solutions are in place and the Singapore government has matching ambitions. Yet, a doption rates are lagging behind. The Green Mark Scheme was first launched in 2005, was revised in 2015, and has been further updated in 2021. Together with the Green Building Masterplan, Singapore seeks to achieve the national **80-80-80 target by 2030**; which is to green 80% of buildings by GFA, to have 80 per cent of new developments by GFA be Super Low Energy (SLE) buildings, to have an 80 per cent improvement in energy efficiency (compared to 2005 levels) for best-in-class green buildings. In 2022, 49% of buildings have me t the basic green mark standard, 7% of new buildings by GFA have been classified as SLE, and buildings have achieved 65% to 70% improvement in energy efficiency over 2005 levels. Global labour and material shortage, as well as price increases will challenge our ability to meet the 2030 national target.

Three factors are central to accelerating the adoption rates:

Awareness of proven green building solutions: Many technology companies have solutions available today to help developers, operators and regulators achieve the required energy targets. Having a centralized platform to identify the right technology and solution for specific projects will enable faster decision making and adoption rates.

Achieving Green Mark 2021: With the Green Mark standard in place, product specifications designed around the Green Mark requirements can help identify targeted solutions for specific projects efficiently, enabling faster decision making and adoption rates.

Clear and proven business case: The increase in raw material and logistics costs, coupled with project delays have put added strain on budgets. The government can help owners alleviate some risk while they invest in a lower carbon future. The announcement of grants, coupled with Proof of Concept projects to validate results before full implementation is a strong model of public and private partnerships.


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Public-Private Partnerships to Accelerate Adoption of Solutions

Singapore Green Building Masterplan

The Singapore Green Building Masterplan and Green Mark Scheme outline the national plan for a more sustainable built environment, and provide clear pathways to achieve these national ambitions. These pathways and standards can be used by technology providers to localize specifications towards these standards, helping the industry determine suitable options for projects, and enable faster decision making and procurement.

Raising Solution Awareness

Solution awareness is crucial to ensuring adoption of green technologies and can be easily addressable. Yet, a myriad of offerings and changing standards can pose a challenge to building owners and developers.

We need **easy-to-navigate repositories of validated green solutions**. Existing resources like the SGBC product listing and the Super Low Energy Building Hub are paving the way, and by joining forces across the public and private sectors we can streamline the procurement process.

Beyond showing how technologies match existing standards, efforts can be enhanced to offer "live" experience of products and technologies. Besides BCA's SkyLab, a number of developers and solutions providers have already launched demo centres and facilities to validate and showcase proven solutions. The proof of concept model for retrofit projects can also be a measured approach towards larger scale adoption of technologies. Seeing is believing.

Initiatives like the SGBC product directory and SLEB Hub can be further leveraged to point projects to relevant technologies to achieve the desired Green Mark ratings. Linking the products in these platforms to the Green Mark standard can help accelerate the adoption process for projects.

Development of live demo facilities for hands-on experience and validation of technologies and applications are other resources to help the industry understand the latest technologies and solutions in the market.

Funding support

Even though energy efficient solutions have good return on investments, the upfront costs can be a barrier for their implementation. Therefore, funding options which incentivize green solutions are needed. This could be in the form of grants for demonstration projects or green financing of proven solutions. With the announcement of government grants to support green buildings, there is an opportunity for an open dialogue between public and private sectors to pair the grants with Proof of Concept pilots to enable building owners to test different technologies before making a decision on a complete retrofit of existing buildings.

Case Study 1 - Republic Plaza

Republic Plaza is a Grade A office landmark and state-of-the-art intelligent building in the central business district. As one of Singapore's tallest skyscrapers, standing at 280 metres in height with 66 storeys, Republic Plaza has been recertified with the Green Mark Platinum in 2021. It was one of the three tallest skyscrapers in Singapore, and among the first batch of buildings to receive the BCA Green Mark Gold award when it was introduced in 2005.

Since 2009, the corporate headquarters of CDL has been voluntarily reducing its annual carbon emissions to net zero for CDL corporate office operations including its data centre.

In 2012, Republic Plaza invested in green retrofitting works, including upgrading its chiller systems to further enhance its energy efficiency and attained the highest BCA Green Mark Platinum rating.

In 2018, CDL became the first company in Singapore to attain ISO 16745 by releasing the carbon intensity disclosure for Republic Plaza.

In 2019, CDL raised a $100 million green bond, which was allocated towards initiatives to enhance energy and water efficiency at CDL's flagship office building in Republic Plaza.

Since 2020, Republic Plaza has been the main site for the company's green building innovation pilots. Various energy efficient and innovative solutions have been deployed throughout the building to optimise building operations, facilities management, and building occupant's health, safety and well-being, especially during the COVID-19 period.

In 2021, an EC+ AHU (air handling unit) trial by Danfoss was completed at Level 15 of Republic Plaza, where an improvement of 40% to 50% in air distribution efficiency was noted. The EC+ AHU recorded superior performance in motor efficiency by at least 50% and performed better when compared to the conventional belt driven fan; by up to 30% or 1,800,000 kWh of energy savings a year. This has improved reliability and lowered the maintenance cost for CDL (up to 5% savings) due to ease of maintenance.

Other on-going pilots include a smart air distribution system that uses AI and IoT to optimise air-conditioning, allowing buildings to maximise energy efficiency by automating real-time decisions based on occupancy, weather conditions, and weather forecast data. A smart FM system offering demand-based maintenance is also being implemented to centrally and pro-actively manage Republic Plaza's building performance with minimum resources.


UBLIC PLAZA

Case Study 2 – Successful Public-Private Partnership Project in Sønderborg, Denmark

ProjectZero – showing the power of energy efficiency in action

ProjectZero – a public-private partnership in the municipality of Sonderborg, Southern Denmark – shows the potential of energy efficiency in action and has become a real-life showcase on the path to carbon neutrality. Initiated in 2007, the project aims to create a CO2-neutral Sonderborg by 2029, based on sustainable growth and the creation of new green jobs. The project spans both the city council and public activities, but also private companies who are setting their own high climate standards as ZEROcompanies and ZEROshops.

Since 2007, energy-related carbon emissions have been reduced by more than 50% and the municipality is on track to delivering on their 2029 vision for a carbon neutral energy system[1]. This has been done through focusing on energy efficiency, including buildings, lighting, appliances and processes, transport etc. The remaining energy use will be renewable.

In 2022, the entire world had the opportunity to visit ProjectZero as the 7th annual IEA Global Conference on Energy Efficiency. The aim of the conference was to move from talk to action by allowing participants to visit and see the solutions putting Sonderborg on the path to carbon neutrality. Danfoss proudly supported the conference

1 ProjectZero (2020) Monitoring report

Opportunity

The opportunity is here: the solutions to accelerate the transition carbon neutral buildings are ready and proven. We can make this a historical turning point.

The economic upside of investing in energy efficiency in buildings is clear. The payback time is short and it creates the green jobs of the future. This means we can restart our economies sustainably and accelerate the green transition. We need to get to work – together. The key to accelerate green buildings in Singapore is ensuring **stronger public-private partnerships to enable:**

1. Technology companies like Danfoss can help to localize specifications and product parameter based on the Green Mark 2021 standard to help the industry better evaluate solutions for their projects, linking the information on the SGBC Product Listings and SLEB Hub to the Green Mark standards can also facilitate the selection criteria for solutions. Danfoss has gone a step further to develop a navigation document to help stakeholders understand how available technologies contribute to the Green Mark 2021 standards. This document is available on SGBC and BCA's websites.

2. Clear and structured funding options for adopting technologies and solutions to achieve Green Mark standards through Proof of Concept implementations, will enable stakeholders to have confidence in carrying out a full retrofit based on validated energy energy savings, leading to a clear ROI, with a mid-term view that energy tariffs will continue to rise.

3. Formalize public-private arrangements with clear implementable options:

    a. Pair government grants to Proof of Concept projects to enable building owners to test and validate green building technologies for retrofit projects.

    b. Co-develop a central portal as a common depository of available products, solutions, trainings, grants, and financing options for the building industry to meet the Green Mark 2021 standard.

    c. Co-develop awareness campaigns on common priorities, like the impact of carbon tax for building owners, updates to the proposed central portal, available training programs, and certification process for the Green Mark 2021 standard.

Focusing on energy efficiency in buildings not only tackles one of the most emitting sectors, it is also one of the most cost-effective ways to curb emissions. Singapore's government has set a clear direction and target for the built environment, which has led to common priorities for all stakeholders in the industry. The public-private partnership proposals mentioned in this whitepaper can enhance industry capabilities, minimize duplication, and improve effectiveness in meeting these common priorities to meet the 80-80-80 target. Whether focusing on new constructions or retrofits, energy efficiency of buildings is a tremendous opportunity for real climate action – today.

City Developments Limited

City Developments Limited Introduction and Background

The global race to zero is upon us as climate and social issues remain top risks in 2022. With about 70% of the global population estimated to be living in cities by 2050, the world's building stock is also expected to double by 2060. The built sector is therefore in a prime position to design, construct and invest in green and healthy buildings, through sustainable procurement and green building solutions. Figures have shown that 80% of buildings that will exist in 2050 already exist. Aligned partnerships between architects, building and construction actors, suppliers, regulators and asset fund managers will accelerate action required for a green restart. The return on investment goes beyond energy performance indicators. Investing in sustainability ensures healthier spaces for building occupants and substantial carbon savings. The green restart therefore calls for a collective shift in behaviour, and how we understand building usage and design.

According to the EcoVadis Sustainable Procurement Barometer 2021, the shift towards more sustainable procurement is already in motion. 63% of global companies are prioritising corporate sustainability goals compared to 25% in 2019. "Reducing cost" as a priority has decreased to 36% in 2021, compared to 56% in 2019. This presents new opportunities for green solutions to scale. With the launch of the Singapore Green Plan in 2021, the government is leading the adoption of green procurement to influence service providers and suppliers to be more sustainable. Under the GreenGov.SG initiative, the public sector aims to peak its carbon emissions ahead of the national target of net zero emissions by or around 2050. This will be achieved by purchasing products that meet high resource-efficiency or sustainability standards. Government agencies have committed to progressively considering supplier's sustainability-related policies and practices during new tender applications. City Developments Limited (CDL) supports and has aligned its sustainability strategy with global and national goals towards sustainable development and net-zero emissions.

Shown in picture: CDL Treehouse won the Guiness World Record for the largest vertical garden in 2014

Integrating Sustainability into CDL's Strategy and Operations for a Net-Zero Future

CDL's sustainability strategy stems from its corporate ethos of "Conserving as we Construct", which was established in 1995. Its value creation business model is anchored on four key pillars—Integration, Innovation, Investment, and Impact; which has guided CDL to achieve three key deliverables: "Decarbonisation", "Digitalisation & Innovation" and "Disclosure and Communication".

CDL's Future Value 2030 Sustainability Blueprint, implemented in 2017, maps out clear strategic goals and interim environmental, social and governance (ESG) targets across CDL's business strategies and operations.

ESG integration will not be possible without strong leadership commitment and collaboration amongst all stakeholders towards achieving the company's ESG priorities. This is reflected in CDL's corporate governance structure with the Board's direct supervision and active engagement across all operational units. Since 2012, CDL's sustainability function has received direct supervision from the Board Sustainability Committee. The portfolio led by the Chief Sustainability Officer has been empowered to remain independent in setting goals and tracking performance, while at the same time being fully integrated into the company's strategy and operations.

In 2018, the CDL Group introduced its G.E.T. strategy—focusing on Growth while adopting an ESG lens, Enhancement of assets to drive operational efficiency and Transformation to deliver long-term and sustained value. CDL continues to be a leader in the global real estate and local built sector with its ESG performance recognised by leading international sustainability benchmarks and ratings. In 2021, CDL ranked 5th in the world and maintained our position as the world's most sustainable real estate management and development company for the 4th consecutive year. Other notable accolades include maintaining double 'A's in the 2021 CDP Global A List for corporate climate action and watersecurity.

During the pre-Green Mark era, there were few who shared similar commitment levels to environmental conservation or green buildings. CDL sourced for like-minded supply chain players and cross-sector partners to co-develop and pilot smart home and green innovations, with clear operational guidelines and corporate governance to guide its decision making. For its efforts in engaging the supply chain, CDL was placed in the top 8% of companies assessed by CDP for supplier engagement on climate change in the 2021 CDP Supplier Engagement Leaderboard. This was the second consecutive year the company has achieved this milestone. CDL plans to continue its strong engagement with key stakeholders realise its science-based targets towards a net zero portfolio from 2030.

Sustainable Procurement Policies and Systems

Since 2001, CDL has implemented an independent audit tool called the 5-Star EHS Assessment System to assess, measure, and improve its main contractors' EHS management and performance. This ensures a comprehensive, audited, and appraised approach is available to manage and mitigate EHS risks. CDL has leveraged on the use of eco-friendly and recycled materials certified by approved local certification bodies, such as the Singapore Green Building Council and Singapore Environment Council since 2003 via its corporate EHS Policy. This is further supplemented by additional policies, namely the Responsible Procurement Guidelines implemented since 2008; and the Green Procurement Guidelines for property developments, since 2009. These internal policies provide clear specifications in securing vendors and suppliers, to address cyclical supply chain disruptions and transitional risks caused by climate change.

CDL's Supplier Code of Conduct, introduced in 2015, provides comprehensive guiding principles for its vendors and suppliers to comply with the company's expectations relating to environment, health, safety, and ethical employment. CDL has also established a target to ensure 100% of its appointed suppliers are certified by recognised EHS standards by 2030. In the interim, 100% of CDL's main contractors and key consultants for property development obtained recognised EHS certifications in 2021. CDL reviews and evaluates the EHS culture and track record of potential suppliers and contractors before awarding development project contracts. In 2021, 93% of suppliers appointed by asset management were certified by recognised EHS standards.

CDL establishes double materiality impacts of its business with consistent engagement with its stakeholders, especially suppliers. In a supply chain segmentation study completed in 2020, environmental and social risks, such as embodied carbon intensity and forced labour, were assessed for CDL's top 100 suppliers and top five building materials procured for our developments. The study helped to strengthen CDL's understanding of potential risk hotspots within its supply chain to further enhance its supply chain strategy.

Setting Goals in Alignment with Global Climate Action

What gets measured gets managed. CDL was the first Singapore real estate company to set validated Science Based Targets initiative (SBTi)-validated targets for a 2°C warmer scenario in 2018. The company was one of 87 pioneering companies to answer the UN Global Compact's call for Business Ambition towards 1.5°C in 2019. Following key outcomes from the UN Climate Change Conference in Glasgow (COP26) in 2021, CDL renewed its previously validated science-based targets from a 2°C to 1.5°C warmer scenario, with more stringent carbon emissions reduction targets based on a more recent baseline year of 2016 instead of 2007. This business ambition was successfully assessed and validated by SBTi in 2021, providing clear transition pathways for the company to effectively track, monitor and disclose its performance metrics. Concurrently, CDL commenced its third climate change scenario analysis to study the prolonged impacts of COVID-19 on climate risk factors and mapped the net zero regulatory landscape across five of its key markets, which could impact the business's financial bottom line in 2030.

Effective decarbonisation will also require whole lifecycle thinking in design, construction and building operations and maintenance. In February 2021, CDL was the first Southeast Asian real estate conglomerate to sign the World Green Building Council (WorldGBC)'s Commitment. At COP26, CDL was one of 44 pioneering companies to further expand its commitment towards a net-zero whole life carbon-built environment. Through this commitment, CDL has pledged net zero operational carbon by 2030 for its new and existing wholly-owned assets and developments under its direct operational and management control. This also entails a reduction in embodied carbon and compensating residual upfront emissions via offsetting for new developments by 2030 and for all buildings to be net zero carbon by 2050.

Shown in picture: Irwell Hill Residences, People-centric Design for Work and Leisure

Digitalisation & Sustainable Technologies for a Green Restart

Recognising that innovation and digitalisation play a critical role in achieving a net zero future, CDL set up a Green Building & Technology Application team in 2020. The team collaborates with the organisation's Enterprise Innovation Committee, leveraging cutting-edge technology to reduce CDL's carbon footprint in the way it designs, builds, and manages its assets.

As companies globally realise the challenge in reducing Scope 3 emissions, CDL has been studying the feasibility of circularity solutions like advanced low-carbon construction methods and materials to reduce embodied carbon. To achieve this, CDL has ramped up on buildable designs moving towards less labour-intensive processes and focuses on Integrated Digital Delivery and Design for manufacturing and Assembly (DfMA) technologies. Through this, CDL can reduce its reliance on on-site workers, enhance workplace safety and health, and drive productivity improvements in construction and facility management.

Over time, CDL has built strong ecosystem partnerships with its property development and asset management teams to pilot smart facilities management and low-carbon technology to meet national green building plans towards a super-low energy, low carbon and a City in Nature future.

Given the rising green building standards and incumbent changes to regulatory requirements around decarbonisation, CDL developed a holistic Green Building Framework in 2020. This 3S Framework features Smart, Sustainable and Super Low Carbon (3S) to fast-track innovation and adoption of digitalisation to support CDL's business growth and net zero transformation. It is aligned with the Building and Construction Authority (BCA), Super Low Energy (SLE) buildings requirements, as well as international standards for advancing health and well-being in buildings. The framework prioritises embodied carbon management across CDL's value chain, which is in line with its pledge to the Net Zero Carbon Buildings Commitment in 2021.

Shown in picture: 80 Anson Road, Artist Impression

Key Features of 80 Anson Road (Awarded Green Mark SLE Platinum)

First development along Anson Road to tap onto district cooling

Solar PV system will generate renewable energy to meet 30% of the development's major energy-use systems, such as lighting and lifts

Building's exterior uses horizontal sun shading fins on every level, which reduces heat and energy consumption

Energy savings for the residential component is estimated to be up to 1.7 million kWh per year, equivalent to powering approximately 400 4-room HDB flats

Green features, including energy and water efficient appliances, allow cost savings of up to approximately $450,000 per year

South Beach Tower, Residences and JW Marriot

Microclimatic Canopy with 1,800 m^2 Solar Panels

Lightweight, 280m-long canopy filters sunlight and solar glare

Channels breeze into the public spaces providing comfortable and cool environment all year round

Rainwater is collected through the lower points of the canopy and recycled to irrigate garden landscape

Photovoltaic cells: Convert solar energy to electricity to light up the canopy and towers at night

Sustainable façade: Shingled glass that reduces glare and heat from the sun & slanting façades to catch the wind and direct air flow to the ground level spaces

10,000 sqm of greenery: Trees and plants are grown in the sky gardens, roof terraces, and balconies

Shown in picture: South Beach Tower, Residences and JW Marriot

Digitalisation & Sustainable Technologies for a Green Restart

Since 2004, CDL has retrofitted all its managed buildings by upgrading chiller plants, introducing motion sensors, installing energy-efficient lighting, and recladding facades. The cumulative efforts from previous initiatives since 2012 continue to yield an estimated annual energy savings of at least 14 million kWh, equivalent to $3.2 million of cost savings.

The adoption of renewable energy remains integral in the design and construction of CDL projects. CDL has been an early adopter of PV systems, reflected in both its commercial and residential properties, South Beach, Tampines Grande and D'Nest Condominium. CDL has participated in the emerging Renewable Energy Certificates (RECs) marketplace since 2017. In 2018, CDL was the first Singapore developer to purchase RECs using SP Group's blockchain-enabled platform. By procuring locally-sourced RECs, CDL attributed 100% of the electricity consumed by its headquarters' operations and part of its commercial buildings' operations in 2020 to renewable sources. This offset 1,184 tonnes of carbon emissions in 2020, equivalent to powering over 611 typical 4-room HDB flats for one year.

Investing in proptech capabilities is vital for business growth. CDL piloted digiHUB, a proprietary smart enterprise platform for building performance management developed by CBM Pte Ltd, a wholly-owned building and facility management subsidiary of CDL. Leveraging on three key technological advances in the digital age – the Internet of Things (IoT) Sensors, Edge Computing, combined with Artificial Intelligence (AI) and Machine Learning, digiHUB is a predictive and integrated facilities management (FM) solution. It synergises the different IT capabilities and has revolutionised the delivery of FM services. Its proof-of-concept and pilot was first carried out in 2019 at CDL's corporate office located at Republic Plaza, and completed in 2021, with endorsement by Infocomm Media Development Authority. Through digiHUB, CDL is the first Singapore company to secure a discount on a sustainability-linked loan through the adoption of an innovative project that supports the UN SDGs on a large-scale basis. In 2021, CDL invested in Taronga Ventures, an APAC-based PropTech VC fund. This investment will provide CDL access to a steady stream of pipeline and portfolio start-ups with innovative technology and business models, with a focus on Asia as well as on ESG.

Shown in picture: Republic Plaza, CDL Corporate Headquarters in Singapore

Bridging Communities to Reach Net-Zero

Creating positive impact is one of the objectives of sustainability practices. In order to achieve a net-zero world, super low energy buildings are the way forward. To date, CDL has built two net zero facilities using eco-friendly technologies—the Singapore Sustainability Academy (SSA) and the CDL Green Gallery at the Singapore Botanic Gardens. The SSA, a BCA Green Mark Platinum-certified building, is the first in Singapore to have its construction materials, Cross Laminated Timber and Glued Laminated Timber, verified by the Nature's Barcode™ system as coming from responsible sources.

Greening the built environment is a collective effort and working with partners and stakeholders is key to amplify impact and drive change along the value chain. CDL designed and built the Singapore Sustainability Academy as Singapore's first ground-up and zero-energy facility dedicated to advocacy, capacity building, and the UN Sustainable Development Goals (SDGs). It is based on an extensive partnership involving six government agencies and 15 founding industry and non-governmental organisations partners. Since its opening in June 2017, the SSA has been a hallmark of CDL's community engagements as Singapore's leading knowledge and networking hub for sustainability which provides industry training, networking and capacity building for climate action and implementation of relevant SDGs. Since its opening, the SSA has hosted over 700 events and trainings and welcomed over 23,700 attendees to its events. In 2021, virtual SSA events further reached out tomore than 1,700 participants from over 25 countries, including Switzerland, Nigeria, Malaysia, Thailand, and the United States.

Furthermore, CDL also partnered with the National Library Board to launch My Tree House, the world's first green library for children. It was created to encourage environmental literacy and appreciation amongst kids. CDL also developed Youth4Climate, a platform for youths to come together to do social good via programmes, such as the Youth4Climate Festival, organised in partnership with Ministry of Sustainability and the Environment, the National Environment Agency, the National Parks Board, and ActiveSG. In 2017, CDL launched the Women4Green network, a platform dedicated to encouraging and inspiring women to create a financially, environmentally, and socially sustainable future.

With the need to tackle the climate emergency, no action is too small. No one company or organisation, let alone individual, can save the world alone. The science is clear about climate threats. Today, it is the art of engaging stakeholders, changing mindsets and behaviours that is most challenging. Committing to the Race to Zero will add purpose to the Triple Bottom Line. As Singapore's real estate pioneer and green building leader, CDL has aligned our business with global and national goals to mitigate the negative impact of climate change and will continue to accelerate action towards a more resilient and sustainable future for all.

Shown in picture: Singapore Sustainability Academy at City Square Mall Skypark (2017)

Singapore Sustainability Academy at City Square Malls' Skypark (2017)

Designed and built by CDL with six government agencies and 15 industry and NGO partners

A BCA Green Mark Platinum-certified building

The entire facility is built with over 80% of structural materials from sustainable sources

The SSA features 3,200 sq ft of solar panels on its rooftop, generating 60,000 kWh per year, more than enough to fully power the academy's average consumption of 50,000 kWh

It is also retrofitted with an outdoor deck made from 95% recycled materials comprising 65% reclaimed Forest Stewardship Council certified wood and 30% polyethylene. It has been awarded the highest-tiered certification by SGBC

CDL Green Gallery @ Singapore Botanic Gardens

To reduce environmental impact, the 314 sqm gallery was assembled off-site before being installed and pieced together.

Constructed from Hempcrete, a biomaterial that consists of the hemp plant, lime, sand and water. This material is not only resistant to pests, fire, mould and mildew, but also keeps indoor temperatures cool with its high thermal efficiency.

With 105 solar panels installed on its roof, the CDL Green Gallery generates 31,000 kWh annually, surpassing the gallery's estimated yearly energy consumption

Other innovative green features include energy-efficient air conditioning, as well as LED lights that consume 57% less energy than conventional lighting. The gallery is also clad with vertical green walls, which are irrigated with water from the nearby Swan Lake, rather than potable water.

For its innovative eco-friendly features, the gallery was accorded the BCA Green Mark Platinum status—the highest tier of green buildings in Singapore.

Shown in picture: CDL Green Gallery @ Singapore Botanic Gardens

SP Singapore Polytechnic

Singapore Polytechnic Introduction and Background

To realise the goals of Singapore Green Plan 2030 and the aspirations mentioned earlier in the paper, there is a need for a strong eco-system, particularly on the supply side, in terms of equipping new talents and the existing workforce with new green skills and working hand-in-hand with the companies, especially SMEs, in the adoption of new technologies and innovation. As the MOE sectoral coordinator among the polytechnics and ITEs for the Built Environment (BE) sector, Singapore Polytechnic (SP) believes we are well-positioned to lead and play this pivotal role.

SP's Industry Focus

SP's mission, besides pre-employment training (PET) for students, has expanded strongly in the past 5 years. We have collaborated with industries in their transformation journey, through continuing education and training (CET) of the workforce, and providing solutions through projects and consultancy.

Guided by SP's belief to "train with industry, for industry", SP has refined our CET offerings and strengthened our industry collaborations. This belief is aligned with the Singapore Green Building Council's (SGBC) desire to forge better public-private partnerships to foster innovation and collaboration. Over 1,000 companies have sent or sponsored their employees in SP's CET courses, with the number of company-sponsored training places increasing three-fold from 2017 to 2021. SP has also established training collaboration agreements with more than 20 industry partners in various sectors, so that our training is strongly in line with fast-evolving industry technological and skill needs.

The newest showcase of our Public-Private Partnership is the upcoming Memorandum of Understanding (MoU) between SP, Danfoss and SGBC, to provide innovation, technology and new skills to companies in the Built Environment (BE) sector. It has always been SP's goal to collaborate with like-minded partners to forge new partnerships for a common goal, and meet industries technologies and skills needs without "re-inventing the wheel".

Equipping Talents with Green Skills

Equipping Talents with Green Skills

We will need to grow a talent pool to sustain the drive towards greening 80% of our buildings. SP has been increasing our programmes in training, upskilling and reskilling our workforce to meet these demands. These include courses in Energy Efficiency and Management, Solar Photovoltaic (PV) Systems, Air-Conditioning and Mechanical Ventilation (ACMV) Systems, Green Solution Technology and Workplace Safety, Electric Vehicle and Smart Urban farming. More courses are being planned to incorporate new skills related to sustainability.

In addition, to increase the adoption of competencies and new technologies by companies, especially in support of the transformation of small and medium-sized enterprises (SMEs) for significant company-wide changes, SP uses the andragogic framework of the "Mindset, Skillset and Behaviour" approach. This is elaborated below.

Mindset

Any significant transformation initiative starts with the awareness and belief in a new possible future, and strong impetus and urgency from key business owners and leaders to make things happen. Thus, SP would invest in bringing these stakeholders through learning journeys and awareness workshops on proven green building solutions (e.g. from Danfoss), case studies on how these are already implemented, and how they eventually translate to business outcomes (e.g. through CDL). For the BE industry, these mindset developments would also include understanding the BCA Green Mark 2021 (GM: 2021) certification scheme, which has been instrumental in pushing the adoption of new green technologies and designs.

Together with Danfoss and Grundfos, SP is organising an overseas immersion trip to Denmark in 2022 for local business leaders to study best-in-class adoption and practices in energy, carbon and water efficiency and low carbon/net zero solutions and technologies. Similar to the success achieved in our other LEAD programmes, we believe these experiences will enable our local industry leaders to seek new opportunities in embracing environmental sustainability and energy efficiency to make their businesses and customer solutions more resilient and future-proof.

Equipping Talents with Green Skills

Skillsets

Equipped with increased awareness and impetus, these companies would need to have a competent workforce skilled in the areas of green solutions and technologies, such as energy efficiency and carbon reduction. We are using GM: 2021, as well as priority skills for the Green Economy identified by SkillsFuture Singapore (SSG), to guide the development of upskilling modular courses. Combined with meaningful certification programmes and tied in with the necessary knowledge and skillsets of the Green Mark associate and Green Mark Accredited Professional, companies are able to acquire the relevant GM: 2021 Certification Standards based on their aspirations. SP also partners with Singapore Green Building Council (SGBC) to co-organise learning journeys and technical sharing to keep professionals up-to-date with the latest Green Building trends and technologies.

SP is an accredited training provider under SGBC, where green building-related courses provide participants with continuous professional development (CPD) points. As CPD points are a requirement in the annual license renewal of Green Mark Accredited Professionals, carefully curated and updated courses with CPD points will be a systemic way of ensuring their continual upskilling.

Behaviour

To facilitate sustained enterprise-wide adoption after skillset and technological acquisition, employees would need to perform and utilise their competencies regularly. As course designs could be contextualised to a company's work processes, we could ensure relevance, effectiveness and sustainability of employee performance through SP's various workplace learning methodologies, particularly the 5 Moments of Needs (5MoN) framework. A 5MoN solution enables learning in the workflow while employees perform their jobs. It also reduces and optimises traditional formal learning time (which requires employees to pause their work to learn). Thus far, more than 16 companies have benefited from this approach with SP.


CURIOSITY

Partnering Industry with Innovation and Productivity

Innovation is a key driver to achieving SG Green Plan 2030 targets. SP Technology, Innovation And Enterprise centres have dedicated full-time staff focused on building and developing a pipeline of new capabilities with national R&D eco-system players and key industry partners to meet the future needs in various selected industry domains. SP uses these capabilities to assist companies in these industries to increase their competitiveness and equip them for tomorrow's competitive landscape. SP has a good track record of co-innovating and co-creating solutions with the industry supported by our 12 centres, with close to 300 projects per year on average in the past three years. In particular, we are keen to leverage our capabilities in energy efficiency, carbon management, advanced materials, data science, 5G & AIoT and Smart Facilities Management to support the BE industry and help transform SMEs in this sector.

We wish to highlight SP's Advanced Materials Technology Centre (AMTC). AMTC has developed partnerships with stakeholders such as Enterprise SG, Building and Construction Authority (BCA), National Environment Agency (NEA), Land Transport Authority (LTA) and Trade Associations (Singapore Green Building Council, Micro Builders Association, Specialists Trade Alliance of Singapore, Built Environment Technology Alliance, etc.), and built strong technical capabilities. AMTC's track record in green building materials includes the development of a technology to convert incineration ash into aerogel & foam glass for use in advanced building and industrial applications. The outcome of this produces 20% more durable environmental-friendly road pavement material incorporating recycled plastic, and heat reflective glass coatings for buildings, which could reduce energy consumption by 9%. Some have been licensed, while others are undergoing real-world test-bedding. More research work is being conducted with industry partners to address flammability problems, create better solutions for water-proofing and passive roof cooling, and address the need for sustainable, light-weight, and high-strength materials.

While the industry is generally willing to support the use of new BE technologies, especially those already in use overseas, they face challenges in the adoption process. For example, there is difficulty in obtaining validation and certification for local usage. One common concern was that new BE solutions were not easily approved by the authorities due to a lack of track record or a lack of complete environment, effectiveness or safety assessment in the local context. To enable solution adoption, AMTC proactively journeyed with our industry partners to further development work, performing and advising on necessary tests and certifications, product test-bedding in a real environment over some time, and doing further environmental impact and product shelf-life assessments to meet the regulatory requirements.

The Centre for Environmental Sustainability and Energy Efficiency (ESEE) in SP is another centre which can enhance companies in the BE industry. It provides consultancy and solution services focusing on energy efficiency, carbon reduction and the adoption of Green Mark standards. The centre is partnering with key industry technology providers, such as Danfoss and Grundfos, to co-develop solutions to support the drive for Super Low Energy buildings and Net Zero Energy buildings.

Opportunity

SP looks forward to becoming a key member of the proposed Public Private Partnership together with SGBC, CDL and Danfoss. We believe our sectoral coordination role among the polytechnics, our track record in PET, CET and industry projects with local companies, our network of partnerships with key BE industry stakeholders and our various technology capabilities and expertise will enable SP to make significant contributions to the bold objective of accelerating procurement and adoption of green building solutions.

We hope this partnership will broaden our ability to reach out to more like-minded partners, and come together to address the decarbonisation challenges faced by our nation.

Conclusion

The opportunity is here: to accelerate towards carbon neutrality and mark this moment as a historical turning point. The solutions are ready and proven. Now, it all comes down to the scale and speed of implementation.

The economic upside of investing in a low carbon economy is clear. So, let's focus on driving energy efficiency in our buildings and industry. To accelerate electrification of transport systems – moving goods and people on land and at sea, while also enabling smart sector integration in our cities. All in addition to creating the green jobs of the future, and ensuring we move closer to achieving our goals.

This is where the transformation starts

Join the transformation and continue the conversation on danfoss.com

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