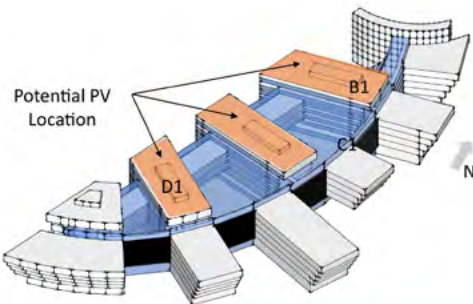




THE SINGAPORE ENGINEER

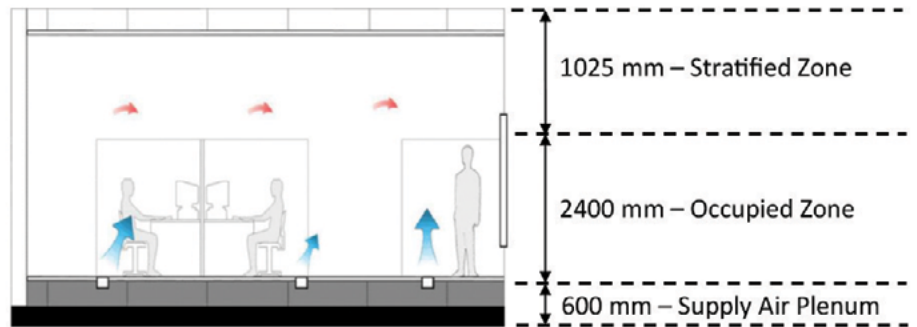
April 2020 | MCI (P) 004/03/2020

COVER STORY:
Creating a sustainable
and smart workplace



Total Number of PV Cells (B1 + C1 + D1)	869 nos.
Total Energy Generation (MWh/Year)	431.8

Smart Cooling



PLUS

SUSTAINABILITY: Leading real estate company discloses ESG performance and strategy to accelerate climate action
MEP ENGINEERING: Design and construction of a Super Tall Tower in China - A Singaporean Engineer's involvement and perspective
RAILWAY & ROAD ENGINEERING: Smart transportation beyond 2020

Railway & Transport



Infrastructure



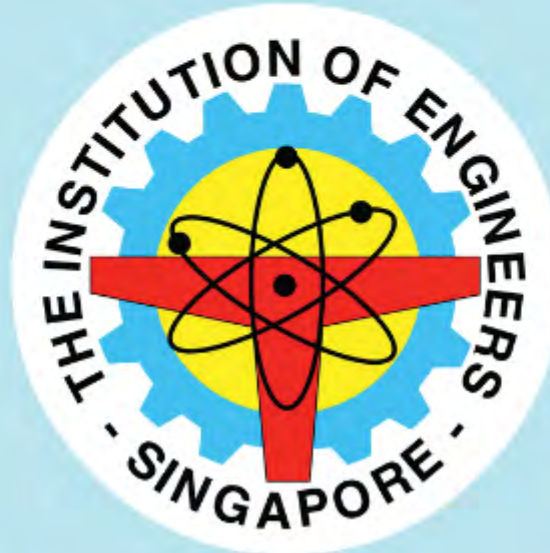
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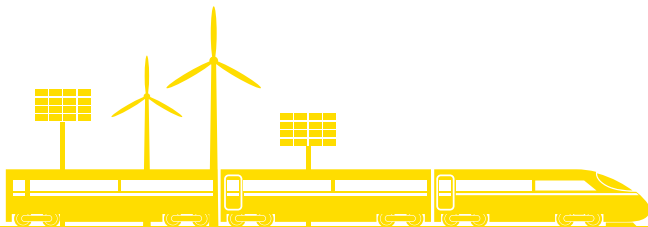
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President
Prof Yeoh Lean Weng
Chief Editor
T Bhaskaran
t_b_n8@yahoo.com

Publications Manager
Desmond Teo
desmond@iesnet.org.sg
Publications Executive
Queek Jiayu
jiayu@iesnet.org.sg

Editorial Panel
Dr Chandra Segaran
Prof Simon Yu
Dr Ang Keng Been
Mr Gary Chiam
Dr Victor Sim
Mr Syafiq Shahul
Dr Alexander Wiegand
Media Representative
Multimedia Communications
(2000) Pte Ltd
sales@multimediacomms.sg

Design & layout by **2EZ Asia Pte Ltd**
Cover designed by **Irin Kuah**
Cover images by **Safdie Surbana Jurong**
Published by
The Institution of Engineers, Singapore
70 Bukit Tinggi Road, Singapore 289758
Tel: 6469 5000 | Fax: 6467 1108
Printed in **Singapore**

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ASHRAE ISSUES STATEMENTS ON RELATIONSHIP BETWEEN COVID-19 AND HVAC IN BUILDINGS

ASHRAE has published two statements to define guidance on managing the spread of SARS-CoV-2, the virus that causes COVID-19 disease (Coronavirus), with respect to the operation and maintenance of heating, ventilating and air-conditioning systems in buildings.

“In light of the current global pandemic, it is critically important that ASHRAE responds with guidance on mitigating the transmission of the virus, as well as ventilation and filtration recommendations”, said 2019-20 ASHRAE President, Darryl K Boyce.

“ASHRAE has a significant role to play in ensuring safe and healthy building environments and these statements offer the expert strategies needed at this time”, he added.

ASHRAE developed the following statements in response to widening false statements surrounding HVAC systems. ASHRAE officially opposes the advice not to run residential or commercial HVAC systems and asserts that keeping air-conditioners on during this time can help control the spread of the virus. The official statements are as follows:

Statement on airborne transmission of SARS-CoV-2/COVID-19

“Transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled. Changes to building operations, including the operation of heating, ventilating, and air-conditioning systems, can reduce airborne exposures”.

Statement systems to reduce SARS-CoV-2/COVID-19 transmission

“Ventilation and filtration provided by heating, ventilating, and air-conditioning systems can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air. Unconditioned spaces can cause thermal stress to people that may be directly life-threatening and that may also lower resistance to infection. In general, disabling of heating, ventilating, and air-conditioning systems is not a recommended measure to reduce the transmission of the virus”.

HVAC filters, along with other strategies, help to reduce virus transmission while removing other air contaminants that may have health effects.

ASHRAE’s Environmental Health Committee also developed an Emerging Issues Brief to support the above two statements. According to the brief:

“There is great concern about the real possibility of transmission through the air of various pathogens, especially SARS-CoV-2, among staff and administration in healthcare facilities, office workers, retail workers and patrons, manufacturing workers, and residents in private and public facilities and the general public in outdoor

settings and in public transportation. ASHRAE is uniquely qualified to provide guidance on the design, operation, and maintenance of heating, ventilating, and air-conditioning systems to help reduce the dangers of pathogen transmission through the air in these settings”.

ASHRAE Epidemic Task Force established

ASHRAE has announced the establishment of the ASHRAE Epidemic Task Force to help deploy its technical resources to address the challenges of the current pandemic and future epidemics as it relates to the effects of heating, ventilation, and air-conditioning systems on disease transmission in healthcare facilities, the workplace, home, public and recreational environments.

The task force will also provide recommendations for setting up temporary field hospitals in convention centres, arenas and indoor stadia to deal with surges.

The primary role of the task force is to maintain communication with members, industry partners, building owners, facility operators, government agencies and the general public. Specific responsibilities of the task force include:

- Serving as a clearing house to review all technical questions and requests for technical guidance submitted to ASHRAE.
- Coordinating activities of ASHRAE’s internal resources.
- Partnering with and monitoring the activities of external organisations, including the more than 60 members of the ASHRAE Associate Society Alliance (AASA) of organisations related to the HVAC&R industry around the world.
- Reviewing, organising, consolidating and publishing clear and concise summaries with citations of the most relevant information available to the built environment.

The task force is chaired by 2013-14 ASHRAE Presidential Member, Dr William Bahnfleth.

“We have assembled an outstanding group of experts to serve on the task force. They are high-level building professionals with collective experience in design, construction, operations and research, who are well qualified to offer guidance on how to protect building occupants and support healthcare facility needs during the uncertainty of an epidemic”, said Dr Bahnfleth.

Leading experts in medicine and public health will serve as consultants to the task force.

ASHRAE

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating ventilation, air conditioning, refrigeration and their allied fields.

(More information on ASHRAE’s COVID-19 Resources can be obtained by accessing www.ashrae.org/COVID19)

TIME TO RELOOK AT SILICON WAFERS

TO REDUCE SOLAR PV COST: MIT RESEARCHERS

With most of the potential areas for cost savings in solar panels already pushed to the extreme, further cost reductions are becoming more challenging to find.

Now, researchers at MIT and at the National Renewable Energy Laboratory (NREL) have outlined a pathway to slashing costs further, this time by slimming down the silicon cells themselves.

Thinner silicon cells have been explored before, especially around a dozen years ago when the cost of silicon peaked because of supply shortages. However, thin silicon wafers were too brittle and fragile then, leading to unacceptable levels of losses during the manufacturing process, and they had lower efficiency.

According to the researchers, there are now ways to begin addressing these challenges through the use of better handling equipment and some recent developments in solar cell architecture.

Their new findings are detailed in a paper in the journal *Energy and Environmental Science*, co-authored by MIT postdoctoral researcher Dr Liu Zhe, professor of mechanical engineering Tonio Buonassisi, and five others at MIT and NREL.

Currently, 90 per cent of the world's solar panels are made from crystalline silicon. Today's silicon photovoltaic cells are made from wafers that are 160 micrometres thick, but with improved handling methods, the researchers propose this could be shaved down to 100 micrometres – and eventually as little as 40 micrometres or less.

This will not only reduce the cost of the individual panels, but more importantly, allow for rapid expansion of solar panel manufacturing capacity. This is because the production efficiency of silicon wafer plants, which are generally separate from that of solar cells, would be increased.

Dr Andre Augusto, an associate research scientist at Arizona State University who was not connected with this research, said that refining silicon and wafer manufacturing was the most capital-expense (capex) demanding part of the manufacturing process.

“Going thin solves this (supply) problem in part as you can manufacture more wafers per machine without increasing significantly the capex.”

He added that “thinner wafers may deliver performance advantages in certain climates,” performing better in warmer conditions.

The study looked at the efficiency levels of four variations of solar cell architecture, including PERC (passivated emitter and rear contact) cells and other advanced high-efficiency technologies, comparing their outputs at different thickness levels. The team found there was in fact little decline in performance down to thicknesses as



Currently, 90 percent of the world's solar panels are made from crystalline silicon, and the industry continues to grow at a rate of about 30 percent per year. Photo: MIT

low as 40 micrometres, using today's improved manufacturing processes.

It will take time to develop the necessary equipment and procedures, but with existing technology, it should be “relatively simple to go down to 100 micrometres” which would already provide some significant savings, said Dr Liu. Further improvements in technology such as better detection of micro-cracks before they grow could help reduce thicknesses further.

New technologies that grow thin wafers of silicon crystal directly rather than slicing them from a larger cylinder could help enable thinning down to as little as 15 micrometres, he noted.

Development of thin silicon has received little attention in recent years because the price of silicon has declined from its earlier peak. But, because of cost reductions that have already taken place in solar cell efficiency and other parts of the solar panel manufacturing process and supply chain, the cost of the silicon is once again a factor that can make a difference.

The purpose of this study is to provide a roadmap for those who may be planning expansion in solar manufacturing technologies. By making the path “concrete and tangible”, it may help companies incorporate this in their planning.

Dr Liu opined that the different key players in the industry could get together and lay out a specific set of steps forward and agreed-upon standards, as the integrated circuit industry did early on to enable the explosive growth of that industry.

The team also included Sarah Sofia, Hannu Lane, Sarah Wieghold and Marius Peters at MIT and Michael Woodhouse at NREL. The work was partly supported by the U.S. Department of Energy, the Singapore-MIT Alliance for Research and Technology (SMART), and by a Total Energy Fellowship through the MIT Energy Initiative.

COMPANIES COLLABORATE TO EXPLORE HYDROGEN AS A

LOW-CARBON ALTERNATIVE FOR SINGAPORE

To capture the opportunities offered by low-carbon alternatives for energy sources, five Singapore and two Japanese companies entered into a Memorandum of Understanding (MoU) to study how hydrogen can contribute to a clean and sustainable energy future for Singapore.

Under the MOU signed recently, PSA Corporation, Jurong Port, City Gas, Sembcorp Industries, Singapore LNG Corporation, Chiyoda Corporation, and Mitsubishi Corporation will develop ways to utilise hydrogen as a green energy source. This involves the research and development of technologies related to the importation, transportation and storage of hydrogen.

Working closely with Chiyoda, a key technology and supply chain solution partner, the companies will identify and demonstrate use cases using Chiyoda's SPERA Hydrogen and Liquid Organic Hydrogen Carrier (LOHC) technology to allow hydrogen to be safely transported in chemical tankers at normal atmospheric temperature and pressure.

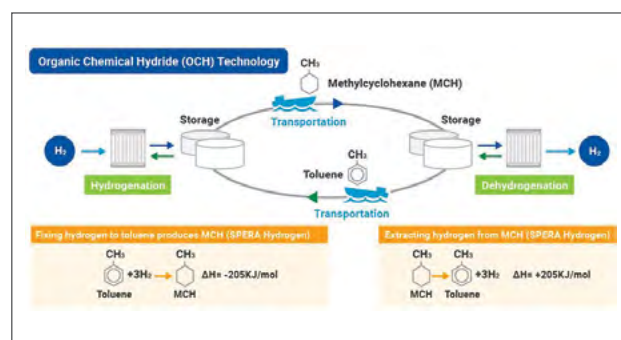
Mitsubishi will support this development as the main shareholder of Chiyoda. The five Singapore companies will work closely with Chiyoda and Mitsubishi to evaluate the technical and commercial feasibility of hydrogen usage, to develop a business case for hydrogen import and utilisation in Singapore.

Some potential areas of application which the companies are examining include transport, energy generation, and smart electrical grid systems.

Alongside this MOU, the National Research Foundation (NRF) will also work with the Maritime and Port Authority to tackle the maritime decarbonisation challenge through research and technology development.

Professor Low Teck Seng, CEO of NRF, said: "We are encouraged that companies are coming together, leveraging each other's expertise, to study how hydrogen can be used as an emissions-free alternative to existing carbon sources. These companies will work alongside our researchers to look at how technologies in this area – such as catalysis and membrane technologies – can be further developed for the production and distribution of hydrogen."

He noted that the effort will be supported by public sector agencies, so as to accelerate the potential use of hydrogen to reduce Singapore's carbon footprint.



Chiyoda's SPERA Hydrogen technology concept. Image: Mitsubishi

Organic waste has huge untapped potential to provide clean energy

The world is only using a fraction of the potential to produce gas from organic waste, which could cover around 20% of today's global demand for gas, according to the report 'Outlook for biogas and biomethane: Prospects for organic growth', released recently by the International Energy Agency (IEA).

Modern societies and economies produce increasing amounts of organic waste, such as agricultural residues, food waste and animal manure, that can be used to produce biogas and biomethane, with multiple potential benefits for sustainable development. Biogas offers a local source of power and heat for communities, and a clean cooking fuel for households. Upgrading it to biomethane brings all the energy system benefits of natural gas without the associated net emissions.

Every part of the world has significant scope to produce biogas and/or biomethane. The availability of sustainable feedstocks for these purposes is set to grow

by 40% by 2040, according to the IEA report.

The largest opportunities lie in the Asia-Pacific region, where natural gas consumption and imports have been growing rapidly in recent years. There are also possibilities across North and South America, Europe, and Africa.

Most of the biomethane resources examined in the IEA report are currently more expensive to produce than the prevailing natural gas prices in their region, but the cost gap is projected to narrow over time. Recognition of the value of avoided carbon dioxide and methane emissions goes a long way towards improving the cost-competitiveness of biomethane.

The production and use of these gases embody the idea of a more circular economy in which resources are continuously used and reused, and in which rising demand for energy services can be met while also delivering wider environmental benefits.

SIT, SMRT AND SSG PARTNER

UP TO DEVELOP SKILLS OF LAND TRANSPORT

SMRT Corporation has partnered the Singapore Institute of Technology (SIT) and SkillsFuture Singapore (SSG) to develop a sector-specific training collaboration to support skills development and workplace learning.

This is to help upskill small and medium enterprises (SMEs) to improve rail reliability and drive innovation and productivity enhancements across the land transport sector. About 100 of these SMEs, which provide services to SMRT, are expected to benefit.

An MOU on the partnership was signed at SIT's Applied Learning Conference in January.

Leveraging on SIT's expertise in workplace learning and SMRT's ongoing efforts to put knowledge to practice at the workplace, the two organisations will co-develop the training curricula, with support from SSG.

SMRT will also help its value chain of SMEs, ranging from cleaning companies to rolling stock maintenance service providers, to identify skills gaps holistically and recommend appropriate training, in areas such as data-driven predictive maintenance and project management.

Mr Lee Ling Wee, CEO of SMRT Trains, said, "We are excited to partner SIT and SSG in this initiative. With Singapore's rail network set to increase to 360km by 2030,

from about 230km currently, there is a need to build a pool of local talent for the growing rail industry. This MOU also encourages our partners to train and work with us to continuously deepen operations and maintenance expertise in our rail industry."



Signatories of the MOU comprised (from left to right): Mr Lee Ling Wee, CEO, SMRT Trains; Dr Michael Fung, Deputy CE (Industry), SSG; and Associate Professor Ivan Lee, Vice President (Industry & Community), SIT. The signing was witnessed by (from left to right): Mr Neo Kian Hong, Group CEO, SMRT Corporation; Mr Seah Moon Ming, Chairman, SMRT Corporation; Mr Ong Ye Kung, Minister for Education; Mr Ong Tze-Ch'in, CE, SSG; and Professor Tan Thiam Soon, President, SIT. Photo: SIT.

Partnership advances the digital future of water

Grundfos, a world-leading pump and water technology company, and Augury, a fast-growing data analytics company and leading Digital Machine Health solution provider, are digitalising water and utility infrastructure worldwide by signing a long-term strategic partnership. Together, they hope to develop smart diagnostics solutions and services for Grundfos' customers.

The two companies have already been working together successfully over the past two years to test new products and service offerings across several markets and industries. Now, they are committing to the next step, and offering a range of services and new business models enabled by connected equipment.

"By adding an AI-driven intelligence layer on top of existing assets, we can automatically collect mechanical and operational data, providing actionable machine health insights and diagnostics to our customers and service organisation. When we stand 10, 15 years from now, this could end up being one of those defining moments where we took a real step forward", said

Tommy Due Høy, Group VP, Global Service & Solutions, Grundfos.

Augury works with the world's largest manufacturers and industrial companies to transform their operations by providing real-time diagnostics regarding the health and performance of their machines. The combination of Augury's AI-based solutions with Grundfos' deep applications expertise has the potential to change water delivery and services.

"Water is at the core of how we live, work, and thrive - yet it often goes unnoticed. Through this partnership Grundfos and Augury will work to make water a safer, more available and more useful resource for businesses, individuals and even nations worldwide. We have spent the last eight years working with manufacturers and utilities to ensure that people around the world can always rely on the machines that matter and have seen first-hand the impact it brings. I am thrilled to be partnering with Grundfos to bring this impact to a wider market", said Saar Yoskovitz, Co-Founder and CEO of Augury.

ADDITION OF OPTIONAL PUBLIC CHARGING

STANDARD FOR ELECTRIC VEHICLES

As part of the government's commitment to create a sustainable transport system, LTA and EMA have jointly announced the addition of Japanese fast-charging method CHAdeMO as an optional public charging standard for electric vehicles (EVs).

This enables charging providers to bring in a larger range of public charging options for EV users and supports the wider adoption of EVs in Singapore.

Adopted primarily by Japanese EV manufacturers, CHAdeMO, an abbreviation of CHArge de MOve, allows for fast charging of EVs using a direct current (DC) interface.

A CHAdeMO DC charger with a power rating of up to 120 kW can fully charge an electric car in about 30 minutes. Some examples of EV models equipped with CHAdeMO

charging inlets include the Nissan Leaf, Mitsubishi iMiEV and Honda Fit EV.

Under Technical Reference 25 (TR25), the national EV charging standard, it is mandatory for charging service operators to provide Type 2 alternating current (AC) (slow charging) and/or Combo 2 (DC) (fast charging) chargers at their public charging stations. Optionally, charging service operators can provide CHAdeMO chargers at their public charging stations.

According to the joint statement from both agencies, CHAdeMO DC chargers with a power rating of not more than 120kW can be imported and installed in Singapore, as long as they are provided alongside Type 2 AC and/or Combo 2 DC charging points. This is to ensure sufficient inter-operability for existing EVs in the market.

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NEW TECHNOLOGY ROADMAP

AND GUIDE TO SMART FM LAUNCHED

The Singapore International Facility Management Association (SIFMA), in partnership with the Agency for Science, Technology and Research (A*STAR), has launched a Consortium Operations and Technology Roadmap (COTR) as part of efforts to transform the Facilities Management (FM) sector to be future-ready. This was announced by Mr Zaqy Mohamad, Minister of State for National Development at the opening ceremony for the International Facility Management Conference 2019 on 1 October 2019. The roadmap was also developed with support from the Building and Construction Authority (BCA), Infocomm Media Development Authority (IMDA) and Enterprise Singapore.

With Singapore's growing number of buildings, ageing workforce and manpower constraints, the local FM sector faces significant challenges in ensuring that service standards are met. The use of innovative technologies will help to ensure buildings are well maintained at optimal performance and sustainability. The COTR charts more than 50 near-, mid- and long-term technology solutions aimed at improving service delivery outcomes. It also maps technology solutions that may require further research and development.

"Digitalisation is taking the world by storm and has disrupted Singapore's FM sector. With the reconstitution of SIFMA, we believe that it is timely to work with our partners and government agencies to plan for a future-ready FM sector. With the development of the FM COTR, this will enable us to work towards the digitisation of the FM sector while improving the productivity, effectiveness and sustainability of the nation's buildings. We are excited to build towards the FM sector of tomorrow while tackling the challenges of today", said Tony Khoo, President, SIFMA.

Professor Tan Sze Wee, Assistant Chief Executive of A*STAR's Science & Engineering Research Council, added, "By putting a technology roadmap in place, SIFMA members will be able to make better-informed decisions in their innovation strategies and future-proof their businesses. This will help improve the competitiveness of the facilities management sector. A*STAR is glad to be part of this multi-party collaboration, and we will continue to support the sector's needs with our technologies and roadmapping expertise".

One key outcome of the COTR is the development and adoption of advanced technology solutions that enable



The International Facility Management Conference & Expo 2019 was officially opened on 1 October 2019. Image: CEMS.

integrated and data-driven predictive FM services. In rolling out this roadmap, A*STAR, BCA, Enterprise Singapore and IMDA will work alongside SIFMA to promote the use of such technologies by FM companies.

Facilitating the wider adoption of Smart FM

A Guide to Smart FM has also been made available to developers, Government Procurement Entities and building owners as an easy-to-use reference to identify, implement and reap the benefits of smart technology solutions for their business operations. This guide was jointly developed by a taskforce under the tripartite Facilities Management Implementation Committee (FMIC), comprising representatives from various agencies, building owners, FM service providers, and trade associations and chambers (TACs).

Mr Hugh Lim, CEO of BCA, said: "BCA is glad to be working closely with SIFMA and our tripartite partners in developing the COTR and the Guide to Smart FM, with more than 100 people from 50 organisations involved in workshops and consultations. The COTR and the Guide to Smart FM help firms identify and implement technologies and solutions for FM, such as AI-assisted centralised management systems and 3D printed parts for FM. We hope these efforts will greatly help to improve service delivery through Smart FM technology adoption and facilitate a more progressive and productive FM sector."

Reconstitution of SIFMA

The Singapore International Facilities Management Association (SIFMA) has recently amended its constitution to take in corporate memberships. This would allow SIFMA to better represent and serve the industry by amassing more support and awareness for industry development efforts like the COTR.

BCA TO RECOGNISE TWO NEW ACCREDITATION SCHEMES FOR MANAGING AGENTS AND FIRMS

To support the industry's initiatives in raising the standards of managing agents (MA), the Building and Construction Authority (BCA) will recognise two new accreditation schemes - by the Association of Property and Facility Managers (APFM) and the Association of Strata Managers (ASM) - who expect to roll them out in a year's time. The accreditation schemes aim to raise the professionalism and improve the competencies of MA firms and individual MAs, with a focus on those providing services to Management Corporations Strata Titles (MCSTs).

Under the schemes, individual MAs will need to undergo training conducted by either APFM or ASM, and the BCA Academy. In order for MA firms to receive accreditation, they need to ensure that a minimum number of their individual MAs are accredited. APFM and ASM will administer their respective accreditation schemes through an Accreditation Panel, an Examination Board and a Disciplinary Committee.

The one-year period will allow time for MA firms to send their eligible staff for training, so they can improve their knowledge and competencies, and meet the requirements for accreditation. The lists of accredited MA firms and accredited individual MAs will be published on APFM and ASM's websites.

APFM and ASM will receive a certificate of recognition from BCA for their accreditation schemes, which will be subject to renewal every three years. So far, more than 10 MA firms have indicated their intention to support the accreditation schemes, including Colliers International Consultancy and Valuation (S) Pte Ltd, Jones Lang Lasalle Property Consultants, Newman & Goh Property Consultants Pte Ltd and Suntec Real Estate Consultants Pte Ltd.

Commenting on the initiative, Mr Chin Chi Leong, Commissioner of Buildings, BCA, said, "BCA recognises the need for competent MAs and has worked with the industry associations to develop a competency framework to train and upskill MAs. We are encouraged that the industry is taking the initiative to raise standards and professionalism through a structured programme and accreditation. Individual MAs will learn about key legislative provisions, basic principles of facilities maintenance and services, as well as communications and administrative skills. These skill sets will help improve the running of the estate. We encourage MCSTs to help create the demand by engaging the services of accredited firms and individual MAs, going forward. As a good practice, MCSTs should also spell out the key performance indicators clearly in the service agreement and review the performance of the MA firms and individual MAs on a regular basis".

Dr Lim Lan Yuan, President, APFM, said, "APFM started the Accredited Managing Agent (AMA) Scheme with the

Singapore Institute of Surveyors and Valuers (SISV) in 2003, and it has since been widely accepted and recognised by stakeholders in the property management industry. We are now enhancing the AMA Scheme in tandem with the objectives of the amended Building Maintenance and Strata Management Act, to further professionalise the provision of property and facility management services. Owners of properties, residents, management corporations, managing agents and all in the value chain of property and facility management will benefit from the enhanced scheme, through the structured approach to training, certification and accreditation of persons and firms providing property management services".

Mr Chan Kok Hong, President, ASM, said, "Strata management is a specialised area of property management. It is more complex and demanding, particularly in mixed-use developments where there are likely to be differences in the vested interests of subsidiary proprietors. The accreditation scheme is a timely initiative in upskilling the workforce to meet increasing technological and service demands and in attracting new entrants to join the MA industry which currently faces a shortage of trained strata management personnel. With the accreditation scheme in place, MCSTs can make informed decisions in selecting MA firms and individual MAs who meet their needs while being assured of service quality. ASM is pleased to be a champion of this drive. We are pleased to collaborate with the Real Estate and Construction Academy as the training partner for the accreditation scheme".

New Strata Management Guides

In another effort to help homeowners and council members of strata developments better manage their estates, BCA has put together a series of Strata Management Guides to share best practices and practical information on dealing with common issues faced by MCSTs. BCA developed these guides taking into consideration feedback received through regular stakeholder engagement.

The guides will provide stakeholders and lay persons with greater clarity on their roles and responsibilities with regard to matters concerning strata developments, within the provisions of the Building Maintenance and Strata Management Act. These guides, which will be shared through BCA's website, are meant to serve as an easy-to-understand and practical resource for MCSTs. The first five guides covering fundamental concepts and information on strata management, and common topics relating to general meetings, are now available for download at <https://www1.bca.gov.sg/regulatory-info/building-maintenance-and-strata-management/strata-management-guides>.

ST ENGINEERING PARTNERS SUTD

TO ADVANCE CONTINUOUS LEARNING IN DESIGN THINKING

As part of its ongoing efforts to advance continuous learning, ST Engineering recently signed a Memorandum of Understanding (MoU) with the Singapore University of Technology and Design (SUTD) for the co-development of courses and programmes to build workforce competencies in human-centric design and innovation. The fully-sponsored courses and programmes will equip employees with design thinking skills that will help them approach problem-solving through a user's lens, enabling new perspectives and creativity in developing effective solutions that better address customers' needs.

The MOU is expected to benefit up to 1,000 ST Engineering employees.

Centred on design thinking courses and technical specialist training programmes that are tailored to ST Engineering's operational and training needs, the key areas of cooperation under the MOU include:

- The co-development of new design methodologies for Maintenance, Repair and Overhaul (MRO) operations, which will form the basis of a new three-day MRO-centric design thinking course to help employees develop a more holistic approach to problem-solving. This has applications in areas such as Aerospace MRO where design thinking can help to reduce workflow and process complexities which are increasing as a result of automation. This course will be offered through the SUTD-MIT International Design Centre.
- The development of a tailored 'Innovation by Design' ModularMasters (MM) two-year, part-time programme where senior technical and engineering employees will be able to subscribe to SUTD's bite-sized, skills-based modules to meet their workplace learning needs. Employees who complete the MM programme and wish to further their training in design thinking can advance to SUTD's Master of Innovation by Design (IbD) degree programme where subject credits earned from the MM programme can be used to offset the credits required for the IbD programme. These programmes are designed to give employees more flexibility and opportunities in learning even as they take on full time work.

Prof Chong Tow Chong, SUTD President said, "We are happy to partner ST Engineering in their lifelong learning efforts. Over the past two years, SUTD Academy and the SUTD-MIT International Design Centre's Design Innovation team have delivered Design Innovation training to close to 400 staff from engineering to senior leadership roles. It shows that ST Engineering shares our belief in the effectiveness of design thinking and innovation. With the continued strong support of our industry partners, SUTD is committed to imparting design skills that help workers stay relevant in today's innovation-intensive economy".

Vincent Chong, President & CEO, ST Engineering said, "As businesses retool to adapt to digitalisation and changing

business climates, employees too will need to keep pace and continually acquire new skillsets to sharpen their professional edge. Design thinking will augment our work, enabling fresh perspectives and approaches to solving our customers' challenges, ultimately strengthening our competitiveness."

He added, "As a global company, we remain committed to continuous learning and investing in our employees' growth and professional development. Our collaboration with SUTD adds to the growing list of workforce development initiatives that we have in place to strengthen our employees' competencies and prepare them for the future".

This MoU builds on ST Engineering's past collaborations with SUTD which has seen some 400 employees benefit from its design innovation programmes over the last two years.

In 2018, ST Engineering embarked on a three-year collaboration with the National University of Singapore (NUS) on training programmes that are targeted at strengthening domain expertise in fast-evolving areas. To-date, nearly 500 employees have attended basic and intermediate data analytics courses at NUS.

A training programme with Singapore Polytechnic, focused on building the competencies of engineers and technicians from the company, in digital transformation and robotics, has also benefitted more than 500 employees since 2018.

ST Engineering has also introduced e-learning programmes to promote employee self-development and a continuous learning culture.

ST Engineering and URA to collaborate

ST Engineering recently announced its collaboration with the Urban Redevelopment Authority (URA) to develop and commercialise an Urban Planning Solution that supports global digitalisation efforts in city planning and management. Designed with an open-source technology stack, the solution will benefit city planners of all scales as it can be customised to different cities' needs and reduce the cost outlay.

The solution builds upon URA's existing suite of city planning solutions that have been used for Singapore's URA's urban planning. ST Engineering will leverage its capabilities in modelling, visualisation and sense-making to further enhance URA's urban planning tools and extend the solution for global deployment.

PUB WATER QUALITY DEPARTMENT RE-DESIGNATED AS WHO COLLABORATING CENTRE

Singapore's National Water Agency PUB's Water Quality Department has been re-designated as a World Health Organization (WHO) Collaborating Centre for Safe Management of Drinking Water and Integrated Urban Water Management from 2020 to 2024.

This marks PUB's third consecutive four-year term since 2012. As a WHO Collaborating Centre, PUB played an active role in hosting and participating in WHO Expert meetings, supporting WHO programmes, and contributing technical expertise to WHO research studies and publications.

"This re-designation is a testament to PUB's water management expertise and its high standard of water quality. We are pleased to support WHO and its Member States as a regional knowledge and technical resource centre. It has been a privilege for us to share our expertise, conduct training courses and collaborate actively on research opportunities. We also stand ready to provide resources to assist in drinking-water safety during emergency and disaster response", said Dr Lim Mong Hoo, PUB Chief Specialist (Water Quality) and Director for Water Quality Department.

PUB's Water Quality Department implements a stringent and comprehensive water quality sampling and monitoring programme, and conducts over 500,000 water quality tests annually, covering more than 300 parameters to

ensure a clean and safe water supply to the whole of Singapore. It also carries out R&D to improve water quality and water quality monitoring technologies, and enhance laboratory-testing capabilities.

"WHO is pleased to continue our partnership with PUB. As a leading water utility renowned for its integrated water management and drinking water quality, PUB is a valuable member of WHO's global network and has generously shared its knowledge, experience and resources in drinking-water management towards WHO's urban drinking water and public health strategies. We look forward to greater collaboration between both organisations to implement sustainable water solutions worldwide", said Dr Maria Neira, Director of the Environment, Climate Change and Health Department, World Health Organization.

In its third term as a WHO Collaborating Centre, PUB will also participate in the technical review of chemicals stipulated in the 4th edition of the WHO Guidelines for Drinking-Water Quality, for the publication of the second addendum to the current edition.

PUB is also one of the two WHO Collaborating Centres for Water and Sanitation in the Western Pacific Region. There are a total of 14 WHO Collaborating Centres for Water and Sanitation worldwide.

On-site sodium hypochlorite generation systems combat COVID-19

Italian company, De Nora, a global leader in electrochlorination, water disinfection and water filtration technologies, supports local communities in the fight against COVID-19 and resulting bleach shortages.

De Nora MIOX and ClorTec on-site hypochlorite generators have been confirmed to produce sodium hypochlorite at a concentration range identified by the United States Center for Disease Control to kill the virus that causes COVID-19. De Nora MIOX and ClorTec systems address the issues around the availability of bleach by generating, on-demand, a low concentration sodium hypochlorite solution, which is commonly referred to as bleach, using three everyday consumables - water, electricity and food grade salt. By producing bleach on-site, users can become more independent and self-reliant.

"With offices around the globe, De Nora has been, since the very beginning, on the front line of this pandemic, quickly responding to support our local communities", commented De Nora Water Technologies CEO, Dr Mirka Wilderer.

"On-site technologies are essential in this crisis, and we are proud to be able to share nearly 100 years of chlorine production know-how in several ways. We can offer advice to our customers on how to divert hypochlorite production for other applications such as the cleaning of surfaces. We also provide point-of-use treatment solutions to organisations to safeguard their operations in the face of bleach shortages. Our commitment to being their partner of choice is confirmed by our availability to solve problems side-by-side with our partners and customers, offering our expertise, products, and services to help in the COVID-19 crisis with quick, simple, and reliable solutions", Dr Wilderer added.



De Nora MIOX on-site hypochlorite generator.

ABS 2019 ATTRACTS MORE THAN 10,500 VISITORS AND CONFERENCE

DELEGATES FROM OVER 50 COUNTRIES

The Architecture and Building Services (ABS) 2019 series of events were held from 1 to 3 October 2019, at Sands Expo & Convention Centre, Marina Bay Sands, Singapore.

Organised by Conference & Exhibition Management Services Pte Ltd (CEMS), the events were officially opened on 1 October 2019 by Guest-of-Honour, Mr Zaqy Mohamad, Minister of State, Ministry of National Development & Ministry of Manpower.

ABS 2019 featured six key architectural and building services exhibitions and 12 industry conferences, attracting more than 10,500 local and international visitors, conference delegates and industry professionals from the built environment sectors.

ABS 2019 was also an important platform for the Government to announce initiatives in the dynamic and constantly changing built environment. This included the launch of the Guide to Smart FM.

The initiatives also included the announcement that all government agencies will be required to adopt Outcome-Based Contracts for all new security contracts from 1 May 2020.

The comprehensive platform presented by ABS 2019 spanned 10,000 m² across three exhibition halls and

displayed an array of new products, innovations, technologies and solutions to manage and facilitate transformation of the industries, including the latest Virtual Reality (VR) tools employed by the built environment industries. The events also addressed issues faced by the various industries, brought about by climate change and the call for environmentally sustainable products.

ABS 2019 was driven by the six international showcases - International Facility Management Expo (iFAME) 2019, ArchXpo2019, LED & Light Asia 2019, Safety & Security Asia (SSA) 2019, Fire & Disaster (FDA) 2019 and Work Safe Asia (WSA) 2019.

They attracted a wide array of visitors such as conference delegates and key players from various related industries, including architects, contractors, developers, engineers, facility managers, government agencies and interior designers.

In total, 200 exhibitors from 18 countries displayed their products and solutions at the exhibitions.

ABS 2019 also hosted 12 conferences, workshops and master classes led by industry experts.

Some of the topics discussed included Smart Nation technologies, smart facility management, safety and security of people and buildings, enhancement of fire safety in residential and commercial buildings, as well as manpower management.

Rescheduling of World Cities Summit and concurrent events

The organisers of World Cities Summit (WCS), Singapore International Water Week (SIWW) and CleanEnviro Summit Singapore (CESG) have announced that in view of the corona virus (COVID-19) situation, they have taken the collective decision to reschedule the three events to 20 to 24 June 2021.

The statement also adds that despite the rescheduling of WCS, SIWW and CESG, the organisers will continue to work with strategic partners, business leaders, governments and delegates around the world to discuss challenges, opportunities and share best practices for developing more resilient, sustainable and liveable cities.

More information on the rescheduled events may be obtained by emailing:

info@worldcities.com.sg

info@siww.com.sg

info@cleanenvirosummit.sg

Rescheduling of Ecosperity Week 2020

Temasek has announced that Ecosperity Week 2020 (originally scheduled to be held from 6 to 8 July 2020) has been rescheduled and will now be held from 1 to 4 June 2021. This includes the Ecosperity Conference and Singapore Sustainability Investing and Financing Conference (SSIFC). This decision has been made in line with local and global measures to limit the transmission of the corona virus (COVID-19).

The statement from Temasek says that it prioritises the health and well-being of all attendees, speakers and partners of Ecosperity Week, and will continue working with global business leaders, policymakers, investors, entrepreneurs and academia together to drive action on sustainable development.

More information may be obtained by emailing ecosperity2020@temasek.com.sg

CREATING A SUSTAINABLE

AND SMART WORKPLACE

Surbana Jurong Campus was one of the winners of the inaugural BCA Green Mark for Super Low Energy (GM SLE) Award.



The new headquarters of Surbana Jurong embodies the character of Singapore as a Garden City.

Surbana Jurong Campus won a Green Mark Platinum (Super Low Energy) Award at BCA AWARDS 2019. Including Surbana Jurong Campus, a total of 17 projects received the inaugural Green Mark for Super Low Energy (GM SLE) Award.

Being built in Jurong Innovation District (JID), a vibrant ecosystem of enterprises in advanced manufacturing, urban solutions and smart logistics, the 68,915 m² development will house the global headquarters of Surbana Jurong (SJ), one of the largest Asia-based urban and infrastructure consulting firms. JID is master planned and developed by JTC.

Accommodating up to 4,000 employees, Surbana Jurong Campus will support SJ's rapid growth, by facilitating stronger teamwork and knowledge-sharing among its Singapore and global talents, and will serve as the nerve centre for research and development and innovation in the built environment, to create and bring practical and viable solutions to industry and the community. The location of the campus in JID provides the company access to a vibrant and collaborative ecosystem of R&D and capability developers, startups, and technology enablers, for potential collaborations to accelerate the adoption of smart technologies and solutions.

Designed by Safdie Surbana Jurong, a collaboration between Safdie Architects and Surbana Jurong, the campus will serve to demonstrate what a sustainable, people-centric and future-ready workplace would look like. Created by the renowned architect, Moshe Safdie, the

new headquarters embodies the character of Singapore as a Garden City, by integrating the structure harmoniously with the natural landscape.

SJ's multi-disciplinary team of experts has undertaken the entire development from start to end. This encompasses consultancy solutions from project funding, architecture and landscaping, engineering, workplace strategy, cost and project management, through to integrated facilities management and security services.

Driving digitalisation and innovation

The building of Surbana Jurong Campus will embrace the use of digital technologies to scale up productivity and efficiency, and is well aligned with Singapore's push to transform the built environment sector.

The development will demonstrate SJ's leadership in leveraging Building Information Modelling (BIM) and extending it to a comprehensive Integrated Digital Delivery (IDD) which fully integrates processes and stakeholders along the development value chain through advanced info-communications technology and smart technologies.

Additionally, SJ will apply its proprietary solutions such as BIM:FM technology to the facilities management process to increase productivity and achieve cost savings for long-term building maintenance and operation cycles. The construction also utilises the Design for Manufacturing and Assembly (DfMA) approach, with the use of

precast materials, a competency of SJ displayed in its affordable housing projects.

GREEN BUILDING FEATURES

In line with SJ’s commitment towards delivering sustainable urban solutions, creation of the campus, which is situated in a greenfield site, pushes the boundaries of sustainability, in terms of architectural and engineering design, construction and operation.

Passive design features

The landscape lost is replaced with accessible roof gardens. Further, rain gardens and bio-swales will enhance water conservation.

In order to reduce heat gain into the buildings, a 4-step approach has been adopted:

- Performing climate analysis and sun tracking, and identifying the critical facades.
- Massing of buildings tailored to site and context, minimising direct east- and west-facing facades, and optimising the Window to Wall ratios of the facades to minimise heat gain into the building.
- Providing efficient shading, including a self-shading façade to maximise natural light and minimise solar heat gain and reliance on artificial lighting, whilst also reducing glare.

- Optimising the specification of materials, to achieve an Overall Envelope Thermal Transfer Value (ETTV) of 35.4 W/m².

Active design features

The campus utilises solar photovoltaic technology which will yield around 430 MWh of renewable energy annually.

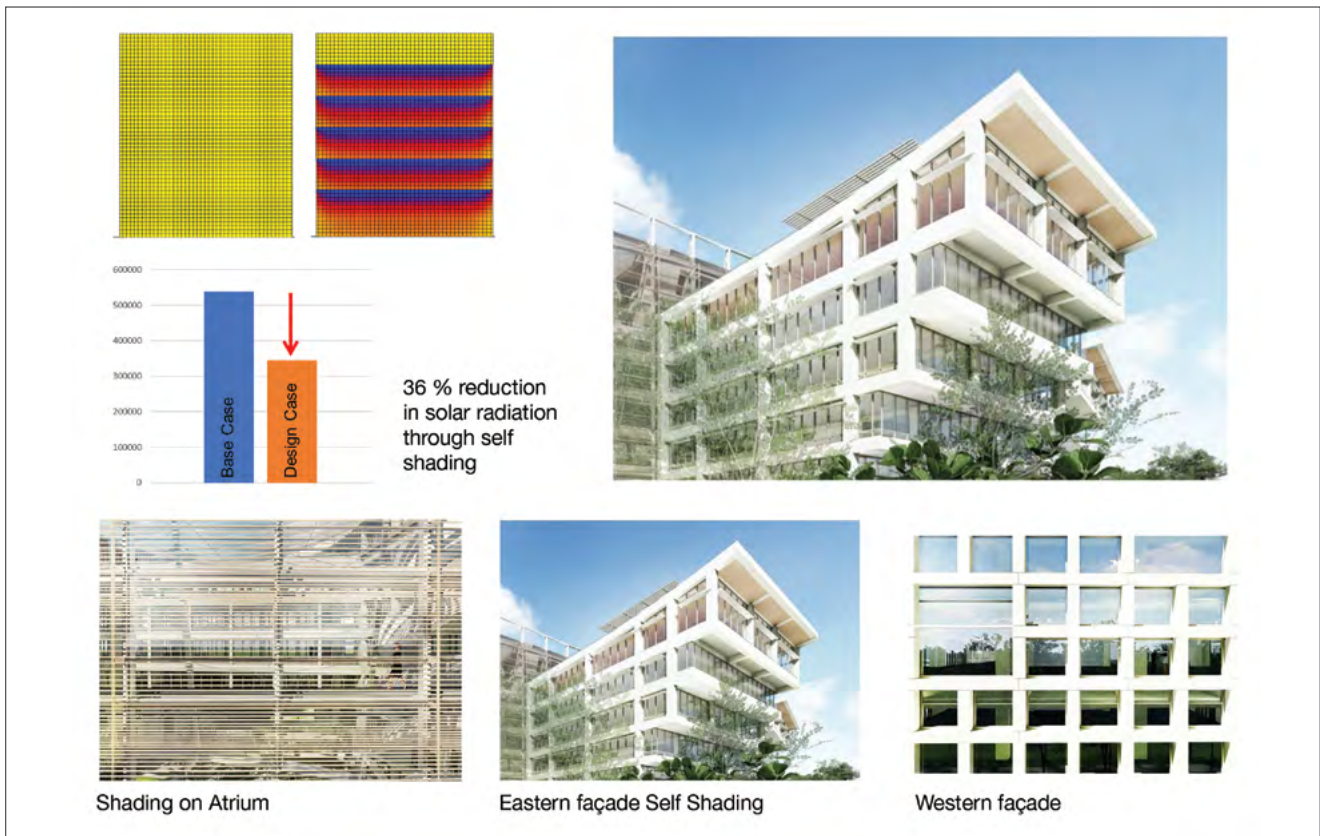
Surbana Jurong Campus is also one of the largest developments in Singapore to fully implement underfloor air distribution for improved indoor air quality and energy savings.

Further, the use of electronically commutated motors for the Air Handling Units (AHUs) is expected to help achieve high air distribution efficiency.

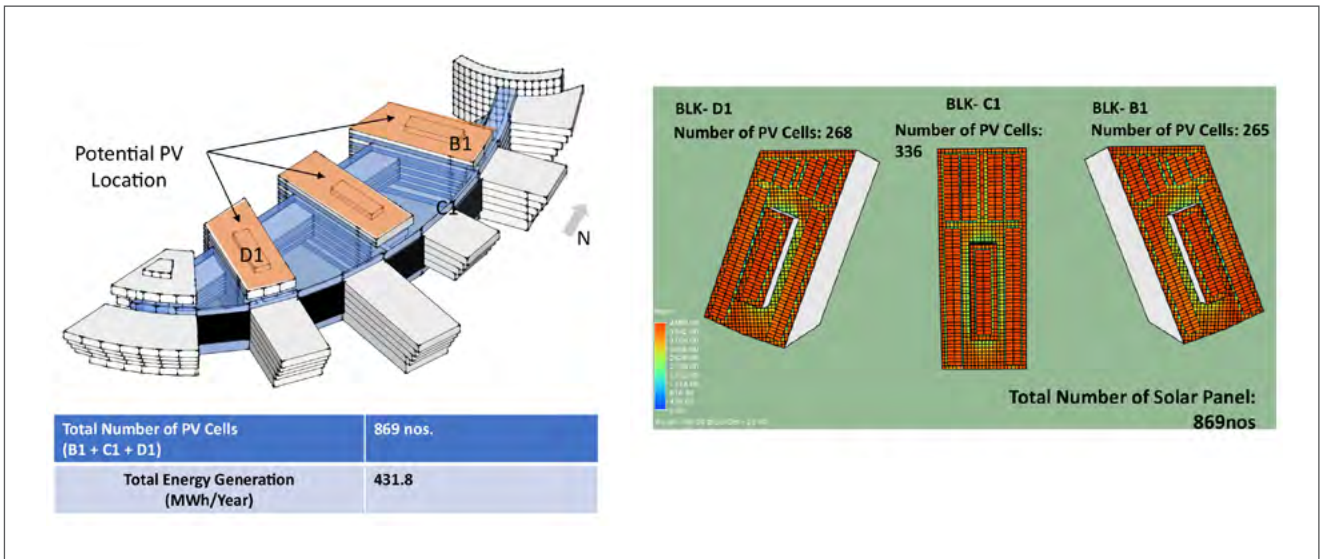
The adoption of Demand Controlled Ventilation, where ventilation levels are determined by CO₂ levels and the fresh air intake is adjusted according to occupancy, also contributes to a reduction in energy consumption.

Surbana Jurong Campus also boasts many other green technologies, including smart lighting and smart parking systems, and predictive smart building control systems aided by live energy and water management dashboards.

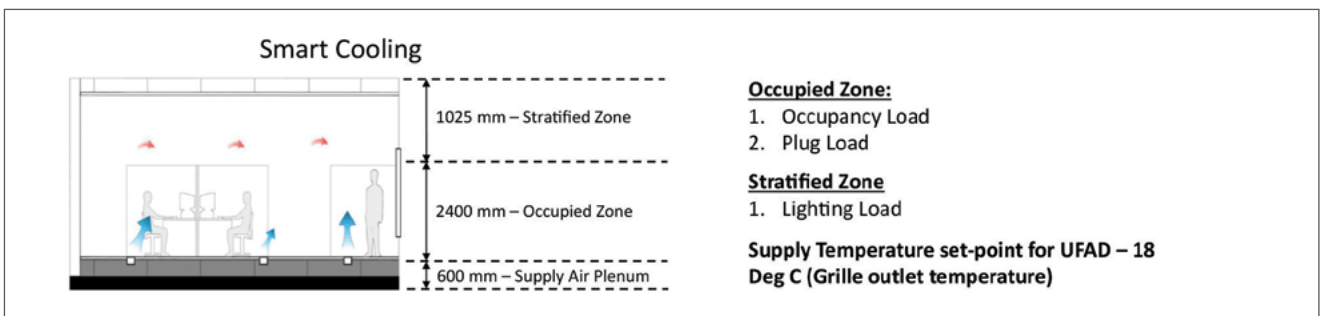
All images by Safdie Surbana Jurong.



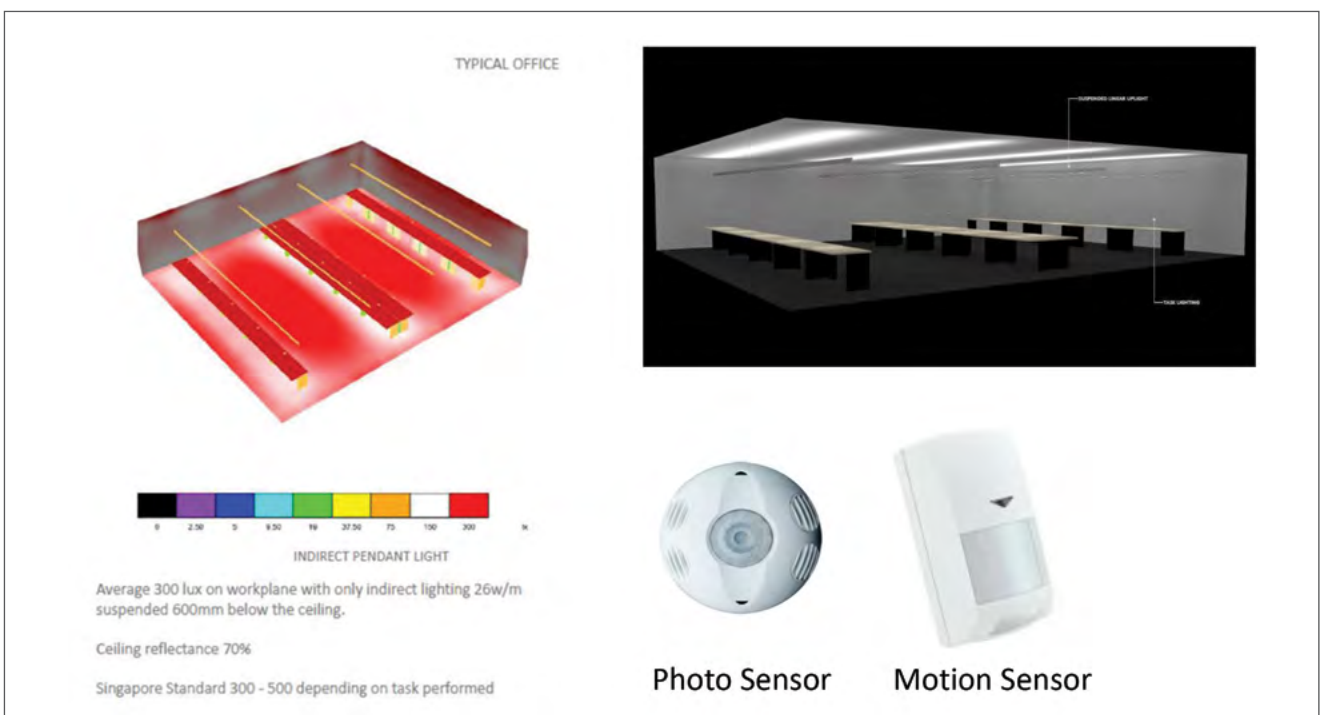
Providing efficient shading of the facades, including self-shading of the eastern façade and optimising the Window to Wall ratio on the western façade, results in a reduction in the heat gain whilst improving daylighting and reducing glare.



The installation of Solar PV will offset 4% of total energy consumption by the building.



Implementation of underfloor air distribution will improve indoor air quality and result in energy savings.



An additional 15% of energy savings will be generated by using smart lighting.

RENEWABLE ENERGY CAN SUPPORT

RESILIENT AND EQUITABLE RECOVERY

IRENA's first Global Renewables Outlook highlights the benefits of decarbonisation of the energy system.

Advancing the renewables-based energy transformation is an opportunity to meet international climate goals while boosting economic growth, creating millions of jobs and improving human welfare by 2050, according to the first Global Renewables Outlook, released by the International Renewable Energy Agency (IRENA) recently.

While a pathway to deeper decarbonisation requires total energy investment up to USD 130 trillion, the socio-economic gains of such an investment would be massive, the Outlook reveals. Transforming the energy system could boost cumulative global GDP gains above business-as-usual, by USD 98 trillion between now and 2050. It would nearly quadruple renewable energy jobs to 42 million, expand employment in energy efficiency to 21 million and add 15 million in system flexibility.

IRENA's Director-General Francesco La Camera said, "Governments are facing a difficult task of bringing the health emergency under control while introducing major stimulus and recovery measures. The crisis has exposed deeply embedded vulnerabilities of the current system. IRENA's Outlook shows the ways to build more sustainable, equitable and resilient economies by aligning short-term recovery efforts with the medium-and long-term objectives of the Paris Agreement and the UN Sustainable Development Agenda".

"By accelerating renewables and making the energy transition an integral part of the wider recovery, governments can achieve multiple economic and social objectives in the pursuit of a resilient future that leaves nobody behind", he added.

The Global Renewables Outlook examines building blocks of an energy system along with investment strategies and policy frameworks needed to manage the transition. It explores ways to cut global CO₂ emissions by at least 70% by 2050. Furthermore, a new perspective on deeper decarbonisation shows a path towards net-zero and zero emissions. Building on five technology pillars, particularly green hydrogen and extended end-use electrification could help replace fossil-fuels and slash emissions in heavy industry and hard-to-decarbonise sectors.

Low-carbon investment would significantly pay off, the Outlook shows, with savings eight times more than costs when accounting for reduced health and environmental externalities. A climate-safe path would require cumula-



Transforming the energy system could boost cumulative global GDP gains, meet climate objectives, as well as contribute to job growth and socio-economic welfare.

tive energy investments of USD 110 trillion by 2050 but achieving full carbon neutrality would add another USD 20 trillion.

The Outlook also looked at energy and socio-economic transition paths in 10 regions worldwide. Despite varied paths, all regions are expected to see higher shares of renewable energy use, with Southeast Asia, Latin America, the European Union and Sub-Saharan Africa poised to reach 70% to 80% shares in their total energy mixes by 2050. Similarly, electrification of end uses like heat and transport would rise everywhere, exceeding 50% in East Asia, North America and much of Europe. All regions would also significantly increase their welfare and witness net job gains in the energy sector despite losses in fossil fuels. However, economy-wide, regional job gains are distributed unevenly.

While regional GDP growth would show considerable variation, most regions could expect gains.

Raising regional and country-level ambitions will be crucial to meet interlinked energy and climate objectives and harvest socio-economic welfare. Stronger coordination at international, regional and domestic levels will be equally important, the Outlook concludes, with financial support being directed where needed, including to the most vulnerable countries and communities. As partner of the Climate Investment Platform, launched to drive clean energy uptake and mobilise clean investment, IRENA will advance collaborative action targeted to help countries create enabling conditions and unlock renewable investment.

(More information on IRENA can be obtained from www.irena.org)

LEADING REAL ESTATE COMPANY DISCLOSES

ESG PERFORMANCE AND STRATEGY TO ACCELERATE CLIMATE ACTION

The company also achieves top positions in international rankings and indices.

City Developments Limited (CDL) has released its Integrated Sustainability Report (ISR) 2020 'Changing the Climate. Changing the Future', its 13th sustainability report since 2008. The digital report communicates CDL's progress in 2019 towards its material Environmental, Social and Governance (ESG) goals and targets established under the CDL Future Value 2030 sustainability blueprint. This forward-looking blueprint drives CDL's integrated sustainability strategy towards 2030, a milestone year for sustainable development and the global climate agreement.

According to the 2019 Global Status Report for Buildings and Construction, the built environment sector accounts for some 40% of global energy-related greenhouse gas emissions. With the global push for a low-carbon economy, there is great potential for the built environment to contribute to a climate-resilient future. CDL's ISR 2020 highlights its strategy anchored on four pillars - integration, innovation, investment and impact. It reports the company's efforts in accelerating green building and sustainability efforts as well as expanding its outreach and advocacy to a larger ecosystem comprising multiple stakeholders along its value chain.

Mr Sherman Kwek, CDL Group Chief Executive Officer, said, "The current COVID-19 global pandemic serves as a reminder of things that many of us take for granted - our environment, our health, our safety and our freedom. Many countries have implemented unprecedented restrictions to contain the COVID-19 spread and these disruptions to our businesses, communities, supply chains and daily lifestyles have caused us to rethink and recalibrate our way of life. One ray of light during this timeout is that it offers Mother Nature a much-needed breather from the impact of rapid globalisation, production and excessive consumption. In this coming decade leading up to 2030, there is an even more urgent need for businesses to collectively reduce their carbon footprint and actively accelerate climate action. Every stakeholder shares the responsibility to protect our fragile environment".

Ms Esther An, CDL Chief Sustainability Officer, said, "Since we integrated sustainability into our business 25 years ago, CDL has continued to push the envelope with green building innovation and climate-focused strategies, integrating ESG within the business to create long-term value for our stakeholders. In the midst of the COVID-19 pandemic and the current climate crisis, CDL will continue to strengthen our ESG strategy and climate resilience, sharpen our competitive edge through innovation, and proactively cultivate a strong, global eco-conscious business mindset in the communities we operate in."



The Singapore Sustainability Academy is one of CDL's sustainably designed and built projects. Located at City Square Mall, Singapore's first Eco-mall, the zero-energy academy is a Green Mark Platinum building awarded by the Building and Construction Authority, and the first in Singapore to have its construction materials, Cross Laminated Timber (CLT) and Glued Laminated Timber (Glulam), verified by the Nature's Barcode system as coming from responsible sources.

Strategic ESG integration

CDL's track record in effective ESG integration and sustained performance has been recognised by 12 leading global sustainability rankings and indices, including the 2020 Global 100 Most Sustainable Corporations in the World by Corporate Knights in which CDL was ranked the world's top real estate company as well as the top Singapore company. CDL was also the only company in Southeast Asia and Hong Kong to score double 'A's in the 2019 CDP Global A List for corporate climate action and water security.

In the year under review, CDL achieved a 38% reduction in carbon emissions intensity from base-year 2007, meeting its interim 2019 target and is firmly on track to achieve its target of a 59% reduction by 2030. In addition, from 2012 to 2019, CDL achieved more than SGD 28 million in savings due to energy-efficient initiatives and retrofitting works at eight of its commercial buildings.

As the first real estate company in Singapore to have its carbon reduction targets assessed and validated by the Science Based Targets initiative (SBTi), CDL took a step further in its carbon management by joining the pioneer batch of 87 companies worldwide to pledge support to the UN Global Compact's 'Business Ambition for 1.5°C' campaign in September 2019. CDL pledged to set climate targets across its operations, aligned with limiting global temperature rise to 1.5° C.

To augment business resilience and capital investment, CDL embarked on its second climate change scenario planning exercise in 2019 where a more stringent 1.5° C

warmer scenario was studied, covering the financial impact of physical and transition risks of CDL's properties in its major markets. It also conducted a supply chain study to identify and assess the environmental and social risks of its top suppliers and frequently used building materials.

CDL is the first Singapore company to embrace the UN SDGs in its ISR since 2016, and it has further aligned its ESG efforts with 14 relevant UN SDGs out of 17, with an increased focus on UN SDG 3 (Good Health and Well-being). Since 2018, CDL has stepped up its embrace of UN SDG 3 in the way it manages its properties and engages its stakeholders with a view to promoting awareness and the adoption of healthy and active living.

More effective sustainability-related disclosures

As an early adopter of sustainability reporting, CDL's robust and progressive sustainability reporting has evolved into a hybrid model that harmonises with the demand for increased corporate ESG disclosures by investors. CDL has adopted global frameworks such as GRI Standards since 2008, IIRC's Integrated Reporting Framework since 2015 and SDG Reporting since 2016, and disclosures such as those recommended by the Task Force on Climate-related Financial Disclosures (TCFD) since 2017 and the Sustainability Accounting Standards Board (SASB) in 2019.

Given the rise of ESG investing and responsible banking, CDL's ESG-centric vision has allowed the company to tap on green financing. Last year, CDL secured its first green loans amounting to SGD 500 million for new property developments and pioneered a first-of-its-kind SGD 250 million SDG Innovation Loan - an expansion from its pioneering issuance of a SGD 100 million green bond by a Singapore company in 2017.

With the privatisation in 2019 of its former London-listed hotel subsidiary, now known as Millennium & Copthorne Hotels Limited, CDL is looking to enhance the alignment between the hotel subsidiary's ESG practices and CDL's long-standing sustainability strategy so as to achieve greater synergy within the Group.

To ensure accuracy and transparency, CDL's ISR 2020 is independently assured by Ernst & Young in accordance with the International Standard on Assurance Engagements 3000 (Revised) and the greenhouse gas emissions disclosures are externally verified in line with ISO 14064.

CDL's Integrated Sustainability Report 2020 is available on www.cdlsustainability.com.

Corporate leadership in climate action and water security

For its robust and multipronged climate and water strategies and disclosures, CDL is the only company in South-east Asia and Hong Kong to be recognised on both the 2019 CDP A List for corporate climate action and 2019 CDP A List for water security.

CDP is a global non-profit that drives companies and governments to reduce their greenhouse gas emissions, safeguard water resources and protect forests.

This is the second consecutive year that CDL has received an 'A' score for climate change strategy, and the first year that the company has received an 'A' score for water security, based on its first participation in the CDP disclosure for water security.

In Singapore, in addition to the huge potential to reduce carbon emissions, there is also the urgency to tackle the country's water requirements. In 2015, Singapore was projected by the Water Resources Institute to become one of the world's most water-stressed countries by 2040.

In the face of the global climate emergency and resource depletion, CDL's long-standing climate and water management strategies help future-proof its business for a new climate economy.

CDP is widely recognised as the gold standard of corporate environmental transparency, using a detailed and independent methodology to assess organisations. It allocates a score of A to D- based on the comprehensiveness of disclosure, awareness and management of environmental risks, and demonstration of best practices associated with environmental leadership, such as setting ambitious and meaningful targets. While more than 8,400 companies disclosed environmental data through CDP in 2019 for independent assessment against its scoring methodology, only 181 companies and 72 companies have made the A grade for their action on climate change and water security, respectively.

Mr Sherman Kwek, CDL Group Chief Executive Officer, said, "CDL is honoured to be recognised by CDP with two regional awards - 'CDP 2019 A List: Climate Change' for two consecutive years and 'CDP 2019 A List: Water Security' for the first time. 2019 ended the decade with record heat, devastating bushfires and high-impact weather that have continued to plague our environment. In this new decade, there is an urgency for businesses to actively reduce their carbon footprint and accelerate climate action. As a significant contributor to carbon emissions, the building sector must play a bigger role in driving emissions reduction. Being on the 'A List: Water Security' reaffirms our commitment to conserving precious water resources in Singapore, which was ranked first among various countries as having the highest risk of water-stress by 2040 according to the World Resources Institute. CDL will continue to steer affirmative climate action to support the global agenda towards a low-carbon and sustainable future by 2030."

As part of its carbon management strategies, CDL has implemented a science-based approach to setting reduction targets for carbon emissions intensity. In 2018, CDL was the first Singapore property company to have its carbon reduction targets validated by the Science Based Targets initiative (SBTi). CDL has raised its carbon emission intensity reduction target to 59%, from the previous 38%, across its Singapore operations by 2030 from base-year 2007. For its development projects, CDL has committed to using sustainable building materials, instead of their conventional equivalents, to reduce embodied carbon by 24% by 2030.

To further lower CDL's carbon footprint, CDL is increasing the adoption of solar energy through the procurement of Renewable Energy Certificates (RECs). By procuring locally-sourced RECs, CDL can attribute 100% of the electricity consumed by its headquarters' operations and part of its commercial buildings' operations in 2019 to renewable sources.

In 2015, CDL established targets to reduce water use intensity by 15% against 2007 levels by 2030, and in 2017, as part of its ambitious targets in the CDL Future Value 2030 sustainability blueprint, CDL voluntarily raised its reduction targets to 38% against 2007 levels by 2030. As part of its strategic approach in water management, CDL also annually performs an impact analysis on its utility bills to better understand the implications of higher water tariffs.

CDL ranked the world's top real estate company

At the World Economic Forum 2020, held in Davos, Switzerland, in late January 2020, it was announced that CDL has been ranked the world's top real estate company, on the 2020 Global 100 Most Sustainable Corporations in the World, taking 36th place. Since 2010, CDL is the first and only Singapore company to be included for 11 consecutive years in Global 100, one of the world's leading sustainability indices. This year, CDL has once again emerged as Singapore's top-ranked sustainable company, a position held since last year.

Analysed by Corporate Knights, a Toronto-based international media and investment research firm, the Global

100 ranking is recognised as the world's pre-eminent sustainability equity index and gold standard in corporate sustainability analysis.

Mr Sherman Kwek, CDL Group Chief Executive Officer, said, "Climate change affects all of us and concerted action is needed to mitigate its impact. Beyond delivering financial performance, businesses have a responsibility to their investors, stakeholders and the community to drive environmental stewardship. We are immensely honoured to be recognised as the world's most sustainable real estate company. Over the past two decades, our ethos to conserve as we construct has led to our prioritisation of ESG integration to create value and future-proof our business. The Global 100 ranking affirms our progress and initiatives to drive transformations for our industry and be a change catalyst. We will continue to strengthen our ESG targets, innovate and proactively encourage a global green-minded business mindset. Working together with other stakeholders within the larger ecosystem, we will forge ahead in the new climate economy and steer our built environment towards a more sustainable future".

CDL's Future Value 2030 sustainability blueprint

Since CDL launched its Future Value 2030 sustainability blueprint in 2017, which sets ambitious ESG targets that contribute towards the UN SDGs, CDL increased its carbon emissions reduction target from 38% to 59% (from baseline year of 2007) and aims to reduce embodied carbon in building materials by 24% com-



To-date, close to 70% of CDL's portfolio of Green Mark certified developments and office interiors are rated Green Mark Gold^{PLUS} and Platinum. This includes its flagship building, Republic Plaza (shown in the picture), which received the highest tier Green Mark Platinum certification.

pared to their conventional equivalents, as mentioned earlier.

In addition, CDL proactively adopts sustainable construction methods and integrates innovative technologies to enhance the environmental performance and financial value of its properties, as well as create comfortable green living spaces. To optimise resource and cost-savings, sustainability considerations are factored into the entire development lifecycle, starting from land acquisition and design to construction and building management. Since 2011, CDL has set a minimum target for all its new developments to achieve a Green Mark Gold^{PLUS} certification by Singapore's Building and Construction Authority (BCA), exceeding the mandatory Green Mark certification level.

To-date, close to 70% of CDL's portfolio of Green Mark certified developments and office interiors are rated Green Mark Gold^{PLUS} and Platinum - the highest tier certification. It is also on track to achieve its target of achieving Green Mark certification for 80% of CDL owned and/or managed buildings by 2030.

CDL is also listed on 11 other leading sustainability benchmarks, rankings and indices such as CDP (since 2008); Dow Jones Sustainability Indices (since 2011); FTSE4Good Index Series (since 2002); and MSCI ESG Leaders Indexes (since 2009) and 'AAA' ratings by MSCI ESG Research (since 2010).

More information on CDL's sustainability efforts can be found at www.cdlsustainability.com.

BCA introduces new Green Mark scheme for transit stations

The Building and Construction Authority (BCA) has introduced a new Green Mark scheme for transit stations, which was developed in consultation with Land Transport Authority (LTA) and industry practitioners involved in station developments, to ensure that their design, construction and operation can be enhanced in an environmentally sustainable way. The scheme was piloted in four MRT stations over the past one year. Canberra Station is the first to be accorded the Green Mark Platinum Award under the new scheme.

With increasing demands from urban development, our rail network will be expanded over the next few decades. It is important for transit stations to be designed with environmental sustainability in mind to cut down on their carbon footprint. Adapted from the BCA Green Mark scheme established in 2005, the new Green Mark for Transit Stations scheme was tailored to the specific needs and operational requirement of transit stations in Singapore.

Besides setting a high standard for energy performance, the scheme also considers criteria such as integration with its surroundings, with seamless connectivity and accessibility to all public transport nodes such as bus stops and taxi stands. The scheme also places high emphasis on ventilation performance of the station design, which enhances the thermal comfort of users. At least 50 stations are estimated to be in the pipeline to meet the Green Mark Platinum standard, and from these developments, there is an estimated reduction in energy consumption of about 33 GWh per annum, which translates to the energy used to power up 7,500 4-room HDB flats per year.

BCA Chief Executive Officer Mr Hugh Lim said, "BCA has been constantly reviewing and improving the Green Mark scheme to ensure that it remains relevant to the evolving needs of the people and the built environment. With the increasing demand for transit

facilities, this new addition to the suite of Green Mark schemes will provide a holistic framework to enhance the sustainability of transit stations. We are glad to have LTA's support in the development of this new scheme as we continue to push for higher environmental sustainability standards, as part of Singapore's efforts to mitigate the environmental impact of urbanisation".

Canberra Station, the first to be accorded the BCA Green Mark Platinum Award under the new scheme, was constructed with extensive use of environmentally-friendly materials and products. The station incorporates biophilic design to help liven and enhance commuters' experience. Edge planting, green roofs and vertical greenery along with daylighting provision within the platform help to provide thermal comfort as well as visual relief. During the design stage, the design team also conducted an in-depth study to ensure the effectiveness of weather protection measures against wind-driven rain, for commuters' comfort. This ensures that the station remains well-ventilated at all times, while minimising infiltration of rain during heavy showers. The station is also equipped with automatic dual speed escalators, an energy-efficient lift system, LED lighting, water-efficient fittings and an irrigation system with rain sensors.

Said Land Transport Authority Chief Executive Ngien Hoon Ping, "As part of our long-term vision to provide a transport network that is convenient and well-connected, we will be adding new stations to our existing network over the next few years. In tandem with our goal of improving rail connectivity, we are equally committed to implementing practices that promote environmental sustainability throughout the planning, design and construction of our stations. The Green Mark Platinum certification for Canberra Station shows our efforts are on the right track and encourages us to strengthen our efforts".

DESIGN AND CONSTRUCTION OF A SUPER TALL TOWER IN CHINA -

A SINGAPOREAN ENGINEER’S INVOLVEMENT AND PERSPECTIVE

by Yap Chuen Meng, WSP Singapore

This article documents the Author’s involvement in the Construction Administration and Site Supervision stages of a super tall tower project, in Tianjin, China. The challenges during these stages included facilitating cross-office collaboration, BIM-related collaboration with the Contractors, and managing the design changes with the Contractors. Also, some technical design challenges are briefly discussed, such as stacking three functions in a single tower; Mechanical, Electrical and Plumbing (MEP) floor considerations; and designing for a cold climate.

INTRODUCTION

The Tianjin CTF Finance Centre, a 530 m super tall, mixed-use tower, is a 380,000 m² development comprising multiple function Grade A offices, a 5-Star hotel and apartments, and sitting over a 5-storey retail podium and basement car parks. The Council on Tall Buildings and Urban Habitat (CTBUH) recognises the Tianjin CTF Finance Centre as one of the world’s tallest completed buildings.

WSP provided MEP System Engineering Design, Procurement, Construction Administration and Site Supervision services. Engineering Design started from 2009 and the project was completed in 2019.

The WSP Hong Kong team conceptualised and developed the MEP systems design with the Architects, Skidmore, Owings & Merrill (SOM) and Ronald Lu and Partners (RLP). The MEP systems included HVAC, Electrical, Plumbing and Sanitation, Fire protection, and Extra Low Voltage (ELV) systems.

The Author was involved in the project while working in the WSP Beijing Office. He was involved in the project’s Construction Administration and Site Supervision stages. The involvement period was from 2013, which covered the project’s basement excavation to substantial completion.

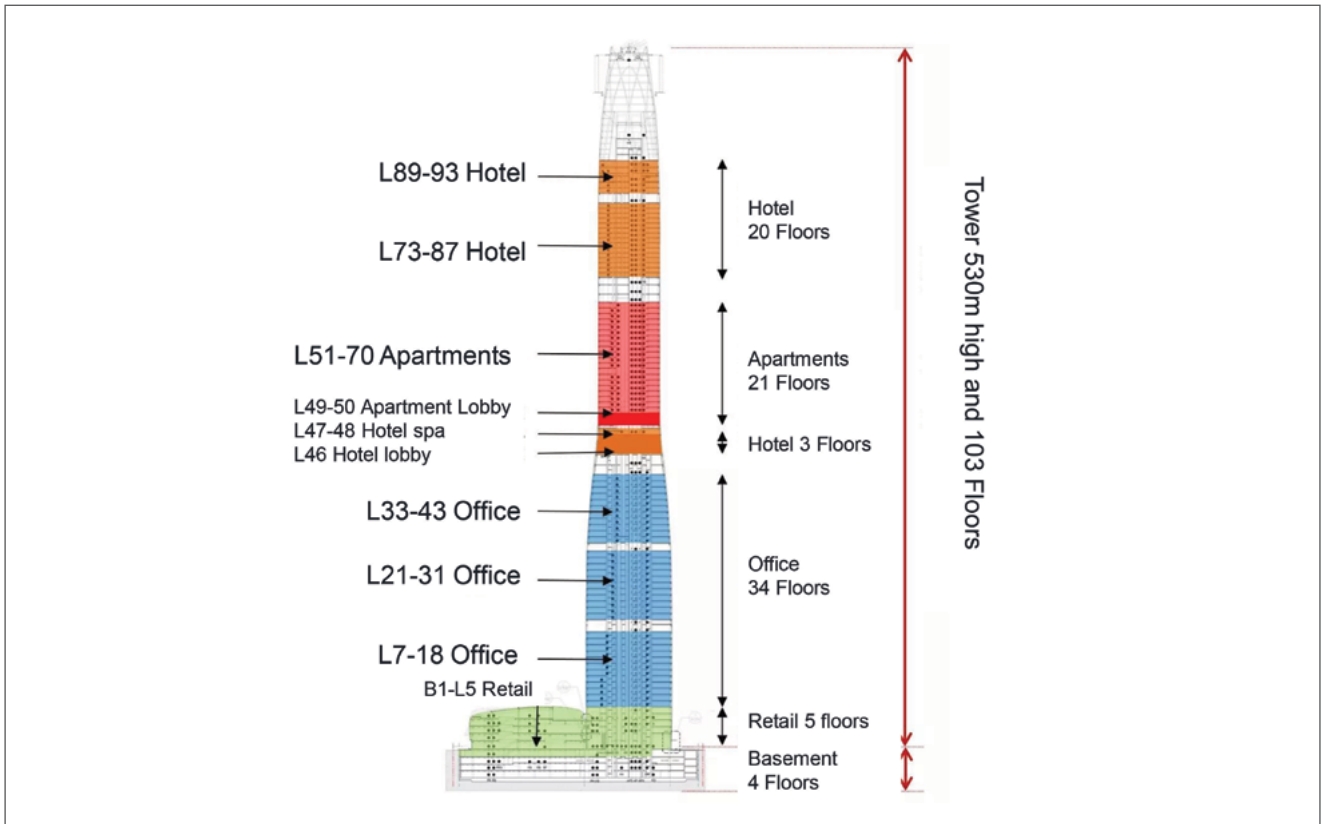
The Main Contractor for the project was China State Construction Engineering Corporation, 8th Engineering Division Corp (CSCEC).



Aerial view of the super tall Tianjin CTF Finance Centre. Image: CSCEC.

	Area	Description
Total	291,500 sqm above ground And 98,000 sqm below ground	530meter tall tower and 103 floors
Grade A Office	141,000 sqm	L7 to L43
Apartment	48,500 sqm	L49 to L70
5 Star Hotel	64,000 sqm	L46 – 48 and L73 to L93
Retail	38,000 sqm	B1 to L5 Retail
Basement carpark and back of house	98,000 sqm	

Project data.



Multi-functional stacking of the tower.



Time-lapse photo collage showing the construction sequence, from basement, superstructure, facade and internal MEP system, to completed project. Image: CSCEC.

PROJECT MANAGEMENT

DESIGN STAGE

The MEP design was undertaken by Parsons Brinckerhoff Hong Kong office, which later globally changed its name to WSP Hong Kong, following its acquisition by WSP. As the Author was based in the Parsons Brinckerhoff Beijing office (later WSP Beijing), during the project’s design stage, he provided code interpretation inputs, participated in inter-office discussions and shared his design experiences on super tall tower design projects in China, like Qingdao Hai Tian Center (370 m), Qingdao Centre (300 m) and Beijing CBD Z6 (formerly 400 m).

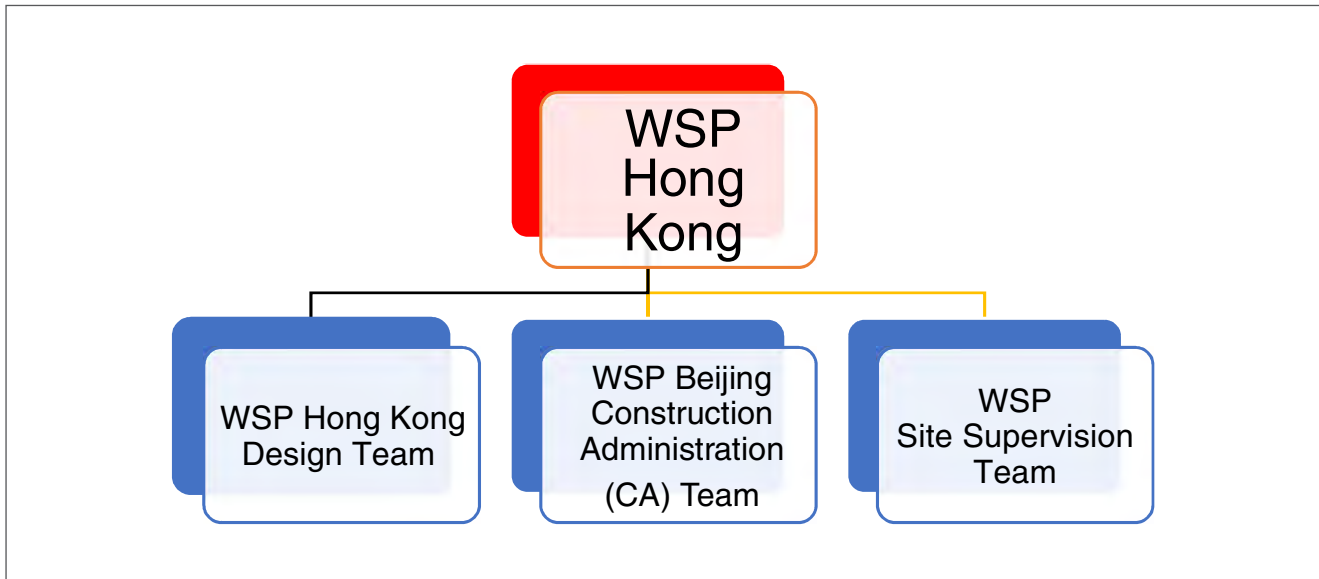
CONSTRUCTION ADMINISTRATION AND SITE SUPERVISION

The project team, during the Construction Administration and Site Supervision stages, comprised WSP Hong Kong and Beijing Offices and the Site Team.

As the Construction Administration stage involved three locations, careful consideration had to be given to the following:

Division of roles and responsibilities

As this was a large-scale project, substantial resources were mobilised across the Hong Kong and Beijing offices, during the Construction Administration stage. However,



WSP's project organisation chart.

being organised and well managed is a prime factor for success. In the Construction Administration stage, review work on the Contractors' submittals was divided among the three teams. All system design-related shop drawings and major equipment were reviewed by WSP Hong Kong. Detailed shop drawings and minor equipment and fittings were reviewed by WSP Beijing. Method statements and testing procedures were reviewed by WSP Beijing and the Site Team. In assisting the Main Contractor to develop the BIM model, WSP Beijing deployed full time staff at the site, for three months, to resolve main services routing and co-ordination, create a clash-free model, and assist in model updates to reflect major design changes.

Inter-team communications

Daily communication was done through emails and phone calls. Weekly communication was done through three-way, inter-office teleconferencing, to discuss progress, installation issues, and the path forward. Monthly meetings in Tianjin were attended by the Author and the Site Team, to discuss progress and technical issues. Quarterly meetings in Tianjin were attended by the Hong Kong Team, the Author and the Site Team. Ad-hoc meetings were conducted through teleconferencing, when required.

Document management

ACONEX was adopted as the project's document management system. It is a web-based platform from where collaboration and processes like shop drawing submittals, equipment and product submittals, and review comments were managed.

Design change management

Design changes were communicated from the Design Team to the Construction Administration Team. Where there was a major design change, the Design Team would issue new drawings for the Construction Administration Team to follow up with Contractors. Minor design changes were issued as written instructions to the Contractor,

and the Construction Administration Team followed up with the Contractors. The Design Team communicated with the Local Design Institute on regularising all submission drawings.

Working with the Main Contractor and Sub-Contractors

The Construction Administration Team and Site Supervision Team worked closely with the Main Contractor and Sub-Contractors to manage progress, quality, budget and timely information dispersion.

TECHNICAL CHALLENGES

For a Singaporean engineer, it was a treasured opportunity to be involved in a 500+ m super tall tower, and address several challenges in the project.

OVERALL DESIGN CHALLENGES

MEP services for multi-functional building

Two functions being stacked into a single super tall tower is common. Examples of such projects include China World Trade 3 in Beijing (330 m), with offices and hotel, which was completed in 2008, and Shanghai Tower in Shanghai (632 m), with offices and hotel, which was completed in 2016.

Three functions (office, hotel and apartments) being stacked within a single tower is less common. Examples of such projects include Burj Khalifa (827 m), in Dubai, completed in 2010, and Guangzhou CTF Finance Centre (530 m), in Guangzhou, completed in 2017.

In a project with multiple functions, each function requires its own MEP system to meet ownership, facilities management and performance requirements. The Tianjin CTF Finance Centre project has four functions - offices, hotel and apartments in the tower and retail outlets in the podium. There were four separate MEP plants, piping and cable trays. However, to reduce investment cost and system complexity, MEP equipment and services were combined where technically possible

and allowed by the Client. Despite this, multiple pipes and cable trays still run in the basement. Their positioning had to be well-co-ordinated and care had to be taken to ensure they did not enter other function areas. In the basement, multiple pipes and cable trays to carry cables for three functions had to enter into the core to rise up to the tower. Strategies for entry at different floors, advanced planning of riser locations in relation to the functional zones / MEP floors, basement core corridor services height co-ordination, and routing of specialised items like the hotel laundry chute, had to be considered. BIM 3D co-ordination and implementation proved to be a useful tool, as there was instant visualisation and clash detection, unlike working with a 2D CAD system.

Multiple MEP floors

Within the tower, there were six MEP floors. L19 & L20 house the major office MEP equipment, L44 & L45 house the apartment zone's major MEP equipment, L58 house the apartment zone's minor MEP equipment, L71 & L72 house the hotel's major MEP equipment, and L88 and L93-96 house the hotel's minor MEP equipment. Within the MEP floors, planning of the plant rooms and co-ordinating the delivery of the multiple services along the corridors were crucial to the success in delivering the MEP systems for these floors. Special consideration was given to the staircase pressurisation ducts. These are large-sized, fire-rated ducts, running from the fan room into the staircase pressurisation shaft. The Construction Administration Stage Engineers had to work with the Designers, BIM modellers and the Contractors Team to resolve all MEP co-ordination issues, using 3D BIM.

High pressure fittings and equipment

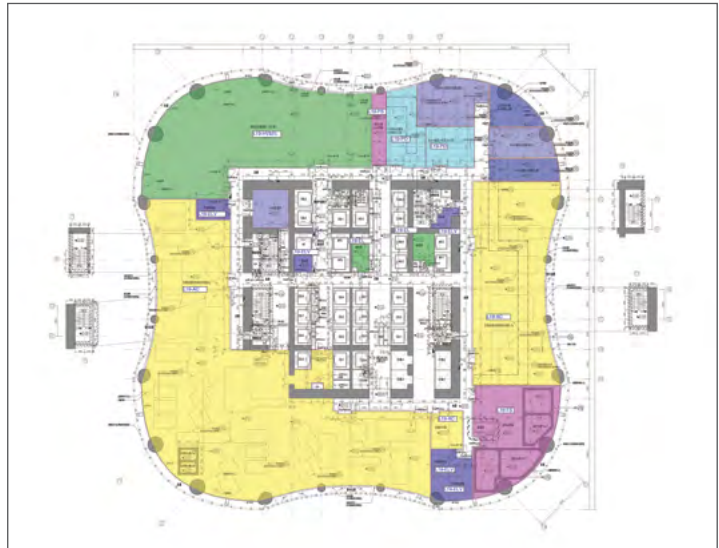
The Construction Administration Stage Engineers checked the design pressures against pressure ratings of fittings and equipment to ensure that the design pressures are below the pressure ratings of fittings and equipment, and to ensure that flanged joints requiring fastening of bolts had sufficient space for tightening of the bolts.

Efficient vertical transportation system

The tower has Grade A offices, luxurious apartments and a 5-Star hotel. The highest performance is expected of the vertical transportation system, in terms of waiting time, handling capacity, size of lifts and comfort of ride. Specialised Lift Traffic Analysis software was used to carry out a detailed study of the vertical transportation system.

Tower core

The tower core accommodates MEP elements (lifts, numerous MEP risers and AHU rooms), architectural elements (staircases, lift lobbies, the first floor traffic into the lift lobbies) and structural elements (structural core walls, lintel beams and corners). The Architect, Structural Engineer and MEP Engineer collaborated to incorporate all these into the design. At the Construction Administration Stage, the Construction Administration Stage Engineers had to work with the Main Contractor and Sub-Contractors to co-ordinate architectural design,



An MEP floor's multiple plant rooms for various functions.

structural elements and MEP services for each floor, to ensure suitability for construction.

Geographical location

The project is located in the northern hemisphere, in a region that has a hot, humid summer and a cold, dry winter. Cooling and dehumidification is required in summer. The air-conditioning system requires low chilled water temperatures to achieve the required dehumidification of the fresh air intake and the cooling of the air-conditioned spaces. This design requirement is like the requirement in Singapore. However, the air-conditioning system also had to have dual ability, as it has to do outer zone heating and inner zone cooling in winter. The outer zone is close to the external glass façade and heating has to be provided, while the inner zone gains heat gained from occupants and lighting, and cooling is more regularly required. In winter, humidification of the air-conditioning air is required. The selection of a suitable humidification technology required detailed study and can be discussed in a separate, specialist article. In winter, there is the possibility of MEP services being subjected to freezing/icing, thus anti-freeze designs for water carrying pipes were crucial. The measures included externally installed pipes with wire heating wrap and sufficiently thick thermal insulation, wire heating for outdoor dampers and using a pre-action fire sprinkler system for the Basement 1 carpark.

Typically, in Northern China, the practice is to use a low energy consumption cooling system during winter. In winter, the cold water for the air-conditioning system is generated through dedicated dry type cooling towers in lieu of chillers. The cold water temperature is typically sufficient for the air-conditioning system to do sensible heat removal. The chillers do not need to operate for this purpose. Also, heat recovery between exhaust air and fresh air is provided at the MEP floors through a heat recovery system. The Construction Administration Stage Engineers had to work with the Designer, Vendors and Contractors to ensure the above were implemented as specified.

TECHNICAL CHALLENGES (OFFICE ZONE)

Design of a dual cooling and heating system

As described in the earlier section, a dual cooling and heating system was required, thus a VAV air-conditioning system and perimeter underfloor radiators were designed for the office zone.

In Singapore, designing a VAV air-conditioning system is common in offices. However, in a cold climate, perimeter heating near the glass façade is required. In this project, a underfloor radiator system was designed to keep the occupants located near the glass façade (perimeter zone occupants) warm. The Construction Administration Stage Engineers had to work with the Designer, Site Team and Contractors to ensure that the underfloor radiators, piping, valves and floor grilles were integrated and co-ordinated with the raised floor system, for a seamless and aesthetically pleasing look for the office floor.

Engineered smoke exhaust system for the office zone

The Code of Practice in China requires an engineered smoke exhaust system for the office zone, which uses fire-rated ducts. The Construction Administration Stage Engineers had to include the additional duct and co-ordinate it with other MEP services in the office floor.

TECHNICAL CHALLENGES (APARTMENT AND HOTEL ZONES)

Apartments

Typical DX units with outdoor condensing units are not suitable for deployment in apartments in super tall towers. A central air-conditioning system using a 4-pipe system and full apartment floor heating has been provided. Also, a central hot water system has been provided for the bathrooms in the apartments, instead of an electric hot water storage heater inside each apartment.

Swimming pool

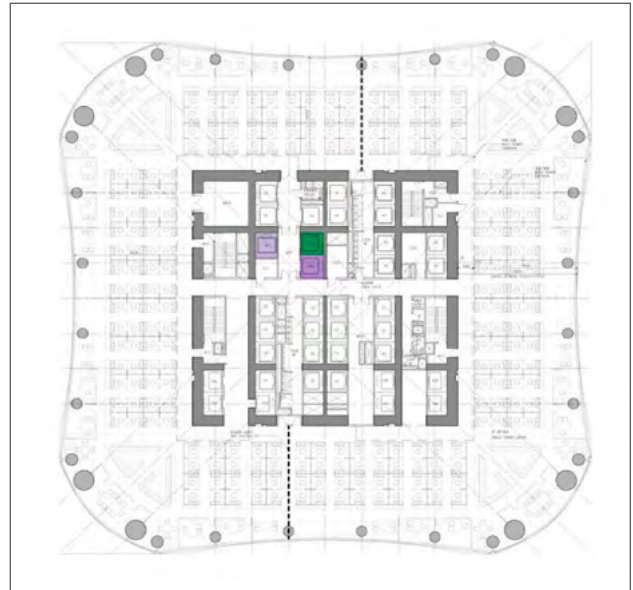
The hotel has an indoor swimming pool. The provision of heating for the swimming pool water and preventing surface condensation during winter were challenges that had to be addressed. A dehumidifier cum energy recovery system has been provided to dehumidify the air and simultaneously recover heat to partially heat the indoor swimming pool water.

Hotel guest rooms

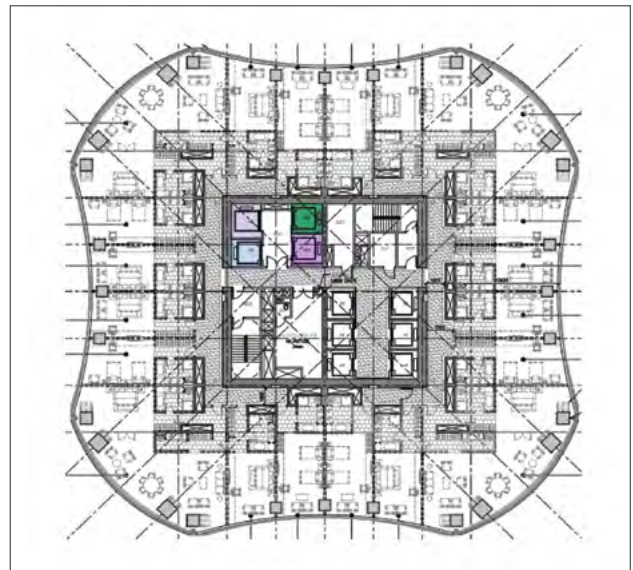
The air-conditioning system in the hotel guest rooms has been provided with cooling and dehumidification in summer, and heating and humidification in winter. The bathrooms have been provided with a central air-conditioning system using a 4-pipe system and floor heating.

BIM MANAGEMENT

The Construction Administration Stage Engineer on site and the Contractor worked side by side to produce a co-ordinated and clash-free BIM model. Weekly reviews sessions were organised to review the completed BIM model. Only after obtaining the joint approval of the BIM model by the Main Contractor and Owner, could the MEP installation commence on site. For this effort,



Typical office floor. Image: RLP.



Typical hotel floor. Image: RLP.

the project's BIM design and implementation work was awarded the 2015 MIPIM Asia Silver Award.

LOCAL DESIGN INSTITUTE

There was close collaboration with the Local Design Institute, which was the Architect & Engineer On Record for the project. All design drawings were provided by WSP to the Local Design Institute for submission to the Authorities.

CONCLUSION

Being involved in super tall towers in the Construction Administration and Site Supervision stages, the Author has gained experiences which may be applicable to Singapore in future, when 500+ m super tall towers are approved for design and construction.

NEA AWARDS MAIN TUAS NEXUS

IWMF EPC CONTRACT

A consortium will design , construct and commission a Waste-to-Energy Facility and Materials Recovery Facility.

The National Environment Agency (NEA) has awarded the main engineering, procurement and construction (EPC) contract for its Tuas Nexus Integrated Waste Management Facility (IWMF) to the consortium comprising Keppel Seghers Engineering Singapore Pte Ltd (Keppel Seghers), China Harbour (Singapore) Engineering Company Pte Ltd (China Harbour) and ST Engineering Marine Ltd (ST Engineering).

The total value of this contract is about SGD 1.5 billion. Under the contract, the consortium will design, construct and commission a 2,900 tonnes per day (tpd) Waste-To-Energy (WtE) Facility and a 250 tpd Materials Recovery Facility (MRF) as part of the IWMF Phase 1 development. The MRF will sort household recyclables collected under the National Recycling Programme (NRP).

A separate IWMF Phase 1 EPC contract for an 800 tpd Sludge Incineration Facility and a 400 tpd Food Waste Treatment Facility is in the tender phase and will be awarded later this year.

The IWMF is an integral part of NEA’s long-term plan to meet Singapore’s solid waste management needs. It will be equipped with state-of-the-art solid waste treatment technologies to improve energy and resource recovery from waste. It will also be Singapore’s first integrated facility to treat incinerable waste, source-segregated food waste and dewatered sludge from PUB’s Tuas Water Reclamation Plant (Tuas WRP) at a single facility.

The IWMF will be co-located with PUB’s Tuas WRP to collectively form the Tuas Nexus. The integration of solid waste

and used water treatment processes at Tuas Nexus will enable both agencies to harness various synergies to further improve overall plant performance and optimise land use.

Some of the key Tuas Nexus synergies include the co-digestion of IWMF source-segregated food waste with Tuas WRP’s dewatered sludge to improve biogas production. The biogas produced will then be combusted at IWMF to improve overall plant thermal efficiency and boost electricity generation. The electricity generated by IWMF will be sufficient to sustain the operations of Tuas Nexus and excess electricity will be exported to the grid. The amount of excess electricity exported to the grid by IWMF when it is fully operational will be able to power up to 300,000 four-room HDB apartments.

“The concept of the Tuas Nexus has stirred a lot of interest in the global waste management industry, as well as in the used water treatment industry. It marks a new chapter for solid waste and used water treatment here in Singapore based on a circular economy approach. It is the first greenfield project that involves the development of two mega waste treatment facilities located side-by-side to exploit co-location synergies, and one that will spin off many similar circular economy developments in the years to come”, said Mr Tan Meng Dui, CEO, NEA.

Singapore aims to reduce the average daily amount of waste sent to Semakau Landfill by 30%, from 0.36 kg/capita in 2018 to 0.25 kg/capita by 2030. IWMF will help Singapore achieve long-term environmental sustainability goals by improving resource and energy recovery from waste.



An artist's impression of the Integrated Waste Management Facility (IWMF)'s Waste-to Energy building which will also house a Material Recovery Facility. Image: National Environment Agency (NEA).

PUB AWARDS TUAS WRP

BIOSOLIDS TREATMENT CONTRACT

This facility will form the key interface between the Tuas Water Reclamation Plant and the Integrated Waste Management Facility.

National water agency, PUB, has awarded the contract to build the biosolids treatment facility for the Tuas Water Reclamation Plant (Tuas WRP) - a major component of the Deep Tunnel Sewerage System (DTSS) Phase 2 project - as the construction of the plant gathers steam this year.

Sembcorp Design and Construction Pte Ltd, a wholly-owned subsidiary of local construction and property group, Chip Eng Seng Corporation Ltd, will construct Tuas WRP's biosolids building, digesters and greasy waste receiving facility. Works have been scheduled to start in April 2020 and are due to be completed in 2025.

The contract is valued at SGD 433 million and was awarded following an open tender exercise in August 2019, during which a total of 11 bids were received.

These facilities will form the key interface between Tuas WRP and the National Environment Agency's (NEA) Integrated Waste Management Facility (IWMF). Collectively, Tuas WRP and IWMF are known as Tuas Nexus, Singapore's first initiative that integrates water and solid waste treatment processes to harness synergies of the water-energy-waste nexus.

At Tuas WRP's biosolids treatment facility, used water sludge will be co-digested with IWMF's food waste to increase the yield of biogas which will then be combusted at the IWMF to boost power generation and improve its

overall plant energy efficiency.

"This is a key contract that will build components critical to realising the synergies between Tuas WRP and IWMF, with PUB and NEA working together closely to make Tuas Nexus a reality. Once completed, Tuas Nexus will set the bar for addressing long-term resource sustainability and climate change", said Mr Yong Wei Hin, Director, DTSS 2, PUB.

PUB's DTSS Phase 2 project consists of a 100 km network of deep tunnels and link sewers. Slated for completion in 2025, it will channel used water via gravity from the western half of Singapore to Tuas WRP for treatment. Existing conventional WRPs in Ulu Pandan and Jurong will be progressively phased out.

With an initial treatment of capacity of 800,000 m³ per day, Tuas WRP will house the largest membrane bio-reactor facility in the world, with an overall 30% more compact footprint compared to conventional plants.

In July 2019, PUB appointed a joint venture to construct Tuas WRP's Influent Pumping Stations which are responsible for pumping used water from the underground sewerage tunnels to the plant for treatment. Another 14 construction tenders for Tuas WRP will be called over the next two years, including for the construction of the plant's domestic and industrial liquids modules.



An artist's impression of Tuas Nexus, which shows the co-location of the Tuas Water Reclamation Plant (Tuas WRP) and the Integrated Waste Management Facility (IWMF). Image: PUB, Singapore's National Water Agency and National Environment Agency (NEA).

CYBERSECURITY

IN THE NEW AGE OF RAIL

by Ling Fang, Senior Vice President, Alstom Asia-Pacific

Whilst digitalisation is the way forward, it brings with it an important challenge.

We tend to take our personal safety for granted when travelling by rail, whether it is our daily metro commute or a cross-border journey at high speed. Mercifully, in the context of the millions of kilometres travelled every year, accidents are rare. However, even as the rail transport industry moves to embrace the digitalisation of systems and operations, which will improve physical safety for passengers (among other benefits), a potential new challenge is emerging. The deployment of digital technologies inevitably opens the door to risks, threats and the possibility of cyber attacks.



Ms Ling Fang

The future of rail transport is unquestionably digital. Traditional features provided via electromechanical and/or analogue electronics are increasingly being implemented with software. Advanced software solutions are allowing operators to have real-time information on train movements and analyse overall performance - ultimately reducing costs by streamlining processes and improving efficiency and reliability. From predictive maintenance to automated signalling, and from driverless operation to enhanced passenger experience, digital technology is enabling more advanced performance and delivering benefits to authorities, operators and passengers.

Addressing the reality of cyber threats

The downside of this exciting future is that trains that increasingly rely on digital technology are complex computer systems and, like any digital system, can be hacked.

It must be recognised that the risks are real. Railway transportation is as susceptible to cyber attacks as any other industry. In practical terms, the risks of a cyber attack for railway operators and their stakeholders may be summarised as follows:

- Risks to operations, in terms of quality of service and revenue generation.
- Potential risks to the safety of passengers and assets.
- The impact on company image and reputation.

Every stakeholder in the development of railway systems - systems integrators, service providers and original equipment manufacturers (OEM) - has to make an active contribution to the resilience of the overall railway system and ensure that it has the necessary

internal organisation, processes, products and solutions to support this.

Ensuring the security of a railway system is significantly different to securing a typical IT infrastructure, since the ultimate goal is the safety and reliability of a mass transportation network. There are practical issues to be borne in mind - the system architecture is distributed across long distances with a large variety of contexts, from a centralised control room to on-board embedded equipment. Also, the anticipated duration of the rail system, as a whole, is much longer than the life cycles of the various technologies that go to make up the overall system. It is also necessary to integrate and secure several generations of technologies, each of which has its own security levels.

Additionally, from the perspective of operational demands, it is simply impossible to just halt an entire train network's operations or access an entire fleet, at the drop of a hat, in order to broadcast a new patch, for example.

Elements of a cybersecurity philosophy

To address these issues, it is necessary to implement a Secure Development Life Cycle and a vulnerability management process. This starts with an initial Cybersecurity Risk Assessment, in order to identify the main risks and the mitigations to be implemented. During the risk assessment, the context (likelihood of the threat and system vulnerabilities) is defined and the mitigations are allocated to the system components, finding the right balance between protection level, operational constraints, time to market and to deploy, and, naturally, cost. It is also necessary to harden equipment and services with protective measures against cyber hacking and put in place reliable mechanisms to detect cyber intrusions. Finally, Security Testing and Security Assurance will ensure that the selected security measures are correctly implemented. Rail networks are operating in a rapidly changing context and it cannot be assumed that security measures, once implemented, will be effective for all time. That is why it is essential to put in place a robust vulnerability management process that allows the detection and remediation of any vulnerabilities identified in the system's components. This is the only way to maintain security throughout the life cycle of the rail networks.

Having said that, it must be recognised that cybersecurity goes beyond simply the development of products and solutions. It must also cover other phases such as manufacturing, testing & commissioning, supply chain and installation,



The future of rail transport is digital. Image on top: Alstom / TOMA - M Genel. Image on right: Alstom / Adam Shumaker.

as well as maintenance, and includes the decommissioning and disposal activities at the end of an asset's useful life. It must also include threat landscape evolution monitoring and vulnerability watch over time, compliant with a strong security incident management approach.

The whole cybersecurity philosophy cannot be abstract - it crucially demands that the industry hires the right people and trains them well. Adequate resources must be provided to install, administer, operate, and maintain the system. These steps will ensure the system's security over its complete life cycle and constantly increase its threat intelligence. High priority must be given to elements like a company-wide cybersecurity handbook that lays out security policies & processes, backed up by regular mandatory training sessions for everyone interacting with the system, operators and maintenance staff.

Industry-wide co-operation

The task of ensuring cybersecurity cannot be the responsibility of one player alone. The whole industry needs to cooperate to collectively address the issue. When a new system is being implemented, or a legacy system updated, all industry stakeholders need to sit together and agree on the security risk evaluation and the relevant protection target they want to achieve. A common language, a common methodology, and common references are needed. Such collaboration should also cover incident/threat sharing. We need to have, at industry level, a common view of threats identified and incidents recorded. This will support the definition of the relevant measures and priorities the industry should adopt.

The work currently being carried out in international standardisation committees, such as IEC 62443 for industry or Shift2Rail or CEN/CENELEC for railways, is heading in the



right direction and should be given even more support. These groups are due to deliver results in the near future.

It can also be helpful to identify existing best practices with industry partners. A notable example is an agreement between train manufacturer Alstom and aircraft manufacturer Airbus, to introduce into the railway business the best practices of the air transport industry. The rail and air industries are both engaged in moving large groups of people, and both are subject to the lethal possibility of terrorism. A cyber attack on a train, with hundreds of passengers travelling routes through densely populated city centres, would be catastrophic. The cybersecurity co-operation agreement signed by Alstom and Airbus, in 2017, will support a new risk management model for the transport industry, focusing on the co-development of new analysis services concerning transport vulnerability and new shared core protection technologies.

In light of society's vulnerability to cyber attacks, and the particular risks faced by major transport operators, all stakeholders, including passengers, need the reassurance that railway products and services meet the latest cybersecurity and government specifications.

SMART TRANSPORTATION

BEYOND 2020

Key insights are presented, from the 2019-2010 edition of a Discussion Paper produced by Stratus Technologies.

INTRODUCTION

Business leaders operating in and around the transport industry should keep abreast of the following future trends in 2020 and beyond:

Paving the way forward using smart technologies

Smart technologies are making the customer experience more convenient. Contactless payment is already a global norm, while China is pioneering facial recognition technology as a payment method. Companies operating in and around the transport sector must keep abreast of smart technologies to retain a competitive edge.

Gains in safety and efficiency with increased automation

Automation holds great potential in both public and private transport. Inspection technology reduces human error and helps to prevent rail accidents, whilst allowing for improved velocity and fluidity.

Improved customer experience through digital automation

Customer-facing technology is changing. Transport operators are widely adopting and updating smart digital platforms, improving communication and purchasing processes alike.

Addressing cyber security vulnerabilities related to connectivity

With the exciting opportunities posed by increased connectivity comes increased risks and an increased demand for cybersecurity. The transport industry needs to keep digital security as a focus as it embraces connectivity.

Embracing a more sustainable future

Smart technology offers powerful benefits from a sustainability perspective, with improved transport systems leading to smoother traffic flow, improved railway network efficiency, and reduced emissions.



Across the globe, digital technologies are transforming transportation. Real-time data captured from sensors installed along tracks and inside trains enables remote diagnostics and predictive maintenance.

THE SMART STATE OF PLAY: TRANSPORT ACROSS ASIA

The introduction of state-of-the-art digital technologies across the globe is reshaping societies and fundamentally changing the way transport companies operate. Asia is a particularly early adopter, leading the transformation of the sector.

From Singapore to Hong Kong to India, smart technologies are already being deployed to strengthen public and private transport systems while improving safety. Computer-based management, control and communication systems are fast changing the way things are done - from ports and distribution centres moving towards full automation, to ride-sharing services transforming the point-to-point travel market, and much more.

A key example of this is the railway sector, where legacy ICT infrastructure is being replaced by highly effective Train Control and Management Systems (TCMS), empowered by IoT and Big Data analytics.

Real-time data captured from sensors installed along tracks and inside trains enables remote diagnostics and predictive maintenance.

This not only allows equipment, tracks and stations to operate more efficiently but also improves safety for workers and passengers alike, while reducing long-term costs.

At the same time, this sector benefits from an enormous amount of Big Data generated from many interconnected stakeholders, which is already being used to improve safety, commuter experience, and the efficiency of station and freight operations in ways that were unimaginable not long ago.

SMART TECHNOLOGIES ARE TRANSFORMING ASIA'S RAILWAY SECTOR

With a growing population and over 1 million vehicles on the road, Singapore is a small city state that faces challenges in optimising the use of its limited land space to achieve more efficient, safe, and reliable public transportation.

Although only 12% of the land in Singapore is set aside for roads and transport infrastructure, the major Asian metropolitan hub has created an immensely efficient railway network, by embracing digital transformation and digital readiness.

As a part of the country's Smart Nation initiative, Singapore has adopted new smart technologies across all aspects of its transportation network - especially in the SMRT networks - to ensure Singapore is smart-city-ready. This not only enhances back-end operations, such as maintenance processes, but also favourably impacts customer experience.

Traditional maintenance processes such as train tunnel and site inspections were once carried out manually by engineers who would enter identified problem sites and take photos and videos, often causing costly operational

disruption. Today, Singapore's Land Transport Authority (LTA) has implemented a Drone Task Force, harnessing the power of technology to inspect and monitor train tracks and tunnels with zero downtime.

With a mandate to improve both operations and maintenance efficiency, SMRT-NTU Corporate Laboratory has identified three innovative technology improvement projects.

The first is a train-mounted, real-time condition monitoring system. This technology has the ability to detect defects on power rails and running rails along the network, using radio frequency technology to monitor the electrical contact between trains and tracks.

Another innovation is the Automated Inspection System for Train Wheels and Axles. This system automates the inspection using a portable robot equipped with a track-mounted sensor.

A high-precision mobile laser-cladding repair system is also in the pipeline, using laser technology to repair defective rails. This impressive technology can repair worn-out rails overnight (within regular servicing hours) rather than over three nights currently required. These trials follow the success of the introduction of pneumatic train doors which monitor air pressure, movement speed and power systems, paving the way for enhanced train reliability.

Billions of dollars have also been spent in Singapore to enhance the customer experience, embedding MRT infrastructure with feedback loops and tracker sensor systems which calculate journey time. This well-received innovation enables commuters to plan and estimate trip journeys using real-time information.

SMART TECHNOLOGY AND RAIL: AN ENVIRONMENTAL IMPERATIVE

Smooth day-to-day operations of railway systems are the lifeblood of any major metropolitan city - it is a sector that cannot fail.

The magnitude of a railway system failure can be understood by analysing what happened in Hong Kong, in 2018.

In October 2018, a signalling fault on the train network sent Hong Kong into commuter chaos. Four major lines were down. Train frequency was reduced, and travel times were increased by 40 minutes, leading to large crowds of disgruntled commuters at stations across the city. Crowd control measures had to be put in place and the MTR called on commuters to use other forms of transport.

Hong Kong's railway operator was then forced to seek overseas expertise to investigate what was classed as its worst service breakdown ever. The network-wide signalling failure was so rare that there was nothing in its handbook to deal with an emergency of that magnitude.

Whatever the reason for the system failure, this is an example of the severity a system outage - the impact is costly and extends to all areas of the community.

Singapore is another major Asian hub that has not been immune from signalling failures. In 2017, a system failure led to a collision between an SMRT train and a stationary train, injuring 29 people.

The delays are symptomatic of a learning curve that many Asian cities have to go through as they upgrade infrastructure to cope with swelling urban populations. In Singapore, car ownership is discouraged. Singaporean commuters are joining the front line to advocate driverless rail networks, and the government and railway operators are putting in maximum effort towards installing systems that improve predictive maintenance and stop problems before they occur.

While SMRT continues to run its lines, the rail network and stations were taken over by the government in 2016 to allow the operator to concentrate on improving track service.

For Hong Kong, Singapore or any other Asian metropolitan hub, railway systems are a key part of next generation smart cities as well as an integral part of future urban development planning, as cities transition towards more environment-friendly modes of transport.

All railway systems need to be highly available, with no margin for error, and given the sustainability, safety and economic imperatives, we must look ahead to see how technology can be used to improve outcomes in the transport sector.

WHERE IS TRANSPORT HEADED?

The railway sector is just one of many examples of where transportation in Asia is flourishing, and there are many more opportunities for leaders to look at investing in smart technology to create an even brighter future for transport.

A RAPIDLY TRANSFORMING SECTOR

The International Energy Agency (IEA) identifies four major technological trends impacting road transport - Automation, Connectivity, Electrification, and Sharing (ACES).

From users seeking mobility on demand through services such as ride-sharing, to advances in self-driving cars and the advent of connected vehicles equipped with Cooperative Intelligent Transport Systems (C-ITS) to improve traffic safety, parking management and more, the transport sector is transforming rapidly.

As well as the passenger- and driver-facing applications of smart technologies, the way that goods are being transported is also changing. Machine learning and robotics are already transforming supply chain management, increasing reliability and efficiency, as connected machines find and move stock to a destination, making changes to their route automatically to avoid obstacles such as heavy traffic or congestion, and self-diagnosing faults and scheduling repairs to minimise downtime.

Likewise, the commercial (passenger and cargo) aviation industry is embracing smart technologies. Connectivity improves efficiency, safety and customer experience, while biometric technologies such as facial recognition improve security. Robotics also offers nascent but exciting potential. Japan Airport Terminal Co Ltd is working with Haneda Robotics Lab to trial the introduction of assistance, transportation and cleaning robots in Haneda Airport.

Smart technologies are already changing the face of the transport sector, and Asia is leading the way in embracing a smarter, more sustainable and safer way of moving people and products alike. By staying abreast of the current state and exploring the future potential of smart technology in transport, companies in and around this sector can reap the benefits.

SMARTER CUSTOMER EXPERIENCES

Enhanced customer experience through digital transformation is already a major trend in the transport industry, which can be expected to continue in the future.

As Singapore sets the benchmark and leads global innovation across integrated transport networks, it is important to understand and leverage technological



Railway platform in an Asian city.

advancements to enhance customer experience in neighbouring APAC countries.

In Hong Kong, the RailGen 2.0 program includes a new digital platform bringing improved connectivity, better facilities and enhanced services to commuters, including real-time and personalised information during their MTR journey.

However, there is still considerable space for leaders to invest in, especially in light of the rapidly rising capabilities of smart technology.

EMBRACING AUTOMATION FOR INCREASED SAFETY AND EFFICIENCY

Automation holds great potential in increasing safety and efficiency on railway networks, with inspection technology already reducing human error while surpassing human limitations, in terms of detecting, analysing, predicting and preventing faults more reliably and responsively. At the same time, Positive Train Control technologies work to prevent rail accidents caused by human error, leading to significant advances in automated train operations. This allows railway operators to safely increase the number of trains on-track, improving velocity and fluidity alike.

Fascinating innovations in automation are already taking place in Asia. In 2017, China launched the world's first Autonomous Rail Rapid Transit, or 'smart train', running on virtual rail lines through the bustling streets of Zhuzhou in China's Hunan Province. The train can travel as quickly as 70 km/h, or 43 mph, and carry as many as 300 passengers. Equipped with various sensors, it is able to analyse traffic conditions and reroute appropriately, while various sensors help the train driver to follow the route safely and keep the vehicle in-line and at a safe distance from other vehicles.

Likewise, Indian Railways has announced that artificial intelligence-powered trains (known as Smart Coaches)

will be released soon, which will be able to detect a range of maintenance scheduling issues including wheel defects, security issues and water leaks. Automated reports will be signalled back to maintenance offices which would then undertake immediate repair. The new fleet of AI trains will also use GPS to provide real-time passenger information, improving network efficiency.

SUSTAINABLE, SMARTER AND SAFER TRANSPORT

The population in Asia continues to rise, with millions of people relying on the transport system for their daily commute. Now more than ever, there is intense pressure placed on public transport.

This pressure, combined with the introduction of smart technology, has changed the face of the transportation sector, presenting new infrastructure demands and challenges.

Once again, we can use the example of the railway sector to understand the nuances of public transport in population-dense areas. Operating and running intricate smart railway systems daily, and for millions of people, is a huge undertaking. The logistical challenge has become even more complex with the introduction of smart technologies which particularly address the question of speed. Not only do departure and arrival times need to be monitored in real-time, but operations and building management systems for the train stations themselves need to be governed - lighting, lifts, air conditioning, energy controls, signals and controlling systems - and the list goes on.

With such a delicately interconnected system, if one thing goes wrong, whether it is in the operation of the trains, in the management of the stations, it impacts the whole network. The commute of millions of people can be affected.

Put simply, it is mission-critical to keep trains running on time, all the time, and prevent downtime.



There are many more opportunities for investing in smart technology to create an even brighter future for transport.

TOWARDS TOMORROW

Digital transformation and readiness are changing the way transportation operates and are critical for the success of companies operating in and around this sector. As has been detailed, customer experience and safety are core drivers for future success.

Here we explore what factors need to be prioritised to ensure that the sector is future-ready, and able to harness the benefits of smart technology, by relying on safe, seamless and sustainable transportation.

SMARTER ADOPTION OF SMART TECHNOLOGIES

Albert Tam, Lead Solutions Architect, Stratus Technologies, suggests that for all network players in the transportation sector, reliability should remain paramount, and explains that this is a non-negotiable pillar to partnerships and a critical key to success when adopting smart technology.

Mr Tam highlights that within the railway sector, for example, “reliability stands for the technology that controls the movement of millions of people, from one point to another, in a timely and safe manner”.

When seeking to understand the transportation system, there are many complexities beyond the obvious core service which is just the tip of the iceberg. It also includes moving people and goods to their destinations using public and private vehicles such as trains, cars as well as trucks and air- and sea-freight vehicles. These complexities are often taken for granted, that is, until a piece of equipment fails.

There are three key areas underpinning a railway’s operations and engineering works that need considering:

Peripheral Access Management - This includes engineering works such as building tunnels and laying tracks, as well as station access infrastructure like commuter gates and control systems. They are involved in the smooth flow of people through the gates of each station, as well as identifying unauthorised access by people to areas such as tunnels, tracks etc.

Building Management System - This system identifies the unique environment in which each station operates. Features of the environment include lighting, air conditioning and various other systems that run on sensors. Such environmental factors are critical to prevent outages and maintain commuter experience.

Payment System - This is not usually considered part of a railway project. However, the perspective of commuters, it plays a critical role. Whenever they tap their card, or purchase a token, money is transferred through a payment gateway. This is then sent back to the bank, re-distributed, and identified when the commuters tap their card on the same sensor once they arrive at their destination. This system needs to be reliable to ensure that the right amount is deducted from their card.

As you can see, railways are complex, with many individual components that require always-on technology. This is true for the sector at large, with many systems often facing the additional layer of complexity in having to cooperate with each other to provide an optimised experience.

EDGE COMPUTING: TRANSPORT AT THE EDGE

The Edge is an environment that requires computers to run 24/7 - it is not just inside a data centre, and it is not just involvement when signalling systems are delayed. It can be a combination of both manned and unmanned environments, so at the Edge we need simplicity. For



A subway tunnel in a modern metro.

effective public transportation, we need ease of use and maintenance to ensure the reliable operation of railways, the train and the line - all the way through to building management systems that enhance the commuter experience.

As we rapidly progress towards a digital world, private transport is also changing, with Mobility-as-a-Service driving a shift from private vehicle ownership to mobility on-demand. Edge computing is empowering the transport industry with improved connectivity, coordination and intelligence, allowing for better traffic management and control, smart routing and much more. Getting ready for the smart transportation of the future requires getting ready for Edge computing. And this is an area where partnering with other companies can help drive a competitive advantage in the areas of reliability, simplicity and overall cost-effectiveness.

According to Mr Tam, “The plug-and-play, ready-to-run nature of Edge computing provides peace-of-mind as well as immediate results. It ensures compatibility with legacy infrastructure systems and this enables fully autonomous operations. It can be tested and run seamlessly on existing infrastructure. Plus, it is easy to install, reducing the time for testing and the time to market and resourcing”.

ENABLING CYBERSECURITY TO HANDLE COMPLEXITY

With the exciting opportunities posed by increased connectivity comes increased risks, with the rail industry being a viable target for hackers.

Big Data collected through myriad touchpoints integrated into smart railways, demands cybersecurity that can manage and mitigate risks, both in terms of the trains and datasets themselves. Because Edge computing is distributed, the security risk is different than a centralised environment. The security controls found in private data centres or public clouds, like firewalls or antivirus tools, do not automatically transfer. However, there are some new solutions such as ztC Edge, that have been specifically designed for the Edge. This secure, rugged, highly automated computing platform delivers business-critical industrial applications quickly, reliably, and efficiently, even in decentralised, understaffed locations.

It includes features such as built-in virtualisation, automated restart and data protection, automated local site recovery, simplified security, redundant solid-state nodes, customisable availability, industrial interoperability, OT maintainability, and cloud-based system health monitoring and managed support services. These features allow companies using ztC Edge to increase efficiency and reduce IT dependence, while minimising downtime risk.

SUMMARY

We have explored the current state of play of smart technologies in the transport sector, innovations that are

already beginning to take root, future trends to watch, and how leaders involved in the transport sector can best prepare for the future of transport.

The transport sector is increasingly a technology sector, as populations rise and the imperative for sustainable transport increases, while customers increasingly embrace technology and the convenience it can provide, and improvements in artificial intelligence offer great potential for safety and efficiency in a manner that exceeds human limitations. By adopting a proactive stance towards understanding smart technology and recognising opportunities, transport leaders will be better situated for success in 2020 and beyond.

WHAT IS NEXT?

With 2020 bringing big changes to the industry, leaders must get on the front foot with planning to stay ahead of the market. Here are five key steps to take to maintain a competitive edge:

Develop a stronger cybersecurity infrastructure

To enable sustainable change, all leaders must look to enhancing their cybersecurity infrastructure and ensure that it is future-proof. As we increase the amount of data we manage and handle, the need for strong data protection measures to enable innovation is increasing alongside it.

Be smart about smart adoption

While abundant tools are becoming available, leaders must be careful not to adopt technology for technology's sake. Understand the business problem and be strategic in how you deploy certain solutions across your business.

Make customer experience the focus

We are moving into an even more customer-driven market landscape and so all innovation should be driven by the customer journey. Rather than customer experience as an offering, it should be the core of all business, especially in the transport industry.

Consider the larger smart city ideal

Smart adoption in the transport space must fit into a larger Smart Nation vision that most countries across the region are considering. This means that it must consider several factors at once, including the environmental impact, the end customer, supply chain innovation and more.

Drive sustainable transformation

Leaders can celebrate success too early when it comes to digital transformation, especially as the concept becomes more popular. However, the change has to be sustainable and evolve right alongside the business so that it does not become obsolete at the rate of innovation in technology.

(Stratus Technologies is a major producer of fault-tolerant computer servers and software. More information can be obtained by emailing ap.enquiry@stratus.com)

IMPROVING THE DEVELOPMENT

AND OPERATION OF PUNGGOL DIGITAL DISTRICT

The integration of BIM and GIS is expected to deliver better designs and maximise long-term value.

As development works continue steadily at Punggol Digital District (PDD), Singapore’s first smart and sustainable business park, the technology that underpins Singapore’s national integrated land-use planning will also drive the development of the district, from planning through construction and all the way till when the district is operational.

At the core of this network, a Geographic Information System (GIS) solution, created by Esri Singapore, integrates, manages and analyses a variety of data including BIM (Building Information Modelling) data to provide designers and architects with greater insight to influence a structure’s location, orientation, and even construction materials.

According to Mr Thomas Pramotedham, Chief Executive Officer of Esri Singapore, the seamless integration of BIM and GIS (also considered as GeoBIM) will enable JTC to deliver better designs that maximise the long-term value of upcoming infrastructures and facilities.

“This GeoBIM platform capability will enable planners to visualise and experiment the impact of the designs against existing surroundings and landscape on a 3D map to ensure infrastructure and amenities in PDD support the needs of the community today and for generations to come”, he added.

The smart approach in building PDD does not end there. During the actual construction, aerial scans are taken by drones to track and monitor construction progress.

The aerial scans can also be integrated into a GeoBIM platform to ensure works are in line with PDD’s planned design.

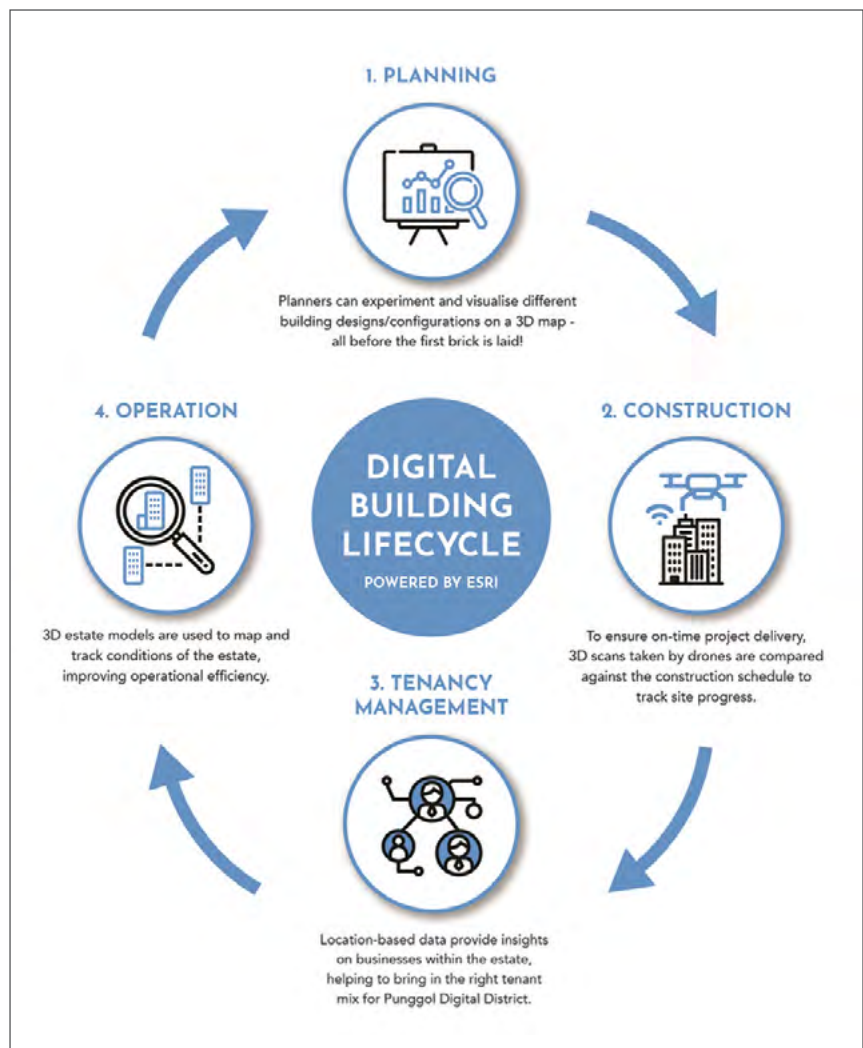
Once the construction of PDD has finished, the GeoBIM platform will continue to be foundational in the district’s day-to-day business operations in areas such as marketing and building management.

“The system will help JTC, master-planner and masterdeveloper of PDD,

analyse consumer patterns, demographics as well as existing services and amenities in the larger Punggol town, to understand the market potential of the district in order to attract the right tenant mix”, Mr Pramotedham continued.

Mr Pramotedham said that beyond managing data on an estate level, the system can ingest BIM and building assets data to provide full operational awareness, through the ability to map and observe asset conditions throughout the facility life cycle.

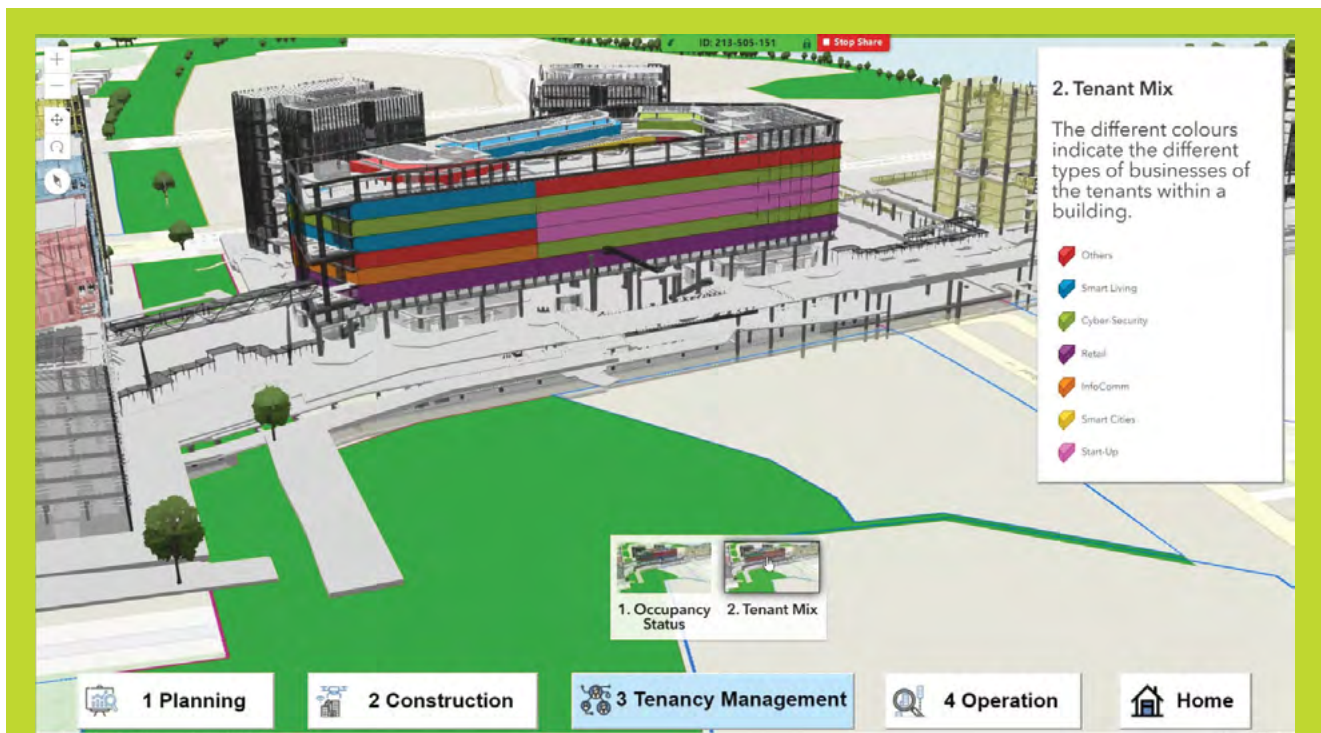
“This capability will allow building managers to analyse patterns of use, make better decisions, and improve overall operational management”, he said.



Digital building lifecycle

Mr Ryan Lee, Director of Smart Digital Division, JTC, said, "Technology is empowering us to better plan, make decisions and manage our buildings and estates. In the case of PDD, GeoBIM allow us to virtually experiment various planning configurations, provide a common platform for

better communication among the multiple disciplines, create efficient building management workflow processes, amongst many others. The use of GeoBIM brings about immeasurable benefits to the whole building project life-cycle and its community".



Tenancy management



Operation

The GeoBIM platform's capability extends beyond the construction phase of assets to include tenancy management and building operation, as well.

RE-IMAGINING

FUTURE WORKPLACES

In collaboration with Bentley Systems and Schneider Electric, Microsoft has rolled out a digital twin of its new regional headquarters at Frasers Tower in Singapore, offering a living blueprint for the future of smart buildings.

Data acquisition and utilisation

At the Microsoft offices in Frasers Tower, data is collected using a mix of 179 Bluetooth beacons in meeting rooms and 900 sensors for lighting, air quality and temperature from Schneider Electric. The platform generates nearly 2,100 data points that are connected to the cloud on Microsoft Azure, enabling the holistic management of the environment.

The sensors enable monitoring of facilities usage, energy and utilities. They optimise space utilisation, air conditioning and lighting adjustments. All these provide a comfortable and productive space for employees, while increasing overall energy efficiency. Open, interoperable technology also allows activity detection enabled lighting and room sensors to reflect room bookings on Microsoft's Smart Building CampusLink app.

Employees and staff use Smart Building CampusLink, an application that is fully integrated with Microsoft Outlook and Microsoft Office 365, taking navigation to the next level by enabling employees to find directions, determine room occupancy and book facilities in real-time. Built on Azure App Services and powered by Azure Data Lake and Office 365 Graph API, Microsoft's regional headquarters in Asia Pacific is the first Microsoft office outside of Redmond, Washington, USA, to implement Smart Building CampusLink.

The sensors could potentially also monitor carbon dioxide levels in the air, that negatively affect work performance and neural activity, noise levels and energy usage, which can result in savings of up to 25%, as experienced at Microsoft's Headquarters located in Redmond.



Facilities can function optimally and sustainably, with the help of sensors, IoT (Internet of Things) and AI (Artificial Intelligence).



Powered by the Azure cloud platform, Microsoft has developed a virtual digital twin model of its offices at Frasers Tower in Singapore.

“Smart sensors allow us to collect meaningful data in real-time, which enables us to optimise various aspects of our spaces, making them more comfortable, while reducing energy consumption in a sustainable and economical manner. Our partnership with Microsoft offers a real model on how connected devices combined with contextualised sensor processing can

deliver smart building systems that do not intrude on the privacy of individuals, and can be applied beyond offices, to buildings, malls and even homes of the future”, said Damien Dhellemmes, Cluster President, Singapore, Malaysia, Brunei, Schneider Electric.

The creation of a digital twin

The data from sensors enable the virtual replication of the physical world by modelling the relationships between people, places, and devices in a spatial intelligence graph. The operational insights achieved through the digital blueprint allows for management and measurement, creating uniquely relevant experiences by correlating data across the physical and digital worlds. Developed and implemented in partnership with Bentley Systems, Microsoft’s digital twin of Frasers Tower in Singapore is a model for smart offices. It brings together the convergence of artificial intelligence, Internet of Things and productivity tools in a relevant manner.

“Digital twins are redefining how we manage infrastructure, from individual equipment installations to large facilities and entire cities. While smart buildings were developed to better manage energy consumption, we have come to realise additional strategic roles of dynamically allocating space, increasing utilisation, reducing costs, improving competitiveness, and enhancing collaboration and productivity. With Bentley’s OpenCities Planner and Microsoft’s Azure cloud platform and Power BI, we have developed a virtual digital twin model of their regional headquarters in Singapore, correlating the data collected across the digital and physical worlds to build domain-specific solutions and unlock new efficiencies, improvements, and opportunities for the modern workplace”, said Kaushik Chakraborty, Vice President and Regional Executive for Asia South at Bentley Systems.

Sustainability and inclusivity

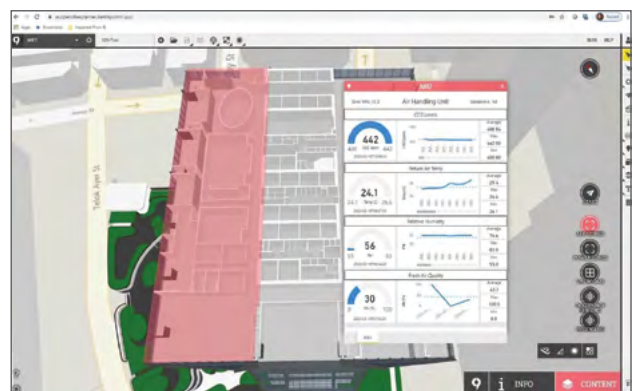
In a world where one can expect more than 40 billion devices generating nearly 80 zettabytes (ZB) of data by 2025, organisations and industries will need to adopt new technologies and build capabilities that will enable them to flourish in an innovation-led, cloud first, artificial intelligence focused future.

Asia Pacific is one of the fastest growing regions for Microsoft which has created a blueprint that will enable organisations to adopt the culture, physical spaces and technologies for a future-ready workplace. Spread across 12,500 m² and six floors, the new Microsoft office at Frasers Tower brings 1,400 people together in an environment that allows the digital and physical worlds to exist in harmony.

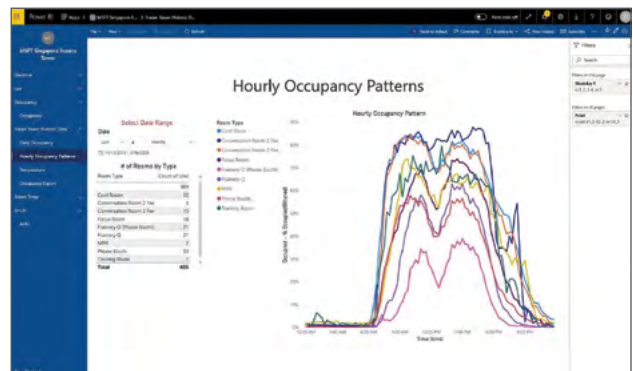
Microsoft has ensured that the new office is inclusive by making it accessible for everyone, regardless of how they communicate, see, hear, or move. Microsoft follows a global standard of accessibility for



A model of Frasers Tower.



Monitoring air-conditioning parameters within the Microsoft office.



Monitoring occupancy patterns within the Microsoft office.

every Microsoft office and in Singapore, they comply with the Building and Construction Authority’s Code on Accessibility in the Built Environment 2013.

“The workplace of the future is about embracing innovation into the very fabric of our space, so that we create multiple touchpoints of connectivity, that are intentionally inclusive and accessible, while being very mindful of sustainability and the environment. At Frasers Tower in Singapore, we worked closely with Bentley Systems and Schneider Electric to implement sensors and telemetry to create a connected workplace that allows us to adjust the space, based on usage, therefore improving energy efficiency”, said Ricky Kapur, VP for Sales, Marketing and Operations for Microsoft in Asia Pacific.

AVENUE IN UK RESIDENTIAL AREA TO FACILITATE

ELECTRIC VEHICLE CHARGING

Siemens has unveiled 'Electric Avenue, W9', which is over half a mile in length, as the UK's first avenue that has been fully converted to cater for electric vehicle (EV) charging.

The 'Electric Avenue, W9' project, implemented in collaboration with ubitricity and Westminster City Council, has successfully converted 24 lamp posts into EV charge points using existing city infrastructure. Residents can now charge EVs at various locations along Sutherland Avenue in London, with similar facilities in a further two adjoining roads due to be completed soon.

The launch follows research conducted by Siemens showing over a third (36%) of British motorists planned to buy a hybrid or electric vehicle as their next car, with two in five people (40%) saying that a lack of charging points stopped them from doing so sooner. This makes it the biggest factor deterring motorists from purchasing an electric or hybrid vehicle.

'Electric Avenue, W9' showcases a shift in attitudes towards EVs, that Britain's capital is experiencing. Data shows 80% of motorists in central London believe it is 'very important' that air quality is improved, and 83% have become more concerned about their carbon footprint in the past five years.

Westminster has seen a 40% growth in EVs charged in the borough during 2019, which is more than any other borough in London.

Powering ahead

Westminster City Council currently has more EV charge points than any UK local authority, with a total of 296 lamp column charge points in the city, 24 of which are located on 'Electric Avenue, W9'. There are plans to reach 1,000 charge points across Westminster City Council within the next year, responding to a 40% rise of EV registrations in the last 12 months.

Siemens and ubitricity have now completed over 1,300 installations covering the breadth of London and leading the way to improve its air quality.

"We know that half of London's air pollution is caused by road transport and Westminster is a particularly busy area. While we cannot solve the challenge of air quality overnight, 'Electric Avenue, W9' is an important showcase of what is possible using existing city infrastructure. It illustrates how residential streets will look in the near future, and accelerates the shift to zero emission vehicles", said Cedrik Neike, Member of the Managing Board of Siemens AG and CEO of Siemens Smart Infrastructure.

"In a city that suffers from some of the worst air pollution in the country, we need to be supporting the change to green technology as much as we can. 'Electric Avenue, W9' gives us a glimpse into the future of streets in West-

minster, where we hope to provide the infrastructure needed for our residents to make the switch to cleaner, greener transport," said Councillor Andrew Smith, Westminster City Council Cabinet Member for Environment & Highways.

Preparing for a rise in EV ownership

Motorists currently believe there are only 100 to 200 EV charging points in London, which is much less than the 1,300 Siemens installations currently available. Meanwhile, almost a third believed there were no EV

Residential streets

Siemens has unveiled the UK's first avenue cater for EV charging, coined 'Electric Avenue'.

24
installations

The 'street of the future' has seen 24 lamppost conversions, providing 132KW of charging capacity using the existing local electricity network



100%
renewable energy

ubitricity's charge points use 100% renewable energy, reducing average electricity emissions by 75% per kWh compared to a typical new combustion engine.



charging points near their home or workplace. The transformation of Sutherland Avenue utilises existing infrastructure for EV charge points, creating a simple, fast network that looks to provide charging to the expected 8,000 EVs forecast to be registered in Westminster City Council by 2025.

“Lamp post charging gives people without driveways a very convenient, low-cost, renewable, energy-friendly way to charge their EVs. Cars spend 95% of their lives idle, so it makes sense to charge them while the driver is doing something else, like sleeping or working. Our technology is designed to keep installation and maintenance costs low, which translates to long-term low costs for EV drivers and councils”, said Daniel Bentham, Managing Director of ubitricity UK.

“As the petrol and diesel car ban draws closer and London boroughs work to improve our air quality, we are excited to have completed our first fully converted Avenue, ‘Electric Avenue, W9’. Our partnership with ubitricity to convert lamp posts for charging EV and hybrid vehicles is one of many initiatives Siemens is undertaking to help fu-

tureproof our roads and help drivers make better choices when it comes to travel”, said Bernard Magee, Sales Director of Future Grid at Siemens.



Sutherland Avenue is UK's first residential avenue fully converted to provide lamp post electric vehicle charging points.

of the future

...ue to be fully converted to
...venue, W9'

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mile compared to a
n car sold today

1,300
lampposts converted

Siemens and ubitricity have now completed over 1,300 installations covering the breadth of London



SIEMENS
Ingenuity for life

London

Electric Avenue, W9
Westminster



SINGAPORE MEETS ITS 2020

SOLAR DEPLOYMENT TARGET

It was achieved in the first quarter of this year.

Solar energy is one of the key switches in Singapore's Energy Story in which we co-create a cleaner, affordable and more reliable energy future. With climate change, how we produce and use energy will see shifts as well. The government and industry are working closely to deploy cleaner energy solutions such as solar energy.

The solar installation that helped cross the 350 MWp target is a 6 MWp rooftop solar installation at an industrial facility at 40 Penjuru Lane, a CapitaLand industrial property held under Ascendas Real Estate Investment Trust.

The solar panels were installed and operated by Sembcorp Industries. This partnership between CapitaLand and Sembcorp Industries allowed the industrial facility to reduce its carbon footprint, and the excess electricity generated is sold on the wholesale electricity market. CapitaLand is also on Sembcorp's newly launched renewable energy certification (REC) aggregator platform and will use the RECs to power its corporate offices and properties with 100% renewable energy.

Sembcorp Industries has partnered CapitaLand Group to install and operate rooftop solar farms at six properties owned by CapitaLand's business space and industrial real estate investment trust, Ascendas Real Estate Investment Trust. The installation formed the largest combined rooftop solar facility in Singapore by a real estate investment trust. 40 Penjuru Lane is one of the properties under this partnership.

Mr Ngiam Shih Chun, Chief Executive of Energy Market Authority said, "In our efforts towards greater sustainability to tackle climate change, Singapore will increase solar adoption, as solar is our most viable source of renewable energy. With strong support from stakeholders, such as the commercial and industrial companies, we have successfully met the 350 MWp solar target this year. We will press on towards the next solar target of at least 2 GWp by 2030 and will continue to work with our stakeholders to make this possible".

Set in 2010, the 350 MWp target for 2020 is equivalent to powering about 60,000 households for a year.

The next target, of at least 2 gigawatt-peak (GWp) of solar deployment by 2030, is equivalent to powering about 350,000 households for a year.

Aligned with its ambition to make industrial estates more environment-friendly to support businesses, JTC will be rolling out extensions for two of its solar initiatives, namely the next phases of the SolarLand programme and the SolarRoof programme, to optimise the use of over

740,000 m² of industrial land and roof space, equivalent to about 103 soccer fields. Estimated to contribute over 82 MWp of solar energy capacity towards the 2030 national target, it will generate about 78,000 MWh to power over 14,600 households and reduce over 32,000 tonnes of carbon emissions per year.

Following the roll out of the first two phases at Jurong Island and Changi Business Park, JTC issued a tender for the third phase of its SolarLand programme in February this year. This will maximise the use of over 560,000 m² of temporary vacant land all across Singapore to deploy more than 67 MWp of solar energy capacity. The system is made modular and flexible by using mobile PV panels and hybrid SPPG substations, and can be redeployed when the land is needed for other uses.



Solar installations at 40 Penjuru Lane. Images: CapitaLand and Sembcorp.

To better use industrial roof space, JTC will be issuing a tender in the first half of 2020 for the second phase of its SolarRoof programme to create an additional 15 MWp of solar energy capacity. Launched in 2016, the SolarRoof model enables the direct export of solar electricity generated from rooftops to the national power grid. Besides its industrial buildings, JTC is also exploring the feasibility of allowing its lessees to tap on the new contract for solar panel installations on their own rooftops. This aims to further catalyse the adoption of solar deployment across Singapore's industrial estates.

“Solar energy is one of the most promising renewable energy sources for Singapore. As the lead agency for industrial development, JTC is partnering the industry and customers to make our development more sustainable. Our SolarLand and SolarRoof programmes aim to overcome some of the constraints faced by the local solar market, such as space constraints and high capital costs. Through these efforts, we hope to reduce the carbon footprint and optimise the use of industrial land and roof spaces by installing solar panels to contribute clean energy to Singapore”, said JTC's Group Director of Engineering, Calvin Chung.



SolarLand installation on Jurong Island. Image: JTC.



SolarRoof installation on JTC Space @ Gul. Image: JTC.



SolarRoof installation on Jurong Town Hall. Image: JTC.

TWO LEADING COMPANIES JOIN FORCES

TO DECARBONISE POWER GENERATION

The cooperation agreement will address the use of 'green hydrogen' and promote sector coupling.

Recently, Uniper and Siemens Gas and Power signed a cooperation agreement for the development of projects on the decarbonisation of power generation and promoting sector coupling. It extends the long-standing partnership between the two companies.

They believe it is important to look at the energy, mobility and industry sectors together, because they all can and must contribute to reducing greenhouse gases.

One focus of the planned cooperation is the production and use of 'green hydrogen' or hydrogen from renewable energy sources. The companies intend to implement projects in this field together, addressing the entire value chain.

The scope of the new cooperation agreement also includes the evaluation of the potential of Uniper's existing gas turbines and gas storage facilities for the use of hydrogen. The focus of the work is to define what role hydrogen can play in the future evolution of Uniper's coal power plants.

Uniper recently announced that it would close or convert its coal-fired power plants in Europe by 2025 at the latest.

Uniper's coal-exit plan is instrumental to make the company achieve its objective of becoming carbon-neutral in Europe by 2035.

Siemens Gas and Power is helping its customers achieve their decarbonisation goals. 'Brownfield transformation' projects are designed to decarbonise coal-fired power plants and significantly reduce CO₂ emissions from gas-fired power plants, including the integration of storage solutions and the use of 'green gas'. By building infrastructures for Power-to-X, Siemens Gas and Power is making a global contribution to cross-sector decarbonisation. Siemens offers all core technologies for a long-term CO₂-free energy supply - from power and heat generation by renewable energies or gas-fired power plants, to power transmission and distribution, to efficient electrolysis for hydrogen production.



Power-to-X conversion technologies allow for the decoupling of power from the electricity sector for use in other sectors, and includes power-to-hydrogen, power-to-mobility, power-to-chemicals, power-to-food, power-to-ammonia, and other options.

Uniper initiated the transition to a more climate-friendly energy supply, as described in its new company strategy. The company has set itself the goal of reducing CO₂ emissions in the European generation segment from 22 million tons today to net-zero emissions by 2035. Uniper already produces around 24 terawatt hours of carbon-free electricity with its hydroelectric and nuclear power plants in Germany and Sweden. Under its new strategy, it now intends to gradually increase the share of 'green gas' or 'green hydrogen' in its conventional gas business, in both power generation and energy trading.

Uniper is a pioneer in the use of power-to-gas technology, which makes 'green hydrogen' possible, having been one of the first to implement such kind of projects. The company has already built the first power-to-gas plant in Falkenhagen in 2013, followed by another one in Hamburg in 2015. Uniper added a methanisation plant to the Falkenhagen plant in 2018. In addition, Uniper is pushing forward cross-sector industrial projects together with refineries and the automotive industry with various real-life laboratory projects, which could make it possible to enter hydrogen production at market conditions in the near future.

Siemens and Uniper have been partners for many years in integrated products, solutions and services along the entire energy value chain. In addition, the companies share a pioneering role in power-to-gas plants in which hydrogen or methane are produced from renewable energies. Power-to-gas plants can provide a technical answer to one of the key questions of the energy revolution: How can the fluctuating energy sources, solar and

wind be stored? The aim of this cooperation is to contribute to improving the economic efficiency and thus the marketability of power-to-gas plants.

Uniper CEO Andreas Schierenbeck said, "After the coal phase-out and the switch to a secure gas-based energy supply, the use of climate-friendly gas will be a major step towards successful energy system transformation; therefore, the decarbonisation of the gas industry, including gas-fired power generation, is essential if Germany and Europe are to achieve their climate targets. We are ready to invest and have set the strategic course to significantly accelerate the decarbonisation of our portfolio. In doing so, it is important to bundle energies, act openly in terms of technology, and work with proven high-technology partners like Siemens".

Jochen Eickholt, Siemens Energy Executive Board Member, said, "Green hydrogen can contribute to achieving climate targets and is thus a key to a successful energy turnaround. And it can do so across sectors in industry, mobility, and heat and power generation. But we are only at the beginning. Joint projects with our customers, such as the partnership with Uniper focusing on 'brown-field transformation' and the design of the 'green hydrogen' value chain, are extremely important here. Here we can show that a CO₂-free, environmentally friendly energy supply is possible and makes sense under real conditions and using existing plants. Together, we are working to master the challenges up to series production and use of hydrogen on a large scale and to make this clear to the world: Our future lies in hydrogen. This is what we are committed to as a company".

Siemens Gamesa to supply turbines for large wind farm in Vietnam

Vietnam has some of the best wind resources in Southeast Asia. In an effort to tap the country's potential and provide more clean energy, Siemens Gamesa Renewable Energy will supply 25 units of its SG 4.5-145 turbines for one of the nation's largest wind farms. With a total capacity of 113 MW, the Hoa Thang 1.2 wind farm will generate enough electricity to meet the demands of over 240,000 people, following its commissioning in 2021.

The deal also marks the largest order in the country for Siemens Gamesa. Additionally, the company has secured a 10-year service contract.

The project, located in the Bac Binh district, Binh Thuan province, on the South-Central coast of Vietnam, is developed by Hoa Thang Energy Joint Stock Company, a special-purpose vehicle of Vietnam's construction group, Trading Construction Works Organization, which has close to 60 years of construction experience.

Hoa Thang Energy is a pioneer in renewable energy in Vietnam, where the fast-growing economy has seen electricity demand rise by around 10% annually. The

Vietnamese government estimates that total power generating capacity will reach 125-130 GW by 2030, up from 46 GW in 2018. In order to mitigate climate concerns, the government also aims for renewable energy to account for 15% to 20% of its total energy output by 2030 and has established a target of developing 6 GW of wind power capacity by 2030.



The Government of Vietnam has established a target of developing 6 GW of wind power capacity by 2030.

LG LAUNCHES NEW COMMERCIAL AIR-CONDITIONER

WITH AIR PURIFICATION FUNCTION

The new commercial air-conditioner from LG Electronics is optimised for crowded facilities where users spend a long time. These include kindergartens, schools, hospitals, offices, retail malls, and especially places frequented by those with weaker immunity and who are more vulnerable to fine dust.

LG's new cassette offers more choices to building owners and consultants.

According to the '2019 World Air Quality Report' published by IQAir, a Swiss air quality technology company, Singapore's air quality stands in the 'Moderate' range. This means that the air quality is acceptable, however some pollutants could be present, that may cause health problems to some people who are sensitive to air pollution.

LG's cassette type indoor unit, equipped with the air purification function, is a good option when considering the installation of air purification products for large indoor spaces. To implement efficient air purifying technology, LG has added air purification solutions to 1 Way and 4 Way cassette indoor units.

AIR PURIFYING PROCESS FOR CLEANER AND FRESHER AIR

LG's air purifying process consists of the following four steps:

Pre-filtration

The multi-layer structure of the pre-filter removes particles with an efficiency that is said to be 2.5 times higher than that of the pre-filters generally used.

Dust electrification

Dust electrification increases the electrostatic force of the particles, thereby improving the filter's collecting efficiency.

Ultrafine dust filtration

Dust particles as fine as PM1.0 in size are removed by the electric dust filter. This is certified by the Korea Air Cleaning Association (KACA).

Photocatalytic deodorisation filter

The deodorisation filter removes odours and harmful gases with high-efficiency gas adsorption technology.



LG has added air purification solutions to 1 Way and 4 Way cassette indoor units.



LG's air purifying process can remove dust particles as fine as PM1.0 in size.

MARRYING A SLIM DESIGN WITH HIGH PERFORMANCE

The new cassette has a Clean Air Delivery Rate (CADR) of 19.1 m³/min which is much higher than the standard CADR of 10.0 m³/min.

Even though LG has added the air purifying process to the cassette, separate filter frames are provided for the air purification filters inside the product. As a result, the product retains its slim, attractive appearance.

Another notable feature of LG's new cassette is its indoor panel with LED lamp and a wired remote control which allows the air quality to be monitored in real-time. Monitoring can be done anytime via the mobile LG ThinQ app.

Moreover, the panel is installed on the body of the indoor unit, therefore it does not take up additional space. Also, since the air purification filters are semi-permanent, maintenance is convenient for building owners.

NEW COOLING SOLUTION

AIMS TO REDUCE ENERGY USE

In a bid to drive sustainable cooling in Malaysia amidst the climate crisis, Grundfos has launched an energy-efficient solution for air-conditioning systems that consumes 50% less energy than current conventional cooling systems.

Urbanisation and hot climatic conditions have intensified demand for air conditioning in Malaysia, reaching 1 million units in 2018, an almost 10% increase since 2013. This demand is expected to further increase over the coming decades as climate change further drives temperatures up. By 2050, Kuala Lumpur's average temperature is expected to rise by 2.3° C, while other cities such as Johor Bahru, Putrajaya and Klang may also see a 1.5° C - 1.8° C increase in temperature.

Recognising the need for sustainable methods of cooling in Malaysian cities, Grundfos has launched its Distributed Pumping System, a first in Malaysia. It is a novel system capable of operating in optimised conditions at any time. This enables significant energy savings over conventional cooling systems that consume high levels of energy, consequently contributing to greater carbon emissions due to issues such as over-pumping to compensate for discrepancies between the chilled water supply and return temperatures, as well as their tendency to run at constant speed and pressure throughout their operations, regardless of fluctuating cooling demands.

With Malaysia's Paris Agreement pledge to reduce its greenhouse gas emission intensity of GDP by 45% by 2030 and cut 32 million tonnes of carbon emissions by 2020, Grundfos Pumps Sdn Bhd forecasts that the demand for distributed pumping systems will increase in the coming years as a result of greater demand for energy efficient solutions.

The Distributed Pumping System is able to intuitively regulate the water flow based on feedback from temperature sensors, meeting the exact requirements of different building zones, and intelligently controlling energy consumption by delivering the right flow at all times. On top of reducing energy consumption and operational costs, this new system

achieves comfort for users of the building by ensuring a consistent building temperature at all times.

This approach to optimum water distribution is made possible by Grundfos' MAGNA3 and TPE3 pumps - both ranges feature compact, intelligent circulator pumps fitted with built-in sensors, variable speed drive, controller and communication module, and advanced IE5 motors ensuring high efficiency. TPE3 is a dry-runner, vertical, in-line pump used as the primary pump, while MAGNA3 is a wet-runner circulator used as the secondary pumps.

The self-balancing nature of Grundfos' Distributed Pumping System also means that control valves are not required, removing the need for tedious and time-consuming balancing, which also reduces the cost of the initial installation.



Mr Anders Christiansen, Regional Business Director, Building Services, Grundfos Asia Pacific with the Distributed Pumping System installed in the cooling circuit.

IES-NUS HELPS FELLOW STUDENTS

THROUGH PROGRAMMING WORKSHOP

Held on 24 January 2020, the IES-NUS Python Workshop 2020 was a three-hour workshop organised by the student chapter, in collaboration with Hackwagon Academy.

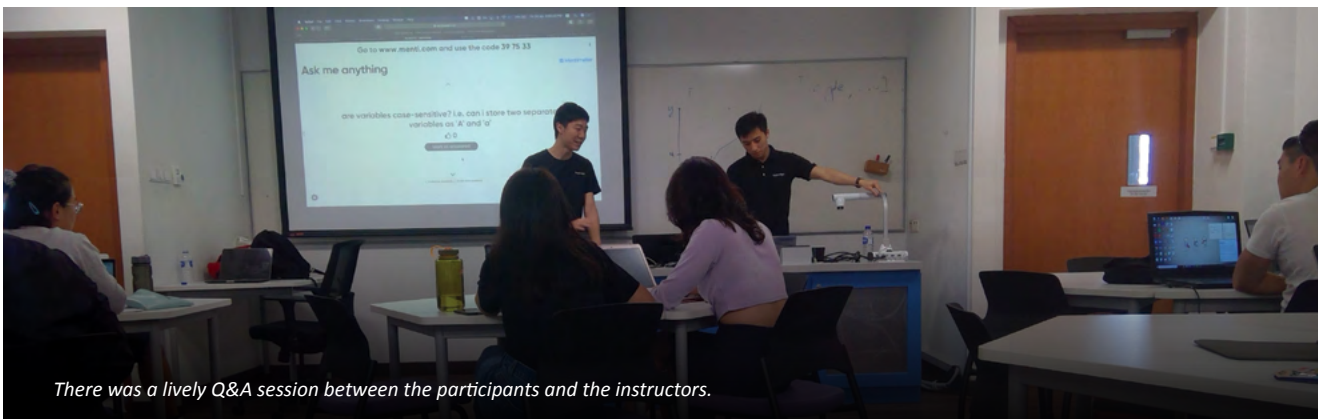
The workshop aimed to help first-year NUS engineering students with no programming background gain confidence in the area, as well as prepare them for the Python programming module that they would encounter later on in their course of study.

A total of 30 students from different engineering majors were in attendance.

During the workshop, participants learnt the basic syntax of the programming language, gained tips on the higher-order thinking skills required for the module, and solved some problems through hands-on-exercises. There was also a Q&A session where they clarified their doubts and expanded their knowledge about Python.



Participants listening attentively while the instructor from Hackwagon Academy went over the scope of contents for the workshop.



There was a lively Q&A session between the participants and the instructors.

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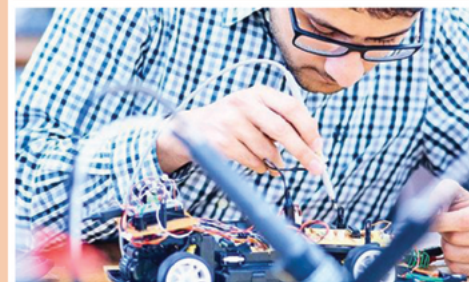


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