

THE MAGAZINE OF THE INSTITUTION OF ENGINEERS, SINGAPORE



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# THE SINGAPORE ENGINEER

September 2018 | MCI (P) 009/03/2018

COVER STORY:

**HDB TESTING FLOATING MODULAR  
SYSTEM FOR DEPLOYMENT OF SOLAR  
PANELS IN OPEN SEA**



**PLUS**

**MECHANICAL & ELECTRICAL ENGINEERING:** Hotel room management solution offers multiple benefits

**ELECTRICAL ENGINEERING:** Short-circuit strength of electrical switchboards

**ENERGY ENGINEERING:** Coal to biomass (wood pellets) mill/pulveriser conversion - a different approach





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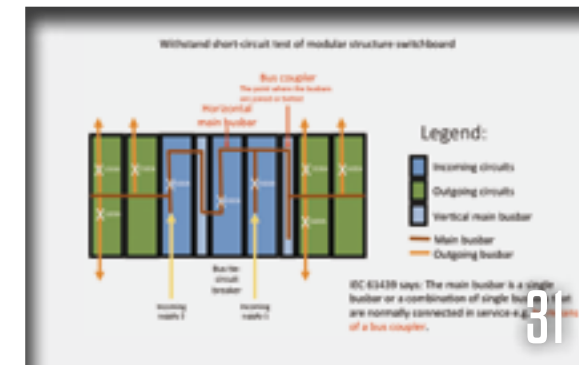
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## NEWLY-THEORISED VIBRATIONS OFFER

# POTENTIAL FOR NOVEL HEATING SOLUTIONS

A research team from the University of Edinburgh has found that ultra-fast vibrations can be used to heat tiny amounts of liquid, in a discovery that could have a range of engineering applications.

The findings could in theory help improve systems that prevent the build-up of ice on aeroplanes and wind turbines.

They could also be used to enhance cooling systems in smartphones and laptops, and make it possible to develop appliances that dry clothes more quickly using less energy.

Using computer simulations, the team demonstrated that tiny quantities of liquid can be brought to a boil if shaken at extreme speeds.

Liquid layers one thousand times thinner than a human hair can be boiled using extremely rapid vibrations – a million times faster than the flapping of a hummingbird's wings.

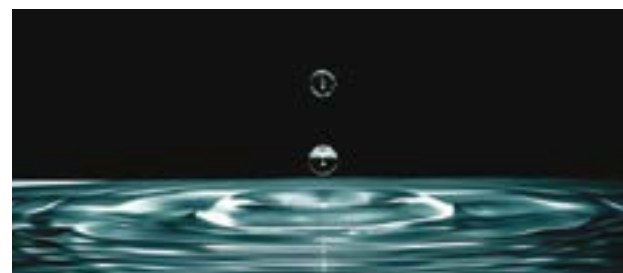
The motion of the vibrating surface under the fluid is converted into heat as liquid molecules move and collide with each other.

It is possible to use vibrations to boil only extremely small quantities of liquid, contained within mere nanometres above the vibrating surface.

Energy from vibrations applied to larger volumes produced tiny waves and bubbles instead, and only a very small amount of heat.

Team leader Dr Rohit Pillai, who lectures at the university's School of Engineering, said: "Exploiting this new science of vibrations at the smallest scales could literally shake things up in our everyday lives. The advent of nanotechnology means that this discovery can underpin novel engineering devices of the future."

The results of the study were published in the journal *Physical Review Letters*.



Extremely rapid vibrations have the ability to heat tiny amounts of liquid.

## KEY INITIATIVES TO TRANSFORM

### ENVIRONMENTAL SERVICES INDUSTRY LAUNCHED

Minister for the Environment and Water Resources, Mr Masagos Zulkifli, launched two key initiatives at July's CleanEnviro Summit Singapore 2018: A regulatory sandbox, as well as the digital plan for the environmental services (ES) industry.

These initiatives serve to catalyse the transformation of the industry and ensure more opportunities for technology collaboration and adoption.

"As a small city state, Singapore has always been keenly aware of the need to balance economic development and environmental sustainability. The environmental services industry faces acute challenges such as an ageing workforce and low productivity, but vulnerability can be turned into strength and opportunity," said Mr Masagos.

Currently, the experimentation of new technologies and solutions is allowed on a case-by-case basis, subject to compliance with existing regulatory requirements. In circumstances where it is less clear whether a new technology or solution complies with the regulatory requirements, some companies may err on the side of caution and choose not to implement it, resulting in missed opportunities.

The regulatory sandbox thus serves as a key enabler for

interested parties to trial innovative environmental services-related technologies and solutions in a controlled environment within a fixed duration, where specific regulatory requirements can be temporarily relaxed, without compromising environmental, public health and safety aspects.

Furthermore, to support the productivity and innovation objectives of the ES Industry Transformation Map, the Infocomm Media Development Authority, in partnership with the National Environment Agency (NEA), has developed the ES Industry Digital Plan (ES IDP).

This will provide SMEs in this field with a step-by-step guide on the digital solutions required at each stage of their growth. The IDP also includes a digital training roadmap, which comprises a curated list of short modular SkillsFuture Series programmes to equip the workforce with the relevant skills to keep pace with digital transformation.

In a statement released by NEA, the agency said that the implementation of these two initiatives, in concert with other ongoing efforts, would help ensure a vibrant, sustainable and professional industry that provides services and solutions to achieve Singapore's Zero Waste vision.

## CAAS COLLABORATES WITH EUROPEAN PARTNERS TO ADVANCE

# AERIAL DRONE SAFETY IN URBAN ENVIRONMENTS

The Civil Aviation Authority of Singapore (CAAS), the European Aviation Safety Agency (EASA) and Airbus have agreed to collaborate in the development of safety standards and regulatory requirements for unmanned aircraft systems (UAS) in urban environments.

The Project Document, which lays out the areas of collaboration, was signed by representatives from the three parties, and establishes a framework for the exchange of information and technical expertise.

This is to facilitate the development of safety standards and regulatory requirements, as well as operational and technological assessments for the deployment of UAS in urban environments, such as last-mile deliveries, leveraging Airbus' experience with the ongoing Skyways project.

The parties will also share safety information and learning outcomes from the urban UAS trials, and have agreed to jointly organise UAS-themed activities such as educational workshops and seminars.

Mr Kevin Shum, Director-General, at CAAS said, "This tripartite partnership is timely as we seek to better define the operating conditions for the growing number of beneficial uses of UAS in urban environments such as Singapore, with aviation and public safety in mind."

Adding on, Mr Jean-Brice Dumont, Executive Vice President of Engineering at Airbus said, "Airbus has been growing our focus on autonomous air mobility ... with the strong support of both CAAS and EASA, coupled with our experiences from Skyways, we are confident that safe and reliable urban air delivery will become a reality very soon."



The Skyways Project is an experimentation which aims to establish seamless multi-modal transportation networks in smart cities. Through Skyways, Airbus aims to develop an airborne infrastructure solution to address the sustainability and efficiency of parcel delivery businesses in large urban environments. Photo: Airbus

## SLA SETS UP GEOSPATIAL INDUSTRY CENTRE

GeoWorks, an industry centre to promote geospatial innovation and competencies, was officially launched on 16 July 2018 by Senior Minister of State for Law and Health, Mr Edwin Tong.

It aims to connect businesses, entrepreneurs and innovators to drive geospatial solutions for the promotion of business growth and opportunities here.

Geospatial information and technology has the potential to transform policy analysis, operations and service delivery, accelerate the growth of industries and generate economic and social value for Singapore.

For instance, it is used in autonomous vehicle trials and development, drone flight path planning and in remote sensing applications for day-to-day navigation and wayfinding.

"In the age of technological disruption, GeoWorks represents the Government's commitment to enhance the use of geospatial information and technology to support digitalisation of our key industries, and to build up capabilities in support of Singapore's Smart Nation Initiative", said Mr Tong.

GeoWorks was first set up by the Singapore Land Authority (SLA) in January 2018 as an initiative under the Singapore Geospatial Master Plan.

The aim of the Master Plan is to leverage emerging technologies and build geospatial competencies to address complex challenges and create opportunities.

SLA Chief Executive, Mr Tan Boon Khai, said: "The launch of GeoWorks is timely as the industry centre will be well-poised to contribute to the various growth sectors in Singapore as well as to tap on other opportunities in Asia and beyond."

As an industry centre, GeoWorks will galvanise the geospatial industry by reaching out to businesses, entrepreneurs and users, supporting them with resources such as geospatial and government data, expertise and access to networks and opportunities.

The ultimate objective is to facilitate the growth of a vibrant geospatial ecosystem, creating value through shared knowledge, expertise and data.

GeoWorks now hosts 22 GeoTech companies, with 17 others, including Amazon Web Services and Autodesk, coming on board as GeoPartners to support the initiative.

To build up and sustain a geospatial ecosystem, regular challenges will be conducted at GeoWorks to encourage the ideation and development of innovative solutions to address challenge statements from user sectors, such as logistics, transport and retail.



## CDL'S MS ESTHER AN HONOURED AS

# PIONEER IN SUSTAINABLE DEVELOPMENT

Global Compact Network Singapore (GCNS), the local chapter of the United Nations Global Compact (UNGC), has congratulated Ms Esther An, Chief Sustainability Officer at City Developments Limited (CDL), on her selection by the UNGC as an SDG Pioneer.

SDG Pioneers are business leaders from around the world who are championing the UN's Sustainable Development Goals (SDGs), through their companies and inspiring others to advance the 2030 Agenda for Sustainable Development. Ten new SDG Pioneers were recognised during the UN Global Compact Leaders Summit 2018 on 24 September at the Headquarters of the United Nations in New York.

Ms An is the first individual from Singapore and one of the first two Southeast Asian women to receive this prestigious recognition.

For the selection of the 2018 UNGC SDG Pioneers, hundreds of nominations were received from diverse regions globally. Through a rigorous process, 10 finalists were selected, who exemplify how business can be a force for good in addressing the challenges we face as a global society.

The SDG Pioneers Selection Group, comprising representatives from the UN Global Compact Board Members, Expert Networks, Global Compact Network Council, Academia, UN Focal Points and previous SDG Pioneers, voted on the nominees, based on a set of criteria. This criteria covers the individual's commitment to embed the Ten Principles of the UNGC and raise awareness on the SDGs, as well as their engagement with the UNGC and its Local Networks.

Ms An said, "Sustainability is a priority and mainstream issue on international political, economic and business agendas Globally, the opportunities created for businesses, by advancing the SDGs, is worth more than USD 12 trillion annually, by 2030. From conserving finite resources and the natural environment, to inclusiveness and investment in long-term financial stability and economic prosperity, there is tremendous potential for companies to align their sustainability strategy with the SDGs".

"For more than two decades, sustainability has been strategically integrated into all aspects of CDL's business and operations. We apply a three-pronged strategy as a property developer, an asset owner and a corporate citizen. We develop green buildings, manage them in a resource-efficient way and engage stakeholders on sustainability", she added.

The CDL Future Value 2030 sustainability blueprint, which was established in 2017, underpins CDL's



Ms Esther An

sustainability commitment and best practices over 20 years and sets Environmental, Social and Governance (ESG) goals and targets towards 2030. These long-term ESG goals and targets are aligned with 10 relevant SDGs. CDL tracks its sustainability-related initiatives and key ESG performance against its 2030 goals through annual Integrated Sustainability Reports and Sustainability Quarterly Reports.

In addition to her work at CDL, Ms An has served on the Management Committee of GCNS since 2005. Since 2011, Ms An initiated the flagship CDL-GCNS Young CSR Leaders Award, nurturing over 1,300 young leaders. The programme was rebranded as CDL-GCNS Young SDG Leaders Award in 2018, to educate and empower young leaders with SDG knowledge and skills, while inspiring companies in Singapore to take action on the SDGs. She also plays an active role in the organisation of GCNS' Annual Summit and has been instrumental in encouraging SMEs to join the local chapter.

Ms An has played a pivotal role in advancing Singapore's national sustainability initiatives and sustainable development in the region. She conceptualised and led the establishment of the zero-energy Singapore Sustainability Academy (SSA). Developed by CDL, the SSA is Singapore's first major ground-up, tri-sector partnership, in support of the SDGs and climate action. Since its opening in June 2017, the not-for-profit SSA has held over 120 sustainability-focused events and training courses, and engaged over 4,500 representatives from the People, Public and Private sectors.

## CDL TOPS SUSTAINABILITY BENCHMARK SCORES

### FOR OFFICE SECTOR IN ASIA

On the back of increased demand for sustainable investments, City Developments Limited (CDL) has continued to rank among the world's most sustainable companies. It has been named as the Sector Leader for Office, Asia, based on the 2018 Global Real Estate Sustainability Benchmark (2018 GRESB) scores. This is the second consecutive year that CDL reached top spot in the 'Office Sector in Asia' category. The 2018 GRESB Real Estate Results for Asia were announced recently at an event held at the Distrii auditorium in Republic Plaza, CDL's flagship building in Singapore.

Each year, GRESB assesses and benchmarks the environmental, social and governance (ESG) performance of real assets worldwide and monitors progress towards global sustainability goals. GRESB Assessments are guided by what investors and the industry consider to be material issues

in the sustainability performance of real asset investments and are aligned with international reporting frameworks such as the Global Reporting Initiative and Principles for Responsible Investment. GRESB Investor Members represent over USD 18 trillion in institutional capital.

In recognition of its corporate sustainability practices, CDL has been listed on 13 leading global sustainability benchmarks, including Dow Jones Sustainability Index (for eight years, since 2011), FTSE4Good Index Series (for 17 years, since 2002), CDP (since 2007), Global 100 Most Sustainable Corporations in the World (since 2010) and MSCI ESG Leaders indexes (since 2009).

Notably, CDL is one of only two Singapore companies included in the Dow Jones Sustainability World Index 2018.

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# NURTURING INDUSTRY-READY TALENT FOR TRANSFORMATION OF MARITIME INDUSTRY

The Marine and Offshore Engineering industry is key to Singapore's role as an international maritime hub leader, contributing 7% to Singapore's GDP and employing more than 170,000 people in over 5,000 establishments.

Engineers in today's competitive maritime industry need the right set of skills to effectively anticipate and manage fast-changing developments. To meet the manpower needs of the industry, Singapore Institute of Technology (SIT) and Newcastle University (NU) jointly rolled out three Marine degree programmes - Marine Engineering, Naval Architecture and Offshore Engineering in 2017.

These three-year direct honours programmes focus on training engineers with deep specialist skills, as well as honing students' critical and analytical skills to be practice-oriented and industry-ready. Exclusive modules include classification rules, electrical power and automation, renewable energy, and advanced construction methods.

Naval Architecture and Offshore Engineering students will learn about the engineering behind the design, structure, operation and management of ships and offshore structures, while Marine Engineering students will study various complex systems onboard vessels and offshore platforms.

To hone their skills, students are constantly exposed to the latest industry practices and cutting-edge technologies. They have many opportunities to visit the industry to allow them to integrate theory with practice. Special guest lectures by industry practitioners enhance the relevancy of the marine programmes as well.

The Integrated Work Study Programme (IWSP), a characteristic feature of SIT degree programmes, is another key differentiating factor. Students will immerse themselves in the industry through a 26-week IWSP work attachment with leading marine and offshore engineering organisations such as Sembcorp Marine, Keppel Offshore & Marine, Singapore Technologies Engineering Marine, Republic of Singapore Navy, Wärtsilä Singapore, Pacific International Lines, and Bureau Veritas Marine (Singapore). This allows them to put their knowledge into practice and, at the same time, gain valuable work experience.

According to Associate Professor Kenneth Low, Programme Director, SIT, "Over 80% of the academics teaching the SIT-NU Marine programmes have more than 5 years of relevant industry experience, and some had even served in leading positions for nearly 20 years."

The faculty members of SIT and NU also conduct regular dialogues with industry captains to ensure that they keep up to date with the latest developments within the industry. With such a symbiotic relationship in place, the aim is to produce a pool of skilled talents who are ready to innovate and take the digital transformation of the maritime industry in good stride.



Mr Choo Boon Kheng (in blue), Head of Project Management Office at Sembcorp Marine, showing students the automated welding process in the Sembcorp Marine Tuas Boulevard Yard's steel fabrication workshop.



Dialogue session between SIT-NU academics and management of Keppel Offshore & Marine Ltd.

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## PUB TO DIGITALISE NATIONAL WATER SYSTEM TO ENHANCE OPERATIONAL CAPABILITIES



The Autonomous Boat is being test-bedded by PUB to monitor the quality of seawater intake into desalination plants. Photo: Singapore International Water Week.

PUB, Singapore's national water agency, launched its SMART PUB roadmap on 11 July 2018, announcing its plans to digitalise Singapore's entire water system to strengthen operational resilience, safety and productivity.

"Business as usual is not sustainable. Not adopting new technology exposes us to inefficiencies and risk, and can render us obsolete or unable to adapt to technological disruptions," shared Mr Michael Toh, PUB's Chief Information Officer.

In the area of water quality management, two key innovations are being worked on – the Remote Micro-Invertebrate Detector (RMID) and the Autonomous Boat.

Developed in-house by PUB's Water Quality Department, RMID is a portable, low-cost device that can provide real-time image detection and identification using AI, with split-second imaging to determine the presence of micro-invertebrates in water samples.

The unit is linked to a mobile app and chat-bot, which enables it to respond to commands, send live reports, and trigger alerts when anomalies are detected. PUB aims to use this on a larger scale by end-2020.

The Autonomous Boat, on the other hand, is being test-bedded to monitor the quality of seawater intake to the desalination plants.

It can brave choppy waters to perform real-time water quality monitoring, collect samples, and take photos and videos of actual water conditions. Programmed to avoid obstacles, the boat is able to self-navigate to the designated sampling points.

Another key feature of the roadmap is the Pre-emptive Leak Management System. It is a preventive measure PUB is taking to improve the reliability of its network, improve incident response time and achieve better water savings. The system will be able to detect potential pipe failures using data analytics, allowing PUB to identify and prioritise high-risk pipelines for renewal.

## GRUNDFOS SINGAPORE APPOINTS NEW COUNTRY MANAGER

Grundfos, a leading pump manufacturer, has announced the appointment of Ki Woong Ahn to the role of Country Manager of Grundfos Singapore, with effect from 1 August 2018.

In his new role, Ki Woong will lead the overall sales operations for the key business areas of Industry, Commercial Building Services, Domestic Building Services, Business Development and Aftermarket Service Sales. Along with Singapore, he will oversee the company's export markets of Cambodia, Myanmar and Sri Lanka.

Ki Woong brings with him 18 years of professional experience from different positions and companies. He has been working in Grundfos Korea for the last seven years, having joined the company, in 2011, as a Segment Manager for Commercial Building Services. Prior to this appointment, Ki Woong was Director, Strategic Planning & Business Development, and before that he was Operations Director.

Before joining Grundfos, he held multiple positions in sales, marketing and engineering, with IBM, in Korea. He also had his own start-up company.

Ki Woong has a Bachelor of Electrical Engineering degree from Korea University, Seoul, Korea, and an MBA from Kelley School of Business, Indiana University, USA.



It is also consulting the industry on similar solutions to optimise its sewer operations.

Furthermore, the agency is planning to eliminate manual, paper-intensive tasks and improve knowledge management. This will be accomplished through systems like the robotic Automated Laboratory System, which tests, scans and records data from water samples around the clock.

A Building Information Model E-Checker to check building plan submissions is also in development. This will ensure that building plans submitted by Qualified Persons are compliant with all requirements, reducing the need for manual checking and resubmissions.

## JTC TEAMS UP WITH ST ENGINEERING TO DEVELOP OPEN DIGITAL PLATFORM FOR PUNGGOL DIGITAL DISTRICT

JTC and ST Engineering have signed an MOU to form a strategic partnership for the design, development and deployment of an Open Digital Platform for Punggol Digital District (PDD).

Under this partnership, both parties will work closely to integrate smart city solutions onto the platform. Both companies will co-invest equally to bring this project to fruition.

In a joint press statement, both companies said that the MOU was the first step towards collaborating with others for its development. Industry partners, including local SMEs, can look forward to opportunities to develop solutions and infrastructure for it.

In contrast to existing business parks and large-scale districts, where solutions and infrastructure are developed in silos, the Open Digital Platform will integrate various smart city solutions in PDD, such as estate management systems, the District Cooling Systems, autonomous goods delivery systems, security, as well as traffic light systems.

This will enable all district operations to be centralised for management, reducing the time taken to identify and react to problems. Estate managers can also proactively optimise and control resources with the use of predictive analytics.

The platform will be interoperable with the Smart Nation Sensor Platform to enable wider sharing of sensor data with public agencies to improve service delivery.

Furthermore, to encourage academics, researchers, start-ups and SMEs to create digital or urban solutions, real-time and historical data will be made available for them.

The data can potentially range from facility utilisation rates, electricity consumption to even equipment breakdown information from estate and building management systems. A digital replica of the entire district will be made available for contributors to test their solutions before going live.

JTC's CEO, Mr Ng Lang, said, "The Open Digital Platform will be the first in Singapore. Businesses, workers, researchers, students and the general public, innovators can plug in ... to develop solutions that will benefit the community. This also creates in Punggol Digital District an environment of innovation and collaboration that is instrumental for the digital economy."

Some of the platform's technologies will first be test-bedded and refined at one-north before deployment by 2023. Both partners will also evaluate the potential of implementing it in other districts like the Jurong Innovation District.

## ADVANCED SPEECH TECH TO HELP ORGANISATIONS IMPROVE FRONTLINE OPERATIONS

AI Singapore (AISG), a national artificial intelligence R&D programme launched by the National Research Foundation, has set up the AI Speech Lab to develop and implement a speech recognition system that could interpret and process the unique vocabulary used by Singaporeans, including Singlish and dialects.

This automatic speech transcribing system could be deployed to assist frontline officers in acquiring relevant information while they focus on interacting with customers or service users to address their queries.

"The AI Speech Lab came about as we ... received multiple requests from agencies and companies for a Singlish speech-to-text engine. This is a challenge that is unique to Singapore and the region which is currently not addressed by existing speech engines offered commercially or by major cloud-based AI providers," said Professor Ho Teck Hua, Executive Chairman of AISG.

The new research lab is led by Prof Li Haizhou from NUS and Assoc Prof Chng Eng Siong from NTU. They recently developed the world's first code-switch (mixed-lingual) speech recognition engine using deep learning technology.

The engine can recognise speech that comprises a mix of English and Chinese words in the same sentence, as if they belong to the same language. Furthermore, to adapt to the local context, words in dialects such as 'jiak ba bueh' or 'hoh boh' ('have you eaten?' or 'how are you?' respectively in Hokkien) are also included into its lexicon.

A paradigm shift in speech recognition and understanding, this technology has been earmarked for adoption by the research lab, with the Singapore Civil Defence Force (SCDF) its first collaborator.

"In an emergency, every minute counts. The new speech recognition system, if successful, will help reduce the time needed to log in information. This will improve how SCDF's emergency medical resources are dispatched and enhance the overall health outcomes of those in need," remarked Assistant Commissioner Daniel Seet, SCDF Director of Operations.

The experience from this collaboration will enable AISG to expand the deployment of the speech recognition engine government-wide. Prof Ho is also confident of its value to the private sector as it can be customised to suit business needs.

## SINGAPORE COMPANIES RECOGNISED FOR LEADERSHIP IN SUSTAINABILITY

The winners of the 2018 Sustainable Business Awards (SBA) were announced recently, in the presence of Minister for the Environment and Water Resources, Mr Masagos Zulkifli. Nearly 70 of Singapore's largest companies and SMEs entered the awards, making it a record year for entrants. Nearly half of the winners across all categories this year are Singaporean companies. This year has also seen the highest number of new companies entering the awards, with over 70% being first-time contestants.

Organised by Global Initiatives, the 4th edition of the awards was run in collaboration with PwC, Business Council for Sustainable Development (BCSD), Control Union and the Fullerton Hotel.

Established in 2012, The Sustainable Business Awards (SBA) is a regional sustainable awards platform that recognises outstanding leadership in sustainable business practices. SBA awards businesses through a rigorous assessment, using a methodology that scores both process and performance, across the following 12 categories: Strategy and sustainability management, Workforce, Community, Energy management, Water management, Waste management and material productivity, Climate change, Supply chain management, Land-use and biodiversity, Business responsibility and ethics, Stakeholder engagement and materiality, and the UN's Sustainability Development Goals (SDGs).

This year, the SBA also created two new award categories - Best Social Enterprise and Best Public Sector Service. These categories aim to give recognition to organisations which are not always acknowledged for their sustainability efforts but often have a big impact with local communities.

"Singapore's sustainability leadership is evident in this year's awards, both in terms of business engagement as well as a country, leading by example in the region. Business can and must strengthen this momentum even further to progress on the Singapore sustainable movement and reach the 2030 UN Goals in time", said Tony Gourlay, CEO, Global Initiatives.

"The awards show that many Singapore companies are leading the way in responsible stewardship and sustainability practices. Practices that will not only benefit business, but also society and the environment. PwC is proud to support the Sustainable Business Awards and organisations in achieving their sustainability ambitions", said Fang Eu-Lin, Sustainability & Climate Change Leader, PwC Singapore.

Assisting the selection of the winners was an expert panel, comprising Soo Yee Leong, Director, ASEAN & ANZ, ACCA; Sanjaya Pathirage, President Director, Control Union; Anthony Tan, Deputy CEO, Singapore Press Holdings; and Tony Gourlay, CEO, Global Initiatives.

### WINNERS OF SUSTAINABILITY CATEGORIES

#### Overall winner

Unilever  
City Developments Limited

#### Best, Strategy & Sustainability Management

Singtel

#### Best Workforce

Sodexo

#### Best Sustainability in the Community

APRIL

#### Best Energy Management

Ericsson

#### Best Water Management

Unilever

#### Best Waste and Material Productivity

Kimberly-Clark

#### Best, Climate Change

Singtel  
City Developments Limited

#### Best Supply Chain Management

Unilever

#### Best Land Use and Biodiversity

City Developments Limited

#### Best Business Responsibility & Ethics

Accor Hotels

#### Best Stakeholder Engagement & Materiality

DSM Singapore

#### Best UN SDGs

Keppel Corporation

### WINNERS OF SPECIAL CATEGORIES

#### Best Flagship Initiative

DBS

#### Best SME

Sindicatum Renewable Energy Company

#### Best Social Enterprise

The Bliss Group

#### Best Newcomer

Sembcorp Industries

#### Best Public Sector Service

Maritime and Port Authority of Singapore

## KEPPEL GROUP WINS RECOGNITION IN THE 2018 GRESB ASSESSMENT

The Keppel Group has been recognised for its effort and commitment towards sustainable practices at the 2018 Global Real Estate Sustainability Benchmark (2018 GRESB) assessment. Keppel Land Limited (Keppel Land), the property arm of Keppel Corporation, topped the 2018 GRESB assessment globally and in Asia-Pacific, in the Developer / Diversified - Office / Residential category. In addition, Keppel Land ranked second in the Developer category, in the Asia and East Asia sectors, as well as sixth, globally, in the Developer category.

Separately, Keppel REIT, managed by Keppel REIT Management Limited, has maintained its Green Star Status in the 2018 GRESB assessment. Under Alpha Investment Partners (Alpha), both the Alpha Asia Macro Trends Fund (AAMTF) II and AAMTF III achieved the Green Star Status. Keppel REIT

Management Limited and Alpha are wholly-owned subsidiaries of Keppel Capital Holdings (Keppel Capital).

Mr Loh Chin Hua, CEO of Keppel Corporation, and concurrently also Executive Chairman of Keppel Land and Chairman of Keppel Capital, said, "The recognition at GRESB spurs us in our sustainability efforts which aim to create value for all our stakeholders. Through harnessing the strengths of our businesses, we will deliver solutions for sustainable urbanisation and help shape a cleaner and greener future".

Keppel Land has a portfolio of award-winning residential developments and investment-grade commercial properties. The company is geographically diversified in Asia, with Singapore and China as its core markets, as well as Vietnam and Indonesia as its growth markets.

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## FIRST SOLARROOF BUILDINGS

### CONNECT TO NATIONAL POWER GRID

In a significant milestone for the solar electricity sector, the first SolarRoof buildings have begun contributing solar-generated electricity to the national grid, allowing businesses and individuals in Singapore to gain greater access to clean energy.

More than 20 JTC buildings are expected to be connected progressively to the national power grid by 2019, and they are expected to generate up to 5 MWp of solar-generated power.

#### SolarRoof - from test-bed to connection

Launched in June 2017, SolarRoof is the first solar energy business model in Singapore that enables the direct export of solar electricity, generated from the rooftops of JTC's buildings, to the national power grid. It is the result of a test-bed project from JTC's first Open Innovation Call in 2015.

The result of a partnership between national industrial infrastructure developer, JTC, and local solar energy retailer, Sun Electric, SolarRoof optimises rooftops for solar power generation and catalyses the adoption of clean energy in Singapore. Consumers can purchase solar-generated electricity, even if the buildings they occupy are not equipped with solar panels.

The first SolarRoof buildings that have begun contributing this source of clean energy to the national power grid include JTC Space @ Tuas Biomedical Park and Offshore Marine Centre.

On the successful connection of the first SolarRoof buildings to the national power grid, after a year of installation and tests, Mr Ng Lang, CEO of JTC said, "We are excited that this partnership with Sun Electric will

provide consumers with greater access to a sustainable source of energy. We hope that this will encourage more building owners to optimise their roof spaces for solar power generation, and do their part to contribute to sustainable energy generation in Singapore."

#### Making solar power accessible to all

Sun Electric was awarded the SolarRoof contract by JTC in 2017, to supply, install and maintain solar panels mounted on the rooftops of JTC's buildings. The electricity generated by the solar panels is currently available for purchase by commercial entities and will be rolled out to consumers. Existing customers include French energy management company, Schneider Electric, leading restaurant-booking start-up, Chope, and local café, Crown Coffee.

Sun Electric also has a SolarSpace programme which delivers the solar electricity in the national grid to any user who is connected to the national electricity network. The patented SolarSpace solution is free for solar installation firms, consumers, and buildings, alike. SolarSpace's proprietary dashboard will also allow its users to track their energy usage, including seeing which specific rooftop their electricity comes from, for greater transparency.

"With the SolarRoof programme, we want to make solar energy accessible to all. We are proud to work with JTC to make solar energy available on Singapore's Open Energy Market (OEM), so that everyone in Singapore can tap on power generated by ourselves. It is truly Our Power", said Dr Matthew Peloso, Founder and CEO of Sun Electric.



Aerial view of the solar panels on the rooftop of JTC's Offshore Marine Centre.

## LENLEASE ASIA FUNDS TOP 2018

### SUSTAINABILITY RANKINGS

Lendlease's Asia funds have again topped the rankings of the 2018 Global Real Estate Sustainability Benchmark (GRESB) in the Asia Retail category.

Used by the industry to benchmark Environmental, Social and Governance (ESG) performance, 903 participants and 79,000 properties, representing USD 3.6 trillion in global assets under management took part in the 2018 GRESB Survey.

In the Asia Retail funds category with 23 submissions, the five Lendlease-managed funds swept the top positions. Asian Retail Investment Fund 1 (ARIF1), which holds 313@somerset, retained its number one ranking as the regional sector leader, from 2017. ARIF 1 topped the Asia rankings, out of 123 submissions. Meanwhile, Parkway Parade Partnership jumped five spots from last year, to

clinch second place. ARIF 2 (Setia City Mall in Malaysia) and ARIF 3 (Jem) came in third and fourth, respectively, while Lendlease Jem Partners Fund, in fifth position, completed the top rankings for Lendlease.

Lendlease Chief Investment Officer, Asia, Ng Hsueh Ling, said, "We are honoured to be recognised by GRESB once again for our efforts in sustainability in Asia. As we mark our 60th anniversary this year globally, we renewed our commitment as a signatory to the United Nations Principles of Responsible Investment (UNPRI). Lendlease is focused on delivering long-term value as governments, investors and the private sector seek trusted partners who can deliver efficient, healthy and resilient outcomes that are financially, environmentally, culturally and socially inclusive".



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## 3M STRENGTHENS

# COMMITMENT TO SINGAPORE

Global science company, 3M, has taken new initiatives to strengthen the company's commitment to its Singapore operations. These include the recent launch of its new Ang Mo Kio headquarters (HQ), the opening of the 3M Customer Technical Center (CTC), and the launch of one of Singapore's largest rooftop solar installations at its Tuas manufacturing plant.

These new initiatives reinforce 3M's operations in Singapore as an important business hub. Since 1966, 3M has invested over SGD 1 billion into its facilities across the country, in the districts of Ang Mo Kio, Woodlands and Tuas, spanning business, R&D, manufacturing, and supply chain operations.

Amongst the guests who attended the launch were the Guest-of-Honour, Dr Amy Khor, Senior Minister of State, Ministry of the Environment and Water Resources & Ministry of Health, and representatives from the Economic Development Board (EDB), Ministry of the Environment and Water Resources (MEWR), the United States Embassy in Singapore, and 3M customers.

3M Singapore also marked the launch by pledging its support for the Singapore Year of Climate Action. Dr Amy Khor and Ms Yuko Nakahira, Managing Director, 3M Singapore, took part in the symbolic act by unveiling the 3M pledge on the sustainability wall of the 3M Customer Technical Center.

"Our Singapore footprint has grown significantly over the last 52 years. As we expand our presence in Singapore, 3M is looking into ways to foster more collaborations with local and regional partners, and develop Asia-centric solutions that address our customers' sustainability challenges. This complements our growth in the region while supporting the government's push for a more liveable city", said Ms Nakahira.

### Larger HQ

The new 3M Singapore HQ is housed inside Techpoint at Ang Mo Kio. Double the size of the previous HQ located at Yishun, the facility spans 10,000 m<sup>2</sup> in floor space across three floors, and currently houses more than 500 employees from 3M's Singapore, regional, functional, and supply chain operations.

A key design highlight of the new 3M HQ is its many collaboration spaces that encourage networking and interaction among its em-

ployees and customers. The spaces are also designed to foster better teamwork and improve productivity levels among 3M staff.

### New Customer Technical Centre

Designed to bring science and innovation closer to its customers, the SGD 1.3 million 3M Singapore Customer Technical Centre (CTC) is a facility housed within the new HQ, that showcases the science of the company's 46 technology platforms across 25 stations.

It is the first 3M CTC in Southeast Asia to feature virtual reality technology that simulates realistic work-at-height training scenarios. Other noteworthy installations include the Curved Dark Tunnel showcasing 3M retroreflective solutions such as sign sheeting and pavement markings that improve traffic safety and mobility.

Locally-developed solutions such as the 3M Rinse-Clean Coating RC-1000 will also be on display. It is an advanced coating solution for exterior surfaces, that reduces their ability to attract dust and dirt. With the solution, surfaces remain dirt-free longer - halving the frequency of maintenance and reducing water and cleaning costs, by up to 20%.

### Rooftop solar installations

The 3M Rooftop Solar Farm, located at the 3M Tuas manufacturing plant, is amongst the largest rooftop solar installations in Singapore. It is capable of generating an average of 2,400 MWh of electricity yearly and supports 3M's 2025 Sustainability Goal to increase the renewable energy component to 25% of electricity use.



The 3M Rooftop Solar Farm is capable of generating an average of 2,400 MWh of electricity yearly.

# SEMBCORP TO SUPPLY SOLAR POWER

## TO SUPPORT FACEBOOK'S SINGAPORE OPERATIONS

Sembcorp Industries (Sembcorp) has signed a long-term solar energy deal with US-headquartered tech company, Facebook. Under this deal, Sembcorp will help provide locally-sourced renewable power to support Facebook's recently announced 170,000 m<sup>2</sup> Singapore data centre, as well as its other Singapore operations, over the next 20 years.

Sembcorp is a homegrown Singapore power player with over two decades in the business. It is said to be the only established power gentailer (generation affiliated retailer) in the country to offer renewable energy, and has one of Singapore's largest solar power portfolios.

Sembcorp will serve Facebook's renewable energy needs through offsite solar panels totalling 50 MWp in capacity. These panels will be installed on close to 900 rooftops in the land-scarce island state, between the end of this year and 2020.

Koh Chiap Khiong, Head of Sembcorp's energy business in Singapore, Southeast Asia and China, said, "At Sembcorp, our goal is to provide energy that makes a difference. One key way is through providing clean energy to companies and our community. Against this background, Sembcorp is very honoured to become Facebook's first

renewable energy partner in Asia, with our new 20-year solar power deal. This demonstrates our ability to offer clients a strong value proposition to support their power needs and meet their environmental goals at the same time. We look forward to working with more companies for such solutions in the future".

Commenting on the deal, Neil McGregor, Group President & CEO of Sembcorp Industries, said, "Our deal with Facebook is an example of how Sembcorp is aligning its business to the future. As our world moves towards renewables and lower-carbon energy, there is an increasing demand for solutions that enable businesses to achieve growth while managing their impact on the environment. Sembcorp is actively working with companies in this, and supporting their efforts towards this dual objective".

Bobby Hollis, Head of Global Energy at Facebook, also welcomed the deal.

"This agreement represents our first step towards supporting our Singapore Data Center and local offices with 100% renewable energy. We are thrilled to have Sembcorp as our partner on this project and excited to see the continued acceleration in the growth of the renewable energy market in Singapore", he said.

## SURBANA JURONG PARTNERS UNIVERSITY IN MALAYSIA

Malaysian-based HELP University has signed a Memorandum of Understanding (MOU) with Surbana Jurong, to set up a Green Design and Technology Centre, as well as to promote sustainability in the built environment.

The centre, which will be based in HELP University's Subang 2 campus, will offer certificate courses on renewable energies, sustainable urban planning, architecture, engineering and infrastructure. It will also focus on research & development in these fields, and there are plans to offer these courses at undergraduate and postgraduate levels, as well as in its international schools, at a later stage.

HELP University is embarking on a mission to transform the institution and its programmes, so that it can train future generations to be ready for Industry 4.0 in which artificial intelligence, increasing automation, and data analytics will play a key role in managing economies, and the lives of human beings.

The Green Design and Technology Centre is part of HELP University's plans to meet the growing demand for courses on sustainability in urban developments, and supports the country's vision of becoming a regional hub for education. As part of the MOU, both HELP and Surbana Jurong will develop and

organise courses on sustainable building design for commercial developers and consultants in Malaysia and the region.

The partnership leverages HELP's experience and reputation in developing quality programmes, and Surbana Jurong's strong track record in providing sustainable planning, design and engineering solutions to the global urban and infrastructure market.

Mr Wong Heang Fine, Group Chief Executive Officer of Surbana Jurong, said, "Our partnership with HELP will train a new generation of architects, planners and engineers in sustainability in the built environment, while increasing awareness and capabilities among developers. This will help ensure that more cities of the future are resilient and sustainable. Surbana Jurong is excited to lend our global experience to this endeavour and we look forward to working with HELP to promote sustainability to the region".

Prof Datuk Dr Paul Chan, Vice-Chancellor and President of HELP University said, "This MOU is the beginning of a long-term plan to implement green curricula into every aspect of training at this new and exciting Green Design and Technology Centre, and we look forward to working with Surbana Jurong to ensure the success of this new venture of HELP University".



## DYSON AND NTU TO LAUNCH A JOINT ENGINEERING STUDIO FOR ASPIRING TECHNOPRENEURS

Nanyang Technological University, Singapore (NTU Singapore) and Dyson are launching an engineering studio that will give students a chance to work with industry experts to develop technological answers to real-world problems.

The Dyson-NTU Studio is Dyson's first on-campus engineering studio in Asia. An undergraduate course module, co-taught by the two partners in the studio, will give NTU engineering students access to advanced prototyping equipment to help them turn their ideas into viable solutions.

Students can choose from a variety of problems facing society in the semester-long Product Development Challenge module. Guided by NTU professors and Dyson engineers, they will develop technology prototypes and test their viability at the NTU Smart Campus.

Starting this academic year, up to 20 NTU engineering students will enrol in this module, each semester.

Prof Louis Phee, Dean of NTU's College of Engineering, said, "Universities have always been fertile grounds for nurturing exciting student ideas. Many innovative game changers like Skype and Facebook grew out of universities' labs and garages".

"With close guidance from NTU professors and Dyson engineers, our students will learn the essentials of translational research, and develop their ideas into useful solutions to benefit industry and society. A new batch of technopreneurs may emerge from this joint initiative", he added.

The studio builds upon an existing Dyson-NTU partnership which includes local and overseas internships for students, and graduate recruitment opportunities.

Mr Scott Maguire, VP for Global Engineering and Operations, Dyson, said, "Like the UK, Singapore needs engineers. More importantly, it needs industry-ready engineers. Our job is therefore to create exciting new

opportunities for young people here, igniting a passion in them to make new technology that solves a problem, to create an original product and design it well. At the Dyson-NTU Studio, students will get the opportunity to experience what it is like to work on problems and iterate solutions under the guidance of Dyson engineers, with the latest lab facilities. We hope that this will inspire them to become engineers when they graduate".

### Industry-relevant education

Dyson will be contributing SGD 500,000 to the studio for a period of five years.

The studio will simulate Dyson's working environment and its research and development processes.

Students from various fields of engineering will work in teams and apply what they have learnt.

They will need to define a problem, design, and develop their ideas, from a blueprint into a working prototype.

They will also get to use equipment such as high-resolution 3D printers and digital fabrication facilities, and learn the latest industry software suites. These include high-resolution rapid prototyping and modelling software.

Since the start of the new academic year, the module has created a lot of interest among students and is already fully subscribed.

The studio will also serve as a platform for industry and career talks, for students and researchers, as well as host engineering-led competitions and tech exhibitions.

Moving forward, Dyson is in talks with NTU to also expand the use of the studio to students from other disciplines, such as business and humanities.

## HDB INKS THREE RESEARCH AGREEMENTS TO ADVANCE SMART AND SUSTAINABLE HOMES

The Housing & Development Board (HDB) signed three new research agreements with industry partners at World Cities Summit 2018, to advance its goal of creating smart and sustainable homes for Singaporeans.

A Memorandum of Understanding has been entered into by HDB and SP Group, to study the potential of developing Tengah into a first-of-its-kind Smart Energy Town.

An agreement between HDB and Robin Village Development Pte Ltd will see research being conducted on the use of 3D concrete printing for the production of unique architectural forms, in order to expand design and construction capabilities.

Meanwhile, a research collaboration agreement was signed between HDB and ISO Landscape Pte Ltd, to study and develop a floating solar system for marine conditions.

Through these partnerships, HDB aims to further leverage technology to optimise energy usage, construction efficiency and design capabilities in HDB estates of the future.

### Powering Tengah with artificial intelligence

Tengah, HDB's newest town announced in 2016, will be Singapore's first and largest smart and sustainable town, planned with green and sustainable features, and smart technologies, from the outset. To realise this vision, HDB will be partnering the SP Group to study the potential of developing Tengah into a Smart Energy Town. This involves developing and test-bedding a centralised energy software

system that will collect, process, analyse, and learn from data on energy consumption at the town-, neighbourhood-, and apartment-levels. The study, which will enable a more efficient and sustainable model of energy management, will be conducted over a one-year period, from July 2018.

HDB will also work with SP Group to explore the development of a centralised cooling system in a housing development. This will offer residents the option of subscribing to the service, as a more energy-efficient solution compared to conventional air-conditioning systems.

### Expanding capabilities through 3D concrete printing

In another first for public housing, HDB will be embarking on a three-year research project with Robin Village Development Pte Ltd and collaborators Witteveen+Bos South East Asia Pte Ltd and Nanyang Technological University (NTU), to explore the potential adoption of 3D concrete printing for the production of unique architectural forms and components which would otherwise be expensive and time-consuming to produce.

The research collaboration, costing an estimated SGD 3 million, will look into developing digital fabrication technologies through the creation of a 3D concrete printer.

### Exploring solar capabilities in the open sea

HDB will partner ISO Landscape Pte Ltd to study and develop a floating solar system for coastal marine conditions which are harsher than the conditions on land.



The Dyson-NTU Studio is Dyson's first on-campus engineering studio in Asia. The facility will provide NTU engineering students access to advanced prototyping equipment to help them turn their ideas into viable solutions.

## ABB LAUNCHES ENERGY-LEAN UPS

The DPA 250 S4 UPS (uninterruptible power supply), from ABB, is said to deliver a market-leading module efficiency of 97.6% and a system efficiency of 97.4%, setting the standard for the future of UPS evolution. Power losses are said to be more than 30% below those of similar products on the market.

The DPA 250 S4 features ABB's decentralised parallel architecture (DPA), covers the power range 50 to 1,500 kW and is specially designed for critical, high-density computing environments such as small- to medium-sized data centres, commercial buildings, healthcare facilities, railway signalling centres and airports.

One DPA 250 S4 250 kW cabinet can host up to six 50 kW modules for 250 kW N+1 redundant power. Up to six 250 kW frames and up to 30 modules can be paralleled for 1,500 kW of uninterrupted, clean power. Secure ring-bus communication ensures there is no single point of failure in the system.

As well as providing a fully scalable and easily maintained UPS, with optimum uptime and energy efficiency, the DPA 250 S4's dual conversion mode ensures power going to the critical load is cleansed of any grid noise or fluctuations. Its transformer-free IGBT (Insulated Gate Bipolar Transistor) converters, which feature three-level topology with interleaving controls, make the device lighter and more energy-efficient, with reduced cooling requirements.



DPA 250 S4 is said to be the most energy-lean UPS on the market.



## TOP ENERGY LEADERS TO TAKE PART IN

## DISCUSSIONS AT SIEW 2018

Singapore International Energy Week 2018 (SIEW 2018), the 11th edition of the event, will be held from 29 October 2018 to 2 November 2018, at the Sands Expo and Convention Centre, Marina Bay Sands, Singapore.

Organised by the Energy Market Authority, Singapore, the event will bring together distinguished global energy leaders to share insights and perspectives on the theme 'Transforming Energy: Invest, Innovate, Integrate'.

Mr Chan Chun Sing, Singapore's Minister for Trade and Industry will deliver the SIEW 2018 Opening Remarks. The SIEW 2018 Opening Keynote Address will feature Dr Fath Birol, Executive Director of the International Energy Agency (IEA) and Mr John Abbott, Downstream Director and Member of the Executive Committee at Shell. They will discuss the investments, innovation and integration needed for a more resilient energy future.

For the first time, the 36th ASEAN Ministers on Energy Meeting (AMEM) and Associated Meetings will be held together with SIEW. Delegates can look forward to strategic discussions with policy makers and senior representatives from the industry and international organisations including:

- Dr Koh Poh Koon, Senior Minister of State, Ministry of Trade and Industry, Singapore
- H E Suy Sem, Minister of Mines and Energy, Cambodia
- H E U Win Khaing, Union Minister for Electricity and Energy, Myanmar
- H E Alfonso Cusi, Secretary of Energy, The Philippines
- H E Dr Siri Jirapongphan, Minister of Energy, Thailand
- H E Dr Arcandra Tahar, Vice-Minister of Energy and Mineral Resources, Indonesia
- H E Li Fanrong, Vice-Administrator, National Energy Administration, China
- Dato Lim Jock Hoi, Secretary-General, ASEAN
- Adnan Z Amin, Director-General, International Renewable Energy Agency (IRENA)
- Liu Zehong, Executive Vice President, State Grid Corporation of China
- Bambang Susantono, Vice-President, Knowledge Management and Sustainable Development, Asian Development Bank (ADB)
- Dr D J Pandian, Vice President and Chief Investment Officer, Asian Infrastructure Investment Bank (AIIB)
- Philippe Monloubou, Chairman of the Management Board, Enedis
- Martin J Houston, Vice-Chairman, Tellurian
- Yuji Kakimi, President, JERA
- Sharbini Suhaili, Group CEO, Sarawak Energy
- Piyush Gupta, CEO and Director, DBS Group

- Didier Holleaux, Executive Vice President, ENGIE
- Ditlev Engel, CEO, DNV GL-Energy
- Tim Holt, CEO, Power Generation Services, Siemens
- Wouter Van Wersch, President & CEO of GE Asia Pacific and Vice-President, General Electric
- Kazuhisa Yano, Chief Asia Representative, Osaka Gas

Other high-level discussions at SIEW 2018 include the 2nd Singapore-IEA Forum, SIEW Thinktank Roundtables, and SIEW Energy Insights. SIEW key partner events, comprising Asia Clean Energy Summit (ACES), Asian Downstream Summit (ADS) and Gas Asia Summit (GAS), will also return this year, featuring discussions on clean energy, refining & petrochemicals, and gas & LNG, respectively.

## Singapore International Energy Week

Singapore International Energy Week (SIEW) is a premier platform in Asia for energy insights, partnerships and dialogues, which brings together the world's leading conferences, exhibitions and roundtables in one week and in one location. SIEW enriches the global energy conversation by convening political, business, academic and energy industry thought-leaders to define and advance the world's leading energy challenges, solutions and actions, across the energy spectrum of oil & gas, clean and renewable energy, and energy infrastructure financing. More information on SIEW may be obtained from [www.siew.sg](http://www.siew.sg).

## Energy Market Authority


The Energy Market Authority (EMA) is a statutory board under Singapore's Ministry of Trade and Industry. Its main goals are to ensure a reliable and secure energy supply, promote effective competition in the energy market and develop a dynamic energy sector in Singapore. Through its work, EMA seeks to forge a progressive energy landscape for sustained growth. More information on EMA may be obtained from [www.ema.gov.sg](http://www.ema.gov.sg).



Reception at Level 4 of Sands Expo and Convention Centre. Image by Marina Bay Sands.

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## HDB TESTING FLOATING MODULAR SYSTEM FOR DEPLOYMENT OF SOLAR PANELS IN OPEN SEA

The success of the study will strengthen solar power development in Singapore.

Singapore's goal is to grow in an efficient, clean, and green way. HDB plays a key role in supporting Singapore's commitment to sustainable development, with initiatives such as driving solar power development in Singapore and developing innovative solutions that drive urban sustainability for the benefit of residents and the environment.

A research collaboration agreement was signed between HDB and ISO Landscape Pte Ltd, at World Cities Summit 2018, to study and develop a floating solar system for marine conditions, that can address the harsh environmental conditions at sea. The collaboration will look at how to overcome the challenges of marine conditions, such as strong winds, wave action, and the accumulation of marine organisms. The study is expected to be completed by 2019.

This initiative comes after HDB successfully installed the floating modular system - an in-house invention by its own engineers - in Punggol Waterway, in 2011, to create a floating wetland system. The invention has since been deployed also to create a floating solar system in Tengeh Reservoir in Tuas, in May this year.

### FLOATING WETLAND SYSTEM

In 2011, HDB successfully test-bedded and implemented an innovative floating wetland system along the My Waterway@Punggol, a 4.2 km long, man-made waterway at Punggol. Invented and patented by HDB, the floating modular system utilises a unique interlocking solution to create a light-weight structure with high strength and rigidity. The resulting form is thus a one-of-a-kind floating system which allows flexible configurations, in any size and shape, to carry heavy loads. In addition, it can be easily assembled and placed anywhere on the water surface.

The floating wetland system facilitates the cultivation of wetland plants that transform the plain water surface into pockets of greenery that beautifies the environment, cleanses the water and improves biodiversity.

Since its implementation, the floating wetland system at My Waterway@Punggol has garnered many international and national awards, including the American Environmental Sustainability (Honour) Award 2017, IES Prestigious Engineering Achievement Award 2016, and



Floating wetland system at My Waterway@Punggol

ASEAN Outstanding Engineering Achievement Award 2016. The system has also generated commercial interest from both local and overseas companies, keen to tap on HDB's invention.

### FLOATING SOLAR SYSTEM

With the success of the floating system, HDB has been studying the expansion of its use in areas beyond greening. One area that is being studied is the use of this system to hold solar panels on water bodies to harvest solar energy.

Currently, a large majority of solar panels are installed on the rooftops of HDB blocks. To-date, solar panels have been installed or are being fitted in more than 2,400 HDB blocks. By 2020, about 5,500 HDB blocks will be fitted with or identified for solar installation.

However, as solar energy generation is dependent on surface area, Singapore's land constraints remain a challenge. As such, there is a need to find other suitable locations for deployment or installation of solar panels.

One of the solutions is to deploy solar panels on water bodies, as a floating solar farm. On water, the solar panels can potentially receive maximum sunlight as these water bodies are typically free of obstruction.

### PILOT AT TENGEH RESERVIOR

In January 2018, HDB signed a Research Collaboration Agreement (RCA) with Million Lighting Co Pte Ltd, to develop a 100 kilowatt peak (kWp) floating solar system in Tengeh Reservoir in Tuas, using HDB's modular system. This is the first time a locally-designed flotation system has been deployed for solar panels.

The modular floating system is light-weight and easily mass-produced, thus enabling these modules to be cost-effective on a large scale. Each module can support up to 75 kg. A total of 864 modules were deployed at Tengeh Reservoir. Together, they support 368 solar panels and inverters, weighing some 9,400 kg. Launched in May 2018, the floating solar system is estimated to generate about 120 MWh of electricity in a year and reduce carbon emissions by 60 tonnes annually.

### Design of floating modules

In designing the floating modules, the stability of the system and ease of maintenance were topmost in the minds of HDB's engineers. Each rect-

angular module is designed with a corrugated surface and a row of grooves and ridges to provide rigidity and strength. On each side of the floating module, there are, at least, two connectors that can be bonded to another floating module with stainless steel pins. This innovative design is currently patent pending.

The design also seeks to optimise the available water surface area, to generate the same amount of solar energy as that generated by the same surface area on land. To achieve this, HDB devoted much attention to the layout of the floating solar system at Tengeh Reservoir. For example, the maintenance pathway is designed to serve two rows of solar panels - one on each side. This reduces the need to provide additional floating modules for maintenance work to be carried out. At the same time, this design also spaces out the panels, which helps to cool them and maintain their efficiency.

All images by HDB



HDB's floating solar system has been deployed at Tengeh Reservoir.



Each maintenance pathway is designed to serve two rows of solar panels, reducing the need for additional maintenance pathways.



## CREATING A SMART AND SUSTAINABLE CITY

When completed, Saigon Sports City could become a model for other urban developments in Asia.



Artist's impression of Saigon Sports City. Image by Keppel.

Saigon Sports City (SSC) is a 64-hectare township that Keppel Land is developing in the prime District 2 in Ho Chi Minh City, Vietnam, in collaboration with Keppel Urban Solutions, a business unit of Keppel Corporation. SSC is envisaged to be a bustling hub, combining modern and sustainable urban living with vibrant and healthy lifestyles.

The integrated township will comprise about 4,300 premium homes and include iconic features such as a waterfront boulevard, an open public plaza and a one-stop lifestyle hub with comprehensive facilities for sports, entertainment, shopping and dining. In addition, biophilic design principles will be incorporated into the development, such as natural lighting and ventilation, a linear park, vertical greenery and picturesque water features with natural filtration, to create a green and beautiful environment.

SSC will be completed in phases, with the first phase, featuring some 90,000 m<sup>2</sup> gross floor area of commercial space and about 1,220 homes, expected to be completed in 2022.

In addition, KUS will collaborate with Microsoft to empower SSC with Azure, Microsoft's intelligent and trusted cloud, to enable essential services such as security and access control, remote monitoring and control of smart infrastructure, and monitoring of community vitals such as air quality. KUS will also

launch an integrated mobile app which would deliver convenient lifestyle, transport and other value-adding services to residents and businesses in SSC.

### Keppel Urban Solutions

Keppel Urban Solutions (KUS) was established as a business unit of Keppel Corporation, to capitalise on the mega trends of rapid urbanisation and the increasing global focus on sustainability.

KUS aims to be an end-to-end integrated master developer of smart, sustainable precincts in the Asia-Pacific region.

The company will harness the Keppel Group's strong track record in large-scale, urban developments, as well as its strengths and diverse solutions in energy, property, infrastructure and connectivity, to create efficient and vibrant smart precincts and cities of the future. It will also advance Keppel's goal of being a choice solutions provider for sustainable urbanisation.

KUS will leverage the Keppel Group's more than two decades of experience as the master developer of large-scale projects in Asia, including the China-Singapore Suzhou Industrial Park, Sino-Singapore Tianjin Eco-City, Sino-Singapore Jinan Smart City, as well as Keppel Bay in Singapore.

## KUS SIGNS MOU WITH ENVISION

In end-January 2018, KUS and Envision, a global smart energy management company, signed a non-binding MOU that will see both companies leverage each other's expertise and resources to further the global push for new and clean energy, and smart cities.

KUS intends to leverage Envision's technologies and expertise in the Internet of Things (IoT), as well as its global ecosystem of energy solutions and services, to advance its business and offerings for integrated urban development and operations. For Envision, the partnership seeks to reinforce its leading position in Intelligent IoT platforms as well as transformational smart energy and smart city solutions, by leveraging the industry expertise of the Keppel Group.

Ms Cindy Lim, Managing Director, KUS, said, "We are pleased to have found a like-minded partner in Envision, a leading renewable energy and Intelligent IoT platform provider, to build new capabilities and capture growth opportunities in promising markets".

Mr Michael Ding, Group Executive Director, Envision, said, "At Envision, we believe that energy can be beautiful. It is possible to achieve clean, secure, plentiful energy, which will be the catalyst to solving the world's biggest issues. However, this possibility hinges on purposeful collaboration with partners like Keppel".

The partnership will enable KUS to integrate Envision's EnOS, an open source, energy IoT platform, into the group's assets and developments, globally. EnOS covers many domains such as wind and solar energy generation, energy storage and network, smart buildings, as well as charging of electric vehicles. It connects dynamic responses to downstream customer demands with upstream renewable supply, by creating synergies across energy facilities of homes, communities and even cities, driven by advanced sensors, software applications, powerful artificial intelligence and data analytics technology.



Concept of city and power grid management. Image by Envision.

## KEPPEL URBAN SOLUTIONS AND ST ENGINEERING INK PARTNERSHIP

Keppel Urban Solutions signed a Memorandum of Understanding (MOU) with ST Engineering at World Cities Summit 2018, which will enable both companies to leverage each other's expertise and resources in designing and implementing smart city masterplans and solutions, as well as collaborate on third-party projects in the Asia-Pacific.

The partnership targets cities and developments looking for end-to-end services that weave in smart city technologies seamlessly. These technologies work to improve user experience, liveability, sustainability and resource-efficiency, in tandem with the site's population, land use, community facilities, physical characteristics, as well as social and economic conditions.

Beginning with Vietnam, where Keppel has a strong presence and track record, the partnership may also be extended to other markets. One of the projects that Keppel and ST Engineering will embark on is Saigon Sports City. Technologies that could be implemented include smart street lighting, smart security management, autonomous vehicles and mobile robots, drone network solutions, and smart environment monitoring. The partners also intend to roll out relevant smart solutions in other Keppel developments.



# GERMAN EUROPEAN SCHOOL SINGAPORE

## OFFICIALLY OPENS NEW CAMPUS

Through the Junior Engineer Academy, the school will also offer a programme for budding engineers.



An exterior view of the new German European School Singapore.



The official launch ceremony was held at the 400-seater auditorium within the campus.



Dr Vivian Balakrishnan and Mr Andreas Michaelis.

The German European School Singapore (GESS) recently held an official launch ceremony to mark the opening of its new 30,500 m<sup>2</sup> campus at Dairy Farm Lane.

The Guests-of-Honour, Singapore's Minister of Foreign Affairs, Dr Vivian Balakrishnan, and State Secretary, The Federal Foreign Office, The Federal Republic of Germany, Mr Andreas Michaelis, together with 10 European ambassadors and country representatives, officiated at the launch, marking a new chapter of GESS' 47-year journey in Singapore.

The GESS campus, which has a capacity for 2000 students, caters to the strong EU community which has

over 10,000 companies operating in Singapore. At the launch, GESS reaffirmed the strong ties between EU and Singapore, with a pledge to forge strong bonds with the local community, while providing a creative and conducive place for students to thrive in.

### Comprehensive facilities to maximise the potential of students

The new campus, which cost SGD 135 million to build, features a wide range of facilities that will act as an incubation space for students of varying interests and talents. These range from creative spaces, performing

arts facilities to sports amenities like an Olympic-sized swimming-pool and a football field.

Students can look forward to enhancing their skills within collaborative learning and break-out spaces that cut across disciplines, sharpening their engineering skills with the Design and Technology Studios and honing their cooking skills at the Cooking Lab. As part of efforts to give back to the community, the Cooking Lab, swimming pool, auditorium and football field are open to the local community, based on availability.

### GESS Launches the Junior Engineer Academy

In line with the push to build a greater pool of STEM professionals, GESS has officially launched the Junior Engineer Academy, a prestigious network initiated by the Deutsche Telekom Foundation that trains budding engineers from grade eight. GESS is the first school outside of Europe to offer the programme, where selected students will undergo training in basic engineering modules, provided through collaborations with universities and engineering companies, such as the National University of Singapore, Pomeroy Studio and Bosch.

Students will have opportunities to learn and network with university academics, scientific bodies and industry experts, in order to tackle real-world challenges in society today. The programme will focus on sustainable urban living spaces, in the context of Singapore's dense urban environment, and will see the students involved in building GESS's very own green wall.

"Our students will be exposed to present and future engineering, while bearing in mind environmental issues in societies", said Christoph Zaenglein, Principal, GESS.

"GESS has always believed in empowering its students by providing them with avenues to pursue their aspirations. With this new campus and with programmes like the Junior Engineer Academy, we hope to mould our students into confident, environmentally conscious, global citizens who are future-ready and able to contribute not only towards Singapore's Smart City future, but also to cities around the world", he added.

### Environment-friendly building design

In line with the school ethos of caring for the environment, GESS received the Building and Construction Authority's Green Mark Gold<sup>PLUS</sup> Award at BCA AWARDS 2017. The features of the building include a green façade with vertical greenery, a rooftop garden, an energy-efficient, water-cooled chiller plant and energy-efficient light fittings. In support of the school's sustainability initiatives, the canteen will also feature green-practices, with investments in re-usable serving plates, bowls and biodegradable plastics.

As the new campus is located near two nature reserves, GESS will also be stepping up its environmental education, weaving it into its curriculum, and will be working together with the community on environmentally oriented activities in surrounding areas.



Design and Technology Studios and other creative spaces, as well as sports amenities, such as an Olympic-sized swimming pool, will serve to maximise the potential of students.



Among the green features of the building is the rooftop garden.



## APPLICATION OF 'AIR-CONDITIONING AS A SERVICE' IN THE FOOD & BEVERAGE SECTOR

The Commonwealth Capital Group's manufacturing and warehousing facility has deployed the Kaer Air model.

### Background

The Commonwealth Capital Group of Companies provides food production, retailing, distribution and logistics services for major brands. In January 2017, the group opened a SGD 70 million 'state of the art' food manufacturing hub with supply chain and other services, all under one roof.

The 300,000 ft<sup>2</sup> facility houses a high pressure processing line (which is considered to be Singapore's first of its type) and a fully-automated, 13-storey, storage and retrieval warehouse system. The technologies and processes deployed in this new facility serve to extend the shelf life of foods, without the use of artificial preservatives, whilst ensuring the retention of their nutritional value.

### Achieving the right indoor temperature

One of the major factors, in ensuring food safety and keeping the 24-hour operations running smoothly, is maintenance of the right indoor temperature.

The Kaer Air (air-conditioning as a service) model is able to deliver this. Instead of investing in and operating air-conditioning equipment, building owners can simply dictate the conditions they want to achieve in their space. Kaer, a leading air-conditioning as a service (ACaaS) provider, will assume all financial and operational responsibility to deliver the conditions and the building owner simply buys air-conditioning at a fixed Dollar/RTH rate on a 'pay as you use' basis.

Such an approach, in this case, has allowed Commonwealth Capital Group to dedicate its time and capital to serving its customers, whilst Kaer is fully accountable for providing the indoor environmental conditions that the group needs throughout the facility.

### Implementation of the solution

To accommodate the 24-hour, mission-critical requirements, Kaer installed two 500 RT multi-compressor chillers to support an actual load of 380 RT (with capacity for future expansion). Additionally, the company designed a special, fresh air make-up system in the kitchen areas, to bring in replacement outside air to compensate for what is being drawn out by exhaust



The Kaer Water plant serves the 24-hour, mission-critical requirements of the facility.

hoods. This was done to maintain an optimal indoor air quality whilst reducing the amount of conditioned air being drawn into the exhaust system, resulting in a reduction in the air-conditioning load of the building, by 25%, and consequently a reduction in the installed capacity of the chiller plant.

Kaer installed fabric ducting throughout the facility as it is more hygienic, easy to maintain, and can be easily taken down for washing.

The company is also using its patented K-RealTime building monitoring and control system to monitor, measure and track the energy efficiency of the plant. K-RealTime consists of sensors and meters, and runs the data through a cloud-based platform. The data is hosted on secure Kaer servers, and engineers can view the data and make decisions around operating parameters, in real-time, round-the-clock, on an interactive user interface that can be accessed on a PC, iPad and smartphone.

Additional automation was added to the on-site control system, with the briQs machine learning technology, developed by Kaer engineers. This technology is said to be the world's first autonomous optimisation tool that helps to run chiller plants efficiently and generate reports and alarms which allow engineers to take proactive measures to maintain the performance of the system, instead of simply reacting to issues as they arise.

### The results

- Reduction in air-conditioning load, by 25%.
- Installation of the briQs autonomous optimisation technology at the industrial facility to deliver Green Mark Platinum levels of efficiency.
- Fully automated operations, resulting in a 90% reduction in manpower required to operate the plant.



Kaer's control centre with remote monitoring, control and AI capabilities.

## HOTEL ROOM MANAGEMENT SOLUTION OFFERS MULTIPLE BENEFITS

It is the result of seamless integration of technologies from partner companies.

Schneider Electric, a leader in digital transformation of energy management and automation, has introduced an enhanced Connected Hotel Guest Room Management Solution, integrating lighting, curtains, bathroom heating, sanitary hot water, and temperature- and occupancy-based energy management, for improved guest experience and operational efficiency.

This fully integrated solution has been developed, and will be deployed, within the framework of the Connectivity Ecosystem partnership between Schneider Electric, Danfoss and Somfy, which was announced in March 2018.

The partnership focuses on accelerating the adoption of connectivity technologies to enhance the living and working experiences for people in residential, mid-size building, and hotel markets, with solutions that work simply together.

Hotels must meet the ever-increasing guest expectations for a digital, frictionless environment that provides control, convenience, comfort, and connectivity.

They also need to address the energy they waste in heating, cooling, and lighting unoccupied rooms, which makes them less sustainable and profitable, as well as prevent maintenance problems in guest rooms.

Historically engaged with the hotel sector, through customised solutions, and thanks to the Connectivity Ecosystem partnership, Schneider Electric has addressed these needs by delivering an improved guest room management solution integrated seamlessly with solutions from Danfoss and Somfy.

The solution allows a seamless integration of Somfy's curtain and blind control as well as Danfoss' mirror heating, bathroom electric under-floor heating and sanitary hot water control, with Schneider Electric's hotel room controllers and EcoStruxure Guest Room Expert, a guest room management system, to provide tangible benefits for hotel operators and system integrators.

### Digital control through one interface

Seamless integration of the guest room management system enables guests to control curtains, as they do for lighting and air-conditioning, with a single digital interface. This level of convenience and comfort improves guest experience and satisfaction.

### Greater energy savings

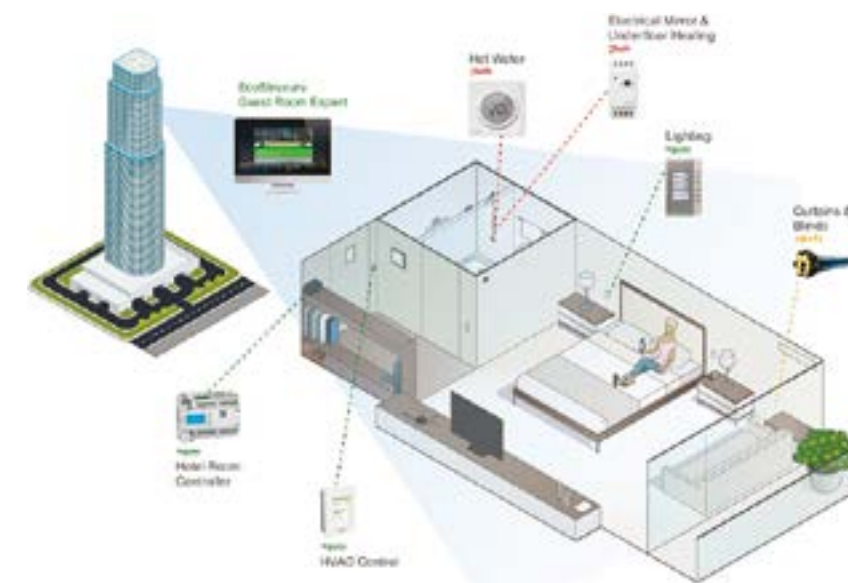
When the Connected Guest Room Management Solution is integrated with the Property Management System, energy savings are gained in unoccupied or unrented rooms. Somfy controllers can close curtains and blinds to mitigate solar heat gain/loss and to preserve furnishings. The lighting, as well as Danfoss underfloor heating and mirror heating, can be turned off. The temperature reverts either to setback mode (unoccupied) or deep setback mode (unrented). The Danfoss domestic hot water algorithm heats the sanitary hot water enough to avoid legionella, while saving energy by avoiding constant heating.

### Improved operational efficiencies

Information from the connected devices and systems in the room is served up to EcoStruxure Guest Room Expert, providing facility management with visibility and control of all conditions in the guest room. Staff can remotely troubleshoot and proactively resolve issues.

### Benefits for system integrators

The fully integrated solutions feature tested, validated, and documented architectures, to enable rapid installation and easy, out-of-the-box commissioning, for improved margins and on-time delivery.



Components of the enhanced Connected Hotel Guest Room Management Solution



## SHORT CIRCUIT STRENGTH OF

# ELECTRICAL SWITCHBOARDS

by Er. Lim Say Leong, Technical Director, Sunlight Electrical Pte Ltd, Member of IEC WG MT121, responsible for IEC 61439, and Convenor of WG for SS 619

Avoiding breaches of safety caused by misinterpretation or manipulation.

### Introduction

In a low-voltage electrical installation, the electrical power is taken either directly from the utility provider or through a step-down transformer. Hence the switchboard that receives power at a low-voltage magnitude of 3-phase 400 V 50 Hz is typically known as the incoming main switchboard (MSB). For some applications, where availability of power is critical, power from another source is needed for emergency purposes. Hence the switchboard that is connected to the emergency power source is known as the emergency main switchboard (EMSB).

MSB and EMSB are major pieces of equipment that contain functional devices for protection and switching to redirect electricity in a safe manner. An electrical switchboard is a single large panel or it can be a combination of standardised modular panels on which switches and other power control equipment are mounted.

IEC 61439 or SS 619 standards for low voltage switchgear and controlgear assemblies require switchboards to be safe for the user, by themselves, and for downstream and vicinity circuits built in the sub-switchboards or distribution boards. The important requirements are typically the following:

- Short circuit protection and withstand strength
- Co-ordination of protection devices
- Electromagnetic compatibility (EMC)
- Avoidance of overheating

### Low-voltage switchgear and controlgear assembly system

IEC 61439-1 defines a switchboard as an assembly system with a combination of one or more low-voltage switching devices, together with associated control, measuring, signalling, protective and regulating equipment, with all the internal electrical and mechanical interconnections and structural parts. An assembly system is a full range of mechanical and electrical components (enclosures, busbars, functional units etc), as defined by the original manufacturer, which can be assembled in accordance with the original manufacturer's instructions, in order to produce various assemblies.

### Short circuit protection and withstand strength

Verifying if a switchboard has passed the short circuit test is important, so as to ascertain if the switchboard is safe:

- In relation to the person operating it.
- In relation to itself, in that there is no self-destruction.
- In relation to other equipment in the vicinity of a downstream circuit.

As far as the short circuit test on the switchboard is concerned, IEC 61439 requires the test to be carried out under the most onerous arrangements, in order to determine if it can withstand the thermal and dynamic stresses resulting from the short circuit current. In many instances, the short circuit requirement may not have been well understood, hence resulting in manipulation or misinterpretation of the short circuit test results.

Of grave concern are the dire consequences of serious accidents that can happen if the most onerous conditions governing the short circuit are not verified as being in compliance with IEC 61439. When non-compliance is discovered, it could be too late, especially if the use is for data centres, hospitals, critical process automation etc. In some instances, luckily, it may be spotted, during tender evaluation or compliance audits, as for example, in most government projects.

Clause 10.5.3 of IEC 61439 gives a comprehensive list of criteria for the exemption of a switchboard from short circuit testing. A switchboard is exempted from the short circuit withstand strength test, when the rated short-time withstand current or rated conditional short circuit current does not exceed 10 kA rms. Also exempted are current-limiting devices such as circuit breakers or fuses, having a cut-off current less than 17 kA at the incoming circuit.

All other switchboards must be tested. When testing is required, Clause 10.11.1 of IEC 61439 stresses that the most onerous condition must be used for testing. Thus, when the switchboard is tested with the most onerous variants of the larger product range, the test results can be used to establish the ratings of similar variants without further testing. As short circuit testing on the switchboard is destructive testing, a new replica or derivative has to be built for delivery to the actual site for use.

Figure 1 is a simple illustration of two incoming supply circuits with a bus tie-circuit breaker between them. Locally, a circuit breaker is used, although a switch-isolator or copper bus coupler can also be used.

Normally, at the power intake MSB of a building or industrial plant, there are three circuit breakers. One serves as

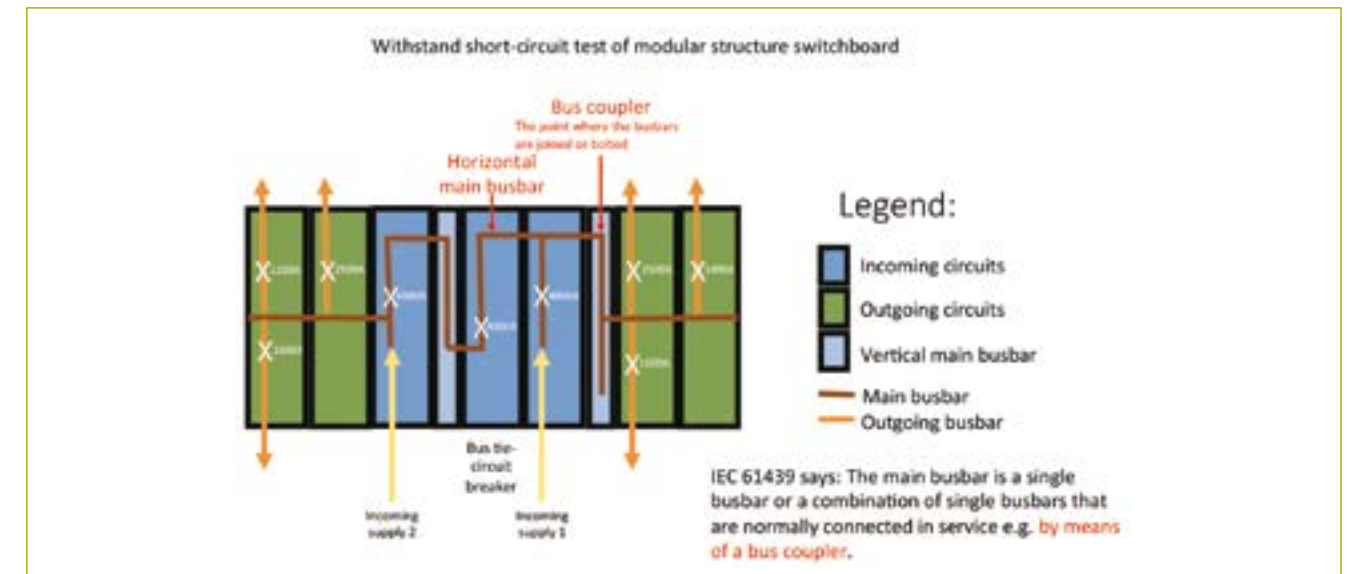


Figure 1: Simple illustration of two incoming supply circuits with a bus tie-circuit breaker between them.

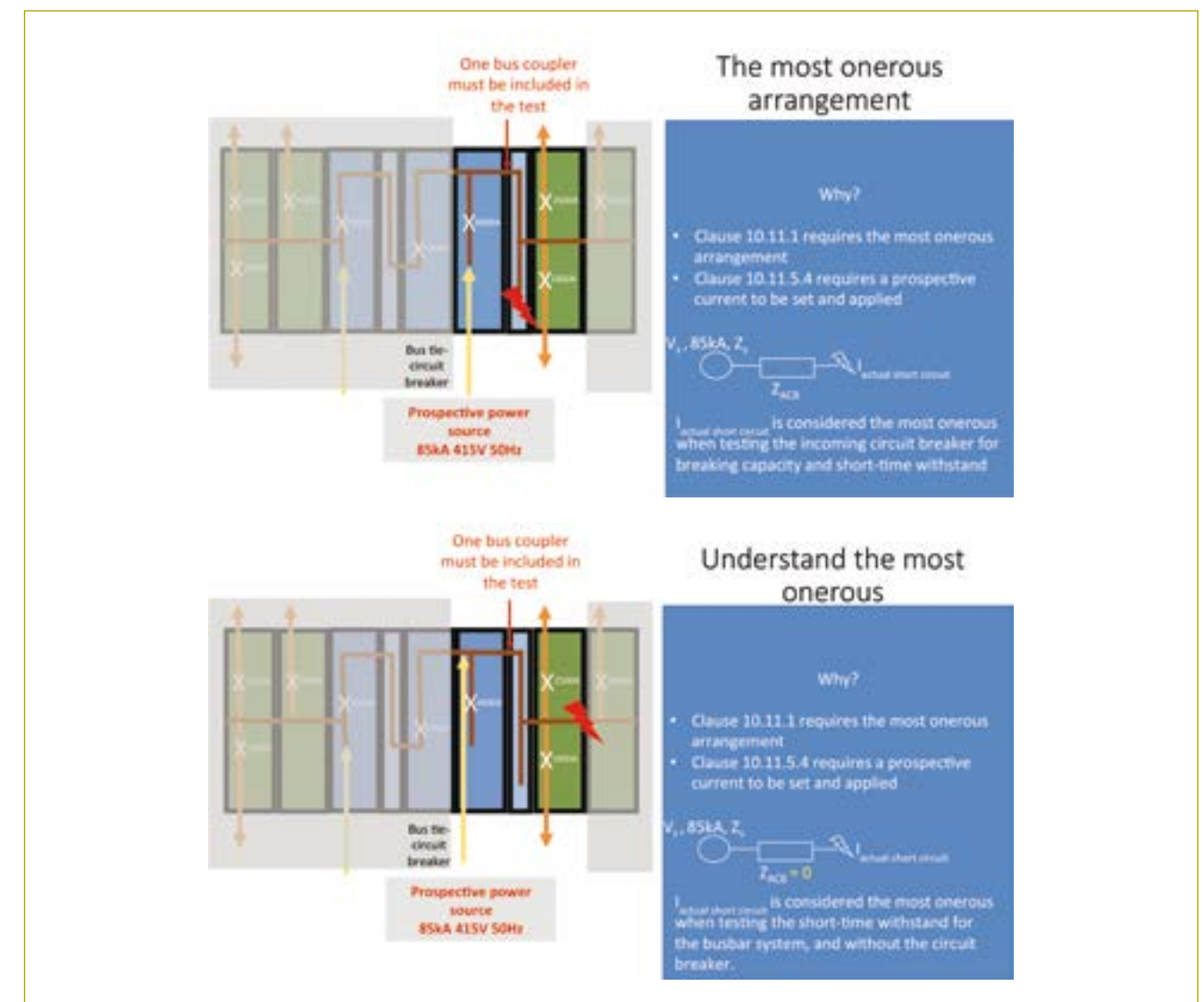


Figure 2: Representative modules selected for the short circuit test for circuit breaker and main busbars to be the most onerous arrangement.



the Incoming Supply 1 circuit breaker and another serves as the Incoming Supply 2 circuit breaker. The third serves as the bus tie-circuit breaker. The three are interlocked, so that the bus tie-circuit breaker can be kept open during normal operations, and closed when either one of the incoming supply feeders fail.

**Test procedure**

Clause 10.11 of IEC 61439 requires that switchboards, particularly of modular structure which have a number of variants, are to be tested using the most onerous arrangements. In this way, the test results can be used to establish the ratings of similar variants, without further testing.

**The need for safety**

There are some misrepresentations in the market that engineers need to be wary of. Take the illustration of Figure 3, where the bus tie-circuit breaker forms part of the short circuit testing. In this case, all the three circuit breakers are of the same rating.

Let us say  $Z_{ACB}$  to be sum of the resistance of the circuit

breaker and the connected copper busbar for each circuit breaker. By circuit analysis, it is obvious that the total resistance of the test circuit in Figure 3 is higher when compared to the resistance shown in the modules in Figure 2. The higher circuit resistance in Figure 3 would cause the actual short circuit current to be lower.

It must also be noted that Clause 10.11.3 c of IEC 61439 does not allow any test result obtained from a test, such as that represented in Figure 4, to be used to establish the ratings of similar variants, without further testing.

The illusion that the test circuit shown in Figure 3 may be a better choice could have possibly misled many engineers and buyers to think that a better choice has been made. If a switchboard that has not been tested for the most onerous arrangements is in use, could we say that safety has been compromised?

*(This is the first in a series of articles to be published in 'The Singapore Engineer', on the topic of safety and requirements for power switchgear and controlgears (PSC), commonly known as electrical switchboards, in order to achieve compliance with IEC 61439 and SS 619 standards).*

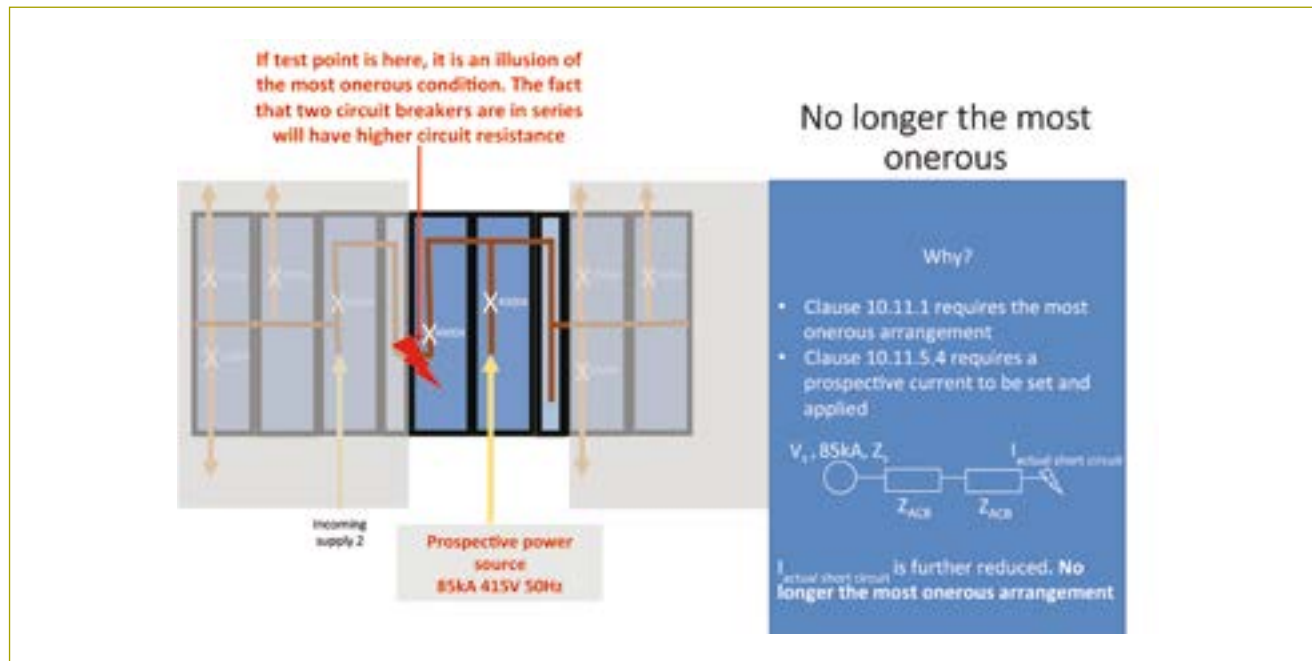


Figure 3: Misrepresentation of the incoming supply circuit selected for the short circuit test.

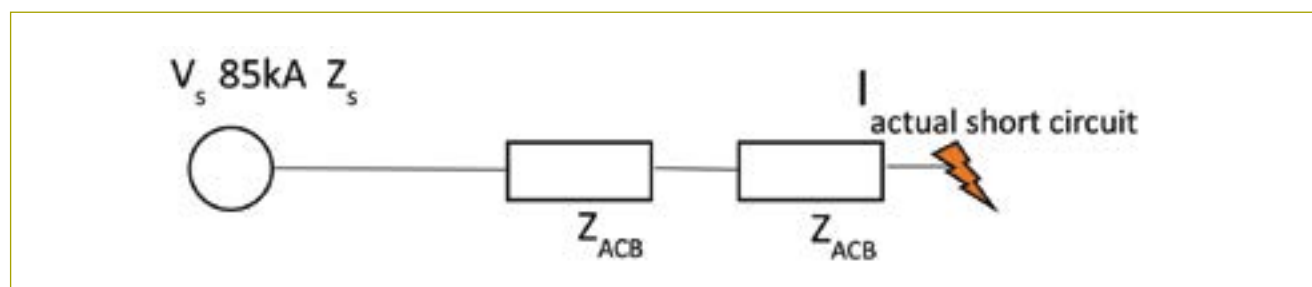


Figure 4: Circuit analysis of two circuit breakers (one incoming supply circuit breaker and the tie-circuit breaker) are connected in series for the test.

EVERY DEGREE MATTERS



STOLZ  
THE INDUSTRIAL COOLING EXPERT



# TOP ELECTRICAL HAZARDS

## IN THE INDUSTRIAL WORK ENVIRONMENT

by Mr Wayne Goodall, Director of Business, Industrial Electrical Infrastructure Business, ASEAN, Australia, India, Korea, Panduit



Mr Wayne Goodall

Electrical safety in the industrial work environment is imperative.

Workers, like electricians and engineers, are exposed to serious electrical hazards, when they are working on or near energised electrical equipment or high voltage installations.

Incorrect wiring, wrong component use, equipment failure, and so on, can lead to electrocution risks. Often, in workplace electrical mishaps, it is due to an arc flash (also called a flashover). An arc flash is the light and heat produced by an electrical explosion caused by a rapid rise in the temperature of the air between electrical conductors, resulting from the movement of unwanted electrical discharge through the air, from one voltage phase to another, or to ground, facilitated by low impedance connections in an electrical system.

According to a US study conducted by the Fire Protection Research Foundation, concerning arc flash injury, the most common work task leading to arc flash injury is the replacement of fuses. Many workers, including those trained and untrained in electrical work, do this without turning off the power and verifying that equipment is de-energised. From the study, arc flash injury has also accounted for 29% of electrical fatalities, from 2003 to 2010, and 36% of non-fatal electrical injuries, from 2004 to 2013, in the US.

Understandably, in most countries, there are stringent compliance procedures and regulations in place, for the protection of workers dealing with electrical equipment and installations. Business owners can be severely punished if there is negligence on their part. Earlier this year, a company in Singapore was fined SGD 200,000 for a workplace death involving a fatal arc flash injury.

There are some common electrical hazards in the workplace that employers and workers need to pay close attention to.

### Unqualified workers working with electrical equipment and installations

In the US, the National Fire Protection Association (NFPA) have put in place the NFPA 70E standard which requires that equipment or installations with 50 V of electricity or more must be covered, protected, or made inaccessible to everyone except qualified electrical workers.

However, workers without certified safety qualifications are often required to use electrical equipment. Even more worrying is the example of a large chemical company, where as many as 90% of electricians and technical personnel did not know how to perform a

thorough 'absence of voltage test' when asked to verify that equipment is safe.

Much more can be done to protect workers from electrical hazards. Sending all employees for safety training programmes can be expensive - especially for all workers whose encounters with such electrical installations are not a core part of their job scope. One way businesses can address this issue is to tap on technology to replace error-prone, manual testing.

### Carelessness and human error

A study on electrical accidents and safety measures, in India, found that electrical accidents often happen due to over-confidence and carelessness, when handling equipment. Assuming that equipment will not cause injury is a recipe for disaster. Electrical mishaps can happen when workers disregard safety rules and regulations that have been implemented, and are nonchalant towards hazards present while working. Workers need to be conscious of potential dangers and take precautions when working with electrical equipment and installations.

For instance, educating workers on different electrical hazards, such as shock hazards and arc flash, and the reasons for their occurrence, will bring workers' attention to the seriousness of safety checks and help cultivate electrical safety habits in the industrial workplace.

### Poor communication and lack of compliance with safety regulations

Employers have a responsibility to ensure the safety of their workers - be it by taking steps to ensure that workers comply with safety rules and regulations, or by ensuring that workplaces and any equipment provided are safe. In the industrial work environment, safety managers need to communicate, maintain and monitor proper safety procedures. With good communication, encouragement, positive reinforcement and consistent checks, safety managers can manage the risks associated with all foreseeable misuses of electrical equipment.

A Finnish study examining the sources of accidents occurring as part of industrial maintenance operations conceded that the decision to use unsafe working methods or to ignore the use of personal protective equipment may ultimately be the workers' own decision. However, it also highlighted that avoiding such unsafe acts was also the responsibility of management, work supervision and task

planning, where it is necessary to support and emphasise safe working - even if the work was to be performed in haste, alone, and/or during the night.

Employers and safety managers should also ensure that all safety or warning signs, symbols and tags, are in place and are visible, to alert workers of possible hazards. They need to ensure that signs that are worn out or faded are replaced. Additionally, they need to ensure that all workers can understand the signs. This is especially crucial in workplaces where there are foreign workers and one language may not be understood by all.

Taking precautions through verbal and visual communication is crucial, but not all. There are also other safety enforcement methods like provision of restricted areas, safety escape routes, alarms, first-aid equipment and so on. Employers and safety managers need to be vigilant when it comes to protecting workers from possible dangers and minimising risks, and there is no shortcut.

### Exposed or faulty electrical equipment

Closely linked to poor communication is damaged or faulty equipment and tools. The same Fire Protection Research Foundation report noted that this is the cause of 37% of non-fatal workplace electrical mishaps in the US.

Poor equipment condition, and user error can cause electrical parts to be exposed, posing a significant risk to safety. These hazards include damaged electrical cords, overloaded plugs, exposed wires, defective equipment and wet surroundings, which can cause electrocution or fires. Greater vigilance is required to check and replace equipment that is suffering from wear and tear, and supervisors need to be on the lookout for substandard equipment that should not be used.

### Lack of verification for absence of voltage

Currently, workers rely on hand-held testers and voltage indicators to verify whether electrical equipment is de-energised. However, these methods place electrical workers at risk, as they expose them to electrical hazards even in the process of performing a test.

While voltage indicators indicate the presence of voltage, they do not determine whether electrical equipment is completely safe to touch. Life-threatening levels of voltage could be present, even when the indicator is not lit, or if it is damaged.

Moreover, hand-held voltage testers are prone to user error and such manual tests require workers to open electrical panel doors before conducting the tests. This exposes workers to the risk of contact with potentially lethal voltages.

Absence of voltage testers (AVTs) provide a solution to this, as they allow workers to verify the absence of voltage, prior to opening electrical panels, while also providing positive confirmation that they are safe to touch.

### Lockout/tagout failure

In Singapore, the Ministry of Manpower's Factories Act (section 24A) indicates that there are five mandatory

standard lockout procedures for the shutdown of electrical equipment, and another five steps to restore the equipment before commencing operation.

Proper lockout/tagout procedures are crucial in the safe workplace. Employers should keep technologies that ease or automate these mandatory requirements at the forefront of their minds. The investment in such an approach not only keeps workers safe, but also delivers on compulsory safety procedures to provide peace of mind.

Identifying and raising awareness of electrical hazards are the first steps in preventing electrical accidents in the workplace. Employers and workers should never discount the dangers present in an industrial work environment. They need to act on mitigating the risks, with safety principles and well-designed features, in order to realise the goal of creating an injury-free workplace.

## Absence of Voltage Tester

Panduit Singapore, an industry leader in control panel, wire harness and heavy-duty cable management solutions, for over 60 years, has announced the release of its VeriSafe Absence of Voltage Tester, in Asia Pacific markets.

As per NFPA 70E requirements, VeriSafe ensures that the entire process of verifying absence of voltage is performed in the proper sequence. At the same time, VeriSafe tests itself, verifies the installation, checks for voltage, verifies the installation, and retests itself - all automatically performed, in sequence, at the push of a button, with no human exposure to electrical hazards.



VeriSafe's indicator module, which serves as the user interface, is typically located on the door of the electrical panel.



# COAL TO BIOMASS (WOOD PELLETS) MILL/PULVERISER CONVERSION

## - A DIFFERENT APPROACH

by Mr Cornelis Zwaan, Coal Milling Projects, South Africa

Coal Milling Projects (CMP) developed a classifier that can be used to convert conventional coal mills/pulverisers to biomass equivalents. The design required developing a design process that involves the understanding of the differences between coal and biomass, and how biomass particles react to drag forces, classification, and grinding. The development entails creating an experimental setup to calibrate drag coefficients for biomass flakes and creating a Computational Fluid Dynamics (CFD) model of the experimental setup, and Hardgrove Grindability Index (HGI) testing of biomass materials. A biomass classifier needs to provide an economical solution to convert a coal mill to a biomass equivalent which assists with reducing environmental impacts of coal-fired power stations, since biomass is carbon neutral. The design was developed around the concept of changing as little as possible on the coal mill and yet to get maximum performance out of it. The final design was installed and commissioned at a power station and the results were significantly better than other designs implemented previously.

### BACKGROUND

Every single day, the world relies on energy to keep economies functional and growing. For decades, the world energy supply predominantly relied on fossil fuels, where their potential energy is converted to mechanical energy which turns a generator to generate electrical energy. In the modern day we live in, there are enormous pressures on fossil fuel power generation, especially on coal-fired power generation. Fossil fuel power generation, using fuel like coal, emits vast amounts of carbon dioxide (CO<sub>2</sub>) into the air, contributing to greenhouse gas accumulation that leads to global warming. Fighting global warming has become one of the greatest challenges and focus points around the world. With fossil fuel power generation having a major environmental impact on the world, strict regulations, and laws, like the carbon tax, have been implemented on the power utilities. These regulations and penalties saw great amounts of old coal power stations being decommissioned and even closing completely. Some of the newer coal power stations spend vast amounts of money to improve their combustion and are investing in new technologies like clean coal technology etc, to keep their emissions within the acceptable standard.

Carbon tax, global warming, and the growing world economy, opened the window for exploring new innovative ways to generate energy. The challenge however, is to find a method that is reliable, sustainable, cost-effective, and environment-friendly. One solution is utilising existing coal-fired power station infrastructure and changing the fuel from coal to biomass. Unlike coal, biomass is a carbon-neutral source and is said to recirculate the carbon dioxide released from biomass combustion. Biomass, or woody biomass, is a mixture of wood, plantation residue, and even bamboo, just to mention a few options. Taking one step back, as these wood forests or

other plantations grow, they absorb CO<sub>2</sub> from the air, and release oxygen, through a process called photosynthesis. The tree forests or bamboo forests are harvested, shredded by a hammer mill to form wood or biomass flakes which are pressed against a die into a pellet. During combustion, CO<sub>2</sub> is emitted, which will be absorbed by the forests again, thereby closing the cycle. The cycle is said to be very short as the cycle can occur multiple times within a human lifetime [1]. Coal is also formed during the absorption of CO<sub>2</sub> from the air, but once coal is combusted, to form coal again, it will take millions of years and therefore coal is called a carbon accumulator, not forming a repeatable cycle - as explained in Figure 1.

A mill/pulveriser forms part of a coal-fired power station's boiler plant. In a mill, coal is crushed to a powder-like substance, called pulverised fuel (or pf). Crushing or milling coal will increase the surface area of the fuel, thereby increasing the combustion efficiency of the boiler.

As the coal is crushed within the mill, it reduces in size. Primary air will induce a drag onto the crushed coal, or pf, and induce primary classification. Some particles will fall back to the grinding table even before it reaches the classifier. Once a particle's drag force overcomes its weight, the particle will enter the classifier of the mill. The classifier is a cyclone separator. The fine or light particles will pass the classifier into the pf pipes leading to the boiler. Some heavier particles will enter the cyclone and depending on its weight overcome the centrifugal force and are airlifted into the pf pipes going to the boiler. Heavier particles will not overcome the centrifugal forces of the cyclone and continue to make their way down the cyclone and eventually fall back to the grinding table for re-grinding.

For a coal-fired power station, to convert to biomass or wood pellets, the mill will be used to break the biomass

pellets into flakes. As with coal, the primary air will induce a drag onto the flakes and transport them to the boiler.

Replacing coal with biomass is very economical, because the existing coal-fired power station infrastructure is available for use. There is no need to build a completely new plant. It must be acknowledged that biomass is different to coal in so many areas and the challenge will be to identify what infrastructure of the coal-fired power station can be used, modified, or replaced. The coal milling plant is part of the infrastructure that can be modified. Modification is needed, because there is a big density difference between coal and biomass and a biomass flake is different in shape to a pf particle. Understanding the particle kinematics of biomass (pellets and flakes), is key in designing or upgrading a coal mill to run on biomass.

### INTRODUCTION

Drax Power Station recently converted three of its six units from coal to biomass, and has a fourth converted on a trial basis. Generating 3960 MW of electricity makes Drax the UK's biggest single power utility and second biggest in Western Europe. The power station generates 2640 MW of electricity from pure biomass wood pellets, making Drax one of the biggest biomass power stations in the world [2]. The power station has Babcock and Wilcox 10 E vertical spindle mills.

### THE PROBLEMS

Before CMP's involvement in the project, attempts to convert the mill to run on biomass were implemented. These attempts include:

- Blanking off some of the ports of the rotating throat (or port ring) to increase the primary air velocity into the mill.

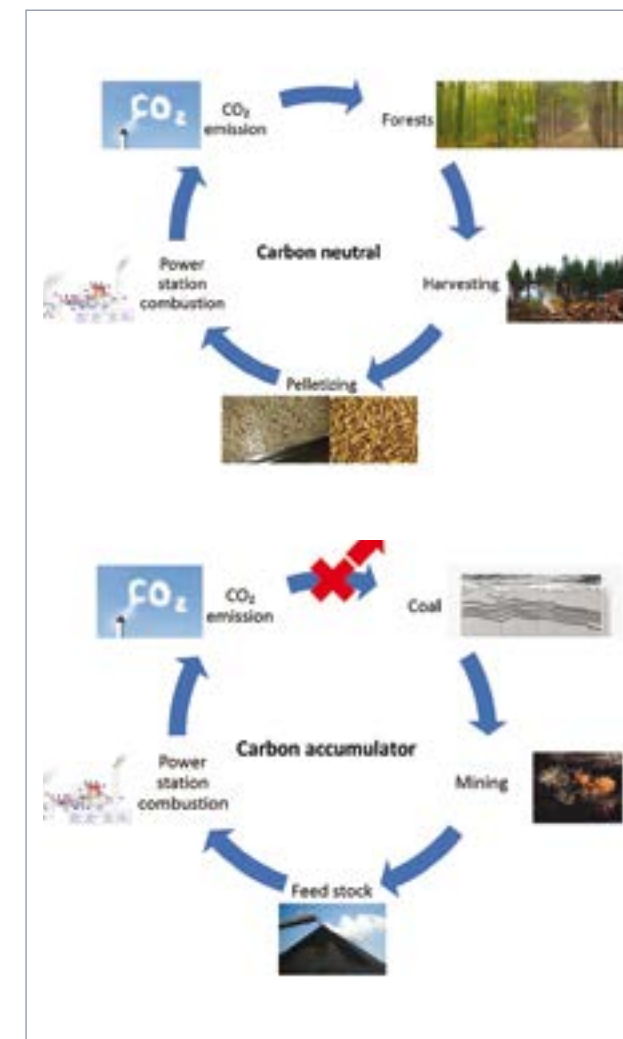


Figure 1: Carbon neutral vs carbon accumulator.

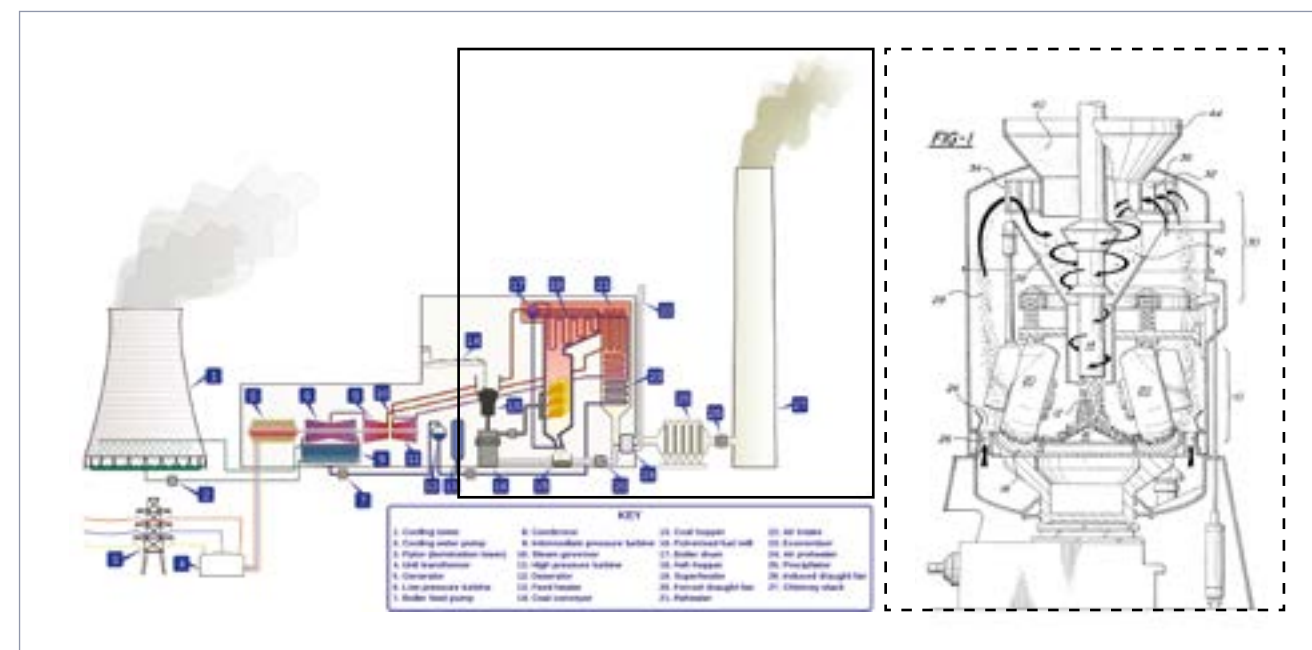


Figure 2: Coal mill/pulveriser forming part of the combustion plant of the power station.



- Blanking off the primary classification area of the mill for increased velocity into the classifier.
- Opening the classifier vanes completely to 90°, to reduce the cyclone forces in the classifier cone to a minimum (an attempt to increase the throughput of flakes).

The following problems occurred with the implementation of the above-mentioned modifications:

- The mill differential pressure increased to a point where the primary air fan motor tripped on high amp alarms. Upon investigation, it was found that the biomass flakes blocked off some areas of the mill and pf pipes.
- Due to mill and pf pipe blockages, the mill was not able to run on 'auto' settings and the operators had to run it on 'manual', which can be frustrating.
- The mill could not be ramped up to maximum loads of 42 TPH. The mill blockages and primary air fan capacity restricted the mill's ability to do so.
- Biomass flake production distributed unevenly into the pf pipes, causing non-uniform distribution to the boiler's burners.

CMP approached Drax Power Station to assist in helping them to find a solution to the problems explained above.

**DESIGN DEVELOPMENT**

Biomass will respond in a different manner, compared to coal, in two main areas, namely, grinding and drag. These two main areas became the focus and required internal development work to be done.

**GRINDING**

Biomass is much lower in density than coal. When ground or milled, 'flakes' are produced, which are made up of fibre-like particles determined predominantly by the methods used to shred them in the hammer mill and the die used to press the flakes into pellets during manufacturing.



Figure 3: Raw coal (left) crushed to pulverised fuel (right), using a coal mill/pulveriser.



Figure 4: Biomass pellets (left) crushed to flakes (right) using a coal mill/pulveriser.

Hardgrove Grindability Index (HGI) is an empirically determined value, indicating the grindability of coal. A sample of biomass pellets was compared to various samples of coal tested under the same testing procedure. The coal samples with a range of HGIs were used in a calibration curve to determine a HGI formula for biomass.

The results of the HGI testing for four coal samples are shown in Figure 5. From the calibration curve, the following HGI formula can be fitted:

$$HGI_{equiv} = \frac{m+12.781}{0.5465} \quad \text{Equation 1}$$

Using the mass fraction passing a 75 micron sieve (*m*), the HGI for the sample of biomass pellets tested gives a HGI of 35, indicating very poor grindability [3]. The grindability of the biomass is not poor due to the density, in fact, biomass's density is lower than that of coal. Rather, the grinding method in a vertical spindle and ball mill is more impact-dominated than shearing-dominated, limiting the ability of the mill to reduce the biomass flake size during grinding. The PSD (Particle Size Distribution) of a biomass pellet before and after grinding (or PSD of the flakes) will be the same. This was confirmed during a study done on torrefied energy crops by Jones et al [4]. Another study done on treated and untreated bamboo by Makwarela O [5] confirmed the poor grindability of raw biomass materials.

**REACTION TO DRAG**

One major factor influencing drag force, is the drag coefficient, *C<sub>d</sub>*, which is a function of the shape of the particle. When calculating the drag force on a pf particle, it is assumed that the particle is spherical in shape [6]. However, a biomass flake is not spherical and therefore reaction to drag will be different to that of a pf particle.

CMP design engineers assumed the shape of a biomass flake to be a square with almost negligible thickness. A CFD calibration experiment was conducted to monitor the drag on the assumed shape for a range of Reynolds numbers under atmospheric conditions. The results are shown in Figure 6. The drag for the square prism at low Reynolds numbers is the same as for a sphere, however, at higher Reynolds numbers, there is a deviance. The

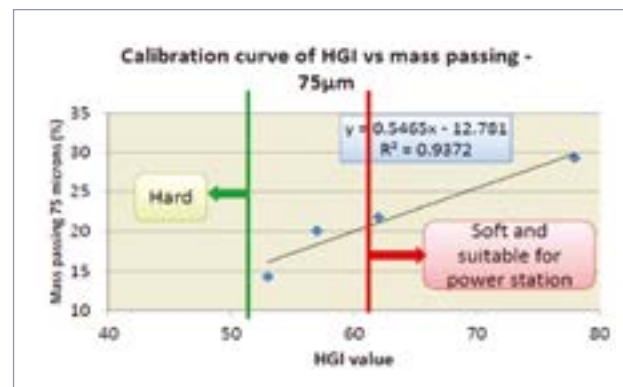


Figure 5: HGI calibration curve of four coal samples [3].

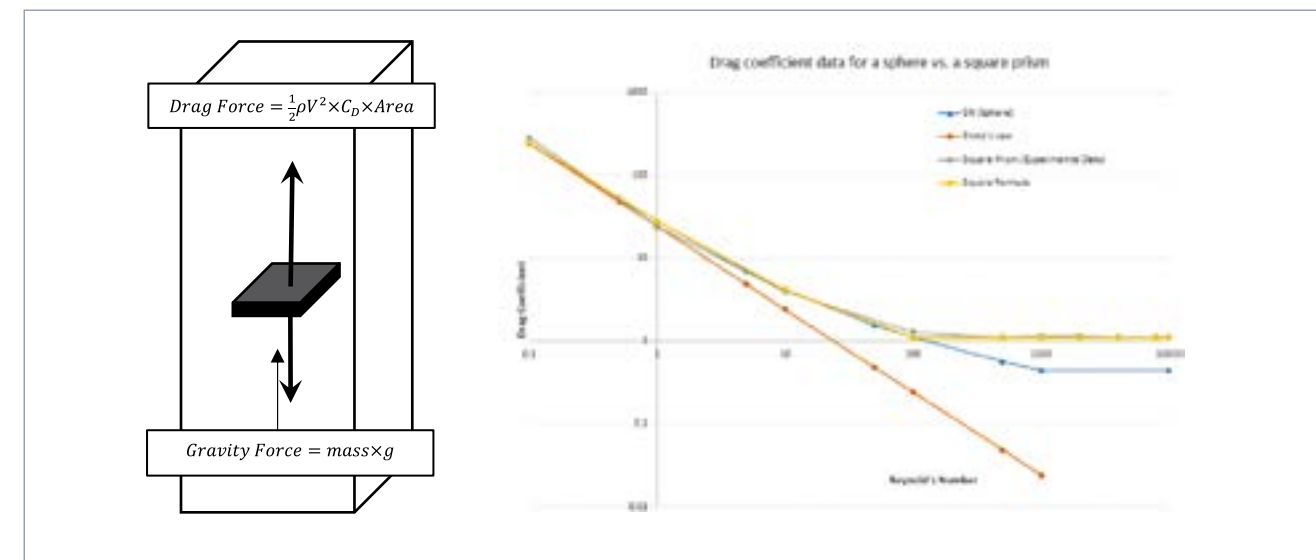


Figure 6: CFD drag coefficient calibration curve for a biomass flake [6].

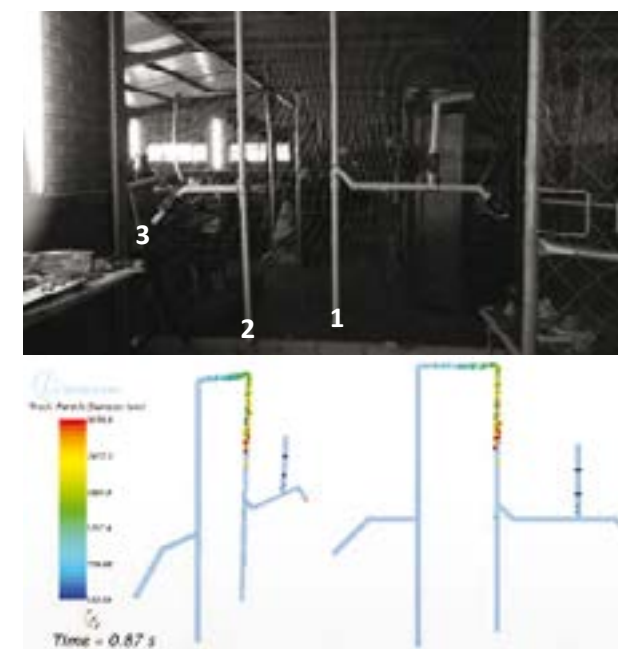


Figure 7: Experimental setup (top) and its CFD model (below).

deviance was built into the exponential drag correlation to fit the CFD formula calibration curve.

The CFD formula was used to define the drag correlation for biomass flakes in a Lagrangian Multiphase CFD model of an experimental setup shown in Figure 7. In the experiment, biomass flakes with known dimensions were released in a negative pressure (or suction) PVC pipe arrangement. The number of released particles accumulating in pockets 1 to 3 were monitored and compared to the CFD results of the same experiment. The Lagrangian particles released in the CFD model are spherical in shape and therefore it was necessary to convert the flakes from square prisms to spheres with equivalent hydraulic diameters. It was assumed that the weight is the same.

The new formulated CFD equation was used as the drag coefficient for biomass flakes for the design of the biomass classifier.

**CONCEPTUAL DESIGN**

**Biomass in a conventional coal classifier**

During the conceptual design process for the biomass classifier, design engineers needed to analyse the performance of a conventional coal classifier when running on biomass for comparison to design changes. A CFD model was implemented.

Figure 8 shows the biomass flakes in a suspended cyclone within the inner cone of the conventional coal classifier. It is also visible that there are no biomass flakes passing to the pf pipes. Figure 9 shows a Lagrangian multiphase plot of the percentage pass rate of flakes and pellets released, passing to the pf pipes. Due to the eddy currents within the cyclone, together with the low density of biomass flakes, the classifier cone (or inner cone) overclassifies the biomass flakes, causing a reduced throughput of biomass flakes. As the feed continues, the inner cone will get saturated and start to block up. The system resistance will increase gradually until the mill trips. This phenomenon was captured and explained the mill's high amp alarms experienced at Drax.

**Biomass in a biomass classifier**

Based on the experimental development work determining how biomass pellets will react to grinding and how biomass flakes (or broken up pellets) will react to drag, CMP design engineers were able to start designing a concept for a more ideal biomass classifier. Due to the low HGI of biomass pellets, causing no change in the PSD of the pellet, once it is broken up into a flake, it was decided to remove the conventional coal classifier completely from the mill as no classification is



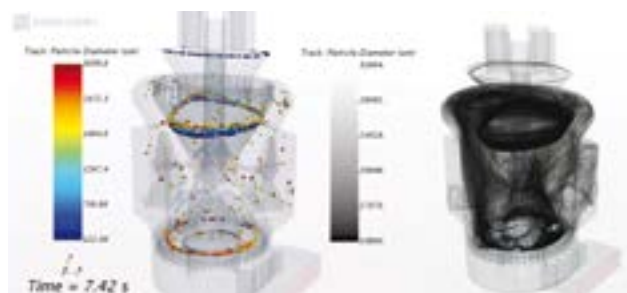


Figure 8: Biomass flakes in suspension with the conventional coal classifier design. The ISO particles are shown (left), and their tracks (right).

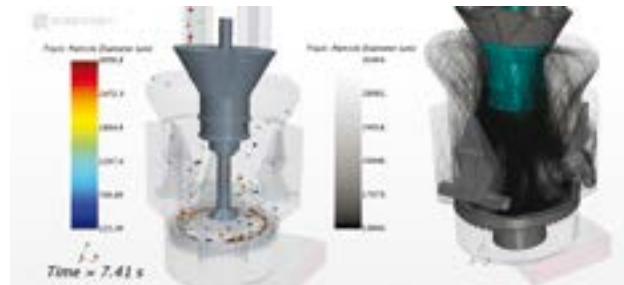


Figure 10: Lowest resistance path classifier, showing the biomass flakes passing without being in suspension. The ISO flake particles are shown (left), and their tracks (right).

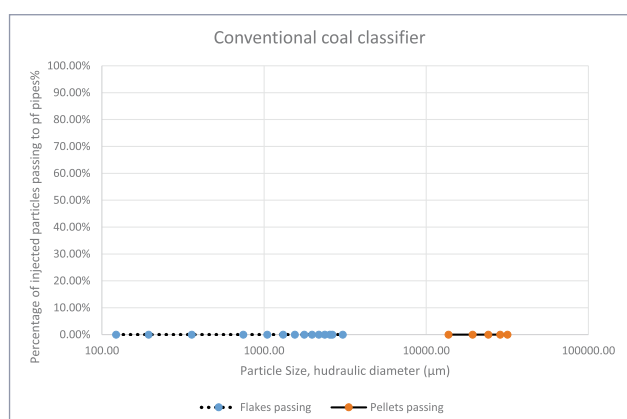


Figure 9: Results of the pass rate of the biomass flakes and pellets released exiting to the pf pipes for a conventional coal classifier.

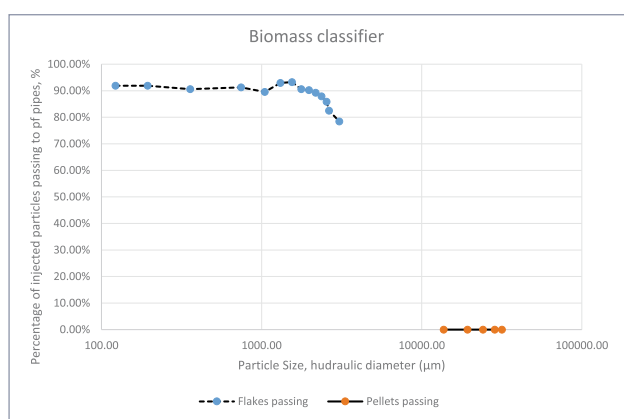


Figure 11: Results of the pass rate of the biomass flakes and pellets exiting to the pf pipes for a CMP biomass classifier.

needed. The new biomass classifier will be designed to only effectively mix the flakes within, to try to get equal distribution to the burners. The new design will provide a short, low-resistance path for biomass flakes to enter the pf pipes. To feed the classifier directly with uniform flow, it was decided to implement CMP's patented version 4 RT (Rotating Throat). The RT was designed to reduce the system resistance and still ensure that sufficient primary classification takes place. Effective primary classification for a biomass mill means, avoiding air lifting of biomass pellets into the biomass classifier (a risk for pf pipe blockages), however also avoiding any biomass material rejection (loss of throughput).

Figure 10 shows the tracks and ISO particles of the biomass flakes and pellets with the biomass classifier implemented. Compared to the ISO particle image in Figure 8, at the exact same time, there are significantly less particles left in the domain indicating a high pass rate of the biomass flakes. The flakes are seen to pass without being held in suspension. The biomass pellets are seen not to be airlifted, indicating sufficient primary classification. However, the pellets fall onto the grinding table where they move in between the grinding balls to be ground to flakes. The particle tracks show that there are significantly more biomass flakes passing to the pf pipes. Figure 11 shows the pass rate plot of the biomass flakes to the pf pipes. The result is a much higher pass rate than the conven-

tional coal classifier, indicating that the biomass classifier does not overclassify the biomass flakes. There is a 0% pass rate of the biomass pellets, indicating that the primary classification of the mill is functioning correctly, avoiding the possibility of passing unground particles to the pf pipes (a pf pipe blockage risk). No biomass material is rejected into the mill reject boxes (loss of throughput risk).

#### FINAL DESIGN AND ON-SITE IMPLEMENTATION

A full CFD study was conducted on the Drax Power Station mills. The model's geometry is shown in Figure 12. The conceptual design of the biomass classifier was implemented into the model. The biomass classifier was optimised to produce a high pass rate of biomass flakes and produce an equal distribution of flakes to the burners. A complex mixing arrangement was fitted within the biomass classifier to produce even distribution to the burners. To accurately simulate biomass flake distribution, the full geometry of the pf pipes, up to the burner inlets, was included in the model, allowing for more accurate representation of mill back pressure. The final design resulted in a Drax biomass conversion kit, consisting of a CMP version 4 RT and a CMP biomass classifier. The patented CMP version 4 RT was chosen as it directly feeds the biomass classifier (Figure 13). Feeding the biomass classifier directly instead of having a throat that induces flow upward into the mill, will increase the throughput of the mill as well as reduce the system resistance.

The biomass classifier CFD predicted performance for Drax is shown in Figure 14. There is a high percentage pass rate for biomass flakes and 0 % pass rate for biomass pellets. Table 1 shows the CFD results for biomass flake distribution at 42 TPH compared to the actual sampling results after the biomass conversion kit was installed. The sampling was done at mill loads of 30, 38, and 42 TPH. At 42 TPH, the CFD results were within 1 % of the actual site tests. Figure 15 shows the mill differential pressure before and after the biomass conversion. At the same primary air fan load, the mill's clean air system resistance reduced by 53.85 %, by implementing the biomass conversion kit. This increased the existing primary air fan capacity, allowing the mill to reach a throughput of 42 TPH, with equal distribution and running on auto-operating control mode.

#### CONCLUSION

A mill whose primary grinding mechanism is normal contact- or crushing-dominated, like a vertical spindle and ball mill, will not reduce the PSD of a raw biomass pellet. The pre-and post-milling PSD will be the same. Steam exploding or torrefying the pellets, might increase the HGI and therefore increase the ability to reduce the PSD.

Based on the results of this study, a conventional coal classifier will overclassify biomass flakes, due to the low density of biomass and its different reaction to drag. Blanking off areas of the mill to increase the velocity into the classifier will not increase the ability of the mill to gain throughput. The effect of the cyclone on the flakes will be dominant, even if the classifier vanes are opened completely to reduce the centrifugal drag component. The mill differential pressure will continue to increase, due to the suspension effect of biomass flakes. Opening the classifier vanes completely to 90°, reducing the cyclone forces to its minimum, will still overclassify the biomass flakes, reducing throughput, and cause non-uniform distribution to the burners.

Due to the contact or crushing forces dominating the grinding in a vertical spindle mill, the PSD of the biomass flakes will be unchanged even if the same flake is ground for more than one cycle. Therefore, in a vertical spindle biomass mill, the mill will merely be used to break the pellet up into a flake and therefore no classification is needed.

Since no classification is needed in a vertical spindle mill, it enabled design engineers to eliminate the high design inputs and costs to modify the mill to run on biomass. Fitting a mill with a dynamic classifier might work, but it generally requires new primary air fans to be fitted to the mill to overcome larger system resistance and it will increase the project costs.

The simple biomass conversion kit reduced the clean air system resistances of the mill by more than 50 %,



Figure 12: Babcock and Wilcox 10 E vertical spindle mill with the optimised biomass classifier and patented CMP version 4 RT installed. The model includes the pf pipes up to the inlet of the burners.

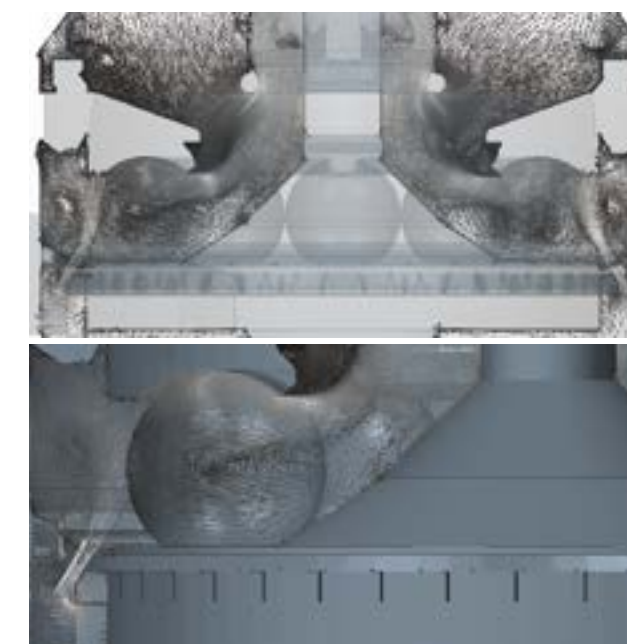


Figure 13: Velocity vectors showing the inward flow in between the grinding balls supplied by the patented CMP version 4 RT.

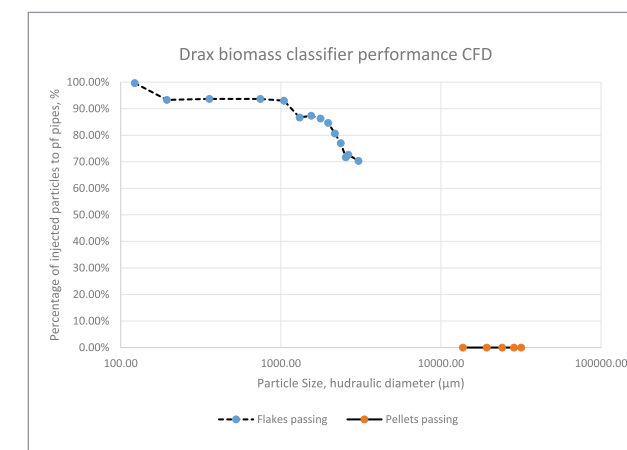


Figure 14: Results of the pass rate of the biomass flakes and pellets exiting to the pf pipes for the Drax biomass classifier.



thereby increasing the existing primary air fan capacity for increased throughput. The Drax 3F mill achieved a throughput of 42 TPH, with the mill operating on auto-control.

The CFD results and design calculations accurately predicted the expected performance of the biomass classifier and patented CMP version 4 RT, verifying the experimental tests and development work done for this project.

It has therefore proven possible to convert a conventional coal mill from coal to biomass equivalents, with the correct design philosophy and minor hardware changes, without replacing mill auxiliaries like primary air fans or adding dynamic classifiers which are very expensive.

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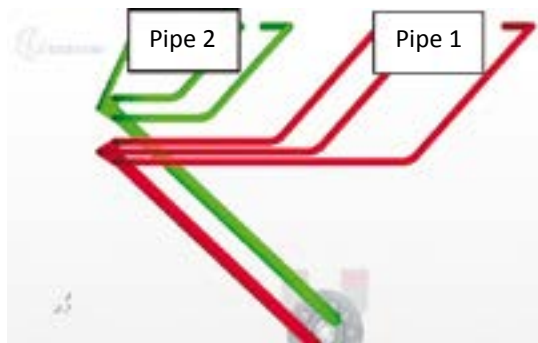
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Pipe arrangement split (%)	CFD prediction (42 TPH)	Drax (30 TPH)	Drax (38 TPH)	Drax (42 TPH)
Pipe 1	49.05	40	46	48
Pipe 2	50.95	60	54	52

Table 1: Biomass flake distribution into the pf pipe arrangement 1 and 2 respectively - CFD results at 42 TPH compared to on-site results with ramping up of the mill's throughput and sampling done at 30, 38, and 42 tons per hour (TPH) [1].

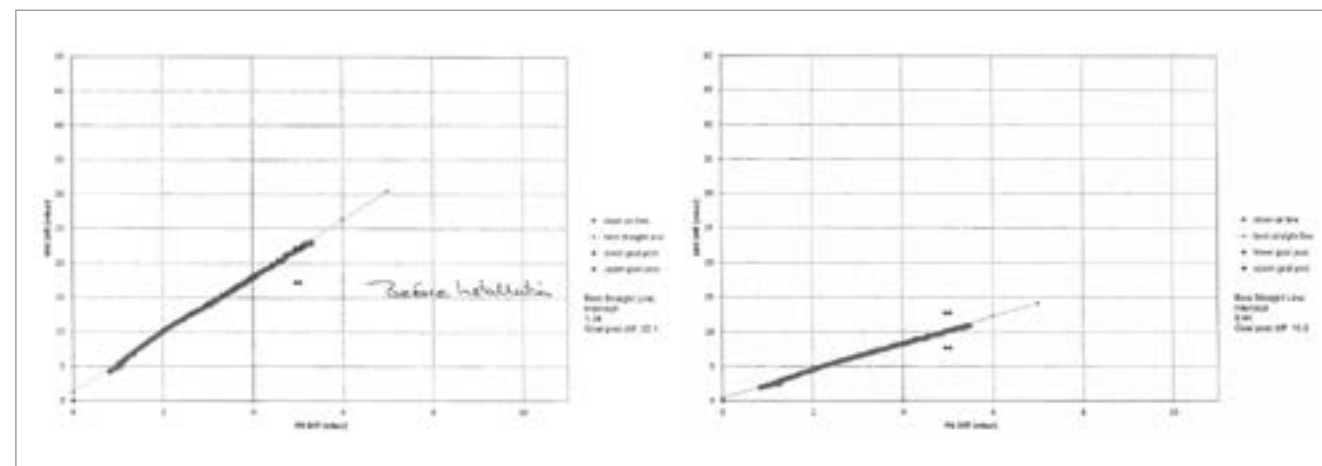


Figure 15: Mill differential pressure before implementing (left), and after implementing the biomass conversion (right) [1].

# YEC AND NTU STUDENT CHAPTER HOLD

## HOLIDAY WORKSHOP FOR SECONDARY SCHOOL STUDENTS

To spread awareness and the passion for science, technology, engineering and mathematics (STEM) to the younger generation, the IES Young Engineers Committee (YEC) and NTU Student Chapter jointly organised a one-day engineering workshop for secondary school students on 22 June 2018.

Held during the June holiday break at the Science Centre, the students were highly encouraged to showcase their creativity and analytical skills while engaging in the fun-filled hands-on activities during the workshop.

The participants, together with the student chapter facilitators, were broken into small groups and they got to know each other through light-hearted ice breaker games.

Thereafter, the groups embarked on a mini challenge of building the most stable bridge out of drinking straws, where they learnt and applied engineering theories such as the mechanics of materials, stress, strains, as well as force balancing.

They were also exposed to civil and structural engineering concepts such as strength and stiffness in design of structures.

The participants also got a taste of electrical engineering by building their own circuit boards for a game of 'Simon Says'. This was an unforgettable and memorable experience for them, since they were handling an Arduino board and other electrical components for the very first time.

The programme concluded with a round of Mathematics, Physics and Logic brain-teasers, where participants were encouraged to think out of the box.

Many participants found the workshop extremely enjoyable as it provided a hands-on experience in the

STEM disciplines and inspired them to study science and engineering at higher levels in the future. They also forged new friendships through their shared experience.

More such workshops to come in the future, perhaps?



Ready for load testing!



The student participants learning about Arduino for the first time.



IES Vice President (Education) Mervyn Sirisena (extreme right), Science Centre Singapore Chief Executive A/Prof Lim Tit Meng (second from right) and IES Student Chapter Advisor Danny Lee (middle row, fifth from left) pose for a group photo with workshop facilitators and participants.



## MAKE IOT HAPPEN:

### A PROJECTED APPROACH TO THE IOT ECOSYSTEM

What is the Internet Of Things (IoT)? How could we make use of it? These were some of the questions that were addressed during a recent ST Engineering roadshow on 13 August 2018, held at ST Electronics' office in Ang Mo Kio.

The key speaker for the roadshow was Mr C K Vishwakarma, a veteran program manager and strategy expert who specialises in technological fields.

He has 15 years of extensive international experience in solutions architecture, program management, and business process transformation and founded entities such as IoTSG, the biggest IoT and deep tech focused special interest group in South-east Asia.

Organised as part of IES and ST Engineering's latest collaborative efforts to promote engineering and enhance outreach, the staff of ST Electronics were invited to attend the event and exchange insights with Mr Vishwakarma.

Many trending topics popped up, such as autonomous vehicles, Big Data, machine learning, robotics and cyptocurrencies.

He also introduced a cutting-edge, IoT-based workflow



Figure 2: Mr CK Vishwakarma giving his presentation

for sensing, analysing and reproducing audio and video data, so that it can be perceived by human beings. With this and other examples, he pointed out that IoT, coupled with AI, is changing how solutions are designed, manufactured, sold, delivered and serviced.

According to him, the pace of digital transformation is accelerating and organisations have their work cut out for them in terms of catching up.

IES Membership Manager Agnes Ong rounded out the event with a short presentation on the Institution, as well as fielding some queries on IES Membership.

## NEW PORTAL TO MATCH TECHNICAL EXPERTS WITH ENTERPRISES FOR INNOVATIVE PROJECT DEVELOPMENT

The TechExpert Portal is a new initiative between IES and Intellectual Property Intermediary (IPI), a non-profit organisation set up by the Ministry of Trade and Industry.

On 2 August 2018, a group of engineers and technical experts gathered at JTC LaunchPad@ one-north to understand more about the online platform, which aims to match technology experts with enterprises that require them for their innovation projects.

Ms Lee Ya Ling, IPI Technology Manager, elaborated that the portal enables experts from all fields to showcase their knowledge and enjoy new collaboration opportunities with the community. Though it is currently in beta, it will gradually expand its offerings in terms of expertise.

Mr Andy Wee, the Vice Chairman of the IES Technopreneurship Development Committee (TDC) took over the mic next, where he shared about the work of the committee, as well as the IES Incubator that has been

striving towards the creation of a vibrant engineering venture community.

The incubator programme's objective is to support science, technology and engineering ventures in going to market and maximising their success, a key point of synergy with the TechExpert Portal.

It was a fruitful session which concluded with some networking between the participants.



Mr Wee introducing to seminar participants the IES Incubator programme.

## IES COLLEGE OF FELLOWS CHAMPIONS START-UP MENTORING THROUGH LEAN LAUNCHPAD PROGRAMME

Do you know what it takes to mentor a start-up to success? The IES College of Fellows led a team of Fellows and Senior Members to the Lean LaunchPad (LLP) Educators' Workshop, where they learned about the important role of mentors in guiding early tech start-ups.

The event, organised by NUS Enterprise, was held on 31 July 2018.

Through it, the College of Fellows aimed to open an avenue for both IES Fellows and Senior Members to play an active role in mentoring members who are or aspire to be technology entrepreneurs, in line with its core objectives.

During the workshop, Professor Wong Poh Kam, Senior Director, NUS Entrepreneurship Centre and Lead Faculty, LLP Singapore introduced the programme and its pedagogy to participants and encouraged them to use their wealth of knowledge and experience to contribute as mentors.

Adjunct Associate Professor Neo Kok Beng FIES, the programme's Engineering Track instructor, then led a group exercise using the Owlet Case with Hypothesis Test Cards and Learning Cards to demonstrate the Lean Validation Process.

Modelled after the US National Science Foundation's I-Corps programme, LLP seeks to help early tech start-ups and publicly-funded research teams learn about technology commercialisation.

"As a leading champion in developing engineers of the future, the IES College of Fellows is in a unique position to mentor aspiring engineer-entrepreneurs.

"We hope that by working with LLP Singapore, we will be able to harness the collective knowledge base of our Fellows towards helping our members validate the commercial potential of their innovations, pinpoint target customer segments and understand product development requirements," said Er. Chong Kee Sen, Dean of the IES College of Fellows.

Participants received a certificate for completing the workshop and were qualified to mentor teams that were taking part in the LLP Singapore programmes at NUS and NTU, which have been held since August and ending in October this year.

The 10-week course educates participants on subjects such as "Customer Discovery & Identification of Technology Solution" and "Validation of Product Market Fit & Business Model Viability".

For more information, visit the IES website or contact Ms Agnes Ong at [agnes.ong@iesnet.org.sg](mailto:agnes.ong@iesnet.org.sg).



Mentors sharing their experience



Group photo of participating IES members



## ACTIVE PARTICIPATION BY IES DELEGATES

### AT 17TH AFEO MID-TERM MEETING

The 17th AFEO (ASEAN Federation of Engineering Organisations) Mid-Term Meeting took place on 6 and 7 August 2018 in Jakarta. It was hosted by Persatuan Insinyur Indonesia (PII), the national body for engineers in Indonesia.

The IES delegation to the meeting comprised Immediate Past President Er. Edwin Khew, Honorary Secretary Er. Joseph Goh, Vice President Mervyn Sirisena, IES Fellow Er. Ong Geok Soo, Chairman of the Women in Science, Engineering and Research Committee Jasmine Foo and Chairman of the Young Engineers Committee Ong Eng Teck.

Some 60 leaders and members from all ASEAN countries, with the exception of Laos, attended the meeting, engaging in practical, face-to-face dialogue on pressing issues, administrative matters, and so on, across 10 working and meeting groups. It was an excellent conduit for friendship and connectivity within the regional engineering fraternity.

#### Summary of Working Group Discussion chaired by IES representatives

##### Working Group on Education and Capacity Building

– Mr Sirisena chaired this working group meeting, which saw some inspirational sharing from Malaysia and Cambodia on their bilateral collaborations on accreditation and training programmes.

He emphasised the importance of continuing adult education and leadership programmes as “people are the only asset that appreciate with time”. He shared about the ASEAN Engineering Deans Summit (AEDS), held at CAFEO 36, with the theme ‘Excellence in Engineering Education’. Members were asked to encourage university deans, rectors and department heads to participate, especially in the Round Table Dialogues.

**Woman Engineers Meeting (WE-AFEO)** – In order to create and maintain an up-to-date one-stop information centre on WE-AFEO, the working group resolved to furnish and complete all necessary information of WE-AFEO on the AFEO website before CAFEO 36 in Singapore this year. Ms Foo, the chairman, also announced that IES would be hosting the Women Engineers Summit during CAFEO 36.

The meeting wrapped up with fruitful discussions and idea-exchange on driving more collaborative and value-added initiatives for the female engineer.



**Working Group on Sustainable Cities** – Chaired by Er. Ong, he highlighted at the meeting the challenges in developing an AFEO-wide guideline for sustainable cities, as each government has its own standards.

Instead, he thought, it might be worthwhile for the Working Group to establish a tie-up with the ASEAN Smart Cities Network, which is initiated by the various ASEAN governments. This would have to be raised at the AFEO Governing Board level.

With regards to the formation of expert panels, the Working Group agreed that this should be set up at the



national level, since it would be easier for governments to recognise and accept the participation of localised experts in their respective national sustainable cities initiatives. If this is successful, the experience could then be shared at AFEO for the benefit of all.

**Young Engineers Meeting (YEAFO)** – Mr Ong Eng Teck led this lively dialogue and brainstorming session among the young ASEAN engineers. Three key areas were addressed: The amendments to the regulations of the Young Engineers of AFEO (also known as YEAFO), the YEAFO programme for the upcoming CAFEO 36, and potential joint activities.

The Young Engineers also updated each other on the key activities of their respective organisations. To encourage greater interaction, various activities that are open to all AFEO Young Engineers have been organised, such as technical visits and monthly cycling trips and in Singapore, the Engineer’s Run in Malaysia, and the Engineering Weekend and Engineer’s Run in Brunei.

**Working Groups on Energy & Environment** – Er. Khew attended both these meetings and expressed the Institution’s interest to participate in these working groups. This would allow IES to contribute and share with others best practices and technologies, especially in the areas of renewable energy (e.g. solar PV research and applications), energy efficiency, water and wastewater treatment, and the collection and treatment

of municipal solid waste. He also made suggestions for the CAFEO 36 technical visit locations, such as the Solar Energy Research Institute and the NEWater Visitor Centre.

**17th Mid-Term AFEO Governing Board Meeting** – The AFEO Governing Board Meeting took place on the second day of the event. The meeting was welcomed by Dr Ir A. Hermanto Dardak, President of PII and called to order by AFEO stand-in Chairman Er. Edwin Khew.

Apart from the appointment of various AFEO positions such as the Secretary-General, Honorary Treasurer, Honorary Advisors and AER Head Commissioner, nominations for the 2018 AFEO Awards were also tabled for consideration. Thereafter, Er. Khew called forth the various working committees to report and update on the activities and discussions made at their separate working group meetings.

The meeting also saw Er. Khew introducing CAFEO 36 to the Board, running through, in greater detail, the programme for both its core events – the Singapore Rail Technology Conference and ASEAN Engineering Deans Summit – as well as the pre- and post-conference meetings, workshops and activities.

Wrapping up the meeting, he extended a special welcome to all Governing Board Members, and encouraged all present to attend the upcoming conference.





## MUTUAL RECOGNITION FOR CHARTERED ENGINEERS IN SINGAPORE AND THE NETHERLANDS

IES signed a Mutual Recognition Agreement (MRA) with The Royal Netherlands Society of Engineers (KIVI) on 20 July 2018 to promote the mutual recognition of Chartered Engineers.

The signing took place at the “Building Sustainable and Resilient Cities in Asia” Forum organised by IES and the Embassy of the Kingdom of the Netherlands in Singapore.

Dr Koh Poh Koon, Senior Minister of State for Ministry of Trade and Industry, graced the event as Guest-of-Honour and Her Excellency Margriet Vonno, Ambassador of the Netherlands to Singapore, attended as Special Guest.

With the agreement, Chartered Engineers from Singapore can gain professional recognition of their qualifications and expertise when they practice in the Netherlands and vice versa. This will help engineers hone their practice overseas and acquire valuable experience. The increased mobility of engineers will also provide the industry with greater access to engineering expertise.

The MRA is a milestone in IES’ efforts to advance the professional standing of local engineers globally. IES launched the Chartered Engineer (Singapore) Registry in 2013 to provide professional recognition to qualified engineers across all sectors, including those from fields that do not require them to be registered as Professional Engineers.



The MRA was signed by Er. Ong See Ho, Vice President, Certification Group, IES and Ms Micaela dos Ramos, CEO, KIVI. It was witnessed by Er. Tan, Ms Vonno and Dr Koh.

Since then, the programme has registered a total of 294 Chartered Engineers in seven different branches of engineering supporting Singapore’s economic growth. These are Aerospace, Chemical & Process, Environment & Water, Infrastructure, Port & Marine, Railway & Transportation and Systems.

“IES hopes that this agreement will stimulate greater co-operation and exchange in engineering to support our economic and societal growth,” said Er. Tan Seng Chuan, IES International Outreach Committee Chairman.

“This Mutual Recognition Agreement is a very important milestone for us, as it takes away barriers and joins together and recognises the best of our engineers both in Singapore and the Netherlands, stimulating cooperation, helping them to find each other,” said Ms Micaela dos Ramos, Chief Executive Officer of KIVI.



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# The Institution of Engineers, Singapore

## 52<sup>nd</sup> ANNUAL DINNER

held jointly with CAFE0 36

14 Nov 2018, 6.00pm - 11.00pm

Resorts World Sentosa, East & Central Ballroom

**THEME: COLOURS of ASEAN**  
**DRESS CODE: National Costume**

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As host of the 36th Conference of the ASEAN Federation of Engineering Organisations (CAFE0 36), IES is proud to bring ASEAN's engineering community to you at our Annual Dinner for the first time. Don't miss the opportunity to connect with multi-disciplinary engineers from close to 30 countries!

CAFE0 36 will take place from **12 - 14 Nov 2018** at Resorts World Sentosa.  
For more information, please visit [www.cafeo36.com](http://www.cafeo36.com).