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THE SINGAPORE ENGINEER

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SPECIAL FOCUS: SUSTAINABLE ENGINEERING

COVER STORY:

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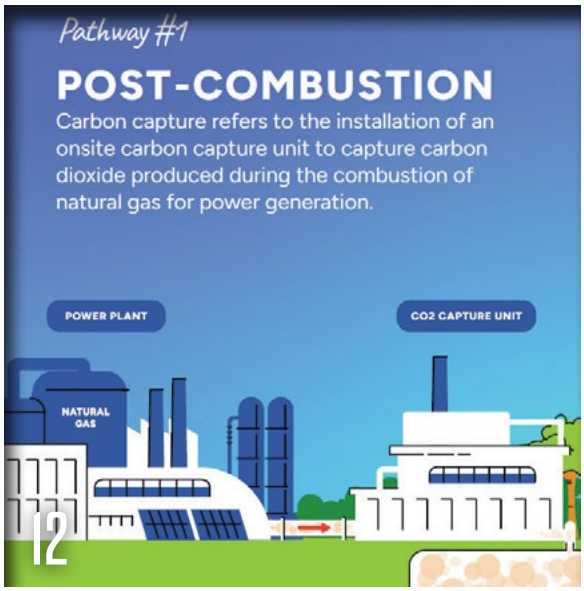

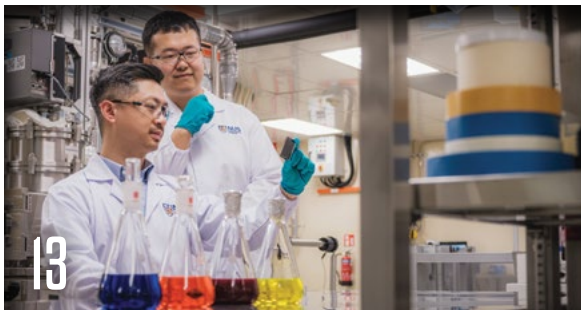

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COVER STORY

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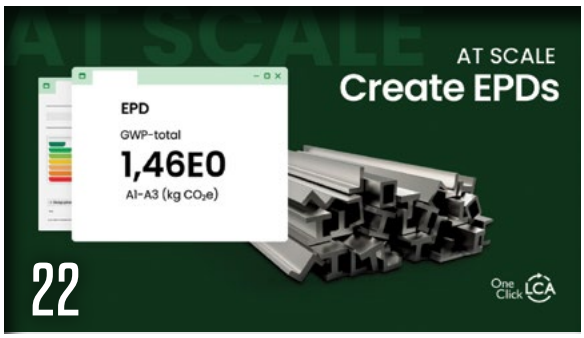


IES plays key role at FEIAP General Assembly

IES was proudly represented at the 33rd Federation of Engineering Institutions of Asia and the Pacific General Assembly (FEIAP GA) in Bangkok, Thailand, from 23 to 25 July 2025, where IES President Er. Chan Ewe Jin, Emeritus President Er. Chong Kee Sen and Honorary Treasurer Er. David Ng actively contributed to regional engineering dialogues.

Driving sustainability forward

Er. Chong chaired the Environmental Sustainability Standing Committee where Er.Ng shared Singapore's Sustainability RoadMap.

Representatives from Engineers Australia (EA) and Chinese Institute of Engineers (CIE) also shared their countries' sustainability perspectives.

Three Working Groups under this Standing Committee were formed to develop the guidelines on Circular Economy, ESG and New Energy. They also attended the tree planting event that was initiated by the standing committee – the 1st FEIAP Tree Planting was carried out in Chinese Taipei in 2024. The next edition of tree planting will be carried out at the next GA in 2026, to be held in Sarawak, Malaysia.

At the dinner, FEIAP presented its inaugural Honorary Fellow Award to IES recipients, Prof Cham Tao Soon, Er. Tan Seng Chuan, Prof Su Guangning, Prof Chew Yong Tien and Er. Chong Kee Sen who was present to receive the award from the FEIAP President.

Both Er. Chong and Er. Ng also attended various briefings by the organiser, Engineering Institute of Thailand (EIT), at its building, and the technical site visit to the MRT Construction site.

IES actively participated in the meetings at the 33rd Federation of Engineering Institutions of Asia and the Pacific General Assembly (FEIAP GA), held in Bangkok.

IES Emeritus President Er. Chong Kee Sen (centre) receives the FEIAP Honorary Fellow Award from the FEIAP President. Looking on is IES President Er. Chan Ewe Jin.

A tree planting event was held at the initiative of the Environmental Sustainability Standing Committee.

Celebrating engineering leaders at the National Day Awards 2025

Mr Tan Gee Paw

Prof Lui Pao Chuen

IES is proud to congratulate two of Singapore's distinguished engineering leaders for being conferred the top two honours at this year's National Day Awards. They are:

- Mr Tan Gee Paw, awarded the Order of Nila Utama
- Professor Lui Pao Chuen, awarded the Distinguished Service Order

Both are recipients of the IES Lifetime Engineering Achievement Award and esteemed members of the IES Advisory Panel.

Mr Tan is a former Chairman of the Changi Airport Group and a former chairman of PUB, Singapore's National Water Agency, where he transformed Singapore's water challenge into global leadership in environmental sustainability through PUB's NEWater and integrated water management systems.

Prof Lui, Singapore's first Chief Defence Scientist, pioneered the nation's defence science and technology, forging critical capabilities that safeguard Singapore's sovereignty and security.

Their journeys show how engineering is not confined to technical solutions but is a powerful force in nation-building, turning vulnerabilities into opportunities and securing Singapore's future.

To the next generation of young engineers, it can be said that their work holds the same potential to change lives, advance industries and make a real impact on shaping the future of the nation.

IES/ACES RE/RTO Awards Night 2025 recognises exemplary Site Supervisors

Graced by the Guest-of-Honour, Er. Thanabal Kaliannan, Commissioner of Building Control at the Building and Construction Authority, the IES/ACES RE/RTO Awards Night 2025, which was held on 13 August 2025, was a resounding success.

The evening celebrated the remarkable achievements and contributions of industry professionals who have demonstrated excellence in engineering and construction supervision.

This year, the Exemplary Site Supervisor Award 2025 was presented to five outstanding Resident Engineers (REs) and Resident Technical Officers (RTOs). These deserving recipients were recognised for their unwavering dedication, exceptional professionalism and commitment to upholding the highest standards in the field.

The event not only highlighted individual excellence but also reinforced the importance of strong leadership and technical expertise in shaping Singapore's built environment.

Congratulations to all awardees for their inspiring contributions!

The Exemplary Site Supervisor Award 2025 was presented to five outstanding Resident Engineers (REs) and Resident Technical Officers (RTOs), at the IES/ACES RE/RTO Awards Night 2025.

Connecting Minds: IES-INCA Deep Tech Accelerator Dialogue on Entrepreneurship and International Growth

It was an inspiring afternoon of collaboration and learning at the Singapore Sustainability Academy on 25 August 2025!

A huge thank you to everyone who joined the dialogue organised by IES-INCA and supported by Singapore Global Network (SGN).

The attendees were privileged to gain insights from the Guest-of-Honour, Mr Shawn Huang Wei Zhong, Senior Parliamentary Secretary (Ministry of Finance and Ministry of Manpower), and a stellar lineup of speakers from across the ecosystem.

The energy was electric during the two panel sessions:

- Panel 1: Technopreneur Journey Sharing

A huge thanks to the moderator and founders for their candid stories on the realities of building a deep tech startup from the ground up.

- Panel 2: Startups/SMEs Go International

Massive insights were shared on scaling beyond Singapore, navigating new markets and leveraging global networks.

A special appreciation to the incredible speakers and panellists:

- Er. Chan Ewe Jin, President of IES
- Ms Esther An, Chief Sustainability Officer, CDL
- Dr Tan Kee Wee, Principal Economist, Waveney Economics
- Dr Sahara Sadik, Deputy Director (Research), Institute for Adult Learning, SUSS
- Ms Joanne Teh, Assistant Director, IMDA

This event underscored the vibrant potential of Singapore's deep tech community. The conversations started here will undoubtedly continue to fuel innovation and sustainable growth.

Er. Chan Ewe Jin, President of IES addresses the attendees.

Er. Chan Ewe Jin, President of IES presents a token of appreciation to Ms Esther An, Chief Sustainability Officer, CDL.

Speakers, panellists and IES representatives at the event which was held at the Singapore Sustainability Academy.

From classroom to career: IES powers engineering futures at NED 2025

The Institution of Engineers, Singapore (IES) unveiled new moves to strengthen Singapore's engineering talent pipeline at the National Engineers Day (NED) 2025 and Engineering Innovation Challenge (EIC) Prize Presentation Ceremony held at ITE College Central, on 1 August 2025.

Graced by Senior Minister of State for National Development and Transport, Ms Sun Xueling, the event centred on the theme 'Shaping the Future with Engineering Innovation', to underscore the creativity and forward-thinking mindset vital to engineering Singapore's future.

"IES is committed to empowering young talents to build the future we want to live in. To solve complex challenges, we not only need engineers, but a full ecosystem of professionals, from engineering technologists to technicians, to work together. From sparking their interest, to offering financial support and professional recognition, we are focused on nurturing the next generation of engineers to lead our nation's growth into the future," said Er. Chan Ewe Jin, President of IES.

The Guest-of-Honour, Ms Sun Xueling, Senior Minister of State for National Development and Transport, delivers her speech.

Er. Chan Ewe Jin, President of IES, addresses the attendees.

Expanding access and recognition in engineering

To strengthen early engagement and exposure to engineering, IES and the Institute of Technical Education (ITE) signed an enhanced Memorandum of Understanding (MoU), at the ceremony.

Under this agreement, all ITE Engineering students enrolled in Nitec, Higher Nitec, Technical Engineer Diploma or Work-Study Diploma programmes will receive complimentary IES Student Memberships, valid until graduation or the end of their studentship, whichever occurs first. These students will have opportunities to participate in dialogue sessions with IES members, local and overseas learning journeys and STEM-related enrichment activities.

In addition, IES will sponsor book prizes to recognise outstanding ITE engineering students, as a form of academic encouragement and professional validation. These efforts aim to ensure that all students, regardless of background, have access to a supported and inclusive pathway into the profession.

IES has also established new Chartership Assessment Centres at ITE and Singapore Polytechnic for Chartered Technicians and Chartered Technologists, respectively, expanding formal pathways to professional recognition in the Built Environment and Infrastructure Engineering sectors. Offering students and practice-based professionals an alternative route to certification, these centres are part of efforts by IES to widen access to industry-recognised credentials and grow Singapore's pool of technically-skilled professionals.

The IES Scholarship Fund, launched in 2024 to support financially disadvantaged engineering students, will award its first six bond-free scholarships this year to students from ITE, polytechnics and universities. The inaugural recipients will be honoured at the IES 59th Annual Dinner in November. The fund received a fresh boost of SGD 180,000, raised through IES Charity Golf 2025 held in July.

Young innovators crowned champions of EIC 2025

Emerging as standouts for their creativity, technical rigour and future-focused solutions, the winners of EIC 2025 were officially crowned champions at the prize presentation ceremony. SMS Sun Xueling presented awards

to winning student teams across secondary schools, junior colleges, ITEs, polytechnics and universities.

This year's challenge drew strong participation from the local and international landscape, with nearly 180 teams competing and 79 advancing to the finals. Finalist teams addressed some of today's most pressing challenges, including renewable energy and materials, digital transformation, healthcare innovation and food resilience.

Now in its 11th edition, the EIC remains NED's flagship competition and a nationwide challenge that empowers students to tackle real-world problems through engineering innovation. It is organised by IES with support from the Ministry of Education and industry partners.

"We were especially impressed by this year's students. Their ideas were creative, thoughtful and grounded in real-world relevance. The EIC continues to showcase the potential of young minds when given the opportunity to solve meaningful problems. We hope this experience sparks their interest in pursuing engineering as a purposeful and rewarding career," said Er. Deckson Ang, NED 2025 Organising Committee Chairman.

This year's challenge drew strong participation from the local and international landscape.

Gearing up for What's Next in Engineering

IES also organised the IES Career Fair, in partnership with NTUC Youth, to connect students and early-career engineers with prospective employers, mentors and education partners. Attendees explored booths put up by engineering firms, government agencies, start-ups and institutes of higher learning, and participated in job-matching, resume clinics and hands-on tech showcases in robotics, AI and sustainability.

IES also organised the IES Career Fair.

A special highlight of the ceremony was a fireside chat with SMS Sun Xueling, who shared her perspectives on the future of engineering and its potential to drive meaningful change. The conversation offered students valuable insights and encouragement as they consider their own paths in shaping Singapore's future.

Fireside chat with SMS Sun Xueling.

RESULTS OF ENGINEERING INNOVATION CHALLENGE 2025

Category 1 – Secondary Schools
Champion Team: S-29
School: Raffles Institution
Project title: WetAlert: The Smart Diaper Solution
Project description: This study demonstrates the potential of using a simple, cost-effective wearable sensor system to address the challenges of elderly incontinence. By detecting moisture in real-time and sending alerts to caregivers or family members, the system significantly improves hygiene, comfort and dignity for elderly users. It also reduces the need for frequent manual checks, easing the burden on caregivers and enabling more efficient care routines.

Beyond immediate caregiving applications, the collected sensor data may also be valuable for health professionals and researchers. By analysing usage trends and moisture patterns, healthcare providers can identify potential health risks or changes in condition, leading to more personalised and proactive care.

This project addresses a pressing issue in ageing societies like Singapore. With further development, refinement and support, this solution has the potential to contribute meaningfully to elderly healthcare, improve quality of life and support more data-driven caregiving in the future.

Category 2 – Junior Colleges
Champion Team: J-35
School: Victoria Junior College
Project title: Modular Fogponics Greenhouse
Project description: The modular fogponics greenhouse aims to bring Singapore closer to its '30 by 30' food goals by making urban farming and growing of vegetables at home easier for users. This project aims to reduce the energy and water consumption as compared to traditional farming/ hydroponic systems in the market, through the use of an ultrasonic atomiser which atomises water into fine mist (fogponics).

In addition, various modules such as water collection modules and greenhouse modules will have microcontrollers that can communicate with each other seamlessly via Serial Communication. Along with an additional suite of sensors that can be added to each module, the product will fit a wide range of users, allowing them to customise and expand their own 'farms', just by adding more modules.

Category 3 – ITE & Polytechnics
Champion Team: I-2
School: ITE College East
Project title: Optimisation of Cement Properties Using Sustainable Materials: Upcycling Shellfish Shell Waste and Recycled Plastics
Project description: This project explores the development of a sustainable cement composite by partially replacing ordinary Portland cement with pretreated shellfish shell waste and recycled plastic flakes. By upcycling these abundant waste materials, the study aims to reduce carbon emissions and improve concrete durability.

Shells are chemically treated with sodium chloride, hydrochloric acid and oxalic acid to enhance compatibility, while plastic flakes are added to boost hydrophobicity and flexural strength. The hybrid mix is expected to retain compressive strength within ±5% of conventional mixes, enhance flexural toughness by 15%-20%, and lower water absorption by up to 10%.

With a projected 15%-20% reduction in CO_2 emissions, the composite offers a low-energy, scalable alternative to traditional cement. Potential applications include marine infrastructure and lightweight insulating materials. This research supports circular economy goals and sustainable construction practices by transforming biological and plastic waste into high-performance building materials.

Category 4 – Universities
Champion Team: U-10
School: National University of Singapore
Project title: Substituting Commercial Retarders with $FePO_4$-Dominated Battery Waste (FPW) in Concrete
Project description: This project explores the use of iron phosphate waste powder (FPW) from expired electric vehicle (EV) batteries as a sustainable substitute for commercial retarders in concrete. Retarders slow the setting time of concrete, which is essential for large pours and construction in hot climates. By repurposing FPW, the study aims to reduce environmental impact while maintaining or enhancing concrete performance.

Concrete samples with varying FPW proportions will be prepared and tested for setting time and compressive strength. The results will be compared against conventional mixes containing commercial retarders to assess performance and feasibility. This research promotes circular economy principles by converting battery waste into value-added construction materials and contributes to carbon emission reduction efforts aligned with net-zero targets for 2050.

Members of U-10 from NUS, the champion team in the Universities category, with Er. Chan Ewe Jin, President of IES, and the Guest-of-Honour, Ms Sun Xueling, Senior Minister of State for National Development and Transport.

ITAP 2025: Engineering the next leap in Advanced Manufacturing

In today's fast-evolving industrial landscape, engineering is no longer just about building systems – it is about architecting transformation. The forces shaping manufacturing today are complex: global trade volatility, fragmented supply chains, rising production costs and the accelerating shift to Industry 5.0, where human-machine collaboration, resilience and sustainability define long-term competitiveness.

From 15 – 17 October 2025, Industrial Transformation ASIA-PACIFIC (ITAP) 2025, a HANNOVER MESSE event, returns to Singapore EXPO.

Organised by Constellar in partnership with Deutsche Messe, ITAP 2025 will bring together 16,000 professionals from 75 countries, over 350 exhibiting brands and 10 country pavilions. It will present the latest technologies, strategies and solutions across the entire spectrum of manufacturing readiness, making it a vital platform for engineers, innovators and decision-makers.

Reflecting the breadth of innovation shaping the industry, this year's exhibitor line-up includes TATA Consultancy Services and EPLAN Software, in Digital Manufacturing; Agile Robots and Voltrium Systems, in Robotics & Factory Automation; and pro-beam GmbH & Co KGA, in Additive Manufacturing. These companies, among many others, will showcase solutions that move beyond theory into applied, scalable transformation.

From Explorer to Trailblazer – a targeted framework for progress

Insights from ITAP Intelligence 2025: Trends, Technologies & Transformation Across APAC – an industry-wide study commissioned by ITAP and conducted by IDC – reveals a telling split: 51% of Asia-Pacific manufacturers are still in early-stage planning or pilot phases, while 49% are actively deploying and optimising solutions.

For engineers, this signals both opportunity and urgency. The path to transformation is not linear. It must be staged, targeted and backed by robust execution plans.

ITAP 2025's Explorer-Adopter-Trailblazer framework addresses the different starting points and ambitions of engineering-led organisations:

- Explorers: Access foundational tools, pilot use cases and peer learning, to de-risk early adoption.
- Adopters: Gain integration roadmaps, proven deployment models and strategies to scale solutions effectively.
- Trailblazers: Engage with frontier innovations in Industry 5.0, AI-enabled production and advanced analytics, to sustain leadership.

"Transformation is no longer aspirational – it is urgent. ITAP 2025 is where decision-makers come to act, supported by real-world solutions, proven use cases, and partner networks," says Audrey Leong, Portfolio Director at Constellar.

The Industrial Transformation Forum (ITF): where strategy meets scale

Anchoring ITAP is the Industrial Transformation Forum (ITF) – a high-level gathering of over 200 C-suite executives and 40+ industry experts. ITF delivers execution-ready insights and strategic clarity across five key pillars:

- Industrial AI – Leveraging intelligence for predictive, adaptive operations.
- Digitalisation strategies – From roadmap design to enterprise-wide rollouts.
- Sustainable manufacturing – Designing for efficiency, circularity and compliance.
- Supply chain resilience – Securing capacity and flexibility in a volatile world.
- Workforce development – Equipping engineers for the next decade of manufacturing challenges.

"At ITF 2025, we are not just discussing transformation, we are enabling leaders to engineer it. This forum is where smart leadership meets executional clarity," says ITF 2025 Chairperson, Stephanie Liew.

From showcases to real-world impact

ITAP 2025 is designed for engineers who want to see and test 'what is next'. Featured zones on the show floor will offer immersive, working demonstrations of future-ready systems, including:

- Additive Manufacturing Learning Journey (by NAMIC)
- Electromobility Pavilion (by Singaporean-German Chamber of Industry and Commerce)
- Future of Robotics (by DEXPO)
- Gateway to Industrial AI (by Microsoft)
- Future Talent Pavilion
- Industry 5.0 Pavilion (by River Venture Studio)
- Smart Factory in Action

These zones will not just display technologies – they will also model how such solutions integrate into live production environments, from initial design to operational scaling.

ITAP 2024, held last year, also facilitated, besides the presentation of the exhibits, 1,700+ business meetings that connected solution providers with manufacturing leaders across borders.

The 2025 edition is set to expand these opportunities for collaboration, innovation and market access.

Singapore as a launchpad for regional growth

Hosting ITAP reinforces Singapore's role as a global node for advanced manufacturing and a launchpad for

regional transformation.

As Dennis Mark, CEO of the Singapore Manufacturing Federation, observes, "This event amplifies Singapore's position, uniting SMEs and MNCs to co-create impactful outcomes and champion Industry 5.0 and beyond."

ITAP 2025 embodies the collaborative model needed to translate engineering innovation into competitive advantage at scale, with support from agencies such as Singapore's Agency for Science, Technology and Research (A*STAR); Singapore Economic Development Board (EDB); Enterprise Singapore (ESG); JTC Corporation (JTC); SkillsFuture Singapore (SSG); and the Singapore Tourism Board (STB).

Why engineers should pay attention

For members of IES (Institution of Engineers, Singapore), ITAP 2025 is more than an event – it is a convergence point where technical expertise, operational realities and strategic vision align. Whether the engineers are designing precision components, automating production lines, integrating AI into operations, or rethinking supply chain systems, the frameworks, case studies and partnerships at ITAP can accelerate their projects and careers.

In an era where industrial change is constant, the ability to engineer transformation – deliberately, effectively and sustainably – will define the leaders of the next decade.

As an added benefit, IES members who attend the ITF will be eligible to earn CPD points, making participation both a strategic and professional development opportunity.

Industrial Transformation ASIA-PACIFIC 2025
15 – 17 October 2025
Singapore EXPO
Learn more & register your visit at www.industrial-transformation.com

A few of the exhibits at ITAP 2024, the previous edition of the event.

Speakers and attendees at last year's Industrial Transformation Forum (ITF). IES members who attend ITF 2025 will be eligible to earn CPD points.

Three gencos to conduct carbon capture and storage studies

Three power generation companies – Keppel's Infrastructure Division, PacificLight Power and YTL PowerSeraya – will be conducting carbon capture and storage (CCS) feasibility studies for the power sector.

Five proposals from these companies have been selected by the Energy Market Authority (EMA) to receive co-funding for the site-specific CCS studies. This follows a Grant Call launched in October 2024 which invited the industry to explore potential power sector CCS solutions as part of Singapore's energy transition towards a low-carbon future.

The grant facilitates the study of two power sector CCS pathways – (a) post-combustion carbon capture and (b) pre-combustion carbon capture.

• Post-combustion carbon capture for natural gas power plants refers to the installation of an onsite CO_2 capture unit to capture CO_2 from the flue gas produced during the combustion of natural gas in power plants.

• Pre-combustion carbon capture refers to the installation of an onsite CO_2 capture unit to capture CO_2 generated during the production of H_2 from natural gas. The H_2 would then be transported to the power plants and combusted to generate electricity.

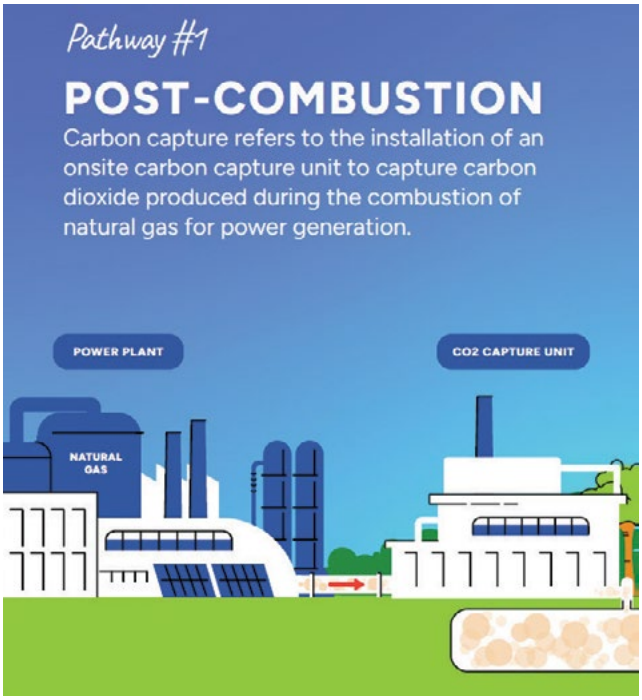
The five studies are targeted for completion in 2026.

The findings from these feasibility studies will allow EMA and the power generation companies to deepen our knowledge and understanding of the power sector CCS pathways, as well as identify infrastructure and site-specific requirements.

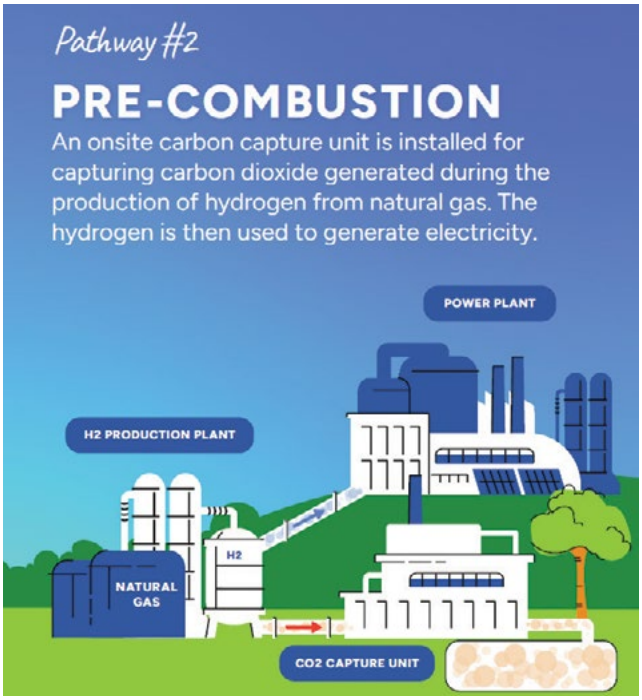
The findings would also provide a useful foundation to conduct more detailed engineering studies in future, such as preliminary Front End Engineering Design (pre-FEED) and FEED studies, to further assess the feasibility of CCS to decarbonise the power sector.

Power Generation Company	Scope
Keppel's Infrastructure Division	Post-combustion carbon capture
Keppel's Infrastructure Division	Pre-combustion carbon capture
PacificLight Power	Post-combustion carbon capture
YTL PowerSeraya	Post-combustion carbon capture
YTL PowerSeraya	Pre-combustion carbon capture

The five proposals selected to receive co-funding for site-specific CCS studies.



Post-combustion carbon capture



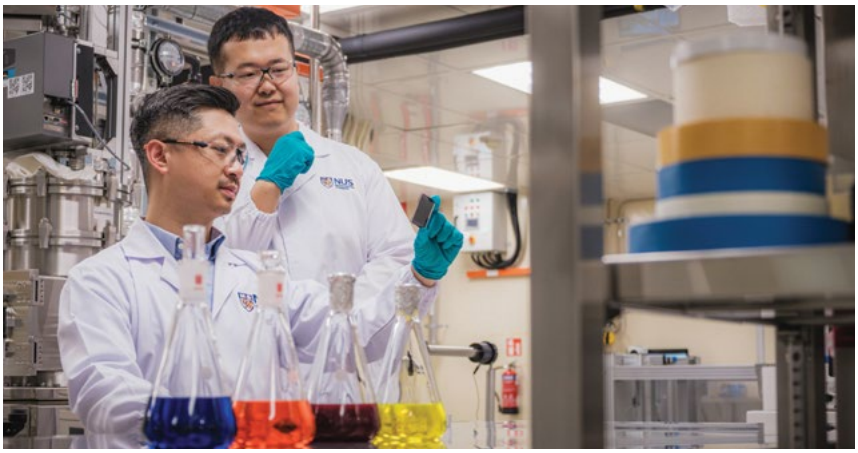
Pre-combustion carbon capture

NUS researchers produce record-setting perovskite–organic tandem solar cell

Scientists at the National University of Singapore (NUS) have demonstrated a perovskite–organic tandem solar cell with a certified world-record power conversion efficiency of 26.4% over a 1 cm² active area – making it the highest-performing device of its kind to-date. This milestone is driven by a newly designed narrow-bandgap organic absorber that significantly enhances near-infrared (NIR) photon harvesting, a long-standing bottleneck in thin-film tandem solar cells.

This latest research breakthrough was achieved under the leadership of Assistant Professor Hou Yi, who is a Presidential Young Professor in the Department of Chemical and Biomolecular Engineering under the College of Design and Engineering at NUS, and leads the Perovskite-based Multijunction Solar Cells Group at the Solar Energy Research Institute of Singapore (SERIS) at NUS.

The NUS research team published their groundbreaking work in the prestigious scientific journal, Nature, on 25 June 2025.



NUS scientists have set a new benchmark in the power conversion efficiency of perovskite-organic tandem solar cells.

Unlocking the promise of tandem solar cells

Perovskite and organic semiconductors both offer widely tunable bandgaps, enabling tandem cells to approach very high theoretical efficiencies.

"Thanks to their light weight and flexible form factor, perovskite–organic tandem solar cells are ideally suited to power applications that are run directly on devices such as drones, wearable electronics, smart fabrics and other AI-enabled devices," said Asst Prof Hou.

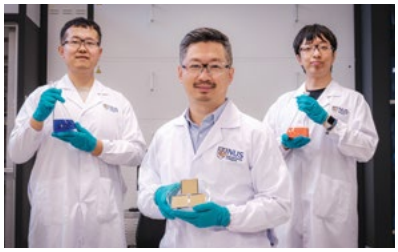
However, the absence of efficient NIR thin-film absorbers – which help to capture sunlight in the NIR region more efficiently and hence improve the overall efficiency of tandem cells – has kept perovskite–organic tandem cells lagging behind alternative designs.

Harnessing the near-infrared

To overcome this challenge, Asst Prof Hou and his team developed an asymmetric organic acceptor with an extended conjugation structure, enabling absorption deep into the NIR region while maintaining a sufficient driving force for efficient charge separation and promoting ordered molecular packing. Ultrafast spectroscopy and device physics analyses confirmed that this design achieves high free charge carrier collection with minimal energy loss.

Building on the organic subcell's performance, the researchers stacked it beneath a high-efficiency perovskite top cell, interfacing the two layers with a transparent conducting oxide (TCO)-based interconnector.

The newly designed tandem cell achieved a power conversion efficiency of 27.5% on 0.05 cm² samples and 26.7% on 1 cm² devices, with the 26.4% result independently certified. These findings mark the highest certified performance to-date among perovskite–organic, perovskite–CIGS, and single-junction perovskite cells at comparable sizes.



Innovators behind the solar breakthrough – Asst Prof Hou Yi (middle), Dr Jia Zhenrong (left) and Mr Guo Xiao (right).

"With efficiencies poised to exceed 30%, these flexible films are ideal for roll-to-roll production and seamless integration onto curved or fabric substrates – think self-powered health patches that harvest sunlight to run onboard sensors, or smart textiles that monitor biometrics without the need for bulky batteries," noted Asst Prof Hou.

The next step

In the next phase, the NUS team will focus on enhancing real-world operational stability and advancing towards pilot-line manufacturing – crucial steps in bringing flexible, high-performance solar technology to market.

Images by National University of Singapore

Aster announces acquisition of condensate splitter assets from PCS Pte Ltd

Aster has announced the signing of an agreement between Aster Chemicals and Energy Pte Ltd and PCS Pte Ltd (PCS) for the acquisition of PCS's entire 50% beneficial interest in a Condensate Splitter Unit (CSU) and associated assets (the Condensate Splitter Facility).

PCS is a leading company within the Singapore Essential Chemicals Complex on Jurong Island and it is also the pioneering company in the essential chemicals industry, in the region.

Through this agreement, Aster will acquire full 100% ownership of the Condensate Splitter Facility including key infrastructure comprising the floating roof crude tank, two fixed roof crude recirculation tanks, and a fixed roof Kero tank equipped with advanced mixing and sampling features.

Post-acquisition, Aster will seek to invest to rejuvenate the CSU. Post-revitalisation, Aster's total capacity will increase from 237,000 barrels per day currently, to more than 300,000 barrels per day. This will enable deeper integration with Aster's existing refining and petrochemical assets.

Group CEO of Aster, Erwin Ciputra, said, "This strategic move augments our commitment to create a compelling value chain of our capabilities and infrastructure in Singapore. This upgrade will enhance feedstock optimisation, reduce downtime, with greater operational flexibility and increased throughput capacity to meet growing regional demand."

"Together with our fully integrated refinery and downstream chemical assets on Bukom and Jurong Island, and through the recent acquisition announcement of Chevron Philips Singapore Chemicals, we will have an enhanced asset base to deliver more reliable and competitive solutions to customers across Singapore and Southeast Asia," he added.

Andre Khor, Group CFO & Deputy CEO, Aster Group (left) and Hisashi Shibayama, Managing Director, PCS Pte Ltd, at the signing ceremony. Image: Aster.

The agreement also paves the way for future collaboration between PCS and Aster on naphtha procurement via the existing pipeline infrastructure, further strengthening the value chain and unlocking synergies in sourcing, processing and downstream integration.

Aster

Aster is a leading provider of energy, chemical, and infrastructure solutions in Southeast Asia, supplying products and services to various manufacturing industries in both domestic and international markets. It is a Chandra Asri-led joint venture with Glencore.

Aster Group launches new subsidiary

Aster Group recently announced the launch of Aster Engineering Services Pte Ltd, signalling a strategic expansion to become an integrated service provider of multidisciplinary engineering and plant maintenance services to the oil and gas, petrochemical and oil and chemical terminal industries in Singapore and the region.

Aster Engineering Services will provide engineering, procurement and construction or construction management services for a plant or terminal. The formation of this new business will support Aster's integrated refinery operations on Bukom Island and downstream chemical assets on Jurong Island. It will also enable Aster to offer comprehensive, end-to-end solutions across interconnected industries.

As part of the launch of this expansion, Aster's parent company, Chandra Asri has acquired an 11.9% equity stake in Hiap Seng Industries Limited, a renowned Singaporean engineering solutions provider with a seven-decade legacy in mechanical engineering, plant fabrication, construction, and maintenance for energy and process industries.

Aster Engineering Services will explore potential opportunities to partner with Hiap Seng Industries Limited and augment its reach to deliver even greater value.

Alstom to convert East West Line stations to the Urbalis signalling system for the Thomson-East Coast Line extension

Alstom, a global leader in smart and sustainable mobility, has been awarded a contract by the Land Transport Authority (LTA) of Singapore to deliver a high-capacity driverless signalling system for the stations of the East West Line which will connect to the Thomson-East Coast Line extension (TELe).

The contract, worth a couple of hundred million euros, covers the conversion of Tanah Merah, Expo and Changi Airport stations to TEL, and the equipment of the line extension to the future Changi Airport Terminal 5 station.

This extension will directly connect the TEL to Changi Airport, improving passenger experience and journey efficiency, while advancing the Singapore's Land Transport Master Plan 2040 (LTMP 2040) objective of seamless, end-to-end connectivity.

As the signalling consortium leader, Alstom will provide its Urbalis communications-based train control (CBTC) system, the same platform already in successful operation on TEL, while its consortium partner, ST Engineering Urban Solutions Ltd will provide the Data Communication System (DCS) and Platform Screen Doors (PSD).

The TEL extension to Changi Airport will provide a direct, high-speed connection to central city areas and residential zones, cutting travel times for both commuters and international travellers. This development represents a key milestone under the LTMP 2040 plan to deliver greater connectivity, resilience and inclusivity in Singapore's land transport system.

Upon completion, the 57 km TEL will run from Tanah Merah through major locations like Gardens by the Bay, Maxwell and Orchard, and up to Woodlands North, with a transfer option to the Johor Bahru – Singapore Rapid Transit System Link.

The teams from Land Transport Authority of Singapore, Alstom and ST Engineering Urban Solution at the Letter of Award Handover Ceremony, for the contract.

The TEL is expected to reduce travel time between Changi Airport and Marina Bay from 55 minutes to approximately 45 minutes. Additionally, journeys between Changi Airport and Gardens by the Bay will be shortened to 40 minutes via the TEL, compared to the current 60-minute duration.

This latest contract strengthens Alstom's long-standing presence in Singapore and builds on its successful delivery of the most recent signalling system in Singapore, for TEL Stage 4 which commenced service in June 2024.

As a leader in the CBTC segment, Alstom's comprehensive CBTC portfolio supports both conventional and intelligent solutions. It can be adapted to all levels of complexity – whether greenfield or brownfield projects – across all grades of automation.

With over 30 years of expertise in CBTC, Alstom's Urbalis signalling system is deployed on 190 metro lines, including 67 fully driverless lines in 32 countries, safely transporting millions of passengers every day. In addition to enabling higher operational efficiency and flexibility, Urbalis systems can reduce energy consumption by up to 30%, through intelligent, energy-saving strategies.

HID and ASSA ABLOY recognised with Red Dot Award

HID and ASSA ABLOY have announced that their self-boarding biometric eGate – the BG100 Speedgate – has received the Red Dot Award: Product Design 2025 in the interior design elements category.

The BG100 Speedgate is a next-generation solution that seamlessly integrates the HID Facepod and document reader with ASSA ABLOY's Speedgate – redefining the passenger journey through airports with a faster, more secure and frictionless experience.

At the core of the BG100 Speedgate is the HID Facepod, an all-in-one facial recognition solution featuring an advanced camera system and algorithms, intuitive multi-touch screens and smart LED guidance. Together, this solution streamlines critical airport touchpoints – from pre-security checks and VIP lounge access to boarding and immigration – delivering a secure, frictionless and touchless experience for travellers.

Keysight installs world's largest commercial quantum control system

Keysight Technologies Inc has delivered the world's largest commercial quantum control system (QCS) to the National Institute of Advanced Industrial Science and Technology (AIST) in Japan. The system has been integrated into the Global Research and Development Center for Business by Quantum-AI Technology (G-QuAT).

'The world's largest' refers to the first commercially delivered quantum control system capable of controlling more than 1,000 superconducting qubits.

This control system is now part of the new evaluation testbed at G-QuAT, which will push the limits of what is possible with quantum computing in terms of both scale and performance.

All quantum computers require a control system to translate from the classical world of code and cables to the quantum world of photons and qubits. As quantum computers grow in size, complexity and performance, requirements for the control system become much more stringent. Any gap in the control system performance can compromise the capabilities of the quantum computer, so it was important for AIST to select the right partner for this critical component.

Thanks to early investments in scalable architecture, Keysight was able to deliver this control system capable of powering leading-edge quantum computers. Extensive testing demonstrated that rigorous requirements on noise, time alignment and phase coherence are maintained across the system.

This delivery establishes Keysight as the first commercial control system vendor to deliver a system that supports 1,000+ qubits and proves that Keysight's QCS can meet the scaling challenges of next-generation quantum computers.

Dr Masahiro Horibe, Deputy Director of G-QuAT, AIST said, "The 1,000-qubit control system developed here is a groundbreaking device, the world's first and largest of its kind, realised through Keysight's exceptional engineering capabilities in response to our advanced technical requirements. The advancement of quantum technology requires not only theoretical progress but also sophisticated engineering to support it."

"This system has enabled the precise synchronisation, control and readout of complex multi-channel signals, making large-scale qubit operations possible. It is a clear demonstration that engineering is paving the way for the future of quantum technology. We express our deep respect for Keysight's development capabilities and look forward with great anticipation to further technological innovations," Dr Horibe added.

Dr Eric Holland, General Manager, Keysight Quantum Engineer Solutions said, "Control systems serve a vital role in quantum computing, acting as the bidirectional bridge between the classical and quantum worlds. We are both honoured and excited to partner with AIST G-QuAT, providing the hardware and software tools necessary to achieve the critical milestone of a 1,000-qubit quantum computer, a key step toward realising quantum advantage for practical business applications."

Keysight's 1,000-qubit quantum control system solution installed at the National Institute of Advanced Industrial Science and Technology (AIST) in Tsukuba, Japan.

Solutions and expertise for future-oriented industrial cleaning processes

The 21st parts2clean event will be held from 7 to 9 October 2025, at the Stuttgart Exhibition Center in Germany.

At this year's event, exhibitors will present a diverse range of solutions, from degreasing and deburring to classic component cleaning and ultra-fine or high-purity applications.

In addition, the attractive supporting programme in the 21st edition of the leading international trade fair for industrial parts and surface cleaning will enable visitors to develop expertise in implementing their individual cleaning tasks reliably, economically and sustainably.

The cleanliness of individual components is a crucial factor in determining the quality of products and whether they will function flawlessly.

Not only does this make parts cleaning a factor that adds value to all industrial sectors, it also means that the ability to clean components effectively and easily is a prerequisite for implementing new product developments.

"With the world's most comprehensive and up-to-date range of solutions for all areas of industrial parts cleaning, parts2clean is the ideal platform for information and procurement," said Ramtin Randjbar-Moshtaghin, Project Director at Deutsche Messe, organisers of the event.

This is also reflected in the fact that market and technology leaders will be represented at the international trade fair.

This year's p2c.EXPERTFORUM programme includes sessions on topics such as sustainability and the circular economy, applications, challenges and solutions in the high purity sector, as well as testing and analysing cleaned surfaces.

Solving the challenges

"Many of the companies will use their presence at the trade fair to show off new and enhanced solutions. But that is not all – the sophisticated supporting programme at this year's parts2clean will also offer a wealth of knowledge and expertise on how to optimise the cleanliness, cost-effectiveness and energy and resource efficiency of parts cleaning," Mr Ramtin Randjbar-Moshtaghin added.

Other topics to be discussed will include cleaning trends in high-tech and growth sectors such as the semiconductor industry and its suppliers, vacuum technology, aerospace, the defence industry, measurement and analysis technology, medical and pharmaceutical technology, sensor technology, new mobility and electronics.

The integrated p2c.EXPERTFORUM, which is being coordinated by the Fraunhofer Cleaning division and the German Industrial Parts Cleaning Association (FiT), will feature presentations over the three days by top-tier experts from industry and associations as well as from the scientific and research community, with simultaneous interpretation (from German to English and English to German).

The forum will be divided into a total of 11 subject areas. The agenda includes the basics of industrial cleaning processes and presentations on innovative products and services, as well as research highlights from the industry.

Current developments, requirements, and benchmark applications will be discussed in sessions dealing with topics including sustainability and the circular economy; applications, challenges and solutions in the high purity sector; and testing and analysing cleaned surfaces. Another topic area will take a look at combined or extended processes and methods such as deburring and cleaning in one process and the functionalisation of surfaces through laser processing.

The special 'Process Chain Technical Cleanliness' show, organised jointly with the CEC (Cleaning Excellence Center), will examine cleaning in conjunction with the associated production processes. It will afford visitors the opportunity to follow the path to clean components, step by step, thus providing an impetus for company-specific solutions.

One of the highlights of this year's supporting programme will be the presentation of the 4th FiT2clean Awards on the last day of the exhibition.

Arkema celebrates its Singapore plant dedicated to products made from castor beans

Addressing the demand for more sustainable solutions.

Arkema recently celebrated its Singapore plant on Jurong Island, which is the world's largest integrated factory dedicated to advanced bio-circular materials.

The Arkema Group is the world's only producer of RILSAN Polyamide 11 (PA11) and OLERIS Advanced Oleochemicals, both made entirely from castor beans.

With the addition of the Singapore plant, global production capacity for PA11 has increased by 50%, supporting fast-growing sectors across the region like electric mobility, advanced electronics and consumer goods.

The event at Jurong Island was graced by Guest-of-Honour Dr Tan See Leng, Singapore's Minister for Manpower and Minister-in-charge of Energy and Science & Technology at the Ministry of Trade and Industry.

Distinguished guests included His Excellency Mr Stephen Marchisio, Ambassador of France to Singapore; Ms Jacqueline Poh, Chief Executive Officer of JTC; and Mr Lim Wey-Len, Executive Vice President of the Singapore Economic Development Board.

Arkema's Singapore plant on Jurong Island.

To meet the growing demand across Asia Pacific, Arkema has announced it will triple its global production capacity for RILSAN Clear, with a new unit in the Singapore plant.

The RILSAN Clear transparent polyamide is used in eyewear, electronics, healthcare devices and home appliances.

Production in Singapore is expected to begin in the first quarter of 2026 and is fully aligned with the company's strategy which is to have Singapore serve as its base for advanced materials across Asia.

Furthermore, the plant strengthens Arkema's global supply chain capabilities and supports the Group's 2028 ambition to accelerate its organic growth in high performance materials and sustainable solutions.

Mr Thierry Le Hénaff, Chairman and Chief Executive Officer of Arkema said, "This plant marks a strategic milestone in Arkema's growth in Asia and our long-standing commitment to bio-based high-performance materials. RILSAN Polyamide 11 enables our customers to combine sustainability with technical excellence – across applications from automotive and electronics to eyewear and medical devices."

"We are proud to deepen our presence in Singapore, a country that offers the ideal conditions for advanced manufacturing, innovation and sustainable growth," he added.

Mr Jermaine Loy, Managing Director, Singapore Economic Development Board said, "Arkema's plant in Singapore manufactures advanced bio-based polymers, enabling it to serve fast-growing sectors such as electronics and consumer goods. This strengthens Singapore's specialty chemicals landscape and creates new and exciting job opportunities in the growing bioeconomy space."

"We welcome Arkema and other like-minded companies to tap on our innovation ecosystem, talent pool and regional connectivity to scale impactful solutions from here," he added.

Ms Jacqueline Poh, Chief Executive of JTC said: "Arkema's facility in Jurong Island serves as a strategic base for its production of advanced materials and specialty chemicals. Beyond manufacturing, Arkema taps into Singapore's vibrant R&D ecosystem to drive innovation and develop sustainable solutions. As the sole producer of RILSAN Polyamide 11, a bio-circular material, Arkema's investment aligns with our vision for Jurong Island as a global hub for sustainable chemicals."

Signing the digital ceremonial plaque at Arkema's Singapore plant are, from left to right, His Excellency Mr Stephen Marchisio, Ambassador of France to Singapore; Dr Tan See Leng, Minister for Manpower and Minister-in-charge of Energy and Science & Technology at the Ministry of Trade and Industry; and Mr Thierry Le Hénaff, Chairman and Chief Executive Officer, Arkema.

Leading the way with the Singapore plant

Arkema is also accelerating innovation through collaboration with local research institutions such as Singapore's Nanyang Technological University, advancing research on sustainable materials. Ongoing joint research includes developing printable powders for precision components and using Arkema's ELIUM thermoplastic resin.

Arkema will continue to build on its presence in Singapore to advance the development of bio-based, recyclable materials and collaborate with ecosystem partners to scale impact across the region.

The total investment for the Singapore site is approximately EUR 400 million. To finance this plant, Arkema successfully placed its first ever green bond in October 2020, for a total amount of EUR 300 million.

RILSAN Polyamide 11

RILSAN Polyamide 11 (PA11) is a 100% bio-based polymer made from castor oil, a renewable raw material. The primary fatty acid in castor oil is used to produce Amino 11 (A11) which is then polymerised into PA11.

Arkema has over 70 years of experience in castor-based chemistry and has developed proprietary technologies to transform this feedstock into high-performance materials. The polymer is used across a wide range of products and industries due to its lightness, toughness, chemical resistance and temperature stability.

- Automotive & Transport: PA11 is extensively used in fuel and fluid management systems like tubes and connectors, as well as in hydrogen tank liners, where its low permeability and durability under pressure variations make it a material of choice.
- Electronics: PA11 supports the reliability of onboard electronics and power systems in electric and autonomous vehicles, offering low dielectric losses and thermal resistance.
- 3D printing: PA11 is used for powder bed fusion printing with high definition and strength suitable for production of parts

that can be found in cars, planes, consumer goods, and even prosthetics and supports.

• Consumer goods: PA11 is extensively used in home appliance and electronics housings for internal components. Even high-performance textiles are a growing market for this sustainable material.

• Sports & Leisure: PA11 can be found in running shoe midsoles and cleated outsoles for good energy return and lightness. Ski boots also use these materials for super low temperature performance.

• Powder & Coatings: PA11 is used in high durable metal coatings thanks to its resistance to chemicals, abrasion and shock.

RILSAN Clear

RILSAN Clear is a transparent high-performance polyamide derived in part from renewable feedstocks. It complements PA11 by offering lightness, toughness, chemical resistance and temperature stability. It is ideal for applications where both aesthetics and durability are essential.

It is used in eyewear frames, electronics casings, medical devices and sporting equipment.

RILSAN Clear also contributes to weight reduction and sustainability goals in design-driven sectors. Like other members of the RILSAN family, it is engineered for recyclability and high performance. PA11's lower carbon footprint makes it one of the most sustainable high-performance materials available today.

OLERIS

Castor oil, the raw material used for PA11, contains a fatty acid with 18 carbon atoms. Eleven of these are used to synthesise amino 11 which is then used to produce PA11. The remaining seven-carbon chain is used to make various products that Arkema markets under the OLERIS brand.

These 100% bio-based products have recognised applications in the lubricant, cosmetic and pharmaceutical industries. One OLERIS product is also a key component in Bostik's Fast Glue Ultra+ instant adhesive.

Facility overview	
Location	38 Banyan Avenue, Singapore 627480
Site area	12 hectares
Production capacity	50% increase in PA11 production
Investment into plant	EUR 400 million (of which EUR 300 million are in green bonds)
Key products manufactured	RILSAN Polyamide 11 (PA11), Amino 11 (A11), RILSAN Clear and OLERIS
Special features (e.g. unique technology, certifications, awards etc	World's largest integrated bio-factory for high-performance polymers. Singapore Environmental Achievement Awards, 2022
Economic and Community Impact	
Employment	Close to 200 high skilled jobs created with the Singapore plant Over 250 Arkema employees (both in the Singapore plant and office) 7 in 10 of Arkema employees are Singapore residents (Singapore Citizens/ PRs)
Local partners in Singapore	Nanyang Technological University, Temasek Trust Fund Advisory, Keppel, Rotary, UTOC, Mun Siong
Sustainability and Innovation	
Environmental initiatives	• Design phase: Use of immersive simulation tools such as 3D plant modelling • Optimised supply chain • Use of low-CO_2-emission heat source • High energy efficiency

Facts and figures on Arkema's Singapore plant

Arkema

Building on its unique set of expertise in materials science, Arkema offers a portfolio of technologies to address ever-growing demand for new and more sustainable materials.

With the ambition to become a pure player in Specialty Materials, the Group is structured into three complementary, resilient and highly innovative segments dedicated to Specialty Materials – Adhesive Solutions, Advanced Materials, and Coating Solutions – accounting for some 92% of Group sales in 2024, and a well-positioned and competitive Intermediates segment.

Arkema offers cutting-edge technological solutions to meet the challenges of, among other things, new energies, access to water, recycling, urbanisation and mobility, and fosters a permanent dialogue with all its stakeholders. The Group operates in some 55 countries with 21,150 employees worldwide.

All images by Arkema

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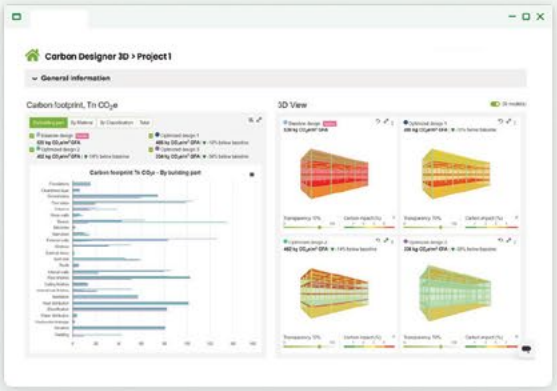

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One Click LCA enables us to make data-driven decisions that not only meet but often exceed our sustainability goals, setting a new standard for the industry. Through its comprehensive analysis, One Click LCA becomes not just a tool for compliance, but a catalyst for innovation in green building practices.

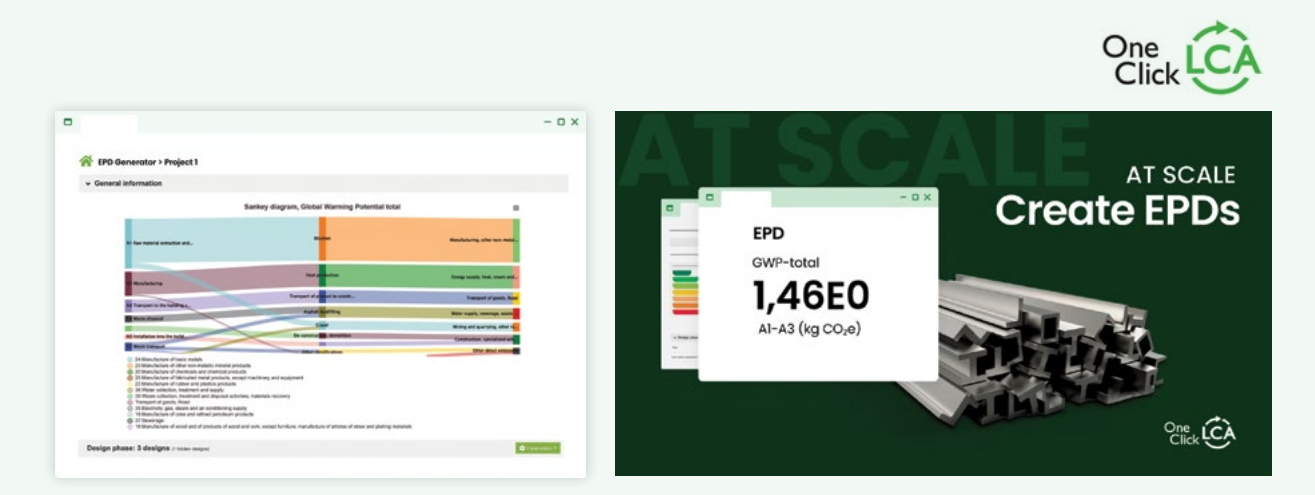
Eason Yu, Project Manager at TERAO Asia

Talk to sales →

sales@oneclicklca.com

EPDs and embodied carbon: enabling low-carbon choices in construction

Leading Singapore's low-carbon material transition.



With AI-powered LCA (Life Cycle Assessment) and EPD (Environmental Product Declaration) software, One Click LCA helps manufacturers conduct LCAs and generate automated and compliant EPDs for their products.

Across Singapore and Southeast Asia, the construction industry is accelerating adoption of low-carbon materials to meet the Singapore Green Plan 2030, Green Mark 2021 and regional decarbonisation commitments.

As focus shifts from operational emissions to whole-life carbon, Environmental Product Declarations (EPDs) have become a vital instrument – enabling manufacturers, developers and procurement teams to make transparent, data-driven material choices.

The embodied carbon of a product is the sum of its emissions from manufacturing, use and end-of-life stages, and should be assessed alongside operational carbon when making design and procurement decisions.

Certification programmes driving EPD adoption

EPDs provide a consistent and verifiable measure of a product's global warming potential (GWP), enabling fair comparisons between material options. The Singapore Green Building Council (SGBC) has integrated EPD metrics into the Singapore Green Building Product (SGBP) certification scheme, enabling benchmarking of low-carbon products.

Producing an EPD can be resource-intensive, but manufacturers can leverage recommended tools like One Click LCA, the AI-powered sustainability platform for construction and manufacturing. With the industry's largest EPD database of over 300,000 construction products, it enables manufacturers to reduce embodied carbon, comply with regulations and publish third-party verified EPDs for global markets.

From compliance to competitive advantage

Manufacturers such as NatSteel have demonstrated how verified EPDs can serve as both a compliance requirement and a market differentiator. Verified carbon performance data enables them to substantiate claims, satisfy certification requirements, and build credibility with developers and contractors seeking low-carbon procurement options.

By generating EPDs, using tools like One Click LCA EPD Generator, manufacturers can position themselves to win projects where carbon reduction is a key evaluation criterion, supporting both local developments and regional exports.

EPD adoption in concrete manufacturing

Concrete accounts for a significant share of embodied carbon in building projects. To address this, tools such as the One Click LCA Concrete EPD Generator enable concrete producers to create and publish reliable, third-party verified EPDs in line with SGBP certification and compliant with global EPD standards including ISO 14025, ISO 21930 and EN 15804.

This helps ensure the credibility of the reported carbon data while supporting market demand for sustainable construction materials.

Data-driven procurement for low-carbon projects

Developers like City Developments Limited (CDL) are consolidating EPD-

backed databases of low-carbon materials to inform procurement strategy. EPDs enable accurate quantification of embodied carbon and support Green Mark scoring, however, limited EPD availability in certain categories still restricts material choices.

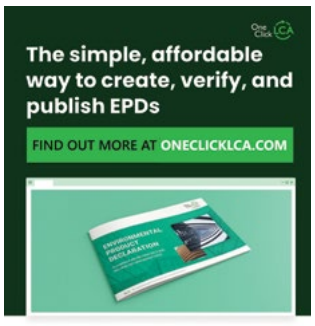
This underscores the need for greater EPD adoption by manufacturers, supported by accessible tools and clear certification pathways, to ensure developers have the verified data required for low-carbon procurement.

Accelerating decarbonisation in Singapore's built environment

With Singapore's newly announced 2035 emissions target and its commitment to net-zero by 2050, the demand for transparent, verifiable carbon data will continue to grow and EPDs will remain an essential tool for meeting these goals.

By adopting recommended tools such as One Click LCA, manufacturers in Singapore and the wider region can meet compliance requirements, gain market credibility and help drive the transition to a low-carbon built environment.

To learn more, visit www.oneclicklca.com



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Singapore's approach to Battery Energy Storage Systems

by Mr Hilman Ya'akop, Mr Zhang Chengyu Stanley, Er. Ho Victor and Mr Chen Mingliang, HiLT Pte Ltd

The trend towards the use of clean and renewable energy will see an increase in the deployment of Battery Energy Storage Systems (BESS). Over the years, Singapore has been clear on the potential of BESS and on implementing the roadmap that was published in 2020.

However, fires involving lithium-ion batteries are not yet well understood by industry, authorities and the public, alike. Compliance is required to different codes and standards, to ensure safety.

This article will explain the approach Singapore has adopted towards mitigating the fire risk, and will also explain the challenges that can arise when deploying BESS in a highly dense, metropolitan city such as Singapore.

CONTEXT AND BACKGROUND

BESS refers to one or more devices assembled, together, capable of storing energy that would be supplied as electrical energy. The threshold, aggregate stored energy capacity per compartment, for all types of lithium-ion batteries, is 20 kWh, so as to adhere to the fire safety requirements in the Singapore Civil Defence Force's (SCDF) Fire Code.

For context, the latest iPhone 16 Pro Max has a battery capacity of 4685 mAh, which is equivalent to 18 Wh. In other words, one will need to assemble 1,112 iPhone 16 Pro Max batteries, to be subjected to the fire safety requirements of SCDF's Fire Code.

Many improvements in handheld electronic devices have been made possible due to improvements in battery technology. Other devices, such as Personal Mobility Devices (PMDs) which use more powerful batteries, have also been made possible.

However, as often reported in the news, fires due to batteries could be deadly as they develop rapidly and produce large amounts of toxic and flammable gases. Hence, it is important for the public to acquire some knowledge on the mechanics of such fires involving batteries, and on the best approach to respond in such situations.

We have stepped into a futuristic world, with smart phones, drones, robots, electric vehicles and artificial intelligence, where batteries are an integral part of our everyday lives. As we continue to embrace electrification in our built environment, the deployment of BESS facilities will continue to increase as they act as buffers to allow the electric grid to quickly respond to surges in demand, increasing grid reliability while our power generation plants achieve energy efficiency.

HISTORICAL DEVELOPMENT

The unit of energy and the unit of power have been named after James Joule and James Watt, respectively, for their contributions to the development of the steam engine. Their contributions fuelled industrialisation in the 19th century, with the use of coal and steam engines, but this phase of industrialisation caused high pollution of the environment.

Fast forward to the 20th century, with the discovery of fossil fuel and internal combustion engines, industrialisation gained pace. As a result, pollution through emission of greenhouse gases and global warming have increased, and remain a concern to major coastal cities, including Singapore, amidst worries of rising sea levels and climate changes.

In the first two decades of the 21st century, renewable sources of energy, such as solar, wind etc, have increasingly been integrated into the grid to reduce pollution of the environment. To ensure grid reliability, installation of BESS has become crucial as it mitigates the intermittent nature of renewable energy generation.

SINGAPORE'S DEPLOYMENT OF BESS

Singapore, being a coastal city state with a high population density and a high density of manufacturing industries, is very well aware of the impact of climate change on the country and hence the importance of embracing the change towards cleaner sources of energy.

In 2018, the Energy Market Authority (EMA) of Singapore published a policy paper on Energy Storage Systems (ESS) for Singapore. In October 2020, EMA followed up by publishing two other documents related to ESS – the Handbook for

Energy Storage Systems [1] and Energy Storage Systems Technology Roadmap for Singapore [2].

In the roadmap, one of the visions is to 'deploy at least 200 MW of ESS beyond 2025 in support of national solar ambition'. In December 2022, Singapore officially launched a 285 MWh ESS on Jurong Island [3], achieving this milestone ahead of the timeline in the roadmap.

In 2024, jointly led by five ministries, the Singapore Green Plan 2030 was launched to advance Singapore's national agenda on sustainable development. In the Singapore Green Plan 2030, the deployment of BESS is seen as crucial for addressing renewable energy intermittency and to maintain grid reliability.

In January 2025, there was news on the award of a hydrogen-compatible natural gas power plant with a large-scale battery energy storage system, to be built on Jurong Island and which would begin operations in 2029 [4]. This aligns with the agenda on Green Energy in the Singapore Green Plan.

Over the past seven years, it is becoming clear to Singapore that BESS is an important component in the process of integrating renewable energy into Singapore's electrical grid. And Jurong Island, as a remote place from the densely populated main island, is the preferred choice when it comes to the deployment of large-scale BESS.

INTERNATIONAL SAFETY STANDARDS FOR BESS

For the deployment of BESS, there are a few international codes that are being referenced, namely, NFPA 855 Standard for the Installation of Stationary Energy Storage System, the International Fire Code, and IEC 62933-5-2 Safety Requirement for Grid-Integrated Electrical Energy Storage Systems – Electrochemical-based Systems.

Each of these documents stipulates the safety standards required for the different types of BESS, including safety tests and criteria that need to be passed. The primary focus and objective of these international standards and the tests required to be passed are to verify the battery's safety.

Under NFPA 855, Electrochemical Energy Storage Systems are required to be listed to UL 9540 Standard for Energy Storage Systems and Equipment.

Under UL 9540, lithium-ion based ESS are required to meet the standards of UL 1973 for battery systems and UL 1642 for lithium batteries. Inverters, converters and controllers are required to be listed under UL1741. The overview of and the relationship between the four UL standard numbers are given in Figure 1.

UL 9540: Energy Storage Systems and Equipment

The standard ensures that the components work together as a system and can be installed without posing a risk to people or property. The requirements can generally be categorised under enclosures, electrical protection, large-scale fire testing, safety analysis of control systems, electrical performance testing, electromagnetic immunity testing, mechanical and environmental testing, and manufacturing and production testing.

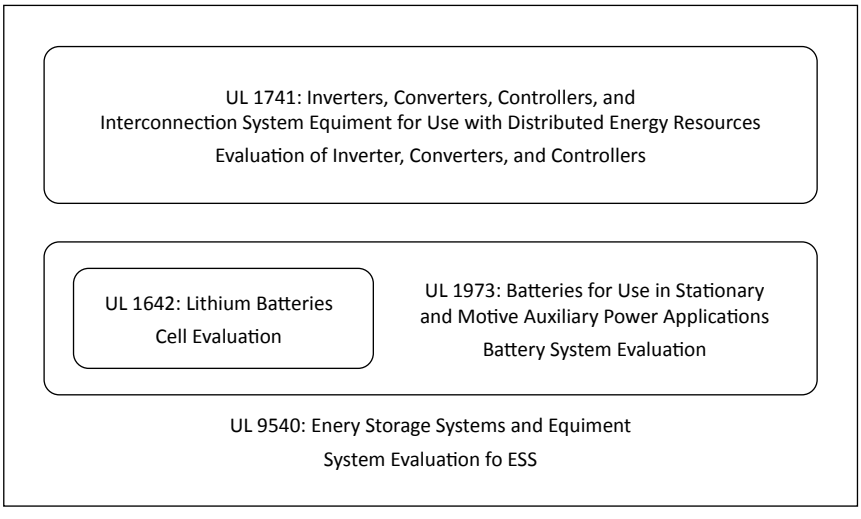

Figure 1: Individual standards within the system level UL 9540 standard [5].

UL 1973: Batteries for Use in Stationary and Motive Auxiliary Power Applications

The tests cover electrical, electromagnetic, mechanical, environmental and failure tolerance. Non-compliant test results include explosions, fires, combustible vapour concentrations, electric shock hazards, leakages, rupture, and loss of protection controls.

UL 1642: Lithium Batteries

The focus is on the cell's performance. Cells will undergo several abuse tests to ensure the battery does not catch fire or explode and, in some tests, does not vent or leak.

UL 1741: Inverters, Converters, Controllers, and Interconnection System Equipment for Use With Distributed Energy Resources

The focus is on the safety of inverters, converters and controllers used in ESS and other renewable energy systems.

NFPA 855: Installation of Stationary Energy Storage Systems

NFPA 855 categorises ESS installations under four types – 1) indoor installations 2) outdoor stationary installations 3) rooftop and open parking garage installations and 4) mobile energy storage systems [6].

For these four types of installations, the list of requirements is different. However, there are some common clauses that are applicable to all types of installations. They are maximum stored energy, under clause 9.4.1; size and separation, under clause 9.4.2; smoke and fire

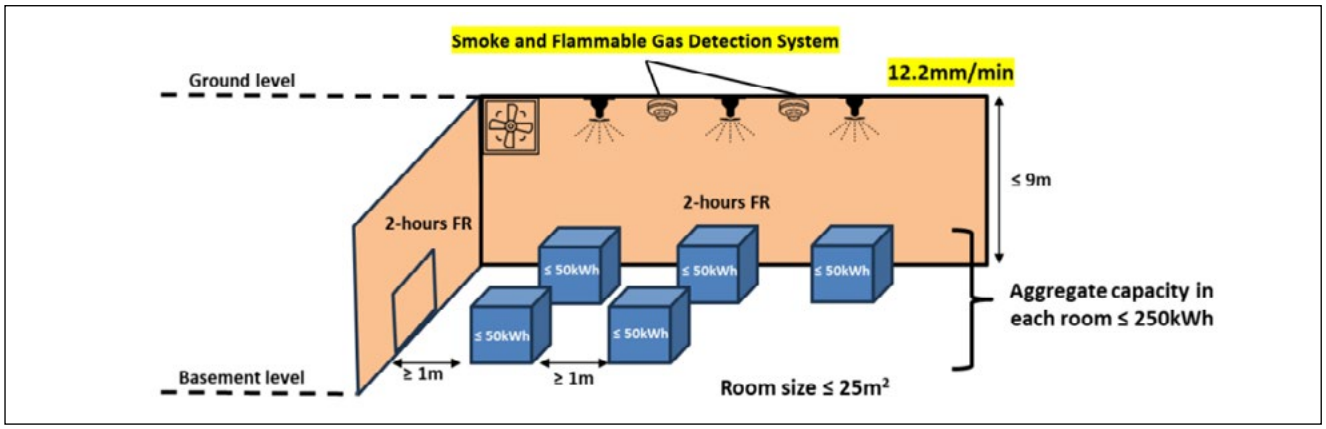

Figure 2: Category 1 ESS [10].

detection, under clause 9.6.1; fire control and suppression, under clause 9.6.2; signage requirements, under clause 4.7.4; and technology-specific requirements, under clause 9.6.5.

The high level of requirements stipulated in these international standards aims to give users confidence in the safety of BESS when deployed in different environments. However, complying with the stringent safety standards directly impacts the cost of deployment. Hence, there needs to be a balance when the authority having jurisdiction (AHJ) includes compliance to standards as part of the requirements for deployment.

Singapore's approach to make sure fire safety objectives are met is by using existing international standards as a baseline, enhancing these codes to bring them in line with Singapore's fire safety framework and ensuring ease of implementation when deploying BESS in Singapore.

CODES AND PRACTICES ADOPTED BY SINGAPORE RELATED TO ESS

The Code of Practice for Fire Precautions in Buildings (i.e. Fire Code) is a living document periodically reviewed by SCDF to ensure that fire safety standards keep pace with Singapore's evolving urban landscape and national development.

In March 2019, clause 7.1.15 on 'ventilation system for rooms housing batteries', was introduced [7]. In this new clause, rooms housing batteries are required to have hydrogen detectors and a minimum of 6 air changes per hour of ventilation provided. Coupled with Table 6.4A on 'compartmentation requirements for special purpose rooms in buildings', the battery room is required to have 2-hour fire compartmentation.

In June 2020, Clause 10.3 on Energy Storage Systems was introduced. It stipulated that the installation should be on the same storey as the fire engine access way, and defined the threshold stored energy and the maximum stored energy [8]. The clause is based on NFPA 855 (indoor ESS installation) requirements, modified for application in Singapore's context.

Clause 10.3.3 on basement ESS installations, introduced in September 2024, became effective as part of the Fire Code's requirements in March 2024 [9].

Using clause 10.3.3 as an example, we can broadly categorise the fire mitigation strategies into passive measures, active measures and fire brigade intervention.

Passive measures include 1) restriction of depth of deployment of the BESS to be within 9 m below fire engine accessway 2) 2-hour fire compartmentation to battery room 3) maximum fire compartment area 4) maximum number of compartments allowed 5) maximum aggregate BESS capacity allowed 6) minimum separations between the BESS and 7) production of fire and explosion testing report.

Active fire protection measures include the provision of 1) sprinklers 2) zoned and independent wet deluge systems 3) smoke detectors 4) smoke purging systems 5) flammable gas detectors 6) battery management systems (UL 1973) 7) fire and explosion testing report (UL 9540A), and 8) pressure relief measures.

Fire brigade intervention is enabled by the provision of 1) display panel outside the main entrance to the room 2) CCTV camera 3) emergency main isolation switch 4) exit staircase of a minimum width 5) fire lift, and 6) unmanned firefighting machine (UFM) etc.

Singapore's Fire Code, in our understanding, being the first in the world to provide a standard for below ground BESS deployment, has a holistic approach towards mitigating the fire risk involved in the deployment of BESS. This guideline for below ground BESS deployment will also allow Singapore, a country with only 700 km² of land area, to overcome its land constraints.

With reference to the October 2020 ESS roadmap published by EMA, SCDF has achieved two short-term external drivers, such as local ESS standards and alternative ESS deployment locations, ahead of the timeline in the roadmap.

However, unlike NFPA 855, SCDF's Code of Practice for Fire Precautions in Buildings does not seem to provide guidelines for outdoor stationary ESS

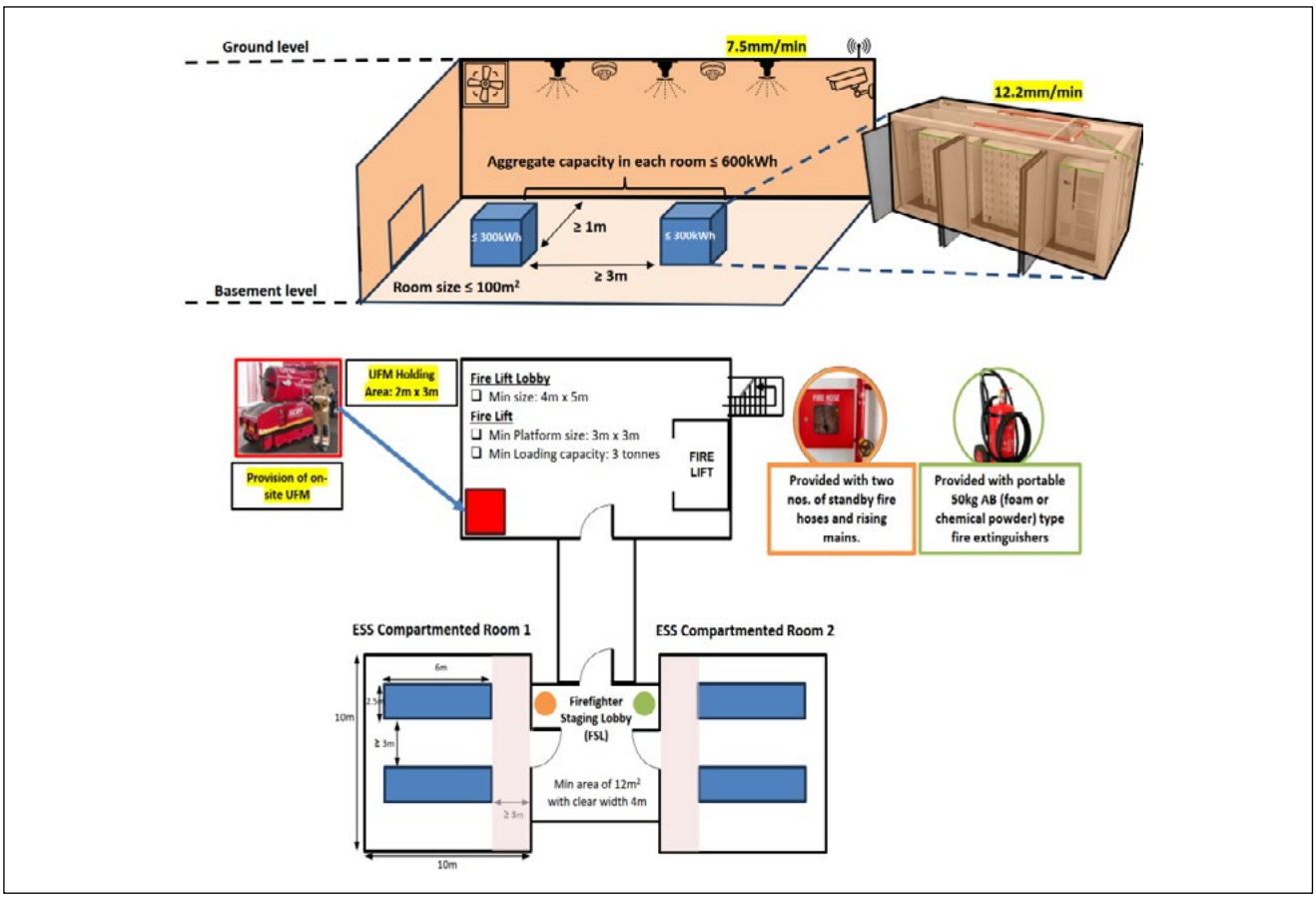

Figure 3: Category 2 Large Scale ESS [10].

installation, except for temporary ESS installation on construction sites. In such situations, reference to NFPA 855 and following the requirements stipulated would still be recommended for safe deployment of such stationary ESS installations.

IMPORTANCE OF UL 9540A

All the four standards – SCDF Code of Practice for Fire Precautions in Buildings, UL 9540, NFPA 855, and IEC 62933-5-2 – have referenced UL 9540A for large scale fire and explosion testing for BESS, because the safety evaluation of the ESS does not rely on integral safety features or the battery management system.

UL 9540A: Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

UL 9540A is a testing procedure that evaluates and documents the fire performance of stationary ESS under thermal runaway conditions, where an electrochemical cell increases its temperature through self-heating in an uncontrollable fashion such that the cell's generation of heat is at a higher rate than what it can dissipate [11].

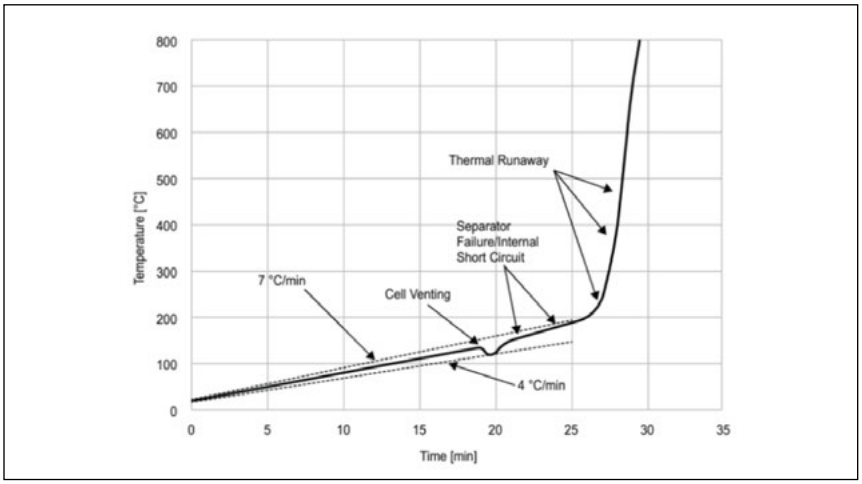

Figure 4: Illustrative example of a thermal runaway temperature curve [11].

Thermal runaway events may lead to fire, explosion and gas evolution. The tests performed put the ESS through a thermal runaway event to evaluate the fire and explosion hazard characteristics of the ESS. The test data is used to determine the ESS' ability to contain and prevent the spread of fire.

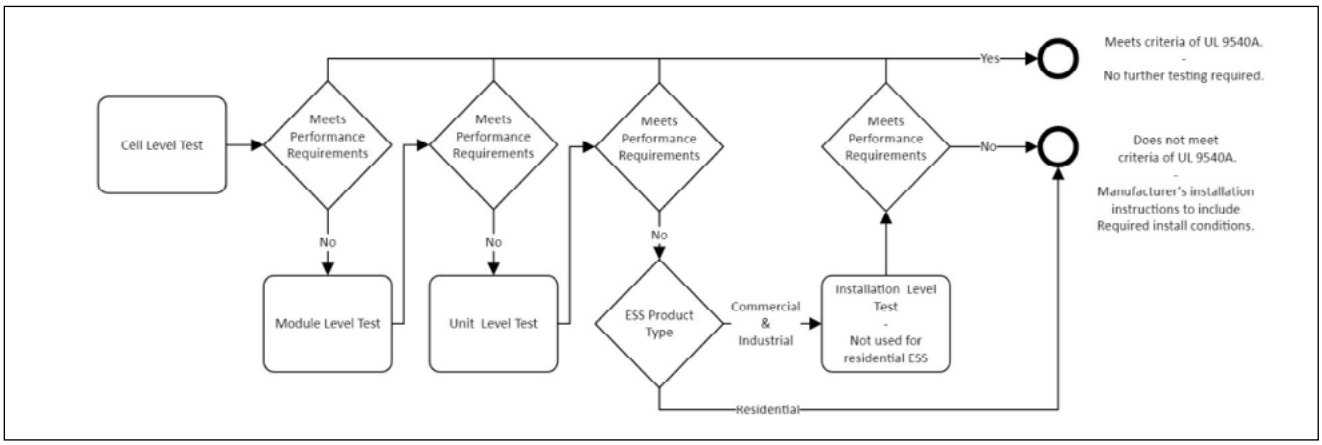

Figure 5: Flowchart of UL 9540A testing [5].

Manufacturers may use cell- and module-level results when comparing and selecting these components for use in an ESS unit. At the unit level, test data such as heat flux limits for means of egress becomes useful for evaluation by a fire safety engineer, to ensure occupant safety is not being compromised when the ESS is deployed at the installation level.

The fire tetrahedron requires all four elements to be present for occurrence of fire, namely, heat to raise the material to its ignition temperature, fuel to support combustion, oxygen to sustain combustion, and chain /chemical reactions caused by free radicals to propagate the combustion.

Under normal circumstances, removing one or more elements will extinguish the fire. A fire involving a lithium-ion battery also involves the four elements – heat generated during thermal runaway; electrolyte (hydrocarbons) in the battery that acts as a fuel for combustion; oxygen released in the cathode of the battery, as part of the chemical reactions between the electrodes and electrolyte; and the chemical reactions which propagate the combustion.

Compared with the usual strategy to remove one or more elements to extinguish a fire, it is often difficult and challenging to extinguish a lithium-ion battery fire, as the elements present are inherent in the battery and it is not feasible to be isolate them in the event of a fire.

UL 9540A Test Level	Performance Criteria
Cell	• Thermal runaway cannot be induced in the cell. AND • Cell vent gas is not flammable in the air per ASTM E918
Module	• Thermal runaway is contained by the module design. AND • Cell vent gas is not flammable in air per ASTM E918
Unit	• Target unit temperatures are less than the cell surface vent temperature. AND • Temperature of target walls do not increase more than 97.0° C/206.6° F. AND • Explosion hazards are not exhibited by the ESS. AND • Flaming beyond the ESS unit doesn't occur for units intended for residential installations as evidenced by burning or charring of a cheesecloth draped over the ESS in thermal runaway
Installation (not used for residential ESS)	• ESS temperature is less than the cell surface vent temperature. AND • Temperature of target walls do not increase more than 97.0° C/206.6° F. AND • Flaming exceeding the width of the initiating ESS does not occur. AND • Flaming outside the test room doesn't occur and meets heat flux limits for means of egress

Table 1: UL 9540A test levels with associated performance criteria [5].

As external heating in the event of a fire is a thermal runaway triggered in batteries, that will lead to further fire propagation, the ability of a battery to withstand heat and determining how much heat neighbouring battery modules are exposed to, during the thermal runaway of an initiating battery module, become fundamental and crucial in analysing the fire safety of a battery.

Therefore, the testing process for UL 9540A is to start from the smallest level of a battery, that is, at the cell level, and proceed to the module level, then to the unit level and lastly to the installation level. If the ESS unit does not meet the performance criteria of a particular level, it is then evaluated at the next level. If performance standards are met at a given level, it meets the criteria for UL 9540A, and additional testing is not required.

- CELL – the basic functional electrochemical unit containing an assembly of electrodes, electrolyte, separators, container and terminals. It is a source of electrical energy through direct conversion of chemical energy.
- MODULE – a subassembly that is a component of a BESS, consisting of a group of cells or electrochemical capacitors connected together, either in series and/or in parallel configuration (sometimes referred to as a block), with or without protective devices and monitoring circuitry.
- UNIT – a frame, rack or enclosure that consists of a functional BESS which includes components and

*Figure 6: Fourier Transform Infrared Spectroscopy (FTIR) test equipment at A*STAR's Battery Centre.*

subassemblies such as cells, modules, battery management systems, ventilation devices and other ancillary equipment.

Singapore is currently in the process of establishing a local facility that can conduct UL 9540A testing. With the UL 9540A report, a full mitigation plan can be proposed, when the critical data is collected and analysed. Pre-compliance testing can also allow for early identification of design flaws and enable design modification, prior to design finalisation or start of production of batteries for ESS installation. A product that meets UL 9540A at a given level will also allow for an accelerated path to market readiness.

It seems that a local UL 9540A testing lab is not one of the deliverables in EMA's ESS roadmap. However, as Singapore continually takes an interest in ESS and gains deeper understanding of the current ESS technology, especially relating to lithium-ion batteries, establishing such a testing lab is an inevitable and necessary step.

The Agency for Science, Technology and Research (A*STAR) will be developing Southeast Asia's first UL 9540A test facility accredited to ISO/IEC 17025. The A*STAR Battery Centre is a test lab with testing capability, that also allows for innovations in 'alternative non-lithium-based solutions for stationary ESS' and 'ultra-safe battery chemistries' – which are long-term external factors and deliverables listed in EMA's ESS roadmap.

The addition of the battery lab also promotes battery safety and enhances the capability of ESS in the region.

CONCLUSION

Since 2018, Singapore's EMA has highlighted the potential of BESS as an important component in the process of transiting to the use of clean and renewable energies such as solar and hydrogen. BESS is a critical component that allows renewable energies of an intermittent nature to be integrated into the grid while not compromising grid reliability.

To mitigate the fire risk of ESS, especially the risk of lithium-ion battery fires, which is not yet well understood, Singapore has selected the remote Jurong Island, to deploy its first large-scale ESS. At the same time, SCDF has introduced the world's first guideline to allow ESS to be deployed underground while recognising the importance of UL 9540A testing which focuses on the batteries' innate ability to prevent fire propagation.

The short-term goals in EMA's ESS roadmap are being achieved, with medium- and long-term goals visible on the horizon, especially with the establishment of a local testing facility that allows for UL 9540A battery testing.

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Profilometry-based Indentation Plastometry (PIP) for evaluation of metallic materials

by Robert Shandro, Principal Consultant and Carla Canturri, Consultant, Cetim-Matcor

The advantages and limitations of this technique are presented.

Profilometry-based indentation plastometry (PIP) is a method to obtain a material's stress-strain curve from an indent profile, by using accelerated inverse Finite Element (FE) analysis and analytical relationships. Similarly to nano indentation, PIP can be used to study small volumes of material and the local variations in mechanical response.

A promising application of this technique has been demonstrated in welds and heterogenous metallic systems, where extracting sufficient material for tensile samples for characterisation is not possible. Indeed, tensile and hardness testing, the two most used mechanical testing methods, are inadequate to deliver the spatial resolution (in millimetres) and the strain-strain curves required to completely characterise a weld.

This need for spatial resolution is compensated by with the size of the indenters used by the PIP technique (1 mm and 2 mm), which is compatible with the size of the heterogeneity in welds. Furthermore, other difficult samples to analyse, due to the anisotropy of their properties and heterogeneity of their microstructure, are those obtained by additive manufacturing.

Although this technique is applicable to a wide range of alloys and processing techniques, understanding the limitations of the measurements is also key to increasing the confidence and fields of application of this technique across disciplines.

To exploit the advantages of PIP, Plastometrex was launched in 2021 to allow the mapping of a component's mechanical properties. Plastometrex is the trade name of a benchtop plastometer, from the company of the same name, using a PIP technique.

Plastometrex derives its results by integrating two types of data – load-displacement measurements taken during the indentation process using a load cell and an LVDT (Linear Variable Differential Transformer), and the residual indent profiles left after indentation. Among these, the residual indent profile is more sensitive to plasticity parameters and, therefore, it is assigned greater weight in the analysis.

The basic steps are as follows: A displacement-controlled indentation of 1 mm diameter and 20 µm depth is performed. Subsequently, an optical profilometer obtains the shape of the indentation and an FE model of the indentation is then run, combining the measured profile of the indent and the load-displacement curve obtained during the indent.

The FE model is run, starting with a trial set of plasticity parameters. Next, a comparison between the measured and predicted residual indent profiles is conducted. The plasticity settings are adjusted repeatedly until the predicted and measured profiles coincide.

The necessity to run an FE model stems from the observation that the load and displacement, if used as the sole measurable behaviour parameter, exhibits a high sensitivity to other related factors, such as frictional effects, tip shape imperfections or material anisotropy. This higher sensitivity to parameters external to the constitutive relations leads to low accuracy and reliability, hindering wider adoption of the technique.

The Plastometrex algorithm implemented within the software CORSICA+, iteratively calculates the parameters of goodness of fit, to fit a work hardening law such as the Voce plasticity model:

$$\sigma = \sigma_s - \left(\sigma_s - \sigma_y\right) \exp\left(-\frac{\epsilon}{\epsilon_c}\right)$$

Where σ_s is the saturation level and ϵ_c is the characteristic strain.

Once these parameters are established, the software can output the results in the form of true stress vs true strain curves. Additionally, the nominal stress vs nominal strain curves can be obtained after the Finite Element Method (FEM) is used for a tensile sample with the plastic parameters found during the iterative process, by applying:

$$\sigma_T = \sigma_N \left(1 + \epsilon_N\right)$$

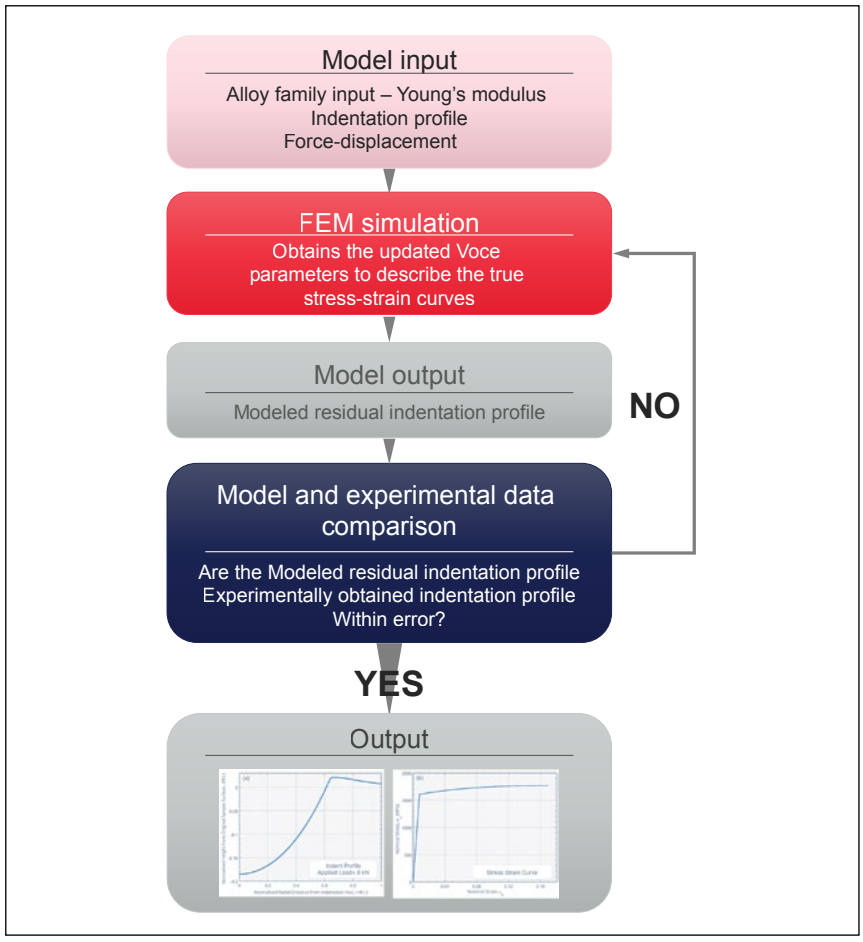
$$\epsilon_T = \ln\left(1 + \epsilon_N\right)$$

Where the subscripts *T* and *N* refer to true and nominal values, these equations only apply for uniform stress and strain fields and are not valid after the onset of necking. By obtaining the nominal stress-nominal strain curve, the user can compare them directly with tensile testing data.

From this curve, the maximum of the nominal stress vs the nominal strain plot, usually taken as the Ultimate Tensile Strength (UTS), is obtained. After this maximum is reached, the necking phenomenon becomes predominant, and the measured values of nominal strain are no longer suitable to describe the behaviour of the specimen which is deforming locally with very high levels of strain.

Effectively, the Plastometrex software CORSICA+ requires a set

The benchtop plastometer from Plastometrex. Image: Plastometrex.



Workflow in the application of Plastometrex technology to obtain stress-strain curves.

of starting parameters to limit the computational time.

These are indicated at the beginning of the analysis by setting the material family of the sample being tested.

PIP is sensitive to both test and sample parameters, which significantly influence the accuracy and reliability of the extracted stress-strain curves. Some of these parameters are reviewed next.

Test parameters

Four parameters have to be taken into account when seting a PIP analysis: the size of the indenter, indentation depth, loading rate, and indentation load.

The size of the indenter can affect the resolution and consistency of results. For example, smaller indenters are more sensitive to individual grains, leading to higher variability, while larger indenters average over multiple grains, improving accuracy.

The shape of the indenter also plays a crucial role, with axisymmetric shapes preferred for computational efficiency as they are better represented by an axisymmetric model. Deviations in indenter geometry can introduce errors, but using multiple indenters or analysing different sections of the load-displacement curve can help resolve ambiguities.

Indentation depth must be sufficient to capture representative bulk behaviour. While deeper indentations improve sensitivity, they may also introduce frictional effects and reduce relevance for low-strain applications. The loading rate influences the material's creep response. Slower rates or dwell times can highlight time-dependent deformation.

To minimise creep effects, rapid loading is typically employed. The indentation load is primarily determined by the desired indent size and grain structure, with only the maximum load used in simulations.

Sample parameters

Other than test parameters, the nature of the sample and its preparation play a crucial role in obtaining reliable and reproducible results.

For a given alloy, the nature of the grains, sample size and surface roughness have a strong influence on the accuracy and applicability of the PIP technique.

For example, depending on the nature of the grains, pile-up or sink-in behaviour is observed during an indentation. These two different behaviours influence

the contact area calculations and the interpretation of mechanical properties.

Grain size and texture influence the representativeness of the results, with larger indenters needed to average over multiple grains. PIP can also detect anisotropy in grain orientation through asymmetries in indent profiles and pile-up patterns.

Although the technique is apt for small volumes, a minimal sample size is needed to ensure bulk-like responses and to avoid edge effects. Thus, the minimum dimensions recommended are 3 mm x 3 mm x 15 mm.

Material surface preparation is also important as surface roughness can introduce variability in indentation results. Smoother surfaces yield more consistent data and, while roughness effects are less critical for large indenters, maintaining a polished surface is still advised.

In terms of applicability for different types of of materials, such as materials with a high levels of porosity (>3%), the PIP technique is not recommended, as porosity in the material can lead to underestimation of yield stress and overestimation of work hardening due to pore collapse under load. The technique is thus best suited for materials with low porosity.

For very hard materials, PIP offers advantages over traditional testing methods, as it avoids issues related to machining and lack of yielding behaviour. However, the indenter must remain elastic and proof testing is recommended.

Residual stresses generally have a minimal effect on results, if the indentation is deep enough. However, in materials with high residual stresses, multiple indentations at varying depths may be necessary to detect and account for their influence.

Technology evaluation

We evaluated the mechanical properties obtained by means of the PIP technique and compared them to the results from full-scale tensile testing with standardised dimensions (ASTM E8). Evaluation tests were conducted by KMTL (Japan), Cetim (France), Cetim-Matcor (Singapore), and Nanyang Technological University (by Prof Upadrasta Ramamurty's group in NTU Singapore). A summary of the alloys studied is shown below:

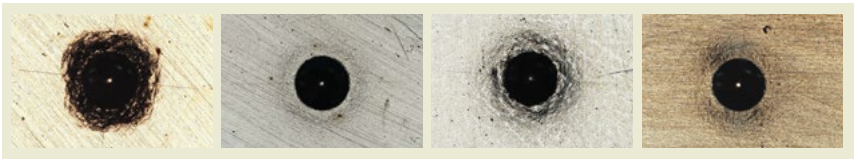
We showed the potential of the PIP technology, with the yield strength predicted with an average deviation of 10% for both the yield and the UT strength. However, challenges remain for cast irons, as the results indicated a maximum error of 28% and 57%, in the measurements of the yield and the UT strength of cast iron, respectively.

We showed how materials exhibiting strong anisotropy, work hardened materials, materials with defects that result in premature failure before necking as well as materials that have undergone severe processing, are difficult to analyse and remain a challenge for the application of the PIP technique.

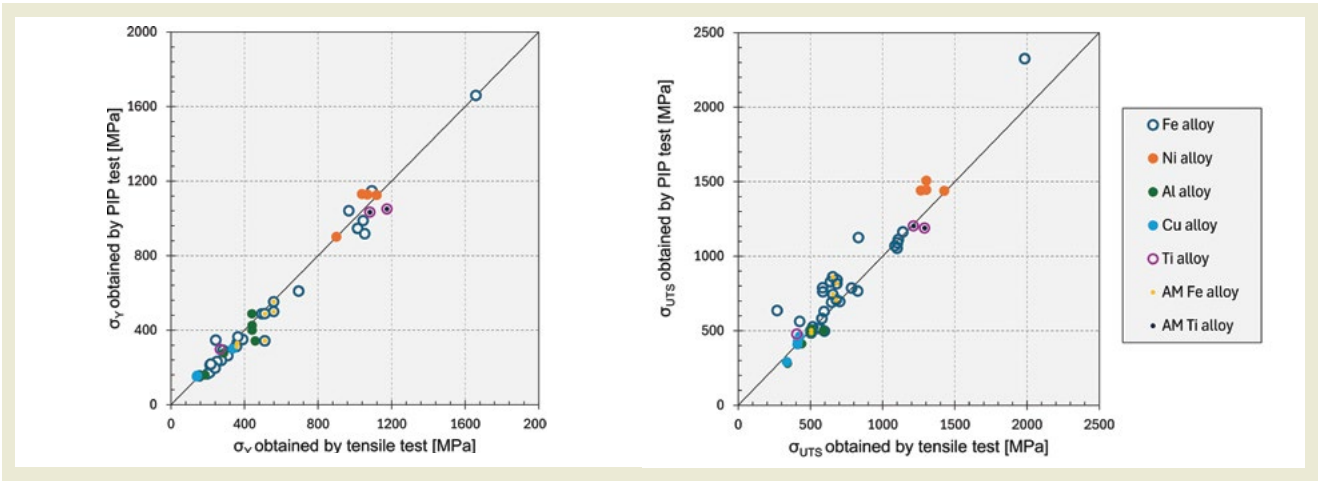
Through this collaboration, Cetim, Cetim-Matcor, KMTL and NTU were able to conduct multi-laboratory testing on a wide range of materials and demonstrated the potential for this technique to be applied to research, material assessment and failure analysis.

Fe alloys	Low alloy steel, Carbon steel, Stainless steel, Cast Iron. Conventional and 3D printed processes (EBM, DED, WAAM)
Ni alloys	Inconel 718
Al alloys	Aluminium alloys
Cu alloys	Pure Cu, brass
Ti alloys	Ti 64, Conventional and 3D printed processes (EBS)

Summary of the alloys studied.



Indentation produced on, from left, cold drawn pure copper, annealed carbon steel, flake graphite, and pure titanium.



Comparison of the measured yield and ultimate tensile strength obtained by the PIP method with that obtained by tensile testing.

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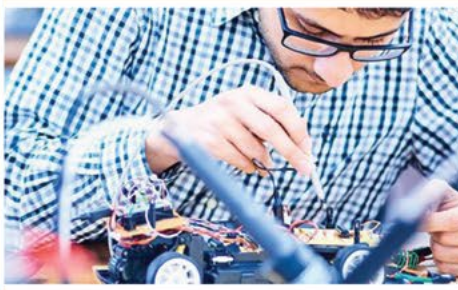

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BAC to build next-generation Mono road legal supercar with Siemens Xcelerator

Overcoming challenges of next-generation vehicle development and homologation in a global market.

Siemens Digital Industries Software recently announced that Briggs Automotive Company (BAC) will move to the Siemens Xcelerator portfolio of industry software and use it to develop the next generation of Mono, its single-seater road legal race car.

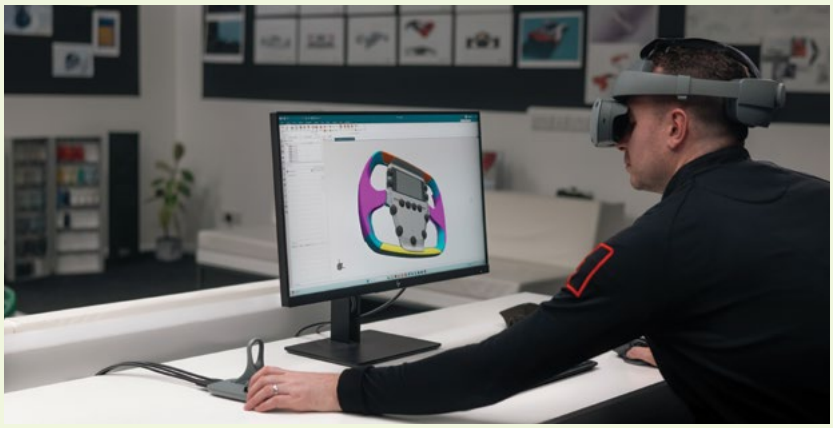
BAC was founded in 2011 by Neill and Ian Briggs to fulfill their vision of a road vehicle that offers the most authentic and pure driving experience possible while implementing the very latest racing technology.

Developed to be equally at home on the road as it is on the track, BAC's 570 kg Mono supercar is powered by a naturally aspirated 2.5 litre powertrain which develops 311 HP and 313 Nm of torque which translates to a power to weight ratio of 546 HP per tonne.

When combined with optimal weight distribution and the lightweight structure featuring BAC's world-leading graphene-infused carbon panels, the result currently allows the Mono to sprint to 60 mph in just 2.7 seconds – which the team is looking to dramatically improve for the next-generation vehicle.

The need to push the boundaries of what is achievable in the high-performance automotive industry led BAC's senior management and design team to reevaluate its core vehicle development technologies. BAC has selected NX X from Siemens' Designcenter suite of product engineering software for the development of its next generation Mono.

"Anything that helps us be ahead of the game and be ahead of anybody else. The reason we chose Siemens' Designcenter software to develop the next generation of Mono is because it is the best – and it gives us the tools we need to take



Briggs Automotive Company (BAC) will move to the Siemens Xcelerator portfolio of industry software and use it to develop the next generation of Mono, its single-seater road legal race car.

A key driver for the move to Siemens Xcelerator is to solve the challenge of serving a global customer base and certifying that a vehicle complies with the regulatory and safety standards set in a particular region or country.

our vision to the next level," said Ian Briggs, Design Director and Co-Founder of BAC.

"Our vision was to create a car that simply didn't exist. The fundamental principle of a sports car is choosing excitement over utility, and we took that to the nth degree. Mono is that philosophy made real – a vehicle without compromise, built to prove that being ahead of the game means refusing to compromise on the driving experience," he added.

Solving the challenge of homologation

One of the key drivers for the move to Designcenter is to solve the challenge serving a global customer base and certifying that a vehicle complies with the regulatory and safety standards set in a particular region or country.

As Briggs explains, "A key challenge for us is homologating the car for the global market. Understanding the specific positional requirements for everything from headlights to driver sight lines is a complex minefield. The great advantage of Designcenter is that it allows us to build that entire regulatory framework directly into our 3D CAD model, giving us new levels of confidence and a greater speed of development."

Customer experience with immersive design

The BAC team is also exploring ways to enhance the customer buying and customisation experience with Siemens' immersive engineering technology, enabling customers to use immersive XR technology to experience their bespoke vehicles – all based on real-world 3D CAD data, presented in high-fidelity realism.

Eliott Marshall, Production Manager at BAC explains, "The thing that makes BAC truly unique is the bespoke elements. Siemens' immersive engineering technology allows us to present to the customers exactly what they are ordering. Being able to sit in their seat fitting jig and see all of the personal customisations they want around them, interact with them as if they are already implemented, is going to get the fire burning within them."

Siemens Digital Industries Software

Siemens Digital Industries Software helps organisations of all sizes digitally transform, using software, hardware and services from the Siemens Xcelerator business platform. Siemens' software and the comprehensive digital twin enable companies to optimise their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future – from chips to entire systems, from product to process, across all industries.

All images by BAC

The BAC team is exploring ways to enhance the customer buying and customisation experience with Siemens' immersive engineering technology – enabling customers to use immersive XR technology to experience their bespoke vehicles.

Kitamura Manufacturing cuts CO_2 emissions with energy visualisation initiative

The company achieves a full return on investment within one year.

Kitamura Manufacturing Co Ltd, from Niigata, Japan, designs, manufactures and sells aluminum truck bodies for delivery companies and other customers.

Each truck body is custom-made in aluminum or stainless steel to meet specific customer requirements and installed onto a chassis supplied by a truck manufacturer. The company holds a strong market share in Japan, particularly for small 2 ton vehicles.

Beyond producing truck bodies, Kitamura Manufacturing uses its aluminum machining expertise to produce protective housings for communications equipment, special purpose vehicles like broadcasting and medical inspection trucks and industrial machinery such as cleaning systems.

For several years, the company has monitored electricity demand across its 10 factories and office buildings at its main site. They had already established a system to prevent excess electricity usage. A flashing light would alert employees when targets were about to be exceeded, encouraging them to save electricity by taking steps like turning off air conditioning.

However, growing awareness of net-zero goals required them to take further steps.

"Since the early 2020s, customers have started asking us to report on our carbon neutrality efforts," explained Yonemoto Hideki, General Manager of the Product Planning Division and Manager of the Carbon Neutrality Promotion Section at Kitamura Manufacturing.

When companies calculate their greenhouse gas emissions to prove their environmental credentials, they are required to include figures for the entire supply chain, not just their own emissions. This means

The 'Limbo Van' is one of Kitamura Manufacturing's iconic products, used by large delivery companies. The height of the loading platform can be adjusted depending on the weight of cargo or the height of the loading bay.

Kitamura Manufacturing's main factory.

Kitamura Manufacturing's energy-saving efforts also impacts its customers' sustainability goals.

In response, the company established a Carbon Neutrality Promotion Office, led by Yonemoto. The office set out to strengthen energy-saving measures, initially focusing on visualising the energy usage for each building. The truck body production painting process is particularly energy-intensive, as it requires high levels of ventilation and utilises electrodeposition treatment.

This process occurs at three plants which together account for 50% to 60% of the company's total electricity consumption. Yonemoto identified these plants as a priority for targeted energy management to achieve significant savings.

A new approach to energy monitoring

To visualise energy usage for each building, Kitamura Manufacturing selected Mitsubishi Electric's energy

saving support devices.

"We considered a cloud-based system, but the cost of this would dramatically increase in proportion to the number of data measurement points. This would be too unpredictable when it came to future scalability, so instead we opted for Mitsubishi Electric's local-based solution," explained Inagaki Yorito of the Carbon Neutrality Promotion Section.

The company had already been using Mitsubishi Electric PLCs for control equipment at its production sites, so it decided to introduce the energy-saving support devices as well.

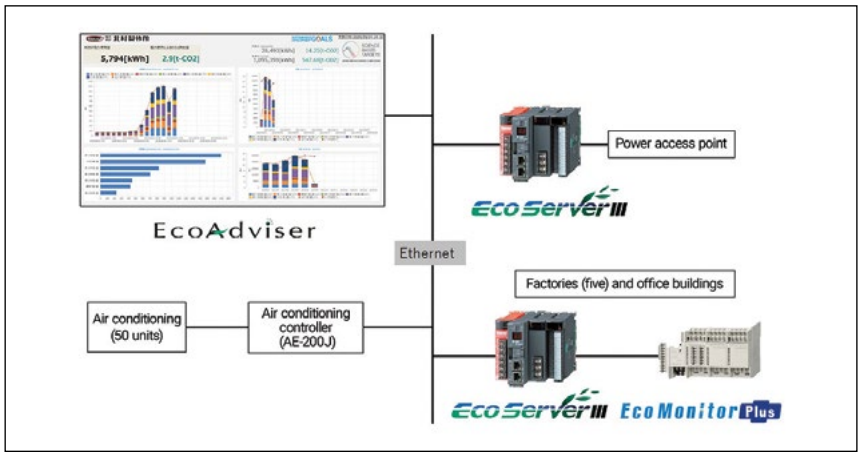
The new system was launched in June 2023. EcoWebServer III energy saving data collection servers and EcoMonitorPlus energy measuring units were installed at five sites, including the three plants with the high energy usage.

The devices, connected via an Ethernet network, feed data into the EcoAdviser energy saving support software, which monitors the power consumption of each site in real time and allows energy-saving activities to be verified on a building-by-building basis.

Automatic and effortless energy saving

Just as the team hoped, visualising electricity usage has significantly enhanced Kitamura Manufacturing's energy-saving efforts. One key improvement was linking 50 office air conditioning units to the network via an AE-200J air conditioning controller. When electricity usage exceeds 90% of the set limit, the system automatically reduces operation, eliminating the need to manually turn off air conditioning units in response to a warning light.

"With the old system, sometimes the warning light would only come on when it was already approaching the limit, so it might be too late to act. The real-time link with EcoWebServer III eliminates this risk, and the air conditioning level is finely adjusted so the office staff don't even notice the difference," said Inagaki.



The system introduced at Kitamura Manufacturing. The electricity usage data collected by EcoWebServer III servers in the factories and office buildings is visualised with EcoAdviser and used to automatically control air conditioning via the equipment's controller.

While employees understand the need to save energy, actions that feel imposed on them can be unpopular. By directly linking the air conditioning units to the energy-saving system, Kitamura Manufacturing has created a seamless, sustainable way to reduce energy use without disrupting workplace comfort.

Return on investment in just one year

One of the key drivers for introducing energy-saving support devices was the need to provide accurate reports to business partners, which can now be created with data from EcoAdviser. As well as being monitored on a PC in the Carbon Neutrality Promotion Section, the EcoAdviser data is also displayed in the buildings' reception areas, showcasing the company's energy saving efforts to employees and visitors.

"We can show the benefits of energy saving in terms of electricity bills, which really resonates with employees," Yonemoto pointed out.

The system has had a significant impact on carbon emissions and electricity costs, achieving a 90 ton reduction of CO_2.

"Thanks to the improvements, we were able to recoup the cost of the system in a year," said Inagaki.

Visualising data has become a key element of Kitamura Manufacturing's drive to become carbon neutral. As part of a company restructuring in October 2024, the Carbon Neutrality Promotion Section became the Carbon Neutrality Division and is establishing carbon neutral solutions from the product development stage.

EcoWebServer III (top) and EcoMonitorPlus (below) used to capture and visualise energy usage.

Based on the expertise gained from the energy-saving support system, and in-line with business expansion, EcoMonitorPlus units will be installed in a new painting plant, from the start of construction. The company also plans to integrate production data from existing PLCs to manage energy consumption on a per-unit basis, further enhancing efficiency and sustainability.

Seco develops a digital tool for production units to drive sustainability

Seco is a leading global provider of metal cutting solutions for indexable milling, solid milling, turning, holemaking, threading and tooling systems. The company has committed to achieving 90% circular waste by 2030, Net-Zero operations by 2035, enhanced supplier documentation, reduced footprint, and a safe, healthy and inclusive workplace.

While all these areas are vital, it can be challenging for local operational sites to understand the full picture of sustainability, to understand their current position, how they align with Seco´s global ambitions, and where to begin or focus their efforts. When Seco´s sustainability strategy was launched, areas such as health and safety were already well-integrated at many sites, while areas like circularity and Net-Zero presented new challenges requiring new approaches.

In 2021, an idea was proposed – the Industrial Sustainability Assessment, a tool designed for Seco's production units to assess their current sustainability level across all areas, making it easier to prioritise and identify actions towards effective and impactful improvements.

The assessment defines six levels, starting from Level 1, which typically means meeting the minimum requirements from a legal perspective, up to Level 6, which represents best practices or end goal. Levels 2 to 5 provide structured, progressive steps that a site can take to move towards Level 6.

This assessment covers the key focus areas of:

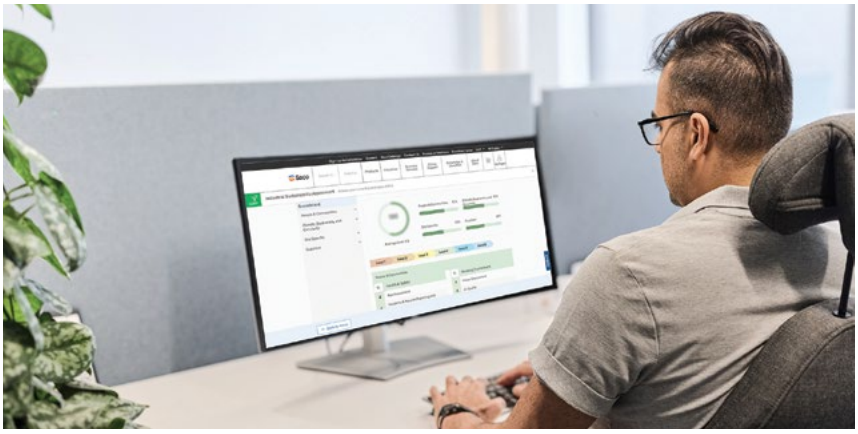
- People and Communities: assessing a broad range of areas from traditional Health & Safety, to Diversity, Inclusion, and Equity to key aspects of Working Environment and Community Involvement.
- Climate Biodiversity and Circularity: assessing areas related to Resources, Emissions and Waste.

Site Specific: looking at how sustainability is integrated into production, the facilities, overall site building, infrastructure and how the site works with development.

- Suppliers: how the site manages supplier responsibility at the local level.

Throughout 2021 and 2022, this way of working was co-developed with sites in Sweden and the Netherlands, along with input from other global sites, to ensure it was created for the sites, by the sites, translating sustainability into practical terms for those who would later use the tool.

In 2023, the first version of the tool was rolled out in Excel for all production sites. However, user feedback made it clear that a more efficient solution was needed. As a result, a project was launched to digitise the tool in MyPages, creating a more streamlined and user-friendly experience.



The Industrial Sustainability Assessment tool is designed for Seco's production units to assess their current sustainability level across all areas and easily make improvements.

Since 2024, the Sustainability Assessment Tool has supported the Seco's sites tracking progress towards the company's global sustainability goals. It addresses key challenges such as understanding a site's current sustainability performance, setting priorities for improvement, tracking progress over time, and enabling the sharing of best practices across sites.

The tool is compatible with mobile devices and allows sites to create action plans focusing on key improvement areas. It also provides an overview of each site's progress across social, environmental and strategic areas of sustainability.

Seco has now initiated work to explore the potential for an externally adapted version of the tool for stakeholders and customers who may also find this approach relevant.

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