

PRESS RELEASE

SERIS celebrates a decade of research excellence and innovation

Singapore's national institute for applied solar energy research launches three flagship R&D projects to further expand and deepen its capabilities

Singapore, 5 April 2018 – The Solar Energy Research Institute of Singapore (SERIS) at the National University of Singapore (NUS) commemorated its 10th anniversary today with a full-day event to celebrate its achievements and showcase its cutting-edge research capabilities.

SERIS hosted a special appreciation and networking event in the morning for senior representatives of government agencies and the solar industry. The institute also organised an Open House programme in the afternoon where members of the public could gain a better understand solar technologies through scientific talks, exhibitions, laboratory tours and movie screening.

SERIS was established on 1 April 2008 by its founding Director Professor Joachim Luther, a global authority on solar energy, with a mission to be Singapore's national institute for applied solar energy research. Supported by NUS, the National Research Foundation Singapore (NRF) and the Singapore Economic Development Board (EDB), the institute has since played an integral role in stimulating the development of Singapore's Cleantech sector.

Over the last decade, SERIS has grown to become one of the leading applied solar institutes in the world. Today, the institute has a staff strength of 220, including 139 scientists, engineers and technicians, 56 postgraduate research students, 25 technical infrastructure and administration personnel. SERIS had also trained 110 PhD students, many of whom are now contributing to the solar energy sector and some have founded their own start-ups.

SERIS has also established strong collaborations with solar companies in Singapore and around the world, garnering S\$30 million in research funding from industry in the last 10 years.

Professor Armin Aberle, Chief Executive Officer of SERIS, said, "Leveraging our world-class research capabilities and services, SERIS is fully committed to be an important player in the solarisation of Singapore and a trendsetter in the global solar energy sector. We will continue to work closely with our research and industry partners to develop novel solutions that can further improve the efficiency and cost-effectiveness of solar power systems. The ultimate goal is to provide affordable, reliable and secure solar power for our homes, offices and industries."

World-class solar R&D

Since its inception, SERIS keeps a strong focus on innovation and pushing the boundaries for industry-relevant solar technologies.

In 2012, the institute developed the world's first all-back-contact silicon solar cell with efficiencies of over 20% using low-cost screen-printed metallisation. The technology was successfully transferred to pilot production at an industrial partner.

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From 2014 to 2016, SERIS supported REC Solar in the development of its award-winning TwinPeak solar module. The panel's world-class efficiency of up to 18% makes it the world's highest-performing multicrystalline silicon solar panel, with power outputs of 20 Watts more than other commercially available standard panels.

In 2017, SERIS commercialised and licensed an advanced tool design and layer formation method - called "monoPoly technology" - for silicon solar cells with passivated contacts to a large European photovoltaic equipment manufacturer. Furthermore, SERIS produced the world's first full-size bifacial module with IBC (interdigitated back contact) solar cells, which generates as much as 30% extra power from sunlight reflected off the ground to the module's rear surface.

SERIS has also developed a proprietary and award-winning real-time monitoring system with very high reliability and availability, which is the backbone of the well-known "Live irradiance map of Singapore" - making Singapore the only country in the world with this capability. The live irradiance and real-time monitoring is also the base of SERIS' leading solar forecasting work.

Shaping the global PV industry

SERIS also designed, implemented and constantly monitors one of the best-performing PV systems in the world, which is installed within the NUS Kent Ridge Campus. Despite the tougher climatic conditions in the tropics with constant high temperatures and high humidity, this system has been able to achieve a 90% performance ratio (PR), with very little degradation. Knowledge gained from the operation of this system has subsequently been shared with the local PV system integration community through workshops conducted by the institute.

In a similar fashion, SERIS is working closely with government agencies and the private sector to enable the SolarNova programme, which aims to install 350 MWp of PV systems on government-owned buildings by 2020.

Beyond the "classic" rooftop installation, SERIS is now widely recognised as the global leader in "Floating Solar". Working in close collaboration with the Public Utilities Board (PUB), SERIS operates the world's largest testbed for floating PV in Singapore, comparatively testing and evaluating 10 different floating PV installations from around the world. This project is funded by EDB. In October 2017, the institute had also organised the first floating solar conference globally at the 2017 Asia Clean Energy Summit.

Mr Lim Kok Kiang, Assistant Managing Director, Singapore Economic Development Board, said: "SERIS will continue to champion the solarisation of Singapore through innovative deployment methods such as floating PV and Building-Integrated Photovoltaics (BIPV). Its new BIPV Centre of Excellence will help with pioneering techniques to retrofit existing buildings with solar systems. These initiatives are instrumental to increasing solar deployment in space-constrained Singapore, and will spearhead new markets for our clean energy industry to strengthen our position as a leading Cleantech hub in Asia."

Please refer to Annex 1 for more information about SERIS' achievements in the last decade.

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New research initiatives to boost solar capabilities

To further strengthen and deepen its capabilities, SERIS has launched on three new flagship R&D projects:

- To embark on a collaborative research project with Nanyang Technological University (NTU) and Campus for Research Excellence and Technological Enterprise (CREATE) of NRF to develop a 30% efficient thin-film-on-silicon tandem solar cell.
- To develop low-cost, high-efficiency building-integrated PV (BIPV) modules and systems to replace parts of the building envelope with PV, including the facades.
- To develop a multi-purpose floating PV system that is suitable for off-shore applications in sheltered waters like Singapore.

These projects will complement SERIS' international R&D leadership in the fields of industrial silicon wafer solar cells, industrial PV module development and testing, "Urban solar", variability management for PV grid integration, and PV quality assurance.

Please refer to Annex 2 for more details on SERIS' new flagship R&D projects.

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About the Solar Energy Research Institute of Singapore (SERIS)

The Solar Energy Research Institute of Singapore (SERIS) at the National University of Singapore (NUS) is Singapore's national institute for applied solar energy research. SERIS is supported by the National University of Singapore (NUS), National Research Foundation (NRF) and the Singapore Economic Development Board (EDB). SERIS conducts research, development, testing and consulting on solar energy technologies and their integration into power systems and buildings. The institute's R&D spectrum covers materials, components, processes, systems and services, with an emphasis on solar photovoltaic cells, modules and systems. SERIS is globally active but focuses on technologies and services for tropical regions, in particular for Singapore and South-East Asia. SERIS collaborates closely with universities, research organisations, government agencies and industry, both locally and globally.

For more information on SERIS, please visit www.seris.sg

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About National University of Singapore (NUS)

A leading global university centred in Asia, the National University of Singapore (NUS) is Singapore's flagship university, which offers a global approach to education and research, with a focus on Asian perspectives and expertise.

NUS has 17 faculties and schools across three campuses. Its transformative education includes a broad-based curriculum underscored by multidisciplinary courses and cross-faculty enrichment. Over 38,000 students from 100 countries enrich the community with their diverse social and cultural perspectives. NUS also strives to create a supportive and innovative environment to promote creative enterprise within its community.

NUS takes an integrated and multidisciplinary approach to research, working with partners from industry, government and academia, to address crucial and complex issues relevant to Asia and the world. Researchers in NUS' Schools and Faculties, 30 university-level research institutes and centres, and Research Centres of Excellence cover a wide range of themes including: energy, environmental and urban sustainability; treatment and prevention of diseases common among Asians; active ageing; advanced materials; risk management and resilience of financial systems. The University's latest research focus is to use data science, operations research and cybersecurity to support Singapore's Smart Nation initiative.

For more information on NUS, please visit www.nus.edu.sg.

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ANNEX 1: ACHIEVEMENTS OF SERIS AT NUS

The Solar Energy Research Institute of Singapore (SERIS) at NUS started its operations on 1 April 2008, as Singapore's national institute for applied solar energy research. Some of its major achievements in the last decade include:

- Supported Singapore-based REC Solar in the development of its award-winning TwinPeak solar module. The panel's world-class efficiency of up to 18% makes it the world's highest performing multicrystalline silicon solar module.
- In collaboration with leading certification bodies, SERIS offers the full range of PV module testing and certification services to the solar industry, in accordance with relevant international standards (IEC, UL).
- SERIS, together with Singapore Polytechnic and Ngee Ann Polytechnic, launched the National Solar Repository (NSR) in 2010. (www.solar-repository.sg)
- Developed the world's first all-back-contact silicon solar cell with low-cost screen-printed metallisation. The cells had efficiencies of more than 20% and the technology was successfully transferred to a company's pilot line.
- In 2013, SERIS' first spin-off company – Fosera Lighting Pte Ltd – won the “Most promising start-up in Singapore Award (category Engineering)” at the Techventure Conference in Singapore.
- Developed a 21.5% efficient n-type monocrystalline silicon solar cell that represents one of the world's best compromises between high performance and low-cost processing.
- Developed a novel surface texturing method for diamond-wire sawn multicrystalline silicon wafers. This invention paves the way for the market entry of this wafer manufacturing method which is much cheaper and cleaner than the presently used method.
- Developed “SolarEYE”, an all-in-one solar cell characterisation, analysis and simulation tool based on artificial intelligence. This technology has already been licensed to two solar companies.
- Developed the world's first full-size bifacial PV module with IBC (interdigitated back contact) solar cells and showcased a prototype at the world's largest PV Expo (SNEC 2017, Shanghai, China).
- Developed bifacial PV modules for sound barrier applications in urban environments, for example along MRT tracks.
- SERIS' “hospital services” – Solar Cell Doctor, PV Module Doctor and PV System Doctor - provide a unique set of value propositions for the PV industry to improve efficiencies, optimise designs and increase energy yields.

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- Jointly with Singapore's Public Utilities Board (PUB) and Economic Development Board (EDB), SERIS launched and continues to operate the world's largest Floating PV Testbed at the Tengeh reservoir in Singapore.
- Developed a proprietary and award-winning real-time monitoring system for solar PV systems, with very high reliability and availability.
- Supports the SolarNova initiative of the Singapore government, by providing technical expertise and economic viability assessments, and also through developing innovative tools for solar deployment using drone-based 3D modelling and proprietary ray-tracing algorithms.
- Trained 110 PhD students in the area of solar energy R&D and innovation, and 52 have graduated. These graduates enjoy good employment prospects in the solar energy sector, including management positions in industry and group leaders in research institutes. Some of them have founded their own start-ups in the solar energy industry.

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ANNEX 2: SERIS - RESEARCH ACTIVITIES OVER THE NEXT 10 YEARS

The Solar Energy Research Institute of Singapore (SERIS) at NUS plans to embark on a series of research projects over the next 10 years to strengthen and deepen its solar capabilities.

Three new flagship R&D projects

(1) Development of a 30% efficient thin-film-on-silicon tandem solar cell in collaboration with Nanyang Technological University (NTU) and Campus for Research Excellence and Technological Enterprise (CREATE) of the National Research Foundation

The practical efficiency of silicon solar cells is limited to about 28% under natural sunlight, whereby the world record efficiency is 26.6% at present. To boost the efficiency of silicon solar cells above the 30% threshold, they need to be combined with a second solar cell on top, to achieve a better harvest of the solar spectrum. The most promising technology path to cost-effective 30% efficient solar cells is to combine a thin-film top cell with a silicon bottom cell.

In this flagship project, NTU and CREATE will develop the thin-film top cells, while SERIS will develop optimised silicon bottom cells. Both III-V materials and perovskite materials will be investigated as top-cell materials.

(2) Development of low-cost, high-efficiency building-integrated PV (BIPV) modules and systems to replace parts of the building envelope with PV, including the facades

With an existing building stock of more than 100,000 and little land for utility-scale ground-mounted PV systems, the vast majority of Singapore's PV capacity will be installed on top of, or attached to buildings. While roof-top PV systems are standard commercial practice, adding PV to the facade of existing or new buildings poses more challenges due to building regulations and lower irradiance reaching the vertical parts of a building.

SERIS will be working on high-efficiency, light-weight solar technologies that are aesthetically pleasing and yet economically viable. Such BIPV technologies open up new business opportunities as they possess immediate commercialisation and export potential.

(3) Development of a multi-purpose floating PV system that is suitable for off-shore applications in sheltered waters like Singapore

SERIS is recognised as the global leader in R&D on "Floating Solar", operating the world's largest testbed at Tengeh reservoir. Given the space constraint of Singapore, there are two areas for expanding this leadership role: (i) multi-purpose floating PV structures; and (ii) off-shore floating systems, specifically for the sheltered waters in and around Singapore. Such efforts could take advantage of the well-established marine industry in Singapore, with a vision to have "energy islands" in the future which will supply energy to nearby industrial zones or living areas.

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Other research projects

- Industrial silicon wafer solar cells: Silicon solar cells dominate the global solar market (> 90% market share), and most experts are convinced that this will not change in the next 10 to 15 years. In its first 10 years, SERIS has established itself as one of the globally leading research institutes for industrial silicon solar cells, covering all major solar cell structures. In the coming years, SERIS will strive to maintain a leading position among the global competitors in order to increase efficiency, reduce cost, and/or enhance reliability and energy yield of silicon solar cells.
- Industrial PV module development and testing: In its first 10 years, SERIS has established itself as one of the globally leading research institutes for industrial PV module development and testing, with a focus on silicon PV modules. In the coming years, SERIS will strive to maintain this leadership position among the global competitors in order to increase efficiency, reduce cost, and/or enhance reliability and energy yield of silicon PV modules.
- “Urban solar” initiatives: These activities address the specific challenges which Singapore faces due to its high-density built environment. It includes 3D city modelling of Singapore with detailed solar potential for each individual rooftop. SERIS will also develop innovative deployment solutions for PV systems in an urban environment, such as in facades, walkways or as fences or sound barriers. One example are PV-powered sound barriers for MRT tracks. In addition, SERIS will also provide strong support and technical advisory to Singapore government agencies and industry in implementing strategic programmes such as the SolarNova programme.
- Variability management for PV grid integration: PV power is weather dependent and thus inherently variable. SERIS’ research in this area involves the development of a fully operational solar forecasting system, as well as impact analyses of the increasing share of variable solar power on the stability and resilience of the Singapore power system. Based on that, suitable grid integration measures, including PV inverter interactions, demand-side management and various types of storage systems shall be explored, including the concept of “virtual power plants” for PV operation. This should also lead to the development of Singapore-specific technical guidelines and standards for PV grid integration.
- PV quality assurance: Activities in this area aim to establish SERIS as the quality assurance institution for PV in Asia. As part of the “TruePower™” project, SERIS is developing an “energy rating” method for PV modules – which has the potential to fundamentally change the rating of PV modules based on “actual energy generated” in different environmental conditions, in contrast to the “rated power” method under the Standard Test Conditions (STC) that is used today. SERIS is also actively engaging in international PV system standards development and certifications, which are relevant and beneficial for the market development in Singapore (e.g. “Tropical Test Conditions”).

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