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Solar panels put up (above) and being adjusted (right) at the Renewable Energy Integration Demonstrator-Singapore project site on Semakau Island. The project will test how different renewable sources work with energy storage systems like batteries, to help Singapore design smarter, more resilient grids for the future. ST FILE PHOTOS

## SINGAPORE IN R&D PUSH FOR GRID RESILIENCE

On the island of Semakau to the south of Singapore, solar panels and a wind turbine generate electricity through a system of interconnected microgrids – one of the largest in South-east Asia – that offers a real-life test bed for how a renewable energy grid may be best devised.

Microgrids are used to generate power in remote areas, where they offer a cheaper and more efficient alternative to building miles of transmission lines and wires from

a large power station.

Here, they are the lifeblood of the Renewable Energy Integration Demonstrator-Singapore (Reids) – a project initiated by Nanyang Technological University (NTU) that will test how different renewable sources work with energy storage systems like batteries, to help Singapore design smarter, more resilient grids for the future.

This comes as Singapore is ramping up its share of renew-

ables, with a goal to produce 2 gigawatt-peak of solar energy by 2030 – which will constitute 3 per cent of the country's total electricity demand in 2030. The Republic has also begun importing up to 100MW of hydropower from Laos, via Malaysia and Thailand.

"Essentially, this is a demonstration of how an offshore renewable grid will look like in many other countries in the region, where renewables are being integrated with conventional



power grids to supplement their power supply, or in remote communities, where the grid has to be a standalone," said Professor Madhavi Srinivasan, executive director of the Energy Research Institute @ NTU.

Different types of battery stor-

age technologies are being tested, such as batteries which were originally used for high-performance applications like electric vehicles. These can be reused in microgrids despite having lost some battery performance, noted Prof Madhavi.

"This is not only more sustaina-

ble as it extends the life of batteries, but also will help to bring down the costs of battery storage in such microgrids," she added.

The central hub of the Reids system draws energy from the microgrids – which are powered by various sources, such as a wind turbine



and solar panels – and redistributes any excess energy unused by one microgrid to another.

By integrating multiple energy sources, each of which is dependent on different weather conditions, the system is able to generate power more consistently.

Five of the eight microgrids are currently up and running with research projects. The number of microgrids running depends on research needs and will change over the year, said Prof Madhavi.

More than 12,000 sq m of solar panels located there, coupled

with a wind turbine, can power up to 500 four-room Housing Board units for a year, with a total output of around 2MW at peak capacity.

The project currently supplies approximately 200 kilowatt-hours (kWh) of electricity on average to the National Environ-

ment Agency's facility at Semakau Landfill daily.

Future phases of the Reids project will incorporate wave and tidal energy sources, especially since mapping of waves and tidal flows has been done in various locations in the area and findings suggest that these are feasible energy sources.

A hydrogen facility – which can convert solar and rainwater to hydrogen, as well as hydrogen to electricity via a fuel cell – is also part of the project.

Professor Subodh Mhaisalkar, associate vice-president (strategy and partnerships) at NTU, said that the Reids project also integrates digital grid management software that will prepare Singapore and the region for the next generation of smart grids.

Smart grids essentially work by integrating real-time information on consumption with the grid to ensure that power is distributed in an efficient way.

"Such comprehensive facilities to test, de-risk and validate the next generation of grid technologies are not yet available in Asia, or other academic institutions worldwide. But this is especially important not just for the future architectures of Singapore's power grid, but also to enable electricity imports," Prof Subodh added.

To date, the university has set up partnerships with more than 30 local and international companies on the Reids project, including British turbine supplier Rolls Royce, and French corporations Engie and Schneider Electric.

Prof Subodh said that the industry partners also hope to export solutions to island communities, such as in Indonesia and the Philippines, as well as technologies for the generation of smart grids in ASEAN.

In addition, the Reids project allows the team at NTU to test and develop systems that can operate together, as many systems currently belong to different companies and are not designed to oper-

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ate across brands or types of devices.

"Once these devices are interconnected, we also have to look at the overall resilience and reliability of the grid," said Prof Madhavi.

The lessons from this project may some day also be applied to the ASEAN grid that would allow the 10 member states to trade and transfer electricity to one another through combining their grids, despite the differences in operator, equipment, demand and supply.

The project will be contributing to the Asia Green Grid Network, a collaborative hub of industry experts from Singapore and Australia that helps to drive electricity grid innovation in Asia, said Prof Madhavi.

The network was launched by Australian company Sun Cable, which is working to create a huge solar power plant in Australia to send electricity to Singapore. It comprises nine other research partners, which include Surbana Jurong, the National University of Singapore, and A\*Star.

Mr Fraser Thompson, co-founder and chief strategy officer of Sun Cable, has previously told The Straits Times that a regional grid that connects ASEAN, parts of East Asia, Australia, New Zealand and India is vital to driving the green transition.

He said the research partnership was meant to give efforts across Asia to create a regional grid a shot in the arm.

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