



Is Singapore's grid stability on the line?

## Singapore's savvy approach to solar growth

Tiny Singapore has been working very hard to secure energy and has been exploring solar panel systems that are hanging, floating, and “urban,” but is the grid stable enough to handle these renewable energy innovations?

When researchers installed a \$22,000 solar panel system in a penthouse in Bukit Timah, it not only generated enough electricity to keep 400 50-watt light bulbs running for day, it also became a testament to Singapore's increasing ingenuity in scaling up its solar photovoltaic (PV) installations despite geographical and financing constraints. Singapore has begun exploring the use of “hanging” solar panel systems like what was installed in the Bukit Timah penthouse as well as floating PV systems and energy storage to overcome the challenge of having a small land area that rules out the creation of large solar farms. The hope is that these innovations will increase the viability and attractiveness of solar PV projects as the land-scarce country tries to meet

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its climate change commitments and become a clean energy hub in Southeast Asia.

### Urban solar plants

One of the promising breakthroughs on the horizon for the Singapore solar PV industry are so-called urban solar plants. The concept suspends solar panels from steel ropes and removes the need for large permanent space, which is in such low supply in the country. Moreover, urban solar plants are designed to be easy to move, so they might be deployed to an open-air carpark, then to a new vacant area when needed.

“Installing such a system over an open-air carpark would not only allow it to absorb the sun's energy, but it would also provide shade for cars. In the future, such systems could also power electric vehicles,” said **Dr Thomas Reindl**, deputy chief executive, Solar Energy Research Institute of Singapore at the National University of Singapore.

Reindl leads four projects to find out how solar energy can be made more viable in Singapore, including a feasibility study of urban solar plants in the country. Working with collaborators from organisations such as solar energy firm Sunseap, he has received \$4 million in funding from the Singapore Economic

Development Board (EDB). IE Singapore reckons that if the urban solar plant project is found to be feasible and scaled up, it could help lower the cost of solar electricity in Singapore, and lead to an increase in solar power adoption.

To gauge the potential of urban solar plants, researchers installed a solar panel system at a Bukit Timah penthouse which generates roughly 20 kilowatt hours of electricity a day. **Frank Phuan**, founder and director of Sunseap, says such “hanging” solar panel systems are ideal for highly urbanised Singapore where there is limited space even on rooftops.

“Solar systems in Singapore are always competing for space with other equipment such as cooling towers, water pumps and piping. [A hanging solar panel system] not only brings tremendous advantages for rooftop installations, but it also opens new opportunities for example in carpark covers or temporary use of land areas which are not earmarked for new developments in the near future,” he explains.

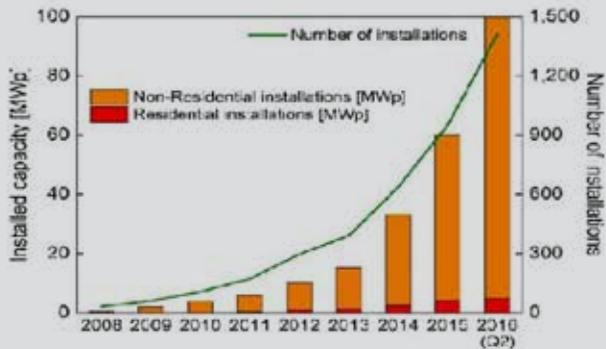
**Yeoh Keat Chuan**, managing director of the Economic and Development Board (EDB) Singapore, reckons these new solar research projects will enable the country to tap into the fast-growing regional solar market and strengthen its position as the clean energy hub in Asia. “The research

### Solar installations in Singapore



Source: Energy Market Authority

## Installed solar capacity from 2008-2016



Source: Energy Market Authority

into next-generation solar cells and systems, in close collaboration with the private sector, will also enable Singapore to accelerate its large-scale adoption of cost-competitive solar energy," he says.

### Floating potential

Another way that Singapore is working around its lack of land for solar farms is to turn to water surfaces instead. Late last year, the country unveiled the world's largest floating solar panel testbed. **Masagos Zulkifli**, Singapore's Minister for the Environment and Water Resources, says the pilot test of 10 floating PV systems at Tengeh Reservoir is the largest globally in terms of the number of systems being tested and the amount of it can produce, which stands at a maximum one-megawatt of energy, enough to power 250 four-room public housing flats for a year.

"Floating photovoltaic systems, those installed over our water bodies, not only help to overcome land constraints, but also have the potential to reduce evaporative losses from our reservoirs," he says. "Given our geography, solar PV systems are a key technology is Singapore's efforts to harness renewable energy." Zulkifli adds that floating PV systems can become more efficient by using water to cool the solar panels, allowing them to yield more energy compared to solar panels that are too hot. Singapore is expected to explore a wider deployment of floating PV systems if the pilot shows them to be economically viable and environmentally sustainable.

**Goh Chee Kiong**, executive director for Cleantech of EDB Singapore, reckons floating PV has become a global trend in the last couple of years, and that the country would do well to take advantage of the high investor interest and momentum behind this technological trend.

"We are seeing developments in Japan, China, Europe, the Americas as well, Australia and even India. What this

means is that it is a highly exportable sector that we want to grow. We are seeing strong interest by various companies wanting to participate in the floating photovoltaics testbed in Singapore," he says, citing eight companies involved in the testbed, ranging from large Japanese and Italian corporations to local small- and medium-sized enterprises. "The starting point is that we want them to establish their business hubs in Singapore," adds Goh. "After which then they will export the knowhow from Singapore, from doing the innovation right in Singapore."

### Rising investor interest

Ramping up investor interest and ensuring the financial viability of solar PV projects are becoming key priorities for Singapore as interest in solar PV deployment is forecasted to continue growing, and innovations are predicted to keep coming.

Installed PV capacity has surged to almost 99.4MWp as of the second quarter of 2016, up from a mealy 0.4MWp in 2008, the Energy Market Authority (EMA) reveals in a recent outlook report. The regulatory agency reckons advancements in electricity generation technologies will bolster Singapore's power sector, including the use of renewable energies such as solar PV. This is despite the apparent inadequate access to funding for solar generation companies.

"The main challenge for solar financing in Singapore is the familiarity of some financial institutions to the solar PV renewable business model and that unfamiliarity tends to heighten the risk aversion and lessen competitive financing terms," said **Camillus Yang**, vice president, corporate development and finance at Sunseap.

As solar PV penetration soars, especially if Singapore intends to fulfill its commitments under the Paris climate change agreement, EMA has



Dr Thomas Reindl



Frank Phuan



Yeoh Keat Chuan

expressed concern on grid stability. **Gautam Jindal**, research associate at Energy Studies Institute of the National University of Singapore, says that other electricity markets have managed this issue by spreading the installation of these resources across large areas – a tactic that is not available to Singapore. Instead, the nation should focus its efforts on developing its energy storage systems (ESS)

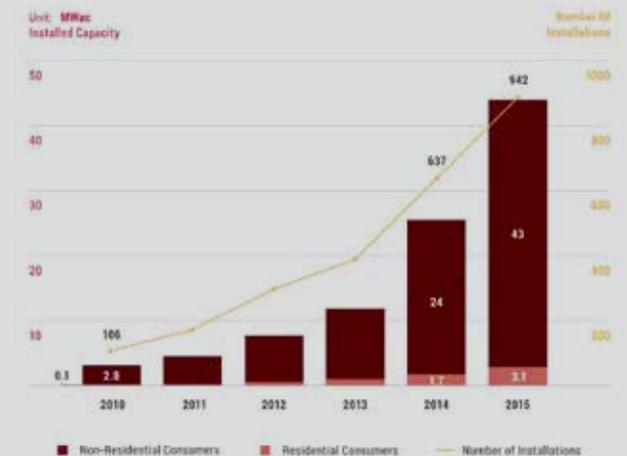
### Unlocking energy storage

"For geographically small, isolated power systems like Singapore, energy storage will play a vital role in supporting higher levels of PV deployment," says Jindal, noting that in 2015, the country opened its electricity market for ESS by allowing them to bid for offering "regulation" service to help correct imbalances caused by load variability.

From facilitating demand side management to firming up output from variable renewable energy sources, ESS can offer many solutions to generators, grid operators and consumers. This has led Singapore to develop a new policy framework to govern the application agnostic integration of energy storage solutions in its electricity market.

"Energy storage has the potential to revolutionise Singapore's electricity market in the coming years; right from enabling Virtual Power Plants to facilitating demand response, to increasing number of prosumers with PV systems on their rooftops," says Jindal. "However, this requires that Singapore develop a solid framework that provides investors with certainty and appropriate incentives to consider investing in energy storage applications that are expected to have the maximum economic value and market potential."

## Solar PV installations



Source: Energy Market Authority