Inside Asia's floating solar dominance

Floating solar | Asia is expected to dominate floating solar's growth over the next four years with up to 70% of global installations of floating PV to take place in the continent. But what are the key drivers behind this surging demand, and what can other continents learn from it? Jules Scully investigates

Faced with ambitious climate targets and rising electricity demand, some governments across Asia have thrown their weight behind efforts to support the development of floating solar projects, recognising its potential in high-density areas that lack suitable space for ground-mounted PV.

As high demand for available land pushes up rent and purchase prices, inland water bodies such as reservoirs, lakes and flooded coal mines located close to urban areas are being exploited to house large-scale floating PV (FPV) plants that dwarf the size of comparable installations in other continents.

Feed-in tariffs (FiTs) as well as tenders and auctions for floating solar capacity have helped drive growth of the sector, while early adaptation of the technology and successful pilot projects have given first movers the knowledge to scale-up installations and deploy advanced floating structures in areas prone to extreme weather.

Markets such as Japan and South Korea are now able to benefit from more than ten years of floating solar experience, according to Frank Haugwitz, senior advisor at renewable energy consulting firm Apricum. "Once the proof of concept was established, it undoubtedly helped to scale-up floating PV in the following years, particularly in China, which started to deploy megawatt-class floating solar systems as early as 2015," he says.

"Additionally, Asia is a fairly dynamic region with some countries experiencing high single or even double-digit annual electricity growth rates. Given that these countries have inland water bodies that are often in the vicinity of load centres, the need for long distance power transmission and associated curtailment issues are eliminated. Because of this on-site consumption, floating PV made a compelling case for many project developers," Haugwitz adds.

A 20MW floating power plant at an irrigation reservoir in Guangxi, China.

Credit: Sungrow

As with ground-mounted solar, China is the world leader in terms of FPV installed capacity, with a host of 100MW-plus projects that are often developed in coal mining subsidence areas. Last April, Hangzhou Fengling Electricity Science Technology completed the second phase of its 320MW Cixi plant, making it the world's largest floating solar installation.

According to figures from IHS Markit, China's installed floating PV base is estimated to be double the size of the next largest 11 countries in terms of installed base greater than 5MW. The research firm says China maintained its ranking as the largest market for floating PV for the third year in a row in 2019, despite a slide in installs due to the general decline of the country's solar market and the removal of the Top Runner policy.

That policy saw China's National Energy Agency issue a tender in 2016 for the installation of 1GWp of FPV in coal mine subsidence areas, mainly in Anhui Province, and another 400MWp in Shandong Province.

Floating PV mounting supplier Sungrow was among the beneficiaries, as more than 400MW of the projects planned by the Chinese government from 2016 to 2017 in these coal mine subsidence areas feature the company's floating system. "These floating power plants not only make full use of these waters, but also promote the local employment and economic development," says Kane Wang, manager of Sungrow Floating's system solution department.

> "Although the national conditions of each country are not the same, each country will have some abandoned waters with very low utilisation value,"

Wang believes this example of supporting the development of large-

Credit: Q CELLS.

An image of the planned 41MW project that Q CELLS is developing at the Hapcheon Dam in South Korea.

scale floating solar in coal areas could be copied in other markets. "Although the national conditions of each country are not the same, each country will have some abandoned waters with very low utilisation value," he says. "We believe that governments of all countries can learn from China's experience and focus on planning these abandoned waters with low utilisation value as floating PV power plants, so as to develop clean energy while making full use of water resources, saving land, driving economic development and employment. This is a choice that every smart and responsible government will make."

IHS Markit says both Sungrow and Ciel et Terre dominate the global market of FPV mounting suppliers, with the companies together accounting for 70% of the total completed or under-construction installations. Sungrow Floating is said to have the largest installed base due to its strong market share in China and other Asian countries, and as of December 2020, its cumulative installed capacity exceeds 1.1GW.

Sungrow has formed a dedicated research and development team to tackle issues such as product reliability under harsh environmental conditions, the impact floating projects have on water bodies and the construction of anchoring technology in areas with large fluctuations in water levels.

Environmental challenges

Despite the potential benefits of developing floating PV – including reduced water evaporation, higher land use efficiency and increased energy yield thanks to the cooling effect of water – there have been calls for additional research into the environmental impact of such installations to allow the technology to take off.

A report from the World Bank and Solar Energy Research Institute of Singapore (SERIS) says that for most countries hoping to develop a well-functioning FPV segment, unique aspects of permitting and licensing need to be addressed through cooperation between both energy and water authorities.

In South Korea, tests carried out at a dam where Q CELLS is looking to develop a 41MW floating plant found that the installation "will have no negative environmental impact", the company says. Currently under construction at the Hapcheon Dam in the south of the country, the project has seen Q CELLS carry out environmental stability tests to ensure that it would have no adverse impact on the dam or its ecological balance.

"Scientific consensus – as a result of monitoring tests conducted on four separate occasions by the Korea Environment Institute (KEI) – showed that the water quality is unaffected and that there is no significant difference between the water area covered by the power plant and the uncovered water area," says Ian Clover, manager of corporate communications at Q CELLS.

As well as the land scarcity, Clover believes that some Asian markets' success in floating solar is partly thanks to knowledge of waterways that ensures there is already a good base level of engineering expertise. He says: "Similar to how in Europe it is the Netherlands that has already made great strides in floating solar thanks to its history of managing and manipulating its water, there is similar expertise in Asian countries, where communities have long relied on local bodies of water for generations. It is an extension of that relationship, in many places."

24GW
Southeast Asia's floating solar potential, according to IEEFA

Q CELLS won the rights to develop the Hapcheon Dam floating solar project last year from K-water (the Korea Water Resources Institute). It will feature the company's Q.PEAK DUO Poseidon modules and have a design inspired by the plum blossom, the symbolic flower of the local area.

While Q CELLS recognises that there are "some additional costs" associated with the installation process of a floating solar plant, it is looking to take advantage of up to 10% higher power generation compared to land-based PV as a result of the cooling effect of the water and the lack of shading.

South Korea's floating PV market has been boosted by the country's Renewable Portfolio Standards policy that requires power producers with an installed generation capacity greater than 500MW to mandatorily supply a certain amount of renewable energy. To meet their targets, these operators purchase Renewable Energy Certificates (REC), with a different weighting applied to various renewable technologies.

"In the case of floating PV, a time and a half REC can be granted," Clover says. "This means, for example, that if 1,000kWh electricity is produced at a floating PV site, it will receive a REC to the value of 1,500 kWh. In this way, floating PV offers distinct and attractive advantages in terms of return on investment."

South Korea will be the location of the world's largest floating project, which will be developed inside the country's Saemangeum seawall, feature around 5.25 million solar panels and have a capacity of 2.1GW when fully operational in 2025.

As Q CELLS makes progress with the Hapcheon project, Clover believes adding floating solar to dams "makes sense", as reservoirs created by them are "generally large, open bodies of water with good road access and pre-existing infrastructure".

Colocation with hydropower

The potential for co-locating FPV with existing hydropower plants in Southeast Asia was revealed in research last year from the Institute for Energy Economics & Financial Analysis (IEEFA), which suggests the region's floating solar potential is at least 24GW. In Indonesia, the think tank says there are "many excellent opportunities" to install floating solar on existing dams/reservoirs, thanks in part to its considerable number of inland water bodies. Citing government data, IEEFA says the country has 231 big dams, 3,489 weirs and 4,311 reservoirs.

Renewables developer Masdar is currently progressing with plans to develop Indonesia's first large-scale floating solar project, which will be built at the Cirata reservoir in West Java and have a capacity of 145MWac. The Abu Dhabi-based company recently formed a joint venture with PT PJBI, a subsidiary of Indonesia's state electricity company PT PLN, to drive development of the plant.

After signing a power purchase agreement for the facility early last year,

Taiwan's record-breaking offshore PV project

Last November saw Taiwanese solar developer and operator Chenya Energy complete the world's largest offshore floating PV project.

The 181MWp facility, called 'Lunwei East No. 1 and No. 2 Photovoltaic Power Station', is located on the west coast of Taiwan, in the country's most densely populated county, and took just over 16 months to construct.

Modules are fixed to a mooring frame and floats that are supported by concrete anchors, with the installation sitting on the seabed during low tide and floating when the tide rises.

Despite concerns from financiers surrounding the construction schedule (which could have affected the feed-in tariff for the project) and the potential danger of earthquakes and typhoons, Chenya was able to secure TWD7.2 billion (US$240 million) in financing from seven banks for the facility last year.

Surrounded by the ocean and with a high population density, Taiwan presents challenges for solar developers looking for suitable land for large-scale projects, a Chenya Energy spokesperson told *PV Tech Power*.

With the country looking to achieve 20GW of installed PV by 2025, the company has welcomed government efforts to back renewables deployment. "The government has provided sound supportive measures for the development of floating solar photovoltaics, which include land inventory, establishing multiple sources of funds, promoting banks to finance solar photovoltaic establishment and promoting the talent development of solar photovoltaic industry," the spokesperson says.

Completion of the project came months after Chenya Energy was acquired by Japanese trading giant Marubeni. At the time, Marubeni said the acquisition would allow it to gain expertise in the floating solar market, an area it plans to expand on in Taiwan and other regions.

The 181MWp project from Chenya Energy Project was completed last November

Masdar is benefiting from PT PJBI's local knowledge, as the partners work on achieving financial close, with construction expected to begin the first half of 2021. "PJBI is playing a significant role in bringing the project to closing, particularly on the permitting work stream, on land-related matters and other crucial local activities," says Ahmed Al Awadhi, director of business development and investment at Masdar Clean Energy.

Set to be built on 4% of the Cirata Reservoir's water surface, the project will feature around 350,000 solar panels arranged into multiple islands anchored to the bottom of the reservoir using mooring lines. It will be connected to the 150kV Cirata switchyard, located approximately 4km away from the power plant.

According to Al Awadhi, Masdar is aiming to expand its business in other Southeast Asian markets through the creation of other joint ventures: "Partnerships lie at the heart of our business and investment philosophy," he says.

"Masdar is keen to apply [floating PV] wherever possible, and we believe that, particularly in Southeast Asia, floating PV makes sense, given land constraints, where traditional solar projects could compete with other usages, such as agriculture. We see floating PV as being attractive in countries such as Indonesia, Vietnam, the Philippines, Thailand and Malaysia."

Policies to support FPV growth

The World Bank/SERIS report says that while few countries have provided financial incentives specifically for FPV, most markets that have preferential FiTs for solar typically also include floating PV. This is the case in countries such as Japan, Malaysia and Vietnam. Taiwan, meanwhile, has a FiT policy that favours floating installations over ground-mounted solar.

Alongside FiTs, the other two other main policies that support floating solar deployment in Asia are auctions and deployment targets. Thailand has a target of 2.7GW spread over 16 projects to be realised by 2037. However, auctions conducted in China and India have triggered a "far greater response", says Frank Haugwitz of Apricum, with India releasing a series of floating PV tenders between 2018 and early 2020 amounting to more than 2GW.

"In general, auctions signalled government support, raised awareness among market stakeholders, triggered technological advancements and led to significant cost reductions in a relatively short period of time," adds Haugwitz.

Tenders and auctions are expected to be the main drivers to help the adoption of floating PV in many Asian countries, according to IHS Markit, which expects the continent to account for more than 70% of all FPV installations in the next four years. Given their experience of the technology, FPV players operating in Asia have the potential to export their knowledge to other markets looking to make use of available water bodies to build FPV capacity to meet clean energy targets.

Benefits could also be transferred in terms of project financing. Minh Khoi Le, a research analyst at Rystad Energy, says that the "relatively unproven" nature of FPV has led to hesitation from banks and investment funds. "As mega-size floating PV plants are commissioned, the sample size gets bigger, lessons learnt lead to better, safer technologies, financing institutes can be more accepting of floating PV," he says. "It just so happens that these Asian regions are quite hurricane-prone, which can make them be the perfect testbed for floating PV."

Despite the progress made in many Asian countries, floating PV is estimated to make up less than 1% of total global installed solar capacity. But as larger floating solar project sizes allow for economies of scale that yield lower installation costs, progress made by pioneers in Asia can pave the way for other markets to follow. ■

Turn to page 55 for a Project Briefing from a 20MW FPV system installed in Guangxi, China.