# Where sun meets water: the rise of floating solar

**Floating solar |** Floating solar has grown at a slower pace than its land-based counterpart but technological developments, efficiency gains and land constraints are making it an increasingly appealing option for developers. Shauna Ng, content executive at Sunseap, examines the technology, its benefits and where the sector is headed.

**Photo of one of the world's largest floating solar farms on seawater in the Straits of Johor, completed by Sunseap Group in March 2021.**

Given its clean, renewable nature as a source of energy, it is undeniable that solar PV power is essential in global efforts to address climate change. As well as ground-mounted and rooftop solar installations, thanks to advancements in technology, solar panels can now also be deployed on water bodies.

Below, we explore floating solar energy systems, detailing the advantages of a floating solar PV plant to upcoming technological innovations.

## Examining the floating solar PV sector

Floating solar PV (FPV) systems are a relatively new concept – the first patent for this type of solar technology was registered in 2008. Since then, floating solar panels have predominately been installed in countries like China, Japan as well as the UK.

As global efforts towards carbon neutrality accelerate, the demand for floating solar capacity is growing quickly. A 2019 report by global research firm Wood Mackenzie estimates that global demand for floating solar power is expected to grow by 22% year-over-year on average from 2019 through 2024. With this rising demand, opportunities for green loans have also risen for the financing of these sustainable projects, stimulating the global economy in its reach towards carbon neutrality.

In 2021, the biggest operational FPV system was in China – a 320MW facility in Dezhou, Shandong province. It deployed the floating array on a reservoir near Huaneng Power's Dezhou thermal power station.

Sunseap has a hand in the installation of FPV systems – in March 2021, Sunseap announced the completion of an FPV system along the Straits of Johor, Singapore with a capacity of 5MWp. While the system may seemingly pale in comparison to the 320MW facility in Dezhou, Sunseap's solar farm is actually one of the world's largest offshore floating photovoltaic system (OFPV). This means that the system is deployed on seawater, instead of on freshwater bodies.

Singapore's spatial constraints led Sunseap to look offshore, to the open seas, as a viable alternative for renewable energy, ultimately deploying the PV system in coastal waters. In doing so,

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**Photo of one Sunseap's personnel inspecting the floating solar farm in the Straits of Johor.**

Sunseap also achieved another milestone: constructing an undersea cable system connecting the floating platform to the mainland, creating a 22 KV electrical distribution network.

OFPV systems carry similar benefits as their freshwater counterparts, albeit with the challenges of sea conditions and associated costs. Unlike inland water bodies, the open sea is subject to a range of conditions and is prone to change, from fluctuations in temperature and rough swells to the corrosive nature of saltwater. Such unfavourable conditions, combined with the biofouling commonly found in warm tropical waters — where microorganisms, plants, algae, and small animals accumulate on surfaces — can potentially accelerate the degradation of PV system components, such as inverters.

With these challenges in mind, Sunseap's OFPV system was designed with a robust constant tension mooring system that is able to withstand changing weather conditions, keeping the platform and all of the operational equipment on board steady. In addition, the system also utilises Huawei's field-proven, smart string inverters to make the floating solar farm more efficient, safer, and more reliable.

The components of the OFPV system, such as the inverters, have also undergone a series of tests for salt corrosion and heat dissipation, demonstrating their resilience to harsh environments and temperatures. By deploying such technology, Sunseap has been able to streamline the operations and maintenance (O&M) process of the floating platform, as well as prevent rust and general material wear and tear.

Comprising 13,312 panels, 40 inverters and more than 30,000 floats, the energy generated yearly from this seawater-based installation can potentially offset an estimated 4,258 tons of carbon dioxide.

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## The benefits of floating solar

It is interesting to note that despite how FPVs are more challenging and costly to build and operate as compared with land-based systems, demand for FPV systems is evidently still on the rise. So, what is driving this demand and the growing popularity of floating solar farms?

### 1. Space, or the lack thereof

One of the biggest advantages of FPVs is that these solar panel installations do not require any land space. Most of these deployments can take place on unused space on bodies of water, such as hydro-electric dam reservoirs, wastewater treatment ponds, or drinking water reservoirs. They are places that are unobscured from the sun and with low risks of vandalism or theft.

This will allow landowners to better capitalise on land area that would otherwise be occupied with the solar installations. In addition, installing solar panels out on open water reduces the need for

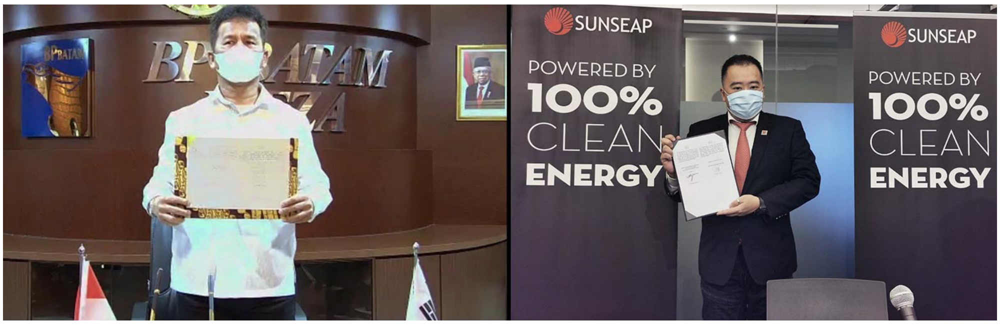


**Photo of the Memorandum of Understanding signing ceremony between Sunseap Group and the local municipal authority of Indonesia's Batam Island.**

tree removal and forest clearing, which is a practice that is used in the case of ground-mounted, utility-scale solar panel installations.

FPV systems thus offer exciting opportunities, especially for land-scarce and densely populated cities, to tap into solar energy.

### 2. Performance and conservation

Another benefit of FPV systems would be improved module performance. Bodies of water have a cooling effect, and this can boost how efficiently these systems generate electricity by as much as 12.5%. Over time, this translates into significant cost savings. Solar modules perform better when they are cooler, meaning that a floating solar array will outperform a land-based solar array of comparable size owing to the cooling effects of the water.

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Besides the water having a cooling effect on the solar-powered systems, it works the other way as well. The floating solar panel installation provides shade to the body of water and reduces the evaporation from these ponds, reservoirs, and lakes. This is a particularly useful environmental benefit in areas that are more susceptible to droughts.

The shade from the FPVs can also reduce the presence of algae that blooms in the freshwater, which is not only dangerous for consumption (if they occur in a source of drinking water) but can also lead to the death of marine life in the water.

### 3. Infrastructure, resources and costs

Floating solar often requires less in terms of both labour and materials than a land-based project of similar size. Additionally, less maintenance may be required as floating panels are generally located away from potential debris sources and shipping routes.

FPV installations are much quicker to build than fossil-fuelled power stations and can be ready in a matter of months, while the latter can take several years to construct. As more countries in Asia-Pacific commit to competitive solar and overall renewable energy targets, FPV installations will be key to meeting these goals.

## The future of floating solar – technological advancements under way

In July 2021, Sunseap signed a Memorandum of Understanding (MOU) with the local municipal authority of Indonesia's Batam Island to build and develop an FPV system on Duriangkang Reservoir in the south of the island.

The FPV is projected to have a capacity of 2,200MWp and span around 1,600 hectares. This will make it the largest FPV in the world to date.

This hyper-scale FPV farm is expected to generate more than 2,600GWh of electricity per annum, potentially offsetting more than 1.8 million metric tons of carbon annually. This is equivalent to taking more than 400,000 cars off the road each year. Construction of the Duriangkang project is slated to begin in 2022 and is expected to be completed in 2024.

On top of the FPV system, the project will also include the development of an Energy Storage System (ESS). The ESS is also slated to be the largest in the world to date with a storage capacity of more than 4,000MWh.

The rapid growth in the solar industry has magnified the key limitation of solar energy – its dependence on the weather. To reap the full benefits of solar energy, we must store some of the energy when it is generated and use it during peak demand – this is where ESS systems step in as a solution, standing as the key to success in our carbon-constrained world. With ESS, electricity can be saved for later, when and where it is most needed. This enables the optimal use of FPV systems while ensuring an uninterrupted supply of electricity.

Sunseap's announcement regarding this project in Duriangkang reservoir might herald a new era for emerging markets such as Malaysia, Thailand, Vietnam and of course, Indonesia as the race to zero gathers momentum with FPVs and ESSs featuring prominently in decisions that will be made in the decade ahead.

Other rising technological advancements in the solar industry include weather forecasting technology such as skycam devices and algorithms that improve energy efficiency. Skycam devices can view clouds and gauge their altitude, density, direction and speed, and predict at what point the clouds will move over a solar farm. This tool helps anticipate momentary losses of solar power due to clouds, giving more time for other power generation units to plug the gaps.

A researcher from the University of Sydney has also found the key to the next renewable evolution. The focus of the research is a class of crystalline compounds called perovskite, a photoactive crystalline substance. Compared to silicon, a material traditionally used in the construction of solar panels, perovskite is much more time efficient in assembling. It is also bendable in a way that rigid silicon is not. Being used at a thickness of up to 500 times less than silicon, it is also very light and can be semi-transparent. This means that it can be applied to all sorts of surfaces like phones and windows.

The research is investigating the layering of both silicon and perovskite onto the same photovoltaic cell, to give a higher voltage than either could give on its own. The numbers so far are impressive: a single layer could be 33% efficient as compared to the 18%-22% efficiency of traditional silicon photovoltaic cells. These sorts of figures, if they can be realised commercially, would revolutionise renewable energy. ■