FLOATING SOLAR – A DEVELOPER PERSPECTIVE

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Abstract

Ground and roof mounted solar PV is well understood and adopted around the world, while placing PV modules on water surfaces may seem experimental. The benefits of floating PV usually cite cooling effect of water, evaporation reduction and reduced pressure on arable land, but general knowledge and publications around this rather niche sector is still holding it back from reaching its full potential. The objective of this work is knowledge sharing from the development perspective, based on real world learnings and potential solutions that are independent from products or country specific challenges. By sharing first-hand experience, the author wishes to contribute not just to FPV development but the broader acceleration of renewable energy uptake.

Keywords: Floating PV, FPV, project development, knowledge sharing, real-world experience

1. Introduction

Although solar photovoltaic (PV) technology is close to 100 years old, floating photovoltaic (FPV) is relatively new. Despite its modest initial uptake, some sources estimate its global potential in the Terawatts (Jin et al, 2023). Cost remains one of the key obstacles, while lack of standardization of products and availability of international design standards further hinder uptake. The lack of experience and understanding of the technology often lead to concerns from local communities and contribute to uncertain permitting timelines. Meanwhile, there is increasing recognition of how FPV can contribute to the overall renewable energy targets, as growing number of suppliers and developers enter this nascent sector (NREL, 2021).

2. Prominent FPV Publications

The first notable publication, that tried to summarize the benefits and challenges of this technology was released in 2019 by The World Bank (The World Bank, 2019), drawing from lessons learned at the world's largest floating solar testbed, which is operated by the Solar Energy Research Institute of Singapore (SERIS, 2016). The second publication of global significance came from international consultant DNV (DNV, 2021). Their document was developed as a joint industry project, with 24 participating companies. A third, albeit lesser-known guideline was also released in 2021, and updated in 2023, but it is only available in Japanese language (NEDO, 2021 and 2023). While all three of these documents are a real treasure trove of general information, they are written from a consultant' perspective and often lack directly applicable, practical advice that project developers need.

3. Site Selection Challenges

3.1. Water body

Projects are more often originated with potential water bodies being offered by their owners, rather than developers choosing the most ideal locations. As such, many of the key considerations like bathymetry, wind speed, wave height, water level fluctuation will become engineering challenges to solve and not a selection criterion. While these are necessary information for design, often they are not readily available and mapping a large lake is very costly; a spending that is not possible at site selection stage. Publicly available data and assumptions are the best compromise in early development stage, while ascertaining the cost of such surveys must be identified and captured in the development expenditure (DEVEX). Furthermore, as many of these parameters change over time, a simple survey cannot measure them, but rather a long-term measurement campaign needs to be considered, which can be incorporated into a pilot system at the eventual project location.

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3.2. Land

While focusing on the water body, it is easy to lose sight of the importance of suitable land. As lakeside land parcels are often desirable for leisure or housing purposes, securing them could be costly and challenging. The size of the permanent land needed will be driven by the project size, location of inverters and electrical facilities, while the temporary land for construction and launching the system will be driven by the desired speed of the project deployment. If the permanent land cannot be acquired at the ideal location, there is possibility to shift the facilities further from the shore, by using horizontal directional drilling for example and taking cable under roads or other land parcels. In fact, water level changes (including unforeseen changes due to climate change) may make it a wise choice not to locate electrical facilities directly on the shore. Access for heavy goods vehicles to the lake and the lakeshore properties can further limit site suitability.

3.3. Grid

Connecting floating PV systems to the grid can be achieved through underwater or floating power cables. While the latter is cheaper and easier to maintain, it also blocks the water surface from boats and may not be suitable for larger lakes, where the water body has multiple users. The additional cost and complexity should be considered from early on, both in CAPEX and OPEX terms.

One of the key technical challenges for FPV systems is grounding, earthing and lightning protection require a different approach than GPV, which may raise questions around the security and quality of the power supplied by the plant. While there are recognized methods for lightning protection for PV systems (IEC, 2020), FPV plants are not yet included. Furthermore, deploying thousands of lightning terminals is not just costly, but also not practical and a risk-based approach can be a more practical solution here.

4. Development Challenges

4.1. Cost competitiveness

One of the biggest barriers to FPV is the constant comparison to GPV and the expectations to bring their cost to the same level. At the time of writing this, an approximate USD0.10 /Wp cost difference exists (Frost & Sullivan, 2023) which makes FPV based offtake opportunities less attractive, than their land-based competitors. As closing this gap may not be possible for some time, it might be a more realistic target to work on different offtake options and quantify the additional benefits FPV can bring. Auctions and FIT tariffs have historically distinguished between roof and GPV and in some countries FPV have also become a separate category.

4.2. Experienced workforce

The nascent nature and relatively small size of the FPV market also means, there is a general lack of experienced workforce. This creates two issues; one is the cost premium demanded by the few, experienced companies and the other is the generally available skill level among PV workers. The good news here is the leading FPV technology providers include training and supervision among their services, which once again, makes product selection crucial for the success of the project. As workforce will need to be trained in most cases, this also creates a great opportunity for community engagement through providing local job opportunities and long-term skills in construction and maintenance.

4.3. Community support

Potentially the most crucial and delicate aspect of FPV projects, is convincing the diverse group of stakeholders (e.g. recreational users, fisherfolks, resort owners, residents, farmers, etc.) about the safety and benefit of the project. Their concerns range from the visual impact to water quality, electrical safety, impact to wildlife or their own livelihoods. In many countries obtaining permits will also be dependent on community support, whether directly or indirectly. Appointing a community engagement officer, making frequent trips to the project location, and holding community engagement sessions are all key steps, which need to be factored in both in the project schedule and the cost estimations.

4.4. Accepted standards

At the time of writing this, the only dedicated national (design) standard comes from Singapore (Singapore Standards, 2022), with IEC, NFPA, VDE, BS, etc. are still yet to release their own guidelines. This gap is often filled by drawing experience from the marine industry and ground mount PV systems, but differences remain, which often leads to delays in permitting or doubts by the local community and grid operators.

Certification and globally accepted standardization of product quality, also lags the roof- and ground-mounted PV systems, where well established and understood processes exist. Testing procedures and acceptance criteria are highly arbitrary to each manufacturer, leaving the customers confused and investors nervous. A recognized and respected name in product testing, released their suggested product testing process, but its application remains voluntary (TÜV, 2020).

4.5. Permitting route

One of the most frustrating consequences of working with emerging technologies, is the lack of clear path for obtaining approvals. While land parcels are easily divided and boundaries can be drawn, existing land use can be converted, obtaining rights for lake surface (or part of) is a relatively uncharted territory in many countries. Furthermore, as anchoring and mooring lines are located under water, it is not just the surface of the lake, that requires approvals for development. Drawing from more developed FPV markets and proactively meeting decision makers to suggest solutions, can accelerate discussions and help bring approvals closer.

4.6. Insurability

The relatively small number of operating FPV plants and some famous instances of catastrophes (PV Magazine, 2019; Recharge, 2020; Offshore, 2021), also present a risk for the insurance industry. Many insurance companies may decline to provide a cover, others might limit the scope or charge a very high premium. As project details will not be available in early stage, it is better to go with more conservative assumptions in cost estimations, while also engaging insurance brokers from the start. Contacting financing institutes, who engaged in similar projects in the past, is another good source for identifying supportive insurance providers.

4.7. Environmental concerns

Covering the water surface with PV modules can create both benefits and issues for the local flora and fauna (e.g. reducing evaporation, cooling the water, creating shade, etc). Likewise, existing biodiversity could be beneficial or harmful for the PV plant (e.g. soiling by birds, marine life chewing on cables and mooring lines, etc). The exact requirements for studies, as well as long-term monitoring activities (e.g. water quality, fish stock, etc) vary from country to country, but some form of environmental impact assessment (EIA) should be considered among the project activities in any case. There are many experienced consultants available, who can draw on their international experience, while working with local experts on the ground. Voluntarily conducting such studies could also help with permitting and community approvals, as the study outcome will answer many of these stakeholders’ questions and concerns.

5. Conclusions

FPV technology has been around for nearly two decades, but only started to gain global acceptance in the past few years. There are increasing number of industry events and market reports, while the sector is still suffering from skilled-labor shortage, cost competitiveness and lack of knowledge sharing by industry players. As project development is the real test of all theories and guidelines, it is essential for practitioners to share their experience and help this sector reach its potential. Making their voices - and often frustrations - heard, will not only help the growth of the industry, but can also pave the way for more FPV friendly landscape for all stakeholders.

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