International Solar Alliance (ISA)

Webinar on Floating Solar PV
30th July 2021 | 16:00 Hrs- 18:00 Hrs IST

Event Summary Report

Background

International Solar Alliance (ISA), established in 2015, undertakes joint efforts to reduce financing costs and the cost of solar technology applications and services. ISA's aim is to bring solar energy into people's lives and homes by making it cheaper, more reliable, and easier to connect to the grid and contribute to universal access to clean energy. ISA also intends to help countries mobilize USD 1 trillion of investment for a massive deployment of solar energy technologies by 2030 and expand solar markets, thereby paving the way for future technologies adapted to the needs of the Member Countries.

International Solar Alliance (ISA) has been supporting member countries to scale up solar in various applications and sub-sectors. ISA is also undertaking joint efforts to mobilize investment, expand solar markets, reduce the cost of finance, and innovative technology applications and services. These efforts are being made to achieve three different but interlinked objectives: promoting a clean energy transition, enabling energy access and energy security, and delivering a new economic driver for all countries. ISA currently has 98 Member countries, which have either signed or ratified the ISA's Framework Agreement.

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Context

Availability of land has been one of the major challenges faced by many ISA member countries for the deployment of ground mounted solar PV projects. Floating Solar Technology in the recent past has appeared as an emerging solution for such geographies, especially countries that have water bodies appropriate for setting up FSPV projects, along with a suitable infrastructure already in existence. Floating Solar PV therefore displays commercial and technological viability for a scalable power generating option as well reduce land-use conflicts.

Besides low land requirements, it also creates the possibility to save water by decreasing loss due to evaporation in reservoirs. This is beneficial to countries that observe a substantial interval between the wet season and dry season. Further, it gives marine life an opportunity to breed in a safe environment as the FSPV minimising fishing. Energy output of Hydro-electric power plants decreases particularly during dry seasons when water flow is less, and solar radiations are high. Hence, deploying FSPV plants in such cases may save investment cost by utilizing the already existing infrastructure. Hydro-Solar PV in hybrid conjugation also gives an advantage of providing round the clock power solution. Additionally, FSPV offers up to 10% increase in yield as compared to ground mounted SPV, since they have better temperature convection and ventilation due to refreshing winds.

The FSPV technology has some challenges related to implementation as well, however large number of FSPV installations around the globe have shown people's confidence in the technology. In 2020, ISA along with the Government of Indian state of Karnataka sanctioned a corpus of USD 1 million for instituting the *'ISA Karnataka Visvesvaraya Solar Award'* for best floating solar project to recognize governments and developers doing outstanding work in the Floating Solar PV. In 2020, the award was jointly presented to Japan and Netherlands. The nomination for the year 2021 is currently ongoing.

ISA looks forward to support and help the member countries in technical assistance/ guidance which is essential in development of the technology. ISA therefore is keen to work with member countries to see how the potential of FSPV can be utilised in potential member countries.

About the Webinar

With an objective to assess the potential and showcase examples of successful projects around the world in Floating Solar PV, ISA hosted a webinar titled 'Floating Solar; A New Pillar of Solar PV (Africa Region)'. This webinar was the first in the series of webinars planned under the overarching theme i.e., Solar for Energy Transition with special focus in African region. During this webinar, a drone assisted virtual tour of a 100 MWp Floating Solar PV Project in Telangana, India was conducted for all the attendees. In this webinar, various facets related to technology options, business models, financing, and benefits of FSPV projects were discussed.

The webinar also addressed practical aspects regarding technology landscape and challenges for FSPV projects currently being faced by implementers, potential in Least Developed Countries in Africa, as well as experience sharing by NFPs through case studies from Africa.

Over 130 participants attended the webinar across the globe including key representations from ISA Member Countries including, Ghana, Malawi, Mali, Niger, Nigeria, Sudan, Togo, Uganda, and Zambia. In addition, distinguished speakers across the world delivered presentations on different aspects related to Floating Solar PV, including benefits of FSPV, scrutiny and selection of appropriate design of a FSPV projects, implementation challenges, and potential assessment in Africa. The programme agenda was as follows:

S.No.	Category	Topic	Speaker
1	Opportunity and key challenges	Design of Floating Solar projects: Opportunities and Challenges	• Mr. Deepak Ushadevi MD & CEO – CIEL et TERRE, India
2	Virtual Tour of 100 MW FSPV in India	Address followed by Live drone assisted virtual visit to a 100 MW Floating Solar PV Project executed by NTPC.	• Mr. U. K. Bhattacharya Director (Projects), NTPC Ltd
3	FSPV Potential in Africa	Assessment of potential of Floating Solar Projects in African Region	• Ms. Zuzana Dobrotkova. Senior Energy Specialist, World Bank
4	Experience Sharing	Floating Solar Projects in Japan	• H.E. Mr. Shingo Miyamoto, Minister, Head of Economic Section, Embassy of Japan in India
5	Country Intervention		• H.E. Mr. Wisdom Ahiataku-Togobo, Director, Renewable & Alternative Energies, Ministry of Energy, Republic of Ghana and NFP Ghana • H.E. Dr. Souleymane Berthe, Director General of AER and NFP, Republic of Mali

Speaker's Profile

Speaker	Profile
 **Mr. Deepak Ushadevi** *MD & CEO – CIEL et TERRE, India*	Mr. Deepak has over 20 years of experience in the solar & semiconductor domain mainly in the IC chip processor segment, solar technology, floating solar technology. His core expertise is in new business initiatives, Technology introduction & Market development. At Ciel et Terre Mr. Deepak developed the solar floating market and interacted with major nodal agencies, PSUs, top EPC & developers to provide floating solar guidelines, presentation, knowledge transfer, to ensure quality and bankable floating projects in India. Under his leadership, a portfolio worth 21 MW floating solar has been developed in India (as of Dec'2020) with 3 projects commissioned and a 75 MWp project currently undergoing in Kerala (India)
 **Mr. U. K. Bhattacharya** *Director (Projects), NTPC Ltd*	Sh. Ujjwal Kanti Bhattacharya is Director(Projects), NTPC Ltd. He has also additional responsibility of Chairman, NGSL, Vice Chairman, HURL and Director on the Board of THDC and NEEPCO. Mr. Bhattacharya started his career in greenfield project construction. Subsequently, he worked in areas of power plant operation and maintenance, renovation and modernization, environment management and technical services at NTPC Farakka (1,600 MW) in West Bengal (India), and later at NTPC Talcher thermal (450 MW) in Odisha (India). He has significantly contributed for NTPC's vertical & horizontal business diversification as well as growth through inorganic route. He had illustrious career in Business Development function of NTPC in Domestic as well as International Arena with special focus on NTPC's diversification into hydroelectricity with acquisition of Koldam and setting up of subsidiary company NESCL for electricity distribution business. He has been at the forefront of JV formulation & Project conceptualization for 1320 MW Maitree Power Project at Bangladesh. .

 **Ms. Zuzana Dobrotkova** *Senior Energy Specialist, ESMAP, World Bank Group*	Ms. Zuzana Dobrotkova leads Innovative Solar Program and contributes to various renewables and energy storage initiatives at ESMAP, World Bank. Prior to joining World Bank, Ms. Zuzana has previously worked with International Renewable Energy Agency (IRENA) in Abu Dhabi and International Energy Agency (IEA) in Paris. Ms. Zuzana's areas of expertise include renewable energy markets and policies, power sector modelling, energy accounting and statistics as well as socio-economic benefits of renewable energy. In recent years Ms. Zuzana's focus has been solar energy and energy storage, including preparation of several large-scale solar projects with storage in West Africa.
 **H.E. Mr. Shingo Miyamoto** *Minister, Head of Economic Section, Embassy of Japan in India*	H.E. Mr. Shingo Miyamoto has over 25 years of experience in the economic sector. H.E. Mr. Miyamoto has experience of working as an Economic Counsellor in the Embassy of Japan in several countries besides India including Embassy of Japan in the United States of America, Embassy of Japan in Indonesia. He has also worked extensively with the Ministry of Foreign Affairs, U.S.A, since 1994. Mr. Miyamoto is recipient of ISA Karnataka Visvesvaraya Award 2020 for Best Floating Solar PV project (Asia Pacific Region) in Japan.

Virtual tour of a 100 MW Floating Solar PV Project in Telangana, India

NTPC gave webinar participants a virtual tour of the 100 MW FSPV located in Ramagundam, Telengana through a live video recorded by air drone. The key highlights of the virtual tour are:

- The project consists of 4 units of 25 MW_{ac} each with individual floater blocks of 2.5 MW. All equipment of FSPV, i.e., PV modules, inverter, transformer, etc. are on a floating platform.
- The FSPV is spread across 450 acres of water surface and is India's largest FSPV.
- Power evacuation is done at 33 kV level.
- Anchoring system used are deadweight concrete blocks of 8-9 tons for module arrays and 1.6 tons for electrical component.
- In view of huge volume of floaters required for the project which would have led to huge transportation costs, NTPC got these special indigenous floaters developed/manufactured locally and got assembled within the vicinity of the project that resulted in creation of job opportunity for the local unskilled manpower as well as reduction in the project cost.
- 20 PV modules are connected to each string. 24 strings formed an array.

- The project brought many technical, environment, social and commercial benefits.

Key Takeaways

Opportunities and challenges

- FSPV are gaining popularity in areas where land is scarce and adequate water bodies are close by. The benefits of FSPV outweigh the costs, including lower land requirements, shorter gestation periods, up to 10% higher yields, and less water loss due to evaporation. The FSPV and hydropower plants in hybrid arrangement is of particular interest owing to the following advantages they offer:
  - Utilization of existing transmission infrastructure
  - Hydropower can smooth variable solar output by serving as storage asset
  - Solar can help to manage periods of low water availability bringing resilience
- The cost of FSPV depends on the depth of the reservoir, more depth, more the cost for anchoring and mooring. It is also true if the reservoir has large variation in water levels.
- FSPV installers should assess marine life and then design the capacity of plant accordingly. If reservoir does not have much marine life, then more surface area can be utilised for FSPV.
- Challenges related to anchoring of FSPV:
  - Uneven contour of natural reservoirs including variation in water level can lead to collapse of the FSPV. Bathymetric, SPT, topography data is therefore necessary.
  - Under water anchoring/ mooring line connections is a challenge.
  - .
- Challenges related to FSPV
  - Extreme weather conditions and natural calamities such as typhoon, tsunami, hurricanes etc.
  - Saline environment can have a negative impact on durability of components.
  - Installation and maintenance of electrical components on water body.
  - Limited availability of qualified developers, suppliers and other contractors.

Potential in African Region

- According to the World Bank, just 1% of the surface area of man-made water reservoirs in Africa has the potential for 100 GW_p FSPV capacity.
- Also, a study conducted by conducted by researchers at the Joint Research Centre (JRC)[1] stated that installing FSPV on 1% of the area of African hydropower reservoirs, could double the current hydropower installed capacity and increase by 58% the electricity output in Africa.
- Hybrid of FSPV and hydropower plant can behave like a solar PV with battery backup but can be more affordable and safer while bringing benefits for hydropower.
- High capacity FSPV in large lakes in Africa, can be injecting into a regional power pool, for the benefit of countries deprived of grid electricity.
- The following observations are based on a World Bank study for a 5x41 MW hydro power project generating 840 GWh/year in Manantali dam, Mali.
  - By adding 70MW of hydro-PV hybrid system could boost annual generation to 992 GWh per year.
  - Adding 170MW of PV could boost annual generation to 1,165 GWh per year with additional investments in substation and compensation basin.
  - Furthermore, up to 4-meter rise in reservoir water level is predicted (for the period July 2018 to August 2018) based on simulations carried out on the operation curve of the power plant by combining 70 MW_{ac} of FSPV with hydro power.

Experience sharing

H.E. Mr. Shingo Miyamoto Minister, Head of Economic Section, Embassy of Japan in India shared Japan's experience in Floating Solar Photovoltaic Projects

- In Japan, Most of the floating solar panels are installed in rainwater reservoirs which have been developed to meet agricultural needs. Because these reservoirs are shallow and immovable, they are ideal for FSPV installation, and around 60,000 of the 180,000 are large enough to support floating solar plants.
- The majority of FSPV plants have capacities of up to 3 MW and represent for over 96 percent of total FSPV installed capacity.
- Typhoons and tsunamis are major concerns for the FSPV projects.

Country Interventions by NFPs in Africa

Intervention made by H.E. Mr. Wisdom Ahiataku-Togobo, Director, Renewable & Alternative Energies, Ministry of Energy, Republic of Ghana

- Ghana has targeted a total of 250 MW by solar PV (245 MW ground mounted SPV and 5 MW of FSPV). So far, 50 MW of grid connected ground mounted solar PV and 1 MW of FSPV has been installed.
- The 1 MW FSPV in Ghana is the first FSPV in Sub Saharan Africa region and is spread across 1.5 acres of water surface. In contrast, 1 MW ground mounted Solar PV plant occupied 4.5 acres of land, indicating the benefit of saving on coverage area in case of FSPV. Also, since fishing is banned at the site of FSPV, it has allowed fish to breed in a safe space.

[1] https://ec.europa.eu/jrc/en/science-update/floating-solar-panels-african-hydropower-reservoirs

Intervention made by H.E. Dr. Souleymane BERTHE, Director General of AER, Republic of Mali

- In Mali, international organisations are developing projects for energy solutions. Considering the cost of batteries, it is viable option to consider hydro power as storage option. Mali needs ISA's assistance in developing such FSPV-Hydro power plants.

Queries Made by Participants During the Webinar held on 'Floating Solar, A New Pillar of Solar PV'

- Queries and their Answers are attached as Annexure-I to Summary Report

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Disclaimer: The views expressed/ data shared in this report are of the speakers only and ISA neither endorses nor validates these views/ data.

Annexure-I

Queries Made by Participants During the Webinar on 'Floating Solar, A New Pillar of Solar PV

(Note: The responses below are given by the speakers and is only for the purpose of general understanding. ISA neither endorses nor validates these data)

Ques 1: What is the maximum cyclonic wind speed that Floating Solar PV (FSPV) can withstand?
FSPVs are required to withstand a wind speed of around 200 kmph Ciel & Terre's Hydrelio floats withstand wind speed upto 210 kmph
Ques 2: How can you computationally prove the water saving potential from evaporation by installing floating PV on water bodies?
Based on the studies, theoretical proofs are obtained to evaluate the water saving potential from evaporation by installing floating PV on water bodies
Ques 3: I had a quote from Ciel and Terre a few years ago. Will I have to deal with France Ciel and Terre or India now for one project in Zambia?
If quotation is received from France, the further steps will be proceeded by Ciel & Terre International (France)
Ques 4: Are you planning to test other Manufacturer's floaters? (For Ciel and Terre)
No. Ciel & Terre manufactures and tests its own floaters.
Ques 5: In one of the research projects in Zambia leveraging hydro reservoir with retrofitted floating PV and onshore wind potential, virtual storage was realized by optimizing the daily dispatch of hydro + FSPV + wind. Have you been able to attain similar feat in other countries?
Ciel & Terre does have certain projects with storage and FSPV. Yet it's not a hybrid of wind, hydro and FPV.
Ques 6: Can we say FSPVs gives an advantage equivalent to Tracker based Plants?
Though FSPVs have a fixed tilt, they organically produce better energy when compared to ground or roof top due to the cooling effect of the water on the panels.
Ques 7: Please specify challenges & C&T's experience in respect to FSPV plants large hydro reservoirs with up to 50m depth and 25m level variation.
Anchoring installations, maintenance of anchors and mooring lines, damages caused by debris, floods, soil erosion, distance between arrays will be higher when compared to low water level reservoirs (to accommodate array movement during water level variation)
Ques 8: What is the rule of thumb in balancing against competing activities like boat cruise, fishing and FSPV coverage on a water body? What is your experience on FSPV ESIA and challenges?
When it comes to developing a floating solar plant on a man-made water body like irrigation reservoir or water storage pond, etc., maximum area of the water body can be covered since there's less to no impact on aquatic life or recreational activities. Whereas on a waterbody like lake or river, we ensure to follow the state's environmental guidelines.

There is not really any rule of thumb - you need to conduct social studies and environmental studies as well as consultations with local communities around their use of the reservoir and all of those together will determine maximal water coverage
Ques 9: During Warranty how you are going to provide defective floaters. Is there any methodology to check the for defective floaters?
In case of a defective floater, the developer claims for a warranty to the subsidiary and an inspection is done. Breakage in any part of the floater that leads to reduce buoyancy or leakages is usually identified as a defect.
Ques 10: Can the floating solar PV resist wind speed of up to 200 km/h or even higher in countries subject to cyclones?
Yes. Hydrelio floats withstand wind speed up to 210 kmph.
Ques 11: Is the solar energy generated from FSPV's in cost less or more per kWh? A general question for the LDC /SIDS which generally are surrounded by seas and are river rich.
Installation cost of the FSPV will be 15-25% higher than the typical ground-mounted/rooftop system, considering the higher safety requirement, however, the energy output is higher when compared to ground or roof top due to the cooling effect of the water on the panels
Ques 12: For the three existing FSPV plants in India, what is the percentage of the surface area covered? Any special considerations in terms of what percentage to be take?
CIAL - recreation pond – 27.7% **Sagardighi Thermal Power Plant – water storage pond – 50%** **Southern Petrochemical Industries Corporation – water storage pond – 71%** **When it comes to developing a floating solar plant on a man-made water body like irrigation reservoir or water storage pond, etc., maximum area of the water body can be covered since there's less to no impact on aquatic life or recreational activities. Whereas on a waterbody like lake or river, we ensure to follow the state's environmental guidelines.**
Ques 13: Are the anchoring solutions warranted for 25+ years?
Standard warranty for 10 Years by C&T, Extended warranty support can also be provided
Ques 14: How do the junction boxes are connected with the PV panels and how the maintenance activities are carried out in case any problem with the boxes?
Junction boxes are connected to the PV panels with the help of DC cables routed through DWC pipes. A trained professional carries out the maintenance activities.
Ques 15: On average what is the cost of a bathymetry study per MWp of FSPV from your experience?
It will depend upon the site-specific condition such as Depth, Area, topography. Approximate per acre INR 1000 can be taken for consideration.
Ques 16: What is the best software for technoeconomic analysis of floating solar PV?
PVSyst
Ques 17: What are the parameters to be included in DPR of floating solar PV?
Key parameters - String configuration, plant layout, yield simulation, anchoring report, float details, site-specific studies report, financial and commercial data etc.
Ques 18: Is the maintenance cost for floating solar is higher than ground one? Any data?

The maintenance cost for a floating solar is comparatively lesser since there's less soiling of the panels.
Ques 19: Comment on identifier un site de projet solaire flotlant? et comment on evalue son potentiel? English translation: How do you identify a floating solar project site? and how do you assess its potential?
Areas with lesser land availability, more energy need and available water bodies give good scope for floating solar.
Ques 20: Pour le système d'ancrage: quels sont les outils pour vérifier la variation du niveau d'eau ???? dans le cas où des crues sont observées, comment sécuriser les équipements?? English Translation: For the anchoring system: what are the tools to check the variation of the water level? In the event that floods are observed, how can the equipment be secured?
Based on data provided by developers/ customers, the anchoring solution is provided. The anchoring and mooring solutions possess a slight movement to adjust to the varying water level. Proper feasibility studies to be conducted for better assessment.
Ques 21: Is the maintenance cost for floating solar is higher than ground one? Any data?
The maintenance cost for a floating solar is comparatively lesser since there's less soiling of the panels.
Ques 22: Is there any specific advantage of choosing frameless double side glass PV Panels over conventional PV panels?
Expected output is higher in double side glass panels. Double side glass panels come with 30 years warranty while conventional PV panels come with 25 years warranty.
Ques 23: How to handle water bodies involving crocodiles and hippos? In terms of both safety and damage risks.
It's better to avoid floating solar in case of crocodiles and hippos considering safety to both the plant and the animals. Log Booms can be alternatively used
Ques 24: What are the cost comparisons between floating solar projects and ground mounted solar projects?
Please Ref Answer to Q 11
Ques 25: What is best cleaning system recommended for a floating solar plant?
Cleaning systems depend on project and area. A specified cleaning system doesn't work for all plants. A conventional cleaning system works for most plants.
Ques 26: What is the rough conservation in water evaporation per MWp?
Ref Q2. a list of developers as of 2 years ago is provided in the Handbook (last annex): https://esmap.org/where_sun_meets_water_handbook but this is just a list of reputable companies - they were not vetted or in any way endorsed by the World Bank
Ques 27: Does the World Bank have a pool of qualified developers, suppliers, and contractors for FSPV that can be considered?
A list of developers as of 2 years ago is provided in the Handbook (last annex): https://esmap.org/where_sun_meets_water_handbook but this is just a list of reputable companies - they were not vetted or in any way endorsed by the World Bank
Ques 28: What is best cleaning system recommended for a floating solar plant?
Please Ref answer to Q26.

Ques 29:	In terms of cost which is expensive between FSPV and ground mounted?
Please Ref answer to Q11.	
Ques 30:	Is it possible to employ drones for FSPV hot spot detection and visual inspection?
Yes.	
Ques 31:	How the modules are cleaned in case of floating solar PV projects?
The maintenance team reaches the panel with the help of secondary floats and clean the panels.	
Ques 32:	Are the floating panels at optimum tilt?
We have a specified tilt of 5 degree and 12 degrees. It can be optimized as per requirements.	
Ques 33:	comment se fait l'ancrage après transport de la plateforme et des flotteurs sur l'eau??? English Translation: How is the anchoring done after transporting the platform and the floats on the water?
Anchoring will be marked and positioned before launching the island from the platform and is later connected.	
Ques 34:	What is the EPC Cost of 1 MW Project?
Cost of project will vary depending upon the site specific conditions, However as per thumb rule it may vary from 5-6 Cr/ MWp	
Ques 35:	please share presentation and the recorded video.
Presentations are attached herewith. **Youtube Link for Webinar is https://www.youtube.com/watch?v=3UZYsWTfPUc**	