

# Floating Solar Power Plants: A Review

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**ABSTRACT:** Energy demand during this era has increased which led us to travel for renewable energy sources; solar power with this respect can fulfill the energy demand. This paper aims at review of the prevailing floating solar plants worldwide with reference to their capacity. Floating solar plants can save the world for generation. Limitations to such power station are land availability, land development & land acquisition, substation capacities, evacuation also timely clearances for the project ashore and evacuation. These are hurdles for completion of the project. Most of the locations projected by the govt considering radiation data in the country are hot and dry regions. Though at these locations the radiation seemed to be higher, the energy yield of those points is a smaller amount thanks to heating of the solar panels and better temperature of the surface of solar cells. To beat these problems an innovative idea has been available front for installation of solar energy plants on the water that's canal tops, water bodies, lakes, dam backwater and reservoirs, which generally belongs to the govt. This paper reveals review regarding the floating solar PV power plants installed within the world

**Key Words:** Renewable energy, solar photo voltaic, solar power plants, floating Solar System, floating solar PV installations in the world, advantages of floating solar power plants, types of floating structures for solar power Plants

## I. INTRODUCTION

The biggest problem in our country is power crisis. Around 70% coal is employed for generation of electrical energy. Irrigation and industry production is get affected thanks to load shedding, daily shutdown, etc. So we'd like to maneuver towards renewable energy sources to get electricity. Now a days renewable energy sources are growing fast not in only India but many other countries. solar power is clean,

efficient and abundant source of other energy. the utilization of solar power solar power decreases atmospheric phenomenon. Area wise seventh largest country is India and has good sunshine. solar power is energy produced by sun created through a thermonuclear process and this process creates heat and electromagnetic radiations. These electromagnetic radiations have the energy that reaches the world. solar power is that the indirect source of energy so we'd like two main components: firstly the collector to gather radiations which are coming from the sun and convert it into the electricity form, secondly storage unit as radiations are varying in nature. to unravel the energy crisis solar power are going to be a superb solution but to use land mounted system is that the requirement of land which is extremely costly and fewer available to urge it. India will generate up to 1.75GW solar energy s from renewable energy sources and 1 GW of solar power in upcoming 10 years.

As per the Nehru National Solar Mission around 5000 MW has been commissioned till date in several parts of the country. to form the country consuming green power in world, the progress isn't just sufficient and wishes hard efforts by every state and state departments.

Floating system has PV concentrator which is extremely light weight and it floats on water bodies, mounted on anchored rafts float on the surface of irrigation canals, water reservoirs, quarry lakes, and tailing ponds. a number of systems exist in France, India, Japan, Korea, the uk and therefore the us. The floating system reduces the necessity of costly acreage, it also saves the beverage that might rather be lost thanks to evaporation, reduces the expansion of algae. The system shows a better efficiency because the panels are kept in cooler temperature than they might get on acreage. The floating platforms are 100% recyclable, utilizing high density polyethylene which can withstand ultraviolet rays and corrosion. Floating solar is additionally called

as 'SOLAR ARRAY' or 'FLOTOVOLTAIC' or 'FLOATING PV'.

## II. BASICS AND OVERVIEW OF FLOATING SOLAR POWER PLANTS

These floating solar plants are installed on water reservoirs like dams, lakes, rivers, oceans, etc. The solar panels are mounted on floating platforms which are anchored tightly to in order that it'll not get damaged even under the more severe weather conditions. Moreover, research suggests that solar panels installed ashore surfaces leads to the reduction of yields, as the ground gets heated and affects the rear surfaces of solar array. Studies also suggests that if the

rear surfaces of solar panels are placed on the highest of the water, the solar panels are going to be ready to cool themselves more efficiently which suggests they're going to last longer and that they can shade the water they float on which reduces evaporation by up to 70%, also their ability to get power goes up as high as 16%. The mixture of PV plant technology and floating technology gives a photovoltaic (PV) floating power generation. This fusion of latest concept consists of floating system which may be a floating body (structure + floater) that allows the installation of the PV module, PV system i.e. PV generation equipment, almost like electrical junction boxes, that are installed on top of the floating system and underwater cable which transfers the generated power to the PV system development.

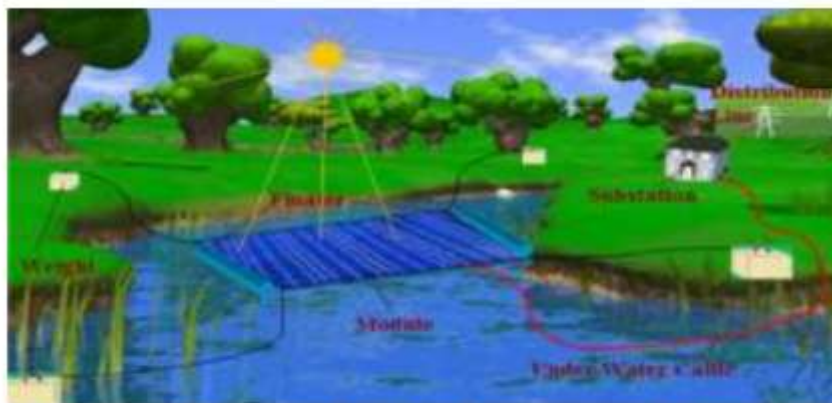


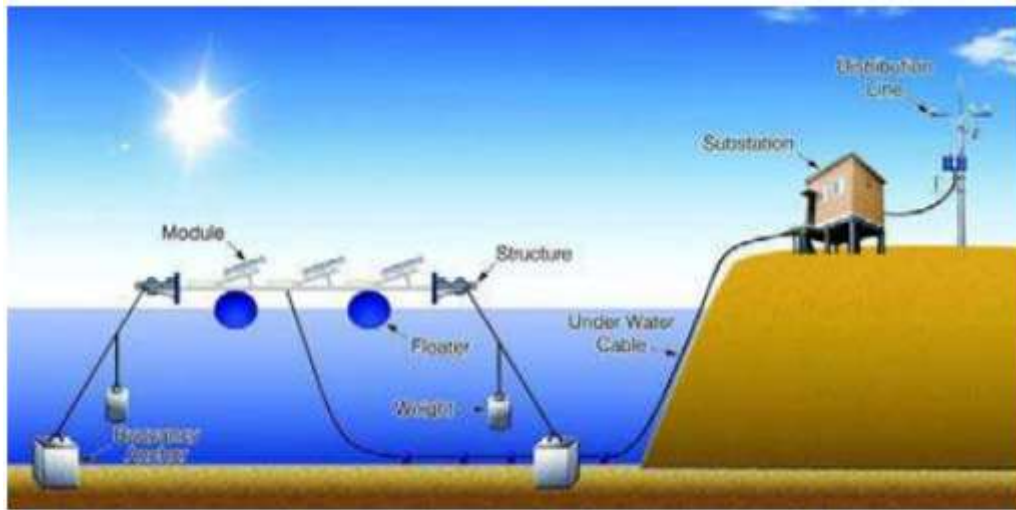
Fig -1: Layout of floating solar power plant.

Floating solar arrays are PV systems that float on the surface of beverage reservoirs, quarry lakes, irrigation canals or remediation and tailing ponds. A little number of such systems exist in France, India, Japan, South Korea, the UK, Singapore and therefore the US. The systems are said to possess advantages over photovoltaic plant ashore. The value of land is more expensive, and there are fewer rules and regulations for structures built on bodies of water not used for recreation. Unlike most land based solar plants, floating arrays are often unobtrusive because they're hidden from public view. They achieve higher efficiencies than PV panels ashore, because water cools the

panels. The panels have a special coating to prevent rust or corrosion.

## III. PARTS OF FLOATING POWER PLANT

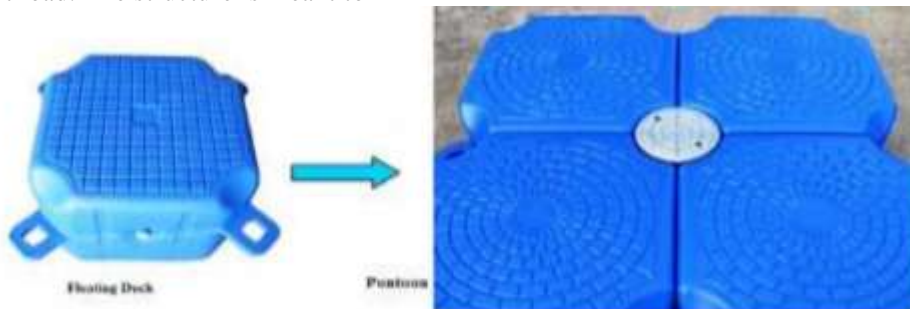
Floating Solar Power plant is an innovative concept in energy technology to meet the needs of our time. The floating PV system is a new method of solar-energy generation utilizing water surface available on dams, reservoirs, and other bodies of water resulting from the combination of PV technology and floating technology. The floating PV plant consists of a floating system, mooring system, PV system and underwater cables.



**Fig -2: Floating PV plant outline**

1. **Pontoon/Floating Structure** - A pontoon is floating structure. It has buoyancy enough to float on water and support an important load. The structure is meant to

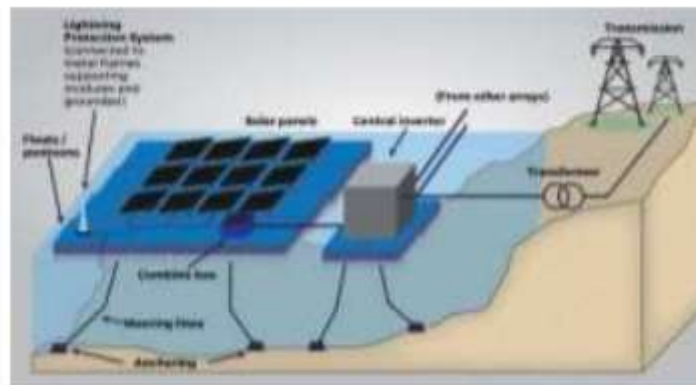
hold number of panels. Floating structure allows installation of PV module



**Fig -3: Pontoon structure**

2. **Mooring Structure** - A mooring structure is that the permanent structure which secures floating structure. The mooring gives free movement of floating structure on the water. An anchor mooring fixes a floating structure's position relative to some extent on rock bottom of a waterway without connecting the floating structure to shore. This enables adjusting water level fluctuations while maintaining its position during a southward direction.
3. **Solar Module** - it's PV Generation equipment, almost like electric junction

boxes, which are installed on top of the floating system. one solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring. Mostly crystalline solar PV modules are used for the floating solar systems.



**Fig -4: Floating Power Plant**

4. **Cabling** - Cabling is to transfer generated power from water bodies to the substation. thanks to their outdoor usage, solar cables are specifically designed to be resistant against UV radiation and very heat fluctuations. These are generally unaffected by the weather.

#### IV. OVERALL ANALYSIS OF FLOATING POWER STATION

Overall analysis includes business and environment factors. Generally analysis is that the foundation for evaluating the probable opportunities i.e. future scope and danger from the external environment and therefore the reform the internal potential and the changing trends. It views all positive and negative factors inside and out of doors the project that affect the success. It helps within the decision-making process and helps in forecasting/predicting the success of the project. The merits, demerits, future scope and danger of Floating solar plants are highlighted within the following section.

##### 1. Merits Of Floating Power Station (Internal, Positive Factors)

- a) Floating solar energy plant system typically generates more electricity than ground-mount and rooftop systems thanks to the cooling effect of the water.
- b) The floating platforms are designed and engineered to face up to extreme physical stress, including typhoon and storm conditions.
- c) These installations reduce water evaporation and algae growth by shading the water.
- d) Geographically any water bodies with abundant sunlight are often wont to install floating plants.
- e) Floating platforms are 100% recyclable, utilizing high-density polyethylene, which may withstand ultraviolet rays and resists corrosion

- f) Number of module install compares with the opposite system.
- g) Non-use (and disturbance) of land which conserves the local environment.
- h) Easy to erect and faster deployment

##### 2. Demerits Of Floating Power Station (Internal, Negative Factors)

- a) Long-term maintenance requirements and sturdiness of floating solar PV is yet to be seen.
- b) Ecological and adverse impacts on water ecosystem.
- c) Relatively young and immature technology.
- d) Lack of experience and knowledge.
- e) Lack of cooperation from local distribution utility.
- f) solar power concentration levels on floating platform.
- g) High waves and salt water possibly damage the solar panels over time.

##### 3. Future Scope Of Power Station (External, Positive Factors)

- a) Growing innovations in Floating technology
- b) Increasing concerns about land neutral energy generation and energy independence
- c) Great potential and increasing awareness for floating PV.
- d) Availability of water bodies and land issues are main accelerators for floating PV Solar Panels.
- e) Increased efficiency of Floating PV over Land PV installed
- f) Availability of trained manpower and Govt. Policies has boosted the arrogance of investors.
- g) Stable floating PV platforms leads to minimum operation & maintenance cost.
- h) The emergence of latest markets and investments in India, China, Thailand, Malaysia and other developing countries.



#### 4. Dangers in Floating Station (EXTERNAL, POSITIVE FACTORS)

- a) Large dependency on land-based PV generation.
- b) Lack of testing and standard procedures of floating solar.
- c) Untested Technology for end of the day .
- d) No promotion and support through a separate policy.
- e) Cost concerns and lack of monetary resources.
- f) Bulky maintenance and repair.

#### V. ENVIRONMENTAL EFFECTS OF FLOATING SOLAR

Floating solar platform allows standard PV panels to be installed on large bodies of water like beveragereservoirs, quarry lakes, irrigation canals or remediation and tailing ponds. simple and affordable floating solar platform is particularly well suitable for energy

and water-intensive industries who cannot afford to waste either land or water. Wineries, dairy farms, fish farms, mining companies, wastewater treatment plants, irrigation districts and water agencies are industries which can enjoy the synergy that floating system creates between sun and water.

#### VI. FIRST FLOATING SOLAR ENERGY PLANTS:

The world's first floating photovoltaic system was installed in 2007 by SPG Solar on a pond at Far Niente Winery in Napa California. It contains 1,000 floating panels linked to 1,300 stationary panels ashore to supply a complete of 4 MW. In Napa of California most of land used for wine fields, therefore the Floating system is chosen to secure the land which is employed for power generation. Figure 3 shows the image of world first solar energy plant



India's first floating solar energy station was installed at pond of Victoria Memorial. A raft like platform fitted with hollow plastic or tin drums would be floating on water. the facility generating equipment like solar panels would be fitted on this raft in order that they will float on water. This system would be ready to generate 10 KW of power and would require an area of around 100 sq metres. The project was funded by ministry of power and renewable energy, it might be the primary floating power grid project in India. The cost of the project is 32 lakh rupees sanctioned by ministry power and renewable energy sources. The project was commissioned by Vikram Solar's in cooperation

with the Arka Renewable Energy College in Kolkata.

The installation is totally flexible and consists of ten one kW fibre glass modules, which structure the floating platform itself. The system is firmly anchored to the bottom of the lake and is connected to the grid employing a submersible cable. The overall system is meant to last for 25 years and produce a minimum generation of 14MWh/year. Fig 4 shows India's first floating solar energy station launched in one of the Victoria Memorial's ponds commissioned in 2014.



### Future India

Having already started on their decide to install 50 megawatt (MW) solar plants on top of several canals, India has taken the creative use of space one step further and is planning on floating an influence station on one among the massive stretches of water in Kerala, astate in south-western India. This floating solar energy technology was developed by India's Renewable Energy College and therefore the plant is being built by Indian energycompany, the National Hydro Power Corporation (NHPC).

### VII. CONCLUSION

With the advancement in solar photovoltaic system, the floating solar energy plant plays an important role. The advantage of the floating system is reduction of evaporation, thus helping preserve water levels during extreme summer. When panels are installed on floating platform, the heating problem of solar array ashore is solved to an excellent extent. This floating technology is long-lasting, cost effective, flexible and fewer time for installation. the benefits and technical details of floating solar energy plant are presented during this paper. With this advancement, country like India can meet its power demand in future.

Floating solar concept is straightforward enough, but there are major technological hurdles. Floating solar application with challenges and opportunities has been discussed.

a) The analysis presented during this paper are often utilized as tool for future development of floating photovoltaic systems

b) To revolutionize floating solar, threats identified got to be tracked appropriately. However, the longer term seems bright for the floating solar technology.

c) Within the near future, the surface of the water bodies related to hydroelectric dams, pumped storage installations, and cooling ponds of electrical power plants—locations that typically have existing power system connections are going to be totally covered with the floating system.

d) Floating system is technically feasible and economically viable.

e) Floating solar technology would convince be an innovative step because it could solve the perennial problem of land.

f) In India large water bodies are available in Eastern, Southern and South-eastern a part of the country in states like West Bengal, Assam, Orissa and Andhra Pradesh, Tamil Nadu and Kerala. This technology are often adopted in these states resulting in considerable savings ashore prices and convey down power generation expenses, thus reducing the gap between thermal and solar energy.

g) Continued research on designing anchoring system for floating PV system is required to completely fix the buoyancy system.

h) The effect of salt water on the PV structure and therefore the module performance has got to be researched.

i) Development of solar tracking system which will change the lean and azimuth angle of floating PV system is required.

j) Most of the projects alive in corporate rigid crystalline PV modules which are incapable of withstanding harsh water environment therefore research on flexible thin film technology for such harsh condition need to be explored.

k) Developments of huge megawatt scale floating solar farms in near future may pay way for the off shore solar technology development.

l) Maximum speed of wind, water current, temperature limit, snow load, cyclone and typhoon has got to be considered while designing the solar array .

m) The efficiency of floating solar plant is 11% higher and reduces the water evaporation by 70%, however the investment of such power station is 1.2% times above the traditional solar energy plant.

n) Appropriate safety measures to move the facility from the water bodies to the land need to be administered .

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