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Design & Study of Floating Solar Powerplant

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Abstract: The non-renewable energy sources are continually running out, and their usage has detrimental consequences on the ecosystem. Three-quarters of the global greenhouse gas emissions are attributed to the use of fossil fuels for energy, raising worries about global warming. The ideal solution to the aforementioned issue is the generation of clean energy from renewable energy sources. Renewable energy is energy produced from a source that is continuously and organically regenerated and does not get exhausted when consumed. There is no requirement for land while utilizing floating solar PV since we can generate electricity from the water's surface without it Additionally, there is no requirement for land, freeing up that space for other uses. Additionally, water evaporation is forbidden, reducing the possibility of water shortages and allowing for the production of energy. We will build a working model of a floating solar power plant as part of this project to generate electricity using sunlight, a renewable source of energy. We have chosen to carry out our working model project on a lake inside the boundaries of Vishwairti Agrotourism in Shirur because the location is an agrotourism resort and has a lake inside its boundaries as well as abundant sunlight that will help us generate continuous energy and calculate the amount of energy needed to run our project.

The generated electrical energy can be also used to fulfill their basic electricity needs such as lightbulbs and chargers as the result of our projects meets the basic needs of the hotel as well as its lake will be used for electricity generation purpose.

Keywords - Solar energy, Renewable source**,** Floating Solar Panel

I. INTRODUCTION

1.1 The Floating Solar Power Plant is a project that uses sunlight, a renewable energy source, to generate electricity. The idea behind "floating solar panels" is to build a solar energy system over bodies of water instead of conventional places like rooftops or open areas. This relatively new concept was useful because it helps reduce water evaporation from storage systems and use the area to generate electricity and store water. This project uses solar cells to convert solar energy into electricity. From the point of view of the PV factor, there are 4 governing elements that affect the PV output power. First comes the energy source, which is daylight, then there is the transformer, which is the solar cell, plus the time when the solar block works, and finally the dimensions of the generation where it is used as auxiliary to the generation**.**

In recent years, more and more countries have shown interest in building floating solar power plants in search of a renewable energy source. We are blessed with sunlight year-round. However, the warm climate also causes large amounts of valuable water resources to drain from reservoirs due to high evaporation. Since floating solar panel systems are built on top of bodies of water and not on land, they should have the added benefit of reducing evaporation. Therefore, the use of floating solar systems is very important and worth investigating. Unfortunately, currently there is no concrete evidence to reduce the evaporation rates of floating

solar panels, and to reduce the cost of the project, we tried to make the base with plastic pontoons, crushing waste plastic instead of concrete to reduce project cost.

1.2 Energy Sources:

Energy is classified into two classifications: -

a) Non -renewable Energy – Non renewable energy sources are finite and as the name cannot be renewed. This type of energy is a secondary energy source which is obtained after processing. Non renewable energy sources include Petrol, Coal, Natural gas, etc. Residues of this energy are harmful to environment. For example, generation of Carbon dioxide and CO3 gas after combustion of petrol by vehicles. Burning of coal causes smoke leading to air pollution. Being a finite energy source, these are getting depleted day by day, adversely affecting the economy by inflation due to shortage.

b) Renewable Energy – Energy that is obtained from an energy source that is not exhausted or that is continuously produced is called renewable energy. Renewable energy sources include solar, wind, water and biomass. Renewable energy is clean energy that has no harmful effect on the environment.

1.3 Floating Solar PV system:

Floating solar panels are photovoltaic systems that float on the surface of drinking water pools, quarry lakes, irrigation canals or remediation and enrichment ponds. In India, South Korea Japan,,France, Singapore, Great Britain and the United States, few systems like this are working. The systems are reportedly superior to terrestrial solar power.. The price of land is more expensive, there are fewer rules and regulations for buildings built on non-recreational water bodies. Unlike conventional terrestrial solar power plants, floating systems achieve higher efficiencies than land-based solar panels because water cools the panels. special coating is provided to panels to prevent corrosion

1.3.1 Components of Floating Solar PV System

a) Pontoon/Floating Structure - A pontoon is a floating structure and its buoyancy is sufficient to float on the water surface and support a large load. The structure is designed to accommodate multiple panels. In this project, we use recycled plastic containers and bottles as a floating structure because it also reduces plastic waste**.**

b) Mooring system - Mooring means any permanent structure to which a floating structure can be attached. The floating structure is attached to the mooring to prevent free movement of the floating structure in the water without attaching the floating structure to the land, anchoring sets the location of the floating structure at a point on the resorvoirs bottom..

c) Solar module - one solar module can only produce a limited amount of power; most installations contain several modules. A panel or array of solar modules, a solar inverter, and occasionally a battery are the standard components of a solar power system. and/or a solar tracker and interconnecting wiring. Crystalline solar modules have been mainly used in floating photovoltaic systems

d) Cabling - due to outdoor use, solar cables are specially designed to withstand UV radiation and extreme temperature fluctuations and are generally not affected by the weather.

1.4 Why floating solar PV now a days?

Solar panels work better when cooled. Therefore, if you have two identical systems, one on land and one in water, the one in water actually works better. Therefore, a country like Germany, which is not known for its tropical climate, can be one of the leading countries when it comes to solar energy. Another benefit of floating solar panels is that they can block sunlight and up to 70% lessen evaporation by shading floating water.

Using floating solar electricity, we can use the surface of the water to produce energy and there is no need for land, which provides this amount of land for other purposes, and water evaporation is prohibited, minimizing water shortage and excess for electricity production.

For example, if a 3-hectare reservoir covered with solar panels could save 40 lakh liters of water from being evaporated per year. Solar panels also prevent sunlight from entering the water, which can reduce rate of

growth of algae. In terms of energy production, one square meter of floating solar panels can produce 500,000 kWh.

1.5 Objectives:

1. To reuse plastic waste
2. To generate electricity from a renewable source of energy
3. To reduce water evaporation from water resources.
4. To save the land for future use by implementing our project on water.
5. To use the area covered by water for electricity generation
6. To calculate energy produced by PV cells
7. To generate clean energy which do not have any adverse effects on environment

II. RESEARCH METHODOLOGY

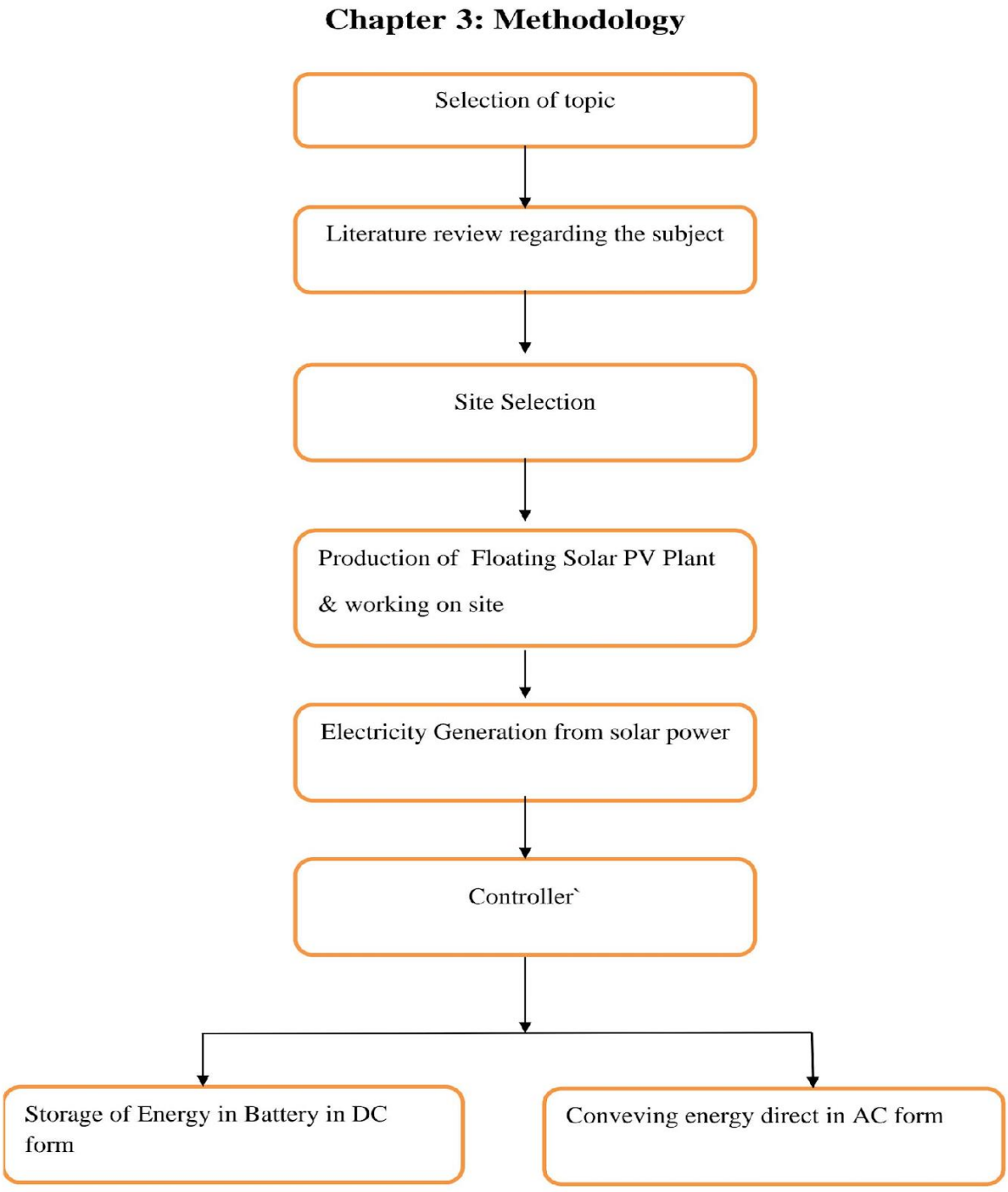

Fig. 2.1. Methodology of project.

2.1 WORKING OF A SOLAR ENERGY SYSTEM

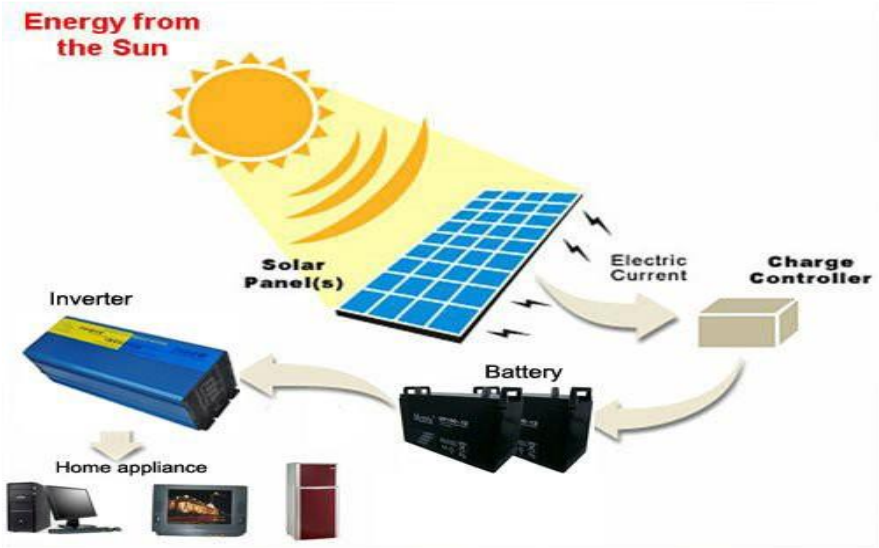

Fig. 2.1.1 Working of a solar energy system

1. The sunlight in nature falling on the solar panel is absorbed by the solar panel
2. The PV cells convert sunlight to DC electricity
3. The DC electricity is then sent to the controller through wiring cables.
4. The current is further converted in AC form and further transferred to battery for storage.
5. The Stored electricity is then used for fulfilling the electricity needs as a source of energy

2.2 Materials Used for this project

Sr. No.	Component	Specifications
1	Solar Panel	12V, 20 Watts
2	Controller	100 W (DC to AC)
3	Battery	12 Volts, 4.5 Ah
4	Cables / Wiring	1.5 mm^2 waterproof cable
5	Plastic Bottles	1 litres capacity
6	Plastic Cans	5 litres capacity

Table 2.2.1. Materials used for this project

Specifications of Solar Panel		
1	Dimensions	450 x 350 x 22 cm
2	Weight	2.5 Kgs
3	No. of cells	36 Nos.
4	Wattage	20 Watts
5	Voltage	18 Volts
6	Voltage at max power	18.2 Volts
7	Panel Type	Polycrystalline

Table 2.2.2. Specifications of Solar Panel

Costing of project		
Sr. No.	Materials	Rates in Rs. (Approx)
1	Solar Panel	3000
2	Waterproof Sheet	50
3	Battery	600
4	Controller	2000
5	Wiring	100
6	Floating Structure	000 (Recycled Plastic bottles, Drums)

Table 2.2.3. Costing of Project

2.3 Procedure for measuring the amount of electricity.

To accurately assess the electricity generation from solar panels, a well-defined measurement procedure is essential. The following steps outline the procedure for measuring the electricity generation both on land and in a floating solar plant:

1. **Measurement Setup:**
   - Install a data acquisition system that can measure and record electrical parameters such as current (I), voltage (V), and power (P) generated by the solar panels.
   - Ensure proper electrical connections between the solar panels and the data acquisition system, following safety guidelines and considering the system's capacity to handle the generated power.
   - Calibrate and validate the data acquisition system to ensure accurate measurements.

2. **On Land Solar Panel Measurement***:*
   - Place the solar panel on a stable surface in an open area where it can receive direct sunlight without obstructions or shading.
   - Connect the solar panel to the data acquisition system.
   - Start recording the electrical parameters (I, V, P) from the solar panel at regular intervals, such as every minute or every second, depending on the desired level of detail.
   - Continue measuring for a predetermined duration, such as a few hours or a whole day, to capture the solar panel's electricity generation under different sunlight conditions.
   - Record environmental parameters like solar irradiance, ambient temperature, and wind speed during the measurement period for reference and analysis.

3. **Floating Solar Plant Measurement:**
   - Install the floating solar plant prototype in a suitable water body, ensuring proper anchoring or mooring to maintain its position.
   - Connect the solar panels of the floating plant to the data acquisition system, considering the electrical safety measures required for operation in a wet environment.
   - Begin recording the electrical parameters (I, V, P) from the solar panels, similar to the on- land measurement procedure, at regular intervals.
   - Monitor the electricity generation continuously over a specific time period, capturing variations due to environmental factors such as wave action, water temperature, and wind conditions.
   - Take note of any additional measurements specific to the floating solar plant, such as the stability of the floating platform, the impact of water on panel cooling, or the performance of any integrated water treatment modules.

4. **Data Analysis:**

- Process and analyze the collected data to calculate various performance parameters of the solar panels, such as power generation efficiency, capacity factor, and energy output.
- Compare the electricity generation measurements between the on-land solar panel and the floating solar plant to evaluate the impact of the floating platform and the potential benefits of the system.
- Consider factors such as solar irradiance, ambient temperature, shading, or water-related effects on the electricity generation to assess the performance and suitability of the floating solar plant prototype.

Fig. 2.3.1. Floating solar powerplant model.

2.4. Generation Details

Vishwa Kirti Agrotourism resort has daily usage of average 150 – 200 Kwa usage of electricity which consists of all the appliances such as Refrigerators, TV set, Sound system, etc. as well as the lights.

While charging, the usual mobile phone charger is rated at 3 to 7 W. This implies that even if it takes your phone two hours to charge, it will only use between 0.006 and 0.014 units, or kWH, of power. A 3W LED bulb uses 3Watts/hour

In our project Storage Battery is 12V 4.5 Ah that means it can store 12 * 4.5 = 54 Watts when fully charged, which means it can store sufficient electricity to power

1. 3W LED lightbulb continuously 18 hrs straight
2. Mobile Charger for approximately 9 – 18 hrs without disruption
3. Other small scale basic electrical needs.

So, by use of our project we can meet the basic electricity needs of the location

III. Results And Discussions.

The Floating solar panel shows the increase in solar energy efficiency. At 1100 W/m^2 of solar radiation, the power gain of the photovoltaic device increases to 5.93 percent. Design and manufacture of a PV system shows that it can increase PV efficiency by lowering the temperature of the solar cell. In relation to these circumstances, the FPV system is one solution to reduce the cost and space required for installing a solar panel, which increases the efficiency of the solar panel and offers ecological technology because it has less impact on the earth. It is proven that after two hours of testing in sunlight, the power gain of the floating solar panel increased by 15.5% compared to the conventional solar cell.

Cost Aspects	**Floating Solar Plant (100 MW)**	**Ground-Based Solar Plant (100 MW)**
Land Acquisition	1 crore (in rare cases)	2 crore
Floating structure	1 crore 50 lacks	N/A
Civil Works	12 crores	36 crores
Solar Panels	300 crores	300 crores
Mounting Structures	1 crore 20 lacks	24 crores
Electrical Component	48 crores	48 crores
Grid Connection	12 crores	12 crores
Installation and Labor	24 crores	24 crores
Maintenance and Operation	1 crore 60 lacks	1.8-3 crore
Security and Insurance	80 lacks	80 lacks
Decommissioning	12 crores	12 crores
Overall Cost	421-423 crore	450-452 crore

Table 3.1 Comparison of FSP and GSP

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