International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 05 | May 2023 www.irjet.net p-ISSN: 2395-0072

Floating solar plant with recycled plastic waste pontoons & overview

Prof . Sarika .P. Thombare[1], Utkarsh Balu Patil[2], Aniket Sudhir Sonawane[3], Manish Sanjay More[4], Mayur Vijay Kondhalkar[5]

[1]Guidance : Prof . Sarika.P.Thombare (M.E Construction Management)
(M.E Construction Management) Ajeenkya DY. Patil Collage Of Engineering Lohegaon, Pune, India
[2,3,4,5] Civil Engineering Department DY. Patil, School of Engineering, Lohegaon Pune, Maharashtra, India

---

Abstract - *Innovative methods are required to maximize energy production while resolving environmental issues due to the increasing rise of renewable energy. This research report provides a thorough analysis of the development of a floating solar plant using pontoons made from recycled plastic waste. The goal is to investigate whether using recycled plastic debris as a sustainable replacement for the flotation bases in floating solar arrays is feasible and could have positive effects. An overview of the current situation of the solar energy industry is presented at the outset of the study, emphasizing the growing importance of land optimization and sustainable practices. The consequences of plastic trash accumulation on the environment and the pressing need for efficient waste management techniques are then covered in depth. The research also explores the effects of using recycled plastic waste pontoons on the general effectiveness and efficiency of the floating solar plant. The potential for energy generation, cost efficiency, and environmental sustainability are examined, taking into account elements like solar panel orientation, system stability, and maintenance needs. The results demonstrate the enormous benefits of using pontoons made from recycled plastic trash in floating solar farms. Reduced environmental effect, optimal land use, and potential financial savings are a few of them.*

Key Words: Pontoon, Photovoltaic Cells, Sustainability, Land optimization, Albedo effect, HDPE

1.INTRODUCTION

Innovative strategies for utilising renewable energy have been driven by the rising global demand for sustainable and clean energy sources. Particularly in regions with a shortage of available land or where the use of waterbodies offers a chance to generate renewable energy, floating solar plants have come to be recognised as a feasible alternative. An overview of a floating solar plant concept that uses pontoons built from recycled plastic waste is given in this research study from the standpoint of civil engineering.

Researchers and engineers have been forced to look into alternative energy options due to the depletion of traditional sources of energy & the pressing need to minimise greenhouse gas emissions. In recent years, interest in solar energy has grown significantly because it is a clean and plentiful source. However, the adoption of conventional land-based solar arrays is hampered by land shortages and environmental issues related to the accumulation of plastic trash. In order to overcome these difficulties, the article suggests a concept for a floating solar plant that uses pontoons built of recovered plastic trash. From a civil engineering standpoint, the suggested design has many benefits. By using recycled plastic for the pontoons, it first addresses the urgent problem of plastic waste pollution. Second, by utilising underutilised water bodies, it optimises land use, making it a desirable solution in urban or highly populated areas. Additionally, the incorporation of recovered plastic waste pontoons offers chances for environmentally responsible building methods. This study paper's main goal is to give a thorough description of the design of floating solar panels using pontoons made from recycled plastic waste. This entails looking at the structural elements, viability, and potential advantages and difficulties connected with this novel technique.

Figure 1 100 mw floating solar power plant at Ramagundam, Telangana

2. METHODS AND MATERIAL:

2.1 MATERIALS REQUIRED:

Several resources are required to build a prototype for a floating solar power plant made out of pontoons made from recovered plastic trash. The stability, buoyancy, and durability provided by the floating platform have all been guaranteed by the careful selection of these components.

Plastic Cans:

Size: 5-liter cans Material: High-density polyethylene (HDPE) or another suitable plastic material

Dimensions: Height is around 30-35 cm, 15 cm Width

Solar Panels:

Type: Photovoltaic (PV) panels

Wattage: Depending on the project's size and power requirements, choose panels. (20 W for prototype")

Dimensions: Dependent on the size and wattage of the panel

Anchoring System:

Ropes for securing the solar plant on the water.

Electrical Components:

Solar charge controller- Select a controller based on the voltage and current capabilities of the system.

Inverter- converts solar energy from DC to AC so that it can be used or connected to a grid.

(Optional) Batteries For off-grid applications requiring energy storage

High-quality cables, connectors, High-quality cables, connectors,

Marine-grade sealants to shield electrical circuits from moisture intrusion

2.2 PROCEDURE FOR MAKING PROTOTYPE

1. The plastic cans should be free of labels and stickers. Make sure the cans are fully cleaned and dried to get rid of any impurities or leftovers.
2. On the PVC foam sheet, measure and mark the appropriate dimensions. The floating solar plant prototype's particular specifications and dimensions will determine the base's size
3. The plastic cans' bottom surface should be covered with glue. Assuring perfect alignment, place the PVC foam sheet on top of one of the cans' adhesive-coated surface
4. Make sure to equally space out the plastic cans with the PVC foam sheets attached in the desired configuration. Apply glue to a can's top surface, then carefully stack another can on top of it while making sure they are perfectly aligned.
5. In accordance with the manufacturer's recommendations, for the glue to completely cure and dry. It can require several hours or perhaps a night.
6. Check the foundation structure for any loose connections or places that need more adhesive after the adhesive has dried. By putting the base in a body of water or a suitable container filled with water, you may check its stability and buoyancy. Verify that it floats and stays in place without exhibiting any signs of instability or sinking.

2.3 MERTS OF USING PONTOONS MADE OF RECYCLED PLASTIC WASTE IN FLOATING SOLAR PLANT:

- Environmental Sustainability: By lowering the demand for virgin plastic resources, using pontoons made of recycled plastic waste helps to preserve the environment. It assists in preventing plastic trash from ending up in landfills or waterways, reducing the harm that plastic pollution does to ecosystems.
- Recycling plastic trash for the construction of pontoons helps to conserve precious resources. The requirement for new materials is lessened by turning plastic trash into useful parts of the floating solar plant, which lowers the extraction of raw materials and the energy required to produce them.
- Cost-Effectiveness: Making pontoons out of recycled plastic trash can be more affordable. Because recycled components are frequently less expensive than new ones, building the floating solar plant was able to be done for less money. Recycling plastic garbage could also lower waste management expenses for incineration or disposal.
- Pontoons composed of waste plastic that has been recycled can have great buoyancy and durability qualities. Long-term floating applications might benefit from the water degradation and corrosion resistance of plastic materials like high-density polyethylene (HDPE).
- Circular Economy Promotion: Adopting pontoons made from recycled plastic waste aligns with the principles of a circular economy. It demonstrates the ability to close the loop in the plastic value chain by transforming waste materials into valuable products, extending their useful life and minimizing the environmental impact associated with traditional disposal methods.

2.4 BENIFITS OF FLOATING SLOAR PLANT OVER CONVENTIONAL SOLAR PLANT

- **Increased Energy Production**: Installing floating solar plants on water bodies, which frequently have less impediments like trees or buildings, has an advantage. As a result, more sunlight is exposed to the earth throughout the day, which increases energy production compared to solar power plants on land.
- **Reduced Land Use**: Floating solar plants effectively utilise otherwise underutilised areas by using water surfaces like reservoirs, lakes, or ponds. This lessens the requirement for buying land, making it a more long-term solution, and helps address the issue of restricted land accessibility particularly in highly populated places.
- **Water Conservation**: The shadowing effect of floating solar panels lowers water surface evaporation, aiding in water resource preservation. The combination of energy production and preservation of water offers an additional advantage in arid regions or areas with a limited supply of water, where it is especially advantageous.
- **Increased Energy Efficiency**: By lowering the working temperature of the solar panels, the cooling impact of water increases their efficiency. The presence of water beneath the solar panels helps maintain cooler temperatures, resulting in higher energy output. Solar panels typically experience decreased efficiency as temperatures rise

3. RESULTS AND DISCUSSION

The study's findings show how economically viable and productive a floating solar plant utilising pontoons built from recycled plastic trash can be. Utilising recycled plastic trash as pontoons provides a long-term, environmentally responsible option that also has financial advantages.

Cost comparison: When compared to conventional land-based solar plants, the floating solar plant using recycled plastic pontoons offers a more affordable option, according to the cost study. Utilising recovered plastic waste greatly lowers the cost of materials for pontoons, which lowers the overall project cost. Reduced land acquisition demands and the opportunity to use existing water bodies, which eliminate the need for major land preparation and related costs, further increase the cost-effectiveness

Table -1: Shows cost comparison between floating solar plant and land based solar plant of 100 MW each

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

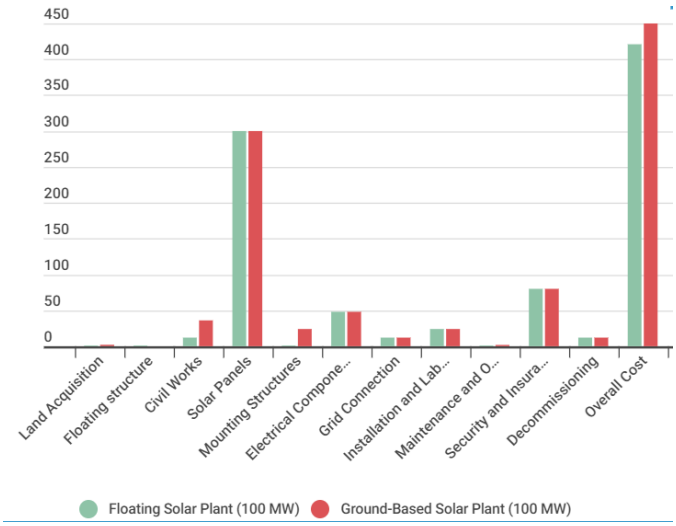

Figure 2 figure showing cost comparison of both solar plant

Energy output: According to an analysis of energy output, a floating solar farm made of recycled plastic pontoons is capable of producing as much energy as solar farms on land. The sun's energy is effectively captured and converted into electricity by the solar panels positioned on the pontoons. Additionally, the plant's floating nature enables ideal orientation and synchronisation with the sun's path, enabling maximum solar irradiation all day long. Additional solar radiation on the bottom of the floating panels may result from the reflecting properties of water surfaces, improving overall energy generation.(albedo effect).a study of comparison of power production between floating solar plant and land based solar plant in south Korea(Young-Kwan Choi " A Study on Power Generation Analysis of Floating PV System Considering Environmental Impact" International Journal of Software Engineering and Its Application) has shown that floating solar plant produced 11% more energy than land based solar plant. We noticed a increase of 8.9 % during implementation of our project.

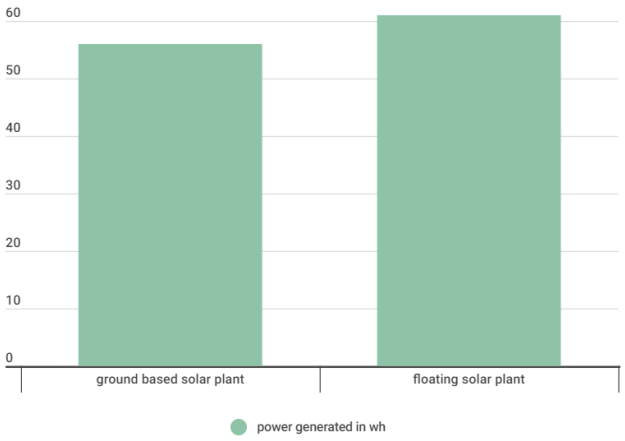

Figure 3 graph showing electricity production comparison of prototype in 1 day

Cost effectiveness of recycled plastic for making pontoons: When comparing the price per square metre between recycled plastic pontoons and traditional pontoons, recycled plastic pontoons provide a more affordable option. The utilisation of recycled plastic material, which is frequently more affordable than newly produced materials, adds to the pontoons' total affordability. Recycled plastic is anticipated to cost 40 rupees per kilogram, making recycled plastic pontoons substantially more affordable per square metre that is 400 rupees per metre square than other materials which may cost form 700-2000 rupees per metre square. Additionally, the production of recycled plastic pontoons could use less complex methods, cutting costs.

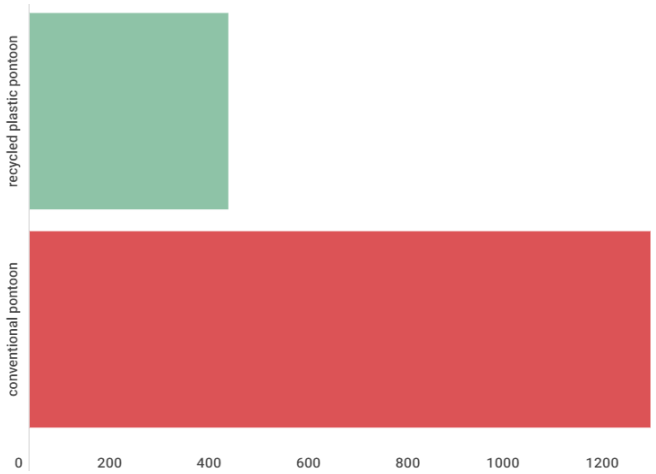

Figure 4 cost comparison of conventional and recycled plastic waste pontoon

Environmental Sustainability: Recycling plastic to make pontoons for floating solar farms can have a big impact on environmental sustainability. Reusing and recycling plastic materials creating pontoons helps lessen the pressure on landfills and reduces plastic pollution in our environment due to the significant amount of plastic waste produced globally. In addition, manufacturing recycled plastic pontoons often requires less energy and emits less greenhouse gases than manufacturing pontoons from fresh plastic. The circular economy's guiding principles are supported by this strategy, which encourages resource efficiency and reduces waste. The World Economic Forum reported that from about 1.5 million metric tonnes in the 1950s to more than 359 million metric tonnes in 2018, the world's plastic manufacturing has surged. Due to their adaptability and durability, plastics, particularly HDPE, have established themselves as a widespread material in a variety of industries. Plastic garbage output has significantly increased globally as a result of plastic production and consumption. A study that appeared in the journal Science Advances projected that as of 2015, the world has produced 6.3 billion metric tonnes of plastic garbage. Additionally, according to this report, the total amount of plastic garbage might exceed 12 billion metric tonnes by the year 2050.If we consider that we require 10 kg of recycled plastic per meter square then we would require 5,00,00,000 kg to make pontoons for a 100 MW floating solar plant.This might help to take a step towards environmental sustainability.

Figure 5 a prototype of floating solar plant of 20 w capacity with recycled plastic cans

4. CONCLUSIONS

In conclusion, research into the construction of floating solar farms using pontoons made from recycled plastic waste offers a viable alternative for the sector of renewable energy. Using recycled plastic trash as pontoons has a number of benefits, including affordability and environmental sustainability. According to the cost research, recovered plastic waste pontoons can be a more affordable option than traditional pontoons. Furthermore, the energy output comparison shows that floating solar plants can produce energy outputs that are equivalent to or even greater than those of their land-based equivalents. This discovery emphasises floating solar technology's promise as a workable choice for capturing solar energy.

Additionally, by encouraging a circular economy strategy and limiting the buildup of plastic trash, the use of recovered plastic waste for pontoons is consistent with environmental sustainability goals. This study aids in resource preservation and the decrease of plastic pollution by turning discarded plastic into useful pontoons. In the end, the use of pontoons made from recycled plastic waste in floating solar plants marks a significant advancement in the production of clean energy and environmental sustainability.

REFERENCES

[1] Young-Kwan Choi " A Study on Power Generation Analysis of Floating PV System Considering Environmental Impact" International Journal of Software Engineering and Its Application

[2] Sampurna Panda, Manoj Gupta, "Comprehensive review on Advanced Cooling Techniques for Photovoltaic Panel", 2022 2nd International Conference on Power Electronics & IoT Applications in Renewable Energy and its Control (PARC), pp.1-5, 2022

[3] Feasibility analysis of Floating Solar Photovoltaic Plant at Srisailam in Andhra Pradesh: India by P S Kulkarni G Mamatha.

[4] Techno economic Analysis of 1 MW Floating Solar PV Plant Swati S Gurfude Deshetty Tanusha Dhayapule Mounika

[5] Sreenath Sukumaran, Sudhakar K. Fully solar powered Raja Bhoj International Airport: A feasibility study. Resource Efficient Technologies. 2017

[6] Hyder Farhan, Sudhakar K, Rizalman Mamat. Solar PV tree design: A review. Renewable and Sustainable Energy Reviews. 2018;82(2018):1079–1096