International Journal of Trend in Innovative Research (IJTIIR)
Available Online @ www.ijtiir.com | ISSN: 2582-0354

Floating Solar Technology

[1]Dr. Damodhar, [2]Badampudi Divakar
[1,2]Sasi Institute of Technology and Engineering
[1,2]Tadepalligudem, West Godavari District, Andhrapradesh, India

Abstract-- Lack of land available, loss of performance at high operating cell temperatures, energy security, and decarbonization goals are boosting the market for floating solar technology (FPV). It's a promising solar photovoltaic application with a vast global market. The shortage of simulation tools for calculating power production is a big barrier when appraising FPV projects. Getting a great idea of and measuring. The cooling effects, and the changes between different FPV technologies, are still a subject of discussion in the industry. As a function, A significant number of larger initiatives will emerge that will necessitate funding. As a result, ensuring bankability is crucial. The aim of this study was to act as a bridge between the literature's claims of improved performance for FPV systems and the results of numerical simulations of energy production utilizing PVsyst®. The increase in production from FPV innovations is below typical, according to the research. The literature's data points (about 10%) range from 0.31 percent to 2.59 percent, depending on the floating planet's atmosphere technology. Higher performance is largely dependent on technology and the atmosphere, per the studies location. The cost of energy ranged from 96.2 €/MWh to 50.3 €/MWh, depending on the source. The sun irradiation that reaches the place and the technology

I. INTRODUCTION

The world's energy demands are skyrocketing. Between 2015 and 2040, it is expected to rise by 28%. Presently, this increase is primarily based on fossil fuels (oil, gas, and coal), which are limited and have adverse environmental impacts. Well-known negative environmental impacts. As a result, alternatives are now available. And more ecologically responsible electricity production sources are needed to be developed. The obvious response is renewable energy. Currently, the renewable energy sector is in a positive cycle. The deployment of renewable energy is experiencing exponential growth globally. By the end of 2018, the global renewable energy sector will have reached its peak capacity contributed nearly 33% (2378 GW) of global output.

This decade has seen exceptional progress in the sector. The total installed capacity of solar photovoltaics (PV) was only about 10.5 GW in 2008, but it achieved approximately 125 GW in 2018. The sector has grown from a single niche market to a large-scale market.A battery is the most common type of power source. Funding and incentive packages. Schemes were a major driving force behind the development and innovations of solar technologies As a result of consumption and the market's rapid expansion is being aided by experience curve effects such as technological advancements. The prices of the sections In 2018, that was 0.30 USD/Wp, a fall of almost 99.6% in 42 years, 1976.

Nomenclature

ABEX	Abandonment expenditures	GHI	Global horizontal irradiation
AC	Alternating current	GW	Giga Watt
BIPV	Building integrated photovoltaic	HDPE	High-density polyethylene
BOP	Balance of plant	IP	Ingress protection
CAPEX	Capital expenditures	LCOE	Levelized cost of energy
CF	Capacity Factor	MWh	Mega-Watt hour
C&T	Ciel & Terre	OPEX	Operational expenditures
DNI	Direct Normal Irradiance	PID	Potentiality of induced degradation
DC	Direct current	PR	Performance ratio
EYA	Energy yield assessment	PV	Photovoltaic
FPV	Floating photo voltaic	RES	Renewable Energy Source
GCR	Ground coverage ratio	TRL	Technology readiness level
		Wp	Watt peak

The installation of large-scale PV systems requires a sizeable portion, with each MW costing about 1.6 hectares. It is a problem in the area, especially in countries with a high population density. It is possible to see competition for land use, like conflicts between different PV applications. Agricultural use or in big cities where there is currently a water shortage. Rooftop usage for reasons other than electricity generation, such as rooftop gardens, is in competition. Moreover, while land resources are finite, the high acquisition costs have a negative impact on the level condition of the business.

The first FPV applications came in 2007, with the Aichi project in Japan being one of the oldest, featuring a 20-kW capacity [16,18]. As a result, FPV applications have spread throughout the world. Many installations can be found in countries such as the United Kingdom, France, and Italy. China, Singapore, and Korea are a few examples [20..........The vast majority of the initiatives developed were small-scale research and development systems. For experimental purposes. The sector is about to undergo a transformation. The first larger plant (7.55 MW) was installed in Japan in 2017.Then, in 2017, China installed a 40 MW FPV plant. The recently, the sector has gained pace, with the most recent plants being installed.

The lack of suitable modelling software for estimating electricity production and, as a consequence, LCOE, is a significant challenge when assessing FPV projects, restricting a company's ability to make well-informed investment risks and making banks hesitant to finance FPV projects. The cooling effect must be fully understood and measured. It's still unclear how different FPV technologies differ from each other Commercial However, studies that quantify the cooling effect remain limited. There's something new on FPV 14 right now. Furthermore, no thermal models for convection between PV modules and water have been developed and incorporated into the simulator for the current range of FPV technologies.

II. OVERVIEW OF TECHNOLOGY

The FPV technology consists of a floating structure comprising PV generation equipment, a mooring system, and an underwater cable that bridges from the solar PV system to a land-based substation. The main objective of aIn some ways, a floating solar plant is similar to a ground-mounted plant.Inverters are installed on top of floating structures in certain cases.The FPV includes the following elements, as seen in Table 1: (a) a moveable structure,mooring and anchoring, inverters, underwater cabling, and mooring and anchoringe) solar modules and their related technologies.

The solar modules, which are normally mounted at fixed tilt angles, are maintained by others. It also gives it the buoyancy it needs to float on its own. The floatable. The structure must be strong enough to withstand both domestic and foreign forces, as well as the weight of the modules. It's true.designed in such a way that the solar modules and all other elements are maintained.On top of that, there were the required tools.Floaters exist in a variety of shapes.available on the market, with various metals, configurations, and so forth.

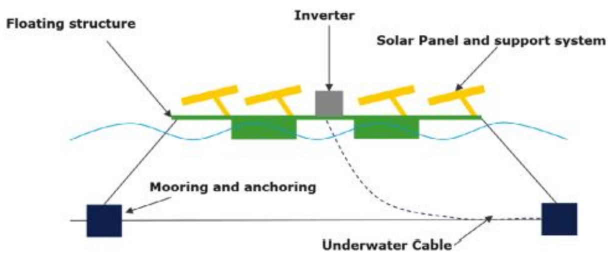


Fig. 1. Main components of a FPV system.

FPV applications are currently primarily constrained to freshwater bodies. Oceans, on the other hand, cover over 70% of the Earth's surface and constitute a considerable, renewable energy source that is still largely unexplored today untapped. As a consequence, the transition to floating solar applications for Natural sites will be discovered near the shore, but then offshore. Added Complexity would be to be expected, as these applications will encounter problems according to their nature. As a result of the severe storm environment and the requirement for floater ability to survive huge (but rare) wave loads FPV on seawater has two challenges: salt corrosion and abiotic hazards (mainly wave impact and wind).

Table: 1

FPV Tecnhology		Brief description
HDPE		• Individual floaters; • Constraints in adjusting module inclination; • Standard mass production; • Fabrication: blow molding process; • Expensive logistics (transportation of floats for 1MWp requires 25 standard truck loads); • Typically requires a production line close by the project location; • Typically bank anchoring is used; • Cooling by convection.
Galvanized steel		• Low-cost manufacturing; • Adjustable module inclination; • Usage of cheap and local materials; • Typically bank anchoring is used; • Cooling by convection.
1 or 2 axis tracking		• Low-cost manufacturing; • Adjustable module inclination; • Adjustable azimuth; • Typically, several moving parts; • Cooling by convection.
Membranes		• The buoyant ring: produced locally from welded HDPE piping (accessible in most parts of the world); • Thin polymer membrane with hydro-elastic properties; • The membrane: produced by specialists (Norway); • Smaller sections of the membrane are welded together in a controlled environment; • Membrane requires low transport volume – relevant for logistics; • Mooring systems based on aquaculture; • Cooling by direct contact of the membrane with water.

Table: 2

Technology Type	Example of supplier	Country of origin	Location ofcompleted FPV projects	Purpose	Peak Power	Total FPVcapacity installed
HDPE	Sungrow	China	Worldwide	Freshwater bodies	1 PV module per float	500 MWp
Galvanized steel	4C Soalr	USA	Singapore, Chile, Maldives	Freshwater bodies	Not Available	< 5 MWp
1 or 2 axis tracking	Solarisfloat	Portugal	Portugal	Freshwater Bodies	67 kWp per island	< 5 MWp
Membranes	Ocean Sun	Norway	Norway, Singapore	Freshwater applications and nearshore sheltered environments	500 kWp per insland, with a dimanter of 72 m	0.1 MWp

III. ADVANTAGES AND DISADVANTAGES

The high expectations of land resources and rooftop areas, conflicts with other sectors such as oil or tourism, and the loss of land are the major factors in the birth and key indicators of floating solar.At a high operating celltemperature, efficiency is optimized. In some circumstances,Surface devices are incorporated into an inventory in inaccessible locations.High infrastructure costs (e.g., substations) are essential in certain situations, and, like in others, The project is in a challenging area, such as on steep or unstable terrain.results in additional site preparations (earthworks). These aspects play a key role.As a consequence of CAPEX, projects are becoming less economically attractive.

1. Shade impacts are minimized because they are positioned in open locations.
2. Higher degradation inhibition.
3. The moisture of the aqueous body's solid body is reduced.Park estimates a 33 percent decrease in water wastage.for natural bodies of saltwater, and up to 50% for building facilities;
4. Increased output due to the cooling influence of the weather.variations in the waterwaysDespite this, there is still a lack of documentation.
5. Higher voltage output due to the reflection (albedo) of the surface.Contribution of water to the increase in electron beam.

Table: 3

Technology	Region/Country	Purpose	Peak Power
Swimsol	Maldives	Nearshore shelterd areas applications. Hs constraints of 1.5–2 m	24 kWp per platform unit
SUNdy	Global potential, however it is more indicated to locations near the tropics, due to the PV modules being installed flat	Open Sea application	2 000 kWp per array
Heliofloat		Open Sea application	Not available in the literature
Moss Maritime		Nearshore and offshore applications. Hs constraints of 3–4 m	40 PV modules per platfomr unit (ca. 15 kWp)

IV. CASE STUDY

The effects of natural habitats on the power output of FPV devices was investigated at three different site sites.The Granada site was chosen because of the abundance of conservatories in the area (demand and customer close) and the proximity of the conservatories.Figure shows the restricted space available for ground-based systems. The location of Barrow Gurney was chosen since the lakes are close to Bristol. (Request and user nearby) and extremely close water treatment works. Finally, the Ballina dam (upstream reservoir) was chosen mostly because of its location.Many advantages suggested that FPV and VR should be co-located.

Fig. 3. Overview of the Almeria location, source Google Earth®.

This area of sun illumination is an important factor to consider when calculating powergeneration at a given location. Irradiation is evaluated at kWh/m2 and is divided into two types: direct and indirect. GHI (Global Horizontal Irradiation) is a term that refers to the amount of sunlight that reaches the earth's surface.

DNI (Direct Normal Irradiance) [44] is a measurement of the amount of light that enters the body through the eyes. The Global Heat Index (GHI) is a measure of how much direct heat there is in the atmosphere.When absorbed dispersed sun energy falls on a flat surface and isone that is thought to be important in evaluating PV power generation.techniques. The GHI was collected for the case study areas.

The Meteotest Institute created the Meteonorm database. Meteonorm is a weather forecasting system that uses geostationary sensors and meteorology models.spanning the years 1981–1990 and encompassing the entire globe.

Fig. 4. Overview of the Barrow Gurney location, source Google Earth®.

V. METHODS

The EYA for the different case studies were performed on PVsyst, asoftware package used to study and simulate solar PV plants, which isextensively employed in the PV industry. It includes comprehensive meteorological and PV system components databases.In this study, a grid connected PV system is designed with thesupport of the mandatory input parameters of the software, includingbut not limited to: site location, local weather data, albedo, systemcomponents (inverters, modules), system sizing, orientation and tilt ofthe PV modules, system sizing and detailed losses.PVsyst® does not yet have an option to simulate FPV systems.However, it is possible to adjust the current available parameters tosimulate these systems, as discussed in the following subsections. To benoted that only the most relevant computation simulation parameterswill be discussed in their work.

The PVsyst® simulations were performed for a 1MWp plant in each of the 3 locations. The primary purpose was to calculate normalized energy (MWh/MWp) and specific power (kWp/m2)., as well as the thermal efficiency (MWh/m2) variables. The first will allow for the estimation of power created for any peak power, while the second and fourth will allow for the estimation of energy generated at any maximum value.the voltage generated for the given site area as well as the capacity factor for the accessible selected site, respectively.Figure 4: Aerial image of the Cay Point site, courtesy of Google Earth®.

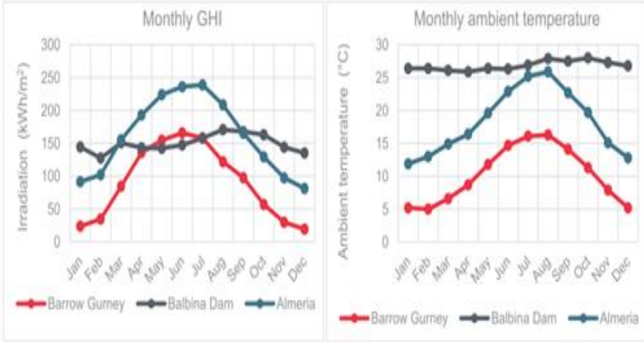


Fig. 5. Summary chart of the GHI and temperature for the different sites.

VI. ECONOMIC ASSESSMENT

The LCOE, which allows for the evaluation of a power production system's economic costs over its lifetime, is a well-established approach for quantifying a technology's economic feasibility. LCOE stands for Life Cycle Cost of Ownership.The cost-to-benefit ratio of a project's overall costs over its whole life cycle.capital expenses (CAPEX), operating and maintenance expenditures (OPEX), and abandonment costs. The projected energy costs (ABEX) are subtracted from their current values.

$$LCOE = \frac{\sum_{y=0}^{Y} \frac{ABEX(y) + OPEX(y) + CAPEX(y)}{\left(1+\frac{R_d}{100}\right)^y}}{\sum_{y=0}^{N} \frac{E(y)}{\left(1+\frac{R_d}{100}\right)^y}}$$

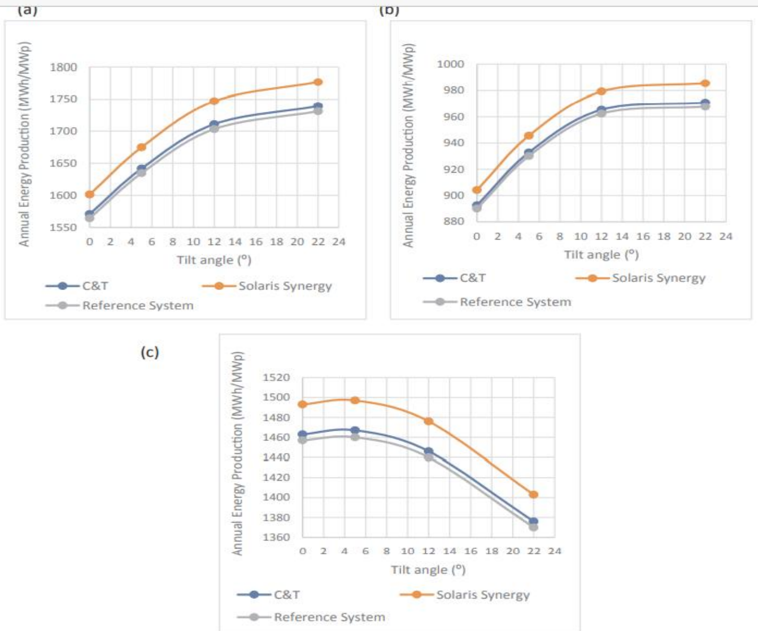
where Rd is the discount rate and y is the year of the FPV system lifespan in question, which can range from zero to Y. The opportunity cost, or the degree of financial risk involved, is reflected in the discount rate.to investment, which is dependent on geography and is also utilized.to convert both the energy generated and the future cost stream. and at their current values. Normally, the discount rates are the percentages range from 5% to 10%. It should be emphasized that a country-specific discount rate was not determined, and 7% was used in all cases in this studystudies. In addition, a 2% inflation rate was taken into account. Finally,it's worth noting that the LCOE study ignores the cost of capital.

The capacity factor, CF, is a fundamental component of the economic assessment of renewable energy sources (RES). It is defined as the ratio between the system power produced (kW) and its rated power.(kW) over a certain time period. It's expressed in percentages. This factor displays how much energy is produced by a system in comparison to other systems. With its maximum output, that is, accounting for the percentage of time that thesystem is running at maximum speed.

$$CF = \frac{E_{prod}/\Delta t}{P_{rated}}$$

VII. RESULT

The ideal tilt angle is usually close to the site's north. As the angle modelled increases, the energy generation drops, as expected, due to the low latitude of the policy proposal's location.location. Yet, due to the high GHI in the area, Ballina's average energy production remains substantially higher than Barrow Gurney's. The PVsyst® simulation was done for the three sites, for various scenarios. Technologies based on the ideal tilt angle. This allows for the highest possible annual energy generation at each location. The ideal tilt angle is generally close to the site's latitude, As the tilt predicted increases for the Ballina location, theDue to the low latitude of the system, energy production is reduced, as expected.location. However, due to the high GHI in the area, Ballina's annual energy production remains substantially higher than Barrow Gurney's.PVsyst® simulation results for the three sites, for various scenariostechnologies based on the ideal tilt angle.



References

[1] International Energy Agency (IEA). Independent Statistics & Analysis. International Energy Agency, Technical; 2017.

[2] Musa SD, Zhonghua T, Ibrahim AO, Habib M. China's energy status: a critical look at fossils and renewable options. Renew Sustain Energy Rev Jan. 2018;81:2281–90.

[3] Hussain A, Arif SM, Aslam M. Emerging renewable and sustainable energy technologies: state of the art. Renew Sustain Energy Rev May 2017;71:12–28.

[4] Resch G, Held A, Faber T, Panzer C, Toro F, Haas R. Potentials and prospects for renewable energies at global scale. Energy Policy 2008;36(11):4048–56.

[5] Renewables 2019 – global status report, REN - Renewable Energy Policy Network for the 21st Century, Paris, France; 2019.

[6] "IEO - International Energy Outlook", U.S. Energy Information Administration. Washington, D.C.: United States; 2016.

[7] Hernández-Callejo L, Gallardo-Saavedra S, Alonso-Gómez V. A review of photovoltaic systems: design, operation and maintenance. Sol Energy 2019;188:426–40.

[8] Komusanac I, Fraile D, Brindley G. Wind energy in Europe in 2018 - Trends and statistics. Wind Europe, Technical report; Feb. 2019.

[9] MIT. The Future of Solar Energy: An Interdisciplinary MIT Study, Massachusetts Institute of Technology (MIT).

[10] Wang X, Barnett A. The evolving value of photovoltaic module efficiency. Appl Sci Jan. 2019;9(6):1227.

[11] Cazzaniga R, Cicu M, Rosa-Clot M, Rosa-Clot P, Tina GM, Ventura C. Floating photovoltaic plants: performance analysis and design solutions. Renew Sustain Energy Rev 2018;81:1730–41.

[12] Sahu A, Yadav N, Sudhakar K. Floating photovoltaic power plant: a review. Renew Sustain Energy Rev Dec. 2016;66:815–24.

[13] Kabir E, Kumar P, Kumar S, Adelodun AA, Kim K-H. Solar energy: potential and future prospects. Renew Sustain Energy Rev 2018;82:894–900.

[14] Liu H, Krishna V, Lun Leung J, Reindl T, Zhao L. Field experience and performance analysis of floating PV technologies in the tropics. Prog Photovolt 2018;26(12):10.