



**Research Article**

**SOLAR PHOTOVOLTAIC CELLS: CHALLENGES AND PROSPECTS**

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**ABSTRACT**

Worldwide natural concerns and the heightening interest for power, combined with relentless advance in sustainable power source advances, are opening up new open doors for usage of sustainable power source assets. Sun based power is the most copious, endless and clean of all the sustainable power source assets till date. The power from sun blocked by the earth is around  $1.8 \times 10^{11}$  MW, which is commonly bigger than the present rate of all the power utilization. Photovoltaic innovation is one of the finest approaches to tackle the sun based power. The solar photovoltaic is a very important power source for meeting rural electricity demand in this region of the country. Thermal energy is required to fulfill several purposes in the domestic, agricultural, industrial, and commercial sectors of the economy. India is growing towards huge solar energy day by day. This paper reviews the photovoltaic innovation, its current challenges and future prospects all over the globe.

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**INTRODUCTION**

A photovoltaic power generation framework comprises of various parts like cells, mechanical and electrical associations and mountings and methods for managing as well as adjusting the electrical yield. These frameworks are appraised in peak kilowatts (kWp) which is a measure of electrical power that a framework is relied upon to convey when the sun is straight forwardly overhead on a crisp morning. A matrix associated framework is associated with a vast free network which by and large is people in general power lattice and sustains control into the framework. They fluctuate in size from a couple of kWp for private reason to sunlight based power stations up to several GWp. This is a type of decentralized power age. Poponi evaluated the prospects for dispersion of photovoltaic (PV) innovation for power age in matrix associated frameworks by the methodology of experience bends that is utilized to anticipate the distinctive levels of total world PV shipments required to reach the calculated break-even prices of PV frameworks, expecting diverse patterns in the connection amongst cost and the expansion in total shipments [1]. Rehman *et al.* used month to month normal every day worldwide sun powered radiation and daylight length information to examine the dispersion of radiation and daylight term over Saudi Arabia and furthermore investigated the sustainable power source creation and sparing assessment of a 5MW introduced limit photovoltaic based network associated control plant for power age [2].

Al-Hasan *et al.* talked about improvement of the electrical load design in Kuwait utilizing matrix associated PV frameworks as the electric load request can be fulfilled from both the photovoltaic cluster and the utility lattice and found during the performance evaluation that the peak load matches the maximum incident solar radiation in Kuwait, which would underscore the part of utilizing the PV station to limit the electrical load request and a noteworthy decrease in top load can be accomplished with network associated PV frameworks [3].

Ito *et al.* considered a 100 MW extensive scale photovoltaic power age (VLS-PV) framework which is to be introduced in the Gobi betray and assessed its potential from financial and ecological perspectives reasoned from power payback time (EPT), life-cycle CO<sub>2</sub> discharge rate and age cost of the framework [4]. Zhou *et al.* performed out the financial investigation of energy age from skimming sun based stack control plant (FSCPP) by dissecting money streams amid the entire administration time of a 100 MW plant [5]. Muneer *et al.* investigated the long haul prospects of substantial scale PV age in bone-dry/semi-bone-dry areas, around the world and its transmission utilizing hydrogen as the power vector [6]. Cunow *et al.* portrayed the megawatt plant at the new Munich Trade Fair Center that speaks to a noteworthy progress in extensive PV plant innovation, both as far as framework innovation and the segments utilized, operational control and expenses [7].

Bhuiyan *et al.* contemplated the financial matters of stand alone photovoltaic power framework to test its plausibility in remote and rustic zones of Bangladesh and contrasted sustainable generators and nonrenewable generators by

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deciding their life cycle cost utilizing the technique for net present investigation and demonstrated that life cycle cost of PV power is lower than the cost of power from diesel or oil generators in Bangladesh and in this manner is monetarily practical in remote and provincial zones of Bangladesh [8]. Alazraki and Haselip surveyed the effect of little scale PV frameworks introduced in homes, schools and open structures in the course of the most recent six years under the PERMER (Renewable Energy Project for the Rural Electricity Market) co-supported by a scope of open and private sources and the structure of budgetary endowments has empowered these remote provincial groups to get a power supply supplanting conventional power sources [9]. Kivaisi introduced the establishment and utilization of a 3 kWp photovoltaic (PV) plant at Umbuji town, in Zanzibar, Tanzania that was expected to give control supply to a town school, wellbeing focus, school staff quarters, and mosques [10]. Bansal *et al.* built up an incorporation of sun based photovoltaics of 25 kWp limit in a current working of the cafeteria on the grounds of the Indian Institute of Technology, Delhi by making a sun based rooftop covering with the photovoltaic cluster slanted at a point of 15° from the flat and faces due south [11]. Ubertini and Desideri contemplated a 15 kWp photovoltaic plant and sun oriented air gatherers combined with a sun breaker structure that was introduced on the top of a logical secondary school [12]. An attempt has been made to analyze the prospects and challenges of photovoltaic cells in the world.

#### **Performance and Reliability**

Analysts and researchers had created and proposed different techniques for assessment of execution of a photovoltaic framework. A short survey of these techniques is exhibited here. Li *et al.* explored the operational execution and productivity normal for a small PV framework introduced at the City University of Hong Kong and the measure of sun based irradiance information falling on the PV board was resolved utilizing the iridescent viability approach [13]. Yu *et al.* built up a novel two-mode most extreme power point following (MPPT) control calculation joining the changed steady voltage control and incremental conductance strategy technique to enhance the proficiency of the 3 kW PV control age framework at various insolation conditions that gives brilliant execution at under 30% insolation force, covering the entire insolation region without extra equipment hardware [14].

Huang *et al.* proposed a PV framework configuration, called "maximum power point tracking" (nMPPO) that can keep up the execution near PV framework with MPPT (Maximum power-point tracking) however eliminate the hardware of the MPPT and the long haul execution reenactment demonstrates that the general nMPPO effectiveness is higher than 93% [15]. Jaber *et al.* built up a PC reenactment model of the conduct of a photovoltaic (PV) gas-turbine mixture framework, with a compacted air store, to assess its execution and also to foresee the aggregate power change productivity and found that half breed plant creates around 140% more power for every unit of fuel expended compared and comparing ordinary gas turbine plants and lower rates of toxin discharges to the environment per kWh of power produced [16]. Stoppato introduced the consequences of Life Cycle Assessment (LCA) of the electric age by methods for photovoltaic boards [17]. Wiemken *et al.* examined impacts of consolidated power age by observing information from 100 PV frameworks that uncovers an

impressive lessening in control vacillations compared with an individual framework and the power range of combined power system demonstrated that created power is produced in a range underneath 65% of the general introduced control [18]. Keogh *et al.* exhibited another analyzer (regularly utilized for estimating sunlight based cells and modules) outline that is straight forward, ease, and decreases transient blunders by utilization of a steady voltage cell-predisposition circuit and it removes a group of I–V bends over 10 years scope of light force, which gives far reaching data on cell execution [19]. So the dissected and assessed the execution of a substantial scale network associated PV framework and checking framework that are introduced at SSDP in Daegu City keeping in mind the end goal to watch the general impact of meteorological conditions on their operation characteristics for monitoring period [20].

Mahmoud *et al.* researched the capability of PV applications in Palestine, distinguishing the hindrances for pervasiveness of PV applications as in different nations and exhibited the unwavering quality and plausibility of using PV frameworks by introducing the test consequences of a PV framework by providing a provincial facility with its energy requests [21]. El-Tamaly and Mohammed exhibited a fluffy rationale method to ascertain and survey the dependability record for each Photovoltaic (PV)/Wind Energy System (WES) Hybrid Electric Power System (PV/WES HEPS) HEPS arrangement under investigation and decided the effect of interconnecting PV/WES HEPS into Utility Grid (UG) [22]. Tanrioven exhibited a reproduction procedure for unwavering quality and cost evaluation of the power sources, for example, wind, sunlight based power and power module (FC) in an autonomous smaller scale network (IMG) framework, which is a dissemination framework with conveyed power sources, for example, microturbine, photovoltaic and power devices and built up an efficient strategy and a PC program for dependability and cost appraisal of the IMG framework containing Fuel Cell (FC), photovoltaic (PV) and wind power (WE) [23]. Stember exhibited a frameworks level approach for dependability investigations for sunlight based photovoltaic frameworks and outlined the convenience of these examinations in photovoltaic frameworks plan [24].

#### **Environmental Aspects and Challenges**

Tezuka *et al.* proposed another technique for assessing the measure of CO<sub>2</sub>-discharge decrease for the situation where the carbon-impose income is utilized as the endowment to advance PV-framework establishments and reasoned that the measure of CO<sub>2</sub>-outflow lessening increments by publicizing the PV framework with appropriation approach even under a similar duty rate and the CO<sub>2</sub>-payback time of the PV framework diminishes significantly if the GDP is expected not to change after the presentation of carbon tax assessment [25]. Krauter *et al.* inspected a CO<sub>2</sub> far reaching balance inside the life-cycle of a photovoltaic power framework and found that the genuine impact of the PV framework regarding net diminishment of carbon dioxide is the contrast between the entirety of electrical yield identified with the neighborhood network and the incentive for reusing and the aggregate of the creation prerequisites and the vehicle discharges [26]. Fthenakis and Kima examined sunlight based and atomic power age technologies'entire lifecycle of power creation; carbon dioxide and different gases radiated amid the extraction, handling, and transfer of related materials and decided the ozone depleting

substance (GHG) discharges, to be specific, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and chlorofluorocarbons because of materials and power streams all through all phases of the life of business advancements for solar– electric and atomic power age [27]. Kannan *et al.* performed life cycle assessment (LCA) furthermore, life cycle cost examination for a circulated 2.7 kWp network associated monocrystalline sun based PV framework working in Singapore and gave different energy payback time (EPBT) investigations of the sunlight based PV framework with reference to a fuel oil-let go steam turbine and their ozone depleting substance (GHG) emanations and expenses are likewise looked at uncovering that GHG discharge from electricity generation from the sun based PV framework is short of what one-fourth that from an oil-let go steam turbine plant and one-a large portion of that from a gas-terminated consolidated cycle plant [28]. Tsoutsos *et al.* exhibited an outline of an Environmental Impact Assessment for focal heavenly bodies, to gauge the size of potential natural effects and proposed fitting moderation measures, can assume a critical part to appropriate undertaking plan and to a consequent task open acknowledgment [29]. Hondo exhibited the after effects of an Life cycle Assessment (LCA) of ozone depleting substance discharges from power generation systems with a specific end goal to comprehend the qualities of nine distinct sorts of energy age frameworks that included solar powered photovoltaic (PV) from the point of view of a dangerous atmospheric deviation and life cycle ozone depleting substance (GHG) outflow per kWh of power produced was evaluated for the frameworks utilizing a consolidated strategy for process investigation and input– yield examination [30].

#### **Issues Related With Photovoltaics Innovation**

Thongpronet *al.* explored the idea of segments of complex power (genuine, receptive and clear power) of a PV-lattice intuitive framework because of low radiation, under 400W/m<sup>2</sup> and found that real power is accessible at high estimations of radiation from a PV cluster and at low radiation level when the exhibit does not give enough yield control, responsive power is drawn from dissemination transformer and sustained into an inverter and loads and subsequently strategies must be conceived to catch this low radiation power and changed over into real power shape [31]. Denholm *et al.* analyzed a portion of the cutoff points to huge scale arrangement of sunlight based photovoltaics (PV) in customary electric power frameworks assessing the capacity of PV to give an expansive part (up to half) of an utility framework's power by comparing hourly yield of a recreated extensive PV framework to the measure of power really usable and found that under high infiltration levels and existing lattice task methodology and principles, the framework will have abundance PV age amid specific times of the year [32]. Lund *et al.* dissected the issues of coordination of power generation from fluctuating sustainable power sources into the power supply outlining the size of the issue regarding overabundance power creation when diverse Renewable Energy Sources (RES) are incorporated into a Danish reference framework with a high level of Combined Heat and Power (CHP) that takes advantage of the distinctive examples in the variances of various inexhaustible sources and the reason has been to distinguish ideal blends from a specialized perspective [33]. Stuckings *et al.* considered shading and resistive misfortune from the fingers of epitomized sunlight based cells by estimating the reflection from the front surface of exemplified silver

electroplated front contact sun based cells utilizing a spectrophotometer with coordinating circle connection and found that the powerful shading misfortune is around 33% of the scope portion of the cell network due to catching of light reflected from the lattice [34].

#### **Jawaharlal Nehru National Solar Mission**

India lies in the sunny belt of the world. India is endowed with vast solar energy potential. Most parts of India get 300 days of sunshine a year. About 5,000 trillion kWh per year energy is incident over Indian land area with most area receiving 4-7 kWh per sq. meter per day. Hence, both technology solar thermal and solar photovoltaic's can effectively provide huge capability for solar in India. The choice of Solar PV activities of 500 MW limit was chosen to be embraced in two clusters more than two money related a long time of Phase I *i.e.*, 2010-2011 and 2011-2012. The measure of PV extends in the main stage in 2010-11 was settled at 5 MW per venture. Under Migration conspire NVVN began the procedure of short posting the on-going undertakings to relocate to the JNNSM. A sum of 16 tasks of 84 MW limit were chosen. These undertaking engineers marked PPA with NNVN in October, 2010 and detailed monetary conclusion. The last date for authorizing of 54 MW limit PV ventures was by end of October, 2011. The 30 MW limit sun oriented warm ventures are to be appointed by March, 2013. Later in August 2010, NVVN began the procedure of choice of new matrix sun powered power ventures containing 150 MW of Solar PV and 470 MW of sun based warm limits. This yielded a colossal reaction and applications were gotten for more than 5,000 MW limit. Preferential tariff for solar PV technology approved by CERC and various SERCs is in the range of Rs 9-11/ kWh. As per the CERC draft tariff order for determination of levelled tariff for solar technology in 2013-14 dated Oct 25, 2012 tariff for solar PV has further come down to Rs 8.75 per unit (or Rs 7.87/unit after considering benefit of accelerated depreciation). Considering base rate of Rs 6/unit, MNRE would need to provide GBI of Rs 2-3 per unit which is quite lower than the GBI provided during Phase I [35].

#### **Future Prospects**

Solar also provides the ability to generate power on a distributed basis. With the fossil derivatives in the verge of exhaustion, the inexhaustible sources are being viewed as the forthcoming possibilities for power. The sun powered photovoltaic innovation is one such source that can gaze upward to as tremendous research is being completed and a critical change in execution has been accomplished. Waldau watched that photovoltaics is one of the quickest developing enterprises worldwide and keeping in mind the end goal to keep up this development rate requirement for new improvements regarding material utilize and utilization, gadget outline, dependability and creation innovations and new ideas to expand the general proficiency emerges [36]. Feltrin *et al.* broke down a few photovoltaic advancements, running from silicon to thin movies, multi-intersection and sunlight based concentrator frameworks for terawatt level organization of the current sun based cells, and for every innovation, distinguished upgrades and developments required for additionally scale-up [37]. Muneer *et al.* portrayed sun based PV power as the arrangement of future power challenges and the measured approach embraced to meet the year 2025 power request of six noteworthy urban areas in India: Chennai, Delhi, Jodhpur,

Kolkata, Mumbai and Trivandrum, demonstrates that the recommended sun oriented hydrogen based power organize has the capacity of giving the power prerequisites [38]. The CPV technology is presently moving from pilot facilities to commercial-scale applications. By Eleventh Five-Year Plan (2007–2012) GOI proposed a solar R&D funding of amount Rs. 400 crore. The working group on R&D for the energy sector proposed an additional Rs. 5300 crore in Research, demonstration and development for the eleventh five-year Plan, with the two largest topics being: research on silicon production for PV manufacturing and research on Light emitted diodes.

## CONCLUSION

An audit of major sun based photovoltaic innovations containing PV control age, Hybrid PV age, different light engrossing materials, execution and dependability of PV framework, estimating, circulation and control is introduced. The distinctive utilizations of sun powered PV framework, for example, building incorporated framework, desalination plant, space, sun based home frameworks and pumps are additionally exhibited. This paper would be valuable for the solar based PV framework produces, academicians, analysts, creating individuals and leaders. A number of major government and industry R&D efforts aim to make STE and CPV a mainstream power source within the next decade. India is each pursuing an aggressive solar energy growth strategy, creating a very important industry and setting up ambitious mid-term targets for the domestic market in the multi-GW scale.

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