ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 6, Issue 6, June 2017

A REVIEW: ENERGY OPTIMIZATION OF SOLAR PV CELL USING VARIOUS METAHEURISTIC TECHNIQUES

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ABSTRACT

Energy from sun can be considered the main source of all types of energies. It can be used by various techniques such as making full use of sunlight to directly generate electricity or by using heat from the sun as a thermal energy. Using Photovoltaic (PV) cells is common in solar energy field. The major objective of this review study is to help anyone getting through solar energy field by introducing developments up to date in the field. One can be assisted and will save time of building a literature review about PV by this review that is considered part of a series compares the performance of PV technologies. In this paper, a comparison survey is included which investigates the three generations of PV cells with the latest characteristics.

Keywords: Photovoltaic technologies, Renewable Energy, Solar Energy, solar cells.

I. Introduction

Photovoltaic, likewise called sun based cells, are electronic gadgets that change over daylight specifically into power. Photovoltaic power were first found by a French researcher Edmond Becquerel in 1839. The principal working sunlight based cell was effectively made by Charles fritts in 1882. It was made of thin sheets of selenium and covered with gold. The utilization of sun oriented boards for producing power and warmth appears to be moderately similar to new improvement, it has really been broadly used to create control since mid 1900‟s. In 1954 Bell research facility mass delivered the primary gem silicon sun based cell. The ringer PV changed over 4% of the sun's vitality into power a rate that was viewed as the front line in vitality innovation. beneficiary researchers Daryl M. Chapin et al made a silicon-based sun oriented cell with a productivity of around 6% revealed in [23]. Researchers kept on rethinking and improved on the outline of the first sun based cell and could deliver a sunlight based cell that was equipped for putting 20% return power rate. In the late 1900‟s as mindfulness developed in the science group about the impacts of a dangerous atmospheric deviation and the requirement for sustainable power source sources, researchers kept on refining the silicon PV and by mid 2000 they could make a sun oriented cell with 24% power return. In only seven years researchers were again ready to expand the power return of silicon sun powered cell utilizing space age materials. By 2007, present day silicon PV Solar cells were working with 28% power return. There are an extensive variety of PV cell advancements available today and more applications

II. Photovoltaic power generation

A photovoltaic power era framework comprises of various parts like cells, mechanical and electrical associations and mountings and methods for managing as well as altering the electrical yield. These frameworks are appraised in pinnacle kilowatts (kWp) which is a measure of electrical power that a framework is required to convey when the sun is straightforwardly overhead on a crisp morning. A framework associated framework is associated with a substantial free network which much of the time is general society power matrix and sustains control into the lattice. They fluctuate in size from a couple kWp for private reason to sunlight based power stations up to many GWp. This is a type of decentralized power era. Poponi evaluated the prospects for dissemination of photovoltaic (PV) innovation for power era in network associated frameworks by the procedure of experience bends that is utilized to foresee the distinctive levels of aggregate world PV shipments required to achieve the ascertained earn back the original investment costs of PV frameworks, accepting diverse patterns in the connection amongst cost and the expansion in combined shipments [1]. Rehman et al. used month to month normal every day worldwide sun based radiation and daylight term information to concentrate the dispersion of radiation and daylight length over Saudi Arabia and furthermore examined the sustainable power source creation and efficient assessment of a 5 MW introduced limit photovoltaic based matrix associated control plant for power era [2]. Al-Hasan et al. talked about enhancement of the electrical load design in Kuwait utilizing framework associated PV frameworks as the electric load request can be fulfilled from both the photovoltaic cluster and the utility matrix and found amid the execution assessment that the pinnacle stack coordinates the greatest occurrence sun oriented radiation in Kuwait, which would stress the part of utilizing the PV station to limit the electrical load request and a noteworthy decrease in pinnacle load can be accomplished with lattice associated PV frameworks [3]. Ito et al. studied a 100 MW expansive scale photovoltaic power era (VLS-PV) framework which is to be introduced in the Gobi leave and assessed its potential from monetary and natural perspectives reasoned from vitality payback time (EPT), life-cycle CO2 emanation rate and era cost of the framework [4]. Zhou et al. played out the financial investigation of energy era from coasting sun oriented smokestack control plant (FSCPP) by examining money streams amid the entire administration time of a 100 MW plant [5]. Muneer et al. investigated the long haul prospects of extensive scale PV era in bone-dry/semi-parched areas, around the world and its transmission utilizing hydrogen as the vitality vector [6]. Cunow et al. depicted the megawatt plant at the new Munich Trade Fair Center that speaks to a critical progress in expansive PV plant innovation, both regarding framework innovation and the parts utilized, operational control and expenses [7]. Bhuiyan et al. concentrated the financial matters of remain solitary photovoltaic power framework to test its attainability in remote and country ranges of Bangladesh and contrasted sustainable generators and nonrenewable generators by deciding their life cycle cost utilizing the technique for net present esteem investigation and demonstrated that life cycle cost of PV vitality is lower than the cost of vitality from diesel or oil generators in Bangladesh and along these lines is monetarily achievable in remote and rustic zones of Bangladesh [8]. Alazraki and Haselip surveyed the effect of little scale PV frameworks introduced in homes, schools and open structures throughout 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 monetary sponsorships has empowered these remote provincial groups to get a power supply supplanting customary vitality sources [9]. Kivaisi introduced the establishment and utilization of a 3 kWp photovoltaic (PV) plant at Umbuji town, in Zanzibar, Tanzania that was proposed to give control supply to a town school, wellbeing focus, school staff quarters, and mosques [10]. Bansal et al. built up a joining of sun oriented 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 powered rooftop covering with the photovoltaic exhibit slanted at an edge of 15◦ from the flat and faces due south [11]. Ubertini and Desideri studied a 15 kWp photovoltaic plant and sun based air gatherers combined with a sun breaker structure that was introduced on the top of a logical secondary school [12].

III. Solar energy

Electrical vitality can be delivered from multiple points of view from daylight utilizing distinctive procedures like photograph substance, warm, sunlight based cells and so forth. Figure 1 demonstrates the stream graph of electrical vitality era from daylight. By watching figure1 it can be expressed that all begins with the atomic combination of the sun then sun oriented vitality is acknowledged in radiation shape and with the assistance of sunlight based gatherers, electrical power can be created in various ways. Gatherers can be of various sort contingent upon the techniques used to create the vitality required [26], few of them are:

3.1. Tank-type collector

In an Integral collector storage unit the solar radiations are absorbed by water collected in the storage tank. These tanks are usually mounted in an insulation box and have glazing on one side and are painted black, dark blue or coated with a selective surface. The sun shines through the glazing and hits the painted tank, warming the water inside the tank. Steel is typically used to manufacture these tanks, while copper is used for water tubes [25].

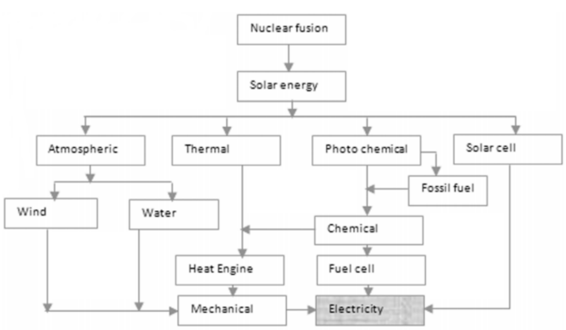

Figure 1: Solar Power Generation

3.2. Pool collector

Heating swimming pool water is among one of the important applications of active solar heating systems. To heat water in the seasonal swimming pool, special types of collectors have been developed. Thesetypes of collectors are usually unglazed and special copolymer plastic is used for their construction. These collectors are not able to withstand solidifying conditions and are operated at an approximate temperature range of 10 – 20 ºC [24].

3.3. Flat-plate collector

In solar space heating and domestic solar water heating applications, Flat-plate collectors are among the most widely used collectors in the world [25]. These type of collectors are typically used up to a temperature range of 75 ºC [28]. However it is possible to have higher temperature operating range from high efficiency collectors. As the evaporation temperature of water is 100 ºC, it has to be replaced by some other heat transfer liquid in such type of high efficiency collectors. These collectors are of two basic types' i.e. liquid type and air type [27]. They do not require any tracking system and cost of maintenance is also less [29].

3.4. Evacuated tube collector

Evacuated tube collectors vary widely in their operation and construction. They are made up of a number of annealed glass tubes, having an absorber plate within each of them. As tubes are the natural configuration of an evacuated collector, they become different from plat-plate collectors which are made up in the same way and perform from one band to another [24].

3.5. Concentrating collector

They are used for higher temperatures using optical systems (reflectors and refractors) to concentrate energy on an absorbing surface. The reflectors are usually mirrors, parabolic dishes, etc. These collectors can achieve very high temperatures 150-500 ºC because the diffused solar resource is concentrated in a small area. In order to have an efficient operation, the reflectors must be able to track the sun continuously. The geometrical concentration area ratio is given by [29]:

$$C = \frac{A_a}{A_r} = \frac{R^2}{r^2} = \frac{1}{\sin^2 \theta_s}$$

C – Concentration ratio, non-dimensional value;
Aa – area of the collecting aperture, m2;
Ar – area of the absorber, m2;
R – Distance from the sun to the concentrator, m;
r – Radius of the sun, m;
 s– half of an angle subtended by the sun, º.

This ratio depends on whether the concentrator is a three-dimensional (circular) concentrator such as a paraboloid or a two-dimensional (linear) concentrator such as a cylindrical parabolic concentrator [29].

IV. LITERATURE REVIEW

Ali Al-Karaghouli, L.L. Kazmerski [13] addresses the requirement for PV nearby planetary group to control a wellbeing facility in the rustic regions in southern Iraq. The creators utilized HOMER programming PC model to decide the most monetary framework. They proposed framework with an every day heap of 31.6 kWh which is made out of 6-kW PV modules, 80 batteries (225 Ah and 6 V), and a 3-kW inverter. The aggregate beginning cost, net present cost, and cost of power delivered from the framework are 50,700 US$, 60,375 US$, and 0.238 US$/kW h, separately. The investigation demonstrates that the cost of power created from the diesel generator is four times more noteworthy than that delivered from the PV framework, which highlights the advantage of utilizing this framework in remote regions. The examination likewise demonstrates that utilizing this little PV framework rather than a diesel generator can keep the arrival of 14,927 kg/year of CO2, 36.8 kg/year of CO, 329 kg/year of NOx, 4.08 kg/year of HC, 30 kg/year of SO2, and 278 kg/year of suspended particles.

Souissi Ahmed, Hasnaoui Othman, Sallami Anis [14]; the creators proposed an improvement arrangement of a half and half arrangement of sustainable power source by utilizing the Homer programming for remote ranges in Tunisia. The Hybrid frameworks include blend of various vitality sources like wind/battery, PV/battery, wind/PV/battery, wind/PV/diesel/battery. The climatic information are particular for the region of Hawaria in Tunisia. The ideal setup of the half breed framework wind/PV/diesel/battery planned for dependable load supply and furthermore considered the meteorological information changes is reasoned from two ideal designs chose: (wind/PV/battery) and (diesel/battery). For the wind/PV/battery the ideal setup is made by 8 kW board PV, 2 wind turbine, 118 batteries and 12 kW control converters. The underlying expense and the operation cost 165.450 US$, 2.102 US$/yr separately. The aggregate net present cost 189.559 US$ and the cost vitality created 0.540 US$/kWh. For the diesel/battery the ideal design is formed by 5 kW diesel generator, 18 batteries and 2 kW control converters. The underlying expense and the operation cost 11.934 US$, 10.707 US$/yr, individually. The aggregate net present cost 134.747 US$, the cost vitality delivered 0.382 US$/KWh and the diesel 11.269 L. For the wind/PV/diesel generator/battery with heap of 85 kWh/d the ideal design is created by 8 kW board PV, 2 wind turbine, 118 batteries, 5 kW diesel generators and 12 kW control converters. The creators demonstrates that the mix of a diesel generator, as buck-up source, with the half and half wind/PV/battery framework is the best answer for assurance the solid supply without intrusion of the heap under the climatic information change. The ideal measuring of the half and half wind/PV/diesel/battery framework is found from the two ideal designs picked: (wind/PV/battery) and (diesel/battery).

ZeinabAbdallah M. Elhassan , Muhammad FauziMohdZain [15]; talked about the proficient arrangement of economical sustainable power source for local utilized and its aggregate cost in Khartoum in Sudan. The creator's technique was the accumulation of the essential information of sunlight based radiation, wind speed and other required info information, and after that the creators utilized HOMER programming to build up the cross breed streamlining reenactment. The proposed load is 54 kWh/d, and 5.3 kW as a pinnacle. The cost of the PV module including establishment has been thoughtful as 220 SP/W for Sudan. The cost of turbine with tower and establishment has been considered as 96000 SP/turbine. For load higher than 1 kW, turbine from southwest wind control (demonstrate: W175, limit, 3 kW) has been considered at the cost of 200000 SP/turbine with tower and establishment. The operation and upkeep cost has been taken as 500 SP/year. Moreover 800 kW converter and 3500 batteries were viewed as and the aggregate net present cost 19.1 US$. The creators found that it is ideal to utilize wind/PV mix framework for 50 homes rather than single home framework. Moreover if the turbine cost diminishes in Khartoum the general cost of vitality would be low. The reproduction comes about show that using inexhaustible generators, for example, wind generator and PV decreases the working costs utilizing a second rate class of lodging at Khartoum state.

Deshmukh et al. [16] depicted strategies to model half and half sustainable power source framework (HRES) segments, HRES outlines and their assessment demonstrating that the cross breed PV/wind vitality frameworks are ending up noticeably progressively famous and highlighted the issues identified with entrance of these vitality frameworks in the present appropriation arrange as it gives prospects of fusing in power era ability to enhance control quality, because of the scattered era.

Wei et al. [17] showed productive white natural light-emanating gadget in view of exciplex with higher luminance and iridescent proficiency and this bi-utilitarian gadget with electroluminescence (EL) and PV exhibitions is promising to be utilized as white presentations or backdrop illumination source later on as it can be charged by sun based vitality through extra mechanical assembly free of work and can likewise be utilized as an optical sensor to UV light.

Ito et al. [18] introduced strategies of TiO_2 film manufacture for color sharpened sun based cells that comprises of pre-treatment of the working photograph terminal by $TiCl_4$, varieties in layer thickness of the straightforward nanocrystalline-TiO_2 and use of a topcoat light-scatterin g layer and additionally the grip of a hostile to reflecting film to the anode's surface bringing about a change effectiveness of worldwide air mass 1.5 (AM 1.5, 1000W/m2) sunlight based light to electric control more than 10% .

Jaber et al. [19] built up a PC reproduction model of the conduct of a photovoltaic (PV) gas-turbine half breed framework, with a compacted air store, to assess its execution and in addition to anticipate the aggregate vitality transformation productivity and found that cross breed plant delivers around 140% more power for every unit of fuel expended contrasted and comparing traditional gas turbine plants and lower rates of poison discharges to the air per kWh of power created.

K.R. Ajao, O.A.Oladosu and O.T. Popoola [20]; utilized HOMER programming for enhancement to locate the best money saving advantage of half breed - sun oriented influence era with respect to utilize taken a toll in Nigeria. The money saving advantage examination of a wind/sun powered cross breed framework was finished utilizing HOMER programming and correlation was additionally made with utility supply. Focal framework power is the slightest costly alternative yet may not be accessible to most country family units a long way from the matrix. Henceforth it is important to supply these regions from disengaged control sources. The proposed framework utilized (0.05 – 0.4 kW) PV board with (0.4 kW DC) FD arrangement wind turbine, (0.1 – 1.5 kW) converter, and (200 Ah/12 V, bank estimate: 1-8 batteries, vision 6 FM200D) battery. The creators result acquired from the advancement gave the underlying capital cost as 3,455 US$ while working expense is 69 US$/year. Add up to net present cost (NPC) is 4251 US$ and the cost of vitality (CoE) is 1.74 US$/kWh. The creators found that, the half and half framework have a compensation back time of around thirty-three years and at current expenses.

Bhuiyan et al. [21] concentrated the financial matters of remain solitary photovoltaic power framework to test its achievability in remote and provincial regions of Bangladesh and contrasted inexhaustible generators and nonrenewable generators by deciding their life cycle cost utilizing the technique for net present esteem examination and demonstrated that life cycle cost of PV vitality is lower than the cost of vitality from diesel or oil generators in Bangladesh and accordingly is monetarily plausible in remote and rustic zones of Bangladesh.

Alazraki and Haselip [22] 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-subsidized by a scope of open and private sources and the structure of money related endowments has empowered these remote provincial groups to get a power supply supplanting customary vitality sources..

V.Key challenges facing the growth and development of PV in India include:

- *Cost and T&D Losses*: Solar PV is some years away from true cost competitiveness and from being able to compete on the same scale as other energy generation technologies. Adding to the cost are T&D losses that at approximately 40 percent make generation through solar energy sources highly unfeasible. However, the government is supporting R&D activities by establishing research centers and funding such initiatives. The government has tied up with world-renowned universities to bring down the installation cost of solar power sources and is focusing on up gradation of substations and T&D lines to reduce T&D losses.

- *Land Scarcity***:** Per capita land availability is very low in India, and land is a scarce resource. Dedication of land area near substations for exclusive installation of solar cells might have to compete with other necessities that require land.

- Funding of initiatives like National Solar Mission is a constraint given India's inadequate financing capabilities. The finance ministry has explicitly raised concerns about funding an ambitious scheme like NSM.

- Manufacturers are mostly focused on export markets that buy Solar PV cells and modules at higher prices thereby increasing their profits. Many new suppliers have tie-ups with foreign players in Europe and United States thereby prioritizing export demand. This could result in reduced supplies for the fast-growing local market.

- The lack of closer industry-government cooperation for the technology to achieve scale.

- The need for focused, collaborative and goals driven R&D to help India attain technology leadership in PV.

- The need for a better financing infrastructure, models and arrangements to spur the PV industry and consumption of PV products.

    - Training and development of human resources to drive industry growth and PV adoption
    - The need for intra-industry cooperation in expanding the PV supply chain, in technical information sharing through conferences and workshops, in collaborating with BOS (balance of systems) manufacturers and in gathering and publishing accurate market data, trends and projections
    - The need to build consumer awareness about the technology, its economics and right usage

    - Complexity of subsidy structure & involvement of too many agencies like MNRE, IREDA, SNA, electricity board and electricity regulatory commission makes the development of solar PV projects difficult.

- Land allotment & PPA signing is a long procedure under the Generation Based Incentive scheme

VI. Application of Solar Cells

Solar cells, sometimes called photovoltaic cells, convert energy from the sun directly into electricity. Solar cells produce renewable energy, and are durable, portable and low-maintenance. Introduced in the 1950s, their first use was for communications satellites, and they continue to provide power for many space-based applications. On earth, growing numbers of large-scale solar “farms” generate electricity, augmenting traditional power plants. Solar cells also produce energy in remote settings, powering equipment far from the nearest electrical outlet.

1. Solar Power Farms

United States government requirements including the Renewable Portfolio Standards have mandated that electric utilities produce a significant fraction of their power through renewable sources such as solar energy. Facilities such as the Agua Caliente Solar Project in Arizona produce electricity for local communities. When its final phase is completed, the power plant will have more than 5 million solar cells, producing a total of 290 megawatts of power. At the time of publication, the United States has 9,360 megawatts of electrical generating capacity from photovoltaic cells.

2. Off-Grid Power

In addition to producing electrical power for the commercial grid, solar cells see wide use as an off-grid energy source. For example, many traffic, emergency and construction road signs use solar cells for power, reducing the need for gasoline-powered generators for remote and mobile uses.

3. Rooftop Solar Panels

Many commercial and residential buildings have solar panels that produce electricity; in most cases, the building gets its power primarily from a conventional utility connection, but the solar cells generate enough power to reduce the owner’s conventional electric use and the associated electric bill. The solar panel connects to a power management system that automatically switches to the utility when solar power isn’t available.

4. Satellites

Communications satellites require an electric power source that is lightweight, lasts for years, and works in the vacuum of space. Because solar energy is abundant above the earth’s atmosphere, photovoltaic cells have proved an ideal solution for powering satellites. They generate electricity continually without the need for battery replacements or fuel; this is a nearly-absolute requirement for satellites, as their maintenance is impractical and prohibitively expensive.

VII. CONCLUSION

The temperature of the sun based cell hugy affects the effectiveness of photovoltaic framework. With the expansion in surface temperature of sunlight based cells or boards their productivity diminishes significantly. The nearby planetary group is a standout amongst the most critical option wellsprings of vitality. In any case, the issue is that the PV cell is not 100% consumable. To build the effectiveness of the PV cell we have to locate the option which will help the productivity of the sun powered board. PV framework is one of the most ideal approach to expand the productivity of the sun oriented cell, with this there is a shot of expanding the effectiveness up to 20-25%. Cooling of sun oriented cells relies on five noteworthy contemplations that are cell temperature, consistency of temperature, dependability, straightforwardness and ease of use of warm vitality. For drenching process there are different option source that we have talked about above, Water is one of the best asset and furthermore effortlessly accessible.

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