

# A Study of PV Solar Energy Systems and Operational Efficiency

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**Abstract –** Energy is imperative not just for the economic growth of the nation yet additionally to satisfy the expanded need because of the populace development. The urban advancement is one of the central points for expanded use of vitality in any general public. Sustainable power sources will be principle substitute for petroleum products in the telling the truth quality. Vitality emergency and CO<sub>2</sub> contaminations are the significant risk confronting the humanity today. Photovoltaic thermal systems (PVT) can have a job on the above emergency. PVT frameworks in private applications can add to the decrease of vitality utilization for warming cooling and a similar time limiting the all-out surface region of the framework. It chips away at quiet condition and don't deliver any undesirable waste like radioactive materials. Low upkeep cost with life expectancy of 20-30 years is the alluring highlights for the household applications.

**Keywords:** PV Solar Energy Systems, Operational Efficiency, Economic Growth, Development, Applications.

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## INTRODUCTION

The worldwide energy utilization was multiplied somewhere in the range of 1971 and 2010, by 2020 is probably going to in-wrinkle triple. In the meantime, the energy force - so the measure of energy required delivering one unit of pay - diminished consistently. In light of the evaluation of the Inter-national Energy Agency, China's energy request will increment about 30%. We should not overlook either about India, with this extent will achieve 40%.

Regarding abilities, we can say that Hungary has ideal chances, ecological energies - aside from hydropower and wind control - solar energy has extraordinary potential. Part States of the European Union is focused on the European Union need to incorporate the Central and Southern European gas markets, broaden sources and courses. Most imperative things in these programs are energy efficiency and bolster the individuals who produce an attractive item or administration.

In any case, there are huge contrasts between the plans and goals of the Member States. Germany has an intense activity so they will pull back all atomic power from power by 2022. Right now, just 10 EU part nations plan another atomic plant, there are four reactors under development in three nations

(Finland, France, Slovakia) while in three nations (Finland, Hungary, UK) are authorizing stage. These days five nations (Bulgaria, Czech Republic, Lithuania, Poland, and Romania) get ready atomic plants. (PINC, 2016).

Energy is a critical need for the development of a general public. Energy utilization relentlessly increments because of expanded populace, improved present day life and expanded industrialization. Private structures devour impressive measure of energy in any nation. The relentless ascent in expectations for everyday comforts of the populace in the creating nations is joined by the expanded energy utilization in structures. The structure segment is the greatest energy purchaser before transport and industry divisions. Energy required per capita ceaselessly increments and it results in genuine ramifications on contamination, climatic change and asset consumption. With lessening in traditional energy assets and developing natural concerns it is normal that solar energy is going to assume an extremely critical job in future (Natarajan et al 2009).

Energy is a key factor in our connections with nature. Energy utilization decides the degree of the reliance of the people with the environment. Thermal type of energy additionally assumes a critical job in human's life as it can for the most part

be used as either high-grade (high-temperature) or second rate (low-temperature). Solar photovoltaic and warm applications seem, by all accounts, to be one of the potential answers for current energy needs which likewise minimized ozone harming substance outflows. With regards to ozone harming substance discharges and fossil and fissile assets consumption PVT energy is a standout amongst the most encouraging wellsprings of intensity (Dupeyrat et al 2011). Recognizable proof and tackling of the new energy sources to fulfill the expansion in need of energy and lessening the ecological related issues are the best option for the future worldwide energy and natural issues.

Over 85% of the approaching solar energy is either reflected or retained as warmth energy. Therefore, the working temperature of the solar cells increments impressively after delayed tasks in summer, and the cell efficiency drops fundamentally. This makes the PV innovation less appealing for an area with broadened time of sweltering climate. To improve the PV execution, much research exertion has been spent on the advancement of crossover photovoltaic-warm (PVT) authority innovation utilizing air or water as the coolant. Through great warm contact between the warm safeguard and the PV module, both the electrical efficiency and the warm efficiency can be improved (Avezov et al 2011).

The solar radiation expands the temperature of PV modules, the electrical efficiency of the photovoltaic board relies upon its temperature and it is decreased when the temperature increments and bringing about a drop of their electrical efficiency. As temperature is expanded, there are two noteworthy impacts in ordinary PV cell task. To start with, the dim immersion current of the PV cell builds which prompts a lessening in open circuit voltage. Second, the band hole of the photovoltaic material reductions which prompts an expansion in photocurrent. The primary impact is more overwhelming than the second impact and in this manner there is a net diminishing in the solar transformation efficiency with expanding temperature, consequently, the low temperature activity is fundamental. For mono crystalline (c-Si) and polycrystalline (pc-Si) silicon solar cells, the efficiency diminishes by about 0.45% for each degree ascend in temperature, while for undefined silicon (a-Si) cells, the impact is less, with an abatement of about 0.25% per degree ascend in temperature relying upon the module plan (Tiwari 2002).

The solar energy innovation has numerous points of interest and hindrances contrasting with others. The potential focal points are (i) it takes a shot at silent condition and don't create any undesirable waste, for example, radioactive materials, (ii) low upkeep for the framework, (iii) high solid framework and (iv) exceedingly believable framework with life expectancy desire for 20 to 30 years.

In any case, the restrictions incorporate (i) non uniform power age, (ii) high zone necessity, (iii) longer compensation, (iv) less efficiency, (v) high generation and establishment cost, (vi) challenges in coordinating with the present rooftop framework/applications.

## LITERATURE REVIEW

The environmental change is an incredible worldwide biological issue, for which the lively procedures can be made in charge of about 80% (Pálvolgyi, That's why 2010) sustainability. It gets expanding role in nowadays (Bulla, 2006) which implies humankind fulfills the necessities while protecting the earth and characteristic assets for who and what is to come.

Manageability as enthusiastically can be come to as we have to limit energy utilization and this most reduced utilization ought to be delivered however much as could reasonably be expected from ecological energy. Besides, the energy will be utilized to make esteem not just for mild our structure.

Supportable energy the board „energy generation, stockpiling, transport, social, monetary and biological parts of usage of the mind boggling procedure of incorporating use; the exemplary power the board change coordinated practical development"(Dinya, 2015).

In this energy the board the natural energy sources has a key job which can recharge (Barótfi, Its importance 2015) to the use of sustainable power source since it doesn't dirty for the earth moreover mankind can fulfill the requirements. Sustainable power sources, for example, solar energy, hydropower, wind control, geothermal energy and biomass in its different structures (Farkas et al., 2013).

## RENEWABLE ENERGY SOURCES

It consequently washes and flushes the solar boards. It joins spouts to the solar boards as appeared. It contains a five gallon store for cleanser concentrate. There is additionally a dregs channel that contains water conditioner media. It is likewise having an enemy of siphon valve to forestall discharging into the framework. Framework comprises of a controller which naturally gives wash and flush cycles, the controller programming can be changed according to regular necessities. It requires treated water and the channel should be supplanted occasionally.

### Serbotswiss innovations gekko solar.

Gekko Solar is produced for portable arrangement onto Solar PV. It is having a cleaning limit of 400 m<sup>2</sup>/hr. Intensive cleaning utilizing turning brush and demineralized water. Its development depends on

feet, with vacuum innovation, which are turning on two trapezoid-molded equipped belt drives, empowering the robot to amazing adaptable development each picked way. It tends to be radio controlled with a joystick from a separation of 300m. Vacuum based feet development which requires pneumatic force of 8 bar. It can clean slanted boards upto 45 deg.

### **Serbot innovations; gekko solar farm**

Gekko Solar Farm is created for the cleaning of substantial field solar ranches. It is having a cleaning limit of 2900 m<sup>2</sup>/hr. Intensive cleaning utilizing various turning brushes and demineralized water. Its development depends on feet, with vacuum innovation, which are pivoting on two trapezoid-molded outfitted belt drives, empowering the robot to amazing adaptable development each picked way. It tends to be radio controlled with a joystick from a separation of 300m. Vacuum based feet development which requires pneumatic force of 8 bar. It can clean slanted boards up to 30 deg.

### **National Instruments (Prototype Design); Design and prototype of an Autonomous Robot to automatically clean solar panels**

In this utilizing NI's LAB View continuous software mechanical arm was mounted over a moving vehicle. By utilizing the NI Lab View apparatus, controlling for Engine stage, ceaseless contact and controlled weight between cleaning device and SPV board, test time, vibrations opposition. The significant imperative is channelizing the vehicle movement parallel to the Solar PV boards.

### **Tuff fab; Nano Clear: SPV Panel Glass Coating Solution**

It is accessible as an answer which is anything but difficult to apply. When connected it makes the glass surface Non-stick, simple to clean and search new for quite a long time. Client no longer needs to utilize unforgiving synthetics and thoroughly clean your glass any more. Only a wash with clean water or mellow cleanser and a wipe with a delicate towel will clean the boards. In this technique cleaning must be done, just preferred standpoint is cleaning procedure would be simple.

### **Wash Panel: SPV panel array cleaning Robot;**

This framework is completely independent; it has a twofold programmable working through a downpour sensor and by utilization of water planes. It gives a consistent and uniform cleaning. This framework is secluded, with conceivable supervision and manages additional casing, support and extra aides. It tends to be introduced on ground systems, structures, topped rooftop or shed rooftop. For persistent checking it sends instant messages to mobiles, permitting order control from remote locales.

### **Solar Brush: Solar Brush cleans and inspects solar power plants**

It is an automated cleaning framework" for walks Solar over P solar PV board. It can work unto a tendency of 35 degrees. It is remote and battery-powered. It is having a cleaning brush which swipes the residue. Solar Brush is light weight of 2.5 kg. As the cleaning strategy is swiping which may results in stains in the glass of Solar PV board. Execution is extremely moderate of 1m<sup>2</sup>/min.

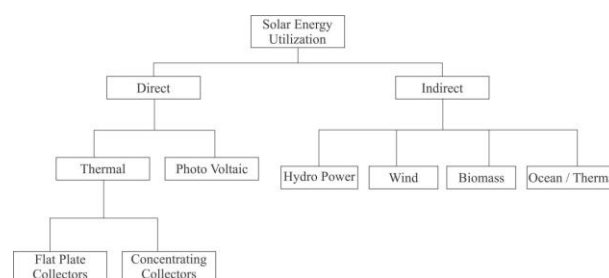
### **HECTOR- Cleaning robot system for Heliostats;**

It is a mechanical cleaning framework for Heliost likewise, as appeared. It is remote, Rechargeable and conveys water arrangement tank with itself. It is intertwined with different sensors which grant it to explore self-rulingly with no human supervision. It requires no outer power or water supply for its activity; it conveys its own batteries and water tank. HECTOR is intended for night and day task. Its execution is moderate and the heaviness of HECTOR is over the board.

## **APPLICATIONS OF SOLAR ENERGY**

Solar has been perceived as a noteworthy world sustainable power source to enhance declining petroleum product assets. Solar radiation episode superficially incorporates pillar and diffuse radiation, just as radiation reflected from the beginning nearby surfaces.

Most sustainable power sources are gotten from solar radiation. It is the goldmine of all vitality. Figure 1 demonstrates the arrangement of solar vitality use. The real utilizations of solar vitality can be ordered into two classifications - solar warm frameworks to deliver warm vitality, and solar photovoltaic frameworks - to create electrical vitality. The immediate transformation of solar vitality to power has progressed uniquely in the course of the most recent two decades, prompting essentially scaled down costs of photovoltaic modules and applications have expanded particularly because of the accessibility of motivating forces in numerous pieces of the world.



**Figure 1 Classification of solar energy utilization**

## Solar Photovoltaic System

The photovoltaic wonder has been perceived since 1839, when French physicist Edmond Becquerel had the capacity to produce power by lighting up a metal terminal in a feeble electrolyte arrangement. The photovoltaic impact in solids was first concentrated in 1876 by Adam and Day, who made a solar cell from selenium that had an efficiency of 1–2%.

Being a spotless and unlimited wellspring of vitality from sun, photovoltaic is an alluring innovation choice. Solar PV is a semiconductor gadget which changes over daylight into power. Solar PV board opens to daylight produces current and voltage at its yield terminal. This voltage and flow can be utilized for our power prerequisites. Solar PV advances use semiconductor materials for change light into power.

A solar cell must have an intersection between two distinct semiconductors. The electrical conductivity of semiconductors is not as much as that of conveyors as and more than that of separators. Semiconductors can be components, for example, Si (Silicon) and Ge (Germanium) or mixes, for example, CdS (Cadmium sulphide), CdTe (Cadmium telluride), GaAs (gallium arsenide) or composites such as  $Ga_{1-x}Al_xAs$ , where  $x$  can be any incentive somewhere in the range of zero and one.

The photovoltaic impact (Figure 2) is most unmistakable in different semiconductor materials. Most business solar cells are made of crystalline and undefined silicon materials. At the point when daylight strikes the solar cell, some portion of the light range bestows enough vitality to make electron-gap matches in the semiconductor material. A potential obstruction in the cell is set up by shaping an intersection between uniquely doped semiconductor layers. This isolates the light-created bearers (for example electrons and gaps) bringing about a prompted voltage of around 1/2 volt. The accessible current is a component of cell region and light power. The power is gathered and transported by metallic contacts put on the two surfaces of the cell (Solanki 2011).

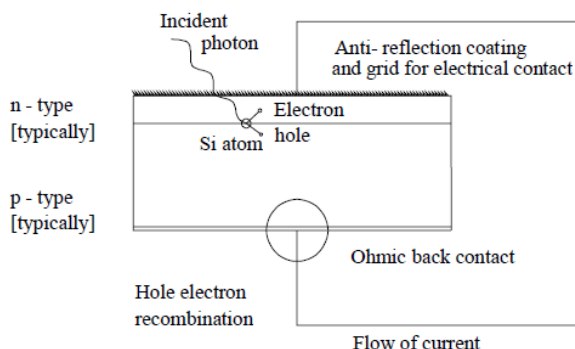


Figure 2 Photovoltaic effect

Photovoltaic cells are framed into modules by associating them in arrangement and parallel so as to get progressively present and voltage. For significantly more prominent power, modules can be interconnected in bigger gatherings to shape clusters. The DC power produced by the solar cell exhibit is normally gone through a power conditioner for voltage and power guideline, and transformation to substituting current.

Economically accessible photovoltaic modules can change over daylight into power with efficiencies running from 5% to 15%. The expense of photovoltaic cells has dropped extensively in the ongoing time to make it even focused with couple of late advances.

Figure 3 demonstrates the straight forward PV framework. Solar boards are essentially exhibit of photovoltaic modules to change solar vitality into power. Charge controllers are utilized to boost the power yield from solar boards, surge into batteries, control charge current and charge level. Batteries store vitality provided to them and is utilized when solar vitality isn't accessible. Inverters are to change over the DC control into AC control for the utilization of AC applications.

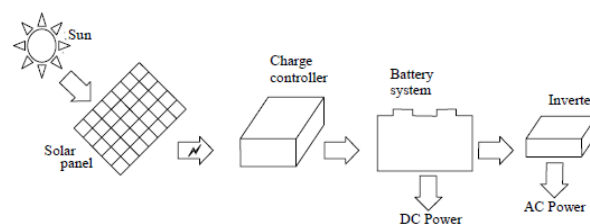


Figure 3 Solar Photovoltaic systems

Usually to have high pinnacle power request in urban areas and towns. Rooftop top PV frameworks not just use the current rooftop space of structures, yet in addition can create power required with the end goal of the structure use.

A rooftop top Solar Photovoltaic framework could be with or without network connection. In framework association framework, the DC control created from SPV boards is changed over to AC control utilizing power molding framework, the DC control produced from SPV boards is changed over to AC control utilizing power molding unit and is sustained to the lattice. These frameworks are regular in many created nations. In a perfect world, matrix intuitive frameworks don't require battery reinforcement as the lattice goes about as the back-ready for encouraging abundance solar power and the other way around.

In matrix intelligent frameworks, it has, anyway to be guaranteed that in the event that the lattice comes up short, the solar power must be completely used or ceased promptly nourishing to the network (if any in abundance) in order to safe-



protect any lattice individual/specialist from getting stunned (shocked) while taking a shot at the matrix for upkeep and so on. This component is named as 'Islanding Protection'.

Independent frameworks (otherwise called non-matrix intelligent frameworks) in a perfect world require a full burden limit battery control back up framework. For remote lighting and correspondences, photovoltaic's with battery reinforcement can be the most practical wellspring of power.

## SOLAR THERMAL TECHNOLOGY

Solar water warmer (SWH) is the most well-known methods for solar vitality usage in view of innovative possibility and monetary fascination contrasted and different sorts of solar vitality use. The vitality from the sun can give boiling water to numerous local and mechanical applications, uprooting the need to utilize petroleum products. As a rule, it is very savvy and natural benevolent technique to produce low temperature boiling water or demeanor of under 100°C.

Two fundamental parts of SWH frameworks are gatherers and capacity tanks. There are a wide range of kinds of designs of authorities. The most ordinarily utilized kind of authority is the level plate.

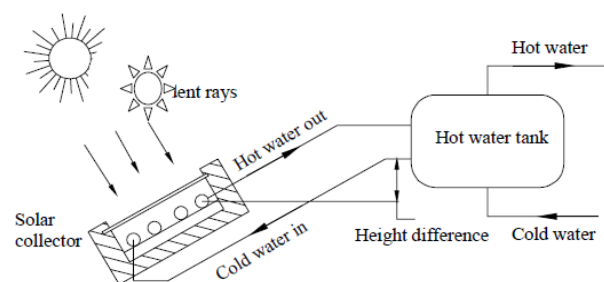
### Flat Plate Solar Water Heating System

In this framework the solar radiation is consumed by level plate gatherers which comprise of a protected external metallic box secured on the top with glass sheet. Darkened metallic safeguard (specifically covered) sheets are kept inside with implicit conduits to convey water. The safeguard sheets ingest the solar radiation and exchange the warmth to the streaming water. The streaming high temp water is then gathered in the capacity tank.

Contingent upon the water supply framework, the framework can be either a shut coupled framework or a gravity encouraged framework. The most widely recognized tank in solar boiling water frameworks is the nearby coupled framework, where the capacity tanks are mounted with the authority on the rooftop (Solanki 2008).

Tanks are put over the authorities to exploit thermo-siphon impact. Cold and denser water spilling out of the tank through the gatherer gets warmed up and returns back to the tank. As the warmed water is less thick, the lightness powers raise the low thickness water to the highest point of the tank. For thermo-directing to be effective, it is basic that a consistent ascent in the pipe work is kept up and that the right width channels are utilized as risers and headers. Rooftop mounted level plate gatherers that use thermo-siphoning are amazingly famous in tropical

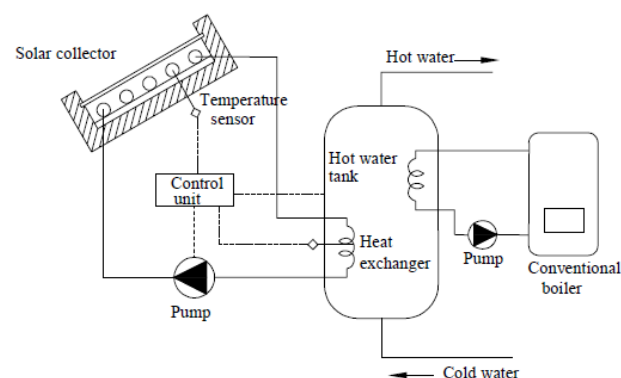
nations, especially in Asia and Middle East. Figure 4 demonstrates a run of the mill thermo-siphon water radiator.



**Figure 4 Thermo-siphon based solar water heater**

The significant favorable circumstances of gravity nourished thermo-siphon based close coupled framework incorporate (i) regular dissemination, (ii) nonappearance of outside vitality need, (iii) straightforwardness and (iv) the most cost viability. In any case, its execution can't be improved amid overcast days.

In a constrained flow framework (Figure 5), water tank can be found even at a dimension lower than the authority and the water is constrained through the gatherer with the assistance of siphons. In these frameworks, a siphon is actuated when the sun sparkles and cold water is pushed through the gatherer. Constrained course frameworks are more costly to buy than either the nearby coupled or gravity feed frameworks, and power is required to give capacity to the circling siphon.



**Figure 5 Forced Circulation based solar water heater**

## CONCLUSION:

The solar PVT collector has an important place among sun powered warm frameworks since it is generally utilized in numerous business applications, for example, the supply of sight-seeing to class structures and agrarian and mechanical drying, and so on. Its points of interest are minimal effort, no solidifying and no high weight issues. Be that as it may, the effectiveness of sun

based air authorities is low a direct result of the low Prandtl number of air. There have as of late been various investigations to build execution of the sun based PVT gatherer. To improve the PV execution, much research exertion has been spent on the advancement of hybrid photovoltaic-thermal (PVT) gatherer innovation utilizing air or water as the coolant. Through great warm contact between the warm safeguard and the PV module, both the electrical effectiveness and the warm productivity can be improved. So as to improve PV electrical yield and to gather extra vitality as high temp water or air, Photovoltaic/thermal (PVT) authorities of different structures have been created. Structured and built up an air/water cooled PVT framework utilizing an industrially accessible PV board and found that the electrical effectiveness of the PV board was expanded when the panel was cooled.

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