

# Solar Power Technology for Electricity Generation

Pradeep Kumar Verma, Assistant Professor  
Department of Electronic Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India  
Email id- pradeep.k.verma002@gmail.com

**ABSTRACT:** *The negative environmental repercussions of using fossil fuels highlight the significance of alternative energy resources and give them a special opportunity to expand and expand. Solar radiation has gotten a lot of attention lately as a renewable energy source, and a lot of research has gone into harvesting solar radiation for power generation. This research examines solar energy technologies to determine which is the most effective for generating electricity. Solar energy may be used to create electricity in two ways: directly and indirectly. PV panels are utilized to convert solar energy into electricity in the indirect method. In the indirect strategy, thermal energy is gathered using concentrating solar energy (CSP) equipment like fresnel catchers and parabolic trough gatherers. This paper examines solar thermal technologies like flying trough collections, fresnel collectables, centralized tower devices, and solar parabola arrays in depth, highlighting problems and promise. A comparative of solar heating energy plants with photovoltaic energy facilities is also provided. PV-based systems are better appropriate for small-scale power production, according to published research. In compared to CSP-based systems, they may also generate more power in a single area. CSP plants, on the other hand, have a superior economic return based on economic reasons.*

**KEYWORDS:** *Concentrated, Development, Parabolic, Reflectors, Solar energy.*

## 1. INTRODUCTION

Electricity demand will increase in the coming decades as the world's populations rises, economic activity expands, and living conditions increase. Conventional fossil fuels like oil and coal are responsible for carbon dioxide production and climate warming. As a consequence, it's essential to look into environmentally beneficial and long-term alternative energy sources (Kabir et al., 2018). Solar radiation is 1 of the greatest enticing sources of electricity for power generation.

Solar energy must normally be conserved physically or electronically throughout the day for usage at night. Using energy storage devices may Higher development and upkeep expenditures, as well as an increase in the levelized cost of produced power, are expected to result. Recent advances in solar power study and production has contributed to reduce the price of industrial solar energy installations (Sampaio & González, 2017). According to a recent International Energy Agency (IEA) report, fossil fuels account for 82 percent of worldwide energy consumption; however, it is expected that by 2035, this proportion By creating new renewable power resources or enhancing current green energy systems, emissions will be reduced by 75% (Novas et al., 2021).

Because the rate at which solar energy falls to the planet 's crust is 120 105 watts, the power absorbed by the globe from the sunlight in a single day could supply the world's energy needs for greater than 20 decades (Zhang et al., 2020).Solar energy infrastructure development may improve Because it is a resource energy source, it provides economic stability. Furthermore, utilizing solar energy has a low environmental effect (Timilsina et al., 2012).

### 1.1 VARIOUS SOLAR CONCENTRATORS IN SOLAR THERMAL POWER GENERATION SYSTEMS:

- concerted cosmological power (CSP):

Lenses and mirrors are used in concentrated solar power (CSP) to emphasis solar radioactivity on a restricted zone. Focused energy may be used to create electricity in

a secondary manner. The absorbed heat from sun irradiation is utilized to generate power in thermodynamic cycles (Handayani & Ariyanti, 2012). These systems can create energy even when the sun isn't shining, which is one of their key advantages over solar generating technology. This may be accomplished by including energy storage equipment, like as a thermal storage tank, to store excess thermal energy generated during daytime hours for use during times when sunlight is unavailable. The most pressing concerns of solar power facilities that use CSP technology are as follows:

Since elevated input fuels the thermodynamics processes, great efficiency may be achieved (Mekhilef et al., 2012).

- The dispersed and reflecting portions of entering solar radiation are wasted since CSP technique only uses the straight portion.
- The performance of CSP systems will improve in areas with greater levels of Straight Standard Irradiation.
- Due to their big capital costs, CSP systems are not appropriate for minor-scale power production (Sánchez-Pantoja et al., 2018).
- *Parabolic trough concentrator (PTC):*

For the CSP, a parabolic manger concentrator (PTC) uses streak emphasis knowledge. Due to oil problems in the 1980s, this technique drew interest. PTC is constructed consists of a collector with a big paraboloid and a supporting tower. Solar rays are focused on a focal line via this method. There is a heat-absorbing sensor there. A material with a higher absorption is placed on the sensor. It is encased in a clear glass tube (Elsheikh et al., 2019). As seen in, a vacuum is produced between the tube and the receiver to reduce heat losses. Receiver shielding relies heavily on vacuum, and a decrease of suction might results in a 4 rise in energy loss By employing fewer elements and a moisture lid, pressure leakage may be minimized. PTC is appropriate for a wide range of application because to its working temperatures spectrum of 100 to 400°C. PTCs are classified according to their operating temperature. PTCs that run

among 300 and 400°C are mostly employed for power production, whereas those that operate between 100 and 250°C are used for heating(Guta, 2018).

- Linear Fresnel reflectors(LFR):

Lined Fresnel reflectors (LFR) are distinguished by the arrangement of reflecting. The top of the device is made up of glass strips that revolve about a dependant perpendicular plane (Kabeel & El-Said, 2015). These strips concentrate on a raised linear receiver, which transmits heat to the (Heat transfer fluid) HTF even more effectively(Dutta, 2019). It was initially developed as a replacement for the central reception tower; however, owing to heat losses caused by the one-axis tracking system, it was not as efficient as planned(“Design of Solar Tracking System for Capturing Maximum Amount of Solar Energy,” 2019). It may be used instead of the parabolic collector because of several benefits such as cheap money price and no revolute linkages, as well as a parabola troughs collectors for direct steam production with near efficiency (DSG) (Kumar & Singh, 2020). Because of the blocking and inter row shading, certain components of the reflector are useless. heat fluxes, efectivity, cosine impact, tubular absorptivity, and other factors all contribute to the LFR's increased leveled cost of energy. In order to decrease losses caused by shade and blockage between two adjacent layers, certain unique designs for semi parabolic LFR solar concentrators are presented. Since the operational temperature of molten salts incorporating liquid nitrates as HTF may reach 550°C, LFR provides the capability of thermally retention depending on liquid salt (Goel & Sharma, 2017).

Challenges of LFR:

- Casting is an excellent and cost-effective process for large-scale Fresnel lens production; but, the molten material's high viscosity and lack of fluidity hinder the fabrication of sharp edges.
- In order to minimize UV damage, advanced materials must be studied.
- Cleaning grooves on a regular basis is required to avoid dust accumulation.

- Excessive expense and maintenance concerns have been created as a result of CSP's desire for a tracking system(Syed et al., 2021).
- Because the system's operating temperature is rather high, a suitable HTF, like as molten salt, is needed for optimal performance.

### 1.2 Photovoltaic(PV) technique:

Photovoltaic (PV) technique is used to change solar irradiation directly into energy. It makes advantage of dispersed sun irradiation as a source of energy. As a result, PV technology may be used in areas with both high and low solar energy. There are many different kinds of photovoltaic resources that may be utilized to generate electricity. The most popular materials used in PV cells are mono and crystalline silicon, Copper telluride (CdTe), Gallium arsenide (GaAs), and Indium gallium phosphide triple-junction solar cells (InGaP). Solar cells are integrated to create a module of several cells in order to produce power on a bigger scale; These units are then assembled into a (photovoltaic) PV array that may be several kilometers long (Anand, 2019).

PV technology is long-term, particularly in small-scale applications. Together grid-linked and off-grid applications are possible with these systems. PV units may be put as fixed systems or combined with a tracking system to generate additional power; however, the tracking system needs more installation space. PV technology was originally utilized in satellites and airplanes to supply power. PV technology, on the other hand, is now utilized to generate electricity both off-grid and on the grid. Transport, communications, and rural electricity are among of the additional uses for this technology.

### 1.3 Comparison between CSP and PV:

- *System efficiency:*

In compared to PV modules for small-scale power generation, CSP technology offers a larger capability for energy output. Although PV facilities have a lower overall efficiency than CSP plants, PV systems need less area for installation. PV power plants produce more energy than CSP plants in the same area. PV systems are smaller than

CSP facilities, allowing for a greater amount of PV structures to be put in the same space.

- *Social acceptance:*

It is vital to consider societal approval while developing a system. Several studies have highlighted the importance of societal acceptability of solar power systems. According to the findings of the researched publications, societal approval plays an important influence in the development of different technologies. Solar power plants are being developed on a local and big scale, demonstrating their acceptability as a sustainable and ecologically friendly foundation of power. In 2013, extra than 800 MW of CSP-based power plants are expected to be constructed in the United States, South Africa, Spain, and India. Solar energy is employed for a variety of reasons, including desalination and heating systems, demonstrating its viability. CSP technology are more suited to large-scale applications, while PV modules may be utilized for both minor and big scale applications.

## 2. DISCUSSION

Solar power is solar irradiation that might be used to create heat, organic responses, or power. The overall quantity of solar radiation hitting the planet much outpaces existing and projected global energy needs. This widely distributed source has the ability to meet all prospective power demands if properly used. Solar energy, like limited conventional fuels such as fuel, petroleum, and synthetic gas, is renewable., is probable to produce in admiration as a sustainable electricity resource in the 21st decade owing to its infinite availability and pollution free quality.

Despite the fact that the Sun is a influential energy basis and that daylight is by far the most plentiful supply of electricity absorbed by Planet, its strength at the surface is rather low. This is mainly owing to the Sun's huge radial dispersal of radiation. Up to 54% of entering light is absorbed or scattered by the Earth's environment and clouds, resulting in a very little additional loss. Visible light makes up over half of the sunshine

that penetrates the planet, with the remaining 45 % made up of thermal energy and lesser quantities of infrared and various types of magnetic energy.

Solar radiation has enormous potential, since it provides Every day, roughly 200,000 twice the world's entire electric-generating capacity is used. Although the fact that solar radiation is unlimited, the expensive cost of gathering, processing, and storing it prevents it from being used in many areas. Solar irradiation may be converted to thermal (heat) or electric electricity, with the latter being the easier option.

Flat-plate collectors are one of the most used systems for capturing solar energy and converting it to thermal emission, which are utilized for solar heating applications. Since the strength of solar energy at the Earth 's crust is so low, these collecting must be enormous. Even in the brightest parts of the world's subtropical areas, a collector needs around 40 cubic metres of surface area to gather enough energy to suit the requirements of single individual.

Flat-plate collection are formed of a charcoal metal plate with 1 or several sheet of glass on top, which is warmed by sunshine beaming on it. The heat is then transferred to fluids that run across the rear of the plates as carriers, like air or water. The heat might be used right away or transmitted to other substance to be stored. Flat-plate catchers are often used for solar water warmers and home heating. A common way of conserving warmth for use at evening or on cloudy days is to utilize insulated tanks to keep the water heated throughout bright periods for utilize at evening or on overcast days. This kind of system may either provide hot water from a holding tanks or provide room warming by pumping heated liquid via pipes in the flooring. Flat-plate collectors raise the temperature of carrier fluids to around 66 and 93 degrees Fahrenheit.

### 3. CONCLUSION

Several solar energy research are evaluated, and their findings are provided. The first step is to compare different solar thermal power facilities. In compared to linear Fresnel reflectors, parabolic trough concentrators are more efficient; yet, they demand a higher initial expenditure. Other ways for obtaining more energy from the sun have

been devised, For example, parabola dish condensers, which are juncture devices suitable for high-temperature situations, may be employed. PV modules, as well as solar heating energy facilities, might transform solar radiation straight to electricity. PV modules are classified according to the materials used in their semi-conductor components. PV modules from the first generation have a larger market share and are more efficient. PV schemes and CSP floras would be likened in the following phases. Created on the price education of PV and CSP control floras, it can be determined that CSP power plants have a higher original asset price than PV plants. CSP plants, on the other hand, have superior economic returns than PV power plants.

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