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## Solar thermal integrated system for power generation

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### Abstract

At present, solar power generation technology is mostly divided into two types, one is solar light power group technology, and the other is solar Solar-thermal power generation technology. Solar power generation mainly contains photovoltaic power generation, photochemical power generation, optical stimulation power generation and biological power generation, among which photovoltaic power generation technology is widely used. Photovoltaic power generation has the characteristics of high efficiency, low pollution and good flexibility, but photovoltaic panels have many defects such as high pollution, high energy consumption and large space career [3-4]. Solar thermal power generation technology mainly includes tower solar thermal power generation system, trough solar thermal power generation system and dish solar thermal power generation system [5]. Than solar-thermal power generation is the sun point-blank light energy through the adoption of many a mirror together, make the heat transfer fluid in the heat pipe heat continuously heating up, and to transfer heat to high temperature steam produced in the steam generator, and then by the power generating units of a renewable energy application technology, it has low cost, stable output power and power generation system of continuous adjustable, and long service life, no pollution and other advantages, therefore, solar-thermal power generation is more competitive power generation technology [6].

**Keywords:** non-renewable, photovoltaic

### 1. Introduction

The cumulative worldwide request for energy since relic fuels temporary a chief character in rising drift in greenhouse gas (GHG) productions then air contaminants. Quick population development and increasing get-up-and-go request, particularly in the emerging countries have carried many qualms such as scarcity, contamination, healthiness and maintenance problems. In Iran, the growth in CO<sub>2</sub> emanations has finished the country as single of the ten principal GHG emitter in the world and also the top backer to impressive carbon dioxide in the Middle East. Therefore, seeking for substitute energy sources and the efficient use of them could be the correct response to this problematic.

Renewable energies contain natural vigor sources almost endless, whichever because of being obtainable in huge statistics or being able of renewing by natural processes. Approving to this meaning, renewable energy includes: biomass, geothermal, hydropower, solar, tidal and wave and wind power.

Solar energy is a nonstop power source that strength offer liveliness security and liveliness individuality to all. This renewable source of energy is effortlessly accessible in many regions around the biosphere and it is a clean technique of energy that does not reason conservational pollution. It characterizes the greatest gifted and practicable choice for control generation today and in the upcoming.

#### 1.1 Principle of solar thermal power generation

Solar-thermal supremacy generation code is that finished the indicators, such as condenser of warmth exchanger will gather solar energy into heat energy gathering of hot indicting, used to heat the boiler device privileged the warmth transfer medium, such as heat transmission oil or melted salt with a heat interchange device, heat transfer average water animated to high fever and high pressure vapor, steam to drive a turbine driven generator to produce electricity. This through the "light - heat - mechanical - electrical energy alteration process of the understanding of control group knowledge is known as focused solar power knowledge. The principle and basic apparatus composition of solar thermal power generation are principally the same as persons of fossil fuel power plants. The biggest metamorphosis is that the heat causes used for power cohort are dissimilar. Solar thermal power generation USES clean and abundant solar energy.

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## 1.2 Solar thermal power generation technology types

### A. Tower solar thermal power generation system

Tower type solar thermal power generation is also known as concentrated solar thermal power generation. It takes the form of a number of arrays of mirrors that reflect solar radiation onto a solar receiver located at the top of the tower, heating the working medium to produce superheated steam, which drives a turbine generator to generate electricity and convert the absorbed solar energy into electricity. Tower solar thermal power generation is mainly composed of four parts: mirror field, heat exchange system, heat storage device and steam turbine generator<sup>[10]</sup>. Tower solar thermal power generation system is shown in f

The main features of the tower solar thermal power generation system are as follows : (1) the concentration-light ratio usually accomplished by the tower solar thermal power generation system is 300 ~ 1,500, and the operating temperature can reach 1,000 ~ 1,500 °C<sup>[7]</sup>. (2) the tower Solar-thermal power generation system has short heat communication distance, low heat loss and high comprehensive competence, which can reach about 14% at present; (3) solar tower power generation is suitable for large-scale and large-capacity commercial application; (4) the tower Solar-thermal power generation system has large one-time outlay, complex device structure and control system, and high cost<sup>[8]</sup>.

### B. Trough solar thermal power generation system

Trough type solar thermal power generation system is to use the groove parabolic mirror concentrated solar thermal control generation system. The focusing mirror from the point of view of geometry is the parabola translation and development of the parabolic trough type; it will be the sunlight in a line, in this article the focal online installation has tubular collector, after focusing to absorb solar radiation energy, and often many groove parabolic series-parallel into concentrating collector array<sup>[11]</sup>. Slot to track one dimensional parabolic face more solar radiation (axis equipment placed between the north and the south, then



**Fig 1:** Trough solar thermal power generation system

What the track). Its geometric concentration ratio is between 10 and 100, and the temperature can reach about 400 °C<sup>[7]</sup>. The trough solar thermal power generation system is shown in figure 2. At present, trough power station has the lowest operation risk and generation cost, and the most commercial value, which is suitable for medium-low temperature solar thermal power generation system<sup>[12]</sup>.

### C. Disc solar thermal power generation system

Disc type solar thermal power generation system using disk

parabolic mirror to focus the sun's rays, installed in the focus of working medium heat absorber absorbs solar radiation heat absorption of heat, heat absorption working medium and working medium of the steam generator heat exchange water, generated by the high temperature and high pressure steam driving turbine generator<sup>[13]</sup>, disc type solar thermal power generation system as shown in figure 4. The advantages of the system are that the concentrator ratio can reach 3,000<sup>[14]</sup>, the receiver's heat absorption area is small, the working medium's heat collection temperature is > 800 °C, and the system efficiency can reach 29.4% at most.



**Fig 2:** Disc solar thermal power generation system

### D. Linear Fresnel type solar thermal power generation system

Linear Fresnel thermal power generation system is similar to parabolic trough thermal power generation. It consists of many horizontal mirrors rotating on a single axis, which form a rectangular mirror to automatically track the sun. The reflected sunlight is gathered on the collector tube, and the fluid medium in the heating tube generates steam directly or indirectly, which drives the steam turbine unit to generate electricity. Linear Fresnel thermal power generation system is relatively simple, and the mirror can adopt plate mirror, which has lower cost but lower system efficiency. The structure of the system is relatively simple, the transmission mechanism is easy to operate, and the collector pipe can be made of steel. Therefore, the cost is lower than the tank system, so it can be applied in many places with its own characteristics, such as heating water/steam, providing steam to buildings and factories (temperature range: 80 °C ~ 250 °C), using small and medium-sized heat engines for medium-low temperature power generation, heating, refrigeration and other multi-generation, solar desalination and so on. However, the focus of this heat collection system is relatively small, so the temperature rise is limited, the heat collection tube needs to absorb heat and dissipate heat at the same time, so the heat loss in operation is relatively large, and the system efficiency is lower than that of the tank system. At present, the application scope is small, and there are not many demonstration projects.

## 1.3 Comparative analysis of solar thermal power generation technology

The characteristics of the above four solar photovoltaic power generation technologies are compared and analyzed<sup>[7,9]</sup>, and the results are shown in table 1.

**Table 1:** Comparison of photo thermal power generation technologies

Project	Tower
Heat transfer medium	Water/steam, molten salt
Focusing technology	Point focusing
Scale (MW)	30-100
Energy storage	Yes
Application	Grid-connected power generation
Concentrated ratio	300 – 1500
Unit efficiency	23%

As can be seen from table 1, trough Solar-thermal power generation has the most extensive application range, up to 30-350mw, and is suitable for middle and low temperature heating, with a generation efficiency of up to 21%. The concentration-light ratio of the tower solar thermal power system can reach 300 ~ 1,500, and the operating temperature can reach 1,000 ~ 1,500 °C. The tower Solar-thermal power generation system can be connected to the grid, and the power generation efficiency can reach about 23% at present.

However, the performance, initial investment and operation cost of the tower Solar-thermal power generation system are not sufficiently commercialized, and the tower power generation cost is high. The concentrator ratio of disc Solar-thermal power generation is 600-3000, the receiver's heat absorption area is small, the working medium's heat collection temperature is > 800 °C, and the system efficiency is up to 30%. However, the structure of disc solar collector is relatively complex, and the reliability needs to be strengthened. Fresnel Solar-thermal power generation system is characterized by simple system, direct use of thermal conductivity to generate steam, its construction and maintenance cost is relatively low. However, its focus is relatively small, the temperature rise is limited, and the heat loss during operation is relatively large. Overall, trough solar thermal power generation system is the most mature in technology, easy to realize, the overall cost is the lowest, and the heat collection temperature is moderate, more suitable for low and medium temperature solar thermal power generation system.

## 2. Conclusion

To sum up, solar energy is a widely used power generation technology, and various solar power generation technologies can meet the different needs of the society and regions for solar power generation. Among them, solar thermal power generation technology avoids expensive silicon photoelectric conversion process, which can greatly reduce the cost of solar power generation. At the same time, the output power of Solar-thermal power generation is continuous and stable, which has the potential to become the power of base load. Among them, the technology of trough Solar-thermal power generation system has been mature, which is applicable to the widest range and has basically realized commercialization.

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