

Research on the Economics of Distributed Photovoltaic Power Generation Integrated into the Grid

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Abstract. In order to accelerate the development of distributed energy, the country vigorously promotes distributed power generation technology, and the development of this technology will gradually break the traditional monopoly of electricity, and energy reform will move towards new development. Distributed photovoltaic power generation energy technology has high utilization rate and low pollution, which is a new trend in energy development. This paper studies the economic benefits brought by the integration of distributed photovoltaic power generation into the power grid for people's lives and the resulting economic benefits.

Keywords: Distributed; photovoltaic power generation; economic benefits.

1. Introduction

Technological advancement, product upgrade and cost reduction are the development trends of global energy transition. China's photovoltaic manufacturing is developing continuously. The state issued a policy on the healthy development of photovoltaic industry, which clarified the taxation and integration of photovoltaic power generation into the power grid. Chinese local governments have also formulated relevant policies to support photovoltaic power generation. With the support, there are opportunities for development. In the process of people's long-term use of energy, coal, natural gas, etc. are all short-term energy benefits. The emission of these fossil energy sources has caused the greenhouse effect, which is also the main cause of environmental degradation. People are facing the challenge of sustainable social development. Under the circumstances, it is necessary to take precautions to find renewable energy, and it is renewable and clean energy[1]. And solar energy is the first choice, solar energy is rich, photovoltaic power generation is to use solar energy to generate electricity. Photovoltaic power generation is safe, pollution-free, pollution-free, free from geographical restrictions, energy can be seen everywhere, can be used freely, stored with confidence, and can generate electricity without burning any fuel. It does not need to occupy the site, and only needs to be installed on the residential roof. Solar energy is the main utilization form of photovoltaic power generation, and it is a power generation technology with the best development prospect at present[2].

There are two forms of application of photovoltaic power generation in China. The first is the application of photovoltaic power generation in the construction of power stations in large areas, and the second is the application of distributed photovoltaic power generation. For the first type of photovoltaic power generation, it is usually difficult to send electric energy to the grid. The transmission line of the power grid is long, and the overall investment cost required for construction is very high[3]. The disadvantage of the second development method is also very obvious. The scale of power generation is very small, and due to the direction of the building, the arrangement and inclination of components cannot be in the best form of solar lighting conditions, resulting in low benefits of distributed photovoltaic power generation projects[4].

2. Principles of Economic Benefit Evaluation of Distributed Photovoltaic Power Generation

Coal traditional energy sources seriously pollute the environment, and the development momentum of new energy sources is getting higher and higher, among which distributed photovoltaic power generation is the most widely used. According to the grid work experience, the evaluation principles of the economic benefits of the distributed photovoltaic system are set. For different development directions, the country has different evaluation results of economic benefits. It is necessary to distinguish multiple benefits and then combine them to form a total economic benefit; the concept of positive economic benefits is relatively macro, and there are solar energy converted into electrical energy[5]. There are benefits from photovoltaic power generation to reduce emissions; the reverse economic benefit needs to be calculated according to the cost of photovoltaic power generation and the cost of system reserve capacity; the change of network loss caused by photovoltaic connection is also one of the factors affecting economic benefits, which has a negative impact on economic efficiency. Funds need to be taken into account when calculating benefits, so as to achieve value conversion. See Figure 1.

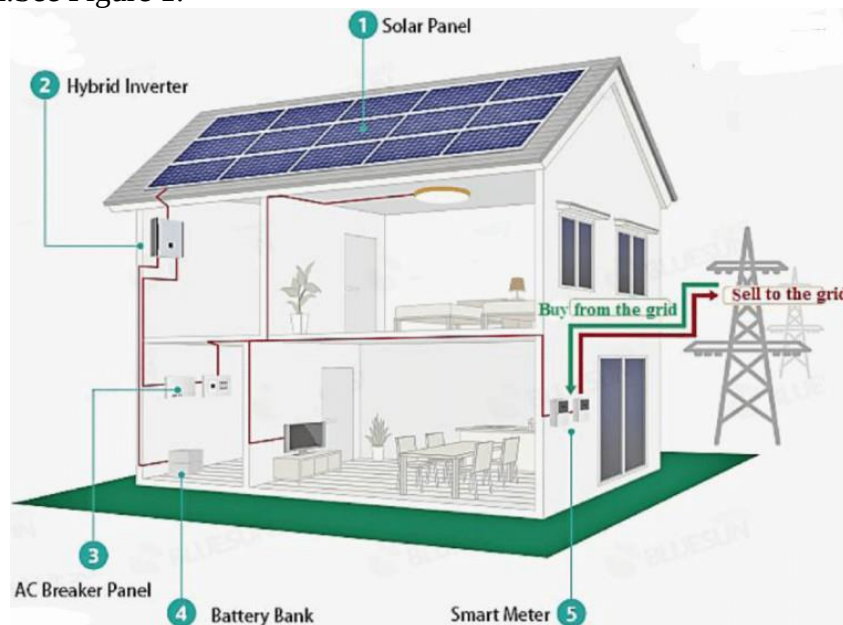


Fig. 1 Photovoltaic power generation in the application form grid-connected technology

2.1. Analysis of the cost and electricity price of distributed photovoltaic power generation

For a distributed photovoltaic power generation project, due to its very simple structure, the cost of power generation only needs to be combined with the financial cost and operation management cost through the calculation of the installed cost, so that the total cost can be calculated. Generally speaking, in terms of the installed cost of distributed photovoltaic power generation, it actually refers to the initial cost applied in the construction of photovoltaic power plants. This kind of cost is generally a one-time investment, so it is also a fixed asset in photovoltaic power plants. At the same time, due to the application of preliminary project costs, the system design fee, material fee, equipment purchase fee, construction and installation fee, and external line access fee of the overall planning project need to be integrated, so that in the process of calculation, statistical calculation is required. Different cost content, and ensure that the summary of the cost is realized while the overall operation develops. Among the operating costs, the cost structure is the external line access fee and installation fee, which also makes it necessary to settle the cost after the installation is completed, and to ensure that all operations of the fixed assets are checked in the subsequent management process. Inspection, and the replacement and renewal of its parts are carried out, and their costs are also recorded at this time. In this regard, in the calculation of basic costs, in addition to maintenance staff

wages and maintenance fees, the main cost is actually the equipment or parts that are replaced when the equipment is damaged and aged. Therefore, according to the current overall construction of photovoltaic power stations, in the process of operation, the basic operating quota is 1%-3%, and the larger the installed capacity of the power station, the lower the overall operating rate. Therefore, in the process of calculation, a separate calculation of its overall operation can be realized. In the financial cost, the cost actually refers to the calculation of the annual interest on the loan borrowed by the project itself before construction, and if the project funds are self-owned funds at this time, then the Financial costs can be calculated as zero. In addition, when the overall cost calculation is carried out, under the application of the subsidy policy, the reduction of its interest rate can guarantee the calculation of its overall cost to a certain extent, and it can also be realized in the calculation process. Extend its time line to improve its application efficiency, so as to ensure the implementation of various cost control work in cost control.

2.2. Calculation of distributed photovoltaic power generation in cost pricing model

In addition to its own fixed costs, it is also necessary to calculate the return rate for its predetermined investment amount, and to ensure that the lowest price of its total power generation cost is set after the project is completed, so as to ensure that the overall operation To achieve cost recovery, and then to meet the operation of the project. If the subsidy is not considered, it is necessary to ensure that the cost electricity price can be proportional to the investment amount of the overall project operation when calculating, so as to ensure that in the process of subsequent application and development, the project can truly meet the cost of 's recovery. In the process of specific calculation, it can be found that if the overall installed capacity of this technology is small, the corresponding investment scale will also be reduced, and if the investment funds at this time are all self-owned funds, and the daily maintenance The cost can also be ignored, so the overall cost can be recovered from the cost relationship, and the existence of risk factors can also be effectively controlled. If there are various problems in the application process, and the maintenance costs are relatively large, it will inevitably lead to the implementation of the project work, and the cost recovery cannot be achieved.

2.3. Factors that affect the cost of electricity price of distributed photovoltaic power generation

For a photovoltaic power generation system, its installed cost will have a volatile impact on its cost according to changes in market development and technological innovation capabilities. At the same time, in the calculation of installed cost, the scale of enterprise development and changes in market supply and demand will also be have an impact on cost. Affected by changes in the current market development, the cost of installed capacity has changed from a continuous increase in the past to a continuous decrease in calculation, and as the price of equipment such as solar modules continues to decrease, this also increases the installed capacity and the basic assembly cost still declines. the trend of. In this regard, if the application of photovoltaic power generation projects is mainly carried out by ordinary residents, then in the application of self-owned funds, the implementation of various tasks can be realized, and the needs of residents' development can also be effectively met. If the application of this project is carried out in small and medium enterprises or large enterprises, the cost of electricity will tend to rise due to its overall increase.

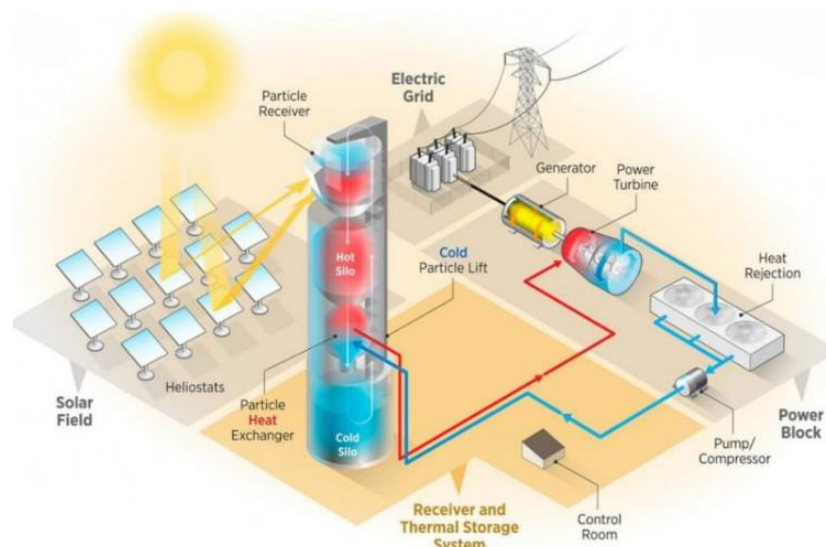


Fig. 2 Schematic diagram of photovoltaic power generation system

As for the total power generation of the photovoltaic power generation system, the annual power generation is the main power generation. In fact, it mainly depends on the application area of the equipment, and the total local annual average solar radiation must be considered, and it is necessary to ensure that the calculation process is carried out. In order to draw conclusions, it is necessary to conduct a comprehensive analysis of its solar cells, total panel area and conversion efficiency. Because the panels of solar energy equipment tend to decline year by year, which also makes the basic calculation process, different calculations will be made according to the actual situation in different regions, but the radiation effects between different regions are different, and the equipment application It is also different, which also leads to greater volatility in cost calculations.

3. Benefits of distributed photovoltaic power generation projects

3.1. Rooftop photovoltaic technology for distributed photovoltaic power generation

Among social benefits, if the implementation of distributed photovoltaic power generation projects is realized, various tasks can be carried out through the application of rooftop photovoltaic technology, especially in the context of the development of the commercial era, this technology can effectively use open space to achieve large Scale promotion, so in the process of basic application, as long as there are idle roofs, there is no need to use special construction sites to realize the application of equipment, so it is very suitable for the characteristics of urban development and operation, and can also be used through large-scale Promote applications to meet infrastructure needs. At the same time, the overall construction cost of the project is low, and there are many types of photovoltaic components that can be selected in the process of practical application, which also makes in the process of construction and application, as long as there are Better network access conditions can reduce power consumption through the application of this system. The construction of the project is very convenient, which also makes the implementation of the duty work without the need for a lot of labor costs after the application of the technology. See Figure 3.

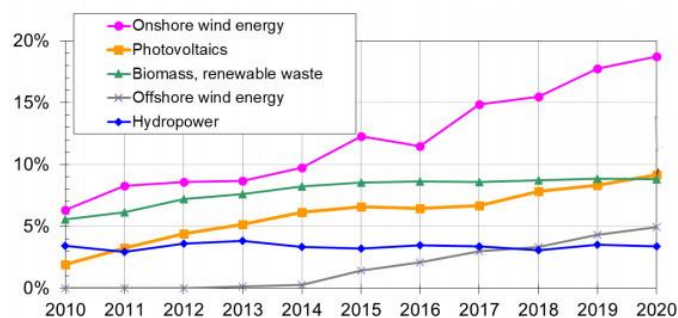


Fig. 3 Factors affecting the cost and price of distributed photovoltaic power generation

3.2. Environmental pollution of distributed photovoltaic power generation

For the protection of the social environment, the establishment of this project can also effectively ensure that the pollution to the environment is reduced when electricity is supplied. The current mainstream power generation technology is still mainly thermal power generation, which not only consumes coal resources, but also leads to the production of toxic gases, which will have an adverse impact on the development and operation of the social environment. During the construction and application of the project, since the project does not need to convert electricity through other media, only direct solar energy conversion is required, so it does not consume other natural resources, so it does not cause environmental pollution problems.

3.3. Overall construction and application of distributed photovoltaic power generation

For the generation of economic benefits, in the process of overall construction and application of this project, the investment cost is small and the rate of return is large, but if it is divided by years, the overall investment return period is about 15 to 18 years, but if its overall equipment failure rate is large, its basic life will be extended to 20 years. From the point of view of economic benefits alone, if the overall payback period is long during investment and construction, it will lead to general economic benefits, so it also needs to be applied and constructed according to the actual situation of the region.

4. Control strategy for the influence of distributed photovoltaic power generation on grid voltage

4.1. The control voltage of distributed photovoltaic power generation exceeds the limit.

Photovoltaic power generation technology is becoming more and more mature, and it plays a significant role in people's lives and industrial production. At the same time, it also improves the economic benefits of power units. In order to apply photovoltaic power generation technology to the power grid, it is first necessary to control the voltage over-limit phenomenon, and to strictly control the power of the photovoltaic power generation meter. According to the power amount of the photovoltaic generator itself, combined with the calculation method of moving average, in the specific calculation process, the problem of power reduction often occurs. With reference to the photovoltaic curve and system architecture, the power generation results are calculated, and the power value of photovoltaic power generation in different time periods is further determined. Generally speaking, the method of controlling the voltage over-limit has a more obvious effect. To ensure more accurate calculation results, the sliding window calculation method can also be used. See Figure 4.

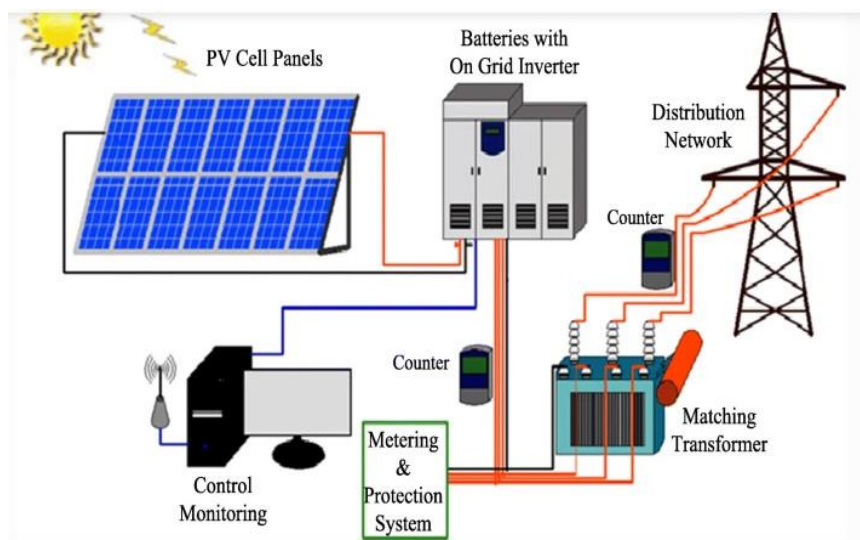


Fig. 4. Control strategy for the influence of distributed photovoltaic power generation on grid voltage

4.2. Distributed photovoltaic power generation Improve the energy storage power generation management system.

The distributed photovoltaic power generation system is mainly composed of three parts: the initial photovoltaic array, the combiner box and the inverter. The main form of power supply stores the energy of photovoltaic power generation first and then applies it to the operation of the distribution network. Photovoltaic power generation is generally composed of three devices: converter, battery, and capacity control to form a power storage and power generation system. The main function of the battery and the converter is to connect. In the process of photovoltaic power generation, the converter plays a key role in controlling the voltage, ensuring that the voltage can be maintained in a constant state no matter what time period. The DC-side architecture can keep the AC voltage constant, and harmonics play a very important role in this process. Therefore, to connect photovoltaic power generation in the power grid, it is necessary to install corresponding AC equipment, and play its own special purpose according to the different modes of the power supply to ensure the stable operation of the energy storage power generation system. See Figure 5.

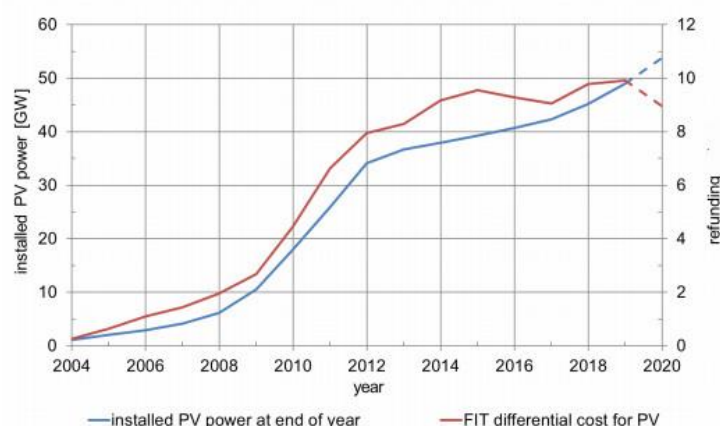


Fig. 5 Economic Analysis of Power Generation Compared with Distributed Photovoltaic and Traditional Power Generation

5. Conclusion

All in all, in the optimization of the energy structure, distributed photovoltaic power generation plays a key role and needs to be paid enough attention to. In the context of advocating green energy,

energy conservation and environmental protection, and sustainable development, the application of distributed photovoltaic power generation technology is in line with this concept. The construction of distributed photovoltaic power generation projects can effectively reduce the energy shortage situation, and can reduce carbon emissions, which has a certain role in promoting the protection of the ecological environment. Therefore, we need to evaluate its economic benefits. From the evaluation of the economic benefits of distributed photovoltaic power generation, we can see that this power generation method will have a positive impact on the optimization of the energy structure, and it is worthy of wide-scale promotion and application. Power grid enterprises should strengthen the research on photovoltaic power generation access network, improve the grid-connected service system of distributed photovoltaic power generation, and promote the development of distributed photovoltaic power generation.

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