

# Analysis of the advantages and disadvantages of BIPV technology

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**Abstract.** As environmental problems such as the greenhouse effect and glacier melting become more and more serious, the society's awareness of environmental protection is becoming stronger and stronger, which makes the development of green buildings extremely important, and the development of many green building materials and environmental protection technologies is also increasing, more attention. In this article, BIPV (Building Integrated Photovoltaic) will be researched and its development discussed. BIPV is to reduce energy consumption through the effective use of solar energy. It is green, environmentally friendly and non-polluting. However, China started late in photovoltaics and lack of research in this area, which makes the application of BIPV technology in China still have high costs and lack of relevant building specification standards. This paper discusses the suggestions for the future development of BIPV technology, hoping to provide meager strength for the development of green buildings in China and provide direction for the future development of BIPV.

**Keywords:** BIPV, solar energy, environmental friendly.

## 1. Introduction

The amount of energy used in buildings in China is rising daily. At present, the energy consumption of the complete building process accounts for more than 46.5% of the country's total energy consumption, of which the proportion of energy consumption for heating, ventilation and air conditioning is as high as 50%. Finding innovative solutions to preserve energy in buildings is crucial for lowering energy usage. Significant [1-3]. Because it has the benefits of local collection and local application, solar energy has the greatest potential to achieve building energy conservation [1]. Combining solar energy with buildings can meet a variety of energy and health needs in buildings, among which building-integrated photovoltaic (BIPV) technology is an important way to reduce building energy consumption. The largest solar building in the world is the Riyuetan-Weipai Building (referred to as Riyuetan) built in China, which uses solar photovoltaic building-integrated technology [4]. Through the analysis of Riyuetan, it can know the importance and advantages of BIPV technology for the development of green buildings. BIPV technology has green advantages such as environmental protection, no pollution, and energy saving. However, BIPV technology still has certain limitations, such as high cost and lack of relevant architectural specifications. The key issue in the development of BIPV at this stage is how to maintain a certain market size by legal and economic means, attract the attention of investors, technology research and developers, ensure the survival and development of the industry, encourage technology research and development, and promote product quality improvement and cost reduction in order to form a larger

solar photovoltaic power generation market. More effort has to be put into the creation of pertinent standards and system development in order to fulfill the pertinent requirements of my country's "carbon peak" and "carbon neutral" targets in order to enable the healthy and quick development of the BIPV business. In order to achieve this, pertinent recommendations are made in this article.



**Figure 1.** The "Micro Pavement" Building of the Sun Moon Temple.

## **2. BIPV-related applications**

Sun Moon Temple "Riyuetan-Weipai Building" (referred to as Sun Moon Temple) is a landmark building in China's Sun Valley, with a total construction area of about 75,000 square meters, a solar thermal area of 4,980 square meters, and a photovoltaic area of 210 square meters making it the largest solar building [4]. As shown in figure 1. Through the application of many building energy-saving technologies and the comprehensive use of solar energy, the comprehensive energy-saving efficiency of the building reaches 88% [4]. Sun Moon Altar uses photovoltaic and building-integrated photovoltaic (BIPV) technologies in the daylighting roof, sunshade components and curtain walls. BIPV opens up new horizons for the application of photovoltaic technology in buildings and stimulates the industrialization of photovoltaic technology and its large-scale application in cities, which has a very broad market prospect. The solar photovoltaic power generation system is mainly composed of photovoltaic modules, energy storage devices, charge and discharge controllers, inverters and loads [5]. Solar power generation, sound insulation, heat insulation, green environmental protection and no pollution. But there are still high costs and lack of building standards.

### *2.1. Advantages of BIPV*

BIPV technology achieves the goal of energy saving, environmental protection and green development through the combination of photovoltaic and construction. It has the following advantages in terms of comprehensive construction, economy, technology and environmental protection [5-6]. (1) The process of solar photovoltaic system generating electric energy is a physical process, green and pollution-free, no harmful substances are discharged, and the environment is not polluted. Solar power is an endlessly renewable energy source. (2) Solar photovoltaic systems are usually installed in idle spaces such as roofs and windows, and do not occupy additional space and do not require additional equipment. (3) The solar photovoltaic system can reduce the consumption of electric energy. Used in conjunction with city power to solve the national power shortage. In addition to ensuring the power consumption of its own buildings, the BIPV system can also supply power to the grid, thereby alleviating peak power demand. (4) In summer, due to the use of a large number of refrigeration equipment, a peak of electricity consumption is formed. At this time, when the photovoltaic array generates the most electricity, the solar photovoltaic system can better convert solar bricks into electric energy. Air-conditioning burden, reduce air-

conditioning electricity costs. (5) Create a variety of texts as needed to add color to the building and provide more creative space for architects. Architects and photovoltaic module manufacturers can jointly determine the parameters of battery and shading technology.

This product will fill a gap in the application field of solar energy products integrating power generation, daylighting, energy saving, green environmental protection and many other advantages. Solar power generation is the frontier of science and technology in the 21st century, and governments around the world support the cause of solar power generation. The promulgation and implementation of the "Renewable Energy Law" and "Renewable Energy Medium and Long-term Planning" have greatly promoted the development of photovoltaic grid-connected power generation and building integration in China. Transition to alternative energy sources, the transition of human society to a sustainable energy system. Solar photovoltaic power generation will enter the energy structure as the energy technology with the most ideal characteristics of sustainable development, and its proportion will become larger and larger, and it will become one of the main components of energy. The solar photovoltaic construction industry has increased the innovative thinking of architecture and design, which is of great value in terms of economical practicality and social aesthetics. BIPV products, as the combination of the huge construction market and the photovoltaic market with great potential, will have infinite and broad development prospects.

## *2.2. Disadvantages of BIPV*

*2.2.1. High cost.* Compared with traditional buildings, photovoltaic buildings need to meet the two characteristics of using green, environmentally friendly and recyclable building materials and having power generation functions. Although after a period of development, the production cost of photovoltaic technology has been greatly reduced, considering the future development of photovoltaic technology, the current production cost is still too high. The PV industry in China industry started late and the space required for photovoltaic materials was not reserved when the building was first designed, resulting in high renovation costs for existing buildings [7]. At present, the cost of photovoltaic power generation is still much higher than that of thermal power generation. In terms of price, the cost of photovoltaic power generation is difficult to compete with the original power generation industry, so the development of the photovoltaic industry still needs strong support from policies [8]. As far as solar photovoltaic technology and building integration (BIPV) are concerned, the high cost has always been the biggest problem restricting the promotion and application of photovoltaic technology. At present, the cost of solar roofs in our country is about 50 yuan/Wp, and each kilowatt requires an investment of 50,000 yuan [9]. The relatively large capital investment is reflected in the relatively high price of home use of rooftop power generation, at 3-4 yuan / (kW-h), which is about eight times the price of traditional thermal power generation [9].

*2.2.2. Lack of building standards.* BIPV is an emerging field, which is a combination of photovoltaics and buildings. Therefore, neither the photovoltaic industry nor the construction industry has a deep understanding of it. As a result, it can only be standardized according to local planning and industry discussions at this stage. At the same time, the construction industry is currently in the standard for BIPV design specifications and related atlas specifications, project construction acceptance standards, and maintenance technical regulations because the pertinent industries do not yet have an accurate and unified concept of "photovoltaic buildings". The situation of an incomplete system and chaotic management has also led to the phenomenon that the quality of the "Golden Sun" project is more or less difficult to meet the standard and the operation effect is difficult to guarantee. In the end, the country decided to stop the "Golden Sun" project in 2013 [10]. In general, China's current BIPV-related standard system incorporates two standards: GB/T 37655-2019, "Code for Acceptance of Photovoltaic and Building Integrated Power Generation System," and GB/T 38388-2019, "Detection Method for Building Photovoltaic Curtain Wall Skylighting Roof." The primary model is the national norm, and industry standards as well as other groups' requirements are matched [10].

### 2.3. *Advice on disadvantages*

The key issue at this stage is how to maintain a certain market size by legal and economic means. By grabbing the interest of investors, technology researchers, and developers, the market for solar photovoltaic power production can be expanded, the industry's survival and growth can be ensured, and technological research and development can be encouraged, the suggestions are as follows [9, 11-14]. The compulsory grid connection system is a common measure adopted by developed countries and regions in terms of renewable energy power generation. Germany and Spain have passed legislation to clarify the legal relationship between renewable energy power generation companies and grid companies. For the renewable energy power produced within the scope of its power supply, the grid operator closest to the power grid operator has the obligation to accept the renewable energy power plant whose geographical location is not in the power supply area of the grid operator. The compulsory grid-connection system can guarantee all renewable energy power generation to be connected to the grid, increase the reliability of power supply and reduce initial investment, ensure the interests of renewable energy developers and thereby promoting the rapid development of renewable energy power generation. The focus of renewable energy commercial development and utilization is on power generation technology and the main factor that restricts its development is the grid-connected electricity price. The "Renewable Energy Law" called for supporting policies like "mandatory quotas" for the production of electricity from renewable sources, "setting grid-connected electricity price standards by region," and "sharing the cost difference between renewable energy and conventional energy in the entire society." In addition, the National Development and Reform Commission published "Trial Measures for the Administration of Power Price and Cost Sharing of Renewable Energy Power Generation" in 2006. The implementation of cost sharing is the basic system for the international community to develop renewable energy. There are generally three types of compulsory means, one is the compulsory quota system, the second is the compulsory purchase system, and the third is the voluntary purchase system. In terms of development speed, the compulsory purchase system is the most effective. In June 2005, Shanghai took the lead in promulgating the "Shanghai City Green Power Subscription and Marketing Trial Measures". The trial method stipulates that: the Municipal Development and Reform Commission arranges an annual guidance plan for green power, units and individuals voluntarily subscribe to green power, with 6000 kW·h as a unit, and based on the user's electricity consumption in the previous year, determine the minimum amount of subscription; The difference in electricity charges between the on-grid electricity price of renewable energy power generation projects and the on-grid electricity price of conventional energy power generation is digested through the green power subscription method or apportioned in the sales electricity price according to national regulations.

By comparing the development status of BIPV-related standards at home and abroad, it can be seen that China's BIPV standardization is still in the photovoltaic industry, in contrast to IEC and ISO, which have released more than a dozen standards involving various BIPV components and have established a BIPV working group. It is the initial stage of the initial combination of power generation standards and building standards, but the BIPV standardization work has begun to attract the attention of all parties and the formulation of local and group standards is also proceeding rapidly.

More effort has to be put into the creation of pertinent standards and system development in order to fulfill the pertinent requirements of my country's "carbon peak" and "carbon neutral" targets in order to enable the healthy and quick development of the BIPV business. Based on this, especially in light of how slowly domestic BIPV-related standards are developing. The following recommendations are made. [10]. (1) To give BIPV a solid foundation for growth, relevant departments should research and build standard systems connected to BIPV. They should also set up a standardization technical committee for BIPV as soon as feasible. Therefore, the content involved in the committee needs to include design, construction, testing, acceptance and other links. The government and enterprises should carry out BIPV promotion plans, encourage the application of BIPV, encourage the use of BIPV or BAPV in the form of buildings to be built and new buildings, and encourage the transformation of BIPV for existing and ongoing buildings. The country and the government should give strong support in terms of policy and technology to projects that actively carry out BIPV transformation, actively install photovoltaic power

generation systems and use BIPV components. For photovoltaic power generation projects that are equipped with energy storage devices or connected to the grid, the local government and the power bureau and other relevant departments should consider "lowering the threshold, unifying standards, and subsidizing incentives", and under the premise of ensuring safety, carry out policy or economic measures for the project. support to promote the development of BIPV. Standards for BIPV modules span a wide range of industries, including building, materials, and photovoltaic modules, making it challenging to create a single standard and impeding the BIPV standardization process. Thus, it is necessary for relevant authorities to take the initiative in gathering specialists from diverse sectors to offer recommendations for the creation of standards across various businesses. Based on this, the China Photovoltaic Industry Association will form the Photovoltaic Building Special Committee in 2020, with China Academy of Building Research Co., Ltd. serving as the secretary. Professionals are continuously trying to promote the BIPV industry's healthy growth.

### 3. Conclusion

This paper discusses the importance of BIPV technology for the development of green buildings through Sun Moon Temple. Building integrated solar photovoltaic technology is environmentally friendly, pollution-free, and reduces energy consumption, but it still has problems such as high cost and lack of relevant building design specifications. This paper explores the proposals on the high cost and lack of building codes, but there are still more problems to be solved by scholars about the development of BIPV technology. It is envisaged that this study will help guide the development of solar photovoltaic building integration technology in the future and that future researchers will help BIPV technology advance. People are now paying greater attention to the construction of green and ecologically friendly buildings as a result of the serious environmental issues. Chinese solar energy resources are both abundant and widely dispersed. Solar power generation using photovoltaic cells has enormous development potential. The inclusion of solar photovoltaic power production in "China's 21st Century Strategy" by the government now would undoubtedly encourage the use and advancement of photovoltaic power generation technology in our nation and increase the scope of its use in buildings.

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