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Promotion and application of Convenient Photovoltaic Charging Car Sheds and Charging Piles

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Abstract: The purpose of this study is to explore China's national strategy to cope with global climate change, with a special focus on solar photovoltaic power generation projects in renewable energy, as well as convenient photovoltaic carports and charging pile projects under the requirements of energy development in Shandong Province. The author analyzes the photovoltaic project of Shandong Energy Building through research, including project situation, environmental resources, project construction and other aspects. The use of the idle carport roof of Shandong Energy Building to build distributed photovoltaics, the use of "self-generation, surplus electricity grid" mode to provide power supply services for enterprises, and for employees to provide charging services for new energy vehicles. Under the climatic conditions of Jinan, the photovoltaic power generation project has good feasibility.

Keywords: Global climate change; Solar photovoltaic power generation projects; New energy vehicles.

1. Introduction

In response to global climate change, China has proposed the "3060" national strategy, which calls for accelerating energy transformation, implementing carbon reduction measures, and developing renewable energy. As a renewable energy source, developing photovoltaic power generation projects is beneficial for improving energy structure, achieving energy diversification, and alleviating dependence and constraints on limited mineral energy. The project utilizes the idle car shed roof of Shandong Energy Building to build distributed photovoltaic, adopts a " surplus electricity grid connection" mode to provide power supply services for enterprises, and also installs charging piles to provide charging services for new energy vehicles for employees. This not only achieves the development and utilization of new energy, but also provides convenient services for employees, Today, with the vigorous development of cities, it is highly worth promoting and utilizing.

2. Convenient Photovoltaic Car Shed and Charging Pile Project Plan

2.1. Project situation

This project is located in Lixia District, Jinan City. It utilizes the idle car shed roof around the Shandong Energy Building to construct distributed photovoltaics, lays ETFE films, and provides power supply services to enterprises using a "surplus electricity grid connection" mode. It also provides charging needs for new energy vehicles for employees through four charging piles. The operation period of solar photovoltaic power stations is 25 years, and the operation period of intelligent charging stations is 15 years.

2.2. Environmental resources

Jinan City is located in the mid latitude warm temperate continental monsoon climate zone, which combines the characteristics of the southern warm and humid climate and the northern dry and cold climate.[1] Influenced by the natural geographical environment, solar radiation, and monsoon, it has the climate characteristics of good lighting, high accumulated temperature, rich heat, abundant rainfall, and simultaneous rainfall and heat, with superior conditions such as light, heat, water, and air. The climate changes significantly throughout the four seasons, with variable climate in spring, more southwest winds, less precipitation, and frequent drought. Summer is hot, with humid air and concentrated precipitation. In autumn, there are fewer clouds and rain, with the main characteristic being high and cool autumn. Winter is cold and dry, with frequent northwest winds. The average annual solar radiation in the project location is 1335.1 kWh/㎡, with a rich annual level of total solar radiation, a moderate stability level of total horizontal radiation, and a high direct radiation ratio level of total horizontal radiation.[2] Suitable for constructing grid connected photovoltaic power stations.

2.3. Project construction

2.3.1. Access system

This project focuses on power generation, fully utilizing the abundant solar energy resources in the local area, and constructing grid connected photovoltaics to supply power to enterprises, reducing electricity costs. This project plans to use 106 320Wp lightweight components, with an actual installed capacity of 33.92kWp. Every 17/18 components are connected in a string, and every 6 components are connected to an inverter. The system is divided into one 33kW photovoltaic power generation system, which outputs 0.4kV AC power through grid connected inverters and is connected to the 0.4kV switchgear in the 10kV distribution room of Shandong Energy Building through an AC cable connection point. The original 10kV distribution room was allocated a backup circuit for photovoltaic grid connection. One 120kW DC charging station and three 7kW AC charging stations are used near the carport to meet the vehicle charging needs.

2.3.2. Renovation of convenient car sheds

The roof photovoltaic module adopts lightweight components, and ETFE film is laid on the roof of the car shed, with an area of approximately 255 square meters. According to the data, the roof load of the car shed can meet the requirements for increasing the load when laying photovoltaic modules, but the main structural load cannot meet the requirements for increasing the load when laying photovoltaic

modules. Therefore, it is necessary to reinforce and repair the car shed as needed.

2.4. Economic analysis

2.4.1. Power generation analysis

The photovoltaic part of the roof is calculated based on the horizontal solar radiation of 1335.1kWh/m2.[3] The annual power generation is approximately equal to:

33.92kW × 1335.1h=45300 kWh.

The theoretical online electricity consumption for the first year is approximately equal to:

45300 kWh × 82.1%=37200 kWh.[4]

The comprehensive efficiency of the photovoltaic system is set at 82.1%.[5] However, due to severe occlusion, it is estimated that the photovoltaic module will suffer a power generation loss of about 60% due to occlusion, and the actual system efficiency of the power station is only 82.1% × 0.4=32.84%.[6]

The first year of power generation after the completion of the power station is 14700 kWh, and the annual equivalent utilization hours are 432.97 hours. During the 25 years of operation, the total power generation is 341,300 kWh, the average annual power generation is 13,700 kWh, and the average annual equivalent utilization hours are 402.45 hours.

2.4.2. Social benefits

The project has an operation period of 25 years and an annual power generation capacity of about 341,300 kWh. Compared with coal-fired power plants, based on a standard coal consumption of 310g/kWh, it can save 4.23t of standard coal annually for the country, reduce greenhouse gas CO2 emissions by about 13.61t annually, and reduce SO2 emissions by about 0.41t.

The project of using car sheds to construct distributed photovoltaics while installing new energy vehicle charging piles has strong social benefits and demonstration leading role, which can further enhance the corporate image

3. Conclusion

As a demonstration project for photovoltaic car sheds and charging piles, this project not only conforms to the principles of national sustainable development and national energy development requirements, but also provides convenient services for employees. It has strong social benefits and demonstration effects, and is very suitable for urban construction and development needs.This project is an environmentally friendly, low energy consumption, and energy-saving solar photovoltaic power generation project, using green energy solar energy as a renewable energy source, which will not cause air and water pollution problems or waste residue stacking problems. It is of great significance for reducing greenhouse gas emissions, saving energy, and promoting the development of related industries.

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