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Building of Rural Roof Distributed Photovoltaic Intelligent Management System based on Big Data Technology

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Abstract

With the proposal of carbon neutrality, rural revitalization and other policies, the rural rooftop distributed photovoltaic industry is found very rapidly. This project mainly studies how to improve the operation and maintenance capabilities of rural rooftop distributed photovoltaics, reduce labor costs, be able to quickly respond to relevant decisions, and timely detect faults, monitor basic operation conditions, increase power generation benefits, and maximize the benefits of all parties. It is an intelligent management system built based on modern information technology related to big data and cloud computing, referred to as rural rooftop distributed photovoltaic intelligent management system.

Keywords

Big Data Technology; Rural Roofs are Distributed; Photovoltaic Intelligent Management System.

1. Research Background

With the proposal of policies such as "double carbon" and rural revitalization, and the National Energy Administration issued a notice on the pilot project of promoting roof distributed photovoltaic development in the whole county. Green and low-carbon development is the internal driving force and inevitable requirement for high-quality rural revitalization. The potential of emission reduction contained in rural areas can be effectively stimulated through rural revitalization. This shows that the potential of roof distributed photovoltaic industry in rural China is huge. This also puts forward higher requirements for the efficiency and quality of roof distributed photovoltaic operation and maintenance services. However, because the decentralized distributed photovoltaic projects will lead to problems such as manpower consumption, low efficiency, high cost and slow decision-making in the traditional operation and maintenance mode, it cannot maximize the benefits. It is precisely so that a full process intelligent management platform should be built to gradually develop the operation and maintenance management of roof distributed photovoltaic projects into an intelligent platform for centralized remote monitoring, and to solve these problems by using "big data", "Internet" and other high-tech technologies. To maximize the benefits of roof distributed photovoltaic projects will strongly promote the realization of the national "double carbon" goal and strongly boost the rural revitalization strategy.

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2. Realistic Background

Photovoltaic power generation refers to the process of converting solar energy into electric energy through photovoltaic power generation system. It is a clean and pollution-free green energy and plays an important role in the trend of replacing fossil energy.

The current photovoltaic power generation market mainly has two forms: one is the power generation of large ground photovoltaic power stations, namely centralized photovoltaic; Second, distributed photovoltaic power generation, mainly roof distributed photovoltaic power generation.

At present, the global photovoltaic industry is dominated by large ground photovoltaic power stations, such as the world's largest photovoltaic power generation base, Qinghai Talatan photovoltaic power station, which covers an area of 609 square kilometers, close to the size of Singapore. A ground photovoltaic power station has a good scale and benefits, but it has obvious disadvantages such as occupying land and limiting power supply frequently.

3. Research Objectives and Main Contents

3.1. Main Contents

Based on the background, in order to improve the operation and maintenance efficiency and service quality of roof distributed PV, and maximize the benefits, the project first visited the villages where roof distributed PV has been installed to learn about their operation mode, the use and trend of electric energy, and found out what problems and deficiencies rural roof distributed PV has in management, operation and maintenance through investigation, and compared with the data referred to to see whether they are consistent. Then consult the data, understand the existing research on intelligent operation and management of rural roof distributed photovoltaic, and finally build a rural roof distributed intelligent management system using modern information technologies such as big data and cloud computing to try to solve these problems, so as to maximize benefits in all aspects and reduce waste.

3.2. Research objectives

Clearly understand the problems and defects in the current rural roof distributed photovoltaic management and operation, as well as some existing research and solutions to this problem, and try to conceive and build a smart management platform for rural roof distributed photovoltaic based on my knowledge and some modern information technologies such as big data. Make a contribution to double carbon and rural revitalization.

3.3. Innovation points and project characteristics

This project is mainly based on modern information technology such as big data to build a smart management platform for rural roof distributed photovoltaic management, operation and maintenance, and promote its digital ecological governance. It also combines the current popular 5G, AI, cloud computing and other technologies, and also uses some in-depth learning algorithms to serve the rural roof distributed photovoltaic.

This project mainly starts with field visits to learn about the specific problems of rural roof distributed photovoltaic in the operation and maintenance party. It adopts the intelligent platform of centralized remote intelligent monitoring, and also needs to combine the application of modern information technology such as "Internet plus", "Internet", "big data", "cloud computing". It is proposed to shorten the processing time of big data and improve the power generation efficiency: the model used by traditional management platform to process the massive data of photovoltaic power station is relatively simple, the platform resource consumption is huge, and the data processing and calculation time is long, which can no longer meet the current demand. Reduce the operation and maintenance cost and enhance the roof

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distributed photovoltaic operation and maintenance capability: provide basic monitoring of equipment operation status. Timely find out the faulty equipment to ensure the timely repair and replacement of the faulty equipment, so as to improve the efficiency of roof distributed photovoltaic power generation. Strengthen roof distributed photovoltaic monitoring and diagnosis.

This research adopts the research method of social investigation and research as the main research method supplemented by literature research, and takes the big data platform as the basis to further study the roof distributed photovoltaic intelligent management system, and explore the feasible monitoring mechanism of the distributed photovoltaic intelligent management system. The scientific research echelon of this project is reasonable and scientific, and has the belief, spirit, ambition and ability necessary for the research topic. We have had a general understanding of the rural roof distributed photovoltaic intelligent management system, as well as its working principles and processes. The roof distributed photovoltaic intelligent management system monitors all aspects of the roof distributed photovoltaic intelligent management system based on cloud computing, big data and other information technologies, combined with various intelligent devices.

4. Roof Distributed - BAPV and BIPV

4.1. Components

BAPV: solar photovoltaic power generation system installed on the existing building combined with photovoltaic and building attached to the building surface.

BIPV: PV building integration, integrating PV products into the building itself as a part of the building, becoming a part of the building.

The difference between BIPV and BAPV mainly lies in the degree of integration of photovoltaic modules and buildings. BIPV integrates PV modules.

It is integrated into the roof or wall of the building, while the PV module of BAPV is only attached to the building surface.

4.2. Application Scenario

BAPV is mainly used in (flat/inclined) roofs, where ordinary photovoltaic modules are fixed on color steel tiles or cement roofs through brackets, while BIPV is mainly used in photovoltaic roofs, photovoltaic curtain walls, photovoltaic ceilings and other decentralized scenarios merchant.

5. PV System Main Components and Related Industry Chain Companies

According to ENF, the main components of photovoltaic system include: solar cell module, photovoltaic inverter, support system, charging controller and energy storage system.

Solar cell module.PV inverter: PV inverter can be divided into grid connected, off grid and hybrid type according to power supply mode. The grid connected inverter corresponds to the grid connected photovoltaic system, and the output voltage is higher than the grid voltage. Therefore, the output AC power can be returned to the mains to meet the user's demand for "self use, surplus power online". The off grid inverter is mainly responsible for converting the DC output from the battery into AC in the system to meet the power demand of AC load. The hybrid inverter has the functions of grid connection and off grid. For large scale BAPV/BIPV, we mainly consider grid connected inverter when analyzing the price. With the increase of inverter output power, the price per watt tends to decline, and the reasonable range of the price per watt of large inverter is 0.1-0.25 yuan/Wp.

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Support systems are classified according to application scenarios. Domestic support systems are mainly divided into flat roofs (36%), inclined roofs (44%) and car sheds (19%); According to the direction of component arrangement, it can be divided into horizontal (17.1%), vertical (18.7%), and horizontal and vertical (58.8%). For support systems, the domestic starting price is mostly distributed in the range of 0.1-1.3 yuan/Wp, with a simple average of 0.4 yuan/Wp and a median of 0.3 yuan/Wp.

According to ENF, the starting price of most domestic charging controllers is less than 4500 yuan/set. According to the maximum input power, the starting price of each watt is less than 1 yuan/Wp. The charging controller is not an essential component of the distributed photovoltaic system. If a system is not equipped with a battery, it is not necessary to install the charging controller. According to the type of technology, the charging controller can be divided into MPPT (41%), PWM (53%) and others (2%). From the perspective of price distribution, the price of MPPT is relatively higher. In addition, the analysis of the relationship between the maximum solar input power of the charging controller and the unit price shows that the higher the input power is, the higher the unit price is. However, with the increase of the input power, the increase of the price tends to decrease.

According to ENF of energy storage system, the price per kilowatt hour of single charging of energy storage system in China is mainly concentrated in the range of 300-2000 yuan. The energy storage system can be divided into lead acid, lithium, nickel and others according to battery technology, accounting for 85%, 11%, 2% and 2% respectively. From the price point of view, the price per kilowatt hour for a single charge of the energy storage system is basically more than 300 yuan. At this stage, the one-time investment of the energy storage system is still high, but the energy storage system is not a necessary accessory of the distributed photovoltaic system

Related industrial chain companies: Tongwei Shares and Aixu Shares of battery chips; Longji, Jinko Energy and Jingao Technology of PV modules; Solar power supply of PV inverter, Jinlang Technology, Goodway, CITIC Bo and Qingyuan of PV bracket.

6. Market Size and Market Opportunities

Throughout the development process of overseas household photovoltaic market, countries have given high subsidies to household photovoltaic in the early stage.

From the perspective of development stage and development mode, there are great differences between domestic and overseas household photovoltaic markets.

In overseas developed regions, the residential electricity price continues to rise, and large-scale power outages caused by insufficient grid investment are also emerging in endlessly. The main driving factors for residential households to install photovoltaic systems are to reduce the cost of comprehensive power consumption and improve the reliability of power supply. The household photovoltaic has changed from the original subsidy driven and full grid access mode to its own economic driven and spontaneous self use mode.

However, there is still a big gap between the level of domestic residents' electricity consumption and that of overseas residents. In 2019, the per capita domestic electricity consumption of urban/rural residents in China will be 688/800 kilowatt hours, less than one third of that in developed regions such as the EU, the United States, Japan and Australia. If the number of people in each household is 3-4, the annual power consumption of domestic rural households is only 2000-3000 kWh, and the annual power generation of a 10kW household photovoltaic system usually exceeds 10000 kWh. Even if all household electricity is provided by photovoltaic, the proportion of power generation that can be consumed for self use is only 20% - 30%.

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Most of the domestic household photovoltaic power generation still needs to be absorbed through grid connection. The main driving opportunity for residents to install household photovoltaic systems is to obtain investment income.

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