

Research on New Model of Photovoltaic Poverty Alleviation Based on Cooperation among Government, Enterprise and Villager

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Abstract—In the basis of the current policy opportunities and advanced technical conditions of the current national poverty alleviation strategy and clean low-carbon energy development strategy, our research team will carry out research on photovoltaic poverty alleviation construction. Our group selects the typical poverty-stricken county—Yangyuan County of Hebei Province as the research object. Through field investigations and in-depth interviews, it studies the influencing factors, current situation and usage mode of PV poverty alleviation construction, and finds the difficulties and blind spots in the implementation of the policy. Conducting logical analysis and summarizing exchanges, trying to launch a new model for sustainable photovoltaic poverty alleviation construction in Yangyuan County, Hebei Province—direct government renting operation, direct lease operation, and enterprise leasing operations. The combination of villagers, enterprises and the government will complete the construction of precise poverty alleviation.

Keywords—*photovoltaic poverty alleviation; government direct rent operation; company direct rent operation; corporate leasing operations; factor analysis*

I. INTRODUCTION

Photovoltaic power generation is clean and environmentally friendly, with reliable technology and stable income. It combines climate change, low carbon development and poverty alleviation to achieve a sustainable green income increase and poverty reduction model. Photovoltaic poverty alleviation is in line with the strategy of precision poverty alleviation and precision poverty alleviation, and is in line with the national clean and low carbon energy development strategy; it is conducive to expanding the photovoltaic power generation market and helping to promote the stable income increase of the poor [1]. Since 2016, the Party Central Committee and the State Council have repeatedly issued a document requesting local governments to combine poverty alleviation and development with energy development and construction, and actively carry out photovoltaic poverty alleviation construction. General Secretary Xi Jinping repeatedly visited the Jinzhai in Anhui, Yongning in Ningxia, and Zhangbei in Hebei to inspect the poverty alleviation work of PV, and fully affirmed the work of photovoltaic poverty alleviation. As an innovative application model for precision poverty alleviation, photovoltaic poverty alleviation is extremely important for poverty alleviation in poor villages. The natural conditions of these villages are relatively poor, and the development

foundation is very weak. At the same time, it is also an important way for the poor people who have no ability to work to get rid of poverty and increase income.

II. INFORMATION COLLECTION

A. Status of Photovoltaic Poverty Alleviation in Yangyuan County

The report of the 19th National Congress of the Communist Party of China pointed out that from the 19th National Congress to the 20th National Congress; it is the historical convergence period of the "two hundred years" struggle goal. Among them, the first one hundred years means that by the time the 100th year of the founding of the Communist Party of China, that is, in 2021, the goal of building a well-off society in an all-round way will be achieved. To build a well-off society in an all-round way, the core problem to be solved is to eliminate poverty [2].

Zhangjiakou City is the main battlefield for poverty alleviation in Hebei Province, and it is also the area with the most concentrated poverty population around the capital [3]. Yangyuan County has obvious illumination advantages, and its geographical location also meets the favorable conditions for grid connection. The villagers have the economic strength to purchase photovoltaic equipment, and the larger power demand has also created favorable conditions for the development of photovoltaic power generation.

In January 2018, the National Energy Administration and the State Council Poverty Alleviation Office issued the "Notice on the First Batch of Photovoltaic Poverty Alleviation Projects for the 13th Five-Year Plan", and announced the first batch of village-level photovoltaic poverty alleviation power station projects in the "13th Five-Year Plan". Yangyuan County of Zhangjiakou City is listed. At the same time, the on-grid electricity price of the village-level photovoltaic poverty alleviation power station is implemented in accordance with the Notice of the National Development and Reform Commission on the Price Policy for Photovoltaic Power Generation Projects in 2018. The provincial subsidy standard is 0.2 Yuan per kWh, and the subsidy is 3 years from the date of grid connection.

In 2018, the village-level photovoltaic power stations in 163 poverty-stricken villages in the county have all been

completed, covering 9,720 poor households; the 100,000-kilowatt centralized photovoltaic power station project is expected to be connected to the grid at the end of June this year, covering 3,334 households.

At the end of August 2018, a 420-kilowatt photovoltaic power station was built and delivered, and the dividends covered all the poor households. The investment of 4.2 million Yuan has already begun to benefit from dividends. Some poor households have already received 1,000 Yuan dividends, covering 24 households with poverty, and the per capita income is 583.3 Yuan. As one of the key projects in Zhangjiakou City, Yangyuan Dongrun Photovoltaic Power Generation Project has been connected to the grid for 180 MW. This shows that Yangyuan County's photovoltaic poverty alleviation has begun to take effect.

B. Visiting Yangyuan County for Research and Obtaining First-hand Data

1) Information collection desk investigation. Mainly through the examination of books and literature, collect and screen information about the "Photovoltaic Poverty Alleviation" program and the situation of rural photovoltaic power generation in China.

Questionnaire survey. Design questionnaires and visit rural areas on the spot. Questionnaires were distributed to local village committee cadres and residents, and questionnaires were collected after they answered all questions independently.

Field investigation. The research team conducted interviews with the Exchange Township and village cadres and residents and asked them about the advantages and obstacles to the implementation of the "PV pro-poor" program, comments and suggestions.

Expert interview. The research team contacted teachers who studied photovoltaics, new energy and rural economy, and asked them about the feasibility and possible problems of the current "Photovoltaic Poverty Alleviation" program in rural China, and asked them to make suggestions.

In the course of the investigation, adhering to the "minimum cost, minimum manpower, and minimum time" under the premise of effectively meeting the research objectives is the principle for determining the investigation strategy [4].

2) Information processing. The data to be reviewed will be summarized and classified, and the collected data will be analyzed by statistical theory and methods. Models will be built, statistical charts will be drawn, and information and materials will be compiled. The group members will fully exchange views and summarize more consistent views and conclusions.

3) Logical analysis. According to the survey results, combined with reference materials, logical classification and depth comparison analysis, summed up the existing problems, and put forward reasonable solutions and effective recommendations.

4) Summary communication and report writing. All members discuss and exchange experiences and experiences in

the research process, and summarize the problems in the research process and write a formal report.

III. COMPREHENSIVE ANALYSIS OF THE SURVEY RESULTS

A. Processing and Analysis of Survey Data

In order to reduce the selection bias and make the sample more representatives, we selected the village of Dushan Village, Yangyuan County, Zhangjiakou City as the survey sample. Because the selected sample is small overall, the finite multiplier is used to calculate the sample size.

$$\text{Sample Size} = \frac{S^2 Z^2}{e^2} \times \sqrt{\frac{N - n}{N - 1}}$$

With a 95% confidence level and a "worst case" of 50/50, a sampling error of 3% is allowed, and n is 1067, and the required sample size is 661. Successfully recovered 601 questionnaires, the questionnaire recovery rate was 91%, and 370 copies were excluded after the invalid questionnaires, the effective rate was 61.6%, which met the basic requirements of the statistical survey.

B. Analysis of Factors Affecting PV Poverty Alleviation

Factor analysis can automatically find the causal relationship contained in the table in a factor analysis table, and draw an intuitive causal map to help people better analyze, solve problems and analyze [5]. After analysis, four aspects of basic factors, psychological factors, acceptance factors and policy factors were selected:

a) Basic factors

Due to the aging of the population, the rural labor force is insufficient in the future and the demand for electricity is increasing. Residents lacked awareness of "Photovoltaic Poverty Alleviation". Technical promotion and subsidies need to be strengthened. In recent years, the income of residents has been increasing, but purchasing power is still limited.

b) Psychological factors

Residents have a certain understanding of photovoltaics and have a higher willingness to install photovoltaic systems. At the same time, it is required to be reasonably priced when implementing photovoltaic equipment. Reasonable price of photovoltaic equipment is conducive to stimulating residents' enthusiasm for the use of photovoltaics, which in turn greatly affects the implementation of "Photovoltaic Poverty Alleviation".

c) Acceptance factors

Most residents hold a wait-and-see attitude. Residents have limited funds and the investment philosophy is relatively conservative. Residents are cautious about one-off high-value investments. In addition to the upfront investment costs, technology and after-sales service are also a concern for residents. In addition, installation and use is also one of the key factors for residents to consider.

d) Policy factors

Taking into account the wishes of the residents and the financial pressure of the government departments, a compromise can be adopted, that is, combining the two subsidies. According to the survey, 40.50% of the respondents hope that the government will issue relevant policies in a timely manner to simplify the subsidy process and reflect the residents' desire for policy. At the same time, 37.40% of respondents hope to establish relevant departments to supervise policy implementation. The "PV Poverty Alleviation" program will be difficult to implement without regulatory support for policy implementation. In addition, some respondents hope that the government can establish an information platform, strengthen publicity, and make information public and transparent.

C. Research Conclusions

This research activity selected the Dushan Village of Yangyuan County, Zhangjiakou City, Hebei Province as a pilot project through the comprehensive consideration of factors such as illumination, infrastructure construction and power demand. The relevant government departments of Yangyuan County, residents of Dushan Village, and Yangyuan County Energy Company For the research object, using the desk research, questionnaire survey, field research, expert interviews and other forms to collect data information, and using the factor analysis method in statistical means to finally get the following conclusions:

1) The problem of severe aging and low education level of the population has led to residents' lack of awareness of "Photovoltaic Poverty Alleviation", and the understanding is not perfect. Most residents have a wait-and-see attitude, so it is necessary to strengthen technical publicity.

2) The labor force is insufficient in the crowd, the residents' fund is limited, and the investment concept is relatively conservative. They are cautious about one-time high investment. If reasonable prices and subsidies are taken into account, farmers will have a high interest in "Photovoltaic Poverty Alleviation". Therefore, it is necessary to formulate appropriate prices and obtain appropriate subsidy policies in order to stimulate residents' enthusiasm for the use of photovoltaics and facilitate the implementation of this project.

3) In addition to the pre-investment costs, technology and after-sales service are also a concern for residents.

In addition, installation is also one of the key factors for residents to consider.

4) Residents generally hope that the government issue relevant safeguard policies, supervise policies, and establish relevant departments, and simplify the procedures. Therefore, it is necessary to cooperate with government departments, establish an information platform, and strengthen promotion. And then, residents feel the openness of information, as well as the security and economy of the project.

IV. CONCLUSION

Photovoltaic poverty alleviation has its own characteristics. It blurs the boundaries between producers and consumers in

traditional power. Users who install photovoltaic systems can act as both producers of electricity and consumers of electricity [6]. Based on this characteristic, we have explored three viable PV poverty alleviation models—direct government renting operations, direct lease operations, and corporate leasing operations. This model combines government, photovoltaic companies and farmers to provide more guidance for the future development of photovoltaic poverty alleviation.

A. Government Direct Rent Operations

Photovoltaic equipment is sold to the government by photovoltaic companies at a price lower than the cost. The government bears the purchase cost of equipment and subsequent maintenance and management costs.

The way for villagers to obtain photovoltaic equipment is to sign contracts with the government and rent them to the government to obtain relevant policy subsidies. The villagers pay rent, net electricity income and initial investment, while the government benefits from rent and grid-connected electricity.

The advantages of this mode: people's use threshold is reduced and the security is good. At the same time, it promoted the popularization of photovoltaic system installation and the implementation of the "Photovoltaic Poverty Alleviation" program.

B. Company Direct Rent Operations

Different from the direct rent operation mode of the government, in this model, the photovoltaic enterprises directly contact the farmers to provide equipment to the farmers. Photovoltaic companies do not charge fees at one time, but earn income from the income of farmers with the specifics of annual operating profit.

The government does not bear any additional costs and acts as a middleman or guarantor. And it can promote the implementation of the "Photovoltaic Poverty Alleviation" program.

The advantage of this model is that it is highly feasible for the government, and for the farmers, the security is good and the economy is good.

C. Enterprise Leasing Operations

We should choose companies that focus on corporate culture and social responsibility, and require them to have ready-made technologies and projects. The enterprise leasing operation model is set up to cooperation with these companies. And the enterprise leasing model is that the photovoltaic enterprise cooperates with the relevant electric power. In this model, a photovoltaic enterprise provides technical equipment to the enterprise at a price lower than the market price, and the enterprise bears the cost of purchasing the equipment. The villagers rent equipment from the enterprise and pay a certain amount of rent and grid-connected electricity to the enterprise to ensure that the company does not lose money. The government grants certain subsidies based on local policies.

The advantage of this model is that the company uses its own company's strength and financial resources to help the

company promote PV poverty alleviation projects and expand the scale, and the company itself does not bear excessive expenses.

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