The Implementation Effects and Practical Challenges of Shanghai's "Sunshine Loan" Policy for Supporting Photovoltaic Projects

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Abstract: This paper focuses on the effectiveness and practical challenges of Shanghai's "Sunshine Loan" policy in supporting the development of distributed photovoltaic (PV) projects, aiming to reveal its role and profound significance in the coordinated development of green finance and renewable energy. Through literature review and case studies, this paper systematically discusses the definition, operating model, and differences between the "Sunshine Loan" and traditional financing models. It analyzes the policy's effectiveness in promoting the growth of PV capacity in Shanghai, shortening the investment payback period, and facilitating low-carbon urban development. The research finds that the "Sunshine Loan" effectively lowers the financing threshold for SMEs and improves project implementation efficiency through a closed-loop mechanism involving government guidance, financial guarantee, and third-party supervision. However, it still faces challenges in financial guarantee capacity, income stability, and support for technological innovation. Compared with other regional and international PV credit policies, the "Sunshine Loan" has advantages in targeted regional support, but its digital application and regional replicability need further optimization. This research provides theoretical basis and practical reference for improving the green finance system and formulating regional PV policies, offering a valuable model for the green transformation of mega-cities in China and the achievement of the national carbon neutrality goal.

Keywords: Sunshine Loan; Distributed Photovoltaics; Green Finance; Policy Effectiveness; Shanghai

1. Introduction

1.1 Research Background

In the past few years, the global energy landscape has been fast-changing, with renewable energy, particularly the photovoltaic sector, representing the most important sector for carbon neutrality. As the largest market for the global photovoltaic industry, China has kept continuously pushing the construction of distributed photovoltaic projects to alleviate energy crises as well as environmental pollution [1]. Shanghai, being China's economic core as well as a mega-city, has shown important development potential in the sector of distributed photovoltaics, taking full advantage of its innovation policies as well as industry basis [2]. To meet the country's green development strategy, the Shanghai Municipal Government has used successive policy instruments to encourage the high-quality growth of the photovoltaic sector. "Sunshine Loan," a green finance product featuring innovation, endeavours to deal with the financing barrier of distributed photovoltaic projects as well as offer financial assistance to SMEs [3]. In the year 2015, the Shanghai Municipal Development as well as Reform Commission as well as the Finance Bureau issued the "Notice on the Implementation of the Distributed Photovoltaic 'Sunshine Loan' Policy" together, introducing the operating mechanism featuring government guidance, financial assurance, as well as third-party involvement, offering comprehensive control of the risk as well as financial assistance to the photovoltaic projects [4]. Nevertheless, the construction growth of distributed photovoltaic (PV) projects throughout Shanghai still encounters issues such as small financing channels as well as long payback periods during investment, requiring the research framework to assess the executing effect as well as regional practicability of the "Sunshine Loan" policy [2]. Based on this, this research concentrates on the executing role of the "Sunshine Loan" policy facilitating the construction growth of PV

projects throughout Shanghai. as well as exploring the feasible value it brings to the green finance as well as energy transition throughout mega-cities.

1.2 Significance of the Study

Research on the "Sunshine Loan" policy is not only of great guidance significance for the growth of the PV industry in Shanghai, but also offers theoretical and actual references for other mega-cities studying the coordinated development of green finance and renewable energy [5]. Analyzing the execution impacts of the "Sunshine Loan" policy, this study is capable of unveiling its concrete role in facilitating financing distribution for PV projects, lowering investment risks, and stimulating green innovations, offering data support as well as offering policy suggestions for regional green finance systems improvement [3]. Moreover, comparing the "Sunshine Loan" with other regional or international PV credit policies, the former's peculiar advantages and adaptability are abstracted, offering reference ideas facilitating the improvement of the country's PV policies [1]. Meanwhile, this research, based on the interaction between the policy, space, and technological relationship, coupling case analysis and literature review, investigating the regional disparities in the development of distributed PV-based mega-cities, constitutes the theoretical basis for building accurate as well as customized regional support policies on PV [4]. Research results are capable of offering the "15th Five-Year Plan for Renewable Energy Development in Shanghai" decision-making reference ideas as well as offering a realistic model of the design of green finance as well as energy transition policies [2].

2. Overview of the "Sunshine Loan" Policy

2.1 Definition and Operating Model

Shanghai "Sunshine Loan" is a green finance policy that advances the development of distributed PV projects. It addresses the financing challenge of distributed PV projects by offering medium- and short-term project loans to Shanghai-registered SMEs, through the mechanism of government guidance combined with market-oriented running [6]. As stipulated in the "Notice on the Implementation of the Distributed Photovoltaic 'Sunshine Loan' Policy" issued jointly by the Shanghai Municipal Development and Reform Commission and the Finance Bureau in 2015, "Sunshine Loan" takes the "government guidance, financial guarantee, and participation of third-party service providers" as the "black base" [7]. In specific terms, the government funds act as a guarantee to minimize financial institution loan risks, while third-party service providers undertake the role of screening projects and all-round monitoring, ensuring the quality of the project as well as the effective use of funds. Evaluation of the project, analysis of the risk, as well as acceptance of the project, constitute a closed-loop management mechanism, effectively improving the credibility as well as the capability of the policy to control the risk [8]. Moreover, "Sunshine Loan" also accommodates the nature of the distributed photovoltaic projects in Shanghai, and takes rooftop photovoltaic projects as well as agricultural photovoltaic projects as the first priority, making use of regional conditions of solar irradiance as well as the subsidies provided through the policies (like the electricity subsidy in Lingang New Area) to offer businesses flexible financing solutions [6]. This model's innovation rests on the comprehensive integration among the resources provided through the government, financial institutions, as well as third-party entities, so as to build a multi-party cooperative green finance ecosystem.

2.2 Comparison with Traditional Financing Models

Compared to traditional financing channels, "Sunshine Loan" shows tremendous innovation and specific support for distributed photovoltaic projects [9]. Traditional financing channels usually employ corporate credit rating and collateral, so that it is hard for SMEs to access loans as there is lack of collateral [10]. "Sunshine Loan," on the other hand, reduces the threshold of financial institutions to offer loans through government guarantees and third-party risk evaluation, allowing more SMEs to enter the photovoltaic project market [7]. Moreover, traditional financing channels usually do not offer specific support for green projects, the approval procedure being complex and time-consuming. "Sunshine Loan," through the guidance of policies as well as dedicated acceptance procedure, streamlines the procedure of approval as well as enhances the efficiency of fund utilization [8]. However, "Sunshine Loan"

also has the limitation it cannot escape, i.e., loan quantity being limited by the government's capability of guarantee, as well as the need for long-term stability of the return on projects, which will restrict the financing opportunities for some high-risk projects [9]. Generally, "Sunshine Loan" surpasses traditional channels in the lowering of financing cost as well as refinement of the policy, so that it provides a green finance development road map to mega-cities.

2.3 Policy Development History

As the construction and evolution of the "Sunshine Loan" policy, Shanghai responded to the green development strategy of the country and the construction drive to upgrade the photovoltaic industry [11]. In 2015, Shanghai initiated the "Sunshine Loan" policy for the first time to deal with the financing difficulty for distributed photovoltaic projects, initially undertaking rooftop photovoltaic projects within industrial parks and commercial rooftops [7]. In 2017, following the execution of the "13th Five-Year Plan for Renewable Energy Development in Shanghai," the "Sunshine Loan" project expanded step by step, including agricultural photovoltaic projects and residential building-mounted solar systems, expanding the range of coverage [10]. Since 2020, Shanghai optimized the policy further by adding an "policy effectiveness" evaluation index, enhancing the matching mechanism between the "Sunshine Loan" project and regional resources, which, especially on "solar energy zones," such as the Lingang New Area, where the policy realized remarkable results [8]. In the past years, as the advocacy of the objectives of carbon neutrality, the "Sunshine Loan" project has been included, together with international cooperation projects, such as the World Bank "Shanghai Low-Carbon City Demonstration Project," expanding the range of the impact of the policy [11]. In the future, the "Sunshine Loan" project would expand the work efficiency more rapidly through digital financial techniques, offering the replicable model of the policy to other Chinese cities.

3. Implementation Outcomes and Real-World Challenges of the "Sunshine Loan" Policy for Photovoltaic Projects

3.1 Analysis of Implementation Outcomes

Since its implementation in 2015, Shanghai's "Sunshine Loan" policy has achieved significant results in promoting the development of distributed photovoltaic (PV) projects, providing crucial financial support for small and medium-sized enterprises (SMEs) and fostering rapid growth in PV capacity [12]. According to relevant studies, as of 2023, Shanghai's distributed PV capacity exceeded 2 GW, with "Sunshine Loan"-supported projects accounting for approximately 30% of this total. In areas designated as "solar energy zones," such as the Lingang New Area, the annual electricity generation from PV projects has significantly increased. Some companies, such as Huohui Optoelectronics, have achieved annual electricity cost savings of over 10 million yuan through PV power generation [13]. By using a model of government-backed guarantees and third-party agency oversight, the "Sunshine Loan" effectively reduced lending risks for financial institutions, attracting more SMEs to participate in PV project development, and shortening the project payback period from an average of 6.8 years to approximately 5.2 years [14]. Furthermore, the policy's closed-loop management mechanism, including project screening, risk assessment, and final acceptance, ensured efficient use of funds and project quality, significantly enhancing public credibility [12]. The "Sunshine Loan" also promoted the coordinated development of green finance and the photovoltaic industry, providing practical support for the implementation of Shanghai's "14th Five-Year Plan for Renewable Energy Development," and making an important contribution to Shanghai's low-carbon city construction [13].

3.2 Assessment of Real-World Challenges

Although the "Sunshine Loan" has obtained great achievements during the expansion of PV project investments, there still exist numerous difficulties during its practice [15]. Firstly, the limited government guarantee capability limits the loan size and coverage of the "Sunshine Loan," being unable to satisfy the financing demand of all SMEs [16]. Secondly, the profitability of distributed PV projects depends on factors like solar irradiance and the efficiency of grid connection. Some high-risk ones cannot pass the high standard review, being unable to extend the practice of the policy [14]. Moreover, the third-party service agencies' oversight

capability varies, some localities even do not have standardized acceptance processes after project practice, being unable to influence the long-term sustainable practice of the policy [15]. Lastly, the "Sunshine Loan" program offers limited support for technological innovation, being unable to fully incentivate the R&D practice as well as the market applications of high-efficiency photovoltaic modules or energy storage technologies, being unable to influence the competitive effect of Shanghai's photovoltaic industry to some degree [16]. These difficulties imply that the "Sunshine Loan" policy structure still requires further optimization aiming to meet the differentiated demands of photovoltaic projects.

3.3 Comparison with Policies in Other Regions or Countries

Compared with photovoltaic financing policies in other regions and countries, Shanghai's "Sunshine Loan" program has unique advantages in policy design and implementation mechanisms, but also certain limitations [17]. For example, Zhejiang Province's photovoltaic loan policy emphasizes market-oriented operation, relying on commercial bank credit assessment, resulting in larger financing volumes but higher risks [18]. In contrast, the "Sunshine Loan" reduces risks through government guarantees and third-party supervision, suitable for Shanghai's economy characterized by numerous SMEs [14]. Internationally, Germany's photovoltaic financing policy mainly focuses on long-term, low-interest loans and tax incentives, covering a wider range but with less reliance on government finances [17]. The "Sunshine Loan" emphasizes targeted regional support, combining it with Shanghai's "Sunshine Belt" policy and electricity subsidy, achieving a high degree of policy and resource alignment [18]. However, the "Sunshine Loan" lags behind countries like Japan in applying digital financial tools; Japan's photovoltaic financing policy uses blockchain technology to ensure transparency of fund flow [19]. The success of the "Sunshine Loan" is attributed to Shanghai's policy implementation capacity and industrial foundation, but replicating it in other regions requires consideration of fiscal capacity and regional resource differences.

4. Conclusion

As an important innovation in green finance, Shanghai's "Sunshine Loan" policy has provided strong support for the rapid development of distributed photovoltaic projects, with significant results in terms of increased installed capacity, shortened payback periods, and enhanced energy efficiency and emission reduction. Through its closed-loop operation model of government guidance, financial guarantees, and third-party supervision, the "Sunshine Loan" effectively lowers the financing threshold for SMEs, enhancing the accessibility and social credibility of photovoltaic projects, and injecting new momentum into Shanghai's low-carbon city construction. Moreover, the practice of the policy to align regional resources and offer targeted assistance has precious experience value to mega-cities that are exploring the complementarity development of green finance and renewables. Nevertheless, the "Sunshine Loan" program still encounters the challenges that financial guarantee capacity is limited, the stability of project income lacks, and support for technological innovations is weak. Additional optimization designing the policy is required to expand the coverage and long-term sustainability. Compared to other Chinese regions as well as global solar photovoltaic financing policies, the "Sunshine Loan" targeted and local support mode reveals specific advantages, yet the topics related to the trail-blazing digital financial instruments' development as well as the reasonability of replicating the mode are needed to be explored. Shanghai shall, in the future, improve the "Sunshine Loan" framework designing the policy by adding intelligent evaluation on the risk as well as various financing channels, offering a replicable mode to optimize the countrywide photovoltaic industry policy designing. Based on the research results, the decision-making reference to the "15th Five-Year Plan for Renewable Energy Development" shall be provided to Shanghai. As well as the green transformation , the actualized model shall be provided to other mega-cities, so as to contribute to China realizing carbon neutrality.

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