

The Development Trend and Measures of China's Photovoltaic New Energy Industry

Shiyao Jia*

Jinan New Oriental, Shandong, China

*Corresponding author: shiyao@sd-haichuan.com

Abstract. To attain the "dual carbon" target, we face the pressing issues of mitigating high carbon emissions and reducing fossil energy consumption. Consequently, the advancement and establishment of renewable energy power systems have emerged as the paramount objective for China's energy sector development. Among them, photovoltaic new energy has gradually developed from the initial auxiliary energy to a substitute or even the main form of energy for power generation due to its convenient and flexible power generation method. However, the photovoltaic new energy industry is currently facing many problems such as weak national policy guidance, insufficient development of digital intelligence, and shortage of professional talents. Hence, to ensure the intelligence, controllability, and stability of the photovoltaic renewable energy industry, China must consistently reinforce policy directives aimed at fostering green and sustainable new energy developments. This necessitates addressing the shortage of skilled professionals in the sector, actively encouraging enterprises to embark on digital transformations within the new energy realm, and intensifying public outreach efforts to enhance public awareness and understanding of the new energy industry.

Keywords: New energy; Photovoltaic; transformation; The digital economy.

1. Introduction

At the 75th United Nations General Assembly in 2020, China initially outlined the "dual carbon" objective, emphasizing the significance of green and sustainable development. Since then, the nation has enacted various policies to propel this agenda forward, including the "Action Plan for Green and Low Carbon Development of the Information and Communication Industry (2022-2025)" issued by the Development and Reform Commission and the Energy Bureau in 2022, and the "Guidelines for the Construction of a Green and Carbon-Neutral Standard System for the Communication Industry (2023 Edition)" promulgated by the Ministry of Industry and Information Technology in 2023. Nevertheless, the challenge of managing fossil fuel consumption and mitigating high carbon emissions remains formidable in the pursuit of the "dual carbon" target. A report released by the National Development and Reform Commission in 2021, titled "Barometer for the Completion of Energy Consumption Dual Control Targets in Various Regions in the First Half of 2021," revealed that over 60% of provinces and regions fell short of their established targets. Furthermore, projections indicate that by 2023, China's carbon emissions will surpass all other nations, accounting for approximately 32% of the global total [1], as depicted in Figure 1.

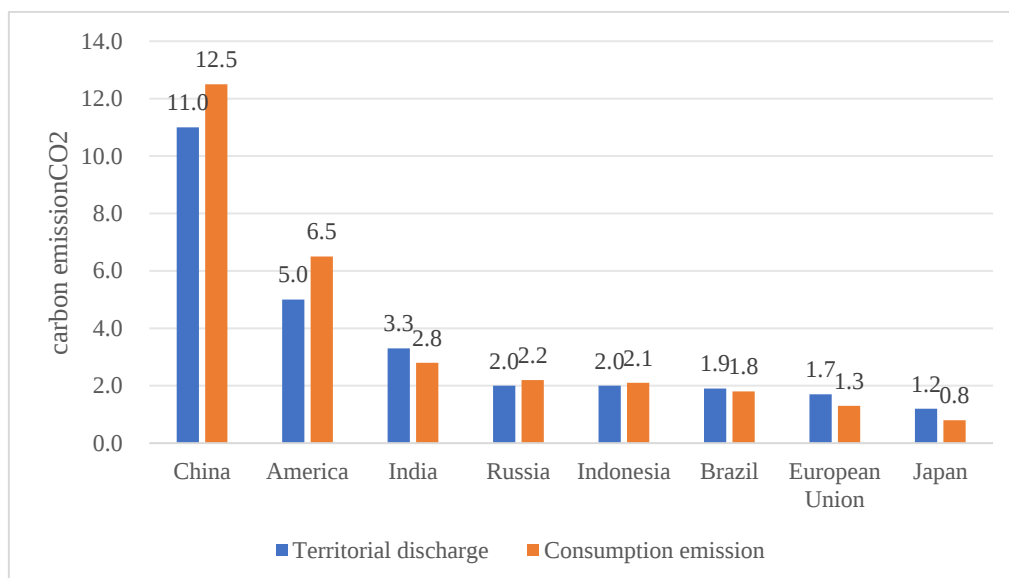


Fig. 1 Carbon Emissions of Various Countries in 2023 [1]

The aforementioned figure underscores that the swift economic growth witnessed in the digital economy era has unfortunately been accompanied by substantial energy wastage and significant increases in carbon emissions. The White Paper on China's Dual Carbon Big Data Index (2022) shows that the power and energy industry is the industry with the highest carbon emissions, but there are also obvious shortcomings. Therefore, prioritizing the development and construction of new energy power systems is now the cornerstone of China's energy development endeavors. We must strive to strengthen the transformation of the power industry towards a new energy structure [2].

Renewable energy sources, including solar, wind, hydropower, and nuclear energy, have played a pivotal role in advancing the development of alternative energy sources for electricity generation. Solar power generation, the primary driver of new energy electricity, holds immense potential and stands as an exceptional option within the realm of renewable energy. Currently, two primary methods dominate solar power generation: solar thermal power and photovoltaic power. Photovoltaic power generation, specifically, involves harnessing devices capable of the "photovoltaic effect," which transforms light energy into electrical energy, for the purpose of electricity generation. Its main carrier is solar cells, and commercial products directly convert solar radiation energy into the form of solar panel components. Therefore, as long as there is sunlight on Earth, photovoltaic power generation can be used, especially in remote mountainous areas and islands. Photovoltaic power generation has gradually evolved from an auxiliary energy source to an alternative energy source due to its convenient and flexible power generation method, and even developed into the main form of energy dependence for local power generation.

2. Current Development Status of China's Photovoltaic New Energy Industry

Over the past ten years, China's new energy power sector has exhibited a consistently favorable and ascending trajectory in terms of both development and exploitation. An announcement from the State Grid Corporation of China, unveiled in Beijing on July 11th, 2024, indicated that by the year 2023, the cumulative installed capacity of renewable energy sources within the operational regions of the State Grid would attain an unprecedented milestone. By the end of 2023, the aggregate installed capacity of wind and solar renewable energy sources within the operational region is projected to surpass 226 million kilowatts, equivalent to approximately 80% of the cumulative installed renewable capacity in the United States by that year and 150% of Germany's total, showcasing a remarkable growth. The accumulated installed capacity of renewable energy sources has achieved 870 million kilowatts, comprising 37.7% of the overall installed power generation capacity, marking a yearly rise of 6.1 percentage points in its contribution to the energy mix. Electricity demand has consistently

scaled new peaks, resulting in a total renewable energy generation of 1.2 trillion kilowatt-hours for the year, underscoring the sector's growing significance. Representing 16.9% of the overall electricity output, the share of renewable energy generation has augmented by 2.0 percentage points annually, reflecting a sustained upward trend. The utilization rate remains at a high level, with a new energy utilization rate of 97.4%, which has remained above 97% for four consecutive years [3].

General Secretary Xi Jinping stressed at the 12th Joint Work Conference of the Political Bureau of the Central Committee of the Communist Party of China: "China has abundant resources such as wind power and photovoltaics, and has enormous potential for developing new energy. We must adapt to energy transformation requirements transformation, the further construction of a new energy infrastructure network, the promotion of intelligent transformation of the power grid infrastructure, and the construction of smart infrastructure and build smart microgrids [4]. As shown in Table 1, according to the 2023 National Electricity Industry Statistics released by the industry statistics released by the National Energy Administration in January 2024, as of the end of December, Cumulated installed power generation capacity in China reached approximately 2.9 GW, up from 13.9%. Of this, solar PV installed capacity is about 600 million kilowatts, up about 55 percent year on year. with the highest year-on-year increase of about 55.2%. Hydropower and nuclear power have grown at different rates at the same time. in different proportions [5]. However, the data also show that the percentage of thermal power plants in the utilization rate of the country's power generation facilities is still the highest. At the press conference held by the National Energy Administration in the first half of 2024, it was also stated that the national photovoltaic power generation in the first half of 2024. generation in the first half of 2024 was 391.4 billion kilowatt-hours, an increase of 47% year on year, and the national photovoltaic power national photovoltaic power utilization rate was 97% [6]. Although the amount of photovoltaic power generation has been increasing year by year, it is still necessary to explore how to better continue building the infrastructure system for photovoltaic new energy generation, Considering that thermal power generation is still the most important source of energy in China.

Table 1. List of Statistical Data of National Electric Power Industry in 2023 (as of December 2023)

Indexing Name	unit	Year-round cumulative	Compared to the preceding year (%)
National installed capacity to generate electricity	10000 kilowatts	291965	13.9
Among them: hydropower	10000 kilowatts	42154	1.8
thermal power generation	10000 kilowatts	139032	4.1
nuclear power	10000 kilowatts	5691	2.4
wind power	10000 kilowatts	44134	20.7
Generation of solar electric power	10000 kilowatts	60949	55.2

3. Major Factors Influencing China's Photovoltaic New Energy Development

The development of the new energy industry under the national "dual-carbon" new infrastructure policy has a huge trend, but at the same time, it also faces enormous challenges. After more than 10 years of effort, the country has made significant achievements in the photovoltaic industry. It has

become a globally recognized leading team, an end-to-end independent, secure and controllable team, and may to some extent become a new model for high-quality development. Through in-depth analysis and summary of the development achievements over the years, it is not difficult to find out that the development of the new energy photovoltaic industry is mainly influenced by the following factors by the following factors:

3.1. Government Policies and Incentives for New Green Energy Development

With regard to the strategic shift from the traditional consumption of fossil fuels to new renewable energy sources such as wind and the country has taken a number of measures to promote renewable energy sources such as wind and photovoltaics. For example, in 2019, the National Development and Reform Commission and the Energy Administration released an announcement about the active promotion of the promotion of unsubsidized and affordable grid access for wind and photovoltaic power generation, the promotion of unsubsidized and affordable unsubsidized and affordable wind and solar power generation; 2021, the country's five government departments and country jointly issued a notice on the guidance and increase of financial support for the healthy and orderly development of industries such as development of industries such as wind power and photovoltaic power generation, suggesting that local government departments and relevant financial and relevant financial institutions to develop industries such as wind power, solar power and orderly development of industries such as wind power, solar power and biomass power generation. 2022, the National Economic and Commission and the National Energy Administration will publish the 14th Five-Year Plan for the energy scheme, indicating that the country should comprehensively promote the large-scale and high-quality development of wind and solar power to continue developing in a comprehensive manner. In 2030, the total installed capacity of wind/photovoltaic power generation will the total installed capacity of wind and photovoltaic power generation will exceed 1.2 billion kilowatts. The guidance of national policies has created a favorable environment for the development of new energy industries such as photovoltaic power generation to a certain extent. However, in terms of new energy infrastructure, we can see that there are still some problems and challenges, and challenges in the new energy infrastructure, such as the delay in the construction of power grid infrastructure in relation to new energy projects, a large number of wind and solar power of curtailment phenomena of wind power and solar power, which limit the efficient use of new energy.

Therefore, authorities must continue to provide the necessary policy support for the development of new energy sources, such as development of new energy sources like solar PV, and the steady and orderly promotion of carbon peaks and carbon neutrality [7].

3.2. Serious Shortage of Photovoltaic New Energy Professionals

With the rapid development of the new energy sector. It is expected that by 2023, new energy will strive to reach 30% of the total energy structure, but there is a mismatch between the number of professional talents and refined management talents [7]. There are gaps in the establishment of new energy majors as a new trend in the development of new energy. energy majors in traditional disciplines, so the construction of photovoltaic new energy majors has not received appropriate attention. With the process of electricity market reform, there are few basic operation and maintenance personnel like photovoltaics, let alone innovative research personnel. At present, reducing the efficiency and cost of photovoltaic materials and solar cells is still an urgent problem that researchers need to solve. Thus, the lack of professional personnel in photovoltaic new energy has led to a lack of quality development in the overall operation reform of the photovoltaic industry, and the operational efficiency can not be improved. development in the overall reform of the operation of the photovoltaic industry, and the operational efficiency can not be rapidly improved.

3.3. Optimization of the Industry Caused by the Lack of Digital Technology in the Photovoltaic New-energy Industry.

2023, the National Energy Board issued the "Multiple Comments of the National Energy Board Regarding In 2023, the Energy Administration issued the "Several Opinions of the National Energy Administration on improve the level of development of energy digitalization and intelligence, promote the development of the energy digital economy and digital economy and green, low-carbon and circular economy" [8]. In the digital economy era, using digital technology wisely can the photovoltaic industry into a more efficient, environmentally friendly and high quality direction. high-quality direction. In the national photovoltaic industry, we are small enterprises with advanced photovoltaic talents and a lack of digital and intelligent development in photovoltaics. The photovoltaic production process and industrial equipment lack numerical control, and photovoltaic energy trading lacks digital platform sharing, supervision, and verification, resulting in insufficient transparency of energy trading information and mismatched production and sales information, as well as time-consuming online transactions. Therefore, we found that digital technology cannot keep many photovoltaic new energy systems up with the pace of the energy digital economy [9].

3.4. Awareness of New Energy Industry Development among the General Public is Low.

The energy crisis is not well understood by the general public. They believe that using and developing new energy is a national issue that has nothing to do with them; At the same time, a lot of problems of developing new photovoltaic energy and their own technology need time for solving. are dependent on natural conditions. Investors need a cost recovery period of 3-4 years, so people prefer to wait and see, or rely on other more "stable" investment choices, rather than trying unknown new things. All of these make people's awareness of participating in photovoltaic new energy weak [10].

4. Main Measures for Promoting the Development of China's Photovoltaic New Energy Industry

How to maximize the efficiency of the use of natural resources, the reduction of energy waste, the creation of favorable conditions for the development of the new energy industry, and the solution of the problems of sustainable development. For the development of new energy industries, and solutions to the problems of sustainable development are common challenges. The common challenges we face are innovation and transformation. Efficient and intelligent development of the efficient and intelligent development of China's photovoltaic new energy industry requires the participation and support of the state, enterprises and the public. How to prevent enterprises from going it alone is a question that is in need of our careful consideration.

4.1. The Country Needs to Further Strengthen Policy Guidance for the Development of Green and Sustainable New Energy

The most effective guidance for promoting the national "dual carbon" new infrastructure policy is through relevant government policy documents. The development of the photovoltaic industry is characterized by small enterprise scale and a small number of enterprises, which are in the exploratory stage and have high exploration costs. Therefore, it is particularly important for the national and local governments to introduce targeted support, regulations, rewards and punishments for the photovoltaic industry. Of course, effective supervision by local governments should also be carried out simultaneously.

4.2. Relevant Training Bodies Must Address the Issue of Insufficient Talent Development in the Photovoltaic New Industry of New Photovoltaic Energy

In 2018, the product profits of China's photovoltaic industry have declined, and photovoltaic subsidies have gradually withdrawn from the market. After continuous "reshuffling" of enterprises, enterprises need to increase their investment in technology and innovation in order to survive, which

requires more and more professionals and researchers to invest in the photovoltaic industry system. Therefore, the national education department urgently needs to address the professional structure issue of cultivating new energy talents in the field of education. The state should also actively support the cultivation of high school education professionals, national training, and social institution training. It should not only support the operation and maintenance of technical personnel, but also support the cultivation of senior research and development talents.

4.3. Photovoltaic Enterprises are the Main Participants in the New Energy Digital Economy

Photovoltaic enterprises should strengthen their digital management philosophy, integrating digitalization into the entire process management of photovoltaic panel research and development, production, sales, trading, installation, and maintenance. At the same time, they should become sound builders and supervisors of the industry system through digitalization.

4.4. Advocate and Help the Public Establish Awareness of Supporting the Development of the Photovoltaic New Energy Industry

The public is the biggest user and beneficiary of new photovoltaic energy, and the main force in energy conservation and emission reduction. It also serves as a barometer for how the photovoltaic industry is developing. new energy economy. We can increase the promotion of policy documents, community activities, etc., cultivate public awareness of green and scientific use of photovoltaics, and make them the army of photovoltaic product users, as well as the feedback army of various photovoltaic product quality

5. Conclusion

The future development trend of China and even the global economy will definitely revolve around the green economy. In order to meet the goals of peaking carbon emissions by the year 2030 and becoming carbon neutral by the year 2060, there will be a need for reform of the current traditional energy system. In the energy system reform, the green photovoltaic industry has made significant contributions. Although there are many problems in the photovoltaic new energy industry, such as weak national policy guidance, digital and intelligent development, and a lack of professional talents. We believe that photovoltaic new energy will continue to develop in a smart, sustainable way through the joint efforts of the country, local governments, enterprises and society, and stable direction, and will further grow and develop, because this is the general trend of global green and low-carbon economic development.

References

- [1] International Energy Agency. CO2 emissions report for 2023. Retrieved from: <https://finance.sina.com.cn>, 2023. Accessed 27th August 2024.
- [2] Jianguang Zeng, Jiangnan Yan, Jie Ren. Consolidate the "double-carbon" new infrastructure, and build China's new energy system under the digital economy. *China's Development*, 2024, 24(2): 82-83.
- [3] International Energy Agency. State Grid Corporation Limited Service New Energy Development Report 2024. Retrieved from: <http://www.chinapower.com.cn>, 2024. Accessed 26th August 2024.
- [4] Jinping Xi. Speaking at the 12th Group study session of the Political Bureau of the CPC Central Committee: We will vigorously promote the high-quality development of new energy in China and make greater contribution to building a clean and beautiful world. Retrieved from: <http://www.chinapower.com.cn>, 2024. Accessed 25th August 2024.
- [5] International Energy Agency. Statistics of the national electric power industry in 2023. Retrieved from: <https://www.nea.gov.cn>, 2024. Accessed 26th August 2024.
- [6] International Energy Agency. Transcript of the press conference in the first half of 2024. Retrieved from: <https://www.nea.gov.cn>, 2024. Accessed 25th August 2024.

- [7] Jian Guo. Research on the investment incentive policy for the development of new energy infrastructure under the target of "double-carbon". Economic research reference, 2024, 5: 89-90.
- [8] International Energy Agency. Several Opinions on Accelerating the development of digital and intelligent energy. Retrieved from: <https://www.nea.gov.cn>, 2023. Accessed 25th August 2024.
- [9] Sa Ma, Jianfeng Huang. Global economic governance under the impact of digital technology and China's strategic choice. Economist, 2022, 5: 48-56.
- [10] Desheng Hu. Analysis of the concept of "public participation". Journal of Guizhou University, 2016(5): 103-107.