



# Challenges and Solutions for New Energy Market Entry in the Context of National Unified Electricity Market System Construction

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**Abstract.** With the “double carbon” goal, new power system construction and other goals put forward and China has become the world’s largest installed capacity of new energy countries, in the near future the new energy industry will move to a higher quality development stage. Then with the installed capacity, power generation, the previous policy protection will be difficult to continue to play the original role, a high proportion of new energy to participate in the power market transactions is the future trend. For the current situation of new energy participation in the electricity market, in the context of the new era will be back to face many difficulties and challenges, only to actually solve the problem to speed up the establishment of the corresponding institutional mechanisms and play the dual role of government and the market in order to make these problems solved, in order to help the realization of those proposed goals.

**Keywords:** “double carbon” goal · new energy · new energy participation in the electricity market · power market transactions

## 1 Introduction

To implement the spirit of General Secretary Xi Jinping’s important speech and to implement the higher requirements of new energy development in the new era, the National Development and Reform Commission and the National Energy Administration have released the Implementation Plan for Promoting High Quality Development of New Energy in the New Era, which focuses on new energy development and utilization, decentralization and centralization at the same time [1]. The implementation plan is based on four aspects: new energy development and utilization, decentralization and centralization, focus on models and technological innovation, and addressing the major challenges of new energy development and utilization. Progress has been made in initiatives and processes to achieve clean energy participation in electricity market trading. In order to achieve maximum carbon emissions and carbon neutrality, the development of new energy systems needs to be accelerated to meet the growing share of clean power,

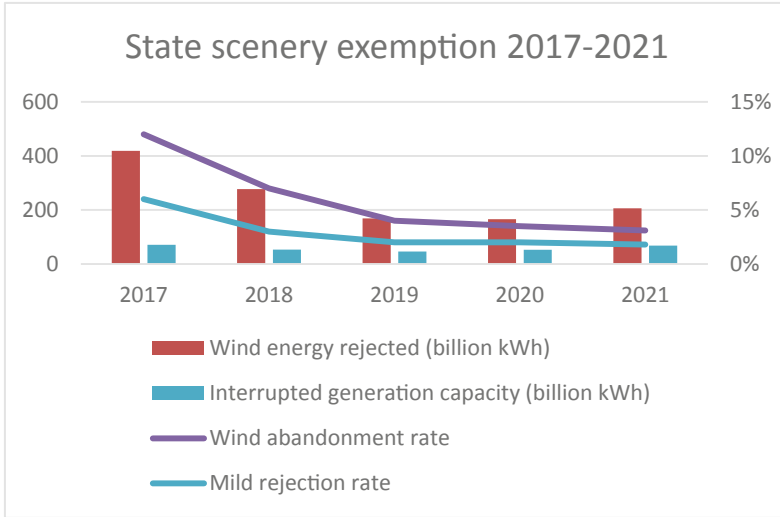
and systematic measures need to be taken in terms of planning concepts, power plant configuration, operation methods and institutional mechanisms under the traditional energy system. In addition to this, the National Development and Reform Commission and the National Energy Administration issued the “Guiding Opinions on Accelerating the Construction of a National Unified Electricity Market System” (Development and Reform Body Reform [2022] No. 118), which proposed two milestones for the establishment of a national unified electricity market system in response to the current problems of electricity market reform and gave new initiatives, thus providing new adjustment ideas for the next step of construction and principle opinions.

The design of the electricity market trading rules should fully take into account the characteristics of new energy sources, and ensure that new energy sources receive the expected return on investment from market participation by promoting direct transactions between new energy projects and different users and encouraging them to enter into long-term power purchase and sale contracts. In the pilot areas of the power spot market, new energy projects will be encouraged to participate in power market transactions through contracts for difference.

So far, China has taken a two-pronged approach to new energy consumption: one in non-pilot areas [2] and one in the pilot areas. In the non-pilot areas, new energy does not participate directly in the electricity market, but it is still a priority in generation and consumption plans and is encouraged to participate directly as a market participant. In the pilot areas [2], priority generation from new energy sources will be used for energy trading contracts, which will be concluded on the basis of contracts in kind or contracts for difference.

In recent years, new energy sources such as wind and photovoltaic power generation have seen significant growth in China. Installed capacity is the largest in the world, and its share of electricity generation is steadily increasing. At the same time, the cost of power generation is falling rapidly, essentially entering a new phase of fixed-price, unsubsidized development, with varying degrees of options for wind and PV power, of course. According to the National Bureau of Statistics, by the end of 2021, China’s installed power generation capacity will be 237,692,000 kilowatts, up 7.9% from the previous year, while thermal power generation capacity will be 12,967,000 kilowatts. This represents an increase of 4.1%; the installed capacity of hydropower plants is 39,092,000 kW, an increase of 5.6%; and the installed capacity of nuclear power plants is 53,260,000 kW, an increase of 6.8%. Wind power generation capacity was 328.48 million kilowatts, an increase of 16.6%; solar power generation capacity was 606.56 million kilowatts, an increase of 20.9% (Fig. 1).

In the context of the “double carbon” target and new power system development, new energy sources will continue to grow in the coming years, and their participation in the market competition is a major trend. However, in the new environment, new energy sources still face many difficulties and challenges in entering the market and participating in trade. We need to accelerate the deployment of new mechanisms for new energy, make full use of the market as an important tool for resource allocation, better understand the role of government, and better achieve the goals of the new energy system and the “double carbon” goal.



**Fig. 1.** National abandoned wind and abandoned light, 2017–2021

To this end, this paper presents some challenges and appropriate solutions to address the current situation of new energy participation in electricity markets in a new phase of cross-country and inter-regional integration and inter-market functional synergies and optimization.

## 2 Analysis of the Current Situation of New Energy Participation in the Power Market

### 2.1 Inadequate Competitiveness System for Adequate Assurance

In recent years, some Chinese provinces and regions have taken the initiative to lower the minimum guaranteed usage hours and encourage new energy to participate in market transactions for practical reasons such as the scale of new energy development exceeding expectations and the high demand for enterprises to reduce energy costs. As early as 2018, in some provinces, the actual guaranteed hours of use for wind power and PV were as low as 800 h or even less than 500 h, far lower than the actual hours of use of 1,800 h for wind power and 1,500 h for PV, as stipulated by the state, and most of these new energy sources are low-cost market commodities. With the rapid development of new energy on a large scale, the number of areas with similar situations is gradually increasing, and it is clearly difficult to implement a fully guaranteed procurement system.

Explicitly abolish the industrial and commercial sales tariff, and promote all the commercial and industrial users who are not directly involved in user market transactions for the time being to participate in the network company's agency power purchase. According to the requirements of the document, the network company security users are left with only residential, agricultural, agent industrial and commercial users to purchase electricity, will also gradually reduce the scale of power purchase by the network

company, priority to ensure that power generation can not exceed the scale of its agent and security users. With the current power grid company as the only purchaser of the new power security, it is likely that the power grid company will not be able to maintain a secure purchase of all the mileage in the case of a difficult power generation plan.

## **2.2 The Cost of Deploying New Energy Sources is Rising**

Thanks to technological advances and modernization in the sector, the investment and construction costs of new energy sources have fallen significantly and conditions have been created in most regions to ensure equal access to the grid, achieving low prices in some areas. However, the price and low cost of access to the grid is not the same as the price of use and cannot be equated. Because new energy sources are intermittent and unstable, their use must also be supported by regulatory and support energy sources and strong transmission and distribution networks.

As the electricity system is reformed and electricity markets are established, a large portion of new energy consumption will initially incur system costs. An important trend for the future is to reflect economic responsibility through market-based approaches and to promote sound investment and economic consumption in the future.

## **2.3 Building New Energy Systems is Entering a New Era**

In January 2022, the National Development and Reform Commission (NDRC) and the National Energy Office (NEO) issued the Guidance on Accelerating the Establishment of a National Unified Electricity System (NDRC [2022] No. 118, hereinafter referred to as “Document 118”). Since the issuance of NDRC No. 9, Document 118 has served as a programmatic document for the establishment of a national electricity market, marking a new stage in the reform of the electricity system and the establishment of a market that achieves synergy and integration between provinces and regions and optimizes inter-market functions. First, it eliminates the inter-provincial inconsistencies that currently hinder the establishment of the electricity market system, vigorously promotes the continuous establishment of provincial/regional electricity markets, facilitates the synergistic operation of markets at all levels, and establishes mechanisms. That is, to allow a wide range of market participants to participate in inter-provincial and inter-regional transactions, to promote the autonomous choice of trading assets by power producers, and to strengthen the interface between inter-provincial and provincial markets in terms of financial responsibility and pricing mechanisms. The second objective is to focus on the overall functional structure of the electricity market, improve the functionality of the electricity market system, and allocate the spot, medium- and long-term trading, and ancillary services markets and their respective roles. The third focuses on designing market mechanisms that are compatible with the new power system, improving the adaptability of new energy participation in the power market, while encouraging new energy offers to participate in the market and disregarding failed power offers when evaluating abandoned wind and light offers. Provinces and cities are encouraged to establish market-based compensation mechanisms for power generation costs according to the actual situation, and to solve the problem of fixed cost compensation for traditional high and low load-rate power plants in the new energy sector by establishing reliable

capacity values in the power market, etc. In March 2022, the Notice on Accelerating the Development of Electricity Spot Market clearly put forward the general requirement of accelerating the development of electricity spot market and fully launched the development of electricity spot market. With the gradual construction of a more complete electricity market system and the further rationalization of market-based pricing mechanisms, new energy should create better conditions for market infrastructure access.

### **3 Challenges and Solutions for New Energy in Power Market Participation**

Although the new energy sector is currently developing rapidly, new energy participation in the electricity market still faces many challenges. One is the growing gap between the domestic new energy guaranteed acquisition system and market consumption, the proportion of market electricity consumption on the electricity side is growing, this part of the new electricity to be supplied through new energy participation in power market transactions, which is related to the new energy guaranteed acquisition system; another challenge is that at this stage, the mechanism of new energy participation in the power market has not yet been formed, the overall scheme of new energy participation in the power market and specific The overall plan and specific details of new energy participation in the power market are not yet clear. Given the uncertainty of new energy generation and the increasing share of generation, the implementation of the renewable energy consumption responsibility weighting policy brings problems and challenges to the design of the market mechanism, so the key issue now is how to consider the capacity characteristics, the regulation income of flexible units and the design of the electricity and auxiliary services market to maximize new energy consumption. Therefore, it is necessary to propose a new energy electricity market participation mechanism that is suitable for the current market situation.

At present, the domestic power market structure is steadily improving, but a complete power market system has not yet been formed, and the unbalanced development of power grids at different levels and in different regions has affected the safety and stability of power grids and the optimal allocation of resources. The implementation of market-based price reform for coal-fired power generation increasingly shows that there is no market price signal reflecting the balance of energy supply and demand, capacity adequacy and auxiliary services; there is no market trading mechanism that allows a high share of new energy; there is no sufficient incentive mechanism for new energy to participate in power market trading, leveraging social capital with market returns and promoting sustainable investment in new energy. Lack of medium- and long-term power trading mechanism and failure to encourage new energy to sign medium- and long-term trading agreements. The mechanism for contracting and evaluating new energy to participate in the spot market is still unclear. There is an urgent need to explore market-based and fair acceptance of various energy sources for auxiliary services such as frequency regulation and standby services, and to improve the mechanism for users to participate in grid regulation in order to further tap the potential of new energy consumption, promote fair public responsibility for clean energy consumption, and better implement the energy structure and energy sector development. The following recommendations are intended

to establish and improve a mechanism that will enable a high level of participation of new energy sources in electricity market transactions and contribute to the establishment of a national single electricity market.

- (1) Clarify the support policies for participation in new energy markets and provide incentives for participation in new energy markets. Given that most foreign new energy relies on renewable energy premiums and quota mechanisms to ensure the competitiveness of new energy in the electricity market, it is necessary to clarify the support system of national renewable energy development funds for new energy production.
- (2) Develop an appropriate investment guarantee mechanism to mobilize investment in flexible regulation resources (especially user-controlled load and new energy storage systems). Develop a capacity compensation or scarcity tariff mechanism to mobilize the potential of flexible regulation resources using operational phasing rules to achieve source-load interaction and further stimulate new energy consumption.
- (3) The volatility, uncertainty and low marginal cost of new energy production should be fully taken into account. At the same time, the accuracy of new energy forecasts should be improved, the time of forecasting should be shortened, the development of multi-unit power markets adapted to new energy participation should be explored, the trading cycle should be shortened, the construction of provincial spot markets should be accelerated, the participation of new generating units in spot markets should be encouraged, and a good link between priority generation security and market-based trading should be established.
- (4) Establish a fair and reasonable mechanism to solve the deviation problem. Since foreign power markets are more tolerant of new energy deviations than traditional markets, methods and penalty mechanisms for predicting new energy deviations should be researched and developed in conjunction with the actual situation of current power markets in each region.

## 4 Conclusion

In this paper, we first analyzed the current situation of the development of the new energy sector, and then studied some issues related to the participation of new energy in electricity market transactions, taking into account the special characteristics of new energy. Firstly, the fully guaranteed purchasing system needs to be optimized and enhanced to match the development of the new electricity market, taking into account the current situation and the long-term development. Second, the market trading mechanism should be improved to enhance the adaptability to the high share of new energy sources. Given the special nature of new generation, new entrants to the market do not necessarily get a larger share of the annual and monthly power transactions. The lead department for medium- and long-term trading and the lead department for spot market development should strengthen coordination, improve trading mechanisms, and gradually transform curve trading into a standardized type of medium- and long-term trading (such as peak-valley separation trading or separation trading for each time period), so that power

generators and users can both buy and sell electricity, increase the liquidity of medium- and long-term trading, shorten the trading cycle, increase the frequency of trading, and provide new energy adjustments to trading contracts. Provide sufficient opportunities. Second, the adaptability of the electricity market to new energy should be improved, allowing power generators and consumers to buy and sell electricity, increasing the liquidity of medium- and long-term transactions, shortening the transaction cycle [4], and increasing the frequency of transactions to provide new energy with sufficient possibilities to adjust their transaction contracts. At the same time, information disclosure should be strengthened, the accuracy of information disclosure should be improved, and access to information should be facilitated so that new energy sources have sufficient market information to make timely price forecasts and risk control.

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