



Recognition of Additional Investment in the Power Grid During the Verification of Transmission and Distribution Electricity Prices

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Abstract. To further promote the healthy development of the power industry and assist in achieving the goals of “carbon peak and carbon neutrality”, it is necessary to accelerate the construction of a new type of power system. In order to better adapt to the new changes brought about by the construction of the new power system to the investment and construction of the power grid, improve the working system for the reporting and recognition of new investments and predicted electricity in the determination of transmission and distribution electricity prices, and enhance the standardization of the determination of transmission and distribution electricity prices, this paper studies and analyzes the impact of the construction of the new power system on the determination of transmission and distribution electricity prices. Based on the needs of the determination of transmission and distribution electricity prices, combined with the requirements of power system planning and investment management of power grid enterprises, a framework and standards for the recognition of new investments in the determination of transmission and distribution electricity prices are proposed.

Keywords: Transmission and distribution electricity prices, new power systems, new investment recognition, major national policy investments, electricity market reform

1 Introduction

With the increasingly severe challenges of global energy transition and climate change [1], China has put forward the strategic goal of “carbon peak and carbon neutrality” (referred to as “dual carbon”), which not only brings profound changes to China’s energy production and consumption patterns, but also points out the direction for the future development of the power industry. As the foundation of modern economic and social development, the reliability and economy of electricity supply directly affect the healthy operation of the national economy and the sustainable development of society. In this paper, the determination of transmission and distribution

electricity prices is particularly important. It is not only a key link in the reform of the electricity market, but also an important approach to ensure the efficient and fair operation of the power system [2].

The determination of transmission and distribution electricity prices refers to the process in which the government determines the transmission and distribution fees that the power grid enterprise will charge to users within a certain period of time based on the actual investment and operating costs of the power grid enterprise, combined with future development needs. This process is directly related to the reasonable profits of power grid enterprises, the electricity costs of users, and the optimal allocation of power resources. In recent years, with the accelerated construction of new power systems, the technological and economic environment faced by the power grid has undergone significant changes, and traditional methods and processes for determining transmission and distribution electricity prices are facing new challenges. On the one hand, the high proportion of new energy, power electronic equipment, and distributed energy integration has raised higher requirements for the safe and stable operation of the power grid, increasing the complexity of power grid construction and operation. On the other hand, the introduction of market mechanisms and the diversification of user demands require more flexible, transparent, and scientific determination of transmission and distribution electricity prices to adapt to the constantly changing market environment [3].

To address the above challenges, this paper focuses on the identification of new investments in the power grid in the determination of transmission and distribution electricity prices. The aim is to propose a systematic and standardized method for identifying new investments through in-depth research on the existing policy system, combined with the relevant requirements of power planning, project investment management, and the basic construction process of transmission and distribution engineering. The recognition of new investments is the basis for determining transmission and distribution electricity prices, and its accuracy directly affects the rationality of electricity prices and the investment return of power grid enterprises. However, there are many problems in the current process of identifying new investments, such as difficulty in forecasting and immature information reporting systems. These problems not only increase the difficulty of pricing, but also to some extent affect the healthy development of the electricity market [4].

The process and achievements of China's transmission and distribution electricity price policy reform are reviewed firstly. Subsequently, this paper discusses in detail the necessity and importance of identifying new investments in the determination of transmission and distribution electricity prices, analyzes the main problems currently existing. Finally, a framework and standards for identifying new investments is proposed. This framework includes six dimensions: investment relevance, planning compliance, planning conformity, construction accessibility, procedural completeness, and economic rationality, each with clear identification criteria and operational guidelines.

2 The Impact of the Construction of a New Power System on the Determination of Transmission and Distribution Electricity Prices

2.1 The Effectiveness of the Reform of China's Transmission and Distribution Electricity Pricing Policy

In order to implement the relevant spirit of Document No. 9 and promote the reform of transmission and distribution electricity prices, the National Development and Reform Commission issued the “Supervision and Review Measures for Transmission and Distribution Pricing Costs (Trial)” in June 2015, and revised and issued the “Supervision and Review Measures for Transmission and Distribution Pricing Costs” in May 2019, which pointed out that the supervision and review of transmission and distribution pricing costs should follow the principles of legality, relevance, and rationality. Power grid enterprises should establish and improve cost accounting systems according to the needs of transmission and distribution pricing supervision, accurately record and reasonably collect production and operation cost (expense) data of transmission and distribution according to voltage levels, services, and user categories. The cost supervision and review of power transmission and distribution pricing should be based on annual financial accounting reports, accounting vouchers, account books, and relevant original materials such as power grid investment, production operation, and government approval documents audited by accounting firms or government departments such as auditing and taxation in the past three years [5].

The “Supervision and Review Measures” have standardized the composition and collection principles of pricing costs for power transmission and distribution, as well as the cost assessment methods. Clearly define that the pricing cost of power transmission and distribution consists of depreciation costs and operation and maintenance costs (including material costs, repair costs, employee salaries, and other expenses), and point out that eight categories of expenses, including expenses that do not comply with relevant laws, administrative regulations, and national financial accounting and tax systems such as the Accounting Law of the People's Republic of China, expenses unrelated to the power grid enterprise's power transmission and distribution business, or expenses that are related to the power transmission and distribution business but offset by government subsidies, policy incentives, social donations, etc. in accordance with relevant national regulations, shall not be included in the pricing cost of power transmission and distribution. The introduction of this method aims to standardize the verification and supervision of transmission and distribution costs, and improve the scientific, rational, and transparent formulation of transmission and distribution electricity prices.

After the issuance of the “Supervision and Review Measures”, in order to further promote the implementation of the reform of transmission and distribution electricity prices, as one of the six supporting documents for the reform of the power system jointly reviewed and approved by the National Development and Reform Commission, the National Energy Administration, and the Central Compilation and Translation Office, the “Implementation Opinions on Promoting the Reform of Transmission

and Distribution Electricity Prices” (hereinafter referred to as the “Implementation Opinions”) was officially issued in November 2015. The Implementation Opinions, based on the principle of “allowing costs plus reasonable benefits” proposed in Document No. 9, further deepen the overall goal of power transmission and distribution reform by determining the transmission and distribution electricity prices according to voltage levels. They pointed out to clarify government funds and cross subsidies, and make them public to the society for social supervision. Establish a sound constraint and incentive mechanism for power grid enterprises, promote improved management, reduce costs, and improve efficiency [6].

On the basis of the “Supervision and Review Measures for Pricing Costs of Transmission and Distribution”, the National Development and Reform Commission has formulated the “Pricing Measures for Provincial Power Grid Transmission and Distribution Prices”, “Pricing Measures for Regional Power Grid Transmission Prices”, and “Pricing Measures for Cross provincial and Cross regional Special Project Transmission Prices”, which have been successively issued and continuously improved. At present, the pricing mechanism for power transmission and distribution business within the operation scope of China’s three major power grids has been basically established, all of which implement pre-approved and regularly adjusted pricing mechanisms. This is an important foundation for the government to effectively regulate monopolistic industries.

2.2 New Requirements for Power Transmission and Distribution Price Reform under the Dual Carbon Background

With the continuous promotion of carbon peak and carbon neutrality goals, China’s future power grid will exhibit characteristics such as a high proportion of new energy, a high proportion of power electronic equipment, and a high proportion of distributed energy. To ensure the safety and stability of the power grid, it is necessary to further strengthen the construction of the power grid. To ensure that the transmission and distribution electricity prices under the dual carbon target can reasonably reflect the true cost of power grid construction, it is necessary to further strengthen the process of determining transmission and distribution electricity prices. Overall, there are mainly the following issues in the current process of determining transmission and distribution electricity prices.

The immature information reporting system increases the difficulty of pricing. Our country’s work in the reporting of transmission and distribution cost information is not yet mature, and there is no detailed explanation of the specific reporting requirements for new investment in the power grid, resulting in the actual pricing process, where the content of the information submitted by enterprises does not match the content required for pricing, or because there are no relevant constraints in the relevant documents, enterprises only report cost and asset data, and refuse to provide other information that can indirectly reflect the accuracy and relevance of costs and assets. In summary, China’s transmission and distribution pricing related information reporting system has not yet established a complete system structure, lacking specific information requirements and explanations of relevant details. As a result, there are prob-

lems in the report submission of power grid enterprises, such as incomplete comparative analysis, low submission quality, lack of transparency in information, and untimely submission, which make supervision and pricing more difficult.

To address the challenges of new electricity generation and investment forecasting, on the one hand, data collection and processing technology can be strengthened, and smart meters and sensors can be used to collect real-time voltage and current data at key nodes. On the other hand, advanced information technologies such as artificial intelligence and big data analysis can be utilized to improve the prediction accuracy of new electricity generation and investment.

In addition, it is necessary to further carry out research on the reporting and recognition of new investments in the power grid during the determination of transmission and distribution electricity prices. By establishing a systematic, standardized, and regulated reporting process and developing recognition standards, it can further standardize the investment forecasting and management behavior of power grid enterprises, and improve the scientific and accurate determination of transmission and distribution electricity prices.

3 Research on the Method for Identifying New Investments in the Determination of Transmission and Distribution Electricity Prices

3.1 Basis and Reference

On the basis of in-depth research on the policy system of transmission and distribution electricity prices, a comprehensive review of relevant policy requirements such as national power planning, project investment management, basic construction process and progress management of transmission and distribution engineering, and reference to relevant enterprise engineering cost and investment management regulations, has been conducted to form a new investment recognition framework and various dimensional recognition standards.

3.2 Identification Framework and Standards

The identification of new investments has the characteristic of being strongly related to the formulation and implementation of power planning and national policies. This paper requires the establishment of a recognition framework and the development of corresponding recognition standards.

The proposed new investment recognition framework and standards can guide the flow of funds towards more standardized and transparent investment channels, with a certain degree of flexibility and resilience to cope with rapid changes in the market and policies. In the context of rapid integration of new energy and distributed energy, the operation and investment of the power grid face long-term uncertainty. Through the proposed correlation recognition framework and standards, it can help power grid enterprises to plan flexibly, taking into account various scenarios that may arise in the

future, including the penetration rate of renewable energy and the development of energy storage technology. And it can regularly evaluate the transmission and distribution electricity prices and related costs based on actual operating conditions and technological progress, helping power grid enterprises respond to market changes in a timely manner while ensuring reasonable returns for investors.

3.2.1 New Investment Recognition Framework.

According to the requirements and regulations of the transmission and distribution electricity price policy, power planning management measures, and specific investment implementation processes of power grid projects, a new investment recognition framework covering six dimensions is proposed, namely investment relevance, planning compliance, planning compliance, construction accessibility, procedural completeness, and economic rationality. The specific meanings are shown in Table 1. Different regions can determine the new investment based on the grid investment plan predicted by the provincial development and reform commission and energy regulatory department, which is in line with the power planning, and according to the principle of equal proportion on an annual basis. Implement and monitor the six dimensional framework item by item based on the progress and situation of investment planning for power transmission and distribution in different regions.

Table 1. Newly added six dimensional framework for investment recognition.

Serial number	Identifying dimensions	Specific definition
1	Investment relevance	The newly added investment should be the investment cost incurred to ensure the provision of transmission and distribution services, and non-transmission and distribution related investments such as power grid auxiliary businesses shall not be recognized.
2	Planning compliance	The newly added investment should be in line with the power planning, and investments that are not included in the corresponding planning cannot be recognized.
3	Plan compliance	New investments should be included in the scope of the power grid investment plan, and investments that are not included in the scope of the power grid investment plan cannot be recognized.
4	Built accessibility	Newly added investment projects should be able to be put into operation within the pricing supervision period. Projects without clear operation plans or projects whose progress cannot meet the requirements for planned operation shall not be recognized as investments.
5	Completeness of procedures	New investments should go through necessary approval, filing and other procedures. Those who fail to complete the relevant procedures according to the corresponding requirements of the project level shall not be recognized.
6	Economic rationality	The economic and technical indicators of new investments should comply with industry standards or fair levels. If new investments do not meet the rationality requirements of economic and technical indicators, they should be executed according to industry standards.

3.2.2 New Investment Recognition Standards.

Table 2. Criteria for determining investment relevance.

Standard	Specific requirement	Standard attributes
Twelve related	1) Transmission and distribution lines;	Relevance criteria
	2) Power transformation and distribution equipment;	
	3) Electricity metering equipment;	
	4) Communication lines and equipment;	
	5) Automation equipment and instruments;	
	6) Hydraulic machinery and equipment;	
	7) Manufacturing and maintenance equipment;	
	8) Production management tools and equipment;	
	9) Transportation equipment;	
	10) Auxiliary production equipment and tools;	
	11) House;	
	12) Buildings.	
Ten exclusions	1) Auxiliary business of power grid, diversified operations, and investment in "tertiary industry" enterprises;	Exclusivity criteria
	2) Assets of power plants that have been separately verified for their on grid electricity prices;	
	3) Investment in independently accounted electricity sales companies;	
	4) External equity investments unrelated to power transmission and distribution business;	
	5) Investment fixed assets (real estate, etc.);	
	6) Other fixed assets unrelated to power transmission and distribution business;	
	7) Cross provincial and cross regional projects that independently determine transmission and distribution electricity prices;	
	8) The fixed assets investment that has been included in the regional grid transmission price accounting shall not be included in the provincial transmission and distribution investment;	
	9) The transmission and distribution assets formed by non grid enterprise investments, such as government subsidies or social investment, transferred by users or local governments free of charge;	
	10) Other unrelated fixed assets investment.	

Regarding the connotation of whether it is related to power transmission and distribution services, the correlation identification criteria of "twelve correlations" and "ten exclusions" are proposed, as shown in Table 2. If it meets the "twelve relevant" standards, it will be recognized under this item; otherwise, it will not be recognized. The cost supervision and review of power transmission and distribution pricing follows the principles of legality, relevance, and reasonableness. This means that only

reasonable costs directly related to power transmission and distribution services can be included in pricing costs. According to the criteria for determining the correlation between the "twelve correlations" and "ten exclusions" proposed, the rationality and accuracy of the cost structure can be ensured, and unrelated or unreasonable expenses can be avoided from increasing transmission and distribution costs. In addition, the pricing cost of power transmission and distribution includes depreciation and operation and maintenance costs, and the principle of correlation requires that these costs must be directly related to power transmission and distribution services, thereby affecting the overall cost structure.

4 Conclusion

The identification of new investments in the determination of transmission and distribution electricity prices must follow a multidimensional framework, which includes six core dimensions: investment relevance, planning compliance, planning compliance, construction accessibility, procedural completeness, and economic rationality. The establishment of this framework aims to ensure that the recognition of new investments not only complies with national power planning and policy requirements, but also reasonably reflects the actual costs incurred by power grid enterprises in providing transmission and distribution services, thereby improving the scientific and accurate determination of transmission and distribution electricity prices.

In the context of the construction of a new power system, the determination of transmission and distribution electricity prices faces challenges such as difficulty in predicting new electricity generation and investment, and immature information reporting systems. Therefore, establishing an institutionalized, standardized, and regulated reporting process and recognition standards is crucial for regulating the investment forecasting and management behavior of power grid enterprises and improving the standardization of transmission and distribution electricity price determination work. This is of great significance for achieving optimal allocation of power resources and the healthy development of the power industry.

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