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# *Optimal Scheduling Strategy of Multi-energy Complementary in New Energy Power System*

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***Keywords:*** New Energy Power System; Multi-Energy Complementary; Optimize the Scheduling Strategy; Energy Utilization Rate; Running Cost

***Abstract:*** With the rapid development of new energy, the traditional power system faces many challenges, and the multi-energy complementary optimal scheduling strategy has become the key to solve these problems. This article aims to discuss the design, application and prospect of multi-energy complementary optimal scheduling strategy in new energy power system (NEPS). In this article, the design principles and objectives of multi-energy complementary optimization scheduling strategy are put forward, and the specific objectives such as improving the utilization rate of new energy and reducing the operating cost of the system are defined. Based on the above, this article constructs a strategy framework and process, covering energy forecasting, scheduling planning, real-time scheduling adjustment and other links, and describes the specific process of strategy implementation. At the same time, this article introduces the key technologies involved in the strategy design, including energy forecasting technology, optimization algorithm technology, intelligent control technology and so on. The reliability and environmental protection of power system can be ensured by implementing the multi-energy complementary optimal dispatching strategy. This article suggests that this strategy should be fully considered and actively applied in future energy planning and power system construction.

## 1. Introduction

Under the wave of energy transformation, the importance of NEPS is increasingly prominent. With the depletion of traditional fossil energy and the aggravation of environmental pollution, the development and utilization of new energy has become an inevitable trend of global energy development [1]. NEPS is an important carrier of this trend. It not only carries the important task of optimizing energy structure, but also is the key force to promote the sustainable development of economy and society [2]. Intermittence and uncertainty of new energy bring new challenges to the stable operation of power system. In order to meet these challenges, multi-energy complementary optimal scheduling strategy came into being [3]. This strategy realizes the complementary advantages between energy sources through rational allocation of various energy resources, improves energy utilization efficiency and ensures the stability of power supply.

NEPS takes new energy as the main energy source, and relies on advanced power technology and equipment to realize energy conversion, transmission and distribution [4]. It is clean, renewable and distributed, which represents the development direction of power system. With the progress of new energy technology and the decrease of cost, its proportion in power system is increasing [5]. Solar energy, wind energy and other new energy power generation equipment have been widely used, providing a lot of clean electricity for the power system. The inherent characteristics of new energy also bring challenges to the operation of power system. This requires that the power system must have stronger flexibility and adaptability [6]. Multi-energy complementarity refers to the complementary advantages and efficient utilization of energy resources through rational allocation and utilization. This includes not only the complementarity between traditional energy and new energy, but also the complementarity between new energy [7]. Optimal scheduling is the key means to realize multi-energy complementarity. It reasonably arranges power generation and energy storage according to the real-time demand of the system and the availability of resources, improves efficiency and ensures the stability of supply. In the NEPS, optimal dispatching is particularly important. Because it can cope with the operational complexity brought by new energy, and realize efficient utilization and stable supply [8]. Therefore, multi-energy complementary and optimal dispatching is the inevitable choice and important support for the development of NEPS.

This study is devoted to discussing the theory and practice of multi-energy complementary optimal scheduling strategy in NEPS, and providing scientific guidance for the optimal operation of power system. The research content involves the basic concept, characteristics and development trend of NEPS, as well as the design, application and evaluation of multi-energy complementary optimal dispatching strategy.

## 2. Multi-energy complementary theory of NEPS

### 2.1. Composition and characteristics of NEPS

The NEPS is a complex and sophisticated system. Its components are diverse and have their own characteristics. New energy power generation equipment is the core of the system. It uses renewable energy such as solar energy, wind energy and water energy to convert it into electric energy. There are many kinds of power generation equipment, such as solar panels, wind turbines, hydropower stations and so on. According to their respective energy sources and conversion mechanisms, they provide a steady stream of clean electric energy for the power system. Energy storage system plays a key role in new energy power network [9]. It can store energy when there is excess power and release energy when there is power shortage, effectively regulating the balance between supply and demand of power grid. Transmission network is also an important part of NEPS. It is responsible for transmitting the electric energy generated by the power generation equipment to the customer end to ensure the stable supply of electric energy.

The operation characteristics of NEPS are closely related to its energy source. The intermittence and uncertainty of new energy sources such as solar energy and wind energy lead to the fluctuation of power generation in power system. This fluctuation brings challenges to the stable operation of power system, which requires the system to have stronger flexibility and adaptability. The environmental protection and sustainability of the new energy power network are also its obvious advantages. It reduces dependence on fossil energy and reduces greenhouse gas emissions. This has made a positive contribution to the response to global climate change.

### 2.2. The principle and mode of multi-energy complementary

Multi-energy complementation is an efficient way of energy utilization. Its basic principle lies in the complementarity, substitution and synergy between energy sources. There are many typical modes of multi-energy complementation, among which wind-light complementation and water-fire complementation are two common ones [10]. Wind-solar complementarity utilizes the complementarity of wind energy and solar energy, and realizes the stable operation of power system by rationally allocating the power generation plan of the two energy sources. This model has a broad application prospect in areas with suitable resource conditions. Water and fire complement each other to adjust the thermal power generation according to the abundance of water energy and balance the supply and demand relationship of power system. Although these models have their own advantages and disadvantages, for example, the complementary scenery is easily affected by the weather, and the complementary fire and water may face the pressure of water resources and environmental protection, they still have broad application prospects in suitable areas.

### 2.3. Theory and method of optimal scheduling

Optimal scheduling is one of the important means to realize multi-energy complementarity. According to the real-time demand of power system and the actual situation of energy resources, this method uses mathematical models and algorithms to carefully plan the power generation schemes and energy storage measures of various energy sources [11]. This aims to improve energy efficiency, reduce operating costs and ensure the stability of power supply. Optimal scheduling theory spans many disciplines such as operational research, cybernetics and computer science. It comprehensively uses the knowledge and methods of these disciplines to provide scientific basis for the optimal operation of power system.

In practice, the optimal scheduling technology is diversified, including linear programming, nonlinear programming and intelligent algorithm. As shown in Figure 1, these optimal scheduling methods have their own characteristics, and it is necessary to select the appropriate method for application according to the needs and characteristics of specific problems.

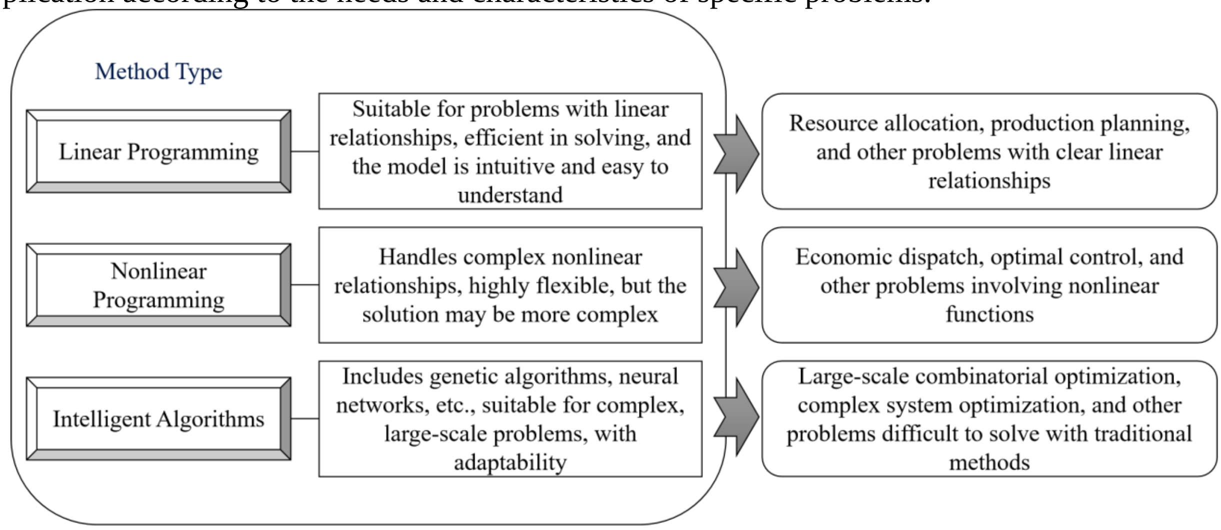


Figure 1 Overview of optimal scheduling methods

## 3. Optimal scheduling strategy design of multi-energy complementary in NEPS

### 3.1. Strategy design principles and objectives

When constructing the optimal scheduling strategy of multi-energy complementarity in NEPS, this article implements several key principles. These include economy, reliability and environmental protection. Table 1 shows the key principles of optimal dispatching strategy design of NEPS and the concrete embodiment of these principles in strategy design. Under the guidance of these principles in Table 1, this article defines the specific objectives of strategy design. The primary goal is to improve the utilization rate of new energy sources, make full use of renewable energy sources such as solar energy and wind energy by optimizing dispatching, and reduce dependence on traditional energy sources. Reducing the operating cost of the system is also one of the important goals. Through reasonable arrangement of power generation plan and energy storage strategy, the operating cost of power system can be reduced and the overall economic efficiency can be improved. In addition, this article is also committed to improving the flexibility and adaptability of the power system, so that the system can better cope with the intermittence and uncertainty of new energy generation and ensure the stability of power supply.

Table 1 Principles for Designing Optimized Scheduling Strategies for NEPSs

| Principle Name | Principle Description | Specific Embodiment in Strategy Design |
|---|---|---|
| Economic Viability | Ensure the scheduling strategy is economically feasible, reduces costs, and improves energy utilization efficiency | Consider factors such as energy costs and equipment maintenance expenses during scheduling, optimize energy allocation and usage to maximize economic benefits |
| Reliability | Guarantee the stable operation of the power system, reduce the risk of faults and power outages, and ensure power supply reliability | Design redundancy mechanisms and backup energy solutions to cope with emergencies and equipment failures, ensuring the continuity and stability of power supply |
| Environmental Sustainability | Promote the use of clean energy, reduce pollutant emissions, and protect environmental sustainability | Prioritize the scheduling and use of renewable energy, reduce dependence on fossil fuels, lower greenhouse gas emissions, and promote the construction of an environmentally friendly power system |

### 3.2. Policy framework and process

In order to achieve the above objectives, this section constructs a strategic framework for multi-energy complementary optimal scheduling. This framework includes energy forecasting, scheduling planning and real-time scheduling adjustment. As the basis of strategy implementation, energy forecasting plays a vital role. Through in-depth excavation of historical data and dynamic capture of real-time information, this link accurately predicts the power generation and future power demand of new energy sources by using scientific analysis methods. These prediction results provide solid data support for the formulation of dispatching plan and ensure the feasibility of the plan. In the stage of dispatching planning, this article fully considers the results of energy prediction and makes a reasonable power generation plan and energy storage strategy in combination with the actual situation of the power system to ensure the balance between supply and demand of the power system. However, it is not enough to rely only on the pre-established dispatching plan. Because of the fluctuation and uncertainty of new energy generation, the power system may face various emergencies at any time during its operation. Therefore, real-time scheduling adjustment is particularly important as the guarantee link of the strategy. According to the real-time operation state of the power system, we can dynamically adjust and optimize the dispatching plan to cope with unpredictable situations such as fluctuations in new energy generation and equipment failures.

In the specific process of strategy implementation, firstly, data collection is needed to collect relevant data of new energy power generation equipment, energy storage system and transmission network. Then a mathematical model is established to simulate and analyze the operation state of the power system. Then the optimization algorithm is used to solve the model and the optimal scheduling scheme is obtained. Finally, the relevant personnel output the scheduling scheme to the operation control system of the power system to realize real-time scheduling and adjustment.

### 3.3. Key technologies and innovations

In the process of strategy design, a number of key technologies are integrated. Energy forecasting technology is one of them. Through the analysis of historical data and real-time information, it accurately predicts the power generation and power demand of new energy sources, and provides a reliable basis for the formulation of dispatching plans. Optimization algorithm technology is at the core of strategy implementation. It uses mathematical methods and computer technology to solve complex optimization problems and get the optimal scheduling scheme. Intelligent control technology is equally important. It ensures the stable operation of the power system through real-time monitoring and adjustment.

In terms of strategy innovation, this article proposes a new scheduling model. This model effectively combines traditional energy and new energy, and realizes the complementary and synergistic effect between different energy sources. This article also puts forward a system integration method to organically integrate all key links and form a complete multi-energy complementary optimal scheduling strategy system. These innovations make this strategy more applicable in NEPSs.

## 4. Conclusions

In this study, the multi-energy complementary optimal scheduling strategy in NEPS is deeply analyzed. This article comprehensively reveals its design principles, objectives, framework flow and key technologies, and highlights the key role and application value of this strategy in NEPSs. Using multi-energy complementary optimal scheduling strategy can significantly improve the utilization rate of new energy, reduce the operating cost of the system and ensure the reliability and environmental protection of the power system. The implementation of this strategy can promote the extensive utilization of new energy, and also has positive significance for promoting the optimization of energy structure and environmental protection.

Based on the comprehensive research results, it is clear that the multi-energy complementary optimal scheduling strategy is a far-sighted and practical energy management method. It conforms to the trend of new energy development and provides solid support for the sustainable development of power system. This article suggests that this strategy should be fully considered and actively adopted in the future energy planning and power system construction to promote the healthy and rapid development of NEPS.

With the progress of science and technology and the improvement of environmental awareness, new energy will occupy an increasingly important position in the power system. The development prospect of NEPS in the future is very broad. As an important support of NEPS, multi-energy complementary optimal scheduling strategy will continue to highlight its application potential. Future research will continue to deepen the discussion and application of this strategy, and continuously improve the utilization rate of new energy and system operation efficiency.

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