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# *Urban Planning and Design of Integration of Unconventional Energy and Power System in the Era of Big Data*

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***Abstract:*** Under the background of big data era, while developing unconventional energy and power system, we must make full use of our existing resources to build a green city. The integration of power system and Internet technology is very important. In order to build a green city and reduce environmental pollution, urban planning needs to be designed and combined with the construction of unconventional energy and power system to improve the sustainable development of the city. This paper mainly uses the method of experimental comparison and control variables to explore the economic benefits and pollution of power system under different conditions. The experimental data show that the pollution caused by the application of unconventional energy in power grid generation is almost zero, which can be ignored, indicating that new energy has incomparable advantages in power grid and urban green construction.

## 1. Introduction

The planning and design of power system based on big data, combined with the development strategy of power grid companies, regional economic construction and other relevant aspects released by the State Grid and the local energy bureau, scientifically and reasonably analyze the overall layout of the city. With the application of big data technology in urban power distribution system, the utilization rate of unconventional energy and electric energy is getting higher and higher. The scale of urban power grid construction is expanding, and the demand for energy is also growing. Therefore, it is necessary to connect unconventional power supply, photovoltaic power generation and solar power supply to the power system. Unconventional energy and power utilization rate are continuously improved, and new fields such as distributed power generation and photovoltaic power generation have been well applied.

There are many scholars and theories studying unconventional energy and power systems, and there are also many people studying urban planning and design. For example, some scholars propose that the core of energy transformation is the new generation power system. The Internet is an important development axis of the new generation energy and power system [1-2]. Some

researchers also believe that the construction of new energy cities needs targeted planning theories and methods. At present, there are many problems in the planning of new energy cities in cities across the country, which is not conducive to the construction of new energy cities [3-4]. Other researchers said that the application of big data makes urban planning and design more effective. The development of big data enables the digital platform to more effectively identify the quantity and quality of urban public resources, thus realizing the orderly and efficient operation of the city [5-6]. Therefore, based on the power system planning and design, the integration of unconventional energy and power in the era of big data has put forward higher requirements for power quality and power supply reliability.

This paper takes power system planning and design as the research object, deeply analyzes the unconventional energy and power industry in the context of smart grid and big data era, and summarizes the conflicts between urban planning and industrial city power demand. These problems can be solved by taking reasonable measures such as coordinated development and scientific layout. This paper studies big data technology and power system optimization in smart grid planning and design, and analyzes and summarizes the measures that need to be taken under the construction of unconventional energy and green, environment-friendly and energy-saving society.

## 2. Urban planning for Integration of Unconventional Energy and Power System

### 2.1. Unconventional Energy

The development of unconventional energy has an important impact on human society and is a new type of renewable energy. The development and utilization of unconventional energy have an important impact on the environment and ecology. Unconventional energy is a renewable, clean and efficient resource, which can be developed and applied under natural conditions, and has little environmental pollution. Unconventional energy is also new energy. It can provide the required energy for human beings under natural conditions. Solar energy, wind energy and nuclear energy are among the new energy resources [7].

Solar energy is a kind of renewable new energy, which can be used when it is not needed, and there is no need to worry about resource depletion. It has the characteristics of wide distribution, high utilization rate and little environmental pollution. It converts solar radiation energy into electric energy, and then converts it into heat energy, so as to realize the recycling of energy from low to high. Wind energy uses natural wind power to generate electricity. It has the characteristics of low cost, high efficiency and renewable. In terms of economic benefits, unconventional energy has high utilization efficiency, and has the advantages of clean environmental protection and high comprehensive utilization rate of resources. Unconventional energy can not only effectively reduce the harm of conventional fossil fuels to the environment and society. At the same time, it is also a new technology of high efficiency and energy saving. Unconventional energy can be directly transformed into other forms of energy. The unconventional energy system is mainly composed of distributed power generation devices, energy storage equipment and other auxiliary facilities. For unconventional new structures and new efficient energy conservation and emission reduction measures, reliable equipment, devices and systems must be available to support the use of these substances during the whole project construction process, and they must be effectively protected and managed [8].

The difference between new energy is mainly reflected in two aspects. First, in terms of utilization, traditional fossil fuels and nuclear power generation all obtain energy through direct or indirect combustion. The new green, environment-friendly, clean and renewable energy is used in a new form, or is converted into electrical energy, chemical energy and photovoltaic cells after the

technical achievements are obtained; Second, new energy has certain advantages over conventional fossil fuels. The new energy power load means that the supply and consumption of electric energy cannot be separated from the grid during the operation of the power system. In the process of new energy power generation, electric energy is a very important and indispensable secondary energy. The main characteristics of new energy are high energy utilization rate, high power conversion efficiency, environment-friendly, long service life, clean and environmentally friendly.

New energy is the most widely used renewable energy in the world today. It can effectively alleviate resource shortage and reduce carbon dioxide emissions. When collecting solar energy, it is necessary to select the appropriate type and scale to ensure that it will not produce pollution. At the same time, ensure that the system can withstand the impact of solar panel components. We should choose different types of new renewable energy with good performance and low price according to different situations. It is necessary to vigorously promote the R&D and application of related industries and improve their efficiency. At the same time, efforts should be made to introduce foreign advanced equipment and improve the system integration. It is also necessary to continuously improve the existing technology level to meet the development needs of new energy [9-10].

## 2.2. Integration of Power System and Unconventional Energy

In the urban power system, the urban power grid is an extremely huge large capacity transmission and distribution network. The design of urban power system includes load calculation, voltage level selection and reactive power compensation scheme. The power supply side is in the urban power supply network to ensure the safety and stable supply of residential electricity. The line shall be laid to improve the voltage level, and the matching between the load size and the transformer model shall be considered and the optimal main wiring mode shall be selected. In addition, it is necessary to consider whether the reserve capacity and equipment can meet the normal operation of the power system. In the whole power system, the most important thing is on the line. In order to ensure the safe and reliable operation of the power grid, we should plan it reasonably. When the power grid fails, it can send signals to the substation in time. But the actual situation is that large capacity transformers need to be placed together to facilitate management and maintenance. Urban power distribution consists of two-level two circuit transmission lines, double feeders, single end to two-way long current. Urban power system is an important part of the whole power supply system, also known as distribution network. The urban power system is a large power grid. In terms of power supply reliability, it mainly depends on AC contact head and DC bus. Its tasks include safe and stable operation, economical and reasonable land use and grid connection operation, and ensuring the power quality proposed by users. Urban power grid is a large power supply system, also known as power grid. It is composed of many power element groups. As the main part of electric energy and signal in the whole supply chain, it is responsible for the transmission, conversion and distribution of electric energy. In a word, it is to convert a large amount of available energy into a power network composed of actual needs or electrical equipment to meet a series of users' requirements for service time and voltage quality [11-12].

Ensuring the safety and reliability of urban power consumption is the primary task of the entire power system. Therefore, a standby generator must be set to prevent the failure transformer from suddenly stopping operation and the power failure of all substations during circuit maintenance. In order to reduce investment costs and create greater benefits while meeting user needs, equipment maintenance and management costs should also be considered, and efforts should be made to make full use of power generation efficiency after its low-cost operation. At the same time, the power quality shall be improved to meet the power supply reliability requirements specified in relevant

national standards and reduce power system failure losses. In case of overload, the circuit shall not be short circuited to cause system oscillation. The three-phase five wire system and two-phase four feeder line shall be adopted to reduce the voltage of two power supplies. The reliability of power supply is an important guarantee to ensure the safety, stability, economy, efficiency and quality of power supply.

In urban planning, there are mutual constraints between urban power grid and other systems. When wiring the power supply network, a reasonable scheme shall be selected according to the local actual situation. Urban power grid planning and design has an important impact on the development of the entire power system, which mainly refers to the rational use and development of energy systems in urban planning. In general, the construction and operation of urban power grid can not be separated from electric energy. In the planning and design of power system, the integration of unconventional energy and power grid is an important task, and the analysis of unconventional energy and power resources in the context of big data era can effectively solve the current shortage of "imbalance between supply and demand". Big data technology provides basic guarantee for urban power supply networking and intelligent power distribution system construction. The construction of power system is of great significance to the energy security, economic and social development of the whole country, and the unconventional energy and power industry are the most critical and representative among them. In the age of big data, people's demand for electric energy is increasing. Therefore, it is necessary to meet user requirements through reasonable planning and design. The special power supply can effectively solve the problem of excessive distribution pressure during the peak load period of the power grid; It can alleviate many practical problems such as the peak valley difference of urban power transmission and transformation and the impact of voltage fluctuation. The unconventional energy and power system in urban power system are a whole, so we must consider their interaction and coordination. New technologies can also be used to improve the operating environment of the power system, reduce the cost input, improve the load level of the power network and achieve the goal of energy conservation and environmental protection. In urban planning and design, the differences between different regions must be fully considered, and a reasonable and feasible scheme must be determined according to the actual situation. At the same time, we should also pay attention to the need to comprehensively consider the local regional economic development level and industrial structure to formulate a more scientific and humanized planning and design scheme [13-14].

## 3. System Testing and Implementation

### 3.1. System Operation Environment

For the urban planning management system, when testing the system, you must first specify the specific operating environment of the system, and you must use the urban planning management system in this environment. The system deployment environment can be divided into three layers: the client layer, the network layer and the server layer of the urban planning management system. See Figure 1 for details:

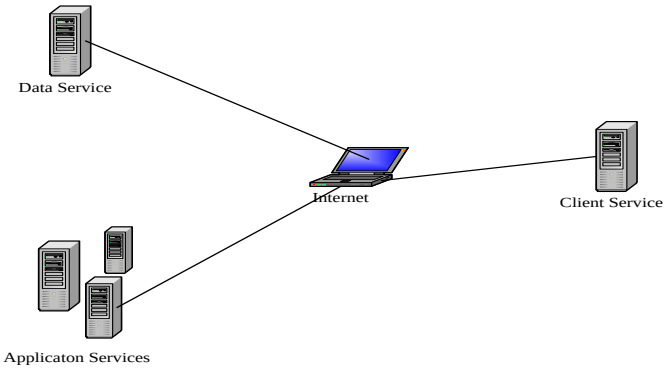


Figure 1: The urban planning and management system.

On the server side of the urban planning management system, it is the main project delivery platform of the urban planning management system. The network layer of urban planning management system is the channel connecting system users and servers. Urban planning management system client, which is the browser page responsible for interacting with urban planning management system.

### 3.2. Setting of Environmental Parameters

Considering the pollution-free emission conditions of renewable energy in different energy technologies, all pollutant emissions generated by the final operation of the integrated energy system can be traced back to the generation of electric energy and steam energy. The pollutant emission intensity is used to measure the pollutant emission per unit of power generation, as shown in Table 1:

Table 1: Pollutant emission intensity of different power generation technologies.

| | Sulfur Dioxide | Carbon dioxide | Carbon monoxide | Nitrogen oxide |
|---|---|---|---|---|
| Coal-fired power generation | 6.43 | 621 | 0.11 | 2.85 |
| Gas power generation | 0.001 | 184.1 | 0.17 | 0.62 |
| Wind power generation | 0 | 0 | 0 | 0 |
| Solar electrical energy generation | 0 | 0 | 0 | 0 |

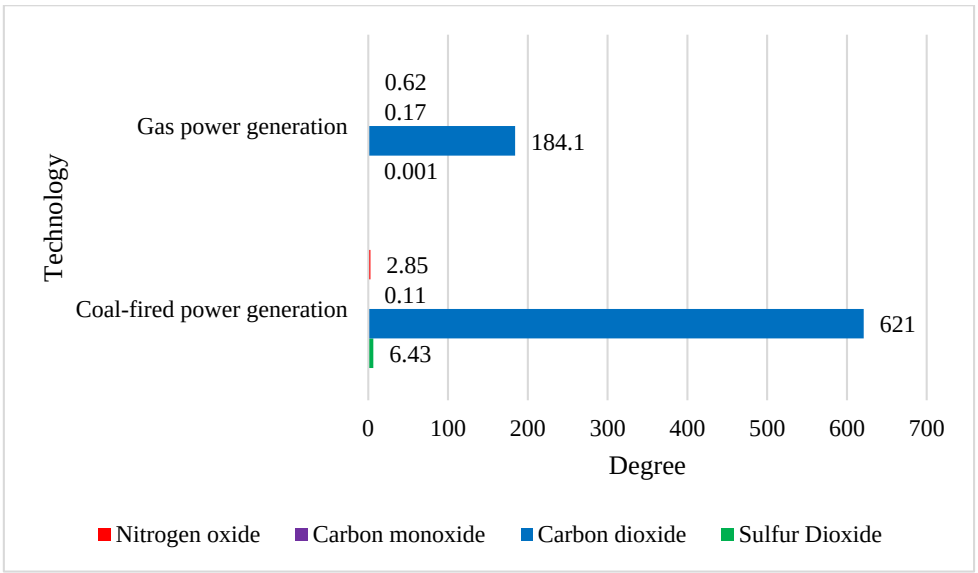

Figure 2: Pollutant emission intensity of different power generation technologies.

As shown in Figure 2, we can see that coal-fired and gas-fired power generation have greater impact on the environment. Among them, the carbon dioxide content produced by coal combustion reached 621, while the carbon dioxide produced by gas was less, 184.1. In addition, the nitrogen oxide content produced by these two methods is 2.85 and 0.62 respectively. This shows that coal has the greatest environmental pollution, followed by gas. In contrast, wind power generation and solar power generation can cause negligible environmental pollution. This shows that unconventional energy generation is a kind of green energy.

Heating load and cooling load are important indexes of energy consumption in integrated energy system. The gradient day method is a method to calculate the heating and cooling loads of buildings based on the cumulative value of the difference between the daily average outdoor temperature and the reference temperature. The number of days per day can be expressed by formula (1):

$$T_{\mathrm{t}} = \begin{cases} 0, s_{as} \prec s_{xwq} \\ (s_{as} - s_{xwq}) \times 1day, s_{as} \geq s_{xwq} \end{cases} \tag{1}$$

Wherein, $s_{as}$ refers to the reference temperature and $s_{xwq}$ refers to the daily average outdoor temperature. If the heating degree days are used as the basis for estimating the load of the integrated energy system, it can be assumed that the heating energy consumption is roughly proportional to the heating degree days. Heat supply energy consumption can be expressed by equation (2):

$$P = \frac{24O \cdot T_{\mathrm{g}} \cdot \mu_t}{\Delta s_{mv}} \tag{2}$$

P is the cumulative heat load and O is the total heat load of the building. The full load equivalent operating time method can not only estimate the load of the subsystem, but also consider the type of equipment, the efficiency of the heating and cooling system and energy saving measures. The proportion of the sum of the maximum output of the load rate $\kappa$ can be expressed as:

$$\kappa_G = \frac{O_{\mathrm{g}}}{O_Y \cdot S_g} \tag{3}$$

### 3.3. Test Method

In the city management system, the test method specifically describes the functional method used in the system test. The test method specifically involves two aspects: functional test method description and performance test method description. The content of function test is mainly used for the content of function modules. Unit tests and integration tests are used for the functional content of these tests. After checking each functional requirement, use and test the entire urban planning management system to determine the general problems of the urban planning management system and improve them in a timely manner. When testing the city management system, the system user must first log in to the system and perform specific operations on each functional module.

After the system function test is carried out, the impact of new energy conversion efficiency on power system economy is explored through experimental comparison. For urban power system, the improvement of unconventional energy conversion efficiency means the reduction of energy conversion loss, which also means that the same amount of unconventional energy can convert more electric energy. Therefore, the improvement of conversion efficiency substantially reduces the cost of the power system to provide flexible services to the power grid, making its profits greatly

improved.

## 4. Analysis of System Test Results

For the power grid, although the use of unconventional energy can convert more electricity, the maximum output power remains unchanged, and the increased part of electricity will be limited by its power and cannot be fully called by the grid. Therefore, the power generation cost of the power grid and the user's electricity expenditure will not decline significantly. See Table 2 for details:

Table 2: Unconventional energy conversion efficiency affects the economy of the power system.

| | Conversion efficiency (%) | System power generation cost | Consumer electric energy expenditure | User reserve expenditure |
|---|---|---|---|---|
| 1 | 31.7 | 21563387.41 | 27864467.55 | 243456.32 |
| 2 | 48.6 | 21561547.55 | 27862154.78 | 243456.32 |
| 3 | 77.3 | 21559879.32 | 27861134.94 | 243456.32 |
| 4 | 95.8 | 21556472.76 | 27858321.77 | 243456.32 |

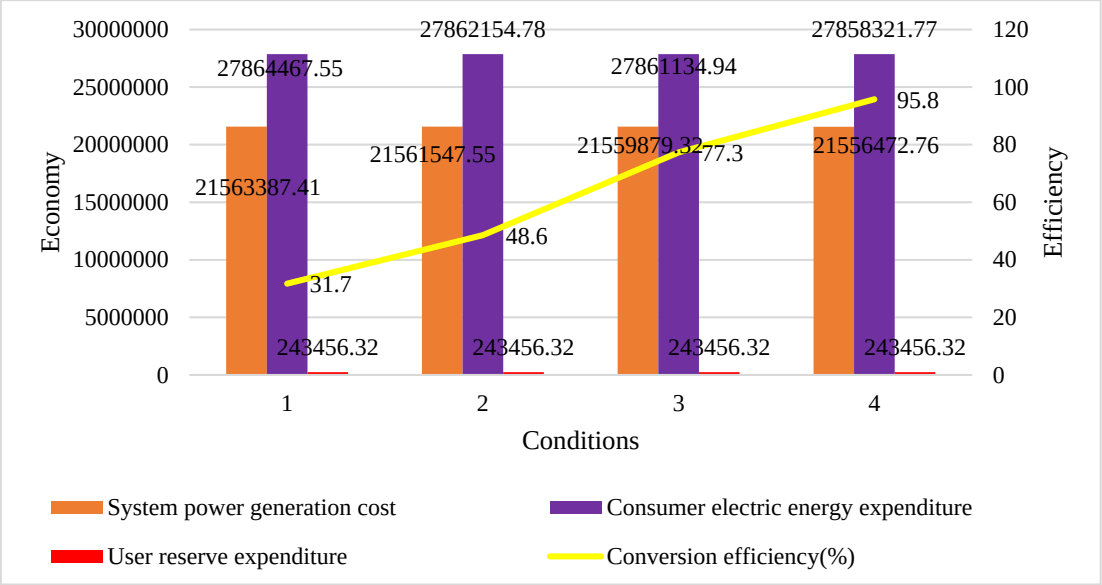


Figure 3: Unconventional energy conversion efficiency affects the economy of the power system.

As shown in Figure 3, when the conversion efficiency of unconventional energy is 31.7%, the power generation cost of the system and the user's electric energy expenditure are 21559879.32 yuan and 27861134.94 yuan respectively; When the conversion efficiency of unconventional energy is 95.8%, the power generation cost of the system and the user's electric energy expenditure are 21556472.76 yuan and 27858321.77 yuan respectively. This shows that with the improvement of unconventional energy conversion efficiency, the power generation cost of the system and the user's electricity expenditure have decreased slightly.

## 5. Conclusions

In order to realize the development of smart grid, reasonably plan urban power grid, and coordinate unconventional energy and power system, this paper uses big data to carry out relevant research. At the end of this paper, through the comparative analysis of the emission of harmful gases by unconventional energy and conventional energy and the impact of new energy on

economic benefits, it is found that in urban planning, the power distribution dispatching and power generation methods of the power grid should be reasonably planned, and the planning of the power grid system using unconventional energy is conducive to protecting the environment.

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