

## Analysis of the Relationship between the Operation Characteristics of Global Energy Internet and the Influencing Factors under the Background of Big Data and Big Energy

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**Abstract.** This paper mainly analyses and extracts the multiple operation characteristics of global energy interconnection under the background of big data and big energy, and analyses the typical influencing factors of global energy Internet operation characteristics and their internal correlation. Firstly, the basic scheme of global energy Internet macro-operation characteristics is proposed; secondly, the multi-operation characteristics of global energy Internet are extracted and summarized; finally, the influencing factors of global energy Internet operation characteristics are extracted, and the relationship among them is studied by improved Fishbone model.

**Keywords:** Fishbone model, global energy interconnection, big data, multiple operation characteristics.

## 1. Introduction

At present, research institutions at home and abroad have made rapid progress in the construction of global energy Internet theory, and the application of large data and large energy integration technology has become a research hotspot in the construction of global energy internet.

Introducing big data technology is an inevitable choice for the development of global energy internet. In the process of the gradual construction of the global energy internet, corresponding technologies are needed to ensure that the operation of the power grid is safer, more efficient and more reliable. With the continuous development of information and communication technology, huge amounts of information are collected in the energy Internet every day. With the rapid growth of data volume, the traditional data processing technology cannot meet the needs of such a huge amount of data. Therefore, with the support of big data technology, the global energy Internet will develop a perfect energy service platform, a robust energy Internet architecture and a new energy management and trading system, which can ensure the stability and efficiency of the global energy Internet [1, 4].

The application of large energy has become the main driving force for building the global energy internet. As an important way to build a new modern energy supply system, the global energy Internet advocated by our country is based on large-scale renewable energy base, promoting the replacement of clean renewable energy to traditional fossil energy on the power generation side, and gradually realizing domestic interaction on the power grid side relying on UHV technology and smart grid technology. Intercontinental interconnection and intercontinental interconnection; by means of new energy utilization technologies such as electric heating equipment, electrified rail transit, electric vehicles, etc., to promote the substitution of electricity for direct consumption of primary energy such as coal, gasoline and diesel on the load side. By improving the level of electrification in the whole society, we can promote the essential change of the form of human energy utilization, and achieve the goal of meeting the world's electricity demand in a clean and green way and changing the development mode of human industrial civilization [5, 7].



# 2. Research on the Macro-operation Characteristics of Global Energy Internet under the Background of Big Data and Big Energy

This section mainly designs the main research scheme of the global energy Internet macrooperation characteristics. The main content of the research scheme includes two parts. One part is to extract and analyze the global energy Internet operation characteristics under the background of large data-large energy based on the current situation and future vision of the global energy Internet development. Its operation characteristics are mainly from the physical infrastructure layer and information technology. The other part is the study of the main influencing factors of the macrooperation characteristics of the global energy internet. It mainly analyses the main influencing factors including international political events, energy prices, technical difficulties and security risks, and makes a detailed study of their internal relationship.

The basic scheme for studying the macro-operation characteristics of the global energy Internet is shown in Fig. 1, which is divided into five layers. From bottom to top, the basic themes can be summarized as follows: extracting the required information based on the current situation analysis and future planning of the global energy internet, analyzing and proposing the multi-operational characteristics of the global energy internet, separating three main feature layers. Then, the dominant factors affecting the global energy Internet operation characteristics are studied, and four key factors are obtained. Through the Fishbone analysis model, the potential correlation among the factors is analyzed concretely, and the complex influence conduction relationship between the factors at different levels under the Fishbone analysis model is established.



Figure 1. Main research plan.

## **3.** Extraction and Analysis of Global Energy Internet Operation Characteristics based on Big Data and Big Energy

### 3.1 Global Energy Internet Development Status and Future Vision

#### 3.1.1. Current Situation Analysis.

Firstly, basic research results are abundant. Relevant scholars have put forward the theory of "three networks integration" to continuously enrich the connotation and strategic system of global energy



internet; the global energy Internet technology and equipment development plan and innovation action plan will be drawn up. Secondly, key demonstration projects have been steadily promoted, and power grid interconnection schemes such as China-Myanmar-Bangladesh, China-Myanmar, China-Laos have been proposed; memorandum of cooperation on power grid interconnection in Northeast Asia has been signed with Korea Power Commune, Softbank Group of Japan and Russian Power Grid Corporation; and with the African Union, the European Union, relevant governments and enterprises. Industry and other industries should establish joint working mechanisms to jointly promote power grid interconnection projects in Africa and Europe.

#### **3.1.2. Future Development Planning.**

The future development of global energy Internet can be divided into three stages: intracontinental interconnection, cross-continental interconnection and global interconnection. The first stage is to promote consensus by 2020, and to start large-scale clean energy base construction by 2030 based on the comparative advantages of technology and economy, to strengthen the interconnection of power grids between continental countries. The second stage: 2030-2040, the development focus is to make important progress on the basis of continuing to strengthen interconnection of major state power grids on all continents, and in accordance with the order of priority and difficulty. The third stage: from 2040 to 2050, we will accelerate the construction of the global energy internet, gradually form a global interconnection pattern, and promote the realization of the "two substitutes" goal.

#### 3.2 Extraction of Multiple Operational Characteristics of Global Energy Internet

#### 3.2.1. Operational Feature Set Extraction.

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Based on the current situation and future vision of the global energy Internet, this section extracts the multi-operational features of the global energy Internet from the physical infrastructure, information technology and financial layer, as shown in Table 1.

Table 1. Global Energy internet Withiple Operational Features Set.					
Characteristic Categories	Operational characteristics				
Physical Foundation Layer	Global grid interconnection				
	Large-scale mutual benefit across time zones and seasons				
	Widely interconnected clean energy base and load center				
Information Technology Layer	Diversity of Key Technologies				
	Two-way flow of energy information				
	Interconnection of Transaction and Dispatching Systems in				
	Multinational Markets				
	Real-time Balance of Supply and Demand				
Financial layer	Electricity Trading				
	Promoting the Development of Strategic Emerging Industries				
	New Investment and Financing Platform				
	Price difference benefit and time difference benefit				
	Strong economy and competitiveness				

	ble 1.	Global	Energy	Internet	Multip	le O	perational	Features	Set
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# 4. Study on the Main Influencing Factors of Macro-operation Characteristics of Global Energy Internet

The global energy Internet needs reasonable dynamic planning and estimation in order to avoid inefficiency and waste caused by blind construction, and the investment cannot be guaranteed by misestimation of international forms. It is an urgent requirement for planning, guiding construction and management to analyze the impact of the same factors on the global energy Internet operation and to study the macro-operation characteristics of the global energy Internet in different policy scenarios and operating environments. Therefore, this part firstly extracts and analyses the influencing factors of global energy Internet operation.



#### 4.1 Extraction of Main Influencing Factors

As the most complex man-made industrial system on earth, the operation characteristics of the global energy Internet will be affected by various factors. Based on the existing research foundation of domestic and foreign scholars, this section extracts the main influencing factors of global energy Internet macro-operation characteristics.

After extraction and induction, the factors affecting the global energy Internet operation can be divided into four main aspects, namely, political events, energy prices, technical difficulties and security risks. The above four primary factors also influence the global energy Internet operation through secondary factors in their fields or other related factors, as shown in Table 2.

Primary factor	Secondary factors (related factors)			
Political events	International energy supply			
	international financial market			
	Energy Transport Path			
Energy prices	Income from investment			
	Energy demand			
	The proportion of primary and secondary energy sources			
Technical difficulties	Long Distance Transmission Loss			
	Peak shaving of renewable energy			
	Demand side response			
Hidden danger	Grid security			
	Cooperative security			

Table 2. Summary of influencing factors of global energy Internet macro-operation characteristics.

#### 4.2 Relevance Analysis of Main Influencing Factors of Global Energy Internet Macrooperation Characteristics based on Improved Fishbone Model

#### 4.2.1. A Subsubsection. the Basic Principle of Fishbone Analysis Technology.

Fishbone analysis method is an analysis method to find the "root cause" of the problem. It can accurately and intuitively show the relationship between the influencing factors of the global energy Internet macro-operation characteristics, and lay a foundation for sorting out the coupling relationship among the influencing factors.

According to the fishbone diagram of the relationship between the influencing factors of macrooperation characteristics, the correlation among the influencing factors can be obtained through analysis. For example, as far as investment income is concerned, the change of energy price unilaterally influences the change of investment income. Besides the most important factor of energy price, the problems of long-distance transmission loss, peak shaving of renewable energy and demand-side response in energy transmission path and technical difficulties will also have a minor impact on investment income. Fig. 2 further obtains the correlation diagram of typical influencing factors of macro-operation characteristics, as shown in Figure 3.



Figure 2. Global energy Internet macro-operation characteristics influencing factors correlation relationship fishbone diagram.

The extracted four primary factors and 11 secondary factors (related factors) that affect the global energy Internet operation are not isolated from each other, but interact and correlate with each other, and even have obvious feedback between the two factors. The change of one influencing factor usually leads to the change of another influencing factor, and then affects the whole influencing factor system through chain reaction. The relationship of each influencing factor is shown in Figure 3. Next, the relationship of each influencing factor will be elaborated in detail.



Figure 3. Typical influencing factors correlation diagram.

With the acceleration of global economic integration, international financial and energy markets are affected by multiple factors such as geopolitics, international situation and emergencies, while financial markets and energy prices will change the structure of energy consumption and the proportion of primary and secondary energy consumption. In forecasting the development of international financial and energy markets, we should also consider the impact of international situation and potential emergencies. The change of energy transmission path caused by international political events will increase the cost of global energy Internet transmission due to the extension or interruption of power transmission path, and then reduce its investment income. The decrease of investment returns will obviously affect the investor's confidence in the financial market, and further affect the financial market by affecting the stock prices of listed companies, forming a chain reaction.

The problem of long-distance transmission loss in technical difficulties mainly affects the investment income of global energy internet, that is, long-distance transmission loss will increase the cost of power supply, and then greatly reduce the investment income of global energy internet. If the renewable energy peak-shaving problem and demand-side response problem cannot be effectively solved, then the peak-shaving cost of power system will soar, which will further cause high electricity prices, and will also affect the investment income of global energy internet. In addition, the above two technical problems will also affect the security of power grid operation. Cooperative security in security risks is a political factor in a large sense. If cooperative security is not guaranteed, the energy transmission path will change because of the conflict of interests of individual countries.

## 5. Conclusion

To sum up, we have studied the macro-operation characteristics of the global energy internet, which includes two parts: one is to extract and analyze the operation characteristics of the global energy internet, including three levels: physical infrastructure, information technology and finance; the other is to extract the diversified factors affecting the operation and to analyze the relationship between them. The influencing factors are mainly divided into four aspects: political events, energy prices, technical difficulties and security risks, and the relationship among them is analyzed.

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