Current Situation and Future of Energy Internet Development

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Abstract. In recent years, with the continuous growth of global energy consumption demand and the continuous advancement of energy structure transformation, the energy field is facing new challenges and opportunities. Energy Internet, as the product of the deep integration of energy system and Internet technology, can become a possible way to approach the "energy impossible triangle" in the process of energy transformation. In this paper, the technology, characteristics, development status and the necessity of application of energy Internet are deeply studied, and then the future trend of energy Internet is analyzed. The energy Internet can promote the transformation of fossil energy utilization to renewable energy utilization, energy allocation from centralized to distributed change, and energy system of electricity, gas storage flow can be reasonably optimized, to achieve energy Internet efficient use of renewable resources, multiple goals can be improved, directly affect the social transformation and development. Energy Internet is an important area of national development today, and it is necessary to integrate more effective technologies while paying attention to potential risks. Through the construction of energy Internet at home and abroad, this paper provides strategies suitable for domestic development to help the country replace petrochemical energy with clean energy and pursue a low-carbon green development path.

Keywords: Energy internet, clean energy, grid technology, big data technology.

1. Introduction

Because the traditional energy Internet mainly relies on fossil energy support, it has the characteristics of easy access, unsustainable and non-renewable dot. As a result, environmental problems such as energy shortage, low efficiency and potential energy security risks have become obvious. Large-scale use the fossil fuel industry model is coming to an end. If the dependence on traditional fossil energy is reduced, a new energy utilization system will emerge. In other words, the third industrial revolution dominated by energy Internet will change the economic model of human society and affect the way of life of human beings [1] in the future. In recent years, with the rapid growth of global energy consumption demand, the energy field will face new challenges and opportunities. In the current energy system, renewable energy such as wind power and tidal power are the main basic supply sources. The application of Internet technology in the energy system is to plan a large-scale global energy network on the basis of new technologies such as power infrastructure and information communication, promote the continuous promotion of the transformation of energy structure, and realize the effective use of various energy sources more conveniently. In the process of society adhering to sustainable development, the energy structure is also constantly changing. However, in developing countries, how to control and deal with risks and hidden dangers at the physical, information and market levels when developing the energy Internet? What impact will the energy Internet have on China's current economic structure? What changes might it bring? These unknown questions have a profound impact on the research field of the future energy Internet.

This paper deeply studies the technology, characteristics and the necessity of application of energy Internet, and then predicts the prospect of energy Internet. At the same time, under the premise of fully understanding the advantages of renewable, distributed, interconnected, open and intelligent energy Internet, by combing the distribution of energy Internet at home and abroad, according to the advantages and disadvantages of the design suitable for the global comprehensive promotion of this system.

2. Energy Internet

2.1. Operation Mode

To meet the consumer's available purchasing power to the maximum extent, there is no lack of energy supply, over development of the situation, to keep the ecological environment clean and environmental protection. As can be seen from the above, these three difficult goals can be achieved to a large extent. With the help of open and shared network technology, the energy Internet can effectively promote the transition from the centralized use of fossil energy to the distributed use of renewable energy [2]. The combination of the energy system and the Internet is an advantageous method of energy transformation, which not only best approaches the ideal goal of "energy impossible triangle", but also optimizes the energy flow such as electricity and gas in the energy system to a certain extent, and realizes the multiple plans of the energy system. In addition, gradually develop new business models, stimulate consumption, encourage innovation and entrepreneurship, and finally achieve comprehensive upgrading.

2.2. Relationship between Energy Internet and Smart Grid

Smart grid is an important concept put forward in the early 21st century and has developed rapidly in recent years. It is the result of the integration of information and communication technology and power grid, and the energy Internet is the product of the integration of Internet concepts and technologies and energy systems [3]. Compared with the smart grid which is mainly distributed power generation and local consumption and control at the same time, the energy Internet is more open and interconnected. Under continuous innovation, it not only focuses on the power system, but also includes the integrated system of providing electricity, gas and electrified transportation. Because the energy Internet is extensive, within the acceptance range, a large area of access to a variety of types of equipment, so different types of energy can also be circulated between the existing energy industry has been transformed. In addition, the physical entity of the smart grid is mainly the power system, while the physical entity of the energy Internet is composed of the power system, the transportation system, the transmission and distribution network and other types of networks. The comparison shows that the energy of smart grid can only be transmitted and used through electric energy, and the energy of energy Internet can also be converted between chemical energy, heat energy and other forms, so that the research focus will shift from local consumption to wide-area coordination [4]. In addition, the development based on the traditional industrial control system is the main operation method of the information system of the smart grid, and in the energy Internet, the open Internet and other information networks will play a more important role [5].

3. Current Technology

Big data technology is the key to forming an energy Internet. The internal data of the big data system includes the real-time production capacity of the power plant, the load of the transmission line, and the number of uses. On the macro side, data reflecting economy, society, policies and other aspects are included to provide ideas for grid design and coordinate the corresponding fluctuation trajectory [6]. After comprehensive and detailed analysis of these unknown data, energy demand can be predicted more accurately in the future, energy scheduling can be optimized, intelligent energy services can be provided, and energy utilization efficiency and supply stability can be improved.

3.1. Multi-source System Optimization

Big data urgently needs to process a large amount of unknown information in a limited time, and if there is a lack of comprehensive information resources, there may be biases and errors in decision-making, leading to reduced management efficiency and waste of resources. Only by establishing a comprehensive data fusion system for power and other energy sources can data be analyzed more

efficiently and accurately, collaborative optimization of decision-making be realized, and information flow in the energy Internet be guaranteed.

3.2. Big Data Enhances the Reliability and Security of Energy Internet

The complexity and variability of the energy Internet will bury hidden dangers of instability, especially the impact of external factors has sharply increased the risk index. Big data can accurately predict the fluctuation of energy supply and demand and avoid the energy crisis caused by the imbalance of supply and demand. Identify potential risks and problems in advance, and take corresponding measures in time to prevent the collapse or failure of the energy Internet system due to multi-directional operation, and ensure normal operation. In the hierarchical optimization of the energy Internet structure, it is necessary to rationally allocate energy resources, improve the efficiency of use, reduce waste and reduce carbon emissions. The traceability of the energy supply chain should be guaranteed, and supervision over the source and direction of energy flow should be strengthened to prevent energy theft and illegal trading. We will reliably control the operation of the energy Internet and the storage of energy resources.

3.3. Openness and Participation in Policy Guidance

In the field of energy, energy Internet is more open than smart grid, people can participate in it more widely, and its impact is more significant. The Energy Internet encourages all types of users to actively participate in the production, consumption and management of energy. Enterprises can participate in the energy market to achieve energy trading and energy demand response [7]. People can become both producers and managers of energy, as well as consumers of energy, thereby diversifying energy sources. Big data provides a reference basis, through the simulation and evaluation of different policy measures, it can predict their impact on the energy market, user behavior and the environment, thus helping the government to formulate targeted policy measures, guide the participation of all parties, and provide an important reference basis for forming a reasonable business model.

3.4. In-depth Data Mining

Find ways to improve the efficiency of energy production and consumption from numerous unknown data to achieve efficient transmission of energy supply and demand. These technologies play a key role throughout the energy Internet, contributing to sustainable energy production and structural transformation of the economy. Because mathematical statistics can help analyze historical energy consumption data and predict future energy demand trends. Neural networks and machine learning can automatically learn patterns from the data and improve the accuracy of energy forecasts. Advanced technologies such as artificial intelligence can optimize energy distribution and scheduling for more efficient energy use.

4. Pros and Cons of Energy Internet

4.1. Advantages

The current technology has been able to meet the efficient circulation and accurate analysis of massive data, and realize automation and intelligent management. In addition, while meeting efficiency, it also better integrates energy management and operation as well as user participation to achieve adequate supply and optimized management of energy and improve utilization rate. The energy Internet can also eliminate regional and time differences in energy, and achieve balanced resource sharing. In the development and utilization of green energy, establish an open and multilateral Internet architecture, so that the energy Internet can help different regions complement each other's advantages, realize the balanced allocation and optimal utilization of resources, realize the sustainable development of national energy resources, and realize the replacement of traditional

energy with renewable energy. Each micro-energy grid in the energy Internet is an independent power generation unit, capable of meeting the energy needs of a specific region, and can manage and control the production and consumption of energy by itself. In addition, the energy Internet is also open, allowing different types of energy nodes such as power generation equipment and load equipment to access the network to realize energy sharing and optimal configuration [8]. At the same time, this openness also enables each node in the network to participate in energy trading and market exchange equally, ensuring supply and demand.

4.2. Current Deficiencies

The technical realization of energy Internet involves a large number of devices and systems, including sensors, communication networks, cloud computing platforms, etc. [11]. Information stagnation and delay during operation will make the authenticity and transparency of energy production, transmission and consumption information unguaranteed. Because it involves a large amount of data interaction and storage, the user's energy usage, energy transaction records, etc. Once these data are leaked, they may be used by criminals, causing security risks of privacy disclosure. The energy Internet urgently needs to strengthen data encryption and privacy protection to ensure that users' private data will not be exposed during the operation of the power grid, causing inconvenience to users. At present, a large amount of investment in the construction of energy Internet is unavoidable, including not only equipment procurement, infrastructure construction, etc., but also the participation of government, enterprises and social capital. But because the profit model of energy Internet is not clear, it needs the continuous innovation of market mechanism to achieve profit.

5. Key of Global Energy Interconnection

5.1. Transformation of China's Energy System

From the supply side, the future energy Internet will gradually replace traditional fossil energy power generation to meet the growing number of power terminal consumption. Because equipment, energy and services can be freely traded, the boundary between producers and consumers will be diluted in the future, highlighting the role of the market in production and consumption allocation, and realizing market mechanism, market behavior, safe and reliable operation [3]. The openness of the energy Internet needs to rely on the support of information technology, promote the intelligent and digital energy system, promote fair and positive competition in the energy market, stimulate innovation vitality, promote scientific and technological progress, cultivate emerging technologies and industries, and promote the reform of the energy supply side to a more market-oriented, flexible and efficient direction. Providing good energy infrastructure support is the fundamental key to the transformation and upgrading of the energy Internet, which can adapt to the needs of various types of power facilities, guide the national economy, and accommodate the wide access of users. For the development of emerging industries, including new energy power generation, electric vehicles, smart home and other fields, enhance the sustainable development of the domestic economy, and encourage the continuous development of the energy Internet market.

5.2. Global Demand for Energy Interconnection

The global Energy Internet must promote the interconnection between different types of energy, enhance the overall efficiency of energy use, reduce energy waste and loss, and can provide technical support for large-scale access and consumption of renewable energy. Due to the current dispersed and unstable situation of renewable energy, energy interconnection can integrate and balance dispersed renewable energy resources to achieve high penetration and stable supply of renewable energy. Countries around the world will move towards the direction of free energy transmission, which can share and exchange energy resources, promote reasonable competition in energy prices, and give users more choices. This is because energy interconnection can adopt a self-organizing network route that combines centralization and distribution to help the smooth operation and

management of the system. With artificial intelligence, energy Internet technology can fully control the intelligent optimal scheduling and monitoring management of the energy system, and improve the controllability and security of the energy system. Through the energy Internet, an energy trading platform based on blockchain technology can be established to realize peer-to-peer trading and crowdfunding of energy, and promote the open and innovative development of the energy market.

6. Future Development

6.1. Future Development Trend

The development trend of the future energy Internet is bound to be clean substitution and electricity substitution. Clean substitution mainly refers to the gradual replacement of traditional petrochemical energy with clean energy in energy development, which is a transition based on the use of clean energy [9]. Electric energy substitution refers to the conversion of fossil energy consumption into electric energy consumption and the increase of the proportion of electricity in the final energy consumption [10]. This "two alternatives" not only reflects the concept of closed-loop design, but from the perspective of terminal consumption, incentivizing the use of renewable energy will further expand the size of the electricity market, improve the level of electrification, and move towards a low-carbon and green future.

6.2. Policy

In terms of the global distribution of clean energy resources, there are abundant wind energy resources around the Arctic Circle and abundant solar energy resources near the equator. In an ideal situation, energy rich production areas can be developed with emphasis and transmission technologies such as UHV grids can be used to transport this clean energy to load centers on different continents [11]. Internationally, after adjusting the conflicts of interest among countries, the energy base and distributed network architecture of each country can support each other to provide more secure and reliable clean energy supply [12]. This will be the only way to fully cover the energy Internet in the future. With UHV grids as the backbone, we will implement and improve the construction of smart grids, and comprehensively promote the construction of power grids at all levels, including power access, transmission, distribution and dispatch. The smart grid can flexibly access and exit power supply, intelligently respond to user's instructions, interact with users in a friendly way, and has the ability of system self-healing. It can not only significantly improve the integrity of the Internet system, but also provide users with more convenient power services and improve people's well-being.

7. Conclusion

Energy Internet is a striking development concept in the field of energy in the world today, aiming at efficient integration and optimal allocation of various energy resources through digital, intelligent and networked technical means, to achieve clean, safe and sustainable development of energy, and reduce pollution caused by traditional energy. At present, there are still some challenges and problems in the energy Internet. This paper finds that the construction of energy Internet needs to fully consider the balance and coordination of energy supply and demand, and need to strengthen the comprehensive scheduling and operation management of all kinds of energy. Due to the characteristics of renewable energy, its production capacity fluctuates greatly, so effective measures should be taken to carry out long-distance transmission and storage of energy. This requires not only the construction of efficient power transmission and energy storage systems, but also the development of new energy transmission technologies and energy storage materials to ensure sustainable development in the future. In the construction process, network security technology is also indispensable, and a perfect security management system should be built. In the continuous innovation and breakthrough in the future, the energy Internet has broad prospects for development. As grid technology matures and costs are further reduced, renewable energy will dominate the energy supply. On the other hand, the application of

emerging technologies, such as artificial intelligence, will bring more opportunities and convenience to the operation and management of the energy Internet. However, with the continuous progress and the active promotion of policies, it is believed that the development of energy Internet will create a better future for us and realize the efficient use of energy and sustainable development.

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