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Innovative Development of Power Grid Enterprises Under the Background of Energy Digital Economy Transformation

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ABSTRACT
The new round of scientific and technological innovation drives the convergence of energy revolution and digital revolution, which gives birth to a new development model of energy digital economy, and provides a new way of thinking and method for breaking through the bottleneck of energy development. In order to grasp the development opportunities, reap the dividends of energy digital economy, and drive the development of the whole energy industry and even the economy and society, power grid enterprises need to re-recognize the important role of scientific and technological innovation, attach importance to the improvement of their own scientific and technological innovation strength, give full play to their internal resource advantage and institutional advantage, and strive to make greater breakthrough in the development of energy digital economy.

Keywords: *Energy Digital Economy, Scientific and Technological Innovation, Transformation*

1. INTRODUCTION

In the era of digital economy, the core of enterprises' competitive strength and transformation adaptability is scientific and technological innovation. Currently, digital giants such as Alibaba, Facebook and Amazon are all technology giants with strong "technology attributes". These technology giants are still building their own technological innovation capabilities to adapt to the rapidly changing internal and external situation and build sustainable competitive strength. Alibaba has successively established Dharma Institute, Lohan Hall and Pingtou Brother, Huawei has established Noah's Ark Lab, Tencent has established two laboratory matrices, namely artificial intelligence and cutting-edge technology, and so on. In the era of digital economy, scale expansion and capital investment are no longer effective ways to promote value growth, and technological innovation has become the first law of value growth [1].

The changes brought by scientific and technological innovation have gradually expanded from the Internet field to the real economy field, forcing traditional industries to carry out digital transformation [2]. The energy industry is also affected by the power of this revolution. Under the impetus of the new round of scientific and technological revolution, the traditional elements (energy) and new elements (data) are integrated and developed, forming a new energy digital economy model, which will be a new form after the digital transformation of the energy field and become the general trend of the development of the energy industry [3].

Power grid enterprises are in the critical period of mixed ownership reform, group management system reform and power market construction. They are faced with the severe situation of increasing green development pressure, shrinking profit space, increasing complexity of power grid operation and diversified customer service requirements. The traditional energy and power operation mode and enterprise management mode will be difficult to adapt to the reform demands and the development law of the energy industry. It is increasingly urgent for power grid enterprises to create a new development mode.

The emergence of energy digital economy under the new round of scientific and technological revolution provides a new way of thinking for solving the operation of energy system. Under the new mode of energy digital economy, the comprehensive changes of production factors, productivity and production relations in the

energy industry have reshaped many fields such as energy consumption, supply, technology and system. Energy digital economy is an upgraded model of traditional energy, and various problems encountered in traditional energy systems can be better solved in the new dimension. Power grid enterprises should turn challenges into opportunities, fully grasp the law of the development of the new round of scientific and technological revolution, accelerate the adaptation and even lead the construction of energy digital economy mode, and strive to occupy a leading position in the development of energy digital economy [4].

2. NEW REQUIREMENTS FOR TECHNOLOGICAL INNOVATION OF POWER GRID ENTERPRISE IN THE TRANSFORMATION OF ENERGY DIGITAL ECONOMY

To build a new energy digital economy development model, power grid enterprises need to realize the transformation of cultural concepts, development models, governance systems and other fields, but scientific and technological innovation is the key to incite the transformation of enterprises in various fields. There are significant differences between the new energy digital economy development model and the traditional energy development model. Therefore, much more attention should pay to the positioning of scientific and technological innovation and the overall improvement of scientific and technological innovation capabilities.

To promote the transformation from scale-driven growth to innovation-driven growth. The development of power grid enterprises witnessed the history of China's power industry, and realized the transformation from scratch and from weak to strong, in which scientific and technological innovation has always played an important role. Power grid enterprises are at the world leading level in many power grid technologies, but the development of these technologies is mainly based on gradual innovation, and the promotion of power grid value mainly depends on scale expansion. In recent years, the total amount problem faced by power grid development has been basically solved, but the structural problems are further highlighted. How to better meet the demands of green development, flexible energy use and personalized service is difficult to be solved by scale expansion. The new round of scientific and technological revolution has become the only way to solve the development problems, and innovation drive will become the new kinetic energy to promote power grid growth, which requires power grid enterprises to pay more attention to the role of scientific and technological innovation.

Energy digital economy needs to define new key areas of scientific and technological innovation. It is difficult to support the construction of energy digital economy mode only by relying on energy technology innovation [5]. From the perspective of hardware foundation, the operation of energy industry should not only rely on the physical network of energy production and operation, but build a new energy infrastructure formed by the deep integration of energy technology and emerging digital technologies such as cloud computing, 5G and Internet of Things. From the perspective of software foundation, under the new model, it is necessary to strengthen the full integration and mining of new data elements and give full play to the ability of data elements to optimize the resource allocation of other elements, which requires the integration of technologies such as big data, artificial intelligence and blockchain with the basic logic of energy and power [6].

Power grid enterprises need to take scientific and technological innovation as an important development strategy, strengthen their own "scientific and technological attributes", rearrange the key areas of scientific and technological innovation under the energy digital economy model, and build sustainable scientific and technological innovation capabilities.

3. CURRENT SITUATION OF SCIENTIFIC AND TECHNOLOGICAL INNOVATION IN POWER GRID ENTERPRISES

Power grid enterprises have vigorously implemented the strategy of strengthening enterprises through science and technology, accumulated profound scientific and technological innovation strength, and continuously enhanced their "scientific and technological attributes". Scientific and technological innovation of power grid enterprises is not only reflected in the core scientific and technological elements such as data, talents, technology and innovation, but also in the power grid enterprises' grasp of the positioning and role of science and technology under the background of energy digital economy transformation. To realize the transformation from traditional energy and power enterprises to leading enterprises in energy digital economy, it is necessary to re-recognize the important role of technological innovation in the transformation and upgrading of power grid enterprises, optimize the strategic positioning of science and technology and the allocation of resources, and consolidate the foundation of technological innovation of power grid enterprises. To give full play to the supporting and leading role of scientific and technological innovation, and promote power grid enterprises to accelerate the transformation of energy digital economy. Relying on the transformation and upgrading of the power grid, power grid enterprises will lead the high-quality development of the energy and power industry, become a leading technology force in the energy digital economy, and give full play to the "vanguard" and "pillar" role of central enterprises.

(1) Big data. As a platform for connecting power supply and demand, power grid enterprises are in a pivotal position in the whole field of energy and power, with huge power grid assets and 1.1 billion power users, which have generated massive data flows and information flows of energy and power. Network advantages and user bases have jointly accumulated energy and power big data resources that constitute power grid enterprises, providing data foundation support for transforming operation and management mode and innovating development mode.

(2) Technology. Power grid enterprises not only have leading advantages in power grid security and control technology, power transmission and transformation technology, power distribution technology and new energy technology, but also have carried out a lot of forward-looking research on digital technologies such as sharing power towers and 5G base stations, Internet of Things, big data centers, blockchain and artificial intelligence. It provides good technical conditions and strong technical support for promoting the integration and application of digital technology in the field of energy and power and promoting the transformation and development of energy digital economy.

(3) Innovation. Power grid enterprises insist on innovation-driven development, vigorously implement the strategy of strengthening enterprises through science and technology, and gradually form an innovation mode of "science and technology+finance+industry", an open innovation path of "four openness and four cooperation", and have established a three-level innovation system with directly affiliated scientific research industrial units, provincial power grid enterprises and grassroots innovation forces as the main body. From the first batch of "innovative" enterprises in China to UHV and HVDC technologies leading the world, the innovation capability has been continuously enhanced.

(4) Talent. Power grid enterprises insist on giving priority to the development of talents, strengthen the construction of high-level talents, and achieve positive results in the construction of scientific and technological talents. Therefore, power grid enterprises have gradually formed a scientific and technological innovation unit with directly affiliated industrial units, directly affiliated scientific research units and provincial scientific research units as the main body, and trained and introduced a number of high-level innovation teams, professional leading talents and "Thousand Talents Program" experts.

4. CHALLENGES FACED BY SCIENTIFIC AND TECHNOLOGICAL INNOVATION OF POWER GRID ENTERPRISES

Facing the trend and requirements of energy digital economy transformation, power grid enterprises are facing new challenges in the strategic positioning of science and technology and the coordination of science and technology elements, and there are still various problems to be further optimized and solved.

(1) The orientation and role of scientific and technological innovation need to be continuously strengthened. Scientific and technological innovation is the core kinetic energy of the development of energy digital economy. The traditional development model driven by scale and capital advantage is difficult to adapt to the needs of energy digital economy transformation and lead the sustainable development of the industry. The key for power grid enterprises to realize development power transformation is to implement innovation-driven development strategy, which lies in scientific and technological innovation. Presently, the strategic positioning of scientific and technological innovation in the transformation and development of energy digital economy needs to be further clarified, the supporting and leading role in promoting the transformation of cultural concepts, operation modes and energy ecological development needs to be enhanced, and the contribution rate of scientific and technological innovation to enterprise management and development needs to be improved.

(2) The synergy ability of scientific and technological innovation elements needs to be strengthened. The transformation of energy digital economy requires higher technological innovation level of power grid enterprises. Power grid enterprises have accumulated abundant resources in data, talents, technology and innovation. However, the value and function of each element need to be further explored, and the ability of integrating scientific and technological innovation resources and coordinating elements needs to be strengthened. To lead the development of energy digital economy, it is urgent to promote the effective coordination of scientific and technological innovation resources such as data, talents, technology and innovation, and improve the efficiency of resource allocation and collaborative innovation.

(3) The position and function of data elements do not match the resource demand of the development of energy digital economy. In the transformation of energy digital economy, data, as strategic means of production, is the core force driving the innovation and development of business model. The value and function of power grid enterprise data need to be further explored. Firstly, there is no clear data development path and method in transforming energy and power information into energy and power data and collecting them into computable resources. Secondly, there is no consensus on the ownership and commercial mechanism of energy and power data. Thirdly, it is still to be explored in data value mining to promote the development of data information towards elements, commercialization and industrialization.

(4) The quality structure of the talent team does not match the talent demand of the development of energy digital economy. Firstly, the reserve of digital professionals in power grid enterprises is relatively insufficient, and the ability and thinking of the talent team to adapt to digitalization needs to be further improved. Secondly, power grid enterprises lack talents in basic forward-looking research, interdisciplinary and achievement transformation, and high-level scientific and technological talents are insufficient. Thirdly, the contradiction of talent structure in the process of transformation and development is prominent, so it is urgent to carry out strategic adjustment of talent structure and accelerate the transformation of talent development mode.

(5) The mode of technological innovation is incompatible with the technical requirements of the development of energy digital economy. Firstly, power grid enterprises have insufficient accumulation and deep application of digital technologies such as blockchain, big data and artificial intelligence. Secondly, the deep integration of energy and power technology with digital technology and information and communication technology is insufficient, and it is urgent to accelerate the accumulation. Thirdly, joint research on major technologies and research and development of key core technologies of "sticking neck" need to be further strengthened.

(6) The status and role of innovation elements are not compatible with the requirements of energy digital economy. Firstly, there are shortcomings in the docking of market innovation needs and the coordination of internal and external scientific and technological innovation resources. Secondly, the original innovation ability is insufficient and the open innovation synergy needs to be strengthened. Thirdly, the mechanism of evaluation, application and value transformation of scientific and technological innovation achievements is not perfect, which fails to give full play to the value of scientific and technological innovation achievements.

5. SUGGESTIONS ON INNOVATION AND DEVELOPMENT OF POWER GRID ENTERPRISES UNDER THE BACKGROUND OF ENERGY DIGITAL ECONOMY TRANSFORMATION

First of all, to pay full attention to the fulcrum role of scientific and technological innovation in digital transformation, and make innovation a new kinetic energy for the development of power grid enterprises. Power grid enterprises need to change from scale-driven development mode to technological innovation-driven development mode, which not only forms a strong value consensus from top to bottom, but also involves the change of thinking mode, business operation, management, performance appraisal, cooperation mode and value evaluation. Power grid enterprises need to conform to the development trend of energy digital economy, and institutionalize the technological innovation development strategy of power grid enterprises. By comprehensively deconstructing the development demands of power grid enterprises in the field of scientific and technological innovation, power grid enterprises can formulate a clear line of scientific and technological innovation.

Secondly, to construct the science and technology innovation matrix under the energy digital economy mode. Cross-border innovation and integration innovation of energy digital economy model technology can create greater value, which requires power grid enterprises not only to pay attention to breakthroughs in energy technology, but also to make technological breakthrough in digital technology and interdisciplinary fields. It is necessary to make a clear and systematic and forward-looking assessment of the importance of massive science and technology at this stage, formulate the science and technology innovation matrix of power grid enterprises according to the importance, urgency and complementarity of technology, increase independent innovation of key core technologies, coordinate research on cutting-edge common technologies and market-oriented introduction of non-core technologies, etc., so as to stimulate different technologies to cooperate with each other and form synergy.

Thirdly, to use market-oriented mechanism to stimulate the value release of internal and external innovation resources. To establish a market-oriented mechanism to encourage internal and external scientific and technological innovation, introduce equity incentive and property rights protection mechanisms, etc., and give play to the role of internal talents, funds, laboratories and other resources. Under the new development requirements of energy digital economy, power grid enterprises will inevitably have many shortcomings in digital technology and cross-border technology. In addition to strengthening their own scientific research strength, power grid enterprises need to introduce and strengthen open innovation, coordinate cooperation with external universities, consulting institutions and technology enterprises, and give full play to the innovation system with energy enterprises as the main body and collaboration of production, education and research.

Fourthly, to create an efficient scientific and technological innovation model with flexible mechanisms. In the digital economy era, all enterprises are crossing the river by feeling the Stone, and bold trial and error and quick iteration have also become the key for enterprises to gain the first-Mover advantage. In order to ensure the advancement, timeliness and adaptability of technology R&D, the traditional project-based scientific

research management mode of power grid enterprises needs to be adjusted, and it is urgent to build a flexible scientific research management mechanism and assessment mechanism, and encourage technology R&D to be put into the market for testing when it has completed its basic functions, and to be iteratively optimized in concrete practice.

Fifthly, to build a value-oriented evaluation model of scientific and technological innovation. To establish a practical and effective scientific and technological innovation orientation, Power grid enterprises should not simply take patents and the number of awards as the key evaluation criteria, especially for the research and development of some basic technologies and emerging technologies, it is necessary to realize the docking between technology research and development and industrial development, and get through the whole link from research and development to practice to prevent repeated development and mismatch between supply and demand. It is indispensable to track the whole process of technological development, understand the value creation and realization of technology, evaluate the effectiveness of scientific and technological innovation in practice and application, and promote the benign interaction between production, education and research.

Sixthly, to cultivate innovative culture and promote the formation of innovative talents highland in energy digital economy. On the one hand, to create an innovation culture that encourages innovation and tolerance failure, and build a talent development environment that integrates protection training, salary, promotion, and open sharing of resources, laying the foundation for stimulating internal innovation; On the other hand, to actively strengthen cooperation with the government, enterprises, universities and scientific research institutions, build a digital talent training base, and accelerate the training of various digital talents that meet the needs of the industry. To promote the construction of high-level digital innovation talent pool, and introduce and reserve high-level talents for the deep integration of digital technology and energy and power, as well as the sustainable development of enterprises.

6. CONCLUSION

To grasp the transformation and development opportunities brought by this technological revolution, power grid enterprises need to take scientific and technological innovation as an important development strategy, reach the belief and consensus that innovation drives value creation, build a scientific and technological innovation system that adapts to the new development model of energy digital economy, and continuously enhance their own scientific and technological innovation strength to lead the development of energy digital economy.

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