The Situation and Countermeasures to Improve the Independent Innovation Capability of Energy Internet Enterprises

Pengwei Cong(✉) and Rui Li

State Grid Energy Research Institute Co., Ltd., Beijing 102209, China
imagecong@126.com, lirui@sgeri.sgcc.com.cn

Abstract. Enterprises occupy an important position in the national innovation system and play a leading role. At present, we are in the period of tackling difficulties in the construction of the energy internet. Enhancing the independent innovation capability of energy internet enterprises can accelerate the breakthrough of key core technologies of the energy internet, which will be conducive to grasping the initiative of future competition and development in the energy field. This paper focuses on the importance and key paths for energy internet enterprises to enhance their independent innovation capabilities, and proposes the main initiatives for energy internet enterprises to strengthen the construction of new power system standards systems, taking the construction of standard systems as the main entry point. This paper addresses the practical needs of energy and power enterprises in building the energy internet, and will provide theoretical and practical support for the formulation of corporate strategies and professional development strategies.

Keywords: energy internet enterprises · independent innovation capability · new power system standards systems · corporate strategy

1 Introduction

Under the goal of carbon peak and carbon neutral, the energy pattern has been profoundly adjusted and the "double high" and "double peak" characteristics of the power system have been highlighted, bringing huge challenges to the power supply and safe and stable operation of the power grid. On the one hand, it is difficult for new energy generation to take up the heavy responsibility of power supply in the short term. In the past ten years, China's installed power generation scale has increased by about 12 times, the total installed capacity for many years ranked first in the world; this year in the complex and severe situation of global energy supply and demand, China's renewable energy installation is expected to exceed 1.1 billion kilowatts. In the process of building a new power system, the proportion of new energy power generation on the grid will further rise, and the structure of China's power supply will gradually be moderately adjusted from coal power units with controlled continuous power output to new energy power

S. Tehseen et al. (Eds.): ICEDBC 2023, AEBMR 258, pp. 579–585, 2024.
https://doi.org/10.2991/978-94-6463-246-0_70

generation with strong uncertainty and weak controlled power output [1]. However, new energy generation is characterrised by randomness, volatility and intermittency, and its contribution to power security is low. Especially under extreme weather conditions, the contradiction between power supply and demand will be further intensified and the risk of shortage will be more prominent. On the other hand, the safe and stable operation of the power system is facing unprecedented challenges. The technical basis of the power system has changed from a mechanical electromagnetic system dominated by synchronous generators to a hybrid system jointly dominated by power electronics and synchronous machines [2]. The rotational inertia of the system will continue to decrease, the physical basis for maintaining the safety and stability of the power grid will be continuously weakened, and traditional stability problems such as power angle, frequency and voltage will become more and more prominent. At the same time, China's power system has a low level of flexible regulation capability, making it difficult to support a power system with a high proportion of new energy on the grid [3].

In order to meet the challenges facing the power system, it is urgent for energy internet companies to improve their independent innovation capabilities [4]. Energy internet emerged in its infancy in 1970 and has been in development for nearly fifty years. In general, the development of the Internet of Energy has gone through three stages: conception (1970 to 2003), diversified exploration (2004 to 2015) and deepened understanding (2015 and beyond).

At present, existing theories have explored the system structure, functional form and key technologies of the Energy Internet in depth, and different research institutions, business organisations, experts and scholars have different understandings of the Energy Internet [5]. In general, the understanding of the energy internet can be broadly grouped into three directions.

The first is an energy internet characterised by "grid+", which realises the wide-area interconnection of power regions [6]. The main feature is the expansion of the electricity network in space, interconnecting different regional grids and realising the cross-regional consumption of different types of new energy in different regions, mainly represented by the global energy internet concept advocated by the Global Energy Internet Development Cooperation.

The second is the energy internet featuring "Internet+", which realises the integration of the internet and energy. The main feature is the use of power electronics, information and communication and the Internet and other new technologies and applications to transform the energy system, to achieve energy control and real-time information sharing, energy sharing and matching supply and demand, so as to consume renewable energy, mainly with Rifkin Energy Internet, the United States FREEDM project, Germany's E-Energy project, Japan's Digital Grid project and China's "Internet" project. Grid project and China's "Internet+" smart energy, etc. as representatives.

Thirdly, the energy internet is characterised by "multi-energy+", which realises the interconnection of various types of energy. The main feature is the interconnection of different energy systems such as electricity, heat, cooling, gas and transport. On the one hand, energy efficiency is improved through comprehensive energy development and utilisation, and on the other hand, renewable energy consumption is achieved by

converting electricity into heat, cold, natural gas and electric vehicle energy storage, mainly represented by integrated energy systems and the Xin'ao Pan Energy Network.

2 The Importance of and Key Paths for Energy Internet Companies to Enhance Their Independent Innovation Capabilities

Promoting the construction of the standard system is an objective requirement to lead the high-level construction of the new power system, and is also an inevitable choice to meet the challenges of energy change. From the perspective of vertical technology system, in order to cope with the huge challenges faced by the new power system, the safe and stable operation of the power system, transmission and distribution network, micro-grid, grid-type flexible DC, demand-side response, electrification, power market and other key technological innovations and changes in application scenarios have led to the development of standard systems in several key areas [7]. From the perspective of horizontal technology chain, the new power system technology field extends to the whole chain of source, network, load and storage, requiring cross-industry and cross-discipline cooperation in development and construction, with great coordination difficulties in technology innovation, market transaction, operation and management, institutional mechanism, emergency protection and other levels, and there is an urgent need to establish an interoperable technical standard system, promote the high-quality application of key core technology achievements in the construction of new power system, help energy and power It is urgent to establish an interconnected technical standard system, promote the high-quality application of key core technology achievements in the construction of new power systems, help the transformation and upgrading of the integration of the energy and power industry chain, and accelerate the construction of new energy systems [8].

China has made a series of major arrangements for green and low-carbon standardisation in the energy sector, and the development of standardisation of new power systems has ushered in an important opportunity period. The National Standardisation Development Outline proposes to improve the standardisation of green development, and calls for "the establishment of sound standards for carbon peaking and carbon neutrality". The Action Plan for Achieving Carbon Peaks by 2030 proposes to "improve the standard system for renewable energy, and accelerate the development and revision of standards in related fields". The 14th Five-Year Plan for a Modern Energy System specifies "strengthening the construction of a new energy standard system, formulating and revising standards and technical specifications in key areas that support and lead the low-carbon transformation of energy, and enhancing the internationalisation of energy standards". This series of major strategic deployment, for the new power system standardization work to clarify the development goals, specify the direction of progress, to create important opportunities [9]. Promoting the standardization of new power systems is a concrete action to implement China's standardization and "double carbon" strategy, a powerful support for China's energy and power industry to occupy the high ground in science and technology and enhance competitiveness, and an important grasp for Chinese enterprises to participate in global governance and international cooperation in

energy and power, which has become a top priority, The "double carbon" standardization work is the top priority.

At the 2022 International Standardization Conference held on August 20, 2022, the International Electrotechnical Commission clearly proposed that China take the lead in developing the world's first international standard framework system for key technologies of new power systems, which indicates that China has the industrial and technological advantages to lead the development of new power systems, and China's standard internationalization strategy has made a new breakthrough. At the same time, it is necessary to be aware that the current energy revolution and digital revolution are merging together, the opportunity for innovation and development is fleeting, the standard system is still missing, the standard and science and technology innovation interaction support mechanism is not yet perfect, the implementation benefits have not yet been highlighted, the level of domestic international standard synergy needs to be enhanced and other issues stand out, and it is urgent to promote the standardization of new power systems [10].

3 Initiatives to Promote the Development of a New Power System Standards System

3.1 Promoting the Restructuring of the Energy and Electricity Technology Standards System

Closely focus on the requirements of ensuring energy security and promoting green and low-carbon transformation, strengthen the concept of "whole chain" and system thinking, accelerate the construction of a new power system technical standard system covering all aspects of the source, network, load and storage, meet the needs of large-scale new energy development, clean use of fossil energy and rapid growth of diversified loads, enhance the grid's energy resources optimization It will also enhance the grid's ability to optimize the allocation of energy resources and promote higher quality, more efficient and sustainable development [11].

The first is to cover the entire chain and strengthen the role of standards in supporting the safe and green development of the new power system. Strengthen the research of basic standards for the safe and stable operation of power grids in the context of the new power system, continuously improve the standards for power grids to cope with large area blackouts, power grids for disaster prevention and mitigation, power storage quality and safety, and strengthen the development and application of energy and power information security standards. Strengthen the standardization of green evaluation of supply chains and energy saving and efficiency of power grid equipment, accelerate the development of standards for new energy-saving and environmental protection equipment and materials, new infrastructure energy structure optimization standards and power demand-side management standards, and vigorously promote the updating and upgrading of standards for comprehensive energy and electric energy substitution.

Second, optimize the dual structure, increase the effective supply of new power system group standards. Group standard organizations should find the standard development needs to support the construction of new power system, focus on new technologies, new

industries, new industries and new modes such as electric energy substitution, demand-side management, virtual power plants, new energy storage, power market, etc., consider the promotion and application mode of group standards, widely absorb the participation of parties related to the construction of new power system, give full play to the role of technically superior enterprises, develop original and high-quality new power system group standards, powerfully enhance the proportion of the market independent development of standards.

3.2 Creating a New Model for the Interactive Development of Technical Standards and Technological Innovation in New Power Systems

Create a new power system technology standard science and technology innovation system with the wide participation of all innovative forces, deepen the integration of scientific research, standards, industry development, promote technology, patents, standards linkage innovation, standards and science and technology research and development, experimental testing, results promotion of the whole interaction.

First, to promote the realization of scientific research and technical standards of the whole process of docking. Explore the establishment of a synchronous collection, synchronous project and synchronous implementation mechanism for scientific and technological research and standard development. In the new round of national science and technology plan task layout to strengthen the new power system key technology field standard research, the standard as an important output indicators into the science and technology plan implementation system. Research to establish a statistical analysis system and incentive mechanism for the transformation of scientific and technological achievements into technical standards.

Second, strengthen the interactive support of standard development and experimental research, inspection and testing. Around the new power system major technology industry direction, the system layout and constantly optimize the experimental research, testing and inspection system. Strengthen experimental research, testing laboratory standardization management, to high level experimental research, testing support high quality standard development, high quality standards to support experimental research, testing high level development.

Third, better play the role of technical standards to promote the application of scientific and technological achievements. Strengthen the awareness of standards, technical standards as a core tool to promote the industrialization of new power system innovation, market, technical standards to promote high-quality transformation of scientific and technological achievements. Broaden the standardization channels of scientific and technological achievements, and use technical standards as an important means to seize the international high ground in the field of energy and electricity.

3.3 Enhancing the Capacity to Implement New Power System Standards

Build a new electric power system standard implementation supervision and evaluation system, solidify the foundation of standard implementation, innovative implementation methods, strengthen implementation supervision, optimize the evaluation mechanism,

promote the formation of a scientific and complete new electric power system standardization management closed loop, and comprehensively enhance the ability to implement standards.

First, enhance the quality of the implementation of standards. To enhance the implementation of efficiency as the guide, highlight the main responsibility of the competent industry departments, linkage of professional management and standard implementation, and promote the realization of new power system standard implementation supervision and evaluation work normalized, continuous and equalized.

Second, improve the quality of standard implementation supervision. Continuously increase the standard implementation supervision work, promote the new power system standard implementation supervision and technical supervision, safety inspection and other business activities of deep integration, supervision to promote implementation, supervision to promote improvement.

Third, improve the quality of evaluation of the effectiveness of the implementation of standards. Establish a mechanism for collecting and analyzing data for the supervision and evaluation of the implementation of new power system standards, and establish a database of typical data and typical cases. Research and build a systematic implementation benefit evaluation model for new power system standards, and improve the level of quantitative evaluation of implementation benefits.

4 Conclusions

Energy internet enterprises to build a new type of power system is a long-term complex systemic project, ultimately rely on scientific and technological innovation to provide strong protection, need to rely on the construction of the standard system to provide strong support. The standardization of the new power system should be enhanced based on the actual situation in China, and fully consider the characteristics of the power industry, such as large investment scale, high technology intensity and strong path dependence, to coordinate development and security, supply and transformation, to help the construction of the new power system to achieve a smooth transition in a gradual manner, and to make new contributions in the construction of a new energy system. This paper puts forward countermeasures and suggestions to enhance the standardization of new power systems from three aspects: reconstructing the standard system, creating a new mode of interaction between standards and scientific and technological innovation, and strengthening implementation and application, which can provide theoretical and practical support for energy internet enterprise companies to formulate corporate strategies and professional development strategies.

Acknowledgement. This work was supported by the science and technology project of State Grid Corporation of China, "Research on promotion path, power transitive model and empirical research of energy Internet enterprises' innovation capability" (1400-202157233A-0-0-00).

References

1. Newell S, Huang J C, Galliers R D, et al. (2003) Implementing enterprise resource planning and knowledge management systems in tandem: fostering efficiency and innovation complementarity. Information & Organization, 13: 25–52. https://doi.org/10.1016/S1471-7727(02)00007-6.
2. Blind L G K. (2010) Putting Innovation at the Centre of Europe - Suggestions for a European Innovation Strategy. bioessays news & reviews in molecular cellular & developmental biology. https://doi.org/10.1002/bies.201100007.
3. Coccia M. (2014) Driving forces of technological change: The relation between population growth and technological innovation. Technological Forecasting & Social Change, 82: 52–65. https://doi.org/10.1016/j.techfore.2013.06.001.
4. Buscha J, Foxonb T J, Taylora P G. (2018) Designing industrial strategy for a low carbon transformation. Environmental Innovation and Societal Transitions, 29. https://doi.org/10.13140/RG.2.2.14170.34240.
5. Ryan, Chris. (2013) Eco-Acupuncture: designing and facilitating pathways for urban transformation, for a resilient low-carbon future. Journal of Cleaner Production, 50:189–199. https://doi.org/10.1016/j.jclepro.2012.11.029.
6. Lenihan H, Mcguirk H, Murphy K R. (2019) Driving innovation: Public policy and human capita. Research Policy, 48:103791. https://doi.org/10.1016/j.respol.2019.04.015.
7. Suocheng D, Zehong L, Bin L, et al. (2007) Problems and Strategies of Industrial Transformation of China's Resource-based Cities. China Population, Resources and Environment, 17:12–17. https://doi.org/10.1016/S1872-583X(08)60005-4.
8. Acemoglu D, Gancia G, Zilibotti F. (2012) Competing engines of growth: Innovation and standardization. Journal of Economic Theory, 147. https://doi.org/10.1016/j.jet.2010.09.001.
9. Datla D, Bush S F, Hasan S M. (2015) Innovation and Standardization: Oxymoron or Pleonasm. IEEE Journal on Selected Areas in Communications, 33:703–710. https://doi.org/10.1109/JSAC.2015.2393473.
10. Mcadam R, Galloway A. (2005) Enterprise resource planning and organisational innovation: a management perspective. Industrial Management & Data Systems, 105:280–290. https://doi.org/10.1108/02635570510590110.
11. Mijiyawa A G. (2017) Drivers of Structural Transformation: The Case of the Manufacturing Sector in Africa. World Development, 99: 141–159. https://doi.org/10.1016/j.worlddev.2017.07.007.