

PAPER • OPEN ACCESS

Research on the strategic framework and path design of Global energy interconnection standardization

To cite this article: Yun Li *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **295** 052014

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the **collection** - download the first chapter of every title for free.

Research on the strategic framework and path design of Global energy interconnection standardization

LI Yun¹, ZHAO Wenhui¹, GAO Yongfeng¹, LI Zhen²

¹China National Institute of Standardization, Haidian District, Beijing 100191, China;

²School of Economics and Management, North China Electric Power University, Changping District, Beijing 102206, China

liyun1@cnis.gov.cn

Abstract. As the main way of global energy supply in the future, the global energy interconnection will bring great impact on economic and social development. In order to give full play to the role of standardization, determine the specific implementation plan, and realize the overall strategy and deployment of the long-term goal of global energy Internet, this paper first summarizes the formulation and status of the strategic planning of the international standardization organization. By referring to the experience of international Organization, global energy interconnection's strategic framework in the field of international energy standardization was constructed, and the path to realize global energy interconnection standardization strategy was designed. Finally, based on the future development of global energy Internet, this paper puts forward the proposal of standardized strategic planning.

1. Introduction

Energy, like air, water and food, is the basic resource on which human beings depend on survival. Today, the earth has been 4.6 billion years old. But the large-scale development and use of fossil energy has been less than 300 years, it has been faced with three major challenges: energy depletion, environmental pollution and climate change. The utilization of renewable energy such as wind energy, solar energy and nuclear energy, as well as technologies such as distributed power supply, ultra-high voltage power transmission, large-scale energy storage and electric vehicles have mushroomed rapidly. The industrial model based on crude and inefficient utilization of fossil fuels laid in the second industrial revolution is approaching the end point [1]. In this context, the Global Energy Interconnection (GEI) as the core of the third industrial revolution will have a great impact on the economic development mode and lifestyle of human society, and GEI will become the main way and inevitable trend of global energy supply in the future [2]. GEI is an unprecedented cross-border, cross-field, cross-professional super complex engineering.

At present, a large number of literatures have studied the GEI standard system. Literature [4] constructed the energy Internet standard system by referring to the three-dimensional architecture based on FICC hierarchical system models proposed by IEC smart grid thematic standard committee (SG3). Literature [5] constructed the hierarchy and system table of GEI standard system according to the four aspects of smart grid, UHV transmission, clean energy and grid interconnection. Literature [6-8] analyzed and studied the energy Internet standard system from the perspectives of information communication, UHV and unified labeling. Literature [9] starts from the technical context of global energy Internet and the demand analysis of standard internationalization, studies the general idea and



specific implementation and deployment of standard internationalization. Existing work on the study of global energy Internet standards, mainly concentrated in the standard system construction, and key problems of standard internationalization, for the global energy standardization strategy research has been conducted, the Internet has failed to put forward to fully mix the current environment of targeted, forward-looking and operability of path [10-15].

This paper discusses the formulation and implementation of the strategies of major international standards bodies of the field of energy. On the one hand, the strategic positioning of GEI in the field of international energy standardization can be established, and the existing problems and gaps can be clarified. On the other hand, it has strong theoretical and practical significance for constructing GEI standardization strategic framework. Draw lessons from the mature experience of international organizations, construct the strategic framework of GEI standardization, and design the path to realize GEI standardization strategy, so as to lay a solid foundation for the work of GEI standardization.

2. Standardization strategy for international reference

Today's scientific and technological progress as well as the continuous development of economic society, and the theme of standards of constant change. In order to strengthen international trade with goods and services, ensure sustainable development and equitable economic growth, enhance innovation capacity and protect health, safety and the environment, and develop high-quality voluntary international standards, the ISO constantly adjusts its development strategy. On the one hand, the strategic focus on ISO, IEC and ITU is to solve the common challenges in the development of global standardization. On the other hand, according to the characteristics of their own institutions, they show their attention to different strategic areas. At present, the development of international standards organizations of greater influence has a history of nearly one hundred years or more. Therefore, the standardization of global energy Internet can be widely recognized by the international community and has a certain international influence, which needs to be accumulated and precipitated over a period of time.

With the development of technology and society, as well as the emergence of new standardization organizations such as industry alliance, ISO, IEC and ITU are facing new development needs and higher challenges. In order to solve the current and future major problems, the three major international standards organizations have constantly updated their strategic plans according to their own work areas. Through in-depth study of the standardization strategies of the three international organizations, ISO, IEC and ITU, this paper aims to provide guarantee of the sustainability and development of GEI standardization development research.

In order to more effectively to expand their influence of international standardization activities and consolidate their leadership, ISO, IEC and ITU did not blindly pursue the expansion of the number of standards and speed up the formulation of standards; Instead, the voluntary international standards should be developed to better reflect the principle of consensus. The standards should have clear market demands and keep pace of technological progress and social development. With the development of the world economy, science and technology globalization, the governance bodies of the global standardization system also show the trend of diversified development. The development of BBS, association (alliance) and other organizational forms and the constant expansion of their influence bring huge challenges to the traditional standardization organizations. In order to make full use of the existing resources, shorten the standardisation period and maintain the coordination and consistency among international standards, ISO, IEC and ITU have proposed the goal of strengthening the cooperation among the three organizations and with other organizations of different types in their respective development strategies. With the development of economy and technology, the three standard organizations will not only continue to strengthen their dominant position in their respective fields, but also further to expand new areas of standardization work. Therefore, the boundary of fields among ISO, IEC and ITU will be weakened, and competition and cooperation will coexist.

3. GEI Standardized strategic framework

For a rising China, its voice, leadership and leadership in various industries in the field of international standards are weak, and it always plays a role as a participant in the work of international standards, which is not commensurate with China's growing influence. Therefore, in order to promote the development of global energy Internet strategy, it is necessary to carry out strategic layout of its standard field. In order to lead and lead the development of the industry, the global energy Internet should take a self-developed route, strengthen communication and cooperation with other organizations, and constantly update and adjust the standardization strategy to adapt to the actual development needs.

Although state grid corporation of China has accumulated rich experience in the field of international standards, it has participated in the research and preparation of standards as an enterprise in other international standards organizations. As a newly established international organization, the cooperative organization lacks experience in standard work. Therefore, the cooperative organizations lack experience in the construction of international standard platforms, including the establishment of institutions, articles of association, policies, regulations and information platforms, etc. Due to the differences of strategic objectives and member units, relevant experience of other international organizations cannot be fully used for reference. At the same time, institutions, articles of association and laws and regulations have a great impact on the follow-up work of international standards, including attracting members to join, set up standards, formulating and issuing standards; On the other hand, the partner organization lacks the operational experience of a standard organization. At present, other famous international standard organizations have experienced a long period of development, some of them have experienced hundreds of years of development, and their standard organization operation mode have been very mature. The operation mode of the standard organization has a direct impact on the enthusiasm for the member units, the working efficiency of the standard and the quality of the standard. Therefore, the lack of experience in the construction and operation of the standard platform is the shortcoming of the current international standard work of the cooperative organizations. Based on this, the strategic framework of global energy Internet standardization constructed in this paper is considered from four aspects including strategic positioning, development goals, supporting system and participants. The strategic framework is guided by the promotion of global energy interconnection, centering on the construction of standardization, based on the participation of global power grid enterprises, and improving the supporting system, so as to achieve the goal of internationalization of global energy Internet standards.

(1) Strategic positioning

Strategic positioning is the basis for the formulation and implementation of the global energy Internet standardization strategy. Standardization strategy is related to the published standards of inheritance and concise, the published planning is the rudiment of standardization strategy, global energy Internet standardization strategic positioning, planning related special should be concise in strategic points, at the same time of using the experience of related special planning, based on the whole, emphasize integration, in autonomous mode to carry out the international standard work, highlight the strategic goal leading role to lead the direction of standardized enterprise. Therefore, the strategic positioning is based on clear global energy Internet development in the future the main line, clarify the relationship between standardization strategy and strong smart grid, the international standardization is the core of the strategy, should not only pay attention to participate in the development of international standards, also should establish meet the connectivity platform dedicated to international standard system, the design of global energy at the top of the Internet and technology guide, promote the healthy development of the Internet, global energy for global energy power, interconnection, energy security and project the ground, the respect such as economic and trade exchanges to form a strong technical support; We should pay attention to the coordination between standards and research and development, attach great importance to improving the initiative of the industry, and take further measures to strengthen the coordination between the industrial technology innovation system and the standardization system. Pay attention to the market adaptability of standards,

so that standards can effectively reflect the needs of the market and be effectively implemented in the development of global energy Internet.

(2) Development goals

The development goal is the expected effect of the global energy Internet and the starting point and foothold in standardization. Global energy Internet standardization strategy target, is to establish the GEI cooperation organization independent leading standards set by the coordination with the coordinated development of the international organization of standardization, form a complete set of new standard system, improve the unified coordination and operation efficiency, standardization organization and the international organization for standardization work standardization management mechanism, the formation of guided by GEI organization, market driven, countries to participate in and promote the standardization of work pattern, promote standardization has become an important support to promote the development of global energy Internet.

At the present stage, the global power grid interconnection technology system is gradually taking shape, and standards are urgently needed in such technical fields as UHV ac/dc hybrid, large-scale energy storage, new type power transmission and integration of three (special) networks. Under the global energy Internet, various transmission technology standards, dispatching operation standards and new energy allocation and absorption standards need to be unified, and some of the standards need to be revised and improved. Therefore, the strategic objectives of the global energy Internet are decomposed, including the unification of the standard system, the improvement in technical specifications and the promotion of the global market. First, we will release cost-effective, efficient and flexible standards and services to speed up the development of technical standards for wind, photovoltaic, solar and oceanographic power generation, and wind, solar and other clean energy power generation technologies. We will improve the construction of UHV ac and dc standard systems, and solve the problems of formulating and unifying standards for technology, dispatching and operation, and new energy allocation. Secondly, it predicts future market, social and environmental trends, integrates innovation and new technology factors, and continuously improves technological research and development specifications, equipment manufacturing specifications, demonstration application specifications and construction and operation specifications. In addition, the key role of Chinese standards of the construction of global energy Internet should be given full play, so that the overall level of standardization will reach the advanced level in the world, and the energy technology standards of some advantageous fields will take the leading position in the world, and become a standard power leading the development of international standardization.

(3) Support system

Standardization should be full of vitality. The global energy Internet standardization strategy should include comprehensive innovation activities in standardized system and mechanism innovation, standardized management process innovation, standardized research method innovation, standardized talent training innovation and other aspects. Support system refers to the institutional innovation that supports the standardization of global energy Internet. System and mechanism construction is the fundamental guarantee for the implementation of standardization strategy and the driving force for promoting the standardization of global energy Internet. The supporting system covers the establishment of organizations, the design of system norms and the construction of information platforms. Institutions set up and the establishment of the job specification is the guarantee of effective management, the implementation of the global energy Internet standardization strategy should be based on principles of "independent, participating", establishing an authoritative, normalized institution as a whole, at the same time establish efficient organization mechanism, evaluation and feedback mechanism, etc., as the global energy the development of the Internet to provide guarantee, guidance, management, supervision and coordination. In addition, the construction of a global energy Internet standardized service information platform is an important technical guarantee, which can effectively to reduce the cost of information communication, expand the scope of application of standards, and realize the openness and transparency of information.

(4) Participants

Participants are participants in the development of the global energy Internet. It includes organizers and participants in global energy Internet standards. Among them, the organizer builds a standard management organization and a standard operation platform to form the standards, rules, policies and procedures of international standard work, organizes members and relevant enterprises who are willing to participate in the standard work, and carries out a series of international standard activities such as the proposal, project establishment, compilation, voting and release of standards. Participants refer to countries, enterprises, scientific research institutions and individuals involved in the formulation of relevant standards through working groups, technical committees and other means. While participating in the work of international standards, these participants will also formulate and release national standards, industry standards, group standards and enterprise standards. In the process of standardization, exchanges and cooperation among international organizations, research institutions and enterprises should be strengthened to build consensus and form synergy so as to realize the global energy Internet standardization strategy and the global clean and green energy transformation.

4. GEI standardized path design

This paper presents a road map covering the three dimensions of the global energy Internet development time cycle, standardization strategic elements and corresponding standardization work contents, as shown in figure 2. The horizontal axis of the standardized strategic roadmap is the development cycle of the global energy Internet, which is divided into the initial stage, rapid development stage and mature stage according to the product life cycle (introduction stage, growth stage, maturity stage and decline stage). Standardization strategy map's longitudinal axis, it is standardization strategic elements, including the top design, the standard development, the implementation of the system, technical institutions and five supporting elements such as talent cultivation, and different development stages of strategic elements to cooperate with each other, work together, constitute the current global energy body content standardization strategy map from the Internet.

The global energy Internet standardization strategy can be divided into three stages: initial stage, rapid development and maturity stage. In the initial stage, the standards organization are driven by a wide range of global issues, and led and participated by the GEI cooperation organization. We will focus on the top-level design of global energy Internet standardization, the formulation and release of core standards, and the development of information platforms and teams. In the stage of rapid development, the operation of the standard organization tends to be mature, and countries take the initiative to join the standard organization. We will focus on developing and improving standards, promote the application of standards, build a strong influence, and establish effective cooperation with international standards organizations. In the promotion stage, the standards organization further promotes the application scope of the standards of publicity; The focus is to build a world-class international standards organization of greater influence on the global energy and power sector.

(1) Top-level designs.

For the standardization of global energy Internet, the global energy Internet cooperation organization should carry out the top-level design of standardization. In the initial stage, in order to guide the industry standard and orderly development, the cooperative organization should start to develop the overall plan and layout of the industry standardization, focus more on the macro level, and formulate the overall plan of the global energy Internet standardization. In the stage of rapid development, the GEI cooperation organization can formulate specific standardization action plan according to the overall planning layout of the early stage, and plan the formulation and revision of specific standards of global energy Internet and the implementation of specific work in the future.

(2) Standard development.

In the initial stage, the development of standards should take enterprises as the core and realize the connection and coordinated development of standards for the upstream and downstream of the industrial chain. In the stage of rapid development of global energy Internet, the formulation of standards should be issue-oriented, aiming at the content of key areas to formulate national standards,

fully reflect the needs of the market, and actively participate in the formulation of international standards; In the mature stage of global energy Internet development, the industrial standard system should be summarized and refined based on the revision of industrial standards. This work should be led by cooperative organizations and supported by industrial technical institutions. In addition, international standards should be given priority wherever possible.

(3) Implementation system. The implementation system includes not only the implementation of standards at all levels, but also the implementation and implementation of policy planning, standard system and other aspects of global energy Internet standardization. Mainly includes the support system construction, the authentication accreditation, the policy support and the demonstration pilot several aspects. In the initial stage, we will focus on building a global energy Internet support system. In the stage of rapid development, a large number of standard systems are gradually established. On this basis, the applicability of the standards should be recognized and certified by the third-party technical institutions according to the standards to guide the orderly development. In the mature stage, summarize the standardization work experience of pilot enterprises in time, and organize the promotion and application of pilot experience in the industry.

(4) Technical institutions. In the early stage of industry development, for the global energy Internet, due to the characteristics of the industry "cross-border", it is difficult to establish a unified coordination of the global energy Internet standardization of professional technical institutions, therefore, only the establishment of standardized technology focus, standards coordination organization. In the stage of rapid development, standardization work should pay attention to the communication and coordination between each bid committee, otherwise there will be problems such as overlapping standards. In the mature stage of global energy Internet development, it is possible to gradually consider providing various standardized technical services such as standardization situation research, standard development, policy formulation and standardization implementation for industry organizations, associations and government management departments.

(5) Personnel training. In the whole life cycle of industry development, the initial stage should be the introduction to standardization concept and knowledge system for industry talents; Standardization work is based on practice, and at the stage of rapid development, it is advisable to strengthen the training of standardized knowledge and accomplishment for industry practitioners, so as to make them become "industry experts + standardized" compound talents. In the mature stage of global energy Internet development, it is necessary to focus on building an expert pool of global energy Internet standardization talents to serve the formulation of various government policies and plans and the revision of standards, so as to improve the level of global energy Internet standardization.

5. Conclusion

The formulation of the global energy Internet standardization strategy should be combined with the actual economic and social development of China, and the development models and ideas of the international organization for standardization should be fully used for reference. Efforts should be made in leading the development of the industry, promoting standard innovation and industrial innovation, and making it feasible. The Internet to build up the global standardization organization structure, innovation, global energy Internet standardization strategy, standardization strategy of continuous improvement mechanism, pay attention to keep the strategic environment sensitivity, focus on the global energy international Internet layout changes, regularly or irregularly to evaluate standardization strategy, realize the dynamic adjustment of strategic countermeasures. It will help us to have a say in the construction and development of the global energy Internet, seize the strategic height of the commanding height of the global energy Internet standards, comprehensively enhance the ability of standards to serve the development of energy, promote international cooperation in energy standards, and enhance China's international strategy.

Acknowledgments

This paper is supported by “State grid corporation of China Technology projects” (Grant No. 521104180012) and “Study on the mechanism construction of association standardization good behavior evaluation project” (Grant No. 572016B-4938).

References

- [1] Zhenya L. Global Energy Interconnection. China electric power press, 2015 (in Chinese)
- [2] Zhenya L. Research of Global Clean Energy Resource and Power Grid Interconnection [J]. Proceedings of the CSEE, 2016, 36(19):5103-5110 (in Chinese)
- [3] Junhua M, Dongxia Z, et al. Study on Standard Framework of Energy Internet [J]. Power System Technology, 2015, 39(11):3035-3039
- [4] Jing Z, Bin L, et al. Study on Standard System for Global Energy Interconnection [J]. Power System Technology, 2017, 41(7):2055-2063
- [5] Pengfei Z, Yun L, et al. Standard System Framework of Information and Communication Technology for Global Energy Interconnection [J]. Smart Grid, 2016, 4(9):851-856.
- [6] Qian S, Ye Y, et al. Status Analyses on Standard System of UHV Transmission for Global Energy Interconnection [J]. Distribution & Utilization, 2017, 34(9):14-19.
- [7] Yu L, Yeping F, et al. Research On Unified Standard System Of global Energy Internet [J]. Microcomputer Applications, 2017, 33(10):51-55.
- [8] Zhiyuan G, Yang C, et al. Study on the Internationalization of Global Energy Interconnection Standards [J]. Electric Power, 2017, 50(11):42-47.
- [9] Bin Li, Q W, et al. Research of the Methodology of Global Energy Interconnection Standardization [J]. Electric Power Information Technology, 2017(3):1-6.
- [10] Zhaoyang D, Junhua Z, et al. From Smart Grid to Energy Internet: Basic Concept and Research Framework [J]. Automation of Electric Power Systems, 2014, 38(15):1-11.
- [11] Tian S, Luan W, Zhang D, et al. Technical forms and key technologies on energy internet [J]. Proceedings of the Csee, 2015, 35(14):3482-3494.
- [12] Yabing Z, Tao Z, et al. Analysis of energy internet key technologies [J]. SCIENTIA SINICA Informationis, 2014, 44(6):702-713.
- [13] Zhao M, Xiaoxin Z, et al. Exploring the Concept, Key Technologies and Development Model of Energy Internet [J]. Power System Technology, 2015, 39(11):3014-3022.
- [14] IEEE B E. IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads [C] // IEEE Std. IEEE, 2011:1-126.
- [15] Dong Z, Zhao J, Wen F, et al. From smart grid to energy internet: Basic concept and research framework. Automation of Electric Power Systems, 2014, 38(15):1-11.