Regional Energy Internet Construction Framework and Key Tasks

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Abstract. Based on the strategic needs of the State Grid Corporation of China in building regional energy Internet, this paper carries out study from the following points: first, analyzing the connotation and characteristics of regional energy Internet; second, building the “three systems” structure of regional energy Interest construction; last, defining the key tasks of regional energy Internet construction from three aspects: infrastructure, technological innovation and market mechanism.

1. Introduction

On January 17, 2019, the Fourth Meeting of the Third State Grid Corporation of China Worker’s Congress and 2019 Working Conference proposed to focus on building a world-class energy Internet enterprise, be upright and keep innovation, responsible and do something, build a “hub, platform and sharing” enterprise, build and operate “strong and smart grid, ubiquitous power Internet of Things”, namely, the development strategy of “three types and two networks”. This strategy reflects that the power system is gradually developing towards the direction of energy Internet characterized by “horizontal synthetic utilization of multiple fossil fuels, vertical source-network-load-storage coordination, which is a major strategic deployment for the State Grid Corporation of China to transfer into an energy Internet enterprise[1-2].

Currently, there are three ways of understanding about the energy: first, the information network is positioned to guide the way of energy network scheduling, to assist the internet in information collection and processing, and to serve as the decision-making network of energy internet [3-4]. Second, energy Internet is regarded as an open architecture that can fully integrate information and communication systems, and becomes a new energy network with large power grid and LAN characteristics [5-7]. Third, energy and Internet are organically combined to realize the efficient use of the network of two-way flow of energy and information with users[8-9].

The change of energy technology is related to the progress and development of other industrial levels, which will have a far-reaching impact on the mode of social production and the mode of people’s electricity consumption, therefore, all countries have invested a lot of money and manpower in carrying out in-depth research on energy internet [10]. In such a context, by combining with the development of energy and power in China, this paper puts forward the overall framework and technical framework of regional energy Internet, and details the key tasks in infrastructure, technological innovation and market mechanism, so as to provide reference and support for the State Grid Corporation of China to implement the major strategic deployment of “three types and two networks”.
2. Connotation of Regional Energy Internet
As for electric power enterprises, energy Internet is a new energy supply system with power system as the core and link, highly integration of multi-type energy network and transportation network and transportation network and characterized by “horizontal multi-energy complement and vertical optimal allocation”, two-way flow of energy flow and information flow. “Horizontal multi-energy complement” refers to, by means of the Internet and based on the historical and real-time transaction data, make intelligent analysis on the supply characteristic of different energy sources and the demand characteristics of energy-using objects in order to realize the optimized and complementary supply of energy across energy categories, and achieve the economical, efficient and safe utilization of energy; “vertical optimal allocation” is to achieve a high integration of energy flow, information flow and business flow through advanced automatic control, information communication, data analysis and other technologies in each energy network with respective to links, such as production, trade, transportation, storage, sales and energy use, so as to support the optimization of vertical energy operation and improve the level of resource allocation.

Regional energy Internet is centered on electricity, based on strong and smart grid and supported by ubiquitous power Internet of Things, which deeply integrates advanced energy technology, modern information communication technology and control technology to realize a smart energy network featuring multi-energy complement, intelligent interactions and ubiquitous interconnection. It is a new value creation platform and ecological system that is fully connected with the total elements, the whole production chain and the whole value chain in the energy field, and is also the concrete realization form of industrial Internet in the energy field.

3. Construction Framework of Regional Energy Internet
At present, the State Grid Corporation of China has put forward a three-layer structure for the construction of ubiquitous power Internet of Things, namely, the physical base layer carrying energy infrastructure, the information integration layer gathering intelligent Internet of Things centre, data middle-office, business middle-office and artificial intelligence middle-office, and carrying out the internal and external business application practice layer. Based on the current forward-looking theoretical research results of energy Internet and overall consideration of China’s energy and electric power development, this paper proposes the concept of “three-function system” for regional energy Internet construction, breaks down the professional information barriers and support the construction and operation of the “three-function system” through the reconstruction and reinforcement of “three-layer structure”.

“Three-function system” is an energy supply system centering on optimal resource allocation, as well as an asset management system centering on safety benefits and a modern service system centering on customers. The coordination and cooperation of “three-layer structure” is further achieved through the running and promoting of “three-function system”. The specific functional system is as follows.

![Figure 1. Three-function system.](image-url)
3.1. Energy supply system centering on optimal resource allocation
The energy supply system focuses on the energy industry and runs through the whole process of energy production, conversion, storage, transportation and consumption, so as to realize optimal allocation of energy resources and comprehensive improvement of energy efficiency. With respect to building an energy supply system, on the one hand, it needs to make full use of the spatial-temporal distribution characteristics and complementary coupling characteristics of various energy sources to achieve the overall balance between the supply and demand of such energy sources. On the other hand, it needs to give fully play to the role of power grid which serves as a hub for energy collection, transmission, conversion and utilization, and promote efficient conversion between electricity, cold, heat and other energy sources, realize interconnection.

3.2. Asset management system centering on safety benefits
The asset management system targets at internal network operation, and optimizes the internal efficiency of regional energy Internet through efficient management and value exploration of grid assets and data assets. It aims to establish an asset management system, coordinate the investment, construction, operation and maintenance of grid assets and data assets. With respect to grid assets, it focuses on solving the “block management” problems of traditional asset management in planning, inspection, materials, finance and other departments, builds a closed loop management system of whole asset life cycle to achieve a comprehensive optimization of risk, efficiency and cost; with respect to data assets.

3.3. Modern service system centering on customer
The modern service system is oriented to the whole society and centers on customer, which takes the”drainage + empowerment” as means to create and share social values. To build a modern customer-centered service system, the key is to build a “one-stop” smart energy platform for customer aggregation, business integration and data sharing. With respect to different customer needs, it builds four service mode: comprehensive energy service mode that provides energy consumers with one-stop energy-using services focusing on customized energy supply; industrial empowerment service mode that provides SMEs with a series of empowerment services including deal matchmaking tradeoff, intelligent procurement and supply chain optimization; the drainage incubation service mode, on the one hand, it introduces the capital, technology and policy support required by the platform construction, on the other hand, it actively explores relevant value points for incubation; the social service mode provides decision-making support and value sharing service, which guides the whole society to create a win-win modern service ecosystem.

4. Key construction task of regional energy Internet
In the construction of regional energy Internet, we should proceed from the actual conditions and clarify the current key tasks. This section makes discussion from the aspects including infrastructure, technological innovation, market mechanism and demonstration projects to clarify the key tasks of regional energy Internet construction, determine the future development direction of regional energy Internet, and give full play to the pivotal role of power grid in energy utilization.

4.1. Infrastructure

4.1.1. Ensuring energy operation safety
It need to give full play to the pivotal role of power grid in energy utilization and to build a safe and reliable smart grid with strong grid structure. Besides, it need to actively response the security risks arising from the substantial increase of external power, the two-way interaction of multiple loads and coordinated operation of multiple energy resources. The key tasks include:
• Expanding energy supply channel and scale.
• Strengthening and improving main grid structure.
• Building a smart distribution network.
• Consolidating the foundation of power grid security defense.

4.1.2. Promoting energy structure transformation
Based on the provincial conditions and energy conditions, give full play to the advantages of clean and convenient electric energy, intensify the introduction of power outside the district, promote the large-scale development of clean energy, promote the coordinate and orderly development of all kinds of energy, facilitate the reform of energy supply side, and promote the transformation of energy structure. The key tasks include:
• Introducing high quality power outside the district.
• Promoting orderly development of clean energy.
• Assisting the optimization of coal power structure in the province.

4.1.3. Building an energy information network
The information development of energy industry has gradually entered a new stage of networking and intelligence. We should improve information sharing platform and carry out unified planning and implementation based on the energy demand of users, so as to provide strong support for the business development of energy users, and lay a good foundation for the future business development of users. The key tasks include:
• Promoting the construction of an energy-aware network.
• Building a high-speed energy communication network.

4.2. Technological Innovation

4.2.1. Strengthening data fusion and access
Realize the “cloud coordination” framework of ubiquitous power Internet of things, establish an Internet of things center, improve the ability of data fusion and access, break down data information barrier, realize the unified access and management of different energy and different business data. The key tasks include:
• Assisting cloud construction of the State Grid of Corporation of China.
• Building an IoT platform.

4.2.2. Improving information processing ability
Build a data management system at the enterprise level, realize the multi-dimensional, whole-process and life-cycle management of the company’s data assets, form a supporting platform focusing on enterprise’s middle office, assist the lightweight asset management and system operation of the company, and achieve the improvement of cross-domain intelligent analysis and application level both inside and outside the company. The key tasks include:
• Creating a data middle office.
• Building a business middle office.
• Building an artificial intelligent middle office.

4.2.3. Strengthening information network security
Deepen the application of situational awareness, cryptographic infrastructure and simulation verification, strengthen the security protection of power monitoring systems and new services, improve the operation and maintenance management system, and strengthen the security defense capabilities of information network. The key tasks include:
• Building a whole-scene network security protection system.
• Strengthening data security protection.
4.2.4. Deepening business lean management
Oriented by “data, grid and business”, break down professional barrier, optimize internal management, promote performance improvement, and promote quality revolution, efficiency revolution and power revolution of the company to realize business collaboration and data sharing, improve the level of digital and online business. The key tasks include:
• Building an intelligent planning system.
• Building a new generation of electric power scheduling system.
• Optimizing and updating coordination of operation and distribution.
• Building a modern (wisdom) supply chain system.
• Building a comprehensive infrastructure platform.
• Continuously promoting power energy substitution.
• Cultivating awareness of energy conservation.

4.2.5. Building a technical standard system
In order to strengthen systematic energy technology management and promote the emergence of new ideas and methods, we should carry out standardized management and establish a technical standard system, it is of great significance for the promotion of energy Internet construction at the present stage. The key tasks include:
• Promoting the standard system construction of energy Internet.
• Building a comprehensive energy efficiency evaluation system.

4.3. Market Mechanism

4.3.1. Establishing a market trading platform
We should establish a unified regional energy market trading platform based on the benefits between the supply and demand side, form a fair and transparent price mechanism, build a customer-centered service system, so as to promote active trading. Meanwhile, we should innovate the operation mode of assets, attract more capital, create and meet regional energy investment and financing needs to make the capital demand side and the supply side match with each other, improve investment efficiency and provide new driving forces for regional economic development. The key tasks include:
• Building a new generation of power trading platform.

4.3.2. Enhancing customer service level
Build an energy Internet ecosystem, build an industry ecosystem, and foster new forms of business by linking internal and external, upstream and downstream resources and demand, give full play to the power grid infrastructure, customers, data, brand and other unique advantages of resources, vigorously cultivate and develop resources commercial operation and other emerging businesses, and strive to enhance customer service level. The key tasks include:
• Establishing a modern service system centering on customer.
• Building an intelligent Internet of Vehicle platform.
• Building a comprehensive energy service platform.
• Building the customer side energy storage cloud network.

4.3.3. Innovating asset operation mode
In order to expand the development channel of energy industry, we should start from the innovation of the operation mechanism of assets, promote the listing of advantageous industries, optimize assets structure, adhere to the concept of marketization, promote the innovation of the operation and management mechanism, and stimulate the market vitality. The key tasks include:
• Carrying out basic resources operation.
• Promoting data appreciation and realization.
5. Conclusions
This paper makes an in-depth study on the connotation of energy Internet, puts forward the “three-function system” for the construction of regional energy Internet and clarifies the key tasks in regional energy Internet construction. The research results can provide reference and support for the State Grid Corporation of China to implement the major strategic deployment of “three types and two networks”, build a regional energy Internet and build new forms of energy services.

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