Research on the Feasible Path of Transformation of Traditional Grid Enterprises to Energy Internet Platform Enterprises

Jianhuang Cai, Yinan Li, Nan Zheng and Jinchun Chen*

Power Economic Research Institute of State Grid Fujian Electric Power Company, Fuzhou, Fujian, 350003, China

*lhchu@ncepu.edu.cn

Abstract. Energy Internet represents the direction of the world's future energy development, is an important means to promote the energy revolution, the traditional power grid enterprises need to adapt to the changes of the energy Internet, accelerate the transformation to the energy Internet platform type enterprise. This paper is based on the system architecture and operation mechanism of the energy Internet, elucidates the changes and characteristics of the transformation and upgrading of the traditional power grid company to the energy Internet enterprise, and puts forward the feasible path of the transformation of power grid enterprises, so as to provide decision-making references for the innovative development of power grid enterprises under the new situation.

Keywords: the Energy Internet Enterprise, the Transformation of Traditional Grid Enterprises, Platform Businesses, the Feasible Path.

1 Introduction

As a new engine of energy digitalization and transformation, energy Internet has become the frontier technology in the field of energy science and technology at home and abroad and an important strategy for national energy development.[1] The development of the power grid to the energy Internet is not only a carrier of power transmission in the traditional sense, but also plays an important role as a platform. Gradually, the grid has been deeply integrated with transportation, buildings and other aspects of production and life, which is not only the network foundation of the energy Internet, but also an important platform to support the development of resource allocation, multi-energy complementarity, subject interaction, energy trading and value-added services.[2] This requires power grid enterprises to come out from the traditional "vertical well" development mode, play the role of the basic platform, and promote the healthy and sustainable development of the energy Internet industry with the concept of building, sharing and win-win.[3] From the characteristics and operation mechanism of the energy Internet itself, this paper clarifies the characteristics of the transformation of traditional power grid enterprises into energy Internet platform enterprises, and then proposes a feasible

A. E. Abomohra et al. (eds.), *Proceedings of the 2023 9th International Conference on Advances in Energy Resources and Environment Engineering (ICAESEE 2023)*, Atlantis Highlights in Engineering 29,
https://doi.org/10.2991/978-94-6463-415-0_93

path for the transformation of traditional power grid enterprises, which is of great significance to the realization of high-quality sustainable development of power grid companies and the promotion of the construction of a new type of electric power system.[4]

2 The system architecture and operation mechanism of the energy Internet

2.1 System architecture

Energy system is characterized by intensive capital, manpower and technology, and there is huge development inertia.[5] As a next-generation energy system, the architecture of the Internet of Energy must be based on the existing architecture, and solve the multilevel and multifaceted problems faced by the energy system through stock upgrading and incremental replacement.

The energy system can be deconstructed in three dimensions: geographically as shown in Figure 1. It can be divided into global, national, urban and other layers; in terms of varieties, it can be divided into coal, oil, gas, electricity, heat and other energy varieties; and hierarchically, it can be divided into the physical layer, the information layer and the application layer.[6] The physical layer includes energy production, conversion, transmission, storage and consumption; the information layer includes information collection, transmission, processing and storage; and the application layer includes control and scheduling, value-added services, market trading, energy finance, supervision and management.

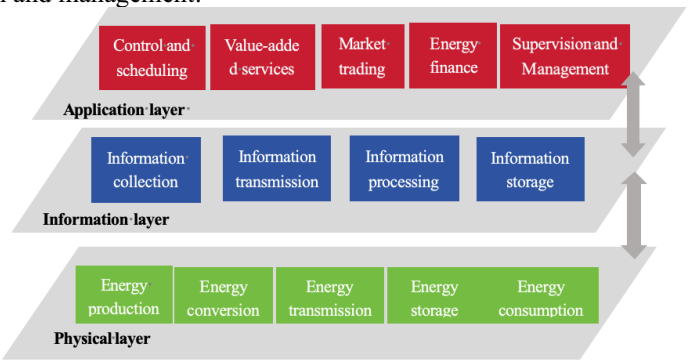

Fig. 1. Hierarchical structure of the energy system

The architecture of the energy Internet has different characteristics from the vertical, horizontal and overall perspectives.

First, it is vertically layered and synergistic, avoiding the transmission of supply and demand imbalances to lower levels and the uploading of fluctuations across levels. The key to solving the problem of high pollution and high emissions is to increase the development of renewable energy to replace fossil energy consumption. Large base and distributed is the main form of development of renewable energy, the former is widely existed in the power generation and consumption difficulties, there is an urgent need to

carry out large-scale large-scale supply and demand matching in the main energy network, to avoid the imbalance of supply and demand to the lower level of conduction; the latter in the system of the bottom layer access, the number of the future growth of a large number of people, will lead to increased fluctuations in the trend or even reverse, the formation of a significant impact on the energy network, the need to be in the distribution network layer or the newly built microgrid layer to be adequately managed to smooth out fluctuations and avoid uploading fluctuations across levels.

Secondly, it is a horizontal multi-link connection, realizing the optimal utilization of multi-species energy.[7] One of the main ways to solve the problem of low quality and low efficiency is to carry out multi-energy complementation. On the one hand, a variety of energy through efficient conversion devices can be used as a backup for each other, thus effectively avoiding the interruption of energy supply and improving the quality of energy supply; on the other hand, different energy sources have different characteristics, and through the characteristics of the complementary can effectively improve the efficiency of comprehensive energy utilization.

Thirdly, the deep integration of physical information applications will support the intelligence of the future energy system. In the energy system, the physical layer is the carrier of energy flow, the application layer is a collection of various types of control, management and service, and the information layer makes the physical layer and the application layer connected through information.

2.2 Operation Mechanism

The operation of the energy Internet will be customer-centered and smarter, which is specifically manifested in predictability and self-evolution, i.e., predicting changes in supply and demand, and efficiently meeting user needs through self-evolution, as shown in the Figure 2.

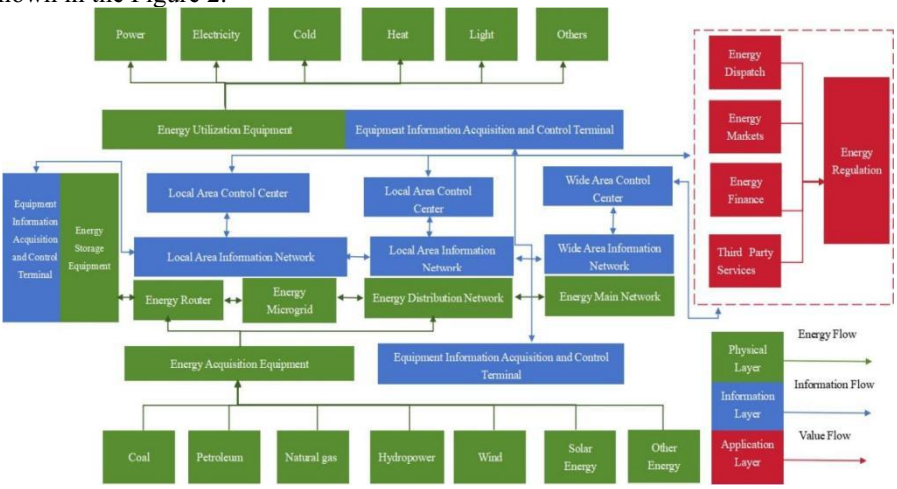

Fig. 2. Basic shape of the energy internet

In the operation of the energy Internet, big data gives the ability to predict, the market determines the allocation method, and multi-energy complementary and source-grid-load-storage coordination are the specific regulating means.The specific operation principle and connotation of the energy internet.are described in the Table 1.

Table 1. Operational principles and specific connotations of the energy internet.

Operating principles	Specific connotations
Big data-driven	Extensively exploiting the value of latent information and empowering the system with predictive capabilities.
Market leadership	Restore the commodity nature of energy and let the market determine the price of energy, reflecting supply and demand, which in turn determines the type of regulation to be used.
Multi-energy complementarity	According to the characteristics of different energy varieties, mobilizing energy conversion devices to achieve the surplus and deficit of a variety of energy sources to help each other.
Source-network-load-storage coordination	Through the in-depth interaction of the four components of source, network, load and storage, the contradiction between supply and demand can be absorbed and the fluctuation can be smoothed out step by step.

In the energy Internet, when there is an imbalance between the supply and demand of a certain energy source, there are two ways of adjustment, as shown in the Figure 3. First, within the energy subsystem, adjusting the amount of energy produced at the source end or the amount of energy stored/released by the energy storage device, i.e., the vertical source-network-load-storage synergistic adjustment. Second, converting the other energy sources into the required energy sources by the horizontal energy conversion device, i.e., the cross-system complementation of multiple energy sources. Both ways can regulate energy supply and demand, the difference is that the former applies to every node of the energy Internet, while the latter applies only to nodes equipped with horizontal energy conversion devices.

When a node does not have a horizontal energy conversion device, it can only carry out the coordination of the source network, load and storage; if there is a horizontal energy conversion device, it can be based on the price of the two modes of regulation in the market to make a choice, and implement the regulation of the lower cost of the program.

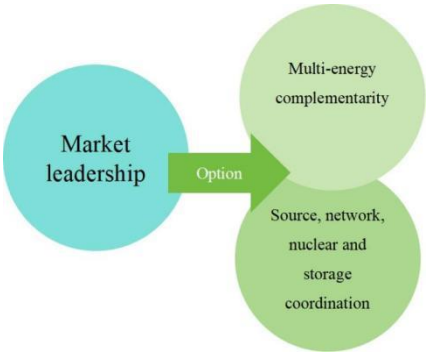

Fig. 3. Regulatory principles of the energy internet.

3 The characteristics of the transformation of traditional power grid enterprises to energy Internet platform-based enterprises

The transformation of the company to an energy Internet platform-based enterprise in the new era needs to be transformed in nine aspects, as shown in the figure 4.

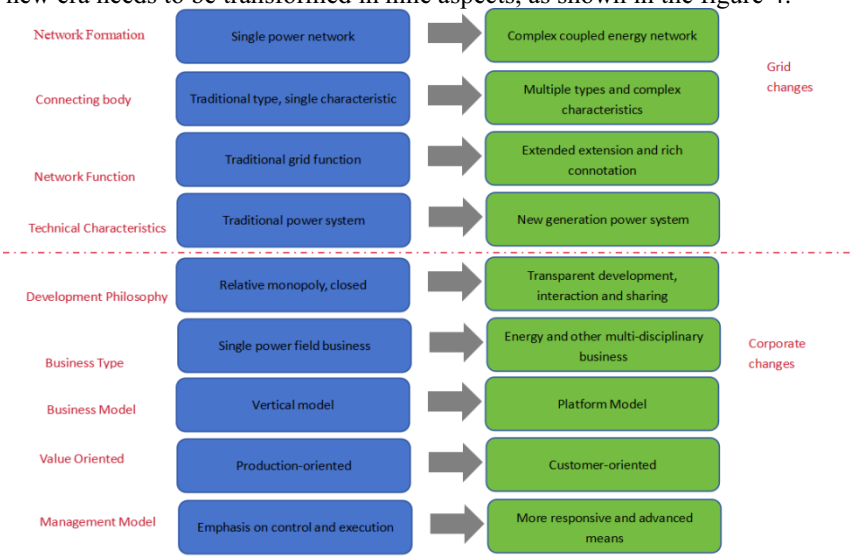

Fig. 4. Nine changes between energy internet companies and traditional grid companies.

(1) Network form, from the traditional single power network to the complex coupling of energy network form. Overall network form, from a single power network to multi-network integration change.[8] To transmission, transformation, distribution, use of electricity in the form of a traditional single power network, gradually upgraded and

developed into a power network as the basis and core, the Internet of Things, transportation networks, information and communication networks, and even heat networks, gas networks, hydrogen energy networks and other energy networks superimposed on the fusion.

(2) The main body of the connection, from the traditional type, single characteristics to the type of diversified, complex characteristics of the transformation. The main body of energy, from traditional fossil energy to a high proportion of clean energy. Higher proportion of clean energy, energy utilization efficiency (natural gas cooling, heating and power cogeneration, cogeneration), the use of clean energy to the cluster and distributed development direction.

(3) In terms of platform functions, the functional extension has been further expanded and the functional connotation has become richer. Transformation from traditional fossil energy development platform to clean energy development platform, as shown in the figure 5. Clean energy is mainly transformed into electricity to be developed and utilized through the power grid, and the power grid has become the most important development platform for clean energy. Transformation from a traditional energy allocation platform to a comprehensive energy allocation platform, with gradual expansion of the allocation scale, more diversified allocation targets and more flexible allocation methods.

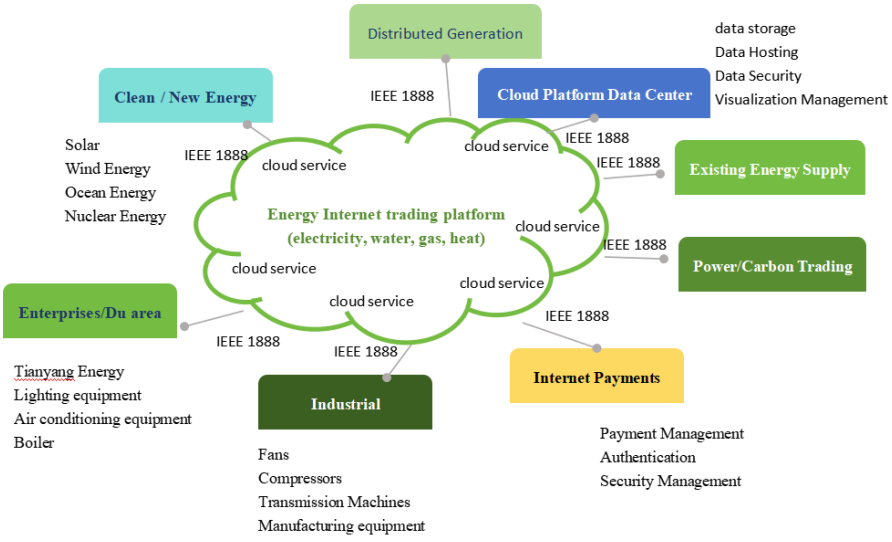

Fig. 5. Energy Internet trading platform.

(4) In terms of technological characteristics, there is a shift from traditional power systems to new types of power systems. In terms of technical requirements, it has transformed from mainly grid technology to the cross-fertilization of energy, information, materials and other multi-disciplinary technologies.

4 The traditional power grid enterprises to the energy Internet platform type enterprise transformation path

Overall, under the general trend of energy clean low-carbon transformation, accelerated construction of new power systems and rapid development of the new Internet economy, the function of the power grid is gradually upgraded comprehensively, requiring the power grid company to comprehensively enhance the ability to allocate energy resources, service users, and business innovation, etc.

First, to create an energy configuration platform, to achieve comprehensive configuration of multiple energy sources and source-network-load-storage multi-energy complementary, and to promote the optimal allocation of energy and power resources in a wide range.

Secondly, to create an energy market trading platform, play the leading role of the market, and build an effectively competitive market system.[9] The power grid is both the carrier of energy transmission and configuration, and a platform for market transactions, and the construction of a large market must give full play to the important role of the market in the optimal allocation of energy resources.

Thirdly, to build a comprehensive service platform, to realize operational efficiency improvement and service upgrading, and to provide comprehensive services for users.[10] The connotation of the integrated service platform includes 2 aspects, ① internally to realize operational efficiency improvement. To promote the optimization of grid business, efficient data integration and comprehensive business integration, and to improve the operational efficiency of grid business and customer service quality. ②Externally, to realize the upgrading of service quality. Based on the big data platform, digging new business models, generating new service models, realizing efficient service docking, ubiquitous objects, digitization, content diversification, and convenient processes, and realizing the transformation of service varieties from a single power supply service to a comprehensive energy service.

Fourth, to create an industry innovation support platform. Converge the main bodies and resources of the industry chain to create the ecological value of the energy Internet industry. Through technological innovation, business innovation and business model innovation, the whole chain of subjects and resources are aggregated, and energy producers, transporters, consumers, equipment vendors and service providers are brought together on a unified platform in the way of "innovation drive + network effect + ecosystem" to create a value creation platform for the Internet of Energy.

5 Conclusion

The transformation of the company to an energy Internet platform-type enterprise in the new era needs to be transformed from strategic adjustment, management mode, grid upgrading, technological change, business transformation, value orientation and other dimensions, to create an energy allocation platform, to promote the traditional grid company to the convergence of various types of resources, to create a trading platform

for the energy market, to play a leading role in the market, and to create a comprehensive service platform, to achieve operational efficiency and service upgrading. Together, we will promote the overall improvement of the grid company's ability in energy resource allocation, service users, and business innovation, and promote the transformation of traditional grid enterprises into a basic platform for energy Internet with supply and demand docking, element reorganization, and integration and innovation.

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