Research on the Market Pattern and Evolution of Integrated Energy Service Market in the Commercial Ecology of Ubiquitous Power Internet of Things

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Abstract. The introduction of UPIoT (Ubiquitous Power Internet of Things) has brought new opportunities and challenges to the entire energy production industry, and also brought new development space for the IES (integrated energy services) market. This paper analyzes the commercial ecosystem of the UPIoT, based on its core technology architecture and the intrinsic association between UPIoT and IES. This paper also analyzes the pattern of the integrated energy service market, classifies the main body of the integrated energy service market, studies different types of IES market competition and the evolution path of market development.

1. Introduction
UPIoT is the second network in the "three-type two networks" strategy proposed by State Grid Corporation of China. UPIoT will realize the interconnection of things and the interaction between human and computer with the technology of big data, cloud computing, internet of things and artificial intelligence[1]. UPIoT will combine different enterprises, users, manufacturers, Internet companies, research institutes, financial companies and other entities in the process of power transmission, power distribution and power consumption, and lead them to form a mutually beneficial and win-win energy ecosystem[2], which will promote the overall mode of operation of the energy industry to the direction of the commercial ecological collaborative evolution and development.

IES is an important business form and emerging market of UPIoT, which contains two layers of "integrated energy" and "integrated service". IES help to open up barriers between different energy subsystems, improve the efficiency of energy integrated use, promote interaction between enterprises in different industries, and meet the diversify needs of end-users.

It can be said that there is profound internal combination between UPIoT and IES, that UPIoT provides technical support and ecological foundation for the development of IES, and IES provides a figurative application scenario for the construction and implementation of UPIoT.

2. The connotation and characteristics of UPIoT
From a technical point of view, the core technology architecture of UPIoT includes four layers, as perception layer, network layer, platform layer and application layer, as shown in Figure 1.

Perception Layer: making use of various intelligent measurement devices to fully realize the state perception, measurement transfer, environmental monitoring and behavior tracking of power source, power net, loads and users in each and every program of power generation, transformation and consumption, to provide the massive data basis for the Network Layer and Platform Layer.
Network Layer: Using The Internet of Things technology and wireless communication technology to access the data and information of the perceptual layer, and uses of light network technology and Internet technology to transmit standardized information to the Platform Layer.

Platform Layer: using massive joint management, open sharing data governance, high-performance intelligent analysis and other core technologies to achieve data information allocation and asset management and to provide data basis for all kinds of applications.

Application Layer: building standard data source, power net information and business line for power company, and providing IES, Internet financial service and Virtual power plant application for market.

3. The commercial ecosystem of UPIoT based on technology architecture
The commercial ecosystem of UPIoT is an economic joint organism, based on its core technology structure, and composed by governments, related enterprises, organizations and individuals. The commercial ecosystem of UPIoT can enhance the allocation of factor resources by opening up all kinds of main business flow, information flow and capital flow. The commercial ecosystem of UPIoT can also promote the further development of all kinds of market subjects in the environment of mutual benefit and win-win with low marginal effect, and realize the circular business system of overall horizontal expansion and vertical deepening.

As shown in Figure 2, the concept of a commercial ecosystem can be deconstructed into four parts[3]: core subsystem, support environment subsystem, social and natural environment subsystem, and customer subsystem.

The core sub-ecosystem is the creator and undertaker of all kinds of business in UPIoT ecology, and is the key link to ensure business flow, information flow and capital flow in UPIoT, mainly composed of enterprises of various kinds of energy and related industries.

The customer sub-ecosystem is the starting point and focus of UPIoT business flow, information flow and capital flow, and is the foundation of the survival and sustainable development of the UPIoT commercial ecosystem. The customer sub-ecosystem is mainly composed of all kinds of end energy consumers in UPIoT, including industrial enterprise users, large building users, residential users, transportation energy users.
The supporting environmental sub-ecosystems provides theoretical research, technological innovation and industry support for UPIoT. It is mainly composed of major trade associations, universities and advisory companies.

The social and natural environment sub-ecosystem is mainly composed of central government and local governments, providing policy guidance and support at the central and local levels for UPIoT.

In this commercial ecosystem, the government, various enterprises, trade associations, universities, research institutions, end-consumers create application scenario for UPIoT core technology structure, constitute the industry chain of UPIoT, form a closed ring of value realization of UPIoT together.

Figure 2. The industry chain of UPIoT

4. IES in the commercial ecology of UPIoT
IES is an important business form and emerging market of UPIoT, and its value realization and market development is depending on the data information resources and core technology support of UPIoT.

IES can collect all kinds of data and information of the terminal users from the perception layer of UPIoT, so as to obtain the user’s energy information and behavioral characteristics data. IES can implement the intelligent clustering and potential demand mining of user data information through the data cleaning, storage, mining and fusion technology of network layer of UPIoT. With the help of the platform layer technology of UPIoT, IES can make full use of the photovoltaic cloud network, smart vehicle network and other business platform, to satisfy the data information and platform source requirements of application, and to provide support for the market-oriented diversified IES applications.

5. The market pattern and Evolution of IES in the commercial ecology of UPIoT

5.1. The Classification of IES Market Subjects
According to the commercial ecological theory and the current situation of the IES market, its market subjects can be classified as: core platform enterprise, dominant enterprise, gap enterprise and speculation enterprise.

Core platform enterprise is the leader of the whole ecosystem resources, it provides opening platform services for the system members, attracts other members to join in the system, integrates and coordinates resources, promotes the value creation and value sharing of the ecosystem. Generally, one commercial ecosystem has one platform-oriented enterprise, and it will be the core of the entire commercial ecosystem. Specifically to the IES market, the core platform enterprises are mainly power grid enterprises, power plant enterprises and other large traditional energy resources enterprises that can provide platform-based and plate-based IES business.
Dominant enterprises are those that control a value chain or a certain business area in the ecosystem through vertical or horizontal integration in the system, and are responsible for the vast majority of value creation activities in these areas, and occupy the majority of the value. Specific to the IES market, the dominant enterprises are mainly such as GCL, ENN, TGOOD and other industrial chain extension enterprises deep in single or several sub-sectors industrial chain, or large-scale energy-saving technology companies.

Gap enterprises are a group of many, small volume companies, they are facing the most intense market competition in every sub-sectors of IES market, such as small energy-saving technology enterprises, equipment manufacturers, design and construction enterprises.

Speculation enterprises are the kind of market body that do not depend on specific ecosystem to survive. They promote the complementary innovation of ecosystem, and help to improve the overall competitiveness of the system. Specifically to the IES market, speculation enterprises are mainly Internet enterprises, financial institutions and other cross-border enterprises, they combine their own business and some IES market demands together, as a market entry point.

5.2. The competition in IES market
According to the characteristics of various market subjects in IES market and their different market positions, the types of enterprise competition in the market can be divided into four categories, as shown in Figure 3.

- **Competition I** refers to the competition between the same kind of business enterprises in the same commercial ecosystem. The purpose of the competition is to compete for ecosystem resources, or to compete for the leader position in the commercial ecosystem.

- **Competition II** refers to the competition between different types of enterprises in the same commercial ecosystem. The purpose of which is to gain a lasting competitive advantage in the ecosystem and ultimately compete for the leading position of the system.

- **Competition III** refers to the competition of similar enterprises in different commercial ecosystems. As their customer types and business contents are similar, Competition III is essentially the competition between different commercial ecosystems.

- **Competition IV** refers to the competition between different types of enterprises in different commercial ecosystems, and the essence of competition IV is normal market transaction competition.

![Figure 3. Different competition in IES market](image)

5.3. The evolutionary path of IES market pattern
With the development of the IES market, the type of market competition is constantly changing, and that will ultimately promote the evolution of the IES market pattern.

In the initial development pattern of the IES market, speculation enterprises try to find the market entry point, gap enterprises fight each other to snatch the scattered terminal market, dominant companies consolidate their strengths, retain their leading position in the subdivision, and try to expand their market influence, core platform enterprises plan to set out their eco-platform layout to
prepare for building their own commercial ecosystem. In the early stage of the market, where the major commercial systems have not matured yet, the competition of the main players is dominated by

With the gradual maturity of IES market and the formation of the ecological platform layout of the major core platform enterprises, the future IES market will form more than one commercial ecosystem centered on several large core platform enterprises, where all kinds of dominant enterprise and gap enterprises attached to to conduct business. Speculation enterprises will implement cross-border cooperation strategy. Each commercial ecosystem will continuously updates the iterative market pattern under the dual-helix of data intelligence and network coordination. In the future, the market competition will be upgraded from the competition between enterprises and the competition between the industrial chain to the competition between different commercial ecosystems, mainly competition III. At the same time, with the change of market development trend, structural adjustment may also occur within each commercial ecosystem, and there will be a certain degree of competition I and competition II.

6. Conclusion
This paper analyzes the commercial ecosystem of UPiIoT in general through the core technical structure. UPiIoT is an economic joint organism composed of multiple market subjects, such as governments, related enterprises, organizations and individuals, which can improve the allocation of factor resources by opening up all kinds of main business flow, information flow and capital flow, and promote the further development of all kinds of market subjects in a mutually beneficial and win-win environment with low marginal effects, and realize the overall horizontal expansion of a circular business system that deepens vertically. On this basis, this paper analyzes in detail the profound intrinsic relationship between IES and UPiIoT and studies the pattern of the IES market, classifies the market subject as the core platform-based enterprises, dominant enterprises, gap enterprises and speculation enterprises. And this paper analyzes the market competition type of the IES market. Thus, it is concluded that the evolution path of IES market pattern is: shifting from the initial stage of various market subjects implementing scattered and disorderly market competition gradually to the competition between several commercial ecosystems.

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