

Research on Energy Trading Model of Energy Internet Based on Information Economy Perspective

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Abstract: In the era of rapid update of big data, smart grids, integrated energy systems and energy Internet are formed under the impetus of ICT technology and the intertwined coupling of various information and energy sources, among which the energy Internet is a product of the deep integration of energy and information, which leads to the improvement of energy resource allocation efficiency under the influence of information interconnection and overturns the traditional energy trading model. In this regard, based on the perspective of information economics, this paper studies how to build an energy trading model in the context of the energy Internet, and proposes the construction route and principles of the trading model after analyzing the necessity of energy trading model implementation. "Finally, we put forward relevant policy measures according to the trading model in order to open up a new model for energy trading.

Keywords: Energy internet, Information economics, Energy trading, Trading model.

1. Introduction

In today's society, the energy competitiveness driven by energy has formed the background of energy games in various countries, and energy exploration, extraction and storage and transportation are transformed and updated by information, thus giving rise to the evolution of various new forms of energy trading. The integration of energy and information economy has promoted the common construction and sharing of energy resources trading platforms. In the context of the energy Internet, the information-physical system of the Ubiquitous Internet of Things [1] fully integrates energy flow, business flow, and information flow to improve the transaction quality of energy supply and demand sides, while providing higher service quality for energy end users [2]. Therefore, the energy trading model under the energy Internet integrates the whole process of energy production, transmission, conversion, storage, consumption, and investment. In short, the energy system will provide an innovative model for multi-energy coupling [3] and interconnection of multiple energy subjects to achieve high-efficiency energy trading under the intervention of information economy, and the development and operation of the energy trading model in the context of the energy Internet

is inevitable.

2. The Connotation of Information Economics

As a discipline studying information and economy, information economics uses the methods of informatics and economics to conduct theoretical research on the basic principles, development laws, formation mechanisms and operation methods of information economy, and one of the important research directions is the impact of information on economy [4]. In microeconomics market theory, the market equilibrium point is Pareto optimal under the complete economic market, when the allocation efficiency of resources is optimal, and requires buyers and sellers to make decisions in the case of complete transparency of market information, the Nash equilibrium point under this game is the market equilibrium point, and the decision made by buyers and sellers at this time is the optimal decision. However, in the real trading process, there is no information market with complete transparency and symmetry for both buyers and sellers, and the market equilibrium point will be close to the market equilibrium point under the condition of perfect market competition only when the degree of information disclosure and transparency increases.

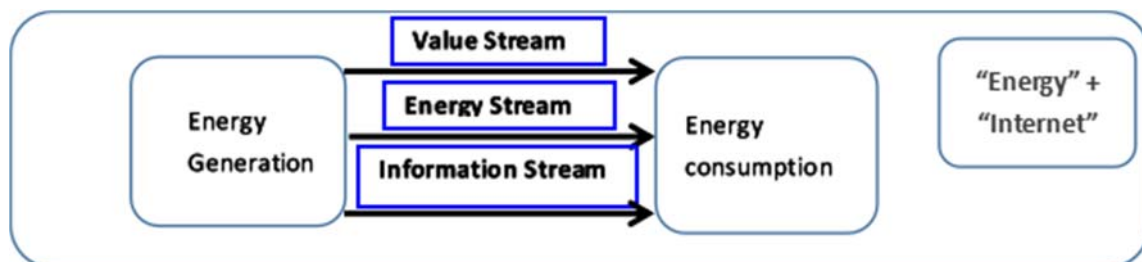


Figure 1. Connotation of Information Economics of Energy Internet

As shown in Figure 1, the energy market converges to a perfectly competitive market through the close coupling of information flow, value flow, and energy flow [5], and improves the degree of information transparency to achieve

the effective allocation of energy resources. The introduction of Internet technology and thinking in the traditional energy industry, a "century-old store", allows information to guide energy and the Internet to fully provide the energy

information needed by both supply and demand sides to guide the optimal allocation of energy resources, improve the efficiency of energy asset utilization, and realize the value created by energy [6].

3. The Necessity of Implementing the Energy Internet Energy Trading Model Based On the Perspective of Information Economics

3.1. Traditional trading mode is extremely high

The energy consumption structure under the traditional energy trading market is unreasonable [7], energy trading is divided into three markets, the primary market is led by the provincial government for the initial energy quota, the secondary market is led by different industries between regions for energy trading, the tertiary market is led by different industries in the region for energy trading, the provincial trading center coordinates the overall balance, individual energy suppliers and demanders cannot access all the energy in the region, according to statistical data. According to statistical data, it is expected that the installed capacity of new energy in China will exceed 1.2 billion kW in 2030 [8], so it is particularly difficult to decentralize energy trading under this centralized resource decision-making approach, and the cost of information data and energy resources acquisition is extremely high.

3.2. Multi-system coupling in traditional trading mode is difficult

As the scale of users expands, the information and systems within the energy system become more difficult to coordinate and operate, the interrelationships are intricate and complex, the difficulty of obtaining energy data and information from the whole platform increases, and the efficiency of centralized resource decision-making is obviously low.

3.3. Energy Internet promotes shared energy transactions

With the application of information technology, energy suppliers and users can quickly and easily access the data and resources they need under the regulation of the energy Internet, forming a "shared energy storage" energy business model [9]. It is flexible and widely distributed to realize decentralized local energy trading and improve energy utilization efficiency and data integration speed.

3.4. 3.4. Improve the efficiency of resource utilization

In the context of deep integration of ICT technology and the Internet with the energy system, the development trend of energy trading platform is bound to develop from centralized overall balance to decentralized local balance, and the energy trading market information will tend to be completely open and transparent, while the roles of energy suppliers and users are interchanged to achieve wide distribution of energy supply point sets, maximize the use of existing resources, and fully develop distributed renewable energy, and finally realize the efficient use of energy.

4. The Construction Route and Principles of Energy Trading Model of Energy Internet Based On the Perspective of Information Economics

4.1. Construction route

Under the innovative combination of information and economy, the energy trading model in the energy Internet aims at solving the energy problem of "open source" and "cost saving", and is guided by innovative development thinking, following the principles of decentralized trading, cost-benefit optimization and market orientation. Therefore, this paper proposes the "four-in-one" innovative trading model of energy investment and value-added services under the perspective of energy economy.

4.2. Construction Principles

4.2.1. Principle of decentralized trading

When dealing with the decomposition and coordination of large systems, the way to control complex system problems is to separate each subsystem in the system for coordination and integration, and finally to carry out global integration and optimization, which is the result of centralized and decentralized decision making together. In the case of a large energy trading system, it is impossible to accurately grasp all the information about the energy data to be optimized, so the centralized trading decision is not scientific, while in the decentralized trading system, energy trading can be realized in a fully competitive market dominated by market mechanisms, in which energy prices, profits and trading rules are determined by the market, and each subsystem is more adaptable to changes in the external environment. The principle of decentralized trading makes it possible to achieve sufficient local self-balancing among thousands of energy trading users.

4.2.2. Principle of Cost-Effectiveness Optimization

Traditional energy trading in the power industry is based on the trading model of provincial power centers, which carry out resource allocation and scheduling transactions in each region. In addition, under traditional trading, the purchase and sale price difference is the trading target, but after the optimization of the trading platform, energy saving and efficient utilization of energy become the widespread trading target, and finally realize the economic index of maximizing profit and minimizing cost of energy trading.

4.2.3. Market-oriented principle

The interconnection of energy information creates an open, autonomous and fully competitive energy trading market. Under the full reform of China's electricity, oil and gas fields, a more valuable market will be created, more fully competitive market players will be cultivated, and under the active market competition each commercial player will continuously improve its competitiveness, making energy trading completely open under the guidance of the market and bringing a new breakthrough in the inherent trading model.

5. Analysis and Construction of Energy Trading Model of Energy Internet Based On the Perspective of Information Economics

5.1. Analysis of energy trading model of energy Internet based on the perspective of information economics

Any kind of trading model is subject to the constraints of trading subjects, trading commodities, trading information and trading time, and also benefits from various reform mechanisms and changes in technological innovation. The analysis of the energy Internet energy trading model under the economic situation generated by the interaction of information data and energy economics is reflected in the following four points.

5.1.1. Diversification of energy trading subjects

In the context of the new electricity reform and the continuous liberalization of the electricity sales side as well as the energy Internet, the subjects of energy trading will no longer be limited to a few approved subjects such as power generation enterprises and power grid enterprises, but the future energy trading subjects and market composition will be more extensive and complex.

The roles of energy suppliers and users will be interchanged, forming a new situation of energy producers and consumers (promuser), energy consumers and providers will have their roles and responsibilities interchanged, and the relationship between supply and demand will no longer be fixed under the traditional energy trading, energy trading will draw on the information interaction under the Internet, making the participation and withdrawal of trading a free and independent choice of users in the context of the energy Internet. Within the reasonable control range of market access and withdrawal mechanism stipulated by the market sector, the trading subjects can realize benefit distribution in a self-consistent manner, forming an efficient and fair energy distribution platform, giving full play to the coupling with information integration and improving energy utilization efficiency.

5.1.2. Diversified energy trading commodities

The diversification of energy commodities and horizontal complementarity is one of the important features of the energy trading mode of the energy Internet. The energy trading commodities change from the traditional single electricity commodity trading to a variety of energy sources such as electricity, oil, steam and heat, realizing diversified supply of energy commodities and optimal utilization of energy under the extensive interconnection of multiple energy commodities [10]. The continuous opening and improvement of energy trading mode and energy market will provide users with a variety of energy products, and the homogeneous single electricity commodity will be derived into differentiated commodities for users' self-customization, providing them with more independent choices.

Innovation and development of the original traditional energy resources utilization form, the energy supply side and demand side of the surplus energy as an important energy commodity, the use of the power supply side of the peak and frequency regulation resources and the use of the side of the adjustable energy, improve the energy storage and conversion of the use of energy, the clever integration of energy use, give

full play to the positive role of flexible resources in the energy trading market.

5.1.3. Transparent energy trading information

Guided by the principle of decentralized trading, the release of energy trading information is developed from a single provincial power center to an Internet energy information publisher. Under the traditional energy trading model, trading information is released uniformly with poor information quality and a single type of information. Under the development of the big data era, the volume of energy trading has increased significantly, and the increase in trading volume has led to a massive increase in the volume of energy information data, while giving rise to large-scale Internet information service providers to provide information services for both energy supply and demand.

The full and transparent energy trading information promotes the effectiveness of the trading market, and the market-oriented energy trading improves the quality and speed of trading while realizing the comprehensive use of energy.

5.1.4. Instant energy trading time

With the in-depth integration of information interaction and 5G technology with the energy Internet, the trading time between energy users changes from a fixed trading cycle to instantaneous energy trading initiated and ended by themselves, and the scope of trading time gradually tends to be instantaneous, fully meeting the intelligent and instantaneous needs of energy users [11].

Under the traditional energy trading model, electricity trading across provinces is time-consuming and labor-intensive, which affects users' energy efficiency and restricts the process of energy trading development.

5.2. Construction of energy trading model of energy internet based on the perspective of information economics

5.2.1. Energy production and consumption model

① Energy self-supply

Under the guidance of decentralized trading principle, energy users can satisfy their own energy demand and realize decentralized micro-balancing of energy trading. Promoting the use of distributed renewable energy generation devices, users can decentralize the formation of local energy nodes if they have surpluses under the conditions of self-capacity, constituting a widely distributed risk-hedging energy supply network [12]. For example, under economically feasible conditions through crowdfunding or benefit sharing and other business models for energy users to install solar photovoltaic panels, configure wind and solar complementary power generation systems between user buildings, and install supporting electric charging piles near the buildings.

In this energy self-supply mode of operation will quickly find investment opportunities and commercial value, and can quickly dock with technology, capital, professional services and other resources to form a highly efficient use of energy production and consumption mode, promote distributed, clean renewable energy efficient use, anywhere collection, and improve the efficiency of energy transactions.

② Shared energy storage

The independent energy storage equipment and renewable energy storage power plants participating in the auxiliary peaking market in the form of shared energy storage have overturned the energy storage mode of my traditional energy

storage situation, in which the storage power plants are relatively independent and loosely connected to the monotonous operation mode. Under the energy trading mode of shared energy storage, all energy storage devices on the grid, power supply and customer side are linked to become an energy storage network, and the energy storage nodes at different levels in the network are linked to each other, coordinated and controlled, and controlled as a whole, to provide power services for the regional grid and new energy power plants together. During the period of shared energy storage transaction, if some of the energy power plants are limited in energy supply under the transaction, the power stored in the shared energy storage system can be released by the dispatching agency in the low and high peaks of new energy supply, which significantly reduces the cost of energy storage, improves the utilization rate of energy storage equipment, and maximizes the economic benefits under the shared energy storage transaction.

Blockchain technology is used for shared energy storage transactions, and the new database technology of blockchain is used to apply the data traceability, transparent transactions, and decentralization in the technology to shared energy storage transactions for direct green energy direct transactions that do not depend on third parties [13]. Blockchain technology as a decentralized, low-cost consensus scheme provides an over-the-counter registration transaction mechanism for shared energy storage market transactions, realizes the securitization of electricity assets for shared energy storage transactions, and guarantees the efficient and cost-effective operation of the shared energy storage transaction market.

③ Energy conversion

The use of terminal multiple energy devices for energy trading, such as plug-and-play for electric vehicles and new energy charging piles and breakthroughs in key technologies such as energy routers to realize terminal multiple energy consumption billing according to a unified standard. Under the energy trading market, different forms of energy are transformed into standardized "joule products" through equivalent conversion, making the whole energy market trading system more inclusive and open, breaking through the horizontal barriers between energy sources and opening the barriers between different energy markets, and carrying out large-scale standardized energy trading.

Under the development of the energy trading model of integrated energy operators, energy optimization is carried out in residential properties, industrial parks, business districts, logistics parks and other areas, conversion technology is incubated, and the application of advanced energy co-generation technologies and low-cost electricity and heat-to-hydrogen technologies is promoted to break the barriers between different types of energy and provide support for various innovative energy trading models [14].

5.2.2. Energy trading model

① Energy trading center

The formation of an energy information trading platform promotes the establishment of a transparent and independent energy trading platform and gives rise to a variety of energy trading models [15]. In the energy trading platform, buyers and sellers can carry out various forms of flexible transactions, such as direct transactions between electricity sellers or large users and power plants. In addition, the energy and power trading center itself is a profitable business model, and the trading center operator manages the flow of funds in the

platform by charging commissions to buyers and sellers for the volume, type of transaction, and form of transaction, as well as management fees and settlement fees.

Energy trading platforms improve energy efficiency by integrating redundant, performance-constrained energy resources among users. The energy trading platform is modeled after similar trading platforms such as the "Energy Uber" battery leasing platform, which provides energy users with an energy information dissemination and transaction matching platform to provide energy information logistics transmission channels. Users release their energy status through the trading center and obtain the current energy supply and demand status of other users to realize energy supply and demand matching on the trading platform and carry out energy leasing business to revitalize the energy stock market, provide value to energy users and improve energy utilization efficiency.

② Energy "Taobao"

The establishment of an energy network trading model similar to Internet shopping sites, providing a large network energy trading platform for various commercial entities, combining the demand side with the supply side and generating "virtual power plants" [16]. Various energy service companies open online stores under the energy "Taobao" platform to sell energy products and various energy services for customers to choose from, for example, providing customers with energy packages that combine various forms of energy, such as cooling, heating, gas and electricity, reducing the need for customers to purchase them separately. The company also offers a wide range of energy products and services for customers to choose from.

We provide "Power Taobao" business, which provides a platform for electricity sellers to sell different forms of energy products, so that users can choose to buy them and realize the B2C energy trading mode. In addition to large power grid enterprises, the platform also supports individual energy users to help each other with surplus and deficit energy transactions, realizing C2C energy trading mode and enhancing the e-commerce and freedom of energy trading. In addition, electricity sellers can also provide customers with customized energy packages to meet their individual energy needs, thus realizing the C2B energy trading model.

5.2.3. Value-added energy service model

① Energy use planning

Energy use planning mainly refers to energy management companies (EMCO) to solve energy consumption and energy hosting problems for users in the process of energy trading, through the user to provide information for analysis and decision-making, in-depth analysis of the user's energy use behavior and energy use structure, with comprehensive data, professional algorithms, special energy source channels to guide and advise users on energy use, for the user to meet the energy use based on the balance of energy. The energy management company will allocate the surplus energy consumption as planning income.

For example, it builds an energy efficiency management platform based on the SaaS model to evaluate the energy consumption of users in parks, enterprises, campuses, etc., realizing a "direct connection" between power producers, power sales departments and consumers [17], and designing Personalized energy utilization plans promote energy-saving energy technologies and reduce energy costs for customers. In addition, a load aggregator can be established to analyze users' energy use behavior scientifically, to deepen demand

response and other resources, and to reduce operating costs to participate in the current electricity and auxiliary markets, achieving a win-win situation for both energy users and operators. Decentralized and distributed, so regional power sales based on blockchain technology will become an important breakthrough for smart energy.

②Energy service

Through cell phones, emails and other network means to enable users to perceive their self-energy-using transaction behavior in real time, provide personalized energy consumption management APP [18] for energy trading users, provide intelligent energy utilization control means, and combine intelligent and remote data-driven innovative services with energy trading platform. In addition, users and electricity sellers pay commissions to complete electricity, natural gas, insurance and credit services on the price comparison service network [19]. The important role of energy Internet data analysis is reflected in how to provide innovative energy services for electricity sellers, new energy users, energy developers, and commercial entities.

5.2.4. Energy asset investment model

①Energy Bank

Energy bank is an innovative transaction model derived from energy storage technology, which aims to store users'

surplus energy in the "energy bank" and draw energy when using it under the premise of reasonable commission and debt ratio. In addition, energy banks can provide energy crowdfunding, energy lending, energy credit rating and other services to users. For example, energy investors can use the energy bank to raise funds when there is a shortage of funds and mobilize multiple platforms to jointly raise funds; users can sign energy lending contracts according to their own energy use planning, similar to the mode of commercial bank loans, to solve the problem of energy planning and energy support for users; users' credit rating can be assessed laterally, and energy bills and data settlements of users can be calculated and analyzed to provide credit collection services for other departments.

③Energy guarantee

In the context of energy internet, the open and transparent information of energy supply side and demand side makes the progress of energy trading fast and efficient. When energy suppliers trade with larger energy users, a creditable third party makes energy guarantees for both the supply and demand sides to improve the speed of capital turnover and promote efficient energy transactions. In addition, the healthy interaction between energy industry and financial capital enriches various application scenarios of energy finance. [20]

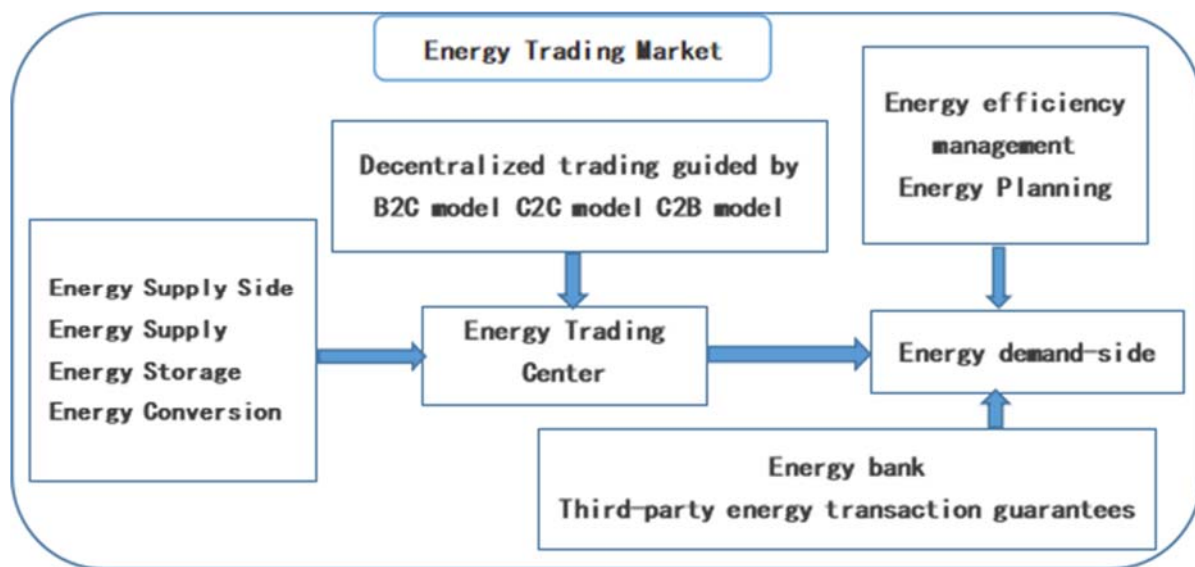


Figure 2. Energy trading model in the context of energy Internet

As shown in Figure 2, the energy trading model innovatively formed under the background of the energy Internet covers a variety of energy sources and trading subjects, realizes the integration of all energy production, supply and consumption of energy supply, energy storage, energy conversion and energy consumption, and establishes an energy trading center through an open information trading network, giving rise to a mixed trading model of multiple trading subjects under the guidance of decentralized trading, which enriches the energy trading The model and market. Under the guidance of the market, it provides the most comprehensive energy value-added and asset investment guarantee business for the power side, provides energy data and energy bills for the power side's energy consumption and establishes an energy efficiency management platform, provides energy banking business for the power side to draw energy conveniently at any time, and provides transaction guarantee by third-party institutions in the process of fund

flow of transactions, and integrates Internet data and information innovation into the whole process of energy transactions. The whole process of energy trading.

It can be seen that the future market competition in energy trading is no longer limited to specific energy business such as part of the energy product market or specific energy service products, but is focused on a large comprehensive energy trading platform with diversified energy trading subjects, diversified trading commodities, instant and rapid trading time, and open and transparent trading information. The competition is about the richness, flexibility and accuracy of the commodities provided by different energy trading entities, and under the coupling of data and information of the energy Internet, the efficiency of energy use is continuously improved and the development mode of energy trading is innovated.

6. Policy Recommendations Policy Recommendations

6.1. Give full play to government support and supervision

The government should increase the central and local capital investment to support the existing innovative energy trading models, support energy enterprises with core technology to enter the trading market, lower the entry threshold of the energy market and industry, strengthen the transparency of data and information opening, realize the energy trading market converging to a perfectly competitive market equilibrium, and improve the trading efficiency of both sides of energy trading. Government departments have the responsibility to support the development of promising energy trading models and encourage each energy trading entity to innovate and improve the existing trading models.

The government and energy management departments should do their duty to supervise energy trading, regulate the trading behavior of each energy trading platform, formulate corresponding trading guidelines and laws and regulations, and regulate multi-energy trading platforms in an orderly manner.

6.2. Actively explore the energy trading platform under blockchain

A fast, transparent, open and safe energy trading system is established under the guidance of information economics and the combination of the public use and transparency degree of information and energy market. Based on this background, we actively explore the "blockchain + energy" trading platform, introduce blockchain technology in the context of energy internet, actively explore the trading point of energy trading and blockchain technology, and realize the energy trading To actively explore blockchain technology in the context of the energy Internet, to explore the transaction fit between energy trading and blockchain technology, to realize efficient operation of energy trading and business processes, and to actively build a multi-body energy trading platform for grid enterprises, new energy enterprises and power enterprises under blockchain architecture.

6.3. Guide and cultivate user-side energy consumption behavior in the trading market

Use multimedia and other channels to carry out consumption propaganda, change the inherent consumption concepts of energy consumption users, promote the new energy consumption concept of energy conservation and consumption reduction, guide consumer users to participate in and support the use of new energy trading services under distributed power generation and photovoltaic power generation; establish an open and transparent energy data sharing mechanism to enable energy users to fully access the energy data they need, make reasonable planning for energy consumption structure, and promote energy conservation and environmental protection At the same time, the scope of clean energy use is gradually expanded; the service structure and service interface of energy trading services are reasonably optimized to improve users' convenience in choosing energy use, and the expertise and service links are decomposed so that the trading subjects in the energy trading market can quickly make trading actions when consuming energy.

7. Conclusion

This paper analyzes the energy trading model of the Internet, information and energy from the perspective of information economics, and the reduced cost of energy information and the broken market barriers between multiple energy sources in the information era have fully promoted the change of the energy trading model, breaking the barriers between horizontal and vertical energy trading under the traditional energy trading, and analyzing the necessity of implementing the energy trading model under the new situation. The need for the implementation of energy trading models under the new situation is analyzed. The Internet of Energy has promoted the "open source" and "low cost" of energy and provided the impetus for achieving energy development goals. On this basis, the energy trading model in the context of the Internet is analyzed, and the energy trading model is proposed with the attributes of diversified trading subjects, diversified trading commodities, instantaneous trading time and transparent trading information, and the models of energy production and consumption, energy trading, energy value-added services and energy asset investment are conceived.

In general, optimizing energy trading model in the context of information economy and Internet requires changing the thinking, improving the degree of integration and utilization of Internet and energy data, and providing innovative models and inexhaustible power for energy trading under information domination.

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