Research on Electricity Trading Service Platform Based on Energy Internet

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Abstract. With the development of energy internet and modern information technology, emerging market entities such as energy storage, distributed generation and electric vehicles play increasingly important roles in electricity market, thus the demand on a more powerful trading platform is prominent day by day. This paper puts forward a new electricity trading service platform based on energy internet, analyzes the main functions, overall architecture, and market entities of the platform. The main functions of the platform include wholesale market electricity services, retail market electricity services, power supply services and value-added services. We also study the trading mechanism for emerging market entities when participating in regulated electricity market, medium and long-term market, generation rights market and spot market. This research helps improve the efficiency of electricity market operation, promotes the development of emerging market entities, and provides convenience to power users.

1. Introduction
The development of energy internet and modern information technology provide technical support and innovative approaches for the construction of electricity market. The demands for a new electricity trading service platform mainly include the following aspects.

• The demands of power users to directly trading on the platform. The construction of energy internet has provided the possibility for all users to "get on the platform" and "directly meet". Guiding electricity users to directly participate in transactions can effectively shorten the distance between the supply and demand sides, reduce the intermediate links, and improve transaction efficiency.

• The demands of emerging market entities to participate in the market. The rapid development of emerging entities at the end of the power grid, such as energy storage, distributed generation, and electric vehicles, has increasingly significant impact on the operation of power systems. It is necessary to guide emerging entities to participate in the market, promoting interaction between power source, network, load and storage.

• Users' needs for diversified energy use and value-added services. With the change of consumption concepts, users have an urgent need for diversified, customized, and interactive energy consumption, and they have a strong demand for lean energy consumption, which puts forward an urgent demand for value-added power data services.

• The needs for power generation companies to participate in transactions and obtain services. With full liberalization of power generation plans, more generating units will participate in market. They are urgent to obtain related services in terms of output prediction, transaction matching, and bidding strategies.
Therefore, it is necessary to build a new electricity trading service platform based on energy internet, acting as an energy allocation platform, integrated service platform, and new business model development platform.

2. Main functions of new electricity trading service platform

The platform is positioned as an electricity and value-added service platform for wholesale and retail market players. The main functions are as follows:

2.1. Wholesale market electricity purchase and sale services

- **Registration management.** Responsible for the registration of various market entities, verifying market entities' approval, settlement, power consumption, and grid connection information.
  - **Transaction organization.** The types of transactions include energy, ancillary services, capacity, transmission rights, power generation rights, carbon trading, renewable energy quotas, green certificates, etc.
  - **Transaction settlement.** Settling transactions according to transaction contracts, meter information, transaction execution conditions and rules, settling electricity bills with market entities.
  - **Information Disclosure.** Organizing information release in accordance with market rules and regulatory requirements, cooperating with regulatory agencies to supervise the disclosure of market entities' information.
  - **Credit Evaluation.** Establishing a credit evaluation index system for electricity market transaction entities, and developing a differentiated service system based on credit evaluation results.

2.2. Retail market electricity purchase and sale services

- **Organizing power users to directly trade on platform.** Providing personalized customized services, organizing all power users to "directly meet" with power generation, reducing transaction costs.
  - **Supporting power users to choose agency transactions.** Supporting the embedding of electricity sales companies. Users can freely choose electricity sales companies and price packages through the platform, and accept various value-added services.
  - **Direct transactions between emerging entities and power users.** Organizing direct transactions between distributed power sources, energy storage, and power users in active power distribution networks to promote local consumption of new energy.
  - **Carrying out decentralized transactions.** Block-chain technology is used to organize decentralized, self-settled electricity transactions, reducing organizational costs and improving transaction efficiency.

2.3. Carrying out diversified power supply services

- **Traditional power supply services.** Responsible for power supply services such as installation, metering, charging, and emergency repair of customers.
  - **Engineering services.** Providing planning and design, equipment testing, agency operation and maintenance, safety management and other services for power users.
  - **Responsible for priority generation and priority purchase.** Signing electricity sales contracts with priority generation companies and priority purchase customers, and purchasing priority generation energy according to government pricing.
  - **Guaranteed power supply services.** Providing guaranteed power supply service for users who do not participate in market.
2.4. Providing various value-added services

- **Energy efficiency management.** Providing users with value-added services such as energy consumption monitoring, energy analysis, energy saving services, demand response, and energy replacement.
  - **Multi-energy supply.** Carrying out comprehensive energy supply such as electricity, heat, water, and cold, providing users with integrated energy solutions.
  - **Big data services.** Providing data products and data services such as customer portraits, equipment evaluations, industrial development evaluations, and industry analysis.
  - **Energy financial services.** Implement data sharing with public institutions, commercial banks, insurance and other industries to provide power trading credit and financial services for power generation companies and power users.

3. Overall architecture

![Overall architecture diagram](image)

- **Figure 1.** Overall architecture of electricity trading service platform based on energy internet

The electricity trading service platform based on energy internet includes six parts: data layer, platform layer, application layer, service channel, service object, and operation system.

4. Market players and positioning

The electricity trading service platform based on energy internet supports a wide range of access and interactions of various entities, which can be summarized into six categories: power source, power grid, power user, energy storage, service provider, and supervision organization.

| Classification    | Name                                                                 | Positioning                                   |
|-------------------|-----------------------------------------------------------------------|-----------------------------------------------|
| Power source      | Thermal power, hydro-power, nuclear power, heating, gas, centralized new energy, distributed new energy, virtual | Power supply, access to electricity services and value-added services |

Table 1. Market entities and positioning
power plants, new energy clouds, etc.

| Power grid       | Power grid enterprise | Power and data transmission, power supply services |
|------------------|-----------------------|--------------------------------------------------|
| Power user       | Priority purchase users, large industrial users, small and medium users, power sales companies, load aggregators, comprehensive energy service providers, etc. | Power consumption, access to electricity services and value-added services |
| Energy storage   | Power supply / grid / user-side energy storage, energy storage cloud platform, connected vehicle platform, etc. | Energy storage, access to electricity services and value-added services |
| Service provider | Grid enterprise market-oriented units, integrated energy service providers, power engineering companies, communications operators, data analysis companies, financial service providers, etc. | Provide value-added services |
| Supervision organization | Government regulatory agencies, etc. | Market supervision |

5. Trading mechanism for emerging market entities

In energy internet, emerging market entities include distributed power sources, distributed energy storage, adjustable loads, electric vehicles, and their aggregates, such as virtual power plants and load aggregators. Before emerging market entities participating in the market, the government need to determine whether policy encouragement is required during the transition phase, including construction subsidies and market participation subsidies. Emerging market entities can participate in various market-based transactions with the same rules as other market entities.

Recently, emerging market entities mainly participate in regulated electricity market (peak-sharing auxiliary service market). In the long run, the types of market transactions that emerging market entities can participate include medium and long-term transactions, generation rights transactions, spot transactions and other ancillary service transactions.

5.1. Participate in regulated electricity market

There are two ways for emerging entities to participate in the peak-shaving auxiliary service:
- First is to conduct centralized bidding with thermal power unit on trading platform.
- Second is to sign a long-term peak shaving auxiliary service agreement with the dispatching agency.

The emerging market entities are facing market competition with traditional thermal power units. The competition depends on the comparison between the actual adjustment cost of emerging market players and the increased coal consumption cost of traditional thermal power units.

5.2. Participate in medium and long-term transactions

Compared with other market entities, emerging market entities have several advantages when participating in medium and long-term market:
- First, emerging market entities can form part of transactions in advance before participating in medium and long-term market transactions.
- Second, after resource aggregation, it can reduce uncertainty to a certain extent, thereby further reducing conservative nature of emerging market entities' transactions.
- Third, the adjustment ability of emerging market entities can make the execution deviation smaller.
Fourth, compared with other market entities, emerging market entities have more flexibility in arranging start-stop and output of units.

5.3. Participate in generation rights transactions
In generation rights transactions, power generation rights are transferred to power generation rights transferees to purchase electricity. Among them, coal-fired power plants that transfer power generation rights are the sellers, and emerging market entities that have been granted power generation rights are buyers. The transaction target is the transaction power of emerging market entities. Emerging market entities have lower uncertainty and better regulation capabilities than centralized renewable energy power generation companies, thus have the time advantage of trading.

5.4. Participate in spot transactions and other ancillary service transactions
The advantage of emerging market entities participating in the spot market is that their adjustment performance allows emerging market entities to flexibly adjust their declared strategies based on expected market prices in a short period of time. Due to their better understanding of internal user, distributed power, energy storage and other unit technical parameters, emerging market entities also have control measures, making it more deterministic in making electricity packages for customers and more profitable.

6. Conclusion
This paper puts forward a new electricity trading service platform based on energy internet, analyzes the main functions, overall architecture, and market entities of the platform, and studies the trading mechanism for emerging market entities based on energy internet. The following conclusions are drawn:

- The electricity trading service platform based on energy internet consists of data layer, platform layer, application layer, service channel, service object, and operation system, and the main functions include wholesale market electricity services, retail market electricity services, power supply services and value-added services.
- The platform supports a wide range of access and interactions of various entities, which can be summarized into six categories: power source, power grid, power user, energy storage, service provider, and supervision organization.
- The emerging entities can participate in regulated electricity market recently, and participate in medium and long-term transactions, spot transactions and other ancillary service transactions in the future.

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