Analysis on Development Strategy of New Comprehensive Energy Service with Game Theory

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Abstract. With the rapid development and full use of modern information and communication technologies such as “Big Data, Cloud Computing, Internet of Things, Mobile Internet”, comprehensive energy service has become a commanding point of strategy of energy companies. Based on the analysis of domestic and foreign comprehensive energy services, this study takes Grid company as an example and discusses the strategic choice and strategic focus of energy enterprises with game thinking in the process of business transformation.

1. Introduction
With rapid development of Internet, big data, cloud computing and other technologies, a new comprehensive energy service model was born against the background of integration of distributed power generation and energy supply technologies, energy system monitoring, control and management technologies, as well as new energy transaction modes. Comprehensive energy service has become an important development direction to improve energy efficiency and reduce energy cost. From a strategic vision of "energy saving, clean and safe "development strategy, energy industry explores operation mode consistent with "build clean, efficient, safe and sustainable modern energy systems", to bring change from market participants to provider of public service. The research used grid company as research object, a leading company in energy industry.

2. Introduction Literatures and Practice

2.1 Foreign practice
International research on this issue is inconclusive. Related concepts that are widely used abroad include Multi-carrier Energy Systems, Multi-vector Energy Systems, Integrated Energy Systems and Energy Systems Integration. Europe was the first region to put forward a comprehensive energy system concept and put it into practice.

As early as in FP5, research on Energy collaborative optimization has been put in a prominent position such as DG TREN (Distributed Generation Transport and Energy) project. Companies in the UK focus on the integration of energy flows between energy systems. Germany focuses more on integration between energy systems and communications and information systems, of which E-energy is a landmark project and other items such as IRENE, Peer Energy Cloud, ZESMIT and Future...
Energy Grid. The U.S. department of energy (DOE) is responsible for relevant energy policies, while America's energy regulator is mainly responsible for government's energy policy implementation. Under this mechanism, the United States achieves better coordination between all kinds of energy system, and comprehensive energy suppliers get better development, such as the United States Pacific gas electric power companies, Edison electric. Japan is the first Asian country to carry out comprehensive energy system research. In 2009, Japanese government believed that a comprehensive energy system covering the whole country should be built to optimize energy structure and improve energy efficiency. JSCA (Japan Smart Community Alliance) was dedicated to research and demonstration of smart community technologies.

So, in the process of providing comprehensive energy services, there are multiple roles and tasks. How to integrate multiple interests, and optimize energy structure, develop technology and improve efficiency from a systematic perspective is a "Great Game".

2.2 domestic backgrounds

2.2.1 Policy promoting. “Four revolutions, one cooperation” energy strategy was proposed. "Advancing revolution in energy production and consumption and building a clean, low-carbon, safe and efficient energy system" was put forward in the 19th CPC report. According to the 13th five-year plan for energy development, the proportion of non-fossil energy consumption will be raised to over 15% by 2020, the proportion of natural gas consumption will be raised to 10%, and the proportion of coal consumption will be lowered to below 58%. These policies have effectively promoted the diversified development of energy supply structure, promote comprehensive energy services.

2.2.2 Technical supporting. The deep integration of technologies and energy, such as Internet, big data, cloud computing and Internet of things, has pushed transformation of energy consumption mode to intelligent mode, thus generated more new value-added services.

2.2.3 Environmental constraints. Influenced by environmental constraints and progress of new energy technologies, the proportion of new energy has been significantly increased. In addition, progress of energy storage technology and gradual popularization of electric vehicles provide a good foundation for construction of comprehensive energy system.

3. Tactics Analysis on transformation to comprehensive energy service

Comprehensive energy service is a new type of energy service mode to meet diversified energy production and consumption of terminal customers.

3.1 Strategic advantages

3.1.1 UHV projects. Grid company delivered the “four AC and four DC” UHV projects included in the National Air Pollution Prevention and Control Action Plan and Jiuquan-Hunan and Zhalute-Qingzhou UHV projects. Ultra-large grid has the world's greatest transmission capacity, largest integration of renewable energy and the highest level of security.

3.1.2 Development of renewable energy. Grid company brought down both the volume and percentage of wind and PV curtailment and realized 100% clean energy power supply in Qinghai for 7 consecutive days, finished the “replacement of coal by electricity for heating” for a total of 1.99 million households in North China, expanding the use of electricity for heating in 500 million square meters.

3.1.3 Incremented power distribution. Explore the way to realize incremental distribution mixed ownership; Set up power supply service institution in parks, respond to electricity demand of customers in parks quickly.
3.1.4 **Smart Service Platform for Internet of Electric Vehicles (EVs).** Grid company developed the world’s largest Smart Service Platform for Internet of EVs with a total of 170,000 charging piles integrated.

3.1.5 **Technology and innovation.** Grid company was selected as one of the second batch of national pilot bases for mass innovation and entrepreneurship and led the development of “Science and Technology Innovation 2030” smart grid project. Grid company won special prize in National Award for Science and Technology Progress and ranked on top among central state-owned enterprises in terms of the number of patents and number of patent applications for seven consecutive years. Grid company led the development of 47 international standards. With increasing international influence, Grid company became the chair of B20 China last year.

3.2 **Strategy selection in Participants**

3.2.1 **Participants.** Comprehensive energy service has three meanings: first, comprehensive energy, covering a variety of energy sources, integrating renewable energy, hydrogen energy, energy storage facilities and electrified transportation on the basis of traditional comprehensive energy supply (electricity, gas, heat and cold); Second, comprehensive services, including energy planning and design, engineering investment and construction, multi-energy operation services and investment and financing services. Third, comprehensive technologies, combined with technologies such as big data, cloud computing and the Internet of things, can achieve multi-energy coordinated supply and comprehensive cascade utilization of energy.

Based on this, main domestic enterprises to carry out comprehensive energy services include: China southern power grid comprehensive energy co., LTD. (established in 2010), Guangdong power grid comprehensive energy service provider (established in 2016), ENN: pan-energy network business model (established in 2012), GCL (Distributed micro energy networks), ENVISION (Internet + energy), the Aliyun new energy solutions, etc.

3.2.2 **Strategy selection.** In a whole industry chain, there are have two roles of vendors: system designer and general service provider. Thus, there has core relationships: relationship between system designer and service providers; relationships between different service providers; relationships between the same service providers. To become a system designer is a goal of every vendors. There are game relations among different service providers. Whether service providers can become core vendors of system designer, also be the competition target. Each service provider will set up and expand its service scope and service area to enhance its competitiveness. These relationships are shown in figure 1.

![Figure 1. Strategy selection among vendors](image_url)
4. Footnotes Highlights on Exploring comprehensive energy services

4.1 Strategic Highlights

4.1.1 Demonstration projects of comprehensive energy services. To establish Research Institute as the Grid company (Suzhou) City & Energy Research Institute to enhance research on energy transition in cities. Investigate actual situation of relevant industrial parks, and explore sustainable and popularized business models. Using the data investigated from this reality of industrial parks, Grid company explore an effective, replicable model of comprehensive energy services.

4.1.2 Accelerate research and development of various coupling technologies to break through key technologies. To make full use of modern information and communication technologies such as “Big Data, Cloud Computing, Internet of Things, Mobile Internet”, and Grid company deepened the application of big data in various business areas. Power generation, multi-energy complementation and traditional energy peak-shaving, energy storage and other technologies are not mature enough. The operation of wind-solar and hydropower multi-energy system cannot be guaranteed due to the lack of test platform verification. At present, China's distributed energy, smart power grid, micro power grid, energy storage, energy Internet and demand-side innovation capability are not enough.

4.2 Concrete measures

4.2.1 Demand-side measures. To establish a household energy management system. Research in home energy management gives individual awareness into their home's energy use. Provide personalized billing service to clearly show the electricity situation. Furthermore, to provide energy-saving solutions based on big data and cloud platform. Third, to build a new type of business model featured by win-win cooperation.

4.2.2 Supply-side measures. To install power management unit in the distribution network to monitor operating indicators such as voltage and frequency of key nodes and locate weak links of the network; To constitute a virtual power plant including PV, wind-turbine, biomass power generation, electric vehicles and energy storage devices, participating in electricity market transactions.

5. Conclusion
With rapid development and full use of modern information and communication technologies such as “Big Data, Cloud Computing, Internet of Things, Mobile Internet”, integrated distributed power generation and energy monitoring, control and management technology, as well as rapid development and extensive applications of new energy trading methods, comprehensive energy services have triggered profound changes in energy systems, becoming the focus of new strategic competition and cooperation among enterprises. Based on analysis of comprehensive energy services development, this paper points out the measures taken by grid company corporation to enter the emerging energy service management market.

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