

## GREAT REVOLUTION: THE BUSINESS PERSPECTIVE OF ENERGY INTERNET IN CHINA

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### ABSTRACT

*In this paper, we present a conceptual study of the Energy Internet in the perspective of business. Firstly, we introduce the origin of the Energy Internet and opportunities in the context of rapid development of energy and information technologies. Then, existing and potential innovative business models are summarized from three aspects: production and consumption of energy, asset investment and trading, and value-added information. Finally, suggestions for development of business model and market mechanism are explored, which provides a roadmap for the development of Energy Internet.*

### INTRODUCTION

#### Advantages of Energy Internet

As the 2nd biggest economy country and the 1st biggest energy consumer, China is facing the challenge on energy transition and CO<sub>2</sub> reduction. To improve national economy transition and industrial upgrading, Chinese government has issued “Internet+” strategy in 2015 to optimize production factors, renew business system and reconstruct business model. With regard to the energy industry, “Internet+” strategy also profoundly changed the traditional form. The concept of “Internet+ Energy” (hereinafter called **Energy Internet**) has become a hot word in China since it was officially proposed by National Energy Bureau of China.

Actually, the concept of Energy Internet has already existed for a while. It was first appeared in 2011 as a new term in Jeremy Rifkin’s book [1] entitled “The third industrial revolution: how lateral power is transforming energy, the economy, and the world”. He believed that Energy Internet is an innovative system which integrates distributed energy resources (DERs), hydrogen, storage and electric vehicles with the internet technology. In addition, he pointed out that fundamental economic change would occur when new communication technologies converge on new energy regimes and forecasted the third industrial revolution “was about to happen”.

#### Energy Internet in China

As a matter of fact, the Energy Internet that Chinese people are talking about is the same in essence with the concept proposed by Rifkin. Nevertheless, as an innovative way to construct energy system, “Energy

Internet” has a richer connotation in China as it gains practical experience from the field of smart grid, microgrid and multi-energy system. “Energy Internet” realizes the integration of energy flow, information flow and business flow. “Internet+” is featured with “openness”, “reciprocity” and “decentralization”, and energy flow as a double helix could be combined with information flow to be more robust, more flexible, more efficient. The core point is to emphasize the openness, interaction, equality, sharing and personalization in the whole process of energy production and consumption, as shown in figure 1.

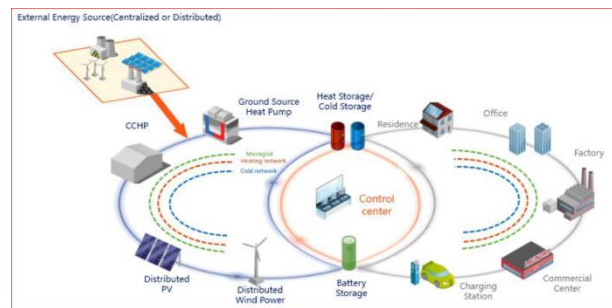


Figure 1: Energy Internet blueprint

In February 2016, the Chinese National Energy Bureau and the Ministry of Industry and Information Technology jointly issued “Guiding opinions on promoting the development of Energy Internet”. In a year later, the Energy Bureau announced the first 55 demonstration projects on Energy Internet. The issuing and implementation of these policies indicate that the Chinese government is strongly supporting the development of Energy Internet.

#### Perspective of Energy Internet

In all ages, from the simple task of burning wood for heat to the green power created by wind turbine, people always try to find the most efficient and economical ways to make our life easier. In the perspective of Energy Internet, energy is beyond a kind of commodity [2] but becomes a very important platform which makes bi-direction interaction, high efficiency and cleanness.

Nowadays, the growing DERs such as wind power, solar power and rapid development of information and communication technologies (ICTS) have been combined to reshape energy form. Moreover, the increasing environment and resource problems are driving people to think about the next generation of energy system. The establishment of the Energy Internet can effectively improve the state of energy in China and

have the following technical advantages. 1) Improving the reliability of the grid structure and system flexibility; 2) Enhancing the coordination dispatching between different regions; 3) Increasing the active control ability of the load; 4) Improving the overall efficiency of energy utilization.

In fact, the innovation of energy system can be equivalent to the innovation of business model and management concepts. A good business strategy will become the core competitive advantage of the energy product and service providers. In the next section, we will discover the existing and potential business models in the perspective of Energy Internet.

## PRELIMINARY STUDY OF BUSINESS MODEL

Peter Drucker, the founder of modern management, once said: "*today's competition between enterprises, is no longer a competition between products, but between business models*". The key point is that firms organize and manage resources (input elements) to meet consumers' needs (output products and services) and form a replicate and sustainable mechanism. As for Energy Internet [3], the difficulty is how to organize different elements based on the internet platform, mobilize the enthusiasm of the participants and conduct value exchange and interest compensation.

Until now, most of the Chinese energy consumers are unable to choose their own suppliers, so there is less motivation for energy public enterprises to think about how to attract clients and raise their loyalty. However, with the deregulation of power market, there will be more energy package (e.g. supplier, tariff and power resource) for users to select. As for energy distributed users/producers "prosumers", they can even build a multi-function trading platform through internet technology, allowing consumers to make the best balance of cleanness, reliability and economy.

Therefore, the innovation and upgrading of whole industry chain are important and indispensable for supporting diversified business models in the Energy Internet age which are summarized from three aspects.

**Production and consumption of energy (Energy Coupling):** The Energy Internet will break the traditional segmentation of energy supply and consumption and combine all resources such as electricity, heat, cold and gas in production, transportation, storage and consumption;

**Investment and trade (price coupling):** The Energy Internet will restore the property of energy goods and realize the real value as far as possible. Therefore, it's necessary to build a two-level market (spot, futures) in energy market and other derivatives markets such as ancillary service, carbon trading and green currency trading;

**Value-added information (information coupling):** The Energy Internet will take information as a link, use data as resource, and use the internet as a mean to provide innovative services through the appreciation of information.

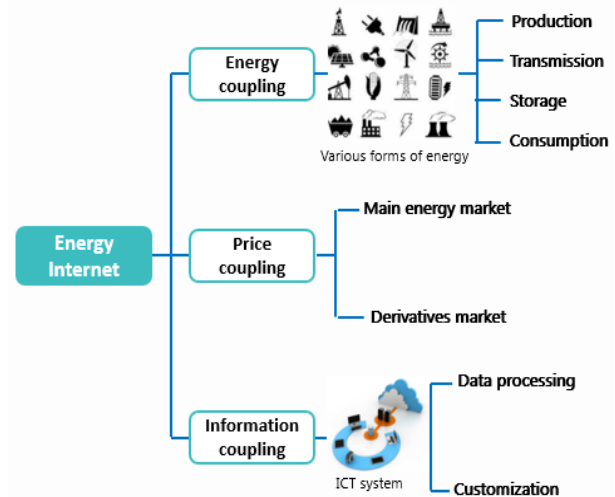


Figure 2: Energy Internet innovation system

As shown in the figure 2, innovation system integrating energy coupling, price coupling and information coupling can give birth to a large number of business subjects and models.

### Production and consumption business model

In the traditional pattern, cold, heat, electricity and gas are regarded as inseparable energies, and their consumption and transaction are still independent. All kinds of energy are connected by the backbone power grid as the hub of mutual transformation, and centralized dispatching and distribution. Meanwhile, by increasing the peak capacity of the supply side, expanding the transmission and distribution capacity of the power grid, the peak energy load can be met and the system can be run steadily.

However, this strategy only focuses on supply side reform but ignores demand side resources, which will cause problems such as excess capacity of resources, irrational energy supply structure and massive resource waste. To deal with these issues, it is necessary to develop distributed energy for energy supply side and actively response to the demand of the user side.

In the perspective of energy production and consumption, we should gradually shift from the government package to the integrator, strengthen interaction among customers, and enhance the enthusiasm of user participation. Energy Internet allows the suppliers and consumers to make quick, convenient and low cost partial transactions. On this basis, the following innovative business models are proposed.

### **Intelligent sensor mode**

In the information age, a big amount of applications of sensors has changed the traditional demand side response system via the innovation of hardware. For example in the aspect of smart building, it's possible to improve the efficiency of comprehensive utilization of energy and reduce cost by monitoring the intelligent sensors of overall parts (lighting, air conditioning, elevator, heating and so on). Meanwhile, in the peak time of using air conditioning, load regulation of building groups can be carried out to achieve more flexible peak control.

### **Flexible energy storage mode**

The development of energy storage equipment has also brought new business models. Through the combination of energy supply and ancillary service, we can create suitable consumption mode according to user characteristics, so that users can freely mix with different energy storage modes, and build their own consumption patterns and customized energy services. This flexible energy storage mode is especially suitable for small and medium users to reduce unnecessary energy waste and improve efficiency.

### **Investment and Trade business model**

In the era of Energy Internet, our goal is to create value based on "user-orientation" principle. On the one hand, users can improve their awareness of energy conservation and environmental protection; on the other hand, the efficiency of asset utilization can be improved by combining energy equipment construction investment and Internet financing leasing business [4].

Compared to the traditional energy industry, renewable energy firms usually carry out financing through the government support and public venture capital, which is often difficult and the investment period is long. However, through the Energy Internet platform, new energy companies will develop more new financing methods, such as financial leasing, venture capital, private equity investment and carbon trading, and create new business models with the Internet.

### **Battery cloud mode**

When Energy Internet data platform alerts that energy providers produce redundant energy resources, we can use the standardization technology to encapsulate this part of the energy in the form of batteries. With the energy smart network, operators can establish the leasehold trading platform for information publishing and trading matching of energy storage battery, and provide logistics transmission channels.

In this way, users can publish their own energy status and the demand for energy storage batteries, and achieve two-way interaction and supply-demand matching on the platform. Battery cloud mode can

improve the efficiency of battery utilization, reduce waste of excess energy, and create value for both parties.

### **Peer-to-Peer financing mode**

Through the Energy Internet financing platform, investors can purchase peer-to-peer financial products based on the new energy equipment, such as photovoltaic panels in solar power projects to be built. Moreover, investors can get the stable rental income from the platform as well as additional income which encourages the enthusiasm for saving energy and emission reduction.

### **Block chain and virtual power plant business mode**

With the large number of distributed energy into the power grid which needs to unify scheduling, virtual power plant (VPP) emerges as a good solution to solve the issues of randomness, dispersion and small capacity. The optimal coordination of multiple DERs can be achieved by higher level of software architecture of VPP, which is conducive to the optimal configuration and utilization of resources. And the block chain technology can provide a fair, credible, central and contractual trading platform for VPP generation resources, which will greatly reduce the cost.

### **Value-added information business model**

Energy Internet is a digitalized energy system in which data plays an important role for the decision making and business strategies development. The role of the information system is no longer monotonous, which has been developed from only performing basic information collection and transmission to analyzing and processing different types of data, such as electricity, natural gas, intelligent transportation, weather and so on. In addition, valuable information can be extracted and transferred to meet the needs of customers in a suitable way according to different algorithms, which improves the system efficiency.

### **Energy stewardship mode**

Based on personalized data information and large data groups, user portrait can be obtained by the professional mathematical algorithm model. Comprehensive energy service firms can provide energy "stewardship" services such as energy prediction, peak valley energy collocation, and priority use of new energy. Meanwhile, they can provide personalized service for all the participants in business transactions, such as users, sellers, new energy developers, etc. in order to create value-added services.

### **Energy "Amazon" mode**

Fast energy distribution system can be established based on big data. Also, a similar "Amazon" energy network trading platform can be constructed. With "Amazon"

energy network, energy providers can freely sell energy products and all kinds of energy services via "online shop", so that customers can make multiple choices according to their needs.

## SUGGESTIONS FOR DEVELOPMENT

Energy system now is in the process of rapid evolution. As a future energy system service model, Energy Internet is still in its infancy. The design of structural framework of Energy Internet should consider the national conditions, energy distribution characteristics, energy consumption situation, as well as the economic and social conditions. In addition, it is necessary to establish a proper standard in the aspects of mechanism, regulatory, technology, etc.

### Market mechanism issues

Building a unified and open, orderly competition market mechanism is strategic issues for the healthy development of Energy Internet. It is necessary to promote the pluralistic development of the main body of the Energy Internet market from the following aspects.

**Specification for market access and exit mechanism:** Based on the regulatory requirements and the demand for electricity reform, it is necessary to a set of soft and hard standards and quantitative indicators to clarify the industry conditions, environmental protection conditions, technology conditions. The companies that violate the laws and rules of the state should be forced to withdraw from the market and piped off.

**Reward and punishment mechanism:** Enterprises with excellent performance should be rewarded by tax incentives and credit rating; on the contrary, for the enterprises that have not met the requirements, policies such as raising taxes, lowering the credit rating, and punishing funds should be implemented.

### Regulatory issues

Regulation is an important issue in Energy Internet ecosystem, the government should take flexible economic tools such as taxation, price and subsidies to help the transformation and upgrading of traditional energy enterprises.

**Tax incentive:** To restore the commodity property of energy product and promote full competition of the energy market, the government should properly release regulation. It is highly recommended to establish a green tax system and increase the support for clean energy and the Energy Internet.

**Price guidance:** To build a better Energy Internet consumption information platform, it is necessary to implement differentiated energy pricing policies, strengthen energy demand side management, and implement contract energy management.

### Technology issues

The progress of technology serves as a cornerstone and driving force for the development of Energy Internet. Government should encourage Energy Internet laboratories and engineering centers on talent training. Meanwhile, the government should strengthen the support for the development of Energy Internet technology, through capital injection, financing guarantee and other forms.

## CONCLUSION

In summary, all of the above related issues are important questions that need to be solved for the long term development. There is no fixed standard answer to each issue. Some issues are interconnected and mutually influenced. Therefore, to promote the sustainable development and fulfill the business potential of Energy Internet, all the stakeholders (including energy product and service providers, operators, regulators, and researchers) in the business process of Energy Internet should cooperate and collaborate with each other.

The ultimate goal of the energy system evolution is to establish a smart, efficient, secure, flexible, diversified, personalized and sustainable energy production and consumption system, which can provide sustainable power for improving people's life quality and promoting economic and social development.

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