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German Smart Meter Development and inspiration

Wang Han [1], Li Ang [2]

[1]Researcher, State Grid Energy Research Institute Co.,Ltd., Beijing, China

[2]Direcor, State Grid Beijing Electric Power Company, Beijing, China

[*] Corresponding author: author@e-mail.org

Abstract. The widespread use of smart meters provides electric power suppliers and power users with a number of innovative business models that add value. The new changes brought by smart meters include two-way communication capabilities, remote monitoring of the status quo of electricity use, transmission of real-time data information, and an increase in the frequency of meter reading, so that both the electricity supplier and the consumer can receive real-time data. These functions represent the corner of the smart meter's potential, in fact smart meter technology can obviously become the basis of a series of innovative business models.

1. Introduction

At the end of 2017, the smart meter replacement work in Beijing was completed in 7 years. Beijing has fully implemented 8.3273 million smart meters. With the popularization of smart meters, customers are becoming more and more accustomed to the convenience of online payment, emergency power transmission, and real-time viewing of electricity usage.

Under the current trend of power reform, traditional power grid operators are seeking to transform themselves, and various types of integrated energy service companies have emerged. Competition for customer resources is bound to become increasingly fierce. However, with the deepening of the concept of green development and the gradual promotion of low-carbon life, the needs of customers are also changing. Simple and convenient services have become the basic requirements of customers rather than the advantages of suppliers. As a connection port between suppliers and customers, smart meters are able to obtain a large amount of customer electricity data. This makes good use of it and strengthens the breadth and depth of data mining. It will not only be able to understand customer needs through data analysis, thus providing value-added services for customers. The mastery of a large amount of data resources will further enhance the ability of market participants to control the market.

In 2013, the German Information Security Agency (BSI) was entrusted by the German Ministry of Economy and Energy to develop a new technical specification for smart metering systems, and put forward a smart meter gateway as the center, based on advanced two-way communication network connection measurement. The intelligent measure-ment system of the instrument network, wide-area electricity market, and demand-side interaction is abbreviated as iMsys. In this architecture, electricity meters are only measuring sensors responsible for collecting data, while smart meter gateways are the core of system intelligence and are key functional modules that connect participants from different regions.

2. Smart metering system of E.ON

E.ON Group is an international, private energy supply company and its main business is renewable energy, energy networks and customer solutions. Since the original group split at the beginning of

2016, the New E.ON Group has started to focus on related businesses in the renewable energy sector and has focused on providing customers with better energy use solutions.

In the “21st edition of the new energy and economic law” in 2012, Germany introduced relevant laws and regulations for the promotion of smart metering system (iMSys) in a wide range of areas. In particular, the scope of promotion and the role of the person responsible are clearly defined and the four situations in which iMsys must be installed: new or extensive repairs Houses; power consumers with an annual electricity consumption of over 6,000 kWh; newly installed new energy power generation equipment and cogeneration facilities with a capacity of over 7 kW; and all technically and economically allowable buildings. In addition, Germany has also established measurement system regulations that clearly define the nature of the open market in the energy measurement industry and have given birth to new roles in the electricity market, such as measurement service providers.

In July 2016, the German Federal Parliament passed the "Act for the Digitalization of the Energy Transition" to support the deployment of smart meters nationwide. The new policy requires that from 2017 to 2032, advanced metering infrastructure be provided to consumers who use more than 6,000 kWh of energy and factory operators which installed capacity is more than 700 kW.

According to preliminary statistics, 40 percent of iMsys needs to be installed in Germany by 2020. This is undoubtedly a huge business opportunity for manufacturers of meter and measurement systems. Leading companies such as Landis & Gyr and Siemens Smart Grid have already been gearing up to launch their flagship products. However, compared with the hidden business value behind the power data collected through iMsys, hardware and software equipment is only a fraction of a million.

E.ON Group seized this favorable opportunity to vigorously promote the operation and use of iMSys. Compared with the traditional meter, the modern metering device provided by E.ON Group can provide customers with a large amount of energy consumption information through the meter display. If the energy consumption exceeds 6000 kWh, the communication module and smart meter gateway added by the metering device can automatically send the consumption data to the corresponding operator at the metering point. Of course, the consumption data has been encrypted according to the requirements of the Federal Information Security Office. In addition, smart metering systems measure and report meter readings every 15 minutes, which makes power consumption more transparent, for example, the potential for saving power can be detected.

The smart metering system can not only provide users with real-time feedback on energy usage, but also can send power usage information to suppliers. At the same time, it can also integrate control terminals to realize real-time control of power-side energy management and distributed power supply equipment. Through smart metering systems, suppliers and customers are closely linked to provide them with large amounts of data and information, making demand-side responses possible. In the future, demand-side energy data may become an important commodity in the electricity market. Therefore, market participants who can grasp the massive load and power generation data will occupy a pivotal position and even have the ability to determine the market. On the one hand, iMsys provides real-time feedback on electrical water usage information for demand-side users, and incorporates real-time floating tariff information delivered from the market side. Together with building and home energy management systems, consumers can use electricity to improve their electricity habits and improve their efficiency and optimization. Energy consumption, low energy smart home. On the other hand, iMsys can provide 24-hour load and low- and medium-voltage grid status information, providing the basis for analyzing and excavating demand-side power and distributed generation characteristics. For power sales companies, understanding the habits of consumers using electricity can help them develop more attractive tariff packages; for power company accounting units, it can help them better understand the real-time power and power generation information on the demand side. For grid companies, having load and distributed generation data can help them optimize grid planning and operation. The iMsys combined with a distributed generation control system can also provide support for grid scheduling and intelligent control of virtual power plants.

Through the smart meter gateway, real-time feedback of electrical water usage information and price information can be provided for the user on the demand side, and power information on the

demand side can also be sent to the corresponding power market participants. More importantly, smart meter gateways can be combined with control terminals to implement energy-side power management and real-time control of distributed power devices. At the same time, the German Information Security Agency has also developed an information security standard that puts forward detailed and strict requirements and technical specifications for the protection of the collection and processing of electrical and personal information in the entire measurement system.

Of course, data security protection is also indispensable. E.ON Group ensures that data security and privacy protection can reach the highest level required by the government.

3. The owner of the data

Smart meters are one of the cornerstones of smart grids and digital energy because they generate a lot of data. As more and more users connect through smart meters, the amount of data available to the system also increases. The importance of smart meters is their simplicity. Compared with battery storage and electric vehicles, their entry barriers are low (front-end costs are usually borne by energy suppliers), which means that they may have the most direct impact on the average consumer. In Europe, the European Union has strong supervision over the installation of smart meters, and countries such as Sweden, Italy and Finland are already approaching 100% of the smart meter penetration rate and benefit from customer participation and active energy management initiatives.

At present, Chinese ownership of the data collected by the meter is not clearly defined, so the general data is also owned by the owner of the meter, which means who gets it, who owns it, and who uses it. Under the background of the new power reform, a large number of power sales companies will soon be flooding into the electricity market. The above new digital business model will enable some companies that are good at data analysis and use to stand out from the competition. At this time, the data owner’s importance will then be highlighted. In the future, there may be disputes over the ownership of data, and even the competition for data among enterprises.

A German utility association (VKU) believes that its members are at a disadvantage because the smart meter data is first transmitted to the grid operator. Many new energy business models rely on the automatic analysis of large data sets of smart meters ("big data"), which means that data ownership will be highly controversial in the future. Those "new" companies that are smart enough to have a deeper understanding and analysis of data will stand out. In the mature market for electricity sales, it is no longer a big company that devours a small company, but a fast company that adapts to the market devours old slow companies.

The peak load for intermittent renewable energy supply is another important area of digital competition. This technology is currently used in large-scale industrial applications and is gradually moving toward the home. For these dispersed power systems, high-cost trading is a stumbling block to new business models. So some people in the industry believe that "blockchain" is one of the ways to solve this problem. In the future, virtual power stations like car batteries will also be a key point in the competition for the downstream market: Cloud-based IT control systems focus on a large number of decentralized power producers and flexible consumers. By intelligently distributing and trading electricity, virtual power plants can relieve grid pressure and allow the integration of renewable energy into existing power systems.

For Internet companies such as Alibaba and Tencent, which have a large amount of customers’ data and have strong data processing capabilities, the digital trend may become a stepping stone for them to enter the energy industry to develop new businesses. Whether through the model of data business services and cooperation with other power selling companies, or directly establishing an independent power sales company, this stock can’t be underestimated. If we further take advantage of the Internet company's own sales platform, its future strengths and competitiveness in the field of power sales are self-evident.

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In order to fully tap the potential value of smart meter data, the State Grid Corporation of China launched a number of research projects based on the application of smart meter data. For example, distribution network resource optimization and service key technology research projects based on business data fusion are full use of smart meter measurement data to conduct research on consumer power consumption behavior, distribution network planning and design models, and short-term load forecasting. In addition, in order to eliminate the islands of data between power distribution and power marketing, the State Grid Corporation of China is implementing work-to-manage data migration work to prepare basic conditions for the analysis of smart meter data. At present, the China Electric Power Research Institute is conducting research on power big data, developing a power big data platform, and conducting key energy technologies such as energy efficiency analysis for big data. It can be predicted that the deep value of smart meter data will be reflected in the next few years. However, at present, the analysis and application of smart meter data in China also have problems such as fragmentation of data, lack of systematicness, and low calculation efficiency of ultra-large-scale data sets.

4. Data security

Recently, Alipay's annual billing event has received extensive attention, and personal information security has once again become a hot topic. Tencent even upgraded its security software for related communications software in 2016. This shows the importance of citizen privacy.

Smart meters are installed on the customer's side. Collecting and using personal data and information of the customer's private electricity will inevitably involve personal privacy issues. Analysis of electricity-related data can reflect the customer's lifestyle to a certain extent, such as the time to go out and go home, the time to go to bed, the time to go out, etc. Once these data are grasped by people in mind, it is very likely that the personal safety of the customer poses a risk.

Compared with China, the German public pays more attention to personal privacy and has strict requirements for collecting, using, and processing customer information. The smart meter system is installed on the demand side and involves the collection and use of user power and private related information. For historical reasons, Germany’s personal privacy is paramount, and it is a very troublesome problem to collect, process, and use user-related information. Although the German Information Security Agency is developing technical standards for information security, most people in Germany are conservative in their analysis of their own power consumption information, knowing when to watch TV, playing computers, washing clothes, sleeping, and vacationing. The German Information Security Agency (BSI) has also formulated technical guidelines and information security for smart meter measuring systems at the national level. Standards, E.ON Group also do not have exceptions to comply with these regulations. E.ON Group's smart meter gateway administrator information security management system has passed ISO 27001 information security management system certification, indicating that the Group's information security management system complies with the German Federal Information Security Office's technical guide 03109-6 and also complies with German legislation. Agency's high security requirements for gateway management. It is worth mentioning that the security responsible for the gateway is not its E.ON Metering GmbH, which is responsible for the smart metering business. Instead, it is a subsidiary of its group called E.ON Stadtwerke. The form not only ensures the information security of the meter, but also effectively reduces the time and economic cost required to establish the certification.

It is currently estimated that the installation of new measurement systems for electricity users will cost about 50 to 70 euros per year. It is still unclear whether the new system can help electricity users save electricity and reduce electricity bills. This makes the German public more skeptical. And

whether the optimization of electricity price packages and grid optimization operation plans facilitated by iMsys can bring economic benefits to users has yet to be verified by the market.

In order to promote smart measurement systems, Germany has, as always, started by defining technical guidelines and introducing laws and regulations. However, it is precisely this rigorous but almost rigid working method that has slowed down the progress of promotion. By the end of 2014, the German Ministry of Economy and Energy is still further formulating relevant regulations and clear preferential policies in order to establish a complete legal framework. This undoubtedly puts forward the relevant products to the German manufacturer, has increased many difficulty to the promotion and the use of the German electric network company, also increased the cost and the expense.

5. Conclusion

In the future smart grid and smart power market, demand-side management and demand response technologies are important means for coping with a large number of distributed power generation, coordination, and optimization of demand-side power consumption, power generation modes, and energy efficiency. The German-defined smart measurement system is beyond the traditional boundaries, connecting users, measurements, the power grid and the market, promoting real-time interaction between them, providing massive amounts of valuable data and information for consumers and electricity market participants, and enabling demand-side response in the true sense while also fostering innovative business models.

References

[1]Fan Shanshan,2018. The progress and challenge of the energy transition in Germany 2017, Energy. 2018(3), pp.92-93.

[2]Fan Shanshan, Lessons learned from the sale of electricity in Germany, Energy. 2016(6), pp.49-51.

[3]Chen Liang, Lv Fangcheng, Xie Qing, Lan Xingni, Sun Shaojun,2011. Real-time Measurement of Two-way Communication Smart Meter Development, Chinese Society for Electrical Engineering. 2011(31), pp.94-99.

[4]Xu Hailan, 2018. Research on Data Application of Smart Meter in Measurement Automation System, Science and Technology Economic Guide. 2018(26), pp.98+216.

[5]Jia Haibo, Zhai, Wang Shuai, 2018. Research on the Development Need of Smart Grid for Smart Meters, Communication World. 2018(1), pp.245.