

# **Analysis and Application of "Internet + Power Demand Side Management"**

## **-----Taking Foshan as a Pilot**

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**Keywords:** Foshan, Internet +, PDSM

**Abstract:** "Internet +" development provides the conditions for the innovation of power management mode. Foshan is a pilot city of national power demand side management, which is a research demonstration. Mainly combing the current situation of Foshan electric power, getting the current situation and development direction of Foshan electric power, and putting forward improvement measures. To promote the pilot development of electric power reform in Foshan area by means of theoretical research and drawing lessons from the experience of advanced western countries and regions on electric power management.

### **1. Introduction**

"Internet +" is the inevitable trend of the development of the power industry. The products and services of the power industry need to rely on the "Internet +" to achieve development. At the end of 2012, Foshan, together with Beijing, Tangshan and Suzhou, became four pilot cities of PDSM. In March 5, 2015, Premier Li Keqiang put forward the "Internet +" action plan, which provided the main basis and carrier for the commercialization of Internet power. The main purpose of DSM is also to promote the connection between suppliers and demanders through the Internet. Therefore, based on the actual situation of electricity demand market in Foshan area, this paper grasps the characteristics of electricity demand management, innovates the system mechanism, management methods and means of power demand side management, and puts forward feasible countermeasures under the new normal economy. The aim is to create a set of "Internet+Power" Foshan model which can be popularized and replicated.

### **2. Research on PDSM under the background of "Internet +"**

As a cleaner secondary energy than primary energy, power resources play an important role in economic and social development. Demand side management (DSM) is an important method to improve the efficiency of power utilization and the production and living index of residents.

#### **2.1. Power demand side management**

Demand side management of electric power refers to the related activities carried out to improve the utilization efficiency of electric power resources, adopt various measures to change the mode of power consumption of electric power users, improve the efficiency of terminal power consumption, reduce the service cost of power supply departments, and realize scientific, economical and orderly use of electricity. The concept of DSM was introduced into China in the early 1990s. Its role is mainly manifested in the following aspects: firstly, it provides a way of saving energy to solve the shortage of power supply, that is, emphasizing market incentives to promote users to actively improve power efficiency, reduce unnecessary waste of resources and save energy; secondly, it attaches importance to the establishment of partnerships between power companies and users, and advocates that power companies adopt scientific management through enhancing the awareness of energy services.

Table 1 Comparison of Demand Side Management and Conventional Resource Management

Number	Type	Purpose	Characteristic
1	Water Conservancy and Power Generation Determined by Water Intake Process	Describing Unscheduleable PDSM	It can determine the amount of electricity saved in each period of time.
2	Hydraulic Power Plant	Describe PDSM to be used whenever necessary	Operating time is uncertain
3	Energy-constrained power plants	Describe POSM with a given total output	Given the total power saving, the output of electricity is variable.
4	Pumped storage power plant	PDSM Describing Change in Power Use Time	Turning Electricity Use Behavior from Peak Period to Trough Period

## 2.2. Research Status of PDSM

Foreign scholars study. Bruce Biewald demonstrates the impact of electricity price on electricity consumption from the perspective of interaction of "electricity consumption demand - electricity price" and two-way feedback. According to the cost function of power users, International Energy Agency predicts the response of power users to PDSM, and draws the conclusion that PDSM can stimulate more power users to voluntarily participate in PDSM projects. Sappington and others introduced the incentive mechanism to promote project investment implemented in the United States, and then explained the role of incentive mechanism in it and the specific operation process.

Research on PDSM in China. Power Demand side management has been introduced into China since 1990s. After more than 20 years of practice and development, it has initially formed. In terms of macro-policy research, in November 2010, the State Development and Reform Commission and other six ministries jointly issued the Power Demand Side Management Measures. On April 8, 2014, the "Notice on the Construction and Application of National Power Demand Side Management Platform" was issued. In the aspect of DSM mechanism, Zhou Fu-qiu and others have made a preliminary discussion on the implementation mechanism of PDSM. They believe that the prominent problems of PDSM at present are imperfect laws and regulations and lack of supporting policies. Based on the theory of cost-benefit analysis, Dong Linlin puts forward a decision-making model suitable for the operation price of power system and power market.

## 3. Implementation Experience of PDSM in Relevant Countries and Regions

The United States has always been the world leader in the application and promotion of PDSM. At present, more than 30 countries and regions, such as the European Union, the United States, Japan, Brazil and Southeast Asia, have also been successfully applied, and more and more attention has been paid to them. China's application started relatively late, and its development is to a considerable extent forced by the current situation of energy and resources. However, with the gradual development of PDSM, the development trend in the future is to build an Internet + demand side management system platform for energy efficiency management of power users.

### 3.1. Major Practices

The United States was the first country to propose and implement PDSM. In the process of implementation, the preliminary effect is not obvious, but after expanding the scope of the pilot project and increasing the pilot project, the comprehensive economic benefits have increased year by year, and the user electricity fee has also decreased. Especially the energy-saving PDSM project is very popular with users. For example, the United States invested \$11.6 billion in 2000, saved 537 billion degrees of electricity and reduced peak load by 22 million kW.

The structure and property right structure of Western European Electric Power Company are diversified. The motivation of implementing PDSM is complex, some for environmental considerations, and some for solving the lack of power capacity. The effect needs further observation. In Eastern Europe and Africa, power demand side management is limited due to the relatively low level of technology and management and political instability. PDSM is still in its infancy in many countries in Asia and Latin America. Canada is also one of the most successful countries to implement PDSM after the United States, and has begun to pay attention to DSM planning of distribution network.

Table 2 Implementation of DSM in two Canadian power companies

Corporate name	Installation capacity (KM)	Power generation form	PDSM Input Funds	Avoidable electricity	Avoidable peak load capacity	Payback period
Quebec Power Company	3600	Water(95%), fire(3%) nuclear(2%).	6600	20	170	2.2
Ontario Power Company	2933	Water(25%), fire(10%) nuclear( 65%).	5000	14	140	3

In short, over the past 20 years, more than 30 countries and regions have successfully implemented PDSM project plans, greatly reducing the number of new power plants, reducing customer electricity costs, reducing environmental pollution, and achieving good economic, social and environmental benefits.

### 3.2. Advanced Experience

First, sound laws and regulations. For example, the German Federal Government introduced the market competition mechanism by amending and improving the Energy Law to create conditions for power companies to implement DSM. In 1992, the Thai Government established the Energy Saving Promotion Fund through the Energy Saving Promotion Act. Second, a sound financial and taxation system. In the process of implementing DSM, the EU will reduce its energy efficiency investment and investment by giving appropriate benefit subsidies to power enterprises. Some countries also levy energy taxes on all electricity users and set up a public plan or fund to encourage energy conservation and promote energy efficiency. Third, a sound incentive mechanism. The EU has set up a public benefit fund, established a cost compensation mechanism for DMS, and given priority support to the research, development and application of new DMS technologies. Fourth, the incentive mechanism for power users. American Electric Power Corp. offers a 20% reduction in electricity consumption and a \$400 subsidy for peak shifting projects in Canada.

## 4. Necessity of DSM in Foshan District

### 4.1. Economic Development and Electricity Consumption in Foshan District

Foshan's economic development level is the first echelon in Guangdong, and its electricity consumption and power supply capacity are at a strong level. According to statistics, the electricity consumption of Foshan in 2015 was 53.307 billion kWh, an increase of 0.19% compared with the same period last year. The GDP generated per unit of electricity was 14.52 yuan per kWh, an increase of 6.22% compared with the same period last year. According to the data of Foshan Municipal Government's work report in 2017, Foshan Power Supply Bureau has sold more than 60 billion kilowatt-hours of electricity, becoming the fourth city in South China Power Grid and the thirteenth city in China with more than 60 billion kilowatt-hours of electricity. The per capita

electricity consumption exceeds 8000 kWh, reaching the per capita electricity consumption level of developed countries.

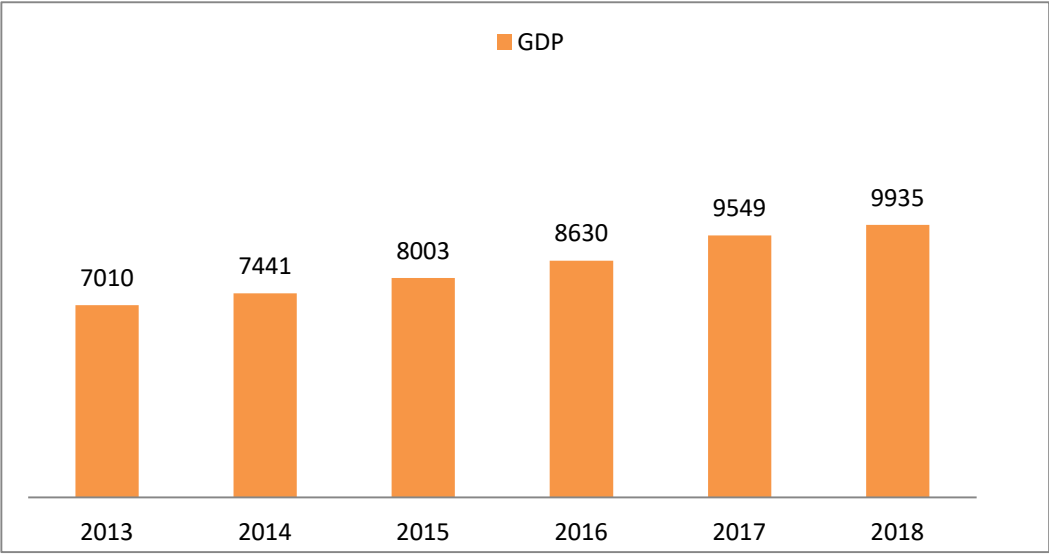


Fig.1 Total GDP of Foshan City from 2013 to 2017

In terms of photovoltaic power generation, Foshan Power Supply Bureau invested 1.546 billion yuan in the construction of Foshan power grid in 2015, promoting 82 photovoltaic power generation projects to be connected to the grid successfully. The photovoltaic power generation reached 11.11 million kWh, and the photovoltaic power generation reached 16.01 million kWh. In 2017, photovoltaic grid-connected electricity reached 16.01 million kilowatt-hours, more than doubling the year-on-year increase.

In 2017, 344 new charging piles were built in the city, covering highway, urban public areas, residential areas, office space within the system and other fields. In terms of electricity substitution, 253 projects have been promoted, with a total electricity substitution capacity of 768 million kWh and a reduction of 651,000 tons of carbon dioxide emissions.

Table 3.Comparison of Electricity Consumption in Foshan City in 2015 and 2017

Time	Electricity consumption (billions of kilowatt-hours)	Photovoltaic power generation (millions of kilowatt-hours)	Substitute electricity (billions of kilowatt-hours)
2015	533.07	11101	7.68
2017	600	16010	8.9

#### 4.2. Necessity and Feasibility

Power Demand side management is a strategic management project to implement the 19th National Congress of the CPC on ecological civilization construction and scientific management of electric power. It can achieve significant power saving, emission reduction, economic, environmental and social benefits. The proposal of ecological civilization has undoubtedly injected a strong new impetus into DSM. At the same time, the unbalance of power supply and demand in Foshan region has existed for a long time. The abnormal development of new energy power poses a major new challenge to the balance of power supply and demand, with regional, seasonal and time-limited power shortages. The serious shortage of power supply in Foshan power grid, the vigorous development of the old city reconstruction project and the increasing difficulty of power grid construction have led to the severe power consumption situation of Foshan power grid, which requires demand side management to achieve efficient utilization of power grid. The implementation of the "Internet +" strategy provides a new means for PDSM, which makes it possible to expand the work content, innovate the work mode, improve the work efficiency and improve the level of scientific management. Therefore, the Internet + demand side management is

an effective way to solve the power shortage problem in Foshan power grid. There is a two-way demand between power supply companies and users for intelligent use of electric energy and information interaction. The research and application of intelligent demand side management system is an urgent need for power supply and demand at present.

## **5. Suggestions and measures**

The first is to speed up the research on PDSM. The United States and other western developed countries have made some achievements in this regard, and have accumulated considerable experience. Foshan can strengthen its reference and learning through investigation and research to improve the construction effect of Foshan PDSM pilot project. Second, to accelerate technological innovation. We will strive to promote the technological innovation of PDSM, build a PDSM technological innovation system with enterprises as the main body, market-oriented and industry-university-research combination, and effectively play the key supporting role of technology in PDSM. Third, improve the standardization level of internal management. Strengthen the investigation of the electric power market in Foshan area, and combine the power supply capacity with the actual situation of the region to rationalize the distribution of electric power facilities.

## **6. Conclusion**

China's electricity consumption growth will basically keep pace with economic growth, faster than the overall energy consumption growth. In 2020, China's total social electricity consumption will reach about 8 trillion kWh. In 2050, China's total social electricity consumption will double that of 2020. In the next 30-40 years, the proportion of electricity will gradually increase to more than 50%. Therefore, in the medium and long term, the energy Internet will be a modern energy system with smart grid as the center and multi-energy complementary. Strengthening the application and practice of PDSM is an important work of power management.

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