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Energy renovation model in China: Research and recommendations

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Abstract

In the past 20 years, a large number of houses in China have aged, and the energy systems of older houses have lagged behind the current living demand. This research compares the energy renovation models in China and the United States, and founds that the Chinese energy renovation model has difficulties such as a small scope of application and difficulties in raising funds. And then, a case study on the Korean. It concludes that in the early stage of the development of building energy efficiency, energy-saving guarantees mode can promote energy-saving projects. In the middle and late stages, the contract guaranteed market survival space can be suppressed, and the energy-saving industry can be adjusted to be dominated by energy-saving sharing.

Keywords

Energy management, energy renovation, house energy system, sustainable development.

1. Introduction

The ageing of energy supply systems and fragmentation of energy management in buildings are currently barriers to the development of older houses as well as a global challenge in sustainable urban development. With the rapid development of industrialization and urbanization, the matter is already being regarded with great concern by the international community. In China, a variety of urban regeneration activities have been undertaken to address this challenge, such as micro-transformation for old community and reconstruction of villages in urban areas. Nevertheless, the situation is not satisfactory. According to relevant sociological poll, the aging population has changed living needs, and the aging infrastructure, inefficient use of energy, difficulties in raising funds for upgrading, and the difficulty in finding adequate parking and charging facilities in old houses community are discouraging new citizens from using them, and the aboriginal have moved out (Cui et al., 2022).

The root cause of this problem is that the energy systems of older houses are lagging behind the needs of social development. If no effective measures are taken, the vacancy rate of older houses in urban centers will continue to rise, which will not only bring a series of social, economic and environmental issues, as well as long-term negative effects on sustainable urban development. Therefore, upgrading the energy system of old houses is urgently needed by the society. Energy system renovation requires the joint efforts and comprehensive

strategies of many parties in the society, so that we can maintain the vitality of the old urban centers, improve the utilization rate of social resources, and promote the sustainable development of the city.

2. Upgrading of energy systems limited in scale

As a major energy consuming country in the world, China's energy structure based on fossil energy is an unsustainable development method, which has caused serious environmental problems, such as smog (Yuan et al., 2014). Therefore, China began to develop a sustainable low-carbon economy in response to the global environmental crisis, and plans to develop the energy-saving industry into an economic pillar industry (Li, 2015). In the energy-saving industry, the energy menagement contracting (EMC) mode is very helpful for energy-saving renovation of existing buildings.

In China, the two main types of EMC are energy-saving guarantee type and energy-saving sharingtype. Studies have found that energy-saving guarantee type can better promote building energy saving projects (Liu et al., 2017)and increase ESCO business volume in a short period of time, but it is not supported by various government fiscal policies supported. On the contrary, the energysaving sharing type that can accept financial support needs ESCO to bear the financing risk, but it is difficult for ESCO to apply for loans. As a result, ESCO's business volume could not be increased, and the financial support provided was wasted.

China's large enterprises are currently not very interested in energy-saving projects. In the energy saving guarantee type, the need for building owners to provide funds or take risks is not what business managers want. On the other hand, SMEs cannot afford the initial large investment in energy-saving projects due to financing difficulties. The uneven distribution of financing risks has become one of the key obstacles to the inability of ESCO's business volume to increase substantially.

On the other hand, the survey found that energy-saving guarantee type and energy-saving sharing type building owners have different concerns in energy-saving projects. Building owners who use energy-saving guarantees are more concerned about how to reduce project costs. Using another type of building owners pay more attention to investment income. The reason may be that in the latter EMC model, the energy-saving equipment purchased for the initial investment belongs to ESCO during the contract period, and the energy-saving benefits during the contract period will be regularly shared by the building owner to ESCO in proportion. At the end of the contract period, ESCO will transfer the energy-saving equipment to the building owner free of charge. In the energy saving guarantee type, since the building owner invests in the purchase, there is no stage of equipment ownership change during the entire contract period. Therefore, building owners who use energy-saving sharing type will pay more attention to investment income. They will worry about whether the energy-saving benefits shared every year can be maintained until the end of the contract period and obtain equipment ownership due to lack of ESCO's credit rating.

Nevertheless, energy-saving sharing that pays more attention to investment income can still maximize the benefits of energy-saving projects. This may be the reason why the state provides economic and policy support. Because the benefits of energy-saving projects come

from the amount of energy saved, the greater the amount of energy saved, the greater the return on investment. Therefore, ESCO focuses on maximizing energy savings not only to maximize the investment income of energy-saving projects, but also to maximize the environmental benefits, social benefits and other comprehensive benefits that cannot be quantified.

In contrast, about the energy-saving guarantee type, because it is more concerned about reducing project costs, it may encourage some ESCOs that can only provide low-quality energy-saving services, thereby compressing ESCOs that provide high-quality energy-saving services. This is because there are no industry standards for ESCO credit ratings and technical ratings in the energy saving industry, and also the ESCO business records are not published. Although the energy-saving guarantee type can ensure that the building owner obtains the initial energy-saving amount of the project during the contract period, the energy-saving amount agreed in this contract may be intentionally reduced by ESCO because the building owner has no energy-saving expertise. This will lead to reduced benefits of energy-saving projects and waste of social resources. As a result, bad money drives out good money, and it is slow to improve scientific research and technology, culture and education, and environmental quality related to building energy conservation. It is difficult to achieve the SDGs promulgated by the United Nations and the country's 2035 target.

3. The ESPC was introduced to China EMC

Energy conservation and improvement of energy efficiency are tools to cope with the global environmental crisis and rising energy prices (Yang & Chou, 2017), because it can not only alleviate energy and environmental crises at the same time, but also the comprehensive benefits it produces can benefit multiple groups in society.

Energy-saving performance contracts (ESPC) first appeared in the United States in the 1970s and were used as a model for energy-saving renovation of existing buildings, and were later introduced to many countries. The ESPC model forms a contractual relationship between an energy-saving enterprise (ESCO) and the building owner. ESCO will upgrade the building owner's electrical equipment, power system, electrical appliances, etc. during the contract period, so that the building owner can obtain the energy-saving amount required by the contract. The ESPC model contract requires ESCO to provide the following tasks: prepare a reasonable energy saving plan, negotiate financing entities, apply for loans for energy saving projects, equipment purchase and installation, and equipment operation monitoring during the contract period (Tetreault & Regenthal, 2011). The current ESPC is mainly based on energy hosting type.

3.1. ESPC & EMC

The origin of the energy management model is the United States, which was later introduced and used by various countries. Due to the differences in national conditions and systems, the ESPC in the United States and EMC in China are also very different.

The implementation of ESPC has received support from all aspects to create an external environment. From a regional perspective, in order to enable different types of buildings to achieve energy conservation and emission reduction in the United States, the federal, state,

and local governments have energy-saving tasks that need to be completed every year, and public facilities are the main targets of energy-saving projects (Gezmen, 2021). However, China's efforts in this area are obviously insufficient for compulsory enforcement. Not only is there no mandatory energy-saving laws and regulations, but energy-saving tasks are not included in the annual performance appraisal of government managers. This has caused local governments to be less interested in energy-saving projects, and even do not understand EMC and national energy-saving industry support policies. EMC is not taken seriously in the government and public sector, making it difficult to implement a number of policy support issued by the state (Xu & Li, 2019).

Regarding the above problems, the development of EMC should be recognized and supported by more local governments, and local energy conservation, energy conservation project growth and energy consumption savings of energy conservation projects should be included in the annual assessment scope of government managers (Zhou & Yu, 2012). To solve the problem of inconsistent pace between the central government and local governments, one of the keys is to improve the external environment for EMC development. The external environment is mainly affected by factors such as the economic environment, policies and laws and regulations, scientific research and technology, culture and education, and industry standards (Chen & Tang, 2016)

4. Case of Korea

South Korea has been very active in improving energy efficiency and introduced ESCO business very early. In terms of policies and laws, ESCO provided financial support in the "Reasonable Energy Utilization Law" in 1991. In 1993, it began to provide long-term low interest loans and preferential tax policies for building energy conservation projects (Lee et al., 2003). ESCO not only obtains legal and economic support provided by the state, but also the investment process of building energy efficiency projects is very clear (Figure 1)

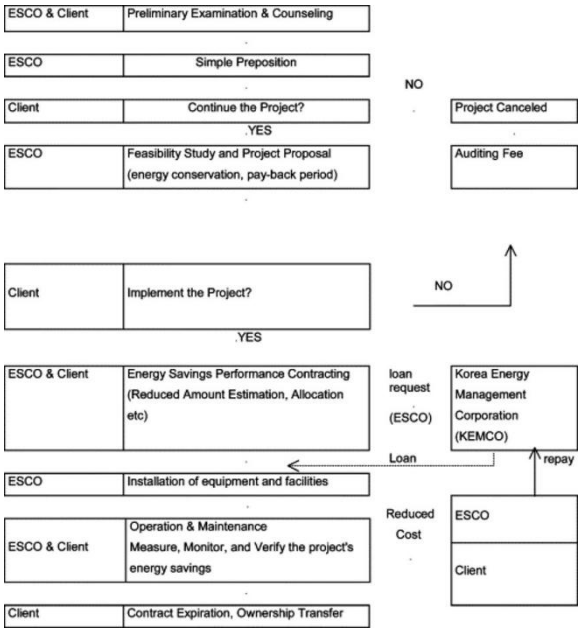

Figure 1: investment Process of ESCO Projects in Korea (Lee et al., 2003)

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However, in the process of promoting ESCO business in South Korea, it still encountered the barriers of national management system differences (VINE et al., 1998), which hindered the expansion of ESCO business in the public sector (Lee et al., 2003). One reason is that government administrators are not familiar with ESPC. On the other hand, because the public sector makes a budget once a year, building energy-saving projects will only be considered when the budget is sufficient. In the budget, the equipment procurement and energy costs are considered separately. As a result, it will take one year after the installation of energy-saving equipment for ESCO to recover the contractual share of the revenue (Lee et al., 2003). This led to the inability of both parties to negotiate, and the energy-saving project was shelved.

In order to eliminate this obstacle, the public sector asked the Ministry of Finance to popularize ESCO business and persuaded they to approve the public sector to sign a long-term ESCO business contract after the corresponding fiscal year. At the same time, it revised the national procurement law in July 1998. Therefore, both the amount of investment and the number of projects of ESCO began to grow rapidly in 1998 (Figure 2) (Lee et al., 2003)

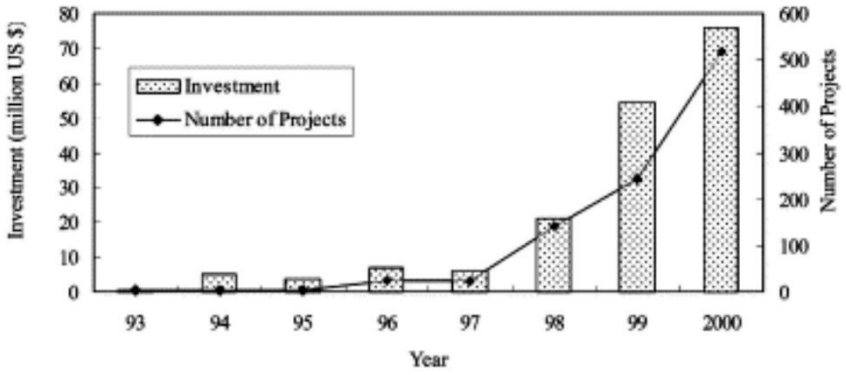

Figure 2: (Lee et al., 2003)

After the ESCO business has been promoted and implemented in some public sector buildings, the implementation in building types has not been smooth. ESCO's business was not very interesting from building owners, because building owners considered it expensive to provide accurate and detailed energy conservation solutions for multiple systems. Therefore, the Korean government prioritizes the energy-saving update of the lighting system, that is, moving the old lighting system with a high-efficiency and energy-saving lighting system (M&V) . Because the lighting system is one of the energy-saving systems that is more immediate with lower cost than other energy-saving projects. From simple to complex promotion methods, people gradually applied ESCO business and the processes, result in later years ESCO business began to diversify (Figure 3) (Lee et al., 2003).

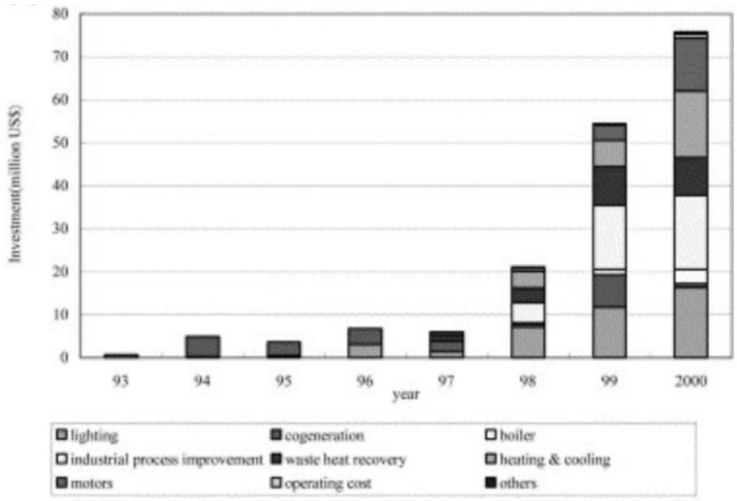

Figure 3: (Lee et al., 2003)

The rapid growth of Korean ESCO business not only benefits from a good external environment and sufficient policy and economic support for ESCO, but also from simple to complex marketing methods (Lee et al., 2003). The efforts made by the Korean government have reaped the huge business volume of ESCO, which not only improved the quality of life of residents but also reduced energy consumption, achieving the purpose of alleviating the energy crisis and reducing carbon emissions.

5. Conclusion

In my opinion, in the early stage of the development of building energy efficiency, we can try to use energy-saving guarantees to promote energy-saving projects but stipulate the maximum contract period. This will not only increase the visibility of EMC, but also increase ESCO's business volume in the short term, achieving the goal of adapting building owners to the EMC model from simple to complex. In the middle and late stages, the contract guaranteed market survival space can be suppressed, and the energy-saving industry can be adjusted to be dominated by energy-saving sharing.

In addition, in order to increase ESCO's business volume and people's acceptance of ESCO, the MUSH market and the real estate industry should be prioritized. Because China is currently in the stage of economic transformation into a sustainable low-carbon economy. In the past 20 years due to urbanization, large tracts of land have been used to build housing, and the tax is obtained through sales. This has not only caused the regional government to rely heavily on the land economy, but also the real estate market is developing rapidly and the bubble is serious. Therefore, the central government began to regulate the real estate market in 2019 to reduce the leverage ratio of real estate and stabilize housing prices. Since 2021 alone, the national housing market has been regulated 320 times by policies and is still increasing. This provides EMC with market demand, because the country’s 2035 goal requires form a green lifestyle and production method (Liu, 2021). A large number of old urban residential areas cannot be demolished and sold. Energy saving renovation will be required to increase housing

rental income by improving living comfort and to resist the risk of depreciation caused by old houses.

In the stage which the development of real estate companies is restricted due to market regulation, the development of real estate companies is restricted due to market regulation, and this can be a good time for ESCO business. Because the development of ESCO businesses affiliated to large real estate companies can not only upgrade the energy-saving properties they manage, but also create a new tax base for the local government. The most important positive impact is to promote EMC and develop the energy-saving industry. The reason is that type of ESCO has a good economic foundation and can use the energy-saving guarantee in EMC to carry out energy-saving projects.

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