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## The study of compensation strategies in promoting renewable energy building

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### ABSTRACT

The important point among Green building index systems is to improve the utilization of renewable energy. The usage of renewable energy can reduce carbon emissions and primary energy consumption. It has great significance to the strategy implementation of environmental improvement and of energy conservation and emission reduction. Due to the lack of legal basis of renewable energy applications in building, incentive policies and some fiscal subsidy would play an important role. As the existence of external problems, the market for renewable energy building development is affected greatly by the incremental cost, market acceptance and policy influence. Based on the principle of external economy, the method of using compensation mechanism to resolve external problems and to compensate the losses of carbon emissions is put forward through the analysis of the model of externality of renewable energy building, and further the theoretical proof of the feasibility implementation is given. The study has some guiding significance and theoretical value to promote the policy implementation of renewable energy building.

### KEYWORDS

REB; Carbon emissions; Compensation strategy; Economic incentives.



## INTRODUCTION

In the “twelfth five-year”, China has made clear the promotion of renewable energy applications goals, proposed to effectively improve solar energy, geothermal energy, biomass and other renewable energy sources using in buildings. By 2020, the proportion of renewable energy consumption in buildings more than 15%. Local governments take a variety of incentives to encourage and support the development of renewable energy buildings. In order to promote the application of renewable energy in the building, to improve building energy efficiency, to protect the environment, to conserve fossil energy consumption, the central government has arranged special funds to support the building applications of renewable energy projects. With the breadth and depth of renewable energy used in buildings, the building energy sustainable development is possible<sup>[1-6]</sup>. The proportion of energy consumption of buildings in society energy end-use will become increasingly higher and higher due to the urbanization and urbanization process. The level of building energy consumption in China is now close to the developed countries<sup>[7]</sup>. From the property, REB can be considered as renewable energy and building integrated application. However, due to its inherent characteristics, it produces a positive external economies throughout the life-cycle of building. From the point of view of economy, the government needs to take certain economic measures to resolve the market failure of the renewable energy in the building because of the existence of external economies. Academician He Zuo-xiu pointed out that the government should solve the problem of policy investment and should carry out the national strategy of energy saving and emission reducing and the government may solve the external problem through implementing corresponding policies in promoting the renewable energy building<sup>[8]</sup>.

## EXTERNAL CHARACTERISTICS AND IMPACT ANALYSIS OF REB

Externality is an important study of neo-classical economics and new institutional economics. External features can be summarized as three aspects. First of all, the externality is a spillover effect of economic activities, the second, economic impact is not reflected the market mechanism but is outside the market mechanism, and the third, the externality is accompanied effect rather than the original effect. Externalities can be divided into three types, positive externality, negative externality and bidirectional externality, in accordance with the impact of externality. Externality problems can lead to differ between private benefits and social benefits (private costs and social costs). The deviation of the difference in costs and benefits can lead to market failure. Externality theory provides a strong basis for government intervention in the economy. Government can make economic policies according to the manifestation and adopt appropriate economic means to achieve optimal allocation of resources<sup>[9]</sup>.

In the field of building energy efficiency, REB exhibits a positive externality for using renewable energy which produces the practical effect of energy saving and emission reduction. In recent years, the REB develops slowly because the market mechanisms can not play an effective role. That is, there is a market failure. The government should take appropriate policy measures to resolve this problem. Generally, the costs of REB are more than the general building. In accordance with the fundamental principle of externalities, external problems should be transformed into internal problems. That is, through institutional arrangements, the social benefits turn into private benefits. In accordance with the principle of externalities, the government should take certain economic means to eliminate or reduce the external costs to enhance the enthusiasm and initiative of investors and consumers. Only in this way, REB can achieve healthy development. In accordance with the laws of the market, REB market would fail if the government does not give positive encouragement to externalities.

In recent years, due to energy shortages, environmental pollution and energy security issues, a lot of countries and regions have a new understanding to the use of energy, and clean energy get unprecedented attention. In the using of renewable energy, China's urban area of solar thermal applications will reach to 2.46 billion square meters, the geothermal resource to 3 billion square

meters area and BIPV to 1079 MW. According to China's current total of nearly 500 million square meters buildings, REB accounts for only a small part, the proportion of REB, comparing to new buildings every year, is very low. Several national ministries have implied many measures, in order to solve the promoting problem of REB. To some extent, these policies promoted the development of REB, but did not reach the ultimate goal of policy implementation<sup>[10-12]</sup>.

The REB is compared with the general building in Figure 1. In Figure 1, the distance of every point on the horizontal axis to the point A represents the amount of general building and the distance of every point on the horizontal axis to the point B represents the amount of REB.  $AB$  represents the total number of buildings. Curves  $MR_1$  and  $MSR_1$  represent the private marginal benefits and social marginal benefits of REB. Curves  $MR_2$  and  $MSR_2$  represent the private marginal benefits and social marginal benefits of the general building. The REB and general building would keep balance in the market mechanism, if we do not consider the external characteristics. That is, the crossing point E. In this crossing point, the equilibrium amount of REB is  $Q_2B$  and the equilibrium amount of general building is  $Q_2A$ . Considering the externalities, the equilibrium of social optimal about REB and general building is the crossing point F. In this crossing point, the equilibrium amount of REB is  $Q_1B$  and the equilibrium amount of general building is  $Q_1A$ . In the equilibrium point  $Q_1$ , the marginal private benefit of REB is  $P_1$  and the marginal private benefit of general building is  $P_2$ . At the same time, the difference  $Q_1Q_2$  is produced between the REB of market spontaneous configuration and social optimum configuration. In the socially optimal configuration, the amount of general building should be controlled at point  $Q_1$ . However, in this case will lead to the private marginal benefits price difference between the general building and REB. The point  $Q_1$  would move to  $Q_2$  if the external benefits can not be transformed into internal benefit. Then, the number  $Q_1Q_2$  of REB will turn into general building. That is the key reason in developing REB from the point view of economy.

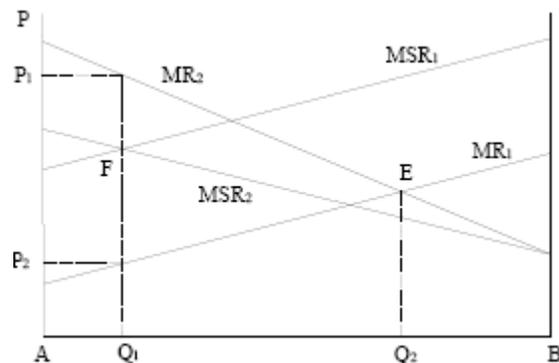


Figure 1 : REB external characteristics analysis

### ANALYSIS IN POLICIES TO RESOLVE THE EXTERNALITIES OF REB

In accordance with the basic methods and principles to resolve externalities, External characteristics of REB can be resolved through the following ways. In Figure 2, we assume that the supply curve  $S$  is determined by private costs  $MC$ , the market demand curve  $D_1$  is determined by the private benefit  $MR$ , the REB market demand curve  $D_2$  is determined by social benefits  $MR$ . Assuming that the government does not take any measures, the investors' max equilibrium amount  $Q_1$  and price  $P_1$  should be determined by the intersection  $E_1$  of the supply curve  $D_1$  and the supply curve  $D_1$ . Thus, the consumers' surplus is area  $\Delta P_1E_1L_1$ , the producer surplus is area  $\Delta P_1E_1O$ , social benefits is area  $\Delta L_1E_1O$  that is, the two together of the consumers' surplus and producer surplus. Conversely, if the government

takes some measures, equilibrium amount  $Q_2$  and price  $P_2$  are determined by the intersection  $E_2$  of the market demand curve  $D_2$  and the supply curve  $S$ . Thus, the number can reach the optimal level of social requirement. The consumer surplus is area  $\Delta P_2 E_2 L_2$ , the producer surplus is area  $\Delta P_2 E_2 O$ , social benefits is area  $E_2 L_2 O$ . Area  $P_1 P_2 E_2 E_1$  represents the pay or benefits influenced by government tax and subsidy policies investors.

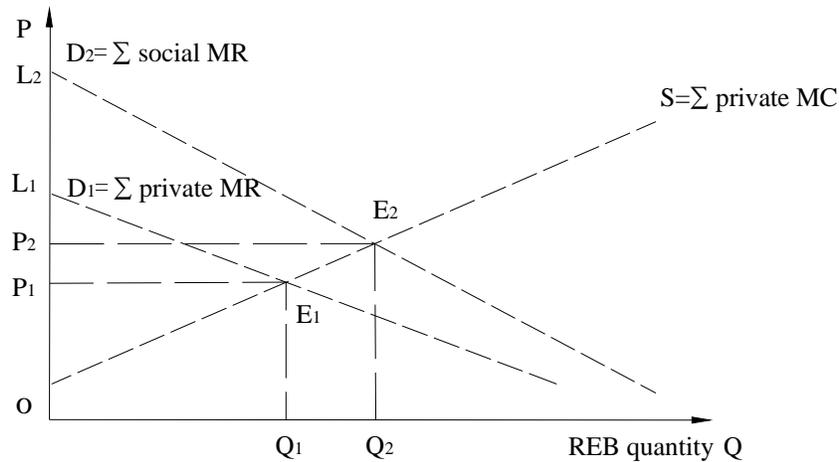


Figure 2 : Policies to resolve the REB externalities

In accordance with the externalities theory, the social benefits or social costs can be translated into private benefits or private costs through economic activity. The principles of economy shown in Figure 3.

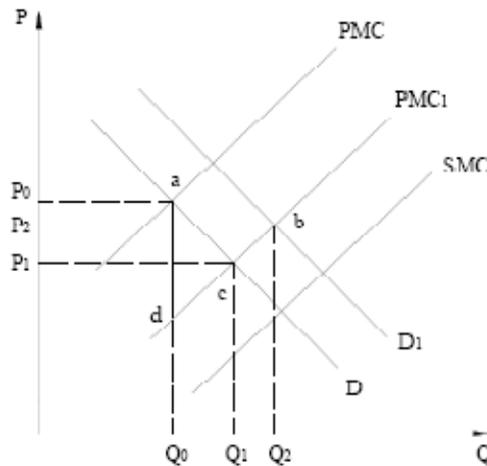


Figure 3 : The compensation principle of economic incentive

In Figure 3,  $D$  is a market demand curve of REB,  $PMC$  is a private marginal cost curve, and  $SMC$  is a social marginal cost curve.  $PMC$  is greater than  $SMC$  for the positive externality of REB.  $Q_0$  and  $P_0$  are the amount and the price of REB, when the building market reaches equilibrium.  $PMC$  is equivalent to a supply curve of REB. To eliminate positive externalities of REB, we should move  $PMC$  to  $SMC$ . From Figure 3, we should increase the amount of REB in the initial stages, and take the economic incentive policies to compensate for the incremental cost<sup>[9-11]</sup>. If the compensation amount is

$a - d$ , private marginal cost curve moves from  $PMC$  to  $PMC_1$ , the amount of REB will increase from  $Q_0$  to  $Q_1$ . This is beneficial to the development of REB. In accordance with principles of economy, the development of REB makes the private marginal cost closer to the social marginal cost, but it does not mean that it totally depends on government compensation measures to support the development of REB. Subsidies for Increasing costs of REB do not increase with  $PMC$  moving to  $SMC$ . When the REB markets develop to the amateur industry chain stage, the compensation amount would gradually reduce until it disappears.

## CONCLUSION

In this paper, the author analyses the external characteristics of REB by using the principles of economy and points out the important role of government policies to resolve the external characteristics of REB. Research shows that in the early stages of promotion, if the government wants to increase the amount of REB, it is necessary to adopt economic incentives for investors to compensate the incremental cost. When the industry develops to a certain stage, the economic compensation would be gradually reduced with the public gradually knowing and accepting the benefit of REB, and with the inventors reducing investment cost. At the same time, the role of government should be changed to market supervision. The research has important theory value and practical significance.

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