Environmental Performance Evaluation and Quota Allocation of Energy Conservation and Emission Reduction for China's Listed Enterprises--Taking Jilin Province As the Example

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Abstract. Energy conservation and environmental protection industry, as an important part of the green industry, is the major fostered project for China in recent years, meanwhile, it is also one of the most potential industry in the 21st century. Energy conservation and environmental protection project mainly includes the technical equipment, products and services, *etc.*, besides, these environmental protection projects have the characteristics of long industrial chain, high degree of association, strong employment absorption capacity, *etc*. In this paper, taking Jilin province as an example and through analyzing the energy conservation and emissions reduction situation of the listed enterprises in China, it takes detail study of the performance review and quota allocation of the listed enterprises in China so that to effectively relieve the resources issue facing by China's economic and social development and promote the transformation of original and vulgar economic development pattern, finally drive China's economic growth through the research.

Introduction

After 30 years of development, China has become the second-largest economic entity in the world. The sustained and rapid growth of economy will inevitably lead to serious environmental problems. In recent years, many important cities in China appear the phenomenon of hazy weather, haze, fog and sand dust *etc.*, which has a great influence on people's life and has a high frequency of occurrence, so the tremendous environmental pressure forces China to choose a road of sustainable development, rather than the old model of economic development. In this case, the environmental problems also attract the attention of the academia. According to the theory of joint production, the ideal output is always accompanied by bad output in the process of production, such as carbon dioxide, sulfur dioxide, water-wasting *etc.* phenomena. Especially in the environment that the greenhouse effect has a great influence and the scholars pay more attention to the environmental evaluation performance modeling and take the carbon dioxide emissions as the undesirable outputs. In addition, some scholars try to take allocation in different countries or regions so that to reduce the carbon dioxide emissions. According to the study, we found that for the large scale of industrial enterprises, there are mainly three kinds of industrial waste emissions, which is wasting of gas and water and solid waste. Aimed at this situation, China's environmental performance evaluation on enterprises' energy conservation and emissions reduction is based on that three aspects. In addition, according to the situation of international energy conservation and emissions reduction of

environment protection, it mainly takes the measures of limiting several kinds of main pollution emission for different areas so that to protect the global environment from too much damaging.

Environmental Performance Evaluation of Energy Conservation and Emissions Reduction for China's Listed Enterprises

As the first putting forward of 'Beautiful China' concept in the five-year plan in 2015, the environmental protection enterprises obtained a great policy support, at the same time it also shows that China begin to enter into the period of economic development drove by environmental protection type of enterprises.

Table 1 Development situation of China's environmental protection projects in 2011-2015

Year	Project number	Financial amount（billion）	Proportion in overall economy
2011	256	83.65	2.3%
2012	381	119.34	7.4%
2013	562	226.95	9.7%
2014	753	321.45	12.2%
2015	1105	520.23	15.9%

From table 1, we can see that the development trend of China 's environmental protection industry shows a tendency of rising as a whole, from the number of 256 environmental projects in 2011 to 1105 in 2015. In addition to the great degree of development in number, the financing amount of environmental protection enterprises also has manyfold increase than before and the accumulated minimum financial amount has risen from RMB 8.365 billion in 2011 to RMB 52.023 billion in 2015. The proportion of environmental protection project occupying the overall proportion of economic development also has constant increase, which shows that China's environmental protection career is developing constantly, furthermore, it increasingly integrates into the development of the economy. Because China is in the key period of rapid development of industrialization and urbanization, transformation of economic growth mode, optimization and upgrading of industrial structure and the pervious damage to the surrounding natural environment is serious, besides, the production mode of many enterprises is behindhand and the consumption of resources and environmental pollution are serious, the development space of China's environmental protection industry is wider.

Energy conservation and environmental protection undertaking projects more gathered in the second-tier cities, occupied 39% of the overall environmental protection project, the causes of this are basically has the following several aspects: a. The economy development system of the first-tier cities is relatively mature and in this case, the enterprises that have serious pollution and damage to surrounding environment located in the first-tier cities have been moved to other lower-tier cities or got upgrading of the industrial structure, so there are relatively less environmental protection project enterprises in the first-tier cities. b. The economic development of second-tier cities is in the accelerating period and in this period, the damage to the surrounding natural environment is bigger. Therefore, the government pays more attention to the environmental protection projects in second-tier cities, by which, the second-tier cities are given the chance of developing environmental projects in policy and the listed enterprises in second-tier cities will also pay attention to the protection and engineering construction of environment. c. Except for the first and second-tier cities, the other areas, due to the lower speed of economic development, relatively lower number of listed companies and fewer large-scale of industrial enterprises, the demand for environmental protection projects is also less. Overall, these factors lead to the phenomenon that the second-tier cities cover

the main distribution proportion of China's environmental protection projects and the other areas cover less proportion, furthermore, this kind of situation will continue to migrate from the first-tier cities to second and third-tier cities and other areas.

The environmental performance evaluation indicators constitution of energy conservation and emissions reduction for China's listed enterprises are shown as the table 2.

Table 2 The environmental performance evaluation table of energy conservation and emissions reduction for China's listed enterprises

	Factor level	Sub-factor level	Proportion coefficient
Management performance evaluation system of environmental cost for listed enterprises	Economic benefit	Input cost	A1
		Environmental compensation proportion	A2
		Energy-saving and Cost-reducing proportion	A3
	Environmental protection	Carbon emission proportion	B1
		Contaminant processing rate	B2
		Resources recycle utilization rate	B3
	resources conservation	Water consumption of enterprises	C1
		Power consumption of enterprises	C2
		Dye consumption of enterprises	C3

The evaluation criteria in table 2 is based on the energy conservation and emissions reduction standard of international related listed enterprises and this type of evaluation standard makes a comprehensive evaluation by dividing the energy conservation and emissions reduction of the whole listed enterprises into three aspects, which respectively are economy, environment and resources. In the aspect of economy, the work goes mainly by the investment on environmental governance, the economic returns of environment governance and the proportion of energy-saving and cost-reducing. In the aspect of environmental protection, it takes calculation based on the basic carbon emissions proportion, processing degree of pollutant and proportion of resource recycle and reuse. In the aspect of resources, it takes statistics of resources in three aspects that cover most of the consumption in the enterprises' production process and the three aspects respectively is water, electricity utilization and dye. Through taking classification of the three big levels and nine child-levels and after weighing its proportion, we can take comprehensive evaluation of the environmental performance of energy conservation and emissions reduction for the listed enterprises. For example, the total coefficient of economic benefits level for the listed S company in Jilin province is 0.6, environmental protection general coefficient is 0.4 and general coefficient of resource conservation level is 0.7, through weighing the comprehensive proportion coefficient of different areas, we can get a comprehensive coefficient, which can be more accurate to reflect the environmental performance of the energy conservation and emissions reduction for one company

and this method is the most commonly used analytic hierarchy process. In addition to that, there are balanced scoring method and fuzzy comprehensive evaluation method *etc.*, and the use of these methods needs to be conducted by combining with the actual situation of enterprises and the local area, only by this way, can it be more accurate to reflect the performance of energy conservation and emissions reduction and environmental protection for one listed enterprise.

Through analyzing the environment performance evaluation of energy conservation and emissions reduction for the listed enterprises in Jilin province, we can see that the investment center of energy conservation and environmental protection in Jilin province is mainly the urban environmental infrastructure construction, which is related to the weak urban infrastructure and large crowds of people moving from rural areas to urban areas brought by urbanization process in Jilin province. The policy support and second-tier cities themselves market demand *etc.* factors cause the second-tier cities become more and more attractive for the entrepreneurs of energy conservation and environmental protection.

Study of the Quota Allocation of China's Listed Enterprises

The quota allocation of listed enterprises includes many aspects, in this article, it mainly refers to quota allocation related to environmental protection. Country or region will issue a pollution emissions norm for each large scale of listed enterprise in every year, for example, restricting one enterprise releasing a set amount of pollution gases in each year, such as carbon dioxide (CO_2), sulfur dioxide (SO_2), nitrogen (NO_2) *etc.*, besides, the emissions tonnage of polluted water will also has a certain degree of restriction, in addition to that, for the solid waste causing pollution, a tighter restriction will be issued for them. These restrictions are the so-called quotas and the countries can control the pollution to environment brought by enterprises in a certain degree in one year through limiting the quotas for listed enterprises, by which, it can not only protect the surrounding environment development and promote the harmonious development of human and nature, also can stimulate the enterprises to develop science and technology and reduce the consumption of resources and damage to the natural environment, finally to achieve the purpose of kill two birds with one stone.

If we want to take a detail study of the quota allocation of China's listed enterprises, it is necessary to use a more mature quota coefficient calculation model. The article uses DEA model to take further wide application of the unified boundary and in the real practical production, take study of the quota resources allocation of listed enterprises. However, the existing DEA model cannot judge the index system existing in the situation input (output) and the common input (output). The basic DEA model cannot further distinguish the quota index, for this reason, in 1993, the western scholar Peterson developed a model of super efficiency (also known as AP model) and it can ranks the efficiency of quota. AP model can take effective study of the feasible solutions. The all study of the AP model assumes mentioned above are independent. There is a saying, if one assessment adjust the input or output, it will not be affected. However, the interaction between the study (such as mutual competition or alliance) usually exists in real life. In addition, this model may meet the situation that the tools are impossible to be used. The current method can only be generating unified and leading edge-single quota index for input (output)by radial model. Therefore, we firstly put forward the solution under the improved DEA model and the solution includes common input (output) of index system.

Using the DEA model to analyze the quota limit of listed enterprises in Jilin province and we found that for the three input of the listed enterprises' quota index, one is considered as the ideal output and the three undesirable outputs are in the application program. After the analysis of the

data since 2012, we got the relevant quota allocation system. What should be noted is that the data-calculated waste gas emissions is added with soot emissions, such as nitrogen oxide and sulfur dioxide. The data about solid waste equals to the summary of common solid waste generation and hazardous solid waste generation. In the process of the establishment of DEA model, the inaccurate quota index output is one problem of influencing modeling. Seiford reviews five possible indexes output with poor processing and each one has its own advantages and disadvantages. We take the consideration of DEA model output as the input method. In addition, in order to prevent the change of environment conditions, the output sum of the quota index of each listed enterprise is constant, by which it can avoid the computing error for model from the larger extent. To this, we adopt the input of the second strategy adjustment research and this input strategy is called the increased proportionally input strategy. Assume that there are N reference sets research and DMJ = Xj + s (X = 1, 2 …,n - 1, n), a total number of M for the species. DEA input model Xj and s type of output, s = Cy + Ti)/y, Ti represents transposition. Through the calculation of DMJ, if all the input DMU increase (decrease) of the positive factors, the time it outputs and increase (decrease) the same factors. Then the DEA model proportion also will increase (decrease) the index of the corresponding output quotas. The quota index of listed enterprises in partial region of Jilin province is as shown in table 3.

Table 3 The quota index of listed enterprises in partial regions of Jilin province

region	Model（4.4）	Model（4.5）	Model（4.7）	Model（4.8）
Tonghua	1.84 （1）	1.86 （1）	1.74 （3）	1.57 （3）
Jilin	1.66 （2）	1.46 （2）	1.54 （1）	1.77 （1）
Siping	2.84 （6）	2.86 （6）	3.42 （4）	2.53 （4）
Songyuan	1.74 （1）	1.43 （1）	2.64 （7）	1.44 （7）

Through the quota analysis of the listed enterprises in each region of Jilin province we can see the result of the quota index of partial listed enterprises in Jilin province. As mentioned before, the model (4.4) and (4.7) is the input index and assumptions of the improved DEA model. Model (4.5) and (4.8) is the corresponding AP model. The numbers in the brackets represent the efficiency grade of the concrete model in each region. As a whole, it can be found that the efficiency model (4.7) is greater than or equal to the corresponding model (4.4) and tools and conditions reduce their own CRS feasible domain model. According to table 4.2, the three researches is valid by the CRS measurement. Among the four cities, Tonghua,Jilin, Siping and Songyuan, Tonghua and Songyuan respectively is the highest and lowest. Accordingly if the study has a higher efficiency score ration, the general judgment is that it has a high performance and there are several other high-performance researches DEA data model, in this case, the high-performance research is focused on the economy-developed regions of Jilin province. The results show that 3 out of 4 regions, their economy rank the top three in the region of Jilin province. The scores of large-efficiency difference model in four regions are(4.4) and (4.7) and the descending order is: Jilin, Tonghua, Songyuan and Siping, although there is no significant difference between the four areas(below the region coefficient 0.05). In other words, the high configuration of quota index of these regions are hardly affect the coefficient efficiency, according to the above formula algorithm, the uniform front and the corresponding distribution-different undesired output assumption can be taken as the calculation coefficient. The iterative algorithm put forward on the basis of DEA model makes design and generates uniform quota allocation coefficient to adapt to multiple input (output). The empirical research shows that the DEA model of economy-developed areas usually exists CRS assumption.

Conclusion

In general, along with the continuous integration with internationalization for China's economy, the destruction brought by economic development to the natural environment is becoming more and more serious, however, the destruction of natural environment has also brought threat to people's health to a great extent. In this case, the country has to take complete assessment on enterprises' environmental performance through controlling the damage brought by enterprises production to the environment, and also takes   scientific quota restrictions for enterprises, only in this way, can we be better to protect our natural environment and promote the sustainable development of economy.

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