

Study on the Economy, Energy and Environment System Coordination of Energy and Chemical Industry Park Projects

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This paper focuses on the existing problems in the coordination of the economy, energy and environment systems of the chemical industrial park projects. In this paper, an index evaluation system on economy, energy and environment system coordination of energy and chemical industry park projects has been designed, a systematic coordination degree evaluation model has been constructed, and non-coordination factors found, which include extensive industrial development mode with single product function and insufficient coordinated interaction between enterprises. Three key influencing factors, including energy saving and emission reduction and economic development policy and energy saving technology, resource utilization and environmental protection policy, energy saving and environmental protection investment and technological innovation were extracted by means of principal component analysis. Moreover, this paper also puts forward the countermeasures and suggestions to the energy and chemical industry park. The results show that the evaluation framework can strengthen energy conservation and emission reduction by establishing energy saving and environmental protection technology innovation system and improving innovation mechanism. The paper concluded that the diversified financing channels and corresponding mechanism can improve the energy saving and environmental protection.

1. Introduction

In recent years, a number of energy and chemical industrial parks have been built in China, which has aroused the development of regional economy (Faunce et al., 2013). However, some problems occur in the construction and operation of energy and chemical industrial park projects, such as serious waste of land and other resources, low energy efficiency, vegetation damage, deteriorating surface subsidence, pollution from waste gas, waste water and waste discharge, and others (Zhu and Geng, 2013). These problems have become the main bottleneck restricting the sustainable development of the project. In the construction and operation of energy and chemical industry park, how to deal with the coordinated development of economy, energy utilization and environmental protection is an important issue to be studied (Ghisellini et al., 2016). With theories on the correlations between economy, energy and environment as theoretical basis and the current situation of the economic, energy and environmental development of the energy and chemical park projects as the foundation, in this paper, the economy, energy and environment system coordination index evaluation system of energy and chemical industry park projects is established, the non-coordinated factors influencing economy, energy and environment systems explored (Wu et al., 2014), the key factors influencing the coordinated development of the economy, energy and environment system of the energy and chemical park projects analyzed, and some countermeasures and suggestions are proposed to improve the coordinated development of the economy (Dong et al., 2013), energy and environment system so as to promote the sustainable development of the energy and chemical park projects (Suberu et al., 2014).

2. Economic, energy and environmental coordination evaluation system of energy and chemical industry park projects

Based on the theory of the coordinated development of energy and chemical industry park projects with economy, energy and environment, this chapter makes an empirical analysis on the coordination degree of

economy, energy and environment of the project. Firstly, the coordination evaluation index system of economy, energy and environment system of energy chemical industry park projects is established, then the corresponding coordination evaluation model is constructed according to its content. The evaluation index system is shown as Table 1. On this basis, the coordination degree of economy, energy and environment system of the park projects is evaluated, and the non-coordination factors analyzed.

Table 1: Energy and chemical industry park project economy, energy and environment system coordination index evaluation system

Coordination degree		Aggregate indicator	Growth indicators	Benefit indicators	Structural indicators
Economic, energy and environmental coordination	Economic coordination	Industrial output Industrial added value	Industrial output growth rate	Yield tax rate Labor productivity	Proportion of output value
	Energy coordination	Coal consumption; Power consumption	Unit power consumption to create the industry; Output growth rate; Unit energy consumption created by industry; Output growth rate	Unit profits to create profits and taxes	Proportion of coal consumption
	Environmental coordination	Industrial SO2 emissions; Industrial soot emissions; Industrial solid waste generation	Environmental management fee growth rate	Utilization rate of industrial solid waste Industrial wastewater discharge compliance rate	Environmental investment accounted for Total investment proportion

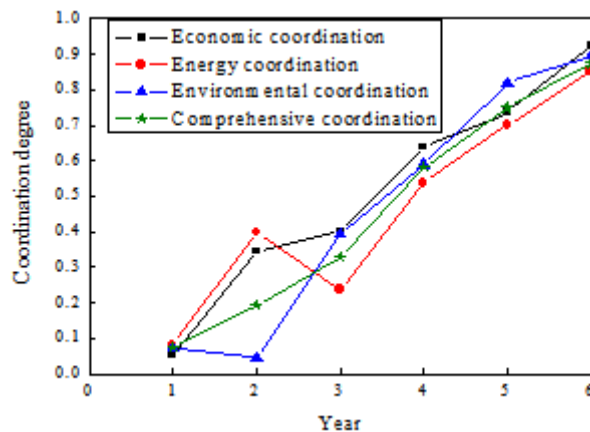


Figure 1: Yu Heng Industrial Park project comprehensive coordination rate chart

After the evaluation method is defined and the evaluation model constructed, this paper takes Yu Heng Industrial Park Project as an example to measure its Economic, energy and environmental coordination degree during the period from 2006 to 2011, using the data collected about Yu Heng Industrial Park Project. It is found that the coordination degree of economy, energy and environment system of this Park is on the rise, with stable development. In 2011, the coordination degree of the system has reached a more coordinated state, as it is shown in Figure 1. Through further investigation and analysis, the non-coordination factors affecting the economy, energy and environment system during the development of the Project are concluded, which mainly include extensive industrial development mode with single product function and insufficient

coordinated interaction between enterprises, high pressure for energy saving and emission reduction brought by unreasonable economic structure and low energy efficiency, as well as inadequate investment in environmental protection. The research results in this chapter provide the basis for the subsequent countermeasures and suggestions, and are of reference value for the evaluation of the coordination degree of similar industrial parks.

3. Studies on the factors affecting the coordinated development of energy, economy and environment of energy and chemical industry park projects

Through the investigation and text analysis, 22 general factors affecting the energy, economic, environmental development of energy and chemical industry park projects are identified in this paper, as shown in Table 2 and Table 3.

Table 2: Affecting the energy and chemical industry park project energy, economy, environmental development of the general factors (Number 1-11)

Number	Influencing factors
1	Park managers on the importance of energy conservation, environmental protection work
2	Park entrepreneurs focus on energy conservation, environmental protection work
3	The introduction and development of energy - saving and environmental protection talents in park enterprises
4	Park economic growth scale and growth rate
5	The economic development structure and development model of the park
6	Park (enterprises) in the energy-saving, environmental protection side of the capital investment intensity
7	Related industry energy-saving technology level (standards, norms, etc.)
8	Relevant industry environmental management technology level (standards, norms, etc.)
9	Energy - saving technology development and technology introduction in park enterprises
10	Park enterprise environmental management technology development and technology introduction efforts
11	Park land resources

Table 3: Affecting the energy and chemical industry park project energy, economy, environmental development of the general factors (Number 12-22)

Number	Influencing factors
12	Park energy resources
13	Park natural raw materials
14	National and local energy development and utilization policies
15	National and local environmental protection policies
16	National and local relevant industry standards
17	Park development strategy and development plan
18	Policies and Measures to Promote Industrial Economic Development in the Park
19	Promote the park energy saving and emission reduction policies and economic incentives
20	Policies and Measures to Strengthen Environmental Protection in the Park
21	On corporate waste gas, waste water, waste discharge supervision
22	Local government 's performance appraisal method for park and manager

The eigenvalues of 22 components are obtained through principal component analysis, as shown in Table 4. The common factor scree plot as shown in Figure 2 can be derived from the above table. It can be seen that the three major factors influencing the coordinated development of the economy, energy and environment of the energy and chemical industry park projects include policies on energy saving and emission reduction and economic development and energy conservation technology level, resource utilization and environmental protection policy, energy saving and environmental protection investment and technological innovation.

Table 4: Explain the total variance

Ingredients	Initial eigenvalue			Ingredients	Initial eigenvalue		
	Total	Variance contribution rate	Cumulative variance contribution rate		Total	Variance contribution rate	Cumulative variance contribution rate
1	3.283	25.938	25.938	12	0.470	2.137	88.564
2	1.972	14.925	40.862	13	0.454	2.062	90.626
3	1.772	8.962	49.824	14	0.417	1.894	92.520
4	1.207	8.054	57.878	15	0.381	1.732	94.252
5	1.190	5.488	63.366	16	0.290	1.319	95.571
6	1.066	5.407	68.778	17	0.230	1.046	96.617
7	0.907	4.845	73.619	18	0.193	0.878	97.495
8	0.703	4.124	77.743	19	0.173	0.785	98.280
9	0.635	3.196	80.938	20	0.158	0.717	98.997
10	0.572	2.888	83.827	21	0.114	0.519	99.517
11	3.283	2.601	86.427	22	0.106	0.483	100.000

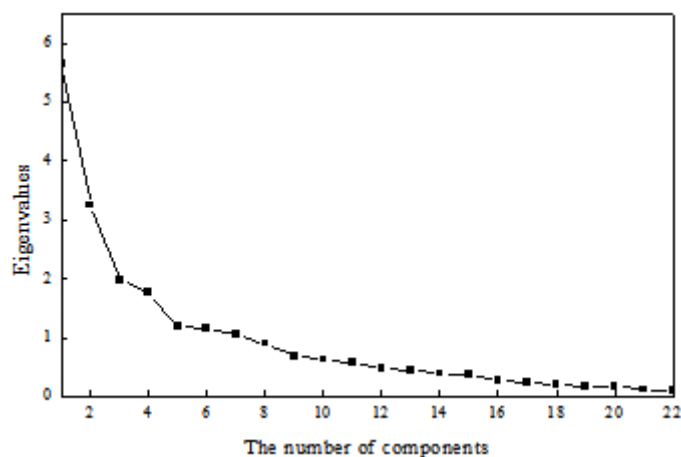


Figure 2: Scree plot

4. Countermeasures and suggestions for the coordinated development of economy, energy and environment of energy and chemical industrial park projects

4.1 Countermeasures for coordinated development

In order to ensure the coordinated development of energy, economy and environment system of the energy and chemical industrial park projects during the development, the following countermeasures are proposed.

(1) We shall optimize the industrial structure and develop circular economy of the park project to ensure the overall coordinated development. The industrial structure adjustment is the key to accelerate the coordinated economic development of energy and chemical industrial park project. Thus it is necessary to promote the economic structure adjustment and maintain the rapid development during the process, promote the fundamental transformation of economic system and economic growth mode, to extend the industrial chain of the park project, and to improve the comprehensive development capacity of the park, so as to ultimately achieve sustainable development.

(2) We shall adjust energy structure to improve comprehensive energy efficiency. As a great amount energy is consumed during the construction and development of energy and chemical industry park project, the most realistic, direct and effective way to alleviate the pressure of energy shortage is to save energy, develop energy use and transformation technology, and to improve the comprehensive energy efficiency.

(3) We shall encourage technological innovation, realize energy conservation and emission reduction, and reduce and control environmental pollution. We shall rely on scientific and technological progress and technological innovation to lead energy-saving and emission reduction work, and carry out innovations in key areas of the energy saving and emission reduction and the surrounding areas so as to achieve a new breakthrough for energy-saving emission reduction work in energy and chemical industry park projects as soon as possible.

(4) We shall increase investments in energy conservation and environmental protection, improve the financing system, and enhance the overall innovation capacity of the industrial park. Technologies and investments are essential for the construction of energy and chemical industrial park. Therefore, we shall increase investments in energy conservation and environmental protection technologies and develop environment-friendly industries, so that environmental protection is implemented during the production of enterprises to ensure the sustainable development of the park.

(5) We shall improve institutional system and the corresponding implementation mechanism. We shall improve institutional system of laws, regulations, local policies and industry regulations, which can provide system guarantee for the coordinated development of economy, energy and environment of the energy and chemical industry park.

4.2 Specific suggestions

In view of the above countermeasures to promote the coordinated development of the economy, energy and environment system of the energy and chemical industry park project, the following specific suggestions are proposed in this study.

(1) We shall promote the in-depth development of the energy industry by optimizing the economic structure of the park and speeding up the high-end extension of the energy-oriented industrial chain. We shall follow the internal laws of industrial organization, techniques and economic system operation, formulate and improve the park development plan, rationally allocate the production factors of the park, and carry out the adjustment, improvement and promotion of the existing industries in the park.

(2) We shall develop the deep processing of coal with adjustment of the energy structure and improvement of the comprehensive energy efficiency. We shall vigorously develop coal transformation and comprehensive utilization to speed up the adjustment of the energy structure in the energy and chemical industry park. We shall pay attention to the proportion of clean and renewable energy, and reduce the development of raw energy products such as coal and petroleum, so as to gradually increase the dependence on new energy sources in the source consumption structure and energy consumption.

(3) We shall establish an energy saving and environmental protection technology innovation system and improve innovation mechanism to strengthen energy conservation and emission reduction. We shall construct an industrialized demonstration park of energy-saving and environmental protection to nurture and develop enterprises of energy-saving and environmental science and technology with independent intellectual property rights and strong market competitiveness.

(4) We shall increase investments in energy saving and environmental protection of the park by opening up diversified financing channels. We shall open up diversified financing channels through legal and economic means.

(5) We shall improve the institutional *system* and complete implementation mechanism. We shall supplement and improve the relevant legal provisions on energy management and environmental protection of the industrial park through legislations, draw up reasonable price policies of energy resources, improve tax and fee system of energy, resources, and environment, and make clear the legal status of the energy management and the environmental protection law enforcement and supervision institutions.

5. Conclusions

Through the study in this paper, the results can be concluded as follows:

(1) The specific project is evaluated based on the evaluation index system and the evaluation model of the economic, energy and environmental coordination of the energy and chemical industrial park projects designed in this paper. The results reveal the following non-coordination factors existing in the economy, energy and environment system of the energy and chemical industrial park project, including industrial development mode with single product function and insufficient coordinated interaction between enterprises, high pressure for energy saving and emission reduction brought by unreasonable economic structure and low energy efficiency, as well as inadequate investment in environmental protection. The conclusion is of reference value for the evaluation of the coordination degree of similar industrial park projects.

(2) The major factors affecting the coordinated development of economy, energy and environment of the energy and chemical industrial park include the policies on energy conservation and emission reduction and economic development, energy-saving technologies, the policies on resource utilization and environmental protection, investments in energy saving and environmental protection and technological innovation, and others. The above conclusion will help to take targeted measures to improve the coordination of the economy, energy and environment system of the energy and chemical industrial park project.

(3) It is essential for the coordinated development of economy, energy and environment of the energy and chemical industrial park to promote the in-depth development of the energy industry by optimizing the economic structure of the park and speeding up the high-end extension of the industrial chain, to develop the

deep processing of coal with adjustment of the energy structure and improvement of the comprehensive energy efficiency, to strengthen energy conservation and emission reduction by establishing energy saving and environmental protection technology innovation system and improving innovation mechanism, to increase investments in energy saving and environmental protection of the park by opening up diversified financing channels, to improve energy conservation and environmental laws and regulations and incentive policies and the corresponding implementation mechanism. The conclusions provide a reference for the government, the park management agencies and enterprises to develop appropriate policies and plan.

The economy, energy and environment system of energy and chemical industrial park projects is a dynamic process, with different stages of development. Therefore, we should follow the development trend of economy, energy and environment system of similar park projects in the future to further study the coordinated development of economy, energy and environment system throughout their lifecycle.

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