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Research on Influence Factors of Building Energy Efficiency and Environmental Protection in Industrial Park in Shenyang

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Abstract

At present, many industrial parks promote the local economic growth, causing environmental pollution and waste of resources. Based on analyzing the 23 factors affecting industrial parks' building energy efficiency and environmental protection by conducting a questionnaire survey and applying the principal component analysis (PCA) with SPSS 19.0 software as auxiliary tool, this paper identifies the 6 key influencing factors such as energy resources of the industrial park, energy recycling (waste heat) of the industrial park, renewable energy utilization of the industrial park, investment in the aspect of energy efficiency and environmental protection of industrial park, technology development and introduction in energy efficiency and environmental protection of industrial park. Some countermeasures and suggestions for promoting the industrial parks' building energy efficiency and environmental protection are put forward, such as perfecting laws, incentive policies and implementation mechanisms of energy efficiency and environmental protection, and optimizing the parks' energy structure and effectively utilizing resources. The research results are helpful to promote high-quality economic growth of Shenyang's industrial parks.

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Keywords: Industrial park; Building energy efficiency; Environmental protection; Influence factors

1. Introduction

Recently, the construction and development of industrial parks are becoming one of the most important ways for local economic growth in China. Meanwhile, after more than half a century of development and construction,

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Shenyang, as one of the old industrial bases in China, formed a comprehensive industrial system, which relies mainly on mechanical industry while raw materials and chemical industry subsidiary. However, some regions, especially in Shenyang, suffer from several serious problems, such as environmental pollution and waste of resources, at the same time of the economic growth. Achieving energy conservation and environmental protection during the construction and development of industrial parks has become a problem to be solve in today's economic and social development. Therefore, this paper study on influence factors of building energy efficiency and environmental protection in industrial parks in Shenyang, China. Also, according to these factors, we put forward some countermeasures and suggestions on the coordinated development of energy, economy and environment in industrial parks in Shenyang.

In western countries, with the improvement of the quality of economic system, all sectors of society pay attention to the sustainable development of industrial park. What's more, the research on resources recycling and environmental protection in industrial parks was paid great attention in academia [1,2]. In 2004, Carla and Carlos studied the multi-objective model of energy, economy and environment and provided decision support for the government [3]. In 2006, Nick, Peter and Swales studied the influence of energy efficiency on economy and environment, and they thought that complementary energy policy must be taken to ensure the coordinated development of energy, economy and environment [4].

Meanwhile, Chinese scholars also begin to pay attention to the problems during the construction and development of industrial parks, which are resource waste and environmental pollution [5-8]. Related researches involve the relationship between China's economic growth and energy, the principles and methods of aggregate balance among energy, environment and economy, China's policies and measures of coordinated development among energy, economy and environment, comprehensive development level evaluation of China's energy, economy and environment, and so on.

Nomenclature

PCA	Principal Component Analysis
α	the Cronbach α reliability coefficient
KMO	Kaiser-Meyer-Olkin test

2. Methods

Based on the investigation and text analysis, we identified 23 general factors that influenced building energy efficiency and environmental protection of Shenyang's industrial parks, which are shown in Table 1. To find out the key influence factors, the method of questionnaire, which is in the form of Likert scale, was adopt to survey the impact of various factors. And the respondents are not only managers, technical experts and relevant staff, who are from enterprises and management committees in the industrial parks in Shenyang, but also professors, architects, planners from related professions. 123 questionnaires were issued, 100 of which are valid, so the questionnaire effective rate was 81.3%. Principal Component Analysis (PCA) was used to analyze the data from the valid questionnaires with SPSS 19.0 software as a supplementary tool, then the key factors who influence the building energy efficiency and environmental protection of Shenyang's industrial parks were found.

Table 1. common factors who influence building energy conservation and environmental protection

No.	Influence Factor	No.	Influence Factor
X1	Geographical location and land resources	X13	Technology of energy conservation and environmental control
X2	Energy resources	X14	Development and import of technology
X3	Development strategy and planning	X15	The utilization of waste heat
X4	The core enterprise competitiveness	X16	The utilization of renewable energy
X5	Distance and communication between the numbers	X17	The policy of energy development and utilization

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