



## Analysis of Influencing Factors of Low Carbon Economic Development Level of Shanxi Coal Enterprises Based on Ground Theory

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**Abstract:-** *With the rapid rise of the world economy, haze, the greenhouse effect, and a series of climate changes. The environment is increasingly challenging the survival and development of human beings. Developing a low-carbon economy has become a common concern of all countries worldwide. The article takes coal enterprises in Shanxi Province as the research object and conducts qualitative research on the coal enterprise management practice by applying the rooting theory. This paper condenses 32 initial categories and 4 main categories through "three-level coding" to form a theoretical model of the factors influencing the level of low-carbon economic development of coal enterprises in Shanxi Province, analyzes the role of different factors on the level of low-carbon economic development of Shanxi coal enterprises, and explores suggestions to improve the level of low-carbon economic development of Shanxi coal enterprises.*

**Keywords:** Low-Carbon Economic; Coal Enterprises; Level of Development

### Introduction

With the rapid rise of the world economy, haze, the greenhouse effect, and a series of climate changes. The environment is increasingly challenging the survival and development of human beings. Developing a low-carbon economy has become a common concern of all countries worldwide. In the energy white paper issued by the British government, the concept of "low carbon" was put forward for the first time. Energy structure adjustment is a key aspect of this concept, which promotes macro-controls and technological innovation, and establishes a more sustainable economic development model that focuses on reducing emissions (Xie et al, 2017; Wu, 2019; Chen, G., & Kexin, B., 2018; Li et al., 2018).

Chinese President Xi Jinping solemnly pledged at the UN General Assembly in 2020. "China will strive to achieve peak carbon by 2030 and carbon neutrality by 2060." China's commitment to meet this pledge is much shorter than that of developed countries, which will require more wisdom and hard work on China's part. Of particular note is that Shanxi, a major coal province, ranks first among 31 provinces (municipalities and autonomous regions) in China in terms of coal reserves, total raw coal production, and the number of coal enterprises (Source: National Bureau of Statistics of China). In recent years, coal enterprises in Shanxi Province have changed their coal mining and production methods and developed a low-carbon economy in all aspects, playing an important role in achieving the goal of "carbon neutrality". However, what is the factors that affect the level of low carbon development of coal enterprises in Shanxi Province, which is the core purpose of this study.





## Research Objectives

1. To explore the factors affecting the level of low-carbon economic development of coal enterprises in Shanxi Province.
2. To explore suggestions to improve the level of low-carbon economic development of Shanxi coal enterprises.

## Literature Review

Foreign research on low-carbon economy of coal enterprises mainly focuses on mining technology application issues and technological innovation issues. Wu (2019) study land ecological restoration and gas extraction, focusing on the importance of using both technologies in coal mining. Scholars such as Li (2019) and Huang and Meng (2019), study the technology of water conservation mining and water source heat pump, analyze the problem of water burst in coal mining, and specify the technical means and steps to solve the problem. On the issue of technological innovation, Chen, G., & Kexin, B., (2018) argue that low-carbon technological innovation plays a very significant role in reducing carbon emissions. According to Gu, Yue, & Yang, Li (2018), a low-carbon pathway analysis is provided for China, India, and Japan, and the argument is made that delaying the reduction of carbon emissions will not benefit the economy. As a result, carbon emission technologies become over-reliant, increasing the risk of achieving GHG reduction targets and increasing the cost of future carbon emissions.

Almost all domestic research on coal's low-carbon economy concentrates on promoting the transformation and integration of coal, as well as improving the technical level and policy level. According to Li et al. (2018), coal enterprises practicing low carbon economies are few, have poor low carbon consciousness, and are not self-motivated. According to Zhu (2018), coal is one of the main sources of CO<sub>2</sub>, which is why promoting industrial low carbon is clearly the best choice for a green and sustainable coal industry. Wang (2019) proposed that through energy adjustment, it could realize low emissions and low energy consumption, and promote the low-carbon development of coal enterprises. You (2019) used FCM and FNN methods to select 16 samples of listed coal enterprises for an empirical study. According to Liu (2017), coal enterprises need independent innovation in order to develop green and low-carbon economies. By using a model and combining economic theories, Sun and Gao (2019) constructed a game study and concluded that when it comes to realizing technological innovation in a low-carbon economy, a reasonable amount of carbon tax should be charged.

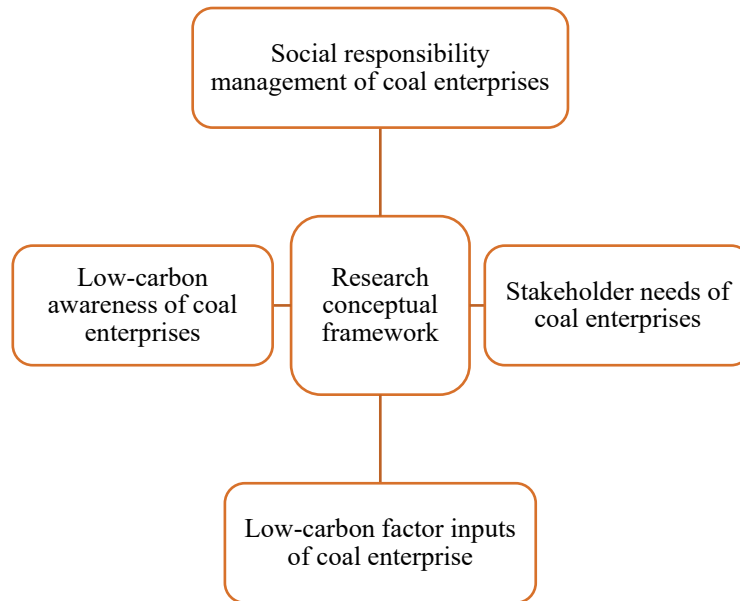


Figure 1: Research conceptual framework

## Methodology

This paper uses semi-structured interview method to collect interview information. The grounded theory is used to analyze the original interview data, and the categories of this study are extracted, and then the logical relationship between the categories is explored.

### 1. Identify the Sample of the Study

This paper mainly studies the low carbon economic development level of coal companies in Shanxi Province. Shanxi Province is a typical resource province. By the end of 2020, there were 805 legitimate coal companies in Shanxi, according to data released by the Shanxi Provincial Department of Coal Industry. Coal companies with an annual production capacity of 0-1 million tons account for 52%; those with 1-2 million tons account for 32.62%; those with 2-3 million tons account for 4.16%; those with 3-4 million tons account for 4.92%; those with 4-5 million tons account for 2.15%, and those with an annual production capacity of more than 5 million tons account for 4.15%. According to the method of equal proportional sampling, approximately 12 coal companies were selected as samples. Five coal companies with an annual production capacity of 0-1 million tons are selected: Shanxi Yangmei Group Nanling Coal Industry Co.Ltd, Shanxi Qinyuan Gengyang Coal Industry Co.Ltd, and Shouyang Jingfu CoalShanxi Liulin Huifeng Xinye Caojiashan Coal Industry Co., Ltd., Shanxi Linxian Yantou Coal Industry Co., Ltd.; Three coal companies with an annual production capacity of 1-2 million tons are selected: Shanxi Liulin Huifeng Xinye Tongde Coking Coal Co.Ltd, Shanxi Liulin Xinfei Mao Coal Industry Co.Ltd, ShanxiLiulin Jinjiazhuang Coal Industry Co.Ltd; Only one coal company is selected for those with 2-3 million tons, 3-4 million tons, 4-5 million tons and more than 5 million tons, as follows: Shaqu No. 2 Coal Mine of Huajin Coking Coal Co.Ltd, Shanxi Xinyuan Coal Co. Ltd, Shanxi Xinjing Coal Industry Co.Ltd and No.1 Mine of Yangquan Coal Industry (Group) Co.Ltd. The 12 coal companies are represented by codes, in order A, B, C, D, E, F, G, H, I, G, K and L. See Table 1 for details.

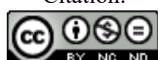




Table 1 Basic information of samples

Production Capacity (1million tons/year)	%	No.	Sample	Production Capacity (1million tons/year)	Code
0-1	52%	5	Shanxi Yangmei Group Nanling Coal Industry Co.Ltd	0.9	A
			Shanxi Qinyuan Gengyang Coal Industry Co.Ltd	0.9	B
			Shouyang Jingfu Coal Industry Co.Ltd	0.9	C
			Shanxi Liulin Huifeng Xinye Caojiashan Coal Industry Co.Ltd	0.9	D
			Shanxi Linxian Yantou Coal Industry Co.Ltd	0.9	E
1-2	32.62%	3	Shanxi Liulin Huifeng Xinye Tongde Coking Coal Co.Ltd	1.2	F
			Shanxi Liulin Xinfei Maojiazhuang Coal Industry Co.Ltd	1.5	G
			Shanxi Liulin Jinjiazhuang Coal Industry Co.Ltd	1.75	H
2-3	4.16%	1	Shaqu No. 2 Coal Mine of Huajin Coking Coal Co.Ltd	2.9	I
3-4	4.92%	1	Shanxi Xinyuan Coal Co. Ltd	3	J
4-5	2.15%	1	Shanxi Xinjing Coal Industry Co.Ltd	4.5	K
More than 5	4.15%	1	No.1 Mine of Yangquan Coal Industry (Group) Co.Ltd	8.50	L

In this paper, 12 managers or department heads of 12 coal companies in Shanxi Province were interviewed by interview method. Due to the influence of the coronavirus epidemic, social software is the main way of interviewing. From January 6, 2021, to March 6, 2021, 9 people were interviewed online through social software (WeChat). The 9 managers or department heads are from 9 coal companies, whose company codes are A, B, C, G, H, I, J, K, and L. From March 12, 2021, to April 11, 2021, 3 people were interviewed face-to-face. The 3 managers or department heads are from 3 coal companies, whose codes are D, E, and F respectively. The whole process takes place over three months from January 6, 2021, to April 11, 2021. See Table 2 for details.



Table 2 Information about Interviewees

No.	Code	Interviewee 1	Position
1	A	Mr Zhang	Department manager
2	B	Mr Wang	Section chief
3	C	Mr Zhao	Department manager
4	D	Mr Cao	Vice general manager
5	E	Mr Wang	Section chief
6	F	Mr Cao	General manager
7	G	Mr Xue	Section chief
8	H	Mr Feng	Department manager
9	I	Mr Gao	Section chief
10	J	Mr Liu	Section chief
11	K	Mr Zhai	Manager assistant
12	L	Mr Chen	Section chief

## 2. Grounded Theory

This study aims to study the influencing factors of the development level of low carbon economy in Shanxi coal enterprises through in-depth interviews with the middle and senior managers of Shanxi coal enterprises. Considering that the content of this study involves the attitudes and opinions of different groups, this study chooses the semi-structured interview method to obtain first-hand data and information. Through grounded theory, the measurement scale is further defined. Firstly, the input and open coding analysis of the obtained original interview materials were carried out, and the initial categories were compressed. Secondly, the initial category is further generalized by spindle coding to form the main category. Finally, the core categories are established by selective coding. Through the three-level coding, the theoretical model of influencing factors of low carbon economic development level of Shanxi coal enterprises is finally formed (see Table 3).

**1) Open-Ended Coding.** Open coding is the first step of grounded theory coding. On the basis of abandoning subjective judgment, researchers extract the initial categories from the original interview texts. In this study, Nvivo11 software was used to conduct a preliminary analysis of 7310 words of original interview text, obtain 1684 words of effective information related to the research object, and extract 51 initial concepts. However, due to the large number of initial concepts and the characteristics of semantic cross, this study further condensed them and formed 32 initial categories.

**2) Spindle Coding.** Spindle coding is a crucial aspect of grounded theory coding. Based on the open coding, this study continues to refine the information by exploring the potential connections among the initial categories and then forming the main categories. Specifically, through spindle coding, this study discovered the logical relationships among the 32 initial categories and further condensed



them to form 4 primary categories: social responsibility management of coal enterprises, stakeholder needs of coal enterprises, low carbon factor inputs of coal enterprises, low carbon awareness of coal enterprises.

**3) Selective Coding.** Selective coding is the final part of the coding of grounded theory. This study systematically analyzed the initial and main categories, and the "Core Categories" with the overarching role were further condensed. After analyzing and comparing 12 original interview texts, 32 initial categories, and 4 primary categories, the researcher finally obtained one core category, which is the research theme of this paper ----the influence of low-carbon economic development on Shanxi coal enterprises. Specifically, in the case of the emergence of the main categories, selective coding is required, and the four independent main categories cannot explain the whole event. Therefore, it is necessary to further explore the connection between the main categories, organically connect the main categories together, and summarize them in a theoretical framework. This will enable us to clarify the relationship between the core categories and other categories, and build an overall explanatory framework. The structural connotation of the main category relation is shown in Figure 2.

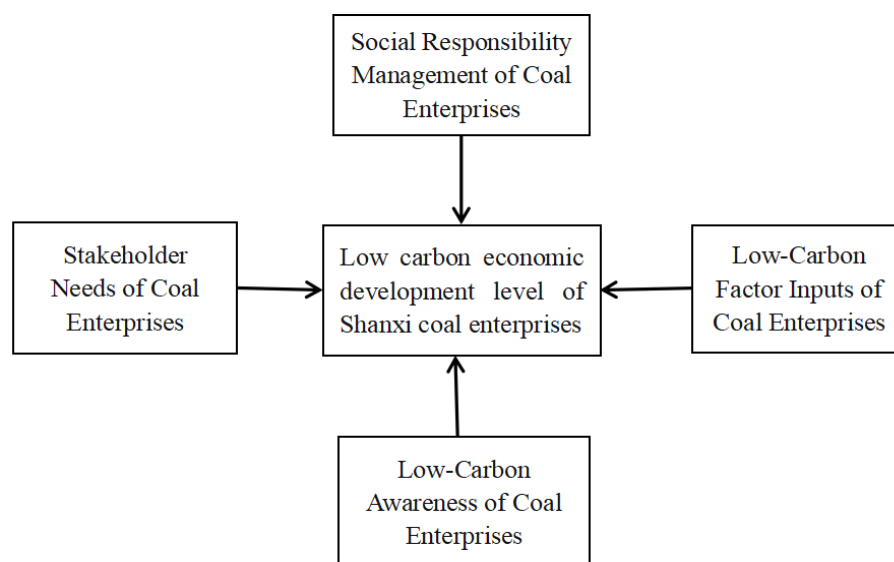


Figure 2: Theoretical model of influencing factors of low-carbon economic development level of coal enterprises

#### 4) Grounded Theory Research Test

**Theoretical Saturation Test.** Theoretical saturation is the basic guarantee for the correct conduct of grounded theory research, which is crucial. All theories should be built on the premise of theoretical saturation. If theoretical saturation is not reached, the follow-up research process should be carried out again from the point of data collection, and so on until saturation. In order to ensure the reliability and validity of the research, only original data and data were used in this study to conduct the theoretical saturation test. No novel concepts or logical relations emerged from the test, and the features of the existing categories could not be further developed. Therefore, it is believed that each concept and category in this study has been fully developed, and the theoretical saturation test has passed.





*Test of reliability.* Coding reliability can be reflected by calculating the degree of coding consistency of the coder. In this paper, the author and the other two are invited to code. There are three coders in total, X1, X2 and X3 are used respectively to represent the coding concepts in each category. Their intersection is the number of consistent coding, expressed by  $X1 \cap X2 \cap X3$ . Their union is the number of all coding. The consistency coefficient is obtained by dividing the intersection of  $X1 \cap X2 \cap X3$  by the union. When the consistency coefficient is greater than 0.8, the reliability is considered acceptable. In this article, social responsibility management of coal enterprises, stakeholder needs of coal enterprises, low carbon factor inputs of coal enterprises, The consistency coefficients of the four main categories of low carbon awareness of coal enterprises were 0.81, 0.85, 0.83 and 0.81, respectively. The coding results passed the reliability test.

*Test of Validity.* This paper adopts the participant test method for the validity test. After the interview, the original resources are transcribed, and the written findings and conclusions are sent to the participants together. The participants are invited to evaluate the degree of conformity between the research conclusions and the actual situation, so as to obtain feedback and approval from the participants. The evaluation results of the degree of conformity of the study participants are all above 95%, which is considered to have good validity.

## Conclusion

In this study, grounded theory is used to analyze the theme of the study, and 32 initial categories, 4 main categories, and 1 core category are identified through "three-level coding". By studying the internal relations among the main categories, factors affecting the development level of the low carbon economy of Shanxi coal enterprises are sorted out.

Table 3 *Grounded Theory*

Level	One-Level Code	Two-Level Code	Three-Level Code
<b>Coding</b>	Open-Ended Coding	Spindle Coding	Selective Coding.
<b>Categories</b>	Initial Categories	Main Categories	Core Categories
<b>Variables</b>	Latent Variables	Index	Subject
<b>No.</b>	32	4	1

## Recommendation

**1.Raise Enterprise Awareness of Low-Carbon Practices.** The strategic decisions of coal enterprises are influenced by the values and ideas of the managers, so it is necessary to establish the awareness of low-carbon development among the managers.

**2. Establish and Improve the Human Resource Management System.** It is imperative for coal enterprises to establish and improve their human resources management systems, integrate flexible and market-oriented factors into their human resources management, realize the flow of personnel, and lay a good institutional foundation for the low-carbon transformation of the enterprise.

**3. Establish a Coordination Mechanism for Stakeholders.** Stakeholders are crucial to the development of the low-carbon economy of coal enterprises. In order for coal enterprises to enhance



their low-carbon economy development level, they need to strengthen contact with stakeholders, clarify their needs, establish a cooperation mechanism, and use the resources of stakeholders.

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