# INFLUENCE OF CORPORATE SOCIAL RESPONSIBILITY ON LOW-CARBON ECONOMIC DEVELOPMENT LEVEL OF COAL ENTERPRISES IN SHANXI PROVINCE, CHINA

**Yuanyuan Liu[1] and Wasin Phromphithakkul[2]**
1Ph.D, Candidate, Management, School of Management, Shinawatra University
Email: 574717729@qq.com
2Ph.D, Management, School of Management, Shinawatra University
Email: wasin.p@siu.ac.th

**Abstract**

This paper aims to study the impact of corporate social responsibility on the low-carbon economic development level of coal enterprises in Shanxi Province, China. According to Krejcie and Morgan's Table, the authors selected 381 samples by stratified random sampling from all 50,000 middle and high-level managers in 806 coal enterprises in Shanxi Province, China. This study used the structural equation model for quantitative research, and sample data were collected through a questionnaire survey. The main tools analyzed in this paper are EFA, Reliability, Validity, and CFA, all based on a significance level of 0.001. As a result of the analysis, corporate social responsibility (CSR) is significantly positively correlated with the low carbon economic development level (LCE) of coal enterprises, and the responsibility management system (RMS) and the implementation of the management system (IMS) serve as significant mediating factors. Therefore, it is suggested that the government, society, and enterprises should pay more attention to establishing and implementing a corporate social responsibility management system. Consequently, this will further improve the low carbon economic development level of coal enterprises in Shanxi Province.

**Keywords** : CSR, Low Carbon Economic, Responsibility Management

**Introduction**

In the era of a low-carbon economy, enterprises are faced with the task of efficient production and the low-carbon responsibility of saving energy and resources and protecting the socio-ecological environment. China's Shanxi Province is a large coal resource province with many coal enterprises. Since 2003, Shanxi Province has produced 9.8 billion tons of raw coal, accounting for a quarter of China's raw coal production in the same period, ranking first in the country (National Bureau of Statistics, 2022). Nevertheless, many coal enterprises in Shanxi continue to operate according to the

previous extensive production model. This model has high pollution, high emissions, inefficient efficiency, and severe harm to societal interests. All sectors of Chinese society have joined hands to take low-carbon measures to address climate and environmental change, which has become a vital force in achieving the goal of low-carbon development. Companies involved in coal mining should strictly adhere to the social responsibility of reducing carbon emissions as an essential part of their business. Therefore, this paper mainly studies the impact of corporate social responsibility in the Shanxi Province of China on the low-carbon economic development level of coal enterprises. Relevant studies (Gong Chen, Bi Kexin, 2018) show that corporate social responsibility positively correlates with low-carbon development. However, the theoretical research on the relationship between corporate social responsibility and improving the development level of a low-carbon economy is still in its initial stage. This paper's topic selection and research direction have significant theoretical and practical significance. The research results will provide a reference for governments and enterprises to formulate and improve policies, laws, regulations, and mechanisms related to the low-carbon economy. Based on previous studies and empirical analysis, this paper explores corporate social responsibility's role path and influence on the low-carbon economic development level of coal enterprises in Shanxi Province and puts forward corresponding countermeasures and suggestions.

**Research objective**

1. To explore the influence mechanism of corporate social responsibility on the low-carbon economic development level of coal enterprises in Shanxi Province.

2. To explore the mediating effect of the liability management system.

3. To explore the intermediary mechanism of implementing the management system.

4. To explore the mechanism of the responsibility management system on the implementation of the management system.

**Literature Review**

Scholars such as Geoffrey Heal(2004) and Oana Pop(2011) believe that corporate social responsibility is an effective tool that can be fully utilized, enabling enterprises to transform from the current economic situation to a low-carbon economy.

According to Jin (2010), corporate social responsibility and the development of a low-carbon economy can change the world for the better. Implementing a low-carbon economy will benefit product innovation, environmental protection, brand effect, and other aspects. In other words, a low-carbon economy will bring additional benefits to enterprises that attach importance to corporate social responsibility.

Taking Gansu Province as an example, Zhang Xiaofang (2016) pointed out that implementing corporate social responsibility will be conducive to the innovation of low-carbon technologies, the recycling of products and services, and the cultivation of the low-carbon culture of enterprises. Finally, it promotes the development of a low-carbon economy in China.

Stale Knudsen(2016) pointed out that the consistency of the game between CSR and the stakeholders of the low-carbon economy is gradually weakening. Nevertheless, as pollution levels or environmental awareness improve, the bilateral relationship between CSR and the low-carbon economy is constantly reshaping, resulting in a stronger consistency between them.

Diamond(2009) believes that there are various channels and ways to reduce carbon dioxide emissions through the implementation of corporate social responsibility. Among them, the reduction of carbon dioxide emissions in the production sector of enterprises can be achieved through the innovation of production technology.

Shahbaz et al. According to (2013), businesses tend to implement carbon emission reduction strategies to establish a positive image, diversify risks, and reduce financing costs by improving the capital market development index.

Sprinkle(2010) argues that producing green and low-carbon products and participating in low-carbon emission reduction projects can reduce taxes, policy constraints, and public pressure.

Tan Zhixiong (2012) believes that a developed financial system is more conducive to carbon trading by enterprises. As the main body of carbon trading, carbon emission enterprises are not only the demanders of carbon sinks but also the suppliers.

Sen & Bhattacharya(2001) believe that enterprises' indirect carbon emission reduction deserves attention; implementing corporate social responsibility can stimulate consumers' enthusiasm and awareness of low-carbon emission reduction.

Lash(2007) and Subramanian(2009) et al noted that consumers would increasingly consider a company's CSR record and context when making purchase decisions. Enterprises also share environmental costs and social responsibilities with consumers by issuing systems and regulations.

There are few types of literature on the relationship between corporate social responsibility and the low-carbon economic development of coal enterprises. Domestic and foreign research on low-carbon economy mainly focuses on the macro level, such as region, city, or industry. There are few studies on micro-enterprises, especially on coal enterprises in Shanxi Province with high energy consumption, high pollution, and high carbon emissions.

**Hypotheses of research**
H1: CSR positively correlates with the low-carbon economic development level of coal enterprises in Shanxi Province.
H2a: CSR positively correlates with the responsibility management system of coal enterprises in Shanxi Province.
H2b: CSR is positively correlated with the coal enterprise management system in Shanxi Province.

H2c:There is a positive correlation between responsibility management systems and coal enterprises in Shanxi Province.

H3a: The responsibility management system is positively correlated with the low-carbon economic development level of coal enterprises in Shanxi Province.

H3b: The implementation of the management system is related to the low-carbon economic development level of coal enterprises in Shanxi Province.

**Research Framework**

In this study, the social responsibility of coal enterprises is determined as the independent variable, and the low-carbon economic development level of coal enterprises is determined as the dependent variable. The mediating variable is social responsibility management, which can be divided into two dimensions: corporate responsibility system and implementation. The relationship between variables is shown in the following figure 1.
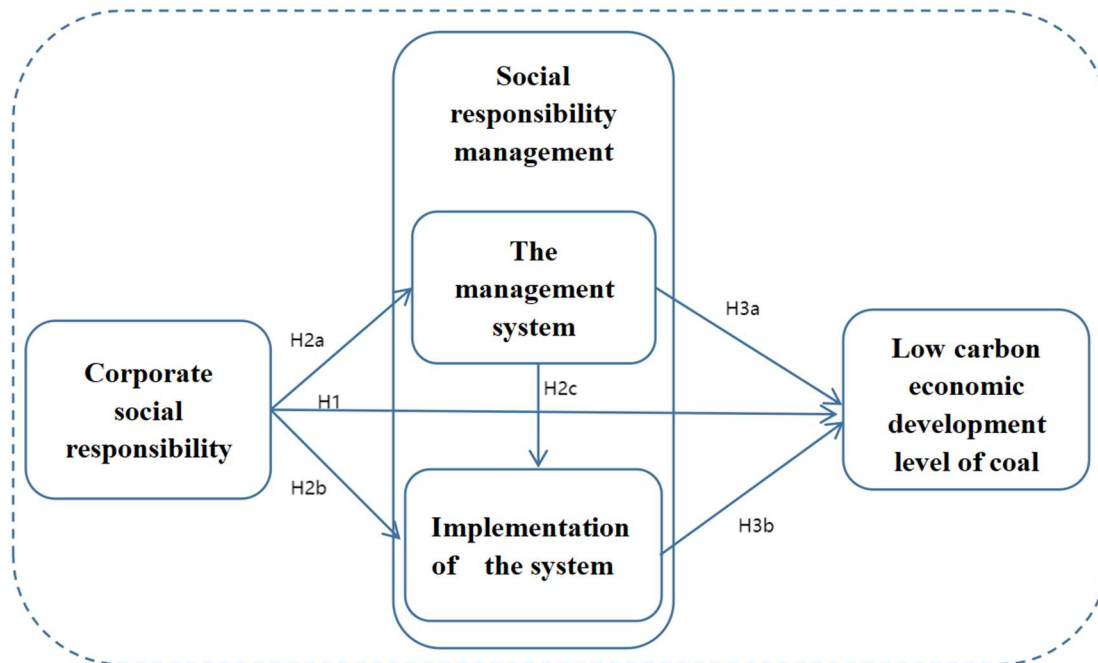


**Figure 1** Conceptual Framework

**Research Methodology**

1. Population and sample of the research

This study adopts a questionnaire survey method to collect the data of middle and senior management personnel in 806 coal enterprises in Shanxi Province. Shanxi Province has 50000 middle and senior management personnel (N=50000). In this paper, according to the sample size calculation method of Krejcie and Morgan (1970), the sample size was determined to be 381 (n=381) under a 95% confidence interval.

2. Instrument of this research

The questionnaire used in this study has four parts: corporate social responsibility, low-carbon

economic development level of coal enterprises, responsibility management system, and management system implementation. The LIKERT-5 scale (Likert, 1967) measures these four aspects. This study adopts and refers to the CSR scale of Gong Chen (2018). They are Government low-carbon constraints, Investors low-carbon constraints, Product demand low-carbon constraint, and Social environment low-carbon constraints; according to Jia Xueying's (2020) low-carbon economic development scale for coal enterprises as reference, they include Enterprise's emphasis on developing low carbon, Comprehensive utilization of "waste ", heat and pressure", Application of low-carbon technologies in coal production and transportation, Environmental protection and governance; The liability management system scale of Zhang Wen (2012) was used for reference and selection, including Low carbon government policy, Low carbon legal System and Low carbon development based on Zhang Wen's (2012) management system implementation scale, It includes low-carbon responsibility demand survey, low-carbon responsibility management report, low-carbon responsibility monitoring, low-carbon responsibility feedback, monetary penalty for violation, reward for low-carbon responsibility, and low-carbon responsibility imputation.ion.

3. Data collection

In this study, stratified sampling was used to select samples from the population and collect relevant data about the samples.

4. Data analysis

This study uses a structural equation model to analyze the impact of corporate social responsibility on the low-carbon economic development level of coal enterprises in Shanxi. Reliability, Validity, EFA, and CFA were used to test the research hypothesis.

**Research Results**

1.Reliability

This study used the Cronbach's coefficient to test the reliability of the data obtained from the survey. The reliability analysis showed  that the overall alpha value  of the questionnaire was 0.977. The Cronbach Alpha coefficients of the scale items of corporate social responsibility, corporate low-carbon economic development level, responsibility management system and management system implementation were 0.966, 0.862, 0.968 and 0.961, respectively. The Cronbach Alpha coefficient of the overall scale and each factor scale is above 0.85, so the scale used in this study has high reliability (Nummally, 1978).

2.Validity

Validity tests include two types: Exploratory Factor Analysis and Confirmatory Factor Analysis.

(1)*Exploratory Factor Analysis(EFA).*Using the statistical software SPSS 26.0, the factor loadings of the measurement items were all greater than 0.7, the Eigen values of R were 10.226, 3.005, 2.586 and 0.920 respectively. In other words, the four factors CRS, RMS, IMS and LCE had explained 88.089% of the standardized variance of the original variable, and the KMO value was 0.916; the Bartlett Test of Sphericity is 12111.652.

(2)*Confirmatory Factor Analysis(CFA).*Confirmatory factor analysis includes two critical aspects: convergent validity and discriminant validity.

*Convergent Validity.* The AVE value of the scale items is greater than 0.8, and the CR value is greater than 0.9, which all pass the test (Fonell and Larcker, 1981) (see table 1). In CFA, the $\chi 2/df$ values of all scale items were less than 5, the RMR and RMSEA values were less than 0.08, and the GFI, AGFI, NFI, IFI, TLI and CFI values were more than 0.9, all of which passed the test (Bollen, 1989). Therefore, the scale items in this study have high convergent validity (See table 2).

**Table 1** AVE and CR

| Code | Factor Loading | AVE | CR |
|---|---|---|---|
| **CSR1** | 0.920 | | |
| **CSR2** | 0.899 | 0.837 | 0.976 |
| **CSR3** | 0.920 | | |
| **CSR4** | 0.942 | | |
| **RMS1** | 0.818 | | |
| **RMS2** | 0.717 | 0.808 | 0.925 |
| **RMS3** | 0.826 | | |
| **IMS1** | 0.930 | | |
| **IMS2** | 0.930 | | |
| **IMS3** | 0.929 | | |
| **IMS4** | 0.791 | 0.878 | 0.966 |
| **IMS5** | 0.779 | | |
| **IMS6** | 0.891 | | |
| **IMS7** | 0.876 | | |
| **IMS8** | 0.938 | | |
| **LCE1** | 0.693 | | |
| **LCE2** | 0.870 | 0.865 | 0.962 |
| **LCE3** | 0.855 | | |
| **LCE4** | 0.860 | | |

**Table 2** Confirmatory Factor Analysis (CFA) Test Results

| Index | Reference Value | Index Value |
|---|---|---|
| **$\chi 2/df$** | $\chi 2/df \leq 5$; Best when $\chi 2/df \leq 3$ | 4.944 |
| **RMR** | RMR$\leq$0.08; Best when RMR$\leq$0.05 | 0.045 |
| **RMSEA** | RMSEA$\leq$0.08; Best when RMSEA$\leq$0.05 | 0.048 |
| **GFI** | GFI$\geq$0.9 | 0.904 |
| **AGFI** | AGFI$\geq$0.9 | 0.900 |
| **NFI** | NFI$\geq$0.9 | 0.900 |
| **IFI** | IFI $\geq$0.9 | 0.905 |
| **TLI** | TLI$\geq$0.9 | 0.900 |

| **CFI** | CFI≥0.9 | 0.905 |
|---|---|---|

*Discriminant Validity.* The correlation coefficients between the measured variables were all less than 0.85, and the AVE square root was more significant than the absolute value of the correlation coefficients between the variables and other variables. Therefore, the discriminant validity among the measured variables was high (See Table 3). The discriminant validity analysis of HTMT values showed that all HTMT values were less than 0.85, indicating a reasonable degree of differentiation among the factors. The study data had reasonable discriminant validity (See table 4).

**Table 3** Fornell-Larcker Criterion Analysis

|  | CSR | RMS | IMS | LCE |
|---|---|---|---|---|
| **CSR** | 0.915 | | | |
| **RMS** | 0.406 | 0.899 | | |
| **IMS** | 0.359 | 0.398 | 0.937 | |
| **LCE** | 0.571 | 0.672 | 0.294 | 0.930 |

**Table 4** Heterotrait-Monotrait Ratio Analysis

|  | CSR | RMS | IMS | LCE |
|---|---|---|---|---|
| **CSR** | - | | | |
| **RMS** | 0.415 | - | | |
| **IMS** | 0.369 | 0.420 | - | |
| **LCE** | 0.585 | 0.710 | 0.306 | - |

3.Structural Equation Model(SEM)

In order to ensure the reliability and validity of the scale used by the research institute, a conceptual model and theoretical hypothesis of corporate social responsibility and the level of low-carbon economic development of coal enterprises have been combined. Firstly, AMOS 26.0 software was used for structural equation modeling and analysis. Secondly, based on the reference model adjustment index; Finally, the proposed hypothesis is verified by the model analysis results. Figure 2 illustrates the path relationship and coefficients between variables of the final model, while Table 5 presents the results of the final model test.
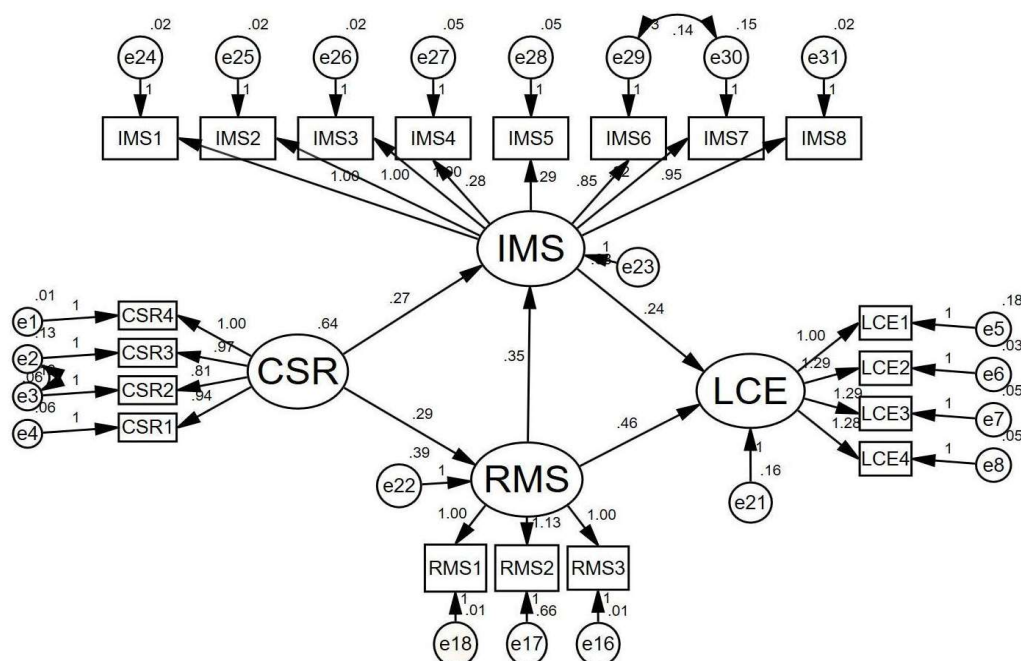
**Figure 2** Final Model Path

**Table 5** The Fitting of Structural Equation Model

| Index | Reference value | Index value |
|---|---|---|
| χ2/df | χ2/df≤5; Best when χ2/df≤3 | 2.395 |
| RMR | RMR≤0.08;Best when RMR≤0.05 | 0.046 |
| RMSEA | RMSEA≤0.08;Best when RMSEA≤0.05 | 0.062 |
| GFI | GFI≥0.9 | 0.910 |
| AGFI | AGFI≥0.9 | 0.902 |
| NFI | NFI≥0.9 | 0.972 |
| IFI | IFI ≥0.9 | 0.983 |
| TLI | TLI≥0.9 | 0.980 |
| CFI | CFI≥0.9 | 0.983 |

From the path relationship of the model and verification results, it can be seen that the five path coefficients (CSR→RMS), (CSR→IMS), (RMS→IMS), (RMS→LCE) and (IMS→LCE) are significant, and the five hypotheses H2a, H2b, H2c, H3a, and H3b all pass the test. However, the correlation between CSR and coal enterprises' low carbon economic development level (CSR→LCE) is not significant. Therefore, Hypothesis H1 is rejected. See table 6.

**Table 6** Structural Equation Model Analysis and Hypothesis Testing Results

| Hypothesis | Path | Estimate | S.E. | C.R. | P | Support |
|---|---|---|---|---|---|---|
| H1 | CSR→LCE | -0.026 | 0.030 | -0.871 | 0.384 | No |
| H2a | CSR→RMS | 0.300 | 0.042 | 7.174 | *** | Yes |

| Hypothesis | Path | Estimate | S.E. | C.R. | P | Support |
|---|---|---|---|---|---|---|
| H1 | CSR→LCE | -0.026 | 0.030 | -0.871 | 0.384 | No |
| H2b | CSR→IMS | 0.285 | 0.059 | 4.802 | *** | Yes |
| H2c | RMS→IMS | 0.345 | 0.071 | 4.876 | *** | Yes |
| H3a | RMS→LCE | 0.472 | 0.040 | 11.675 | *** | Yes |
| H3b | IMS→LCE | 0.252 | 0.028 | 8.999 | *** | Yes |

***Means P<0.001

4.Mediating Effect.

The Bootstrap method proposed by Baron & Kenny (1986) was used to verify the mediating effect of responsibility management system (RMS) and implementation of management system (IMS).

Firstly, AMOS 26 is used to make a regression between the independent variable corporate social responsibility (CSR) and the dependent variable low carbon economic development level (LCE), and it is concluded that the independent variable (CSR) is significantly correlated with the dependent variable (LCE). Thus, the relationship between the independent variable (CSR) and the dependent variable (LCE) is a complete mediator.

Secondly, the full mediation effect is decomposed in this paper, and the effect from CSR to IMS is named a1, the effect from CSR to RMS is named a2, the effect from IMS to LCE is named b1, the effect from RMS to LCE is named b2, and the effect from RMS to IMS is named b3. Therefore, the total mediation effect can be decomposed into three mediation effects ,as shown in table 7.

**Table 7** Multiple Mediation Effect Programming

| Mediation Effect Programming | Mediating effect path |
|---|---|
| ind1=p.a1*p.b1 | a1→b1(CSR→IMS→LCE) |
| ind2=p.a2*p.b2 | a2→b2(CSR→RMS→LCE) |
| ind3=p.a2*p.b3*p.b1 | a2→b3→b1( CSR→RMS→IMS→LCE ) |
| totind=ind1+ind2+ind3 | Total Mediating Effect |
| Total=totind | Total Effect |

In this paper, the role of CSR of coal enterprises on the development level of a low-carbon economy has a full mediating effect, and the total mediating effect is 0.226. The mediating effect of ind1 was 0.066, and the mediating effect contribution rate was 29.20%. The mediating effect of ind2 was 0.134, and the mediating effect contribution rate was 59.29%. The mediating effect of ind3 was 0.025, and the mediating effect contribution rate was 11.06%.

**Discussion**

Through the review of relevant literature on corporate social responsibility and low-carbon economy, it is found that most scholars have studied the impact of corporate social responsibility on

low-carbon performance from the financial level. At the same time, there are few studies on corporate social responsibility and the development level of the low-carbon economy of coal enterprises.

From an intermediary perspective, this study investigates the relationship between corporate social responsibility (CSR) and coal enterprises' low-carbon economic development level. According to Zhang Wen (2012), CSR management is a two-dimensional variable, and this study believes that CSR management consists of the management system and the implementation of the management system. Through a comprehensive analysis of the views of existing researchers, the Bootstrap method was used to confirm the mediating effect's existence further. The results of this empirical study are statistically significant and verify the hypotheses of H3a, H3b, and H2c.

Because they are stakeholders in coal enterprises, product consumers, and investors, their low-carbon demand will significantly impact the low-carbon transformation of coal companies. Jia Xueying (2020) pointed out that the government and the public urged coal enterprises to carry out low-carbon production to reduce carbon emissions. The government will support coal enterprises to implement low-carbon innovation, improve production equipment and products, and reduce pollution in their production. There will be a positive response, whether in formulating the management system or implementing it. This empirical study also verified the hypothesis of H2a and H2b.

## Conclusion

Through the analysis of the above theoretical hypothesis, the research hypothesis of this paper has been fully verified. The main conclusions are as follows:

First, CSR has no direct impact on coal enterprises' development of low-carbon economies.

Secondly, the implementation of a responsible management system and management system plays an important role in the relationship between corporate social responsibility and the level of low-carbon economic development of coal enterprises, and the contribution of the responsibility management system is more significant than the contribution of management system implementation.

Third, in the process of corporate social responsibility positively affecting the development level of the low-carbon economy of coal enterprises, coal enterprises will eventually indirectly affect the development level of the low-carbon economy through the social responsibility management system and then the implementation of the management system. This process forms a chain of mediation utility.

## Research Suggestion

Based on the relevant research on the impact of corporate social responsibility on the low-carbon economic development level of coal enterprises, the suggestions of this paper are as follows:

1. The government should control macro-policy orientation and increase external innovation to stimulate enterprises.

Regulations relating to environmental protection caused by the development of a low-carbon economy raise the operating costs of coal companies. Corporate social responsibility management can be market-orientated, with the low carbon emission reduction costs borne by coal companies controlled within reasonable limits. The competent authorities of the carbon trading market should fully consider the characteristics of the coal industry and formulate policies in line with the actual

situation of coal enterprises to alleviate the information mismatch between the government and coal enterprises and provide policy guarantees for sustainable and sound development of the carbon emission trading market. At the same time, the government can also provide subsidies, tax breaks, and other incentives to coal enterprises whose technological innovation meets the requirements of environmental protection standards to encourage coal enterprises to carry out low-carbon technological innovation. In addition, the government can encourage the financial industry to promote the development of carbon emission trading, including the development of carbon financial product structures and the enrichment of carbon financial products. The financial sector's strengthened support for coal enterprises will help them to carry out low-carbon transformation and sustainable development.

2. Coal enterprises should establish the concept of environmental protection and actively participate in carbon trading.

Coal enterprises should treat carbon emission trading correctly and respond positively to government regulation policies. In the context of low-carbon economic development, all coal enterprises should thoroughly weigh the advantages and disadvantages of high pollution emission behavior. Coal enterprises should plan their development from a long-term perspective, make reasonable environmental protection decisions, and actively carry out technological innovation to reduce energy consumption and pollutant emissions. Under the context of global carbon peak and carbon neutrality, coal enterprises in Shanxi Province of China should actively respond to the country's call, establish correct environmental protection concepts, and enhance their corporate social responsibility. All high-emission coal enterprises in Shanxi should continuously improve production technology through technological innovation and other forms to increase the use efficiency of resources. In particular, implementing the social responsibility management system of coal enterprises can help improve the level of low-carbon economic development of enterprises and promote the sustainable development of enterprises.

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