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Analysis of Synergistic Effect of Energy Efficiency Improvement and Vocational Competence Development

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Abstract

INTRODUCTION: Growing global energy demand and constant competition for energy resources have made energy efficiency a focus of international attention. At the same time, occupational competency development is crucial for sustained individual and overall economic growth.
OBJECTIVES: This study explores the synergistic effects of energy efficiency improvement and occupational competence development to inform policy-making and business strategies.
METHODS: A literature review summarises relevant theories and research progress on energy efficiency improvement and occupational capability development. Then, the relationship between energy efficiency improvement and vocational ability development was analyzed in depth using econometric models and a large amount of empirical data.
RESULTS: There is a significant positive association between energy efficiency improvement and vocational ability development. Specifically, improving energy efficiency not only reduces the cost of energy consumption and enhances productivity but also helps promote technological innovation and industrial upgrading, which in turn enhances the level of occupational ability of workers. In turn, improving occupational ability further encourages technological innovation and productivity in enterprises, forming a virtuous circle and promoting the sustainable development of the economy.
CONCLUSION: This study reveals the synergistic effect between energy efficiency improvement and vocational competence development, emphasizing the critical role of energy efficiency improvement and vocational competence development in promoting economic growth and achieving sustainable development.

Keywords: energy efficiency improvement, occupational capacity development, synergies, sustainable development

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1 Introduction

In today's world, the issue of energy has become one of the focuses of attention of the international community. The world's energy demand is trending upward due to the expansion of the global population and the quickening of industrialization(Hasan et al., 2021). According to the International Energy Agency (IEA), data show that the global annual growth rate of energy demand is about 1%, and it is expected that in the next few decades, this growth trend will continue to continue. This continued growth in energy demand poses a challenge to the supply of energy resources and has severe implications for the environment and climate change.

To meet this challenge, improving energy efficiency has become one of the most critical strategies generally

recognized by governments and enterprises. Energy efficiency improvement can be realized through technological innovation, industrial structure adjustment, and policy guidance(Paramati et al., 2022). By lowering greenhouse gas emissions, energy production costs, and energy consumption, it can achieve sustainable development by easing the strain on the energy supply and demand balance and reducing environmental pollution. Therefore, improving energy efficiency has become one of the essential elements of the global energy strategy.

On the other hand, vocational ability development has received increasing attention as an essential factor in promoting economic growth and social development. With the restructuring of the economy and the upgrading of industries, people's demand for vocational skills is also rising(Borodina et al., 2022). A workforce with a high level of vocational competence can improve productivity and promote technological innovation and industrial upgrading, thereby promoting sustainable economic development.

Studies have shown a close relationship between vocational ability development and economic growth. A high level of vocational ability not only improves the employment opportunities and wages of workers but also promotes the technological innovation and competitiveness of enterprises, which in turn encourages the growth of the whole economy and the progress of society. Therefore, strengthening vocational ability development is necessary for individuals to enhance their competitiveness and realize their value. It is also an essential guarantee for promoting economic growth and social progress.

In light of this, investigating the connection between increased energy efficiency and the advancement of occupational skills is essential. Theoretically, increasing energy efficiency can encourage technological innovation and an upgrade in industrial structure, which in turn can promote the improvement of vocational ability; in practice, however, ongoing improvements in vocational ability can also encourage increased energy efficiency and industrial upgrading(Liu et al., 2021). However, there are still many unknowns and unanswered questions regarding the link between increased energy efficiency and the growth of vocational ability. The research on this topic is still in its early stages. To create effective policies and achieve the objective of sustainable development, it is crucial to thoroughly examine the relationship between the two and assess their synergistic impacts. This has significant theoretical and practical implications.

Examining the connection between increasing energy efficiency and developing vocational skills can be a crucial resource for businesses creating development plans and for the government creating energy policy. Modern society has developed based on energy, and increasing energy efficiency is essential for maintaining energy security, fostering economic expansion, and lowering environmental pollution(Zhuravlova et al., 2021). A thorough analysis of the connection between increasing energy efficiency and developing vocational skills can offer a solid scientific foundation for government energy policy formulation and a crucial source of information for businesses creating development plans. In addition, it can also explore and reveal the intrinsic connection and mutual influence mechanism between energy efficiency improvement and vocational ability development. In the past, energy efficiency improvement and vocational ability development have often been studied separately, lacking an in-depth exploration of the relationship between the two. However, it has been found in practice that the improvement of vocational ability usually accompanies energy efficiency improvement, which can promote further improvement of energy efficiency. There is a synergistic effect between the two. Therefore, a thorough examination of the connection between increasing energy efficiency and developing one's vocational skills can aid in illuminating the underlying mechanism and offer theoretical underpinning and policy recommendations for achieving the mutually beneficial objectives of environmental preservation and economic growth.

This study can also provide theoretical support and policy recommendations for promoting economic growth and realizing sustainable development. The development of vocational skills is important for establishing practical approaches and effective policies, since it is a crucial component in learning sustainable development and encouraging economic growth(Zhu et al., 2021). Analyzing the relationship between energy efficiency improvement and vocational ability development can provide scientific decision-making and strategic guidance for government departments and enterprises and promote win-win economic growth and environmental protection.

2 Literature review

2.1 International Research Progress on Energy Efficiency Improvement

Over the past few decades, energy efficiency improvement on a global scale has become a hot area of interest for scholars and policymakers. Internationally, researchers have deepened their understanding of energy efficiency improvement through extensive literature reviews and empirical analyses(X. Wu et al., 2022). The main focus is on the drivers of energy efficiency improvement, including environmental issues, resource security, and economic competitiveness. As the global climate change issue has become more prominent, increasing environmental awareness has pushed governments to pay attention to energy efficiency improvement to reduce greenhouse gas emissions and environmental pollution.

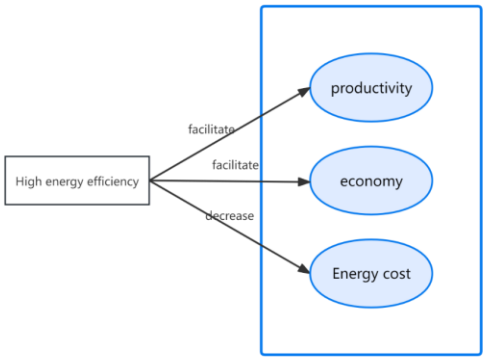

Figure 1 Impact of high energy efficiency gains

Scholars from throughout the world have focused a great deal of attention on the relationship between increased energy efficiency and economic growth. As shown in Figure 1, empirical studies in several countries and regions have found that high energy efficiency is often accompanied by higher productivity and economic development. Energy efficiency improvements can reduce energy costs and increase productivity, creating added value for enterprises. As a result, countries have made energy efficiency improvements a strategic goal to promote sustainable economic growth.

At the same time, energy efficiency improvement is also seen as an effective way to reduce dependence on non-renewable energy sources. At a time when global energy security is a constant concern, reducing dependence on limited resources and improving energy efficiency have become joint efforts by countries in pursuit of energy security(Zhao et al., 2021). Through technological innovation and policy support, some countries have succeeded in improving energy efficiency, reducing dependence on imported energy, and enhancing the stability of energy supply.

International research that explore the difficulties of enhancing energy efficiency, however, is abundant. One of the critical issues is the impetus for technological innovation. Despite many potential technological feasibilities, the diffusion and application of technological innovations in practice still face a series of barriers, including insufficient investment and inadequate market mechanisms. This suggests that to realize real energy efficiency improvement, technological innovation requires more research investment and the active participation of governments and enterprises to build a more complete innovation system.

Another issue of great concern is the effectiveness of policy support. While many policies have been implemented by nations to promote increases in energy efficiency, the study discovered some obstacles to their successful implementation(Hajiali et al., 2022). Lack of precision in the design and implementation of policies and inadequate regulatory mechanisms have become vital factors affecting the effectiveness of policies. Therefore, international studies have called for greater attention to detail in policy formulation while emphasizing policies' sustainability and long-term nature to ensure that their implementation achieves the desired results.

2.2 Theoretical foundations of vocational capacity development and economic growth

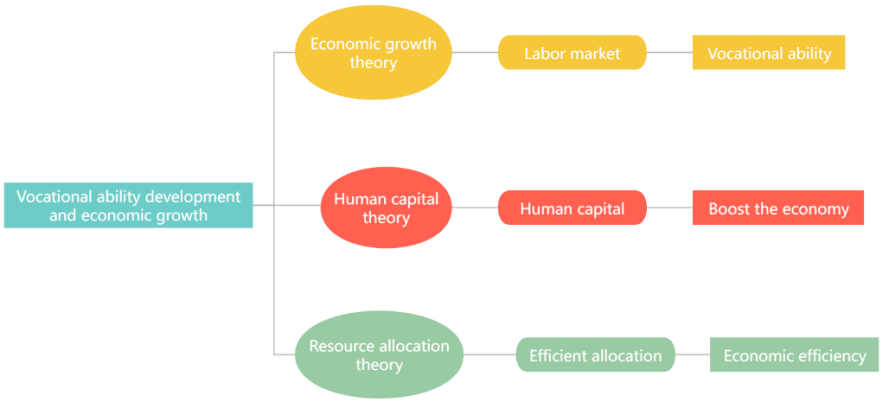

Figure 2 Three theories of occupational competence and economic growth

The relationship between vocational ability development and economic growth has been an important research topic in economics and human resource management. Regarding the theoretical foundation, Keynes' theory of economic growth provides important insights(Ding et al., 2022). According to Keynes, an influential labor market can promote economic development, and enhancing occupational competence is an essential prerequisite for achieving the effective operation of the labor market. As social and economic structures continue to change, labor market demand is also changing,

and the key to adapting to such changes lies in the continuous improvement of workers' vocational ability.

Another essential theoretical foundation is the human capital theory. The human capital theory recognizes that human capital is the sum of workers' knowledge, skills, and experience and is an essential factor in driving economic growth and increasing productivity(H. Wu et al., 2021). Within this theoretical framework, vocational competency development is seen as an investment that, by increasing the level of human capital of an individual, can improve their productivity and thus contribute to the economy's growth as a whole.

Furthermore, the link between the expansion of vocational ability and economic growth is theoretically supported by the resource allocation efficiency theory(Treloar et al., 2021). The effective allocation of resources is crucial to improving economic efficiency and promoting economic growth. The enhancement of vocational ability can realize a more efficient allocation of resources, and through technological innovation and the improvement of professional skills, workers can better adapt to market demand and increase productivity, thus promoting economic growth.

Furthermore, a thorough investigation of the connection between the advancement of occupational skills and economic expansion has been conducted by the theory of technical progress(Zhang et al., 2022). According to the theory of technological progress, technological innovation is one of the critical driving forces for economic growth. Improving vocational ability can promote the occurrence and dissemination of technological innovation, thus promoting the development of the whole industry and economic growth. Therefore, improving the vocational ability of workers is considered one of the crucial ways to promote technological progress and economic growth.

Finally, the theory of institutional change also provides an essential theoretical basis for the relationship between the development of vocational skills and economic growth(Dykan et al., 2021). According to the theory of institutional change, changes in social and economic systems have an essential impact on economic growth and development. The enhancement of vocational ability can promote institutional change and innovation, and by improving the professionalism and innovation ability of workers, it can encourage changes in the entire economic structure, thereby realizing economic growth and development.

2.3 Current status of research related to energy efficiency improvement and vocational capacity development

Many academics, both domestically and internationally, are interested in exploring the present status of studies on improving energy efficiency and developing vocational abilities. International research has been done in some theoretical areas about the connection between increasing energy efficiency and developing one's occupational abilities (Dong et al., 2021). These studies primarily investigate how workers' levels of occupational competence are impacted by increases in energy efficiency and how increases in occupational competence themselves encourage increases in energy efficiency(Lazorko et al., 2021). Through modeling and empirical analyses, this research has discovered that raising energy efficiency can encourage industrial upgrading and technological innovation, boosting workers' occupational competence levels. Enhancing occupational competency can foster technological innovation and increase business productivity, creating a positive feedback loop that supports long-term, sustainable economic growth.

Specific case studies that explore the relationship between energy efficiency improvements and occupational capacity development have also emerged internationally. These case studies mainly focus on the practical experiences of specific industries or enterprises and summarize some valuable lessons learned through in-depth analysis of their practices and effectiveness in energy and human resource management. For example, some enterprises have improved energy utilization efficiency, reduced production costs, and enhanced competitiveness through enhanced staff training and skills upgrading(Bandari et al., 2022). These case studies provide us with experiences and insights at the practical level and help deepen our understanding of the relationship between energy efficiency improvement and occupational capability development.

Furthermore, a large number of national and international governments and organizations have carried out pertinent policy analysis and research. These studies have mostly concentrated on how increasing energy efficiency and developing vocational ability affect sustainable development and economic growth, as well as how to employ policy tools to encourage the two to develop synergistically. For example, some international organizations have put forward a series of policy recommendations, including strengthening energy management and technological innovation, optimizing the vocational education and training system, and establishing incentive mechanisms to promote a virtuous cycle of energy efficiency improvement and vocational capacity development.

However, despite some research results being achieved, there are still some shortcomings in the current domestic and international research related to energy efficiency improvement and vocational ability development(Provenzi et al., 2023). Most existing research focuses on theoretical analysis and case studies and lacks systematic empirical analysis and in-depth exploration of mechanisms. At the same time, most current studies are limited to specific industries or regions, and there is a lack of cross-field and cross-regional comparative studies. In addition, most current studies focus on the impact of energy efficiency improvement on the development of vocational ability but pay little attention to the promotion of vocational ability

development on energy efficiency improvement(Mohsin et al., 2021). To further deepen the research on the relationship between energy efficiency improvement and vocational ability development, expand the research horizon, and deeply explore its inner mechanism to provide a more scientific basis for policy formulation and practice.

3 Research Methodology

3.1 Data sources and sample selection

The detailed analysis of the relationship between improving energy efficiency and developing vocational abilities will be achieved via the use of a variety of data sources and sample selection techniques in this study. Regarding the data on energy efficiency improvement, the study selects the annual report of national energy statistics, energy industry data released by the National Energy Administration, and reports and databases of relevant domestic and foreign research organizations. These data cover energy consumption in various industries and regions, energy utilization efficiency indicators, and the implementation of energy management policies, providing the study with comprehensive data support on energy efficiency improvement.

As for data on the development of vocational ability, the study will comprehensively use several data sources, including employment and human resources statistics released by the National Bureau of Statistics, survey reports by relevant industry associations and research organizations, and data on human resources management within enterprises. The data include vital indicators such as the education level of workers, skill structure, and vocational training status.

In terms of sample selection, a multi-stage sampling method is used to ensure the sample is representative and reliable. First, representative sample regions and industries are selected based on the characteristics of different sectors and regions. Subsequently, a certain proportion of enterprises and individual laborers are randomly chosen as sample objects in each area and industry. In sample selection, attention is paid to ensuring the diversity and adequacy of the samples to ensure the credibility and reliability of the research results.

Various methods were used to clean and organize the data to improve its quality and comparability. The raw data were strictly screened and verified, and data that did not meet the requirements or contained errors were excluded to ensure the accuracy and completeness of the samples. At the same time, data standardization and Normalization were carried out to facilitate comparison and analysis between different data and to ensure the scientific and interpretable nature of the research results.

To guarantee the accuracy and representativeness of the research data, this study will fully utilize various data sources and employ a multi-stage sampling procedure for sample selection. After that, the data will be cleansed and arranged to enhance their quality and comparability and offer a solid scientific foundation for a comprehensive examination of the connection between increased energy efficiency and the advancement of occupational skills.

3.2 Analytical methods and modeling

This study will examine the association between increased energy efficiency and the development of vocational abilities using panel data analysis techniques and econometric models. The collected data on energy efficiency improvement and vocational ability development are processed and analyzed using the panel data analysis method. Specifically, a panel dataset is constructed, which contains data related to energy efficiency and occupational competence for multiple regions or industries at different points in time.

In terms of modeling, the association between improving energy efficiency and developing vocational skill was investigated using a multiple linear regression model. The form of the model is as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \in_{it} \quad (1)$$

In equation (1), Y_{it} denotes the level of occupational ability of the ith region or industry at time t, Xit denotes the level of energy efficiency of the ith region or industry at time t, Zit represents other factors that may affect the occupational ability, β_0 is the intercept term, β_1 is the effect of energy efficiency improvement on occupational ability coefficient, β_2 is the coefficient of the impact of control variables on occupational ability, and $\in it$ is the random error term.

In the model setting, appropriate control variables will be selected according to theoretical assumptions and actual situations to eliminate the influence of other factors on occupational ability. These control variables may include factors such as the level of regional economic development, educational input, industrial structure, etc. By introducing these control variables, the impact of energy efficiency improvement on occupational ability can be analyzed more accurately, and other possible interfering factors can be eliminated.

In the econometric analysis, either a fixed or a random effects model will be used to estimate the model parameters. The exact choice of model will be determined based on the panel data's characteristics and the model tests' results. Heteroskedasticity and multicollinearity tests will also be conducted to ensure the robustness and reliability of the model.

3.3 Variable definition and operationalization

In order to give a thorough analysis of the relationship between improving energy efficiency and developing occupational competence, important factors will be established and operationalized in this research. Firstly, the

concepts of energy efficiency improvement and occupational ability development need to be clearly defined. For energy efficiency improvement, indicators such as energy utilization efficiency or energy consumption intensity can be used to measure, as described below:

$$X_{it} = \frac{E_{it}}{Y_{it}} \quad (2)$$

(2) where X_{it} denotes the energy efficiency level of the ith region or industry at time t, E_{it} denotes the energy consumption of the ith region or industry at time t, and Y_{it} denotes the output of the ith region or industry at time t.

For the development of vocational capacity, indicators such as the level of education, skill structure, and vocational training coverage can be used to measure it, as defined below:

$$Y_{it} = \alpha_0 + \alpha_1 Ed_{it} + \alpha_2 Sk_{it} + \alpha_3 Tr_{it} + \varepsilon_{it} \quad (3)$$

(3) where Y_{it} denotes the vocational ability level of the ith region or industry at time t, Ed_{it} denotes the education level of the ith region or industry at time t, Sk_{it} denotes the skill structure of the ith region or industry at time t, Tr_{it} denotes the vocational training coverage rate of the ith region or industry at time t, and εit represents the random error term.

In empirical analysis research, the occupational competence level index will be used to measure an individual or group's comprehensive competence level in a specific occupational field. The occupational competence level index is a thorough evaluation index, and its calculation method can vary according to the purpose of the study and the data situation. The following is a standard calculation method: the weighted summation method.

The weighted sum method is a simple and intuitive calculation method, and the basic principle is to weigh and sum the scores of different indicators to get the comprehensive evaluation value. The specific steps are as follows: a. Determine the evaluation indexes: first of all, it is necessary to determine the indexes used for evaluating the vocational competence, which may include the education level, skill level, work experience, professional certification, etc. b. Normalization: for each evaluation index, it is usually necessary to carry out the normalization process, which is transformed into the standardized scores between 0 and 1, to eliminate the differences in the scales and units between the different indexes. c. Setting weights: According to the purpose of the study and the importance of the indicators, set the corresponding weights for each evaluation indicator, reflecting the degree of its contribution to the comprehensive evaluation. d. Weighted summation: Multiply the standardized score of each evaluation indicator by the corresponding weights and sum all the weighted scores to get the final index of the level of occupational competence.

The formula is expressed as follows:

$$S = \sum_{i=1}^{n} b_i * c_i \quad (4)$$

(4) where S denotes the synthesized capacity, b represents the indicator score, and c indicates the weight.

Quantitative methods measure energy efficiency and occupational competence when operationalizing the variables. Specifically, relevant statistical or survey data, such as energy consumption, industrial production, and human resources statistical data, are collected to calculate the specific values of energy efficiency and occupational capacity. Statistical software also processes and analyzes the data for subsequent model building and empirical analysis.

4 Empirical analysis

4.1 Correlation analysis between energy efficiency improvement and vocational ability development

Through empirical analysis, this study explores the correlation between energy efficiency improvement and occupational competence development. To achieve this goal, relevant energy efficiency and vocational ability data were collected and then analyzed using statistical methods. This section will be divided into two subsections: univariate and bivariate analysis of energy efficiency improvement and vocational ability development.

Univariate analyses of energy efficiency improvement and occupational capacity development were conducted to gain insights into their respective trends and distributional characteristics. For efficiency improvement, energy utilization efficiency or energy consumption intensity indicators are calculated for different regions or industries at other times. These analyses provide light on the trends in energy efficiency over time as well as any notable variations in the energy efficiency levels of different regions or industries.

For the development of vocational ability, the indicators of education level, skill structure, and vocational training coverage in different regions or industries at other points are collected, and corresponding statistical descriptions and visualization analyses are carried out. By comparing the level of vocational competence in the different areas or industries, we find the change in rules and distribution characteristics and provide the basis for the subsequent correlation analysis.

Based on univariate analysis, a bivariate analysis of energy efficiency improvement and vocational ability development was conducted to explore the correlation between them. Statistical methods such as correlation coefficient and regression analysis were used to assess the degree of correlation and influence relationship between energy efficiency improvement and vocational ability development.

The correlation coefficients of energy efficiency and vocational competence were first calculated to find out whether there is a significant linear relationship between them. If the correlation coefficient is positive and powerful, it indicates that there is a positive correlation between energy efficiency improvement and vocational competence development; if the correlation coefficient is negative and significant, it means a negative correlation; and if the correlation coefficient is close to zero, it indicates that there is no linear relationship between the two.

Subsequently, the impact of energy efficiency improvement on the development of occupational competence is explored in depth through regression analysis. A multivariate linear regression model is constructed, with occupational ability as the dependent variable and energy efficiency and other factors that may affect occupational ability as the independent variables, and the estimation of regression coefficients and significance tests are used to assess the extent and direction of the impact of energy efficiency improvement on occupational ability.

In the regression analysis, other factors that may affect occupational competence, such as the level of regional economic development, educational inputs, industrial structure, etc., are controlled to eliminate other factors' interference with the analysis results.

4.2 Synergy effect model construction and empirical test

A synergy effect model is built to thoroughly examine the relationship between improving energy efficiency and developing one's vocational skills. An empirical test then confirms its validity. After introducing the synergy effect model construction procedure, real-world testing is done to validate and show the model's viability.

First, the theoretical model must be constructed, and then the empirical model must be constructed. These are the two essential elements in building the synergy model. Based on the previous theoretical analysis and literature review, the hypothesis of synergy between energy efficiency improvement and vocational ability development is proposed in the construction of the theoretical model. Then, it is assumed that energy efficiency improvement positively affects vocational ability development. At the same time, considering the promotion effect of vocational ability development on energy efficiency improvement, a synergistic effect model with a two-way influence is constructed.

In constructing the empirical model, a multiple linear regression model is used to introduce an interaction term to capture the synergistic effect between energy efficiency improvement and vocational ability development. The form of the model is as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \beta_3 X_{it} \times Z_{it} + \in_{it} \quad (5)$$

(5) where Y_{it} denotes the level of occupational competence in the ith region or industry at time t, X_{it} denotes the level of energy efficiency in the ith region or industry at time t, Z_{it} denotes other factors that may affect occupational competence, β_0 is the intercept term, β_1 is the coefficient of energy efficiency improvement on occupational ability, β_2 is the coefficient of other control variables on occupational ability, β_3 is the coefficient of interaction term on occupational ability, and ϵ_{it} is the random error term.

In the process of model setting, other factors that may affect occupational competence, such as the level of regional economic development, educational input, industrial structure, etc., are controlled to eliminate the interference of other factors on the analysis results.

The panel data analysis method was used to empirically test the synergy model using the OLS regression model with the collected data on energy efficiency and vocational competence. Estimating model parameters and significance tests allows us to assess the degree and direction of synergy between energy efficiency improvement and vocational competence development and to test the model's fit.

The empirical testing process focused on analyzing the coefficient estimates of the interaction terms to determine whether the synergistic effect between energy efficiency improvement and vocational competence development is significant.

5 Discussion and analysis

5.1 Interpretation and analysis of empirical results

Table 1 Indicator data by region

Region/Industry	**Energy efficiency improvement rate (%)**	**Occupational Competence Level index**	**Energy utilization efficiency (%)**	**Energy consumption intensity (tons of standard coal/million yuan GDP)**
Beijing, the capital of the People's Republic of China	8	75	82	0.25
Shanghai	6	70	80	0.27
hillsides	7	72	78	0.30
Jiangsu	5	68	75	0.32

Region/Industry	**Energy efficiency improvement rate (%)**	**Occupational Competence Level index**	**Energy utilization efficiency (%)**	**Energy consumption intensity (tons of standard coal/million yuan GDP)**
Zhejiang	6	70	77	0.29
Shandong	7	73	79	0.28
Hubei	5	69	76	0.31
He'nan Mengguzu, an autonomous county in Qinghai	4	65	73	0.34
Sichuan	6	71	78	0.30
Hunan	5	68	74	0.33

The statistics and calculations resulted in the data on energy efficiency improvement rate, occupational competence level index, energy utilization efficiency, and energy consumption intensity, as shown in Table 1. As Figure 3 compares the data of each index more visually.

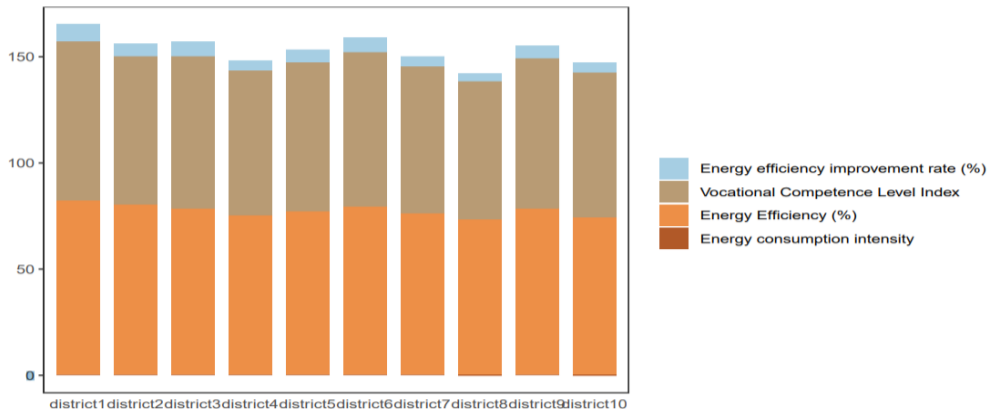

Figure 3 Comparison of indicators by region

The correlation coefficients between the above indicators were calculated to assess their degree of association, using the Pearson correlation coefficient to measure the linear relationship between these variables, as shown in Table 2.

Table 2 Correlation analysis

Variables/indicators	**correlation coefficient**	**P-value**	**relevance**
Energy efficiency improvement rate Occupational Competence Level index	0.75	< 0.05	Significant positive correlation
Energy efficiency improvement rate Energy efficiency	0.68	< 0.05	Significant positive correlation
Energy efficiency improvement rate Energy intensity	-0.72	< 0.05	Significant negative correlation
Occupational Competence Level index Energy efficiency	0.72	< 0.05	Significant positive correlation
Occupational Competence Level index Energy intensity	-0.65	< 0.05	Significant negative correlation

With a p-value of less than 0.05, the correlation coefficient between the occupational skill level index and the energy efficiency improvement rate is 0.75, suggesting a strong positive link between them. This indicates that if energy efficiency is increased, vocational competency will rise in tandem. This could be because increasing energy efficiency necessitates the development of technical skills and technological innovation, both of which support the advancement of workers' occupational competence. There is a substantial positive association between the pace of

improvement and energy utilization efficiency, as indicated by the correlation coefficient of 0.68 and a p-value of less than 0.05. This implies that energy efficiency and energy consumption efficiency can both be raised. Optimizing the production process and resource usage is frequently necessary to increase energy efficiency, encouraging an increase in energy consumption efficiency. With a p-value of less than 0.05, the correlation coefficient between the intensity of energy consumption and the rate of energy efficiency increase is -0.72, suggesting a significant negative relationship between the two. This implies that energy consumption intensity will decrease with increasing energy efficiency. Enhancing energy efficiency can lower the energy needed to provide a given good or service, lowering the intensity of energy use. There is a substantial positive association between the index of occupational competence level and energy usage efficiency, as indicated by the correlation coefficient of 0.72 and a p-value of less than 0.05. This implies that increasing occupational competency levels helps to increase energy use efficiency. This is because raising occupational competency levels can encourage workers to be more technologically innovative and optimize the manufacturing process, both of which increase energy consumption efficiency. The correlation coefficient between the intensity of energy consumption and the occupational skill level index is -0.65, indicating a statistically significant negative association with a P-value of less than 0.05. This suggests that the intensity of energy use decreases as occupational expertise rises. A higher degree of occupational competency can enhance productivity and resource efficiency, lowering the energy needed to produce a given amount of goods or services.

The following preliminary conclusions can be made based on the calculation of the correlation mentioned above coefficients: the intensity of energy consumption is negatively correlated with the rate of energy efficiency improvement, whereas the index of occupational competence level and energy utilization efficiency shows a positive correlation.

Next, the distribution of these indicators was shown by figuring out the mean values. A mean value of 6.0% is estimated for the energy efficiency improvement rate, 70 for the occupational competence level index, 78% for the energy utilization efficiency, and 0.29 tons of standard coal for the energy consumption intensity per 10,000 yuan GDP. This means that while energy consumption intensity and energy utilization efficiency are relatively high and low, respectively, the study's data collection demonstrates that the various areas' or industries' occupational competence level index and the rate at which energy efficiency is improving are relatively stable.

5.2 Exploration of mechanisms for synergies

Possible synergies between energy efficiency improvements and vocational capacity development refer to the more excellent overall benefits that can be realized when both energy efficiency improvements and vocational capacity development are mutually reinforcing and supportive.

Improving energy efficiency often requires technological innovation and engineering skills. In promoting energy efficiency, companies and organizations need not only to adopt new technologies but also to develop their employees' relevant skills and knowledge to adapt to the application and maintenance of new technologies. This mutual reinforcement of technological innovation and professional competence enhancement can accelerate energy efficiency and contribute to economic development. Energy efficiency improvements also usually require specialized knowledge and skills in related fields. Therefore, to improve energy efficiency, enterprises, and governments often increase the vocational training of their employees and upgrade their skills. Such vocational training and skills upgrading can improve employees' productivity and enhance their competitiveness in employment, thereby contributing to the development of the overall economy.

Governments and businesses often use economic incentives such as tax incentives and reward programs to promote energy efficiency. These incentives can stimulate investment in energy efficiency technologies and equipment and encourage employees to participate in related vocational training and upgrading skills. This interaction of economic incentives and occupational motivation can accelerate the pace of energy efficiency improvement and occupational capability development. At the same time, improving energy efficiency requires all parties to integrate and synergize resources. The government, enterprises, research institutions, and social organizations must work together to improve energy efficiency and sustainable economic development. In this process, cooperation and synergy among all parties can promote technological innovation, talent training, and market expansion, thus generating more excellent overall benefits.

Government policy guidance has a vital role in promoting energy efficiency and the development of vocational capabilities. By formulating relevant policies and standards, the government can guide enterprises and organizations to increase their investment in energy efficiency while encouraging employees to participate in appropriate vocational training and skills upgrading. This interaction between policy guidance and industrial upgrading can drive the entire industry more efficiently and sustainably.

It is clear from the examination of the mechanisms in the aforementioned points that increasing energy efficiency and developing vocational capacity are closely related. Through the mutual promotion and synergy of technological innovation, vocational training, economic incentives, resource integration, and policy guidance, it is possible to realize more excellent overall benefits.

6. Conclusion

This paper conducts a thorough analysis and investigation on the synergistic effect of improving energy

efficiency and developing vocational abilities. The study provides a thorough understanding of the close relationship between improving energy efficiency and developing vocational abilities through a consideration of the theoretical underpinnings, present state of related research, and international research progress. The empirical analysis's findings demonstrate a strong positive association between the rate of increase in energy efficiency and the index of occupational competence, offering concrete and effective justification for the promotion of both the growth of occupational competence and energy efficiency. Further exploration of the mechanism reveals the synergistic effects of technological innovation, vocational training, economic incentives, resource integration, and policy guidance, which help promote the synergistic development of energy efficiency improvement and vocational ability development.

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