Research on the environmental evaluation index system of energy development strategy based on the impact mechanism of major situation

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Abstract. In the new era, China's energy development is facing a series of new propositions. The formulation of energy strategy needs to adapt to the changes of the internal and external environments. Based on the analysis of energy strategy evolution for China and different countries in the world, this paper proposes the influence mechanism of the internal and external environments to energy development based on the driver-state-response model, and draws on the PEST model to construct a three-level evaluation index system for energy strategic environment, in which the external environment includes four first-level indicators of international environment, political environment, economic environment as well as social environment, and the internal environment includes five first-level indicators of energy resources, energy supply and demand status, energy infrastructure, energy technology and energy market environment. The index system of energy strategic environment assessment constructed in this paper can provide a reference for China's energy strategic analysis.

1. Introduction
The energy industry, as a basic industry for national economic development, is directly related to economic development, social progress, and the improvement of people's living standards. Energy development is strongly related and tightly coupled with many fields such as politics, economy, and culture. In the new era, China's energy development strategy faces a series of new issues such as ecological and environmental protection, coordinated development of regional economic belts, implementation of rural revitalization strategies. Thus, the future energy development strategy needs to incorporate new concepts such as ecological civilization construction, overall energy security concept, supply-side structural reforms, and more importantly, it should be based on the general trend of energy technology innovation and the pattern of energy revolution. This paper systematically sorts out the evolution of China's energy strategy since the reform and opening up, combined with the analysis of the driving factors for the formulation of energy strategies in different countries in the world, studies the impact mechanism of internal and external environmental factors on energy strategy, and proposes an assessment index system for China's energy development strategy environment, which can provide a reference for the future development of China's energy strategy.

2. Evolution of China's energy development strategy
The research on energy development planning and strategy in China’s history has been carried out many times [1-2]. So far, China has conducted 13 compilations of the outline of the five-year national
economic development plan, all of which include the content of energy. The Sixth Five-Year Plan began to have a special energy plan, and has compiled eight national energy plans. Energy optimization development is an important feature of high-quality economic development. The energy consumption elasticity coefficient reflects the dependence of economic growth on energy consumption. Since the reform and opening up, China's energy consumption elasticity coefficient has undergone a development process of "gradual increase, decline, rebound, and steady decline". With the changes in the relationship between energy and economic development, China's energy development strategy since reform and opening up has generally gone through three development stages, as shown in Figure 1.

Figure 1. Changes for China’s total energy consumption and elastic coefficient since 1980.

The first stage of energy strategy development (1980-1999): In the 1980s, China proposed the strategic goal of quadrupling GDP by 2000. In view of the overall tightening of energy supply at that time, the core of the energy strategy in this stage was to ensure energy supply. Large-scale energy projects were carried out to promote the establishment of more reliable energy supply system. It had been proposed that the total energy consumption in 2000 would double compared with 1980. At this stage, the energy consumption elastic coefficient remained generally stable, with an average value of 0.45, indicating that China's energy industry provided stable support for the economic development.

The second stage of energy strategy development (2000-2011): With the rapid economic growth, China’s energy production and consumption had also entered a stage of rapid development. From 2000 to 2011, the average growth rate of China's total energy consumption reached more than 9%. Among them, the growth rate of total energy consumption in 2004 once exceeded 16%. The elastic coefficient of energy consumption generally maintained an upward trend, with the average value of 0.86, indicating that the supporting effect of energy development on economic development was gradually increasing. But at the same time, environmental pollution problems caused by energy development began to appear in some large cities. Under this situation, the energy strategic direction at this stage had been adjusted, highlighting the adjustment of energy structure and encouraging the development of renewable energy.

The third stage of energy strategy development (2012 to present): Since the 18th National Congress of the Communist Party of China, China’s economy has gradually entered the stage of high-quality development from high-speed development, with energy production and consumption both declining. The average annual growth rate of energy consumption from 2012 to 2019 fell to 2.7%, and the average energy consumption elastic coefficient was 0.41, indicating that energy development is gradually decoupled from economic growth. The theme of the energy strategy at this stage is energy revolution proposed by Comrade Xi, which requires gradually reducing the dependence on coal and building a clean, low-carbon, safe and efficient modern energy system.
3. The impact mechanism of major situation on energy strategy

3.1. Major influence factors on energy strategy

Energy development strategy usually consists of strategic objectives, strategic priorities, and major strategic initiatives. Among them, the strategic goal determines the overall positioning of the energy strategy, which is a choice under the overall consideration of internal and external environmental factors in energy development. This section thoroughly sorts out the current energy strategic goals of more than 10 developed and developing countries [3-4], including the United States, Germany, Britain, France and so on, and analyzes the driving factors behind their energy strategies. It can be seen that the current goals of different national energy strategies mainly include energy security, green energy, energy science and technology, etc. In light of the development background of different countries, the main driving factors affecting energy strategic goals include political pattern, economic development, energy resource endowment, environmental issues, climate warming issues, technological progress, popular will, geopolitical characteristics of energy and the international environment. The specific positioning and driving factors of energy strategies for various countries are shown in Table 1.

Table 1. Drivers under different energy strategic goals.

| Energy strategic goals                  | Driving factors                                                                 | Countries for example |
|----------------------------------------|---------------------------------------------------------------------------------|-----------------------|
| Energy independence                    | Economic development, energy resource, political pattern, global environment    | USA                   |
| Energy security                        | Economic development, energy resource, public opinion                           | Japan                 |
| Energy power                           | Economic development, energy resource, political pattern, geography characteristic| Russia                |
| Green energy                           | Economic development, energy resource, technical progress, building an ecological civilization, public opinion | Germany, Brazil       |
| Energy efficiency                      | Economic development, energy resource, technical progress, public opinion        | Denmark               |
| Energy technology                      | Economic development, technical progress                                       | Japan, France         |
| Energy market                          | Economic development, technical progress                                       | UK, European Union    |
| Clean, low-carbon, safe and efficient  | Economic development, energy resource, building an ecological civilization       | China                 |

3.2. The impact mechanism of major influence factors on energy strategy

Combined with the above preliminary screening of the influencing factors of energy strategies in different countries, the driving-state-response (DSR) model principle is used to analyze the influencing mechanism of environmental factors on energy development strategy, which can visually display the transmission routes of social, economic, environmental and other factors to energy strategy, as shown in Figure 2.
Figure 2. The transmission routs of environmental factors on energy development strategy.

The environmental factors that affect energy development strategy, through the interaction between economic, social and other systems and energy system, promote changes in the energy system, and then drive changes of energy strategy. In such a process, the environmental factors of energy strategy are "drivers". They promote changes in various aspects of energy system, thereby changing energy supply and demand, energy pollution emission and energy technology economy. These can be regarded as "states". The changes in various aspects of energy system will lead to corresponding adjustments to the energy strategy. For example, when the supply-demand relation is tight, the energy security strategy needs to be strengthened, and when the environmental constraints are tight, the clean energy development strategy needs to be strengthened. These are the "responses".

4. Environmental evaluation index system of energy development strategy

Combined with the preliminary analysis of the environmental factors on energy strategy and the PEST model analysis ideas, a three-level indicator system for energy strategy environmental assessment is constructed, as shown in Table 2. The indicator system is divided into external and internal environment. The first level indicators for external environment include international environment, political environment, economic environment and social environment. The first level indicators for internal environment include energy resources, energy supply and demand status, energy infrastructure, energy technology and energy market environment.

Table 2. Three-level indicator system for energy strategy environmental assessment.

| The first grade index | The second grade index | The third grade index |
|-----------------------|-----------------------|----------------------|
| International environment | Trade environment | Trade barrier |
|                        | Trade price | Supply stability |
|                        | Political pattern | Coal import price |
|                        | Macro policies | Oil import price |
|                        | Laws and regulations | Gas import price |
| Political environment | Energy political goal | Energy conservation |
|                       | Financing and taxation policy | Energy efficiency |
|                       | Technology innovation policy | Energy conservation |
|                       | Economic regulation policy | Energy technology |
|                       | Energy law | Electric power law |
Economic environment

- Total economic output
- GDP
- Per capital disposable income
- Industrial structure
- Industry proportion
- Regional economic development
- Development characteristics
- Ecological civilization construction
- Environment pollution
- Social environment
- Population
- Population gross
- Employment
- Employment demand
- Popular will
- Diversified service demand
- Energy saving consciousness
- Resource saving
- Acceptance of new technologies
- Resources
- Energy resource
- Non-fossil energy resource
- Territorial resource
- Space abundance
- Energy supply and demand relation
- Loose/tighten
- Energy structure
- Non-fossil energy ratio
- Energy intensity
- Energy consumption per GDP
- Energy infrastructure
- The rate of penetration
- Intelligence level
- Energy technology
- Technical efficiency
- Technical cost
- Energy market environment
- Market mechanism

5. Conclusions
This article systematically reviewed the development process of China's energy strategy. Combined with the summary of energy strategies of countries with different development levels and the principle of driving-state-response (DSR) model, a preliminary construction of the influence transmission path of environmental factors on energy development strategy has been proposed. What’s more, on the basis of PEST model, a three-level evaluation index system for China's energy development strategic environment was constructed. The research work on the design of the index system for energy strategy environmental assessment conducted in this paper has made a preliminary exploration for the subsequent dynamic assessment of China's future energy strategic environment and the deduction of energy strategy based on strategic environment.

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