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## FACTORS AFFECTING ENERGY SECURITY[1]

*Energy security is a major challenge facing the world today. With the rapid development of the global economy, the demand for energy is growing, and the uneven distribution of energy resources and the uncertainty of supply make energy security increasingly prominent.*
*Taking Northeast Asia as the research object, this paper studies the evolution and connotation development of energy security, and studies three important theoretical bases of energy security: resource scarcity theory, geopolitical theory and sustainable development theory of energy security. The energy import and export volumes, the development and application of various types of energy sources, and the percentage of energy consumption categories in Northeast Asian countries were analyzed. Through the analysis of these indicators, we can reflect the factors affecting energy security and explore how to jointly ensure energy security in Northeast Asia.The conclusion is that the path of energy development is to develop towards diversified energy supply and transform towards environmental friendliness.*

***Keywords:*** *Northeast Asia, energy security, China, Russia, renewable energy.*

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## ФАКТОРЫ, ВЛИЯЮЩИЕ НА ЭНЕРГЕТИЧЕСКУЮ БЕЗОПАСНОСТЬ

*Энергетическая безопасность является серьезной проблемой, стоящей сегодня перед миром. В условиях быстрого развития глобальной экономики спрос на энергию растет, а неравномерное распределение энергетических ресурсов и неопределенность поставок делают энергетическую безопасность все более важной.*
*Взяв за объект исследования Северо-Восточную Азию, в данной статье изучаются эволюция и развитие энергетической безопасности, а также изучаются три важные теоретические основы энергетической безопасности: теория дефицита ресурсов, геополитическая теория и теория устойчивого развития энергетической безопасности. Объемы импорта и экспорта энергии. Проанализированы развитие и применение различных видов источников энергии, а также процент категорий энергопотребления в странах Северо-Восточной Азии. Благодаря анализу этих показателей мы можем отразить факторы, влияющие на энергетическую безопасность, и изучить способы совместного обеспечения энергетической безопасности в странах Северо-Восточной Азии. Путь развития энергетики заключается в развитии в сторону диверсификации энергоснабжения и переходе в сторону экологичности.*

***Ключевые слова:*** *Северо-Восточная Азия, энергетическая безопасность, Китай, Россия, возобновляемые источники энергии.*

[1]Статья публикуется в авторской редакции

**Introduction.** Northeast Asia is located in the eastern part of Asia, and the countries include China, Japan, South Korea, North Korea, Mongolia, and Russia. Northeast Asia is rich in population, with the rapid economic growth of Northeast Asia, the demand for energy in the region is increasing rapidly, Northeast Asia accounts for the world's primary energy consumption continues to grow, and its importance and influence in the global energy pattern continue to increase, energy security has become an issue that needs to be paid attention to.

Energy security refers to the state of ensuring the country's long-term stable and reliable access to energy supply to ensure economic development and national security. The concept of energy security has been enriched since the emergence of the last century, and the theory of energy security has become sustainable in its development. Energy transformation is a major structural change in the energy system. The goal of energy transformation is to reduce carbon emissions, high efficiency, low cost and sustainable utilization. The core of energy transformation is to transform the energy system centered on oil to an energy system centered on electricity, and gradually develop clean energy such as solar energy and wind energy to reduce dependence on carbon-intensive energy. Change the traditional energy structure and transform energy to sustainable green development with high efficiency, low cost and low emissions.

**Research methodology.** This article analyzes the energy import and export volumes, the development and application of various types of energy, and the percentage of energy consumption categories in Northeast Asian countries over the past five years. The energy self-sufficiency rate of Northeast Asian countries was calculated.

This article also briefly analyzes the evolution of energy security and studies three important theoretical bases for energy security. This analysis is based on a review of the existing literature and research on these topics. The reasons for the use of different types of energy in Northeast Asian countries are discussed.

Therefore, this research method combines quantitative and qualitative analysis to comprehensively study the influencing factors of energy security in Northeast Asian countries and make suggestions for future energy security development.

**Main part.** The term energy security first appeared in the early 20th century, and Mason Wilrich first proposed the concept of "energy security" in the 70s of the 20th century, dividing energy security into energy security of importing countries and energy security of exporting countries. He believes that energy security is the result of direct interaction between importing countries and exporters, with importers wanting to obtain sufficient energy supply to support national economic growth, while exporters looking for market and investment security [1, p.626]. The equilibrium between energy supply and demand, as well as the exchange of market interests involving energy, has been established thanks to the collaborative efforts of importing and exporting nations.

In the late 20th century, policy makers led by the United States and the academic community initiated systematic studies on oil security and energy security in order to coordinate efforts to ensure energy safety [2, p.29]. Energy security begins to emphasize the key role of obtaining energy at a reasonable cost to avoid the impact of energy price fluctuations on macroeconomic stability.

Driven by the collapse of the Cold War structure and the globalization of the market economy, the liberalization of the international energy market has become an irreversible trend. This shift has promoted the vigorous development of international energy trade and investment, and has also made people aware of the importance of energy security. The core of energy security lies in building a set of energy supply mechanisms that enable economies to demonstrate high stability and regulatory capabilities in the face of internal or external disturbances, and ensure the continuity and reliability of energy supply under various uncertain conditions. This mechanism not only meets the basic energy needs of economic development and people's living consumption, but also emphasizes the ecological use of energy and promotes the sustainable development of the environment. Pursuing an energy security strategy is not just about balancing energy supply and demand; it is also a consideration for achieving long-term sustainable development goals. On this basis, energy security theory includes the following aspects.

There are also geopolitical issues in Northeast Asia, such as North Korea's nuclear weapons issue on the Korean Peninsula, territorial disputes between China and Japan, and competition between major powers.

Table 1.

| Directional | Descriptive |
|---|---|
| 1. Theories of resource scarcity for energy security: | Scarcity in economics refers to the fact that the resources available to satisfy desires are limited compared to the unlimited desires of human beings. Scarcity theory states that the resources faced by a person include tangible resources (e.g. land, labor, raw materials, etc.) and intangible resources. (e.g. time, skills, knowledge, etc.). Scarcity of resources brings about the problem of distribution and utilization of resources which cannot be produced or obtained without restriction, while human needs are unlimited. Since resources are limited, people have to choose between different needs, hence scarcity of resources. |
| 2. Geopolitical theory: | The security of mineral resources is a critical factor impacting national security and regional geopolitical dynamics. On the one hand, resources are indispensable for a country's economic development, and all countries, except energy-producing regions, must implement global resource allocation strategies. On the other hand, the uneven distribution of world resources affects geopolitical changes [3, p.39]. The competition for strategic mineral resources between developed Western countries and regional powers will have a profound impact on the geopolitical and economic pattern of the world. |
| 3. Theories of sustainable development | Sustainable development theory is a comprehensive development concept that seeks a balance between the economy, society and the environment. The United Nations defines sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs"[4]. In terms of specific content, sustainable development involves the coordinated development of economic sustainability, ecological sustainability and social sustainability, requiring people to focus on economic efficiency, ecological harmony, and social justice in development, and ultimately achieve the all-round development of people. Sustainable development theory embodies the core principles of justice, sustainability and community, and its ultimate goal is to achieve common, coordinated, fair, efficient and multi-dimensional development. |

These geopolitical conflicts will threaten regional security, affect international cooperation, and lead to energy insecurity.

Let us analyze certain aspects of energy security in the Commonwealth of Independent States (CIS) countries from the perspectives of energy supply, adequacy of energy resources, environmental sustainability, and economic efficiency.

First of all, let's analyze the dynamics of energy import and export statistics in Northeast Asia (Figure 2).

During the analysis period, the energy import and export volumes of each country remained within a relatively stable range, which means that the energy systems of the countries analyzed are relatively stable. With the exception of Russia, most countries import more energy than they export, indicating that the country has a certain degree of dependence on energy supply, and the risk of energy supply increases. In particular, China's annual import volume has been growing steadily in recent years, and measures should be taken to reduce the risks. Each country is involved in import and export trade, illustrating the need for international cooperation with other countries.

In the context of international energy trade, the state of a country's energy security is mainly reflected in the demand and pricing mechanism of the commodity market. Energy price fluctuations are not only affected by the dynamic supply and demand relationship within the market, but are also vulnerable to external shocks such as political events and natural disasters. The energy stability of energy-dependent countries is easily affected by these factors. International energy trade depends on the energy supply chain. The interruption or threat of the supply chain may cause economic activity disorder and even trigger a systemic economic crisis. Multilateral cooperation and diversification strategies in energy supply can help reduce such risks and get rid of dependence on a single source. It is a good choice for countries to jointly cope with energy security challenges.

The net volume of energy import and export transactions of a country, defined as the difference between the quantities of exported and imported energy products, constitutes a crucial indicator for measuring both the self-sufficiency capabilities and the degree of reliance on external energy markets.

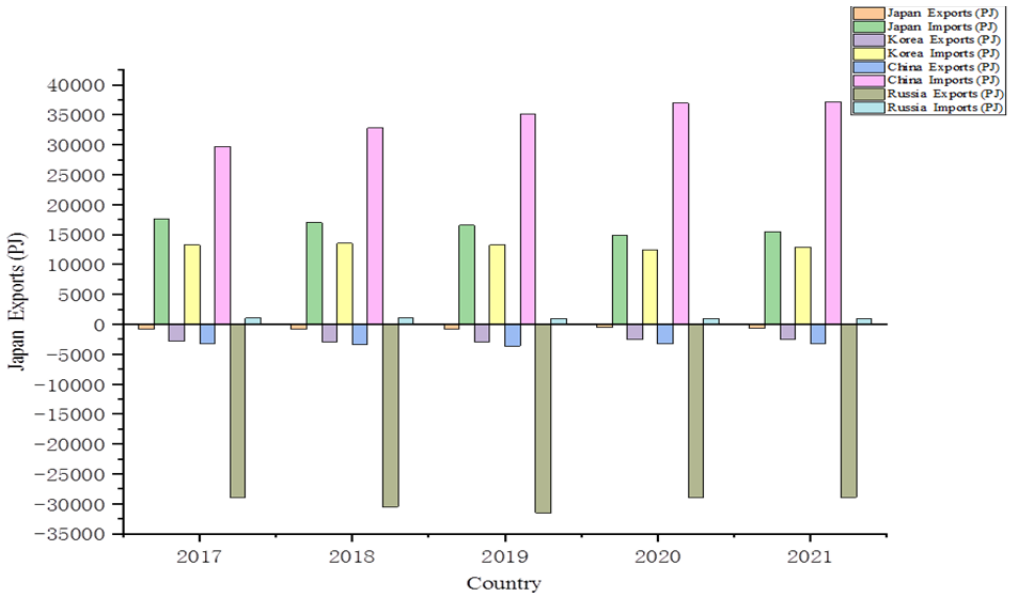


**Figure 1. – Energy import and export statistics of selected Northeast Asian countries from 2017 to 2021**
Source: [4][5]

Table 2.

| | China | Russia | Japan | North Korea | Korea | Mongolia |
|---|---|---|---|---|---|---|
| Energy self-sufficiency (%) | 80 | 191 | 11 | 93 | 19 | 272 |

Source: [4]

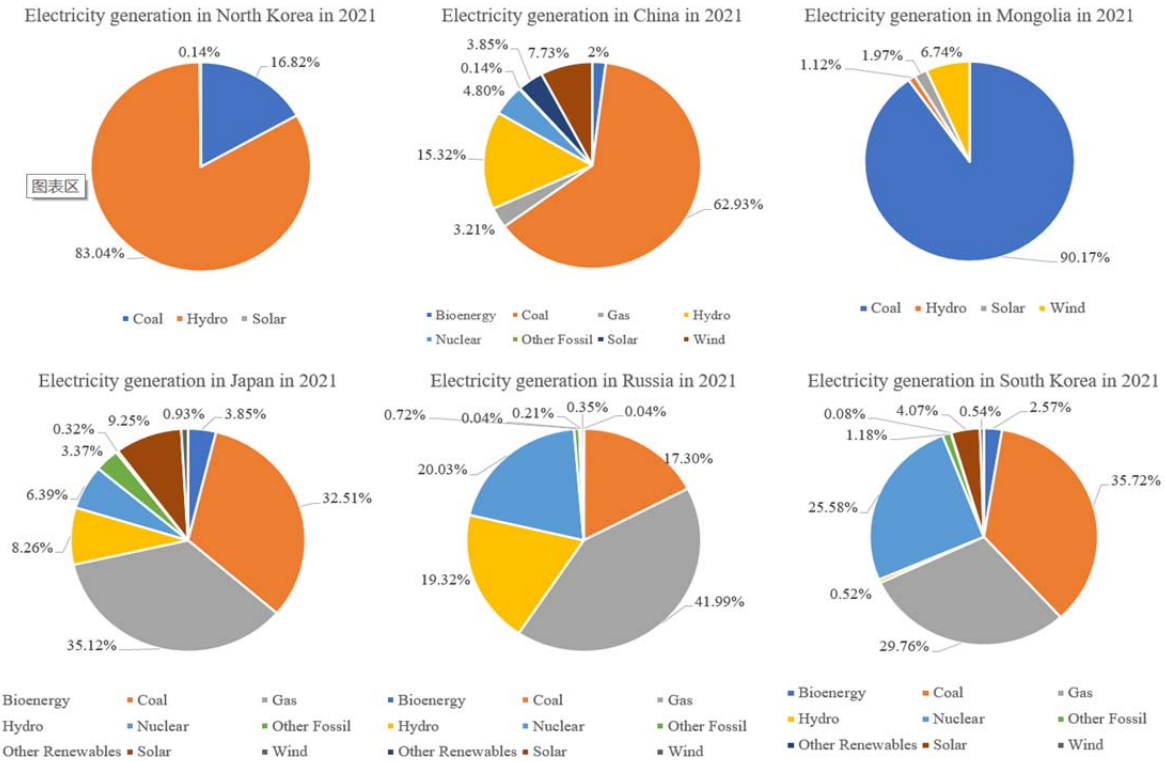


**Figure 2. – Energy sources for electricity generation in six Northeast Asian countries in 2021**
Source: [6]

This metric unveils not only the exploration potential and utilization efficiency of the nation's internal energy resources but also its position and influence within the international energy market. It is therefore of paramount significance for evaluating the energy security status of a country.

Analysis of Northeast Asian countries' energy import and export data and their energy self-sufficiency ratesand the energy self-sufficiency rate of each country, the net trading volume of China, Japan, North Korea and South Korea is negative, and the energy self-sufficiency rate is less than 1, which means that all countries rely on energy imports from other countries to meet the energy needs of national development to varying degrees.

Electricity is the direct energy source for the development of a country's industrial economy. By plotting the types of energy used for power generation in the six Northeast Asian countries in 2021, we can make a clear comparison of the sources of electricity in the six Northeast Asian countries. The energy used for power generation in a country is closely related to the country's resource distribution, policy orientation, degree of industrialization and technological level, and can also reflect the degree of energy transformation in the country.

At the national level, the use of different types of energy reveals the homogeneity of the country's energy structure and the characteristics of its energy mix. According to the data provided by the U.S. Energy Information Administration, an overlay of the share of energy consumption by each type of country in Northeast Asia can be drawn (Figure 3).

The six Northeast Asian countries are still dominated by non-renewable energy sources such as fossil fuels, and the proportion of renewable energy is relatively low, but in terms of sustainable energy development, the advantages of renewable energy are not the same, for example, compared with other countries, South Korea's nuclear energy accounts for a much larger proportion of total energy consumption than other countries.

The type of energy use in the six Northeast Asian countries is affected by the distribution of energy resources within their countries. Countries such as Russia and China, endowed with rich resources including substantial deposits of coal, oil, and natural gas, frequently rely on these fossil fuels as their principal energy source. Countries with scarce resources and lack of local energy resources, such as Japan and South Korea, are more dependent on energy imports while actively developing alternative and renewable energy sources.

Considering the economic cost, countries rich in natural resources tend to develop local resources to obtain raw materials and energy more cheaply.

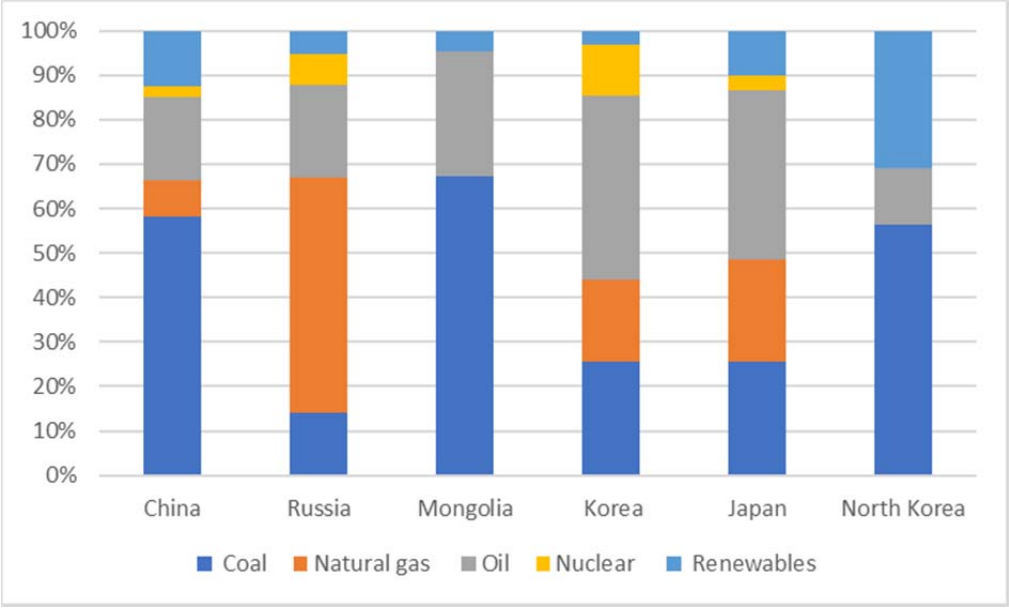


**Figure 3. – Percentage stacked map of energy consumption by category for six countries in North-East Asia**
Source: [7]

On the other hand, countries with limited resources, such as Japan, due to the high cost of energy supply and greater energy dependence, have begun to explore the research and development of new alternative energy sources in pursuit of the dual goals of cost-effectiveness and diversification of energy supply. The urgency of energy demand has driven countries to innovate energy technology in order to modernize their energy consumption patterns.

This process is not only conducive to promoting the promotion and use of new energy technologies, but also promotes the transformation of the energy industry in Northeast Asia to an energy-friendly one.

The economic development level and industrial structure differences among the six Northeast Asian countries fundamentally determine their energy demand and consumption patterns. Economies can be categorized into various types based on their characteristics: large economies, such as those of Russia and China; developed economies, such as Japan; and economies with moderate development levels, such as North Korea. These economies have different costs for extracting, transporting and converting different types of energy, and each country will choose the most appropriate type of energy based on its own economic situation and energy cost-effectiveness. Similarly, different industries have different priorities and needs, and different types of energy are used.

Strengthening international energy exchanges and promoting cooperation between energy suppliers and energy demanders can not only expand procurement channels for energy consuming countries, but also ensure supply stability for energy exporting countries. On the basis of a basic balance between energy demand and supply, we can ensure a stable and sustainable international energy supply and reasonable international energy prices, and achieve energy security in Northeast Asia.

National policies and regulations, dynamics of the international energy market, and the advancement of cross-border cooperation projects together form a guiding framework to stimulate energy development. This incentive mechanism will not only trigger an investment boom in related energy fields and attract capital injections, but will also further promote the development of the energy industry. In this way, the interaction between national-level strategies and international energy markets not only helps the energy industry, but also provides impetus for the green transformation of energy. Take Japan as an example, the "Hydrogen Energy Utilization Promotion Act" and the Japanese government's vision of building a hydrogen society have greatly promoted the development of hydrogen energy in Japan, and hydrogen energy has become the backbone energy source of Japan, improving the situation of Japan's energy structure being single and heavily dependent on energy imports. Furthermore, owing to the intrinsic nature of hydrogen energy as a clean source of power, the pollution generated from energy production is reduced, effectively enhancing the green development trajectory of the energy sector.

**Conclusions**

The general theories of energy security mainly include scarcity theory, geopolitical theory and sustainable development theory. Faced with the increasingly tense energy situation and global climate change, the six countries in Northeast Asia are facing uneven resource distribution, unbalanced energy supply and heavy dependence on external resources in some countries. Geopolitical conflicts, insufficient energy technology, environmental pollution, energy price fluctuations, etc. are also factors affecting energy imbalance.

Countries need to take comprehensive measures, including diversifying energy supply, reducing dependence on energy imports, strengthening energy infrastructure, encouraging energy technology innovation, strengthening international communication and cooperation, etc., to ensure reliable energy supply and national energy security. The path of energy development is to develop towards diversified energy supply and transform towards environmental friendliness.

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