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Ensuring Energy Security in China through International Energy Cooperation

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Abstract: Energy security is an important issue with respect to a country's economic and social development, and affects the national development, the improvement of people's lives, and the long-term stability of society. International energy cooperation has always played an important role in ensuring energy security. As the meaning of energy security shifts toward multiple dimensions, the positioning and main tasks of international energy cooperation are undergoing renewal and evolution. Based on the latest domestic and foreign situations in the energy sector, and considering the new connotation of energy security, this study comprehensively elaborates the positioning of international energy cooperation in China in the new era, and analyzes key issues in recent international energy cooperation. The research indicates that the new energy security concept proposes new and more stringent requirements for China's international energy cooperation. In the near future, it should focus on promoting the establishment of a diversified import and trade pattern for oil and gas, strengthen the interconnection of electricity with neighboring countries, increase cooperation in advanced energy technologies, and actively participate in and lead the global energy governance in order to lay a solid foundation to guarantee energy security under open-up conditions.

Keywords: international energy cooperation; energy security; oil and gas import; power grid interconnection; energy technology cooperation; global energy governance

1 Introduction

Since the reform and opening up of China's economy, China's total energy production and consumption have continued to increase, and energy security remains a key aspect of energy development. Moreover, international energy cooperation continues to play an important role in ensuring China's energy security. In particular, since the launch of the Belt and Road (hereinafter referred to as B&R) initiative, China's international energy cooperation has been expanded and upgraded, injecting new life into the opening-up and development of the energy sector, and laying a solid foundation for energy security. In 2017, it was reported in *Vision and Actions on Energy Cooperation in Jointly Building Silk Road Economic Belt and 21st-century Maritime Silk Road* [1] that China would continue to promote international energy cooperation and to participate extensively in the world energy system.

In recent years, as energy continues to play an increasingly important role in the economic and social development of China, the connotation of energy security has also been constantly enriched. Since making the energy industry cleaner, low-carbon, green and efficient has gradually become an important part of national energy security, China has developed a large number of strategies and action plans to accelerate green and low-carbon

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development [2]. Correspondingly, international energy cooperation is also facing new challenges with respect to ensuring China's energy security. According to the forecast of the International Energy Agency [3], the energy demand of China will continue to grow in the following years. However, owing to the limitation of domestic energy resource endowment [4], increasing the energy imports is still an effective way of safeguarding countries' energy supplies [5]. At the same time, with the acceleration of its own energy green and low-carbon transition, China will introduce more stringent requirements with respect to the clean level of imported energy [6,7]. At present, owing to intensified China–US trade friction and the increased anti-globalization trend, it is important to establish a more open, safe, and efficient global energy governance system [8]. Some studies have reported that it is very important to perform research on how to ensure China's energy security under extreme conditions [9,10].

This paper focuses on the new positioning of China's international energy cooperation under the new energy security concept, and some key problems and their solutions are proposed. It presents some insights into China's energy security.

2 New trend of China promoting energy international cooperation

Since the launch of the B&R initiative, energy cooperation has become a key area of B&R cooperation. By strengthening international cooperation comprehensively, making effective use of international resources, and striving to achieve energy security under open conditions, the above requirements have elevated international energy cooperation to the height of national strategic plan. In China, a preliminary combination of energy international cooperation and domestic energy industry has been achieved.

In the field of oil and gas international cooperation, China has gradually constructed four stable strategic oil and gas import channels in the northwest, northeast, southwest and offshore. Five oil and gas cooperation zones have been established in Central Asia, Russia, the Middle East, Africa, and Asia–Pacific region [11]. From 2014 to 2019, both overseas equality oil and gas production as well as oil and gas imports have continued to increase (Table 1), which constitute an important part of China's energy supply [12].

Table 1. Overseas equality production and import and export of oil and gas in China (2014–2019).

Project	2014	2015	2016	2017	2018	2019
Equality production /(1×10^8 toe)	1.60	1.75	1.80	1.90	2.00	2.10
Crude oil imports/(1×10^8 t)	3.10	3.40	3.82	4.20	4.62	5.06
Natural gas imports /(1×10^8 m^3)	583	585	745	946	1244	1330

In the field of power international cooperation, China has achieved power interconnections with Russia, Mongolia, Myanmar, Laos, and other countries, and this cooperation has promoted the consumption of clean power on a larger scale (Table 2) [13]. Chinese companies have taken an active part in power project implementations in regions such as Southeast Asia, South Asia, and Africa, they have implemented a number of overseas power projects, including the China–Pakistan Economic Corridor Power Cooperation Project. They have invested and operated backbone power grids in the Philippines, Greece, Portugal, and Australia, among others. Engineering and technical services in China have achieved "going global" status, and their projects are distributed in more than 150 countries and regions. The international market has been dominated by Asia and Africa, and will extend to Central and Eastern Europe, Oceania, and the Americas.

Table 2. Power connections and power trade between China and neighboring countries (2019).

Country	Voltage level (kV)	Power import (1×10^8 kW·h)	Power exports (1×10^8 kW·h)
China–Russia	500/220/110	30.99	—
China–Mongolia	220/35/10	—	13.52
China–Myanmar	500/220/110/35/10	14.10	7.70
China–Vietnam	220/110	—	22.20
China–Laos	115/35/10	—	0.23

In the field of global energy governance, China has actively participated in various tasks on the reform and construction of energy governance systems that were initiated by energy international organizations (Table 3) [14]. In recent years, the influence of China has continued to increase, and it has been transformed from an "active participant" to "leader." The establishment of the Belt and Road Energy Partnership (Hereinafter referred to as

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BREP) was initiated by China, and a number of propositions, such as jointly safeguarding energy security, were proposed; these have been highly appreciated by the international community.

Table 3. China's participation in global energy governance.

International organization	China's role
Belt and Road Energy Cooperation Partnership	Leading country, participating country
International Energy Forum	Participating country
Energy Charter	Observer country
International Energy Agency	Partner country
World Energy Council	Participating country
International Renewable Energy Agency	Participating country
International Framework for Nuclear Energy Cooperation	Founding country
World Forum on Energy Regulation	Observer country

The traditional energy security mainly refers to the security of energy supply and demand. With the improvement in the economy, changes with respect to societal demands, the restrictions owing to the ecological environment, and developments in energy technology, the connotation of energy security has multiple meanings [15–17]. From the perspective of the external situation, the global energy structure is adjusting, the global energy trade is becoming multi-polar, the concept of clean, low-carbon, green, efficient development is becoming popular, and energy-related technological innovations are being developed. Owing to the above factors, energy security has been transformed from supply and demand security to multi-dimensional security. Influenced by China–US trade frictions and the COVID-19 epidemic, the world economy is in recession, international trade and investment are shrinking, the international financial market is in turmoil, global trade protectionism and unilateralism are on the rise, economic globalization is facing some headwinds, and the global energy structure is undergoing some adjustments. From the perspective of the internal situation, China has evolved into a new era of socialism with Chinese characteristics [18], and both the international and domestic conditions result in higher requirements for the construction of energy systems. The connotation of China's energy security is also gradually transformed to multi-dimensional, which is reflected in energy supply security, economic security, science and technology security, and sustainable security [19]. International energy cooperation runs through the development process of the energy industry, and has played an important role in ensuring China's energy security. The new internal and external situations mentioned above have also put forward new positioning and new requirements for China's international energy cooperation.

3 New orientation of energy international cooperation in China

Based on the new energy security concept, there is a need to reposition energy international cooperation. The energy international cooperation should be guided by the "Four Revolutions and One Cooperation" new energy security strategy (i.e., energy consumption, supply, technology, system revolution, and energy international cooperation) and the B&R initiative. Energy international cooperation should coordinate international and domestic markets, expand the opening-up scale, develop global partnership actively, promote the diversification of energy imports, increase the interconnection of energy infrastructure, strengthen the energy technology cooperation, and participate extensively in global energy governance. Thus, the new pattern of international energy cooperation will be created.

First, China will continue to ensure the security of the oil and gas supply by energy international cooperation. In 2019, China's crude oil imports were 5.1×10^8 t (year on year growth rate of 9.5%), which accounted for about 22% of the world's total crude oil trade. The crude oil external dependence of China was 72%. In 2019, China's natural gas imports were 1.33×10^{11} m^3 (year on year growth rate of 6.9%), which accounted for nearly 14% of the world's total natural gas trade. The natural gas external dependence of China was 43% [12]. The international community is paying increasing attention to environment protection and climate change governance as it promotes the development of renewable energy sources such as wind and solar energy to replace the role of fossil energy. However, it will be a long journey to achieve the complete substitution of fossil energy based on current technology and economic conditions. Owing to the limitation of domestic sources endowment, the external independence of oil and gas in China is expected to continue to increase in the following years. It is reasonable to

enhance international cooperation, and to increase the acquisition of overseas oil and gas sources. Thus, the source and distribution of oil and gas imports will be diversified.

Second, China will increase the importation of clean power to promote clean energy usage and low-carbon transition by international energy cooperation. At present, fossil energy still accounts for the large majority of energy imports. However, in the future, with the acceleration of electrification, the power demand in China will continue to increase. Thus, the importation of clean energy from abroad will be an important way of ensuring China's energy security. In 2019, the total number of 10 kV interconnection lines and above was 71, and the total power interconnection capacity was 2.6×10^6 kW. The imported power was 4.51×10^9 kW·h, the exported power was 4.37×10^9 kW·h, and the net imported power was just 1.4×10^8 kW·h [13], which is very small compared with China's total power consumption. Therefore, compared with oil and gas pipelines, the capacity of power interconnection is still small and has large development potential.

Third, China will overcome the shortcomings in energy technology by embarking on international energy cooperation. In recent years, although the localization level of China's energy equipment has been significantly improved, the use of some core components and key technologies remains limited by other countries. Further, influenced by China–US trade tensions, the US government has intensified its sanctions on China's science and technologies. Some emerging and basic technologies are listed in the scope of export control, and thus the extended application of Chinese enterprises in the global value chain, supply chain, and industrial chain are being threatened. Some Chinese energy enterprises were sanctioned and the importation of some core energy technologies were blocked, which poses a direct threat to the energy technology security of China. China should enhance international energy cooperation, strengthen exchanges in energy technology and cooperation with friendly countries, and at the same time, overcome its own shortcomings as soon as possible to ensure energy science and technology security.

Fourth, China will promote the establishment of a more open global energy governance system by energy international cooperation. The achievement of an open global energy market is conducive to ensuring the security of China's energy supply. At the same time, certain issues pertaining to energy governance, such as the pricing power in the international energy market, the monetary settlement power, and the power of transformation leadership will also affect China's energy security. At present, China's status in global energy governance is not consistent with its position as the largest country in energy production and consumption as well as the position of the largest energy importing country. Owing to a lack of international influence of RMB as well as the fact that developed countries control the pricing power and dominate the policy making power in the global energy market, China's energy imports face various risks caused by energy price fluctuations. By enhancing energy international cooperation, China can advocate for the building of a more open global energy governance system and constantly enhance its influence in this system.

4 Discussion on key points of China's future energy international cooperation

China will continue to promote the energy international cooperation comprehensively based on the new orientation of energy international cooperation, current development status of energy, China's opening-up strategy, and the new domestic and international situation.

4.1 Establish diversified energy import and trade channels, improve related infrastructure, and ensure the safe importation of oil and gas

At present, China's oil and gas imports are acquired from a few sources. In 2019, oil imports from Saudi Arabia, Russia, Iraq, Angola, and Brazil account for 60% of the total oil imports. Natural gas imports from Australia, Turkmenistan, and Qatar accounted for 63% of total natural gas imports. Seventy percent of crude oil transportation should pass through the Strait of Malacca and the Strait of Hormuz. The above factors introduce more challenges and potential risks to China in terms of its energy supply security. In order to better guarantee the security of oil and gas supply, China should further improve its ability to manage the overseas oil and gas resources, and should actively explore new sources and channels for oil and gas imports. The specific measures are as follows:

First, the diversified importation pattern should be improved. On the basis of maintaining good relations with countries that have cooperated, China will continue to expand new channels for crude oil and natural gas imports in the B&R countries through energy diplomacy. China can deepen and expand the cooperation with key countries and regions in the Middle East, Central Asia, Russia, Africa, the Americas, and the Asia–Pacific region to help

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them to develop more oil and gas resources, and to construct more energy infrastructure. Thus, excessive dependence on individual countries may be reduced.

Second, the construction of onshore oil and gas import channels should be strengthened. With the commissioning of the China-Russia crude oil pipeline, China-Kazakhstan crude oil pipeline, China-Central Asia natural gas pipeline, and China-Myanmar oil and gas pipeline, the onshore oil and gas import capacity of China has been significantly increased. However, offshore imports still account for more than 70% of the total imports, and the routes are fixed and long. China should further expand the transmission capacity of onshore oil and gas pipelines, as well as optimize onshore oil and gas import sources to ensure the safe and stable operation of import channels.

Third, China should focus more on the importation of natural gas. Many countries have focused on the development of natural gas businesses because they consider natural gas to be an important transition to the future energy transition. In policy documents such as the energy production and consumption revolution strategy, and the air pollution prevention and control action plan, China has clearly indicated that natural gas would become one of the main energy sources in China's modern clean energy system. Compared with oil, there has been a rapid growth in the dependence on external sources of natural gas in China because it has closer relationship with peoples' daily lives, and the demand for clean heating during winter has increased in recent years. There is therefore the need to focus more and limit the rapid growth in the external dependence of natural gas. At the same time, we should accelerate the construction of domestic energy storage and transportation systems, as well as the construction of energy infrastructure such as domestic natural gas pipeline networks, receiving stations, and gas storage facilities.

4.2 Actively promote power grid interconnection and increase clean power imports

With the acceleration of China's clean energy and low-carbon transformation, it is very difficult to construct new coal-fired power generation plants. The cost of gas-fired power generation is very high, and it is not expected to become the main power source. The hydropower project development has come to an end, and it will take a long time for wind power and PV power generation to be the main power source owing to their own characteristics. Importing power from neighboring countries is an important way of guaranteeing China's energy security in the 14th Five-Year Plan period and beyond. Further, it will also increase the proportion of clean energy imports.

Mongolia, which borders the north of China, has rich resources in coal, wind energy, and solar energy. Its total proven coal reserves is 1.62×10^{11} t, and its technical development capacity of wind power generation and solar power generation are 1.1×10^{10} kW and 1.5×10^{10} kW, respectively. In particular, the South Gobi and East Gobi regions of Mongolia, which border China, have a vast territory with a sparse population, and have rich energy sources. However, the power demand of Mongolia is very low, and its willingness to turn its own energy advantages into economic advantages through the export of power is strong. Above all, a wind–PV–coal–storage integrated energy base can be built in the south of Mongolia, and the power that is generated can be transferred to North China, Central China, East China, and other load centers.

With respect to Myanmar, which shares a border to the south of China, its technical development capacity of hydropower is 6×10^{7} kW, and most of the hydropower resources are located in the north of Myanmar. It has significant geographical advantages enabling it to transmit power to South China after these hydropower stations are developed. The technical development capacity of Laos' hydroelectric supply is 3×10^{7} kW, and its power demand is very low. Therefore, it is also very willing to export power to its surrounding countries. Laos has plans to become the power battery of the Southeast Asian region, and this could significantly augment the power supply to South China in the future.

Among the other countries sharing borders with China, the Far East region of Russia and Nepal are rich in hydropower resources, both Kyrgyzstan and Tajikistan are rich in renewable energy resources. However, the above areas are far from the load center of China, and owing to limitations in terms of economic and technical conditions, it is currently difficult to develop power generation capacity in these countries, but they can be considered reserves for the long-term importation of clean power.

Above all, it is proposed that China–Laos, China–Myanmar, and China–Mongolia power interconnection projects be promoted in the near future. In the long term, China–Russia, China–Nepal, and China–Central Asia power interconnection projects will be developed to optimize the allocation of clean energy resources on a larger scale, and to guarantee China's energy supply and sustainable security.

4.3 Strengthen advanced energy technology cooperation to develop the most challenging problems

Here, we make a comprehensive assessment of the impact on China's energy technology security, which was caused by China–US trade friction. There is the need to make contingency plans for all kinds of scenarios, and focus on the technologies that restraining energy development.

At present, we should continue to maintain cooperation in advanced energy technologies with developed countries, especially European countries. The key technologies include large-scale affordable renewable energy interconnections, offshore wind power, next-generation nuclear power, heavy-duty gas turbines, combustible ice, hot and dry rocks, energy storage facilities, and hydrogen energy. We will accelerate the introduction of advanced technologies, and will simultaneously strengthen independent research in this area. Thus, we can strive to lead future energy technologies.

China is expected to promote the establishment of an energy technology innovation incubation network among B&R countries. The advantageous resources of energy companies, scientific research institutions, and financial institutions of these countries will be pooled, and the development of innovative energy enterprises will be supported in these countries. Through cooperation in energy science and technology, some kind of alternative energy will be developed, and energy efficiency will be improved in order to provide strong technical support for China's energy security.

4.4 Lead in global energy governance and jointly build safe and efficient energy mechanism

China's energy security will be improved by building a more open global energy governance system. China can play a stronger leading role in global low-carbon energy development after the withdrawal of the USA from the *Paris Agreement*. China is able to make full use of its leading role in multilateral energy cooperation mechanisms, following the principle of mutual benefit, and can continuously deepen energy cooperation with B&R countries in order to realize the open development of the energy industry.

In terms of energy trade, China can actively participate in the construction of global oil and gas market systems and the formulation of relevant trading rules. It should focus on improving trade linkages with Central Asia, Russia, the Middle East, Africa, America, Asia Pacific, and other countries, and it should speed up the establishment of a global natural gas trade system, enhance the function of the international oil and gas operation center, and give full play to shared synergy effect. The use of oil and gas would prove advantageous to strengthening its domestic energy supply capacity and improving the global synergy ability. Relying on the oil and gas trading centers in Shanghai and Chongqing, China will gradually improve its pricing power in the global market. China-based energy trading centers and pricing mechanism will be cultivated step by step, thus guaranteeing China's energy security.

In terms of energy governance, China will continue to rely on existing multilateral energy cooperation mechanisms, actively participate in multilateral cooperation under the framework of the United Nations, G20, APEC, Shanghai Cooperation Organization, and BRICS. China will continue to strengthen communication with the International Energy Agency, International Renewable Energy Agency, International Energy Forum, Energy Charter, and other international organizations. China will put forward some initiatives from the perspectives of enhancing the energy security ability, ensuring energy supply, transport resilience, etc. China and other counties will jointly build a green and low-carbon global energy governance system, and a safe and efficient energy security system. They will work together to ensure an open and fair international energy market, and will jointly safeguard the security of energy transmission channels. The BREP, which was initiated by China, will be built as an influential energy cooperation and governance platform through political, diplomatic, economic, and other various means. BREP will help all of the member countries to solve their energy security issues.

5 Conclusion

The new era has resulted in a concept of energy security that has a new connotation, and this has resulted in the need for new and more requirements for energy international cooperation. China is able to make plans and take actions in the following areas: (1) Optimizing the import structure of oil and gas to realize the diversification of import sources, channels, methods, and main bodies; (2) flexibly promoting power interconnections with neighboring countries to achieve the effective allocation of clean energy resources on a larger region; (3) enhancing advanced energy technology cooperation and increasing the independent innovation abilities to provide strong technical support to energy development; and (4) actively participating in global energy governance to continuously enhance its influence in international energy affairs. China is able to achieve high-quality and

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sustainable energy development through international energy cooperation, and it can also lay a solid foundation for ensuring energy security under open-up conditions.

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