Postprint: Security Benefits for China from the Development and Utilization of Central Asian Natural Gas Resources in the Silk Road Economic Belt and Policy Recommendations

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Abstract

Central Asia is endowed with abundant natural gas resources, and Central Asian countries are vigorously developing these resources, continuously increasing production and export volumes while striving to achieve export diversification, thereby becoming the focus of competition and attention among major world powers and various forces. China, due to its large population and enormous consumption, is heavily reliant on imported natural gas, with its external dependence increasing year by year. Currently, Central Asia accounts for approximately 50% of China' s natural gas import market share. Although this proportion will decline in the future, the total import volume will continue to increase steadily; consequently, Central Asian natural gas maintains a pivotal strategic position in China' s natural gas security framework. Central Asian natural gas resources possess advantages such as high comparative advantage, as well as good security and stability; however, the cooperative development of natural gas resources between China and Central Asia is also subject to disturbances from external factors including political, economic, and cultural dimensions. Therefore, from the perspective of safeguarding national energy security, this paper conducts a detailed analysis of the geopolitical distribution pattern of Central Asian natural gas resources and their assurance level and assurance benefits for China' s natural gas security, examines the impact of external disturbance factors on the development of Central Asian natural gas resources and the assurance risks to China' s energy security, and proposes targeted countermeasures that urgently need to be adopted for the current cooperative development of natural gas resources between China and Central Asia: (1) establish a Vice Premier-level natural gas cooperative development coordination committee; (2) formulate and improve bilateral natural gas trade agreements with the five Central Asian countries; (3) continue to expand the gas transmission capacity of

the Central Asia-China natural gas pipeline; (4) optimize the cooperative development model between China and Central Asia for natural gas; (5) establish a China-Central Asia natural gas trading center.

Full Text

Geo-configuration of Central Asian Energy and National Security in the "Silk Road Economic Belt": Guarantee Benefits and Countermeasures of Central Asian Natural Gas Resource Development and Utilization for China

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Abstract

Central Asia possesses abundant natural gas resources, and countries in the region are vigorously developing these resources, continuously increasing production and export volumes while striving to achieve export diversification. Consequently, Central Asia has become a focal point of competition among major global powers. China, with its large population and enormous consumption, is heavily dependent on imported natural gas, with its external dependence increasing year by year. Currently, the five Central Asian countries account for approximately 50% of China's natural gas import market. Although this proportion may decline in the future, the total import volume will steadily increase, ensuring that Central Asian natural gas continues to hold a pivotal strategic position in China's natural gas security landscape. Central Asian natural gas resources offer high comparative advantages, security, and stability, yet cooperation between China and Central Asia in developing these resources may be disrupted by external factors including politics, economics, and culture. Therefore, from the perspective of safeguarding national energy security, this paper analyzes in detail the geo-configuration pattern of Central Asian natural gas resources, the degree and benefits of their contribution to China's natural gas security, the impact of external disturbance factors on Central Asian natural gas development, and the risks to China's energy security. It also proposes targeted countermeasures and recommendations for current cooperation in Central Asian natural gas resource development: (1) establish a vice-premier level coordination committee for natural gas cooperation and development; (2) formulate and improve bilateral natural gas trade agreements with the five Central Asian countries; (3) continue expanding the gas transmission capacity of the Central Asia-China natural gas pipeline; (4) optimize the cooperation model for China-Central Asia natural gas development; and (5) establish a China-Central Asia

natural gas trading center.

Keywords: natural gas, geo-configuration, cooperation and development, guarantee level, energy security, Central Asia

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Spatial Configuration Pattern of Central Asian Natural Gas Resources

In 2016, the proven natural gas reserves of the five Central Asian countries totaled 19.6 trillion cubic meters, accounting for approximately 10.5% of the global total. These reserves are concentrated primarily in Turkmenistan (89%), Uzbekistan (6%), and Kazakhstan (5%), with only negligible amounts in Tajikistan and Kyrgyzstan[1]. Turkmenistan' s proven natural gas reserves rank fourth in the world, following only Iran, Russia, and Qatar. Due to Central Asia' s central location on the Eurasian continent, it enjoys superior geographical connectivity to the east, west, south, and north, providing convenient conditions for natural gas transportation. Although Central Asian natural gas development is still in its initial stages compared to established global centers such as the Middle East, its abundant resource reserves, favorable extraction conditions, and convenient transportation potential have made it a "new base" for world natural gas development[2], attracting control and competition from major powers and creating sharp strategic conflicts and interest contradictions. In 2016, the five Central Asian countries exported 65.1 billion cubic meters of natural gas, with 52.4% going to China. China' s total natural gas imports reached 72.3 billion cubic meters, of which 47.2% came from the five Central Asian countries[1]. This demonstrates that cooperation in natural gas resource development holds pivotal importance for both Central Asia and China.

Development and Utilization Process and Pattern of Central Asian Natural Gas Resources

Over the past 30 years, the development and utilization of natural gas resources in Turkmenistan, Uzbekistan, and Kazakhstan (hereinafter referred to as the "three Central Asian countries") have experienced dramatic fluctuations and gradual recovery to steady development [Figure 1: see original paper]. Natural gas production increased from 110.9 billion cubic meters in 1985 to 149.5 billion cubic meters in 2016, consumption rose from 48.7 billion cubic meters to 94.3 billion cubic meters, and the volume supplied to outside regions recovered from 62.2 billion cubic meters in 1985 to 65.1 billion cubic meters in 2016.

Turkmenistan' s natural gas plays a primary determining role in the overall pattern. The country reached its peak production of 81.4 billion cubic meters in 1989. Following the dissolution of the Soviet Union in 1991, production dropped dramatically to a trough of 12 billion cubic meters in 1998, with exports falling to zero. This was mainly due to unresolved agreement relationships with Russia, a transit country for international markets. After these disputes were resolved, production recovered rapidly from 1998 to 2008. Due to the financial crisis, production fell sharply in 2008-2009, then fluctuated upward from 2009 to 2016, though it has not yet returned to the 1989 peak level. Turkmenistan' s natural gas consumption is far lower than its production, so most is exported. In 2016, Turkmenistan exported 37.2 billion cubic meters, primarily to Kazakhstan (1.1 billion cubic meters), Iran (6.7 billion cubic meters), and China (29.4 billion cubic meters).

Kazakhstan' s natural gas development and utilization show a basically upward trend. Affected by the dissolution of the Soviet Union in 1991, the country' s economy fell into crisis after independence, and natural gas production declined until 1996, recovering to the level at the time of the Soviet Union' s dissolution in 1997. It has since risen steadily, reaching 19.9 billion cubic meters in 2016. Consumption has also increased year by year. Before 1999, Kazakhstan' s consumption exceeded its production, but since 2000, consumption has remained below production. Among the three Central Asian countries, Kazakhstan has the lowest production and consumption levels. In 2016, its exports reached 16.5 billion cubic meters, mainly to Russia (16.1 billion cubic meters) and China (0.4 billion cubic meters).

Uzbekistan' s natural gas development and utilization shows a fluctuating but steadily upward trend. The country' s natural gas production is significantly higher than Kazakhstan' s. There was a slight decline from 2007 to 2010. Consumption increased steadily before 2002, close to production levels. From 2002 to 2011, it experienced a decline, recovery, sharp drop, and recovery again. From 2011 to 2016, it grew slowly and steadily, with consumption accounting for 81.8% of production by 2016. Uzbekistan' s natural gas exports are relatively small compared to the other two countries, reaching 11.4 billion cubic meters in 2016, primarily to Kazakhstan (1.5 billion cubic meters), Russia (5.6 billion cubic meters), and China (4.3 billion cubic meters).

Future Configuration Pattern of Central Asian Natural Gas Resources

Based on development trends and relevant domestic and international research[3-6], Central Asian natural gas production is projected to reach 250.2 billion cubic meters in 2020, 267.4 billion cubic meters in 2025, and 320.6 billion cubic meters in 2030. Consumption is expected to be 89.7 billion cubic meters in 2020, 102.9 billion cubic meters in 2025, and 115.6 billion cubic meters in 2030. Exports are forecasted at 160.5 billion cubic meters in 2020, 164.4 billion cubic meters in 2025, and 205.0 billion cubic meters in 2030 [Figure 2: see original paper].

Turkmenistan will remain the primary natural gas exporter in Central Asia. According to Wood Mackenzie Energy Consulting, Turkmenistan' s natural gas production will maintain rapid growth for some time, reaching 165 billion cubic meters in 2020, with consumption of 30 billion cubic meters and exports of 135 billion cubic meters, primarily to Russia and Ukraine (90 billion cubic meters combined), China (30 billion cubic meters), and Iran (15 billion cubic meters)[3]. By 2025, production will reach 180 billion cubic meters, consumption 40 billion cubic meters, with approximately 140 billion cubic meters for export, mainly to Russia (80 billion cubic meters), China (30 billion cubic meters), Iran (20 billion cubic meters), and the European Union (10 billion cubic meters)[4]. By 2030, production will reach 230 billion cubic meters, consumption 50 billion cubic meters, with approximately 180 billion cubic meters for export.

Uzbekistan has relatively high natural gas consumption but also substantial export volumes. With large-scale industrial development of gas fields in the Ustyurt region, Uzbekistan' s natural gas production, consumption, and exports will all increase. Production is projected to reach 60.5 billion cubic meters in 2020, with consumption of 43.4 billion cubic meters and exports of 17.1 billion cubic meters. By 2025, production will increase to 64.3 billion cubic meters, consumption 45.3 billion cubic meters, and exports 18.9 billion cubic meters. By 2030, production will reach 68.2 billion cubic meters, consumption 47.5 billion cubic meters, and exports 20.7 billion cubic meters, primarily to Russia (15 billion cubic meters), neighboring Central Asian countries such as Tajikistan (3.7 billion cubic meters), and the Asia-Pacific region (2 billion cubic meters)[5].

Kazakhstan has the lowest levels of natural gas production, consumption, and exports. Production is projected at 24.7 billion cubic meters in 2020, with consumption of 16.3 billion cubic meters and exports of 8.4 billion cubic meters. By 2025, production will be 23.1 billion cubic meters, consumption 17.6 billion cubic meters, and exports 5.5 billion cubic meters. By 2030, domestic production will reach 22.4 billion cubic meters, consumption 18.1 billion cubic meters (including 5.2 billion cubic meters for industrial use, 5.1 billion cubic meters for residential use, and 0.5 billion cubic meters for automotive transport), and exports 5 billion cubic meters[6].

Central Asia' s Guarantee Degree for China' s Natural Gas Security

Historical Evolution of Central Asia' s Guarantee Degree for China' s Natural Gas Security

China' s natural gas resources are also relatively abundant, with proven reserves of 5.4 trillion cubic meters in 2016. However, due to its large population and economic scale, production cannot meet demand, resulting in heavy reliance on imports. China began importing natural gas from other countries in 2006, and by 2007, supply could not meet demand. The China-Central Asia natural gas pipeline was successfully constructed in 2009, and in 2011, Turkmenistan in

Central Asia surpassed Australia to become China' s largest source of natural gas imports. Since then, Central Asia has become China' s primary channel for natural gas imports, playing a crucial role in guaranteeing China' s natural gas security.

China' s natural gas production showed a continuous upward trend from 1980 to 2016 [Figure 3: see original paper], increasing from 14.7 billion cubic meters per year to 138.4 billion cubic meters per year. This can be roughly divided into three stages: the first stage (1980-1995) saw slow growth, with annual production increasing by 3.8 billion cubic meters over 15 years; the second stage (1996-2004) experienced faster growth, with annual production increasing by 24.4 billion cubic meters over 8 years; and the third stage (2005-2016) witnessed rapid growth, with annual production increasing by 95.5 billion cubic meters over 11 years.

China' s natural gas consumption also showed a continuous upward trend from 1980 to 2016 [Figure 3: see original paper], increasing from 14.7 billion cubic meters per year to 210.3 billion cubic meters per year. This can also be divided into three stages of slow, faster, and rapid growth. From 1980 to 1994, production and consumption were basically balanced. From 1995 to 2006, production exceeded consumption. After 2007, consumption gradually surpassed production, with the gap widening continuously.

From 2010 to 2016, China' s natural gas imports increased from 16.35 billion cubic meters per year to 72.3 billion cubic meters per year, with external dependence (the proportion of imports to consumption) rising from 14.7% to 34.4% [Figure 4: see original paper]. The volume of natural gas supplied by Central Asia to China increased from 3.6 billion cubic meters per year to 34.2 billion cubic meters per year, with the proportion of natural gas imported from Central Asia to total imports increasing from 14.7% to 51.8% in 2012, then fluctuating around 50%, reaching 47.3% in 2016 [FIGURE:4 and 5]. Correspondingly, Central Asia' s guarantee degree for China' s natural gas (the proportion of Central Asian gas supply to China' s natural gas consumption) increased from 3.2% in 2010 to 16.3% in 2016 [Figure 5: see original paper].

Future Development Trend of Central Asia' s Guarantee Degree for China' s Natural Gas Security

Based on China' s natural gas development trends and relevant domestic and international research[7-11], China' s natural gas production, consumption, imports, and external dependence are all projected to increase significantly by 2020, 2025, and 2030 [Figure 4: see original paper]. Regarding production, scholars predict that the peak annual production of China' s conventional natural gas will be 240-280 billion cubic meters, with the production growth peak period lasting until around 2045[7-11]. For consumption, different institutions have proposed forecasts for China' s future natural gas demand[7-11]. After comprehensive analysis, this paper projects consumption of 340 billion cubic meters

in 2020, 420 billion cubic meters in 2025, and 500 billion cubic meters in 2030. For imports, due to varying predictions of consumption and production, import forecasts also differ. After comprehensive analysis, this paper projects China' s natural gas imports at 160 billion cubic meters in 2020, 210 billion cubic meters in 2025, and 270 billion cubic meters in 2030. Accordingly, China' s external dependence on natural gas will reach 45.7% in 2020, 50% in 2025, and 54% in 2030, indicating that substantially increasing natural gas consumption will require heavy reliance on imports, thereby raising national natural gas energy risks.

Regarding Central Asia' s guarantee degree for China' s natural gas, based on future Central Asian natural gas exports and the current proportion of gas supplied to China (approximately 50% of total exports), as well as the total capacity of the four branches of the Central Asia-China natural gas pipeline that have been built or are under construction (which will reach 85 billion cubic meters by 2020), this paper projects that Central Asian gas supply to China will reach 80 billion cubic meters in 2020, 85 billion cubic meters in 2025, and 100 billion cubic meters in 2030. Accordingly, natural gas imported from Central Asia will account for 50.0%, 40.5%, and 37.0% of China' s total natural gas imports, and 22.9%, 20.2%, and 20% of China' s natural gas consumption [Figure 5: see original paper]. However, this projection represents a relatively conservative estimate. If the Chinese government can strengthen cooperation with Central Asia and appropriately increase the share of Central Asian gas supplied to China, Central Asian gas supply to China could reach 130-150 billion cubic meters by 2030 (accounting for 63-73% of Central Asia' s total natural gas exports). Under this scenario, although the proportion of Central Asian gas supplied to other countries would decrease, the total volume would still see substantial growth.

Guarantee Benefits and Disturbances of Central Asian Natural Gas for China' s Security

Guarantee Advantages and Benefits of Central Asian Natural Gas for China' s Security

Central Asian natural gas resources offer high comparative advantages, security, and stability. Importing natural gas from Central Asia can promote diversification of China' s energy supply, greatly optimize China' s energy structure, and reduce China' s energy security risks while generating good economic and environmental benefits.

First, Central Asian natural gas cooperation development enjoys geographical advantages. Central Asia is the only overseas land-based natural gas source adjacent to China, with short transportation distances and no need to transit through third countries, making trade negotiations relatively simple. Compared to maritime transport, which requires passage through the narrow Strait of Hormuz and Strait of Malacca, pipeline transport and land routes offer larger

capacity, better security, and greater stability. By diversifying risks, China' s development of natural gas cooperation with Central Asia can reduce dependence on the Middle East and Africa, mitigating the negative impacts of Middle East instability and maritime transport risks on China' s energy security. Furthermore, Central Asia serves as an important hub connecting Russian and Middle Eastern natural gas producing areas and even African sources. With the improvement of infrastructure construction under the "Silk Road Economic Belt," Central Asia can link China' s market with natural gas producing areas in the Middle East and Africa, providing reliable guarantees for China to obtain more natural gas supplies stably.

Second, China can obtain natural gas price advantages. As an emerging country, China lacks sufficient voice in global energy governance, and its price negotiation and bargaining power are relatively weak. Rapidly growing energy demand has forced China to endure unreasonable "Asian premiums" and violent energy price fluctuations. Under these circumstances, developing Central Asia' s vast natural gas cooperation market can not only provide relatively stable natural gas supplies but also gradually increase China' s bargaining power in global natural gas trade through cooperation development, yielding good energy economic benefits.

Third, it can greatly optimize China' s energy structure. Faced with increasing climate change pressure and increasingly serious ecological and environmental threats, China urgently needs to improve its coal-dominated energy structure and increase the proportion of clean energy such as natural gas in energy consumption. It is estimated that natural gas imported from Central Asia is equivalent to nearly two years of coal consumption in the Beijing-Tianjin region; 100 billion cubic meters of natural gas can replace 133 million tons of coal, reducing carbon emissions by 142 million tons and sulfur dioxide emissions by 2.2 million tons, which is of great significance for improving air pollution in China, especially in the Beijing-Tianjin-Hebei region[10].

Disturbance Factors and Potential Risks in Central Asian Natural Gas Cooperation Development

Central Asian natural gas cooperation development may be affected by multiple political, economic, and cultural factors. Politically, it is subject to control and competition among major powers, spillover effects from turmoil in neighboring countries, internal political transitions, and terrorism. Economically, it is subject to financial support and control by multinational corporations. Culturally, Islamic extremism may bring certain negative impacts.

Political factors: The complex geopolitical relationships surrounding Central Asian natural gas gradually formed after the investment boom in Central Asian natural gas in the early 1990s and have been continuously evolving[12,13]. Among these, the Russia-U.S. contradiction is the main conflict in Central Asia, with China serving as an important balancing force. Regarding the

surrounding political environment, the situation in Afghanistan has become the biggest factor affecting security and stability in Central Asia[11]. The 2014 Ukraine crisis brought major changes to the geopolitical situation in the Russia-Central Asia region, and major Central Asian resource countries will inevitably pursue more firmly diversified and balanced diplomatic and energy cooperation strategies[14]. Turkey' s downing of a Russian warplane was the most dramatic event in international geopolitics in the second half of 2015, and the resulting deterioration of Russia-Turkey relations will have far-reaching impacts on oil and gas flows in the Eurasian region[11]. Regarding internal political risks in Central Asia, issues of political power transition and long-term disturbances from separatism, extremism, and international terrorism also pose security threats to Central Asian natural gas cooperation development[15].

Economic factors: Strong economic complementarity is the internal driving force for regional natural gas cooperation. Central Asian countries are rich in natural gas resources but have limited domestic consumption, giving them huge export potential. However, constrained by economic development levels, Central Asian countries cannot independently exploit their natural gas resources and urgently need foreign capital and technology. The involvement of Western multinational corporations has provided technical and financial support for Central Asian natural gas development, but corporate profit pursuit has affected regional development to some extent. Currently, major oil and gas fields in Central Asia have been basically divided among Western multinational corporations, which face a dilemma between their home country' s political intervention and economic feasibility in selecting natural gas export pipeline routes. The U.S. government' s policy of excluding Russia and Iran from Central Asian natural gas pipelines has forced Western multinational corporations to accept trans-Caspian pipeline routes, affecting their enthusiasm for building new pipelines. This will bring uncertainty to China-Central Asia natural gas cooperation development.

Cultural factors: Islam has a history of over 1,000 years of propagation in Central Asia and is the most popular religion with the largest number of believers and widest coverage in the region. During the Soviet period, the central government' s strict restrictions and even cancellation of religious policies basically stopped all religious activities. After the dissolution of the Soviet Union, an ideological vacuum emerged in Central Asia, and economic crisis and social turmoil allowed "non-traditional Islam"—religious radicalism—to flow in, combining with religious extremist forces in Central Asia' s Fergana Valley to produce numerous Islamic radical organizations, such as the Islamic Movement of Uzbekistan (IMU), Hizb ut-Tahrir (HUT), and the Islamic Renaissance Party of Tajikistan (IRPT). These religious extremist organizations have intensified infiltration and propaganda, attempting to establish a theocratic Islamic caliphate state. Since the mid-1990s, religious extremist forces have challenged secular state power through violent means such as terrorist attacks, hostage-taking, and bombings, threatening regional stability and posing significant security risks to Central Asia[16].

Countermeasures for Strengthening China-Central Asia Natural Gas Resource Cooperation

1. Establish a Vice-Premier Level Coordination Committee for Natural Gas Cooperation Development

Central Asia serves as an important hub connecting Russian and Middle Eastern natural gas producing areas and even African sources, so these countries should be considered comprehensively in advance. China established regular premier-level meeting mechanisms with Russia in 1996 and with Kazakhstan in 2012, and also established vice-premier level committees with Russia such as the China-Russia Investment Cooperation Committee and the China-Russia Energy Cooperation Committee[17]. In the future, China should establish a vice-premier level natural gas cooperation development coordination committee with Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan, Kyrgyzstan, and Russia based on existing bilateral high-level regular meeting mechanisms. This committee would specifically organize joint construction and sharing of major infrastructure such as natural gas pipelines and coordinate subsequent gas dispatching. China should also deepen cooperation with the United States, European Union, Turkey, and Japan to avoid an "energy cold war," and actively engage South Korea and India to establish an "Asian Energy Alliance."

2. Formulate and Improve Bilateral Natural Gas Trade Agreements with Central Asian Countries

Central Asian countries' reliance solely on oil and gas exports creates economic insecurity. To avoid uncontrollable economic, political, and transit risk factors, implementing a diversified natural gas export strategy is their inevitable choice. For example, Turkmenistan, the country with the richest natural gas resources, has 12 natural gas export pipelines that are already in use, under construction, or under consideration, exporting to China, Russia, Iran, Europe, Afghanistan, Pakistan, India, and other countries and regions. Similarly, China also implements a diversified natural gas import strategy, importing natural gas from more than 20 countries annually and sometimes reducing imports from Central Asia based on market conditions. Therefore, to eliminate concerns on both sides and minimize the impact of various determined and uncertain risks, China and Central Asian countries should formulate and improve bilateral natural gas trade agreements in areas such as natural gas pricing, customs and tariffs, and service trade as soon as possible. These agreements would provide institutional guarantees at the international legal level to ensure that China-Central Asia natural gas trade remains stable, secure, and economical, achieving mutual benefits.

3. Continue Expanding the Gas Transmission Capacity of the Central Asia-China Natural Gas Pipeline

The Central Asia-China natural gas pipeline includes four lines: A, B, C, and D[18]. Line A originates from Gedaim on the Turkmenistan-Uzbekistan bor-

der, passes through Uzbekistan and Kazakhstan, enters China at the Khorgos compressor station, and connects to China' s West-East Gas Pipeline, with a designed annual capacity of 15 billion cubic meters. It was completed and put into operation in December 2009. Line B follows the same route as Line A, with a designed annual capacity of 15 billion cubic meters, completed in October 2010. Line C has the same start and end points as Lines A and B, with a designed annual capacity of 25 billion cubic meters, completed in May 2014. Line D originates from the Turkmenistan-Uzbekistan border, passes through Tajikistan and Kyrgyzstan, enters China at Wuqia Station in Xinjiang, and connects to China's West-East Gas Pipeline, with a designed annual capacity of 30 billion cubic meters. Construction began in September 2014, with planned completion around 2020. Upon completion, the Central Asia-China natural gas pipeline' s annual transmission capacity will increase to 85 billion cubic meters. However, by 2030, Central Asia could supply China with 100-150 billion cubic meters of natural gas. Therefore, feasibility studies for expanding the Central Asia-China natural gas pipeline should be conducted as soon as possible, with the goal of building Central Asia into China' s largest and most reliable overseas natural gas supply base within 12 years.

4. Optimize the Cooperation Model for China-Central Asia Natural Gas Development

Natural gas cooperation development models mainly include production sharing models, joint venture models, technical service models, and hybrid models of these three[19,20]. China' s natural gas cooperation models with Turkmenistan, Uzbekistan, and Kazakhstan have similarities, but each has its own characteristics due to different national conditions and natural gas industry development status. Therefore, specific choices should be made according to each country' s circumstances. Overall, the approach should be based on the concept of mutual benefit and win-win outcomes, political mutual trust, government-led negotiations, state-owned companies as the main body, comprehensive cooperation across upstream, midstream, and downstream sectors, and pipeline projects as the bond, focusing on bilateral cooperation that drives multilateral cooperation. It should be noted that overseas investments by China' s state-owned enterprises carry strong national characteristics, which have caused concerns and fears in host countries. Therefore, private enterprises should be encouraged to participate in natural gas development. China' s natural gas companies need to change their approach of simply purchasing natural gas assets and instead engage in close cooperation in knowledge sharing and technology development based on host countries' economic development needs and natural gas development strategies, to gain understanding and support from all sectors for Chinese companies' investment and operations.

5. Establish a China-Central Asia Natural Gas Trading Center

As the "Silk Road Economic Belt" development makes Central Asia's role in connecting China's market with Middle Eastern and African natural gas producing areas more prominent, and as Russia gradually pivots toward Asia financially and in energy[21,22], China should consider establishing a China-Central Asia natural gas trading center in Xinjiang. This center would mainly provide three services: (1) non-trading services, including natural gas transportation, storage, and peak-shaving; (2) trading services, including natural gas ownership trading registration, clearing, entrusted trading, and delivery confirmation; and (3) natural gas market information services, enabling market participants to discover prices and forecast more accurately, forming a market-based natural gas pricing mechanism and system. Ultimately, this would improve the natural gas futures market, over-the-counter market, and derivative financial products market, optimize natural gas market resource allocation efficiency, reduce fluctuations in natural gas supply and demand, and provide a stable guarantee environment for the smooth operation of the Central Asia-China natural gas pipeline.

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Note: Figure translations are in progress. See original paper for figures.