

Study on China Turkmenistan Natural Gas Trade Cooperation From the Perspective of Supply-Demand Balance and Diminishing Marginal Utility

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ABSTRACT

With the advancement of policies about domestic environmental protection, energy saving, and conversion of coal-to-gas project, the market demand for natural gas has greatly stimulated. Turkmenistan is rich in natural gas resources, after cooperating with China in the field of natural gas, Turkmenistan has achieved gratifying achievements and provided an endless source of energy for China's economic development. This paper firstly analyzes the current situation of domestic natural gas supply and demand in China and the reasons for the imbalance between supply and demand, then analyzes the present situation of China-Turkmenistan natural gas trade cooperation, at last analyzes the possibility of continuous export of natural gas from Turkmenistan to China from the perspective of marginal utility of natural gas trade. Following conclusions are drawn: China's natural gas dependence on foreign countries continues to rise; the natural gas trade cooperation between China and Turkmenistan has highly complementarity and entered a deep stage of development; there is a greater development space for deepening the natural gas trade between China and Turkmenistan.

Keywords: *Natural gas, energy trade, supply-demand balance, marginal utility of trade*

1. INTRODUCTION

In 2018, the consumption of natural gas was 280.3 billion cubic meters, up 17.43% year-on-year, 18.74 times over that of 1978; The output was 161.02 billion cubic meters, up 7.5% year-on-year, 10.34 times over 1978. China has become a net importer of natural gas since 2007, with a net import of 121.371 billion cubic meters in 2018, 84.47 times over that of 2007. The external dependence of natural gas increased from 5.6% in 2007 to 43.35% in 2018. Internationally, because of the global competition and antagonism between the United States and Russia for natural gas and the blockage of Qatar's natural gas export channel caused by the interruption of diplomatic relations with many countries, China's natural gas imports have severely hindered, the shortage of natural gas supply has become more prominent. The Caspian Sea where Turkmenistan located is known as the "Second Persian Gulf" and "Twenty-First Century Energy Base", because 80% of its territories contain extremely rich natural gas, abundant petroleum and other important petrochemical resources, Turkmenistan is known as "Country on a Gas Field". China and Turkmenistan have had a good cooperative relationship in energy resources including oil and gas exploration, development and trade since 2000 [1], this provides important guarantee for the bilateral economic recovery and development.

2. LITERATURE REVIEW

The research on China-Turkmenistan cooperation mainly focuses on the field of energy, and involves geopolitics, laws & regulations, economic & trade cooperation as well as investment environment. The research about energy mainly includes natural gas development cooperation, trade status, pipeline development, investment environment and geo-strategy. Deng Xiujie [2] reviewed the history of energy cooperation between the two countries, analyzed the causes of rapid development and existing problems, looked forward to the future cooperation. Wang Ran [3] systematically studied the foreign cooperation process of Turkmenistan oil and gas resources, summed up the characteristics of the cooperation between Turkmenistan and other countries, and put forward proposals for China-Turkmenistan natural gas cooperation. In terms of trade status, Zhang long [4] analyzed the current situation of bilateral cooperation and concluded that natural gas cooperation would promote China's energy supply security. As a huge consumer market, China is also an inevitable option for Turkmenistan. Zhang Yansong believes that from the perspective of construction and planning pipelines, there will be 5 countries and regions for future natural gas exports of Turkmenistan: China, Russia, the European Union, Iran and India. It is estimated that the annual export capacity of natural gas will reach 1800-250 billion cubic

meters by 2030 [5]. In terms of investment environment, Merdan said that the preferential treatment of foreign investment enterprises in Turkmenistan is mainly reflected in customs preferences, taxation and import-export management. Open policies are taken to introduce funds and technology, but at the same time, the protection policy is taken to protect domestic industries, the political and economic stability of Turkmenistan, guarantees the improvement of investment environment and international energy cooperation [6]. In terms of geo-strategy, Zhang Yansong et al. argued that geo-strategy of Turkmenistan is very significant. Turkmenistan is China's hub to avoid Russia from joining Europe, the Middle East and South Asia, and is the fulcrum of China's overseas energy base, land energy corridor and Eurasian strategy.

At present, there are some research findings about energy cooperation between China and Turkmenistan, but mostly based on comprehensive analysis, lack of analysis from the perspective of economic theory. This paper analyzes the current situation of domestic natural gas supply and demand from the perspective of supply and demand balance, and put forward reasonable suggestions based on the current situation and existing problems of natural gas cooperation between the two countries.

3. CURRENT SITUATION OF NATURAL GAS SECTION

3.1. China's Natural Gas Supply and Demand

In 2017, the import of LNG was about 38 million tons, 46% over the same period of last year, China has become the biggest importer only after Japan. Relevant data show that in December 2018, natural gas production was 15.250 billion cubic meters, 10.0% over the same period of last year; imported natural gas was 12.74 billion cubic meters, an increase of 17.0% over the same period of last year. With the convening of the International Climate Conference, the issue of pollutant gas emissions has been raised to a higher level. In order to curb the air pollution and protect the environment, the Nineteenth National Congress report listed "pollution prevention" as one of the three key battles, regarded "Winning the Blue Sky Defense War" as a key work in whole country level, actively implemented the coal-to-gas project, all of them stimulated the domestic demand for natural gas [7].

In 2018, <China's natural gas development report 2018 >white paper released by the high energy forum for energy transformation reported that the proportion of natural gas in the primary energy consumption structure will be increased to nearly 14% and 15% in 2030 and 2050, respectively [8]. From the national and provincial point of view, compared with the growing domestic demand, the domestic natural gas supply, including reserves, production and imports, is far from able to meet the demand. Although the serious situation of insufficient natural gas supply in China will be alleviated with the

development of shale gas and sea gas, the situation of sustained dependence on natural gas imports will not be altered.

3.2. Reasons for Supply and Demand Imbalance

Internationally, the tense situation has led to serious restrictions on China's imports of natural gas. Firstly, the United States imposed economic sanctions against Russia by punishing Russia for intervening in the US presidential election, expanded the competition and confrontation between US and Russia's natural gas trade caused by the natural gas transaction between the United States and the European Union, this resulted in tense global natural gas situation and seriously affected China's natural gas imports. Secondly, with extremely rich natural gas reserves and exports, Qatar is the major source country of China's LNG imports. But the interruption of diplomatic relations with many countries, resulted in the cut-off of natural gas transportation channels, this directly affected China's imports of natural gas from Qatar. Again, the Sino-Russia "power of Siberia" east line has not yet reached the ventilation conditions, while the west line negotiations have been shelved indefinitely. Finally, As the largest source country of China's LNG imports, although Australia has abundant LNG, but because of the restrictions from the sea transportation and the carrying capacity of the domestic ports, it is difficult to import liquefied natural gas from Australia.

Domestically, first reason is the expansion of demand. Because of environmental protection, atmosphere control, winter heating and the promotion of coal-to-gas projects and other factors, the domestic demand for natural gas has increased dramatically. Secondly, natural gas storage capacity is insufficient. Finally, the exploration of domestic conventional natural gas is also facing difficult challenges. The continuous low oil price and environmental protection and other factors hampered the production and exploration of shale gas and coal-based gas. Under the combined effect of multiple factors, the domestic natural gas supply is far from meeting the domestic consumption demand.

3.3. Turkmenistan Natural Gas Section

According to the relevant data of BP <World Energy Statistical Yearbook 2019>, in 2018, Turkmenistan's proven natural gas reserves reached about 19.5 trillion cubic meters, with a natural gas output of 61.5 billion cubic meters and a natural gas consumption of only 28.4 billion cubic meters ranks fourth in the world. The gap between supply and demand has promoted Turkmenistan's natural gas export trade, at present, there are five major gas fields in Turkmenistan, showing the regional characteristics of "more in the east than in the west", six natural gas pipelines put into use, TAPI and trans Caspian

natural gas pipelines are under preparation. It is worth noting that Turkmenistan attaches great importance to the diversification of natural gas exports. The president of Turkmenistan proposed to develop the natural gas industry from multiple perspectives, including opening up new export channels, enriching export situation, developing domestic natural gas chemical industry and power generation, etc.

With the re import of "Russian gas" from Turkmenistan in 2019, China-Central Asia D pipeline has opened. With the promotion of TAPI natural gas pipeline and trans Caspian natural gas pipeline project on schedule, Turkmenistan will form a diversified export pattern of natural gas to China in the East, Iran in the southwest, Europe in the West and Russia in the north, thus becoming an important "figure" in the global natural gas market.

4. ANALYSIS OF CHINA-TURKMENISTAN NATURAL GAS COOPERATION

4.1. The Present Situation of Cooperation

4.1.1. Turkmenistan is the largest supplier of natural gas for China

Starting from the general supply and demand model, China-Turkmenistan natural gas cooperation has strong complementarity. China's demand for natural gas has increased dramatically in recent years. However, domestic gas production has been unable to meet the demand, demand has always been greater than supply, the supply-demand gap has been expanding. The import volume and import dependence of natural gas has been increasing year by year, as shown in Figure 1. In 2018, natural gas imports increased by 17.43% compared with last year, and the dependence on imports reached 43.35%, increased 6.61% compared with last year. In 2017, China's total imports of natural gas amounted to 92 billion cubic meters, including 39 billion 400 million cubic meters of pipeline gas, and 31 billion 700 million cubic meters transported to China by pipeline transportation from Turkmenistan, accounted for 34.46% of the total imports, and has become the largest supplier of natural gas of China.

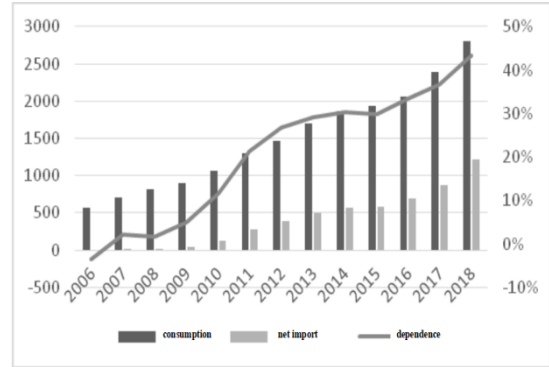


Figure 1 2006—2018 China's natural gas consumption, net import (Billion cubic meters) and import dependence

Sources: The website of the National Bureau of Statistics the website of the National Development and Reform Commission the website of the General Administration of Customs, where net imports are converted according to "net imports = imports-exports" and 1 ton = 1380 cubic meters.

4.1.2. China is the largest demander of Turkmenistan natural gas

At present, rich gas basins in the eastern part and oil basins in the western part are discovered in Turkmenistan. Their natural gas potential reserves are 19 trillion and 500 billion cubic meters, only after Middle East and Russia. At the same time, with fewer population and limited consumption, Turkmenistan has great export potential and advantages. In 2017, Turkmenistan produced 62 billion cubic meters of natural gas and consumed 28.4 billion cubic meters, accounted for 45.81%, shown in Figure 2. The total export volume was 33 billion 600 million cubic meters, and exports to China accounted for 94.35% of the total export volume. China is the largest importer of Turkmenistan natural gas .

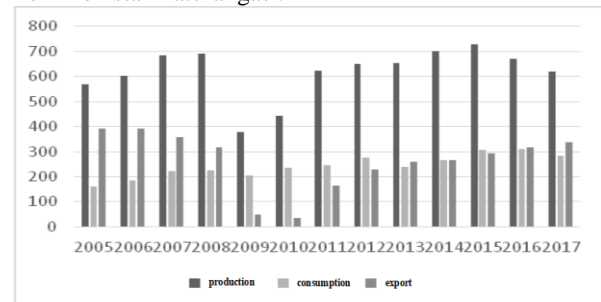


Figure 2 Natural gas production, consumption and export of Turkmenistan from 2005 to 2017 (100 million cubic meters)

Source: 2018 BP World Energy Statistics Yearbook, United Nations Trade Database <https://resourcetrade.earth/>

4.1.3. *There is a steady and healthy development of natural gas trade cooperation between China and Turkmenistan*

Influenced by Turkmenistan’s energy cooperation policy, the early stage cooperation is mainly in the field of energy exploration, development, and refining. In December 14, 2009, heads of state of China, Turkmenistan, Kazakhstan and Uzbekistan jointly opened the first gas treatment plant ventilation valve on the right bank of the Amu River in Turkmenistan. This marked the opening of the line A of China - Central Asia gas pipeline, which marked the beginning of natural gas trade between China and Turkmenistan. Since then the cooperation between China and Turkmenistan has made sustained development. By 2017, the volume of trade reached 31.7 billion cubic meters, with a growth rate of 6.35%. Shown in Figure 3. The completion of D line for China - Central Asia gas pipeline will also increase the natural gas transport capacity of 30 billion cubic meters per year, The capacity of China's natural gas imports from Central Asia will be increased to 85 billion cubic meters / year.

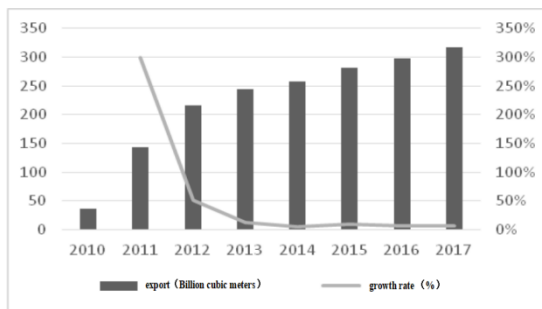


Figure 3 Natural gas trade volume and growth rate between China and Turkmenistan from 2010 to 2017

Source: 2018 BP World Energy Statistics Yearbook, United Nations Trade Database <https://resourcetrade.earth/>

4.2. *Realistic Basis*

China-Turkmenistan natural gas cooperation has several advantages. First, the history and experience of cooperation. The natural gas cooperation between the two countries has a long history and mature experience. Turkmenistan has abundant natural gas resources and also the main supplier of natural gas imports from pipelines. In the process of deepening the cooperation, it has institutional, legal, economic, cultural foundations, so it is easy to deepen the cooperation. Second, the quality advantages of natural gas in Turkmenistan. Compared with other countries in Central Asia such as Kazakhstan, Turkmenistan's natural gas is of higher quality and contains fewer harmful chemicals such as sulphur and hydrogen, which is more conducive to the improvement of the current domestic environmental situation, the smooth

implementation of atmospheric control policies and the coal-to-gas project. Turkmenistan's natural gas has become more and more popular in the transformation of domestic energy consumption structure. By September 2017, Turkmenistan has supplied 179.6 billion cubic meters of gas to China, provided sufficient clean energy for households and enterprises in China and the Hong Kong Special Administrative Region [9]. Third, price advantage and transportation cost advantage. China's natural gas imports mainly include liquefied natural gas (LNG) and pipeline (PNG) natural gas, which has a significant price advantage. China-Turkmenistan natural gas cooperation mainly adopts pipeline transportation, which reduces the transportation cost of natural gas and the total import cost. Compared with LNG transported by sea through the Strait of Malacca, it improves transportation efficiency and security stability. Both countries have the same goal of political and economic development. The diplomatic relations between the two countries have been stable and friendly for a long time. Both sides are committed to realize the national economic development strategy and goal and revitalize their own economy through cooperation. Energy is produced and exported from Turkmenistan, be imported and consumed from China, this is necessary basis for the development of national economy, which meets the strategic needs and interests of both countries. At the same time, due to the recent international tensions, China's natural gas import strategy will inevitably be adjusted, and stable natural gas cooperation between China and Turkmenistan will be received more attention and support.

The cooperation can also provide Turkmenistan with the capital, technology and equipment needed to promote the progress of its oil and gas industry, drive the rapid economic development, realize the diversification of natural gas exports, and safeguard the national interests in competition between the two countries.

4.3. *Economic Analysis*

4.3.1. *Correlation analysis between Turkmenistan natural gas exports and GDP*

It can be seen from Table 1 that the Pearson correlation coefficient between Turkmenistan's natural gas export and GDP is 0.955, indicating that there is a positive and extremely high correlation between the two. Turkmenistan has always been taking natural gas industry as the pillar industry of economic development. In 2007, Turkmenistan's natural gas rent accounted for 45.24% of GDP, about 45 percent higher than the world average, the lowest proportion in recent ten years also reached 8.24%, about 8 percent higher than the world average. In the past, Turkmenistan's exports have been blocked twice because of the natural gas crisis between Turkmenistan & Russia, and the GDP growth rate has declined significantly. In recent years, affected by the factors such as geopolitics,

the decline of international oil and gas prices and limited pipeline transportation capacity etc., Turkmenistan's natural gas export situation is not very optimistic, the GDP growth rate is in a negative situation, in 2015, the GDP growth rate became negative (-0.177%). Thus, Turkmenistan's economic development largely depends on natural gas exports. In this case the natural gas trade cooperation between Turkmenistan and China is of great significance to promote the national economic development of both sides.

Table 1 Correlation test between natural gas export and GDP of Turkmenistan

		EXPORT	GDP
EXPORT	Pearson Relevance	1	0.955**
	Significance (bilateral)		0.000
	N	10	10
	Pearson Relevance	0.955**	1
GDP	Significance (bilateral)	0.000	
	N	10	10

** : significant correlation at 0.01 level (bilateral).Data Sources: World Bank Database; ECIC database

4.3.2. Marginal utility analysis

4.3.2.1. Problem introduction, related concepts and hypothetical premises

Both importing and exporting countries are unwilling to concentrate their trade too much on one or several countries and generally adopt the development orientation of import/export diversification. We introduce the law of diminishing marginal utility to illustrate. The two countries of trade cooperation are supposed to be rational in the process of consumption, aiming at maximizing personal income. Trade can bring commodities (for importing countries) or currencies (for exporting countries), where commodities and currencies can be unified as useful commodities. For the two trading countries, the increase or decrease of import/export volume does not change much in absolute value, but because of the increase of import/export concentration, the potential market risk caused by the influence of trading partners on their import and export behavior will increase, which will lead to the decrease of the marginal revenue per unit with the increase of the volume or amount of natural gas trade.

In order to explain the problem better, we first define the concept of trade concentration (TCR), that is, the proportion of trade volume of goods or services in one industry to their total export/import volume between two trading parties over a period of time (generally one year),

indicating the extent to which the importing or exporting country is restricted by the cooperating party, cooperating party's monopoly or influence of the market. Secondly, the concept of trade marginal utility (TMU), that is, the sum of profit for each unit of trade volume added by both sides in the trade process, can be divided into negative trade marginal utility (NTMU) and positive trade marginal utility (PTMU). Generally speaking, trade marginal utility is positive, otherwise it loses the value of trade.

The following analysis is based on three hypotheses: ① the positive trade utility is constant, it will not be changed by other factors.② the trade risk or potential risk of high trade concentration is greater than that of low trade concentration, which leads to high trade cost or potential cost; ③the negative trade marginal utility (NTMU) will increase with the increase of international trade concentration (ITCR), and this will lead to an accelerated reduction in trade utility.

4.3.2.2. Theoretical analysis

For exporting country, the increase of export trade concentration will increase the extent of export trade by which restricted or affected by importing country, this will inevitably cause the exporting countries' worry and sense of crisis. For example, in order to achieve its geopolitical purpose, Russia tries to monopolize the energy export of Turkmenistan in the form of controlling its energy export, which causes the resistance of Turkmenistan, and then urges Turkmenistan to actively seek the direction and road of diversification of energy export [10]. The reason is that there is a potential risk to Turkmenistan in the process of increasing export trade concentration, and the risk will increase with the increase of trade volume. This risk increases the potential cost of Turkmenistan to maintain the same terms of export trade as low import trade concentration. That is to say, the increase of Turkmenistan natural gas exports to Russia will lead to export concentration. As a result, the negative marginal utility of natural gas trade increases, which generally leads to the decline of the marginal utility of natural gas trade.

4.3.2.3. New problems and explanations of deepening trade cooperation

According to the above explanation are there any further cooperation space between the two countries? Whether the scale of trade need to be controlled? What are the ways to deepen the cooperation? According to the above analysis the marginal utility of trade decreases with the increase of trade concentration. Here, if we want to promote in-depth cooperation in international trade with high trade concentration, we need to improve the positive marginal utility of trade. For China and Turkmenistan, first, the marginal cost of international trade may decrease with the deepening of trade. Generally speaking, international trade cooperation will have higher negotiation and

transportation costs in the early stage. Once trade begins, these higher costs in the early stage will be decreased with decreasing marginal negotiation and transportation costs thorough the deepening trade, which in turn reduces the marginal cost of trade. The second is that both sides increase the utilization efficiency of marginal utility of trade due to the improvement of technical level or social productivity, thus increasing the relative value of marginal positive utility of trade.

4.3.2.4. Potential foundation for deepening China-Turkmenistan natural gas trade cooperation

From the perspective of natural gas trade volume, the cooperation between China and Turkmenistan has reached a high level of trade concentration. Under such a circumstance, are there still any cooperation possibility for the two sides? We can consider from following aspects specifically: Firstly, the increase of Turkmenistan's natural gas production level will reduce the concentration of natural gas export trade to China. According to the <Outline for the Development of Turkmenistan's Oil and Gas Industry before 2030>, Turkmenistan's annual natural gas production will reach about 175 billion cubic meters by 2020 and 230 billion cubic meters by 2030. Even when China-Central Asia natural gas pipeline D is ventilated and the transportation capacity of natural gas exports increases to 85 billion cubic meters, the trade concentration of Turkmenistan's natural gas exports to China will decrease relative to the current level, which will reduce the marginal negative effects of trade. Secondly, the marginal cost of natural gas trade will gradually decrease with the increase of trade volume, including the prenegotiation agreement and transportation costs, firstly by increasing the positive marginal trade utility through reducing the negotiation agreement costs with Russia, the United States and Europe, and then increase the marginal utility of trade. Then, with the implementation of "Belt and Road" initiative and the maturation of two country's energy cooperation committee mechanism, the energy infrastructure will be improved, and the reduction of marginal cost can promote the increase of positive marginal utility of trade. Thirdly, the stable, huge and sustainable market consumption potential of China and even East Asia will increase the attraction and driving force of Turkmenistan natural gas exports to China, together with China's international trade cooperation based on the concept and action of "consultation, co-construction and sharing", so as to reduce the market risk of Turkmenistan natural gas exports and the marginal negative effects of export trade. Fourthly, the continuous improvement of Turkmenistan social productivity level will enable Turkmenistan to obtain more relative marginal positive effects of trade from natural gas trade. Fifthly, faced with current complex international situation, Turkmenistan's continuous export of natural gas to China can help implement its export diversification policy, provide guarantee for economic development, which will

provide more theoretical support and practical basis for trade cooperation.

5. CONCLUSION

5.1. Imbalanced Demand and Supply Will Still Exist in China, External Dependence Will Continue to Rise

Domestic natural gas supply is insufficient, and needs to rely on imports to meet market demand. The report of the Nineteenth National Congress made pollution prevention one of the three major battles to increase the demand for clean energy such as natural gas. Faced the increasing demand brought by the promotion of coal-to-gas projects and preventing the recurrence of "gas shortage", some achievements have been made in expanding natural gas production, increasing imports and encouraging the construction of natural gas infrastructure. In 2019, the domestic natural gas supply basically meets the market demand, but it is in a relatively tense state.

5.2. There is a Strong Complementarity of Natural Gas Cooperation between China and Turkmenistan

In the medium and long term, Turkmenistan's policy of focusing on the development of natural gas industry will remain unchanged. China's import-oriented policy of ensuring energy security and meeting the larger domestic demand will remain unchanged. There is a strong complementarity of natural gas cooperation between China and Turkmenistan. In addition, the two countries have a large space for cooperation in technology and infrastructure such as natural gas exploration, development, processing, transportation and so on.

5.3. The Natural Gas Trade Cooperation between China and Turkmenistan has Entered a Deep Stage of Development

Since Turkmenistan has formally exported gas to China, bilateral trade cooperation has achieved remarkable results and entered a deep stage of development. Natural gas trade has provided a lot of funds and technical support for the sustainable development of the whole industry chain of Turkmenistan natural gas industry, and has provided a continuous impetus for China's economic development. On the sixth meeting of China-Turkmenistan Sub-Committee on Energy Cooperation the two countries pointed out that China-Turkmenistan energy cooperation is mutually beneficial, and they would continue to strengthen energy cooperation and strive to broaden areas of cooperation.

They also exchanged views on cooperation in new energy, personnel training, equipment supply and other fields [11].

5.4. There is a Space for Further Development of Natural Gas Trade between the Two Countries

Turkmenistan has the basic conditions and target requirements for China's natural gas import, which is an important choice for China's natural gas trade cooperation. At the same time, China is also an ideal natural gas export and consumption market for Turkmenistan. In terms of the proportion of imports and exports, although the bilateral trade cooperation has reached a high level, the negative marginal effects of trade will increase with the increase of trade volume. But for China, the natural gas trade cooperation has greater advantages in terms of historical experience, quality, price and transportation costs, and optimization of import structure. For Turkmenistan, it has greater advantages in reducing trade costs, expanding consumer markets and maintaining stable and healthy economic development.

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REFERENCES

- [1] Y.Y. Wang and X.Y. Zhang, *International Cooperation of China's oil and Gas Resources: Reality and Path*, Social Science Literature Press, 2011.12.
- [2] X.J. Deng, "China's Natural Gas Cooperation with Turkmenistan," *International Research Reference*, vol. 2015 (08), pp. 29-33+37.
- [3] R. Wang, "Analysis of Turkmenistan's International Cooperation in Oil and Gas Resources," *Journal of Xi'an University of Petroleum (SOCIAL SCIENCE EDITION)*, vol. 24(01), pp. 54-60, 2015.
- [4] L. Zhang, *The Present Situation, Problems and Prospects of Natural Gas Cooperation between China and Turkmenistan*, Xinjiang Normal University, China.
- [5] Y.S. Zhang and S.Q. Ni, "Chen Qishen, Xing Jiayun, Qiao Shanshan, Analysis of Resource Cooperation between China and Turkmenistan Based on Geo-strategy," *Resource science*, vol. 37(05), pp. 1086-1095, 2015.
- [6] Merdan, *Research on Turkmenistan's Natural Gas Investment Environment*, Science Innovation, vol. 5(1), pp. 32-37, 2017.
- [7] L. Wang and Y. Yu, Three barrels of oil multi – "for gas", winter for spring. Available at: http://www.nea.gov.cn/2018-09/13/c_137465005.htm, September 2018.
- [8] China natural gas development report (2018), White Paper Full Text (text version). Available at: <https://baijiahao.baidu.com/s?Id=1609915756606507476>, August 2018.
- [9] L. Li, "Turkmenistan has supplied 179.6 billion cubic meters of gas to China, Amhe Natural Gas Company supplied 62.7 billion cubic meters," *China Pipeline Business Network*. Available at: <http://www.chinapipe.net/national/2017/32758.html>, August 2017.
- [10] Wang Haiyan, *Turkmenistan's Diversified Export Strategy of Natural Gas [J]*. *Continental Bridge Vision*, 2015 (12) ,pp.74-83.
- [11] The Sixth Meeting of the China-Turkmenistan Sub-Committee on Energy Cooperation was held in Ashgabat, Website of the Embassy of the People's Republic of China in Turkmenistan. Available at: <http://tm.China-embassy.org/chn/zgtx/t1609631.htm>, October 2018.