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Republic of Turkey Gas Complex Development: Problems and Prospects

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ABSTRACT

Turkey is a large, populated and dynamically developing state with growing energy demand. Yet it faces several issues concerning the development of the national energy sector, i.e., energy supply diversity and CO₂ emissions reduction. Natural gas may be a suitable kind of fuel to ensure better development for the Turkish energy sector. Moreover, Turkey plays an important role as a transit country for natural gas supplies and in the future, it can become one of the key gas hubs in the south-eastern part of Europe, as it occupies a strategically advantageous geographical position at the junction of Europe and Asia. However, the existing Turkish natural gas pipeline transmission and storage system have a relatively low capacity, insufficient for natural gas large volumes transit. In addition, natural gas supplies from Azerbaijan and Iran are not reliable enough. This paper reviews the main economic development and energy sector indicators of Turkey, along with current and future natural gas supply and transit projects. The recommendations for natural gas sector development and further energy cooperation with Russia are provided.

Keywords: Natural Gas, Turkey, Russia, Europe, Energy Supply, Energy Cooperation, Natural Gas Pipelines, Blue Stream, Turkish Stream, Trans-Anatolian Natural Gas Pipeline

JEL Classifications: Q4, Q41

1. INTRODUCTION

Turkey occupies a strategically advantageous geographical position on the crossway of Europe and Asia. The country is situated at the crossroads of key transit transcontinental routes from north to south and from east to west. The population of Turkey as of 2017 exceeds 80 million people, which is comparable with the population of Germany. At the same time, it should be noted that 1/3 of the country's population is young people under the age of 19, who is the future productive force of the state (UN, 2017). Obviously, the growth of the employable population should be provided with a sufficient number of jobs, which makes it necessary to maintain high growth rates of the Turkish economy.

Turkey is an industrial country with a dynamically developing economy. According to the World Bank, Turkey ranks 13th in the world in terms of GDP (PPP), that reached \$ 2,254 billion in 2017. At the same time, Turkey maintains positive economic growth rates for more than 20 years (Figure 1) (World Bank, n. d.). It should be noted that the pace of economic growth over the past decade is uneven, which is due to the impact of world economic crises on the economy of the country. It is worth mentioning that in 2017 the Turkish economy grew by more than 7%, which was higher than the rate of growth in China and India, primarily due to the growth of domestic demand by households (Bloomberg, 2018). Turkish economists also note that, despite high growth rates, the economy still suffers drastic inequality in incomes and welfare (Torul and Öztunali, 2018).

According to the World Bank ratings, Turkey is a country with upper-middle incomes. At the same time, since 1990, the per capita GDP of Turkey (by PPP) has grown more than 4.5 times and reached 27.9 thousand dollars in 2017 (Figure 2) (World Bank, n. d.).

In the Turkish economy, the share of industry is about 1/3, agriculture - about 10%, and the service sector accounts for more than half of the produced added value. The largest share in industrial production belongs to the manufacturing industry, the light and textile industries, the food industry, the automotive and chemical industries, in particular. In recent decades, thanks to the privatization program, the presence of the public sector in the Turkish economy has been reduced, and the state tax policy has greatly facilitated business development (World Bank, 2017).

Maintenance of economic growth rates of the Turkish Republic is impossible without the accelerated development of the national energy sector. Total primary energy supply (TPES) in Turkey has

grown more than 3.3 times since from 1990. The growth rate of energy consumption significantly decreased during the period of economic crises (1998–2001, 2008, 2013) but in recent years it has remained quite high (Figure 3) (BP, 2018).

The structure of energy consumption is dominated by fossil fuels - oil and oil products, natural gas and coal. In 2017, the share of oil and oil products in TPES was 31%, of natural gas and coal - 28, HPS - 8%, other RES - 4% (Table 1) (BP, 2017).

Turkey does not own significant hydrocarbon reserves, being a net importer of these energy resources. It is noted, that dependence on imports of oil and natural gas in Turkey is high. In Turkey, the ratio of energy uses in industry and in other industries is generally above the average of the world (Akbalik and Kavcioglu, 2013). However, coal reserves in Turkey are estimated at 11.4 billion tons, and coal extraction in 2017 reached 99.8 million tons (20.8 mtoe, more than 54% of total demand).

Figure 1: Turkey's GDP (PPP) and growth rate in 1990–2017

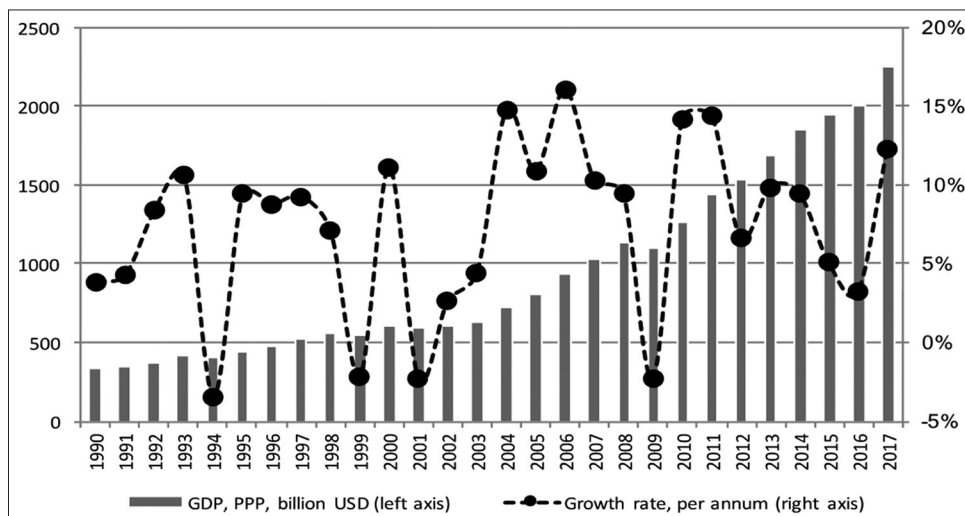


Figure 2: Turkey's per capita GDP (PPP) and growth rates in 1990–2017

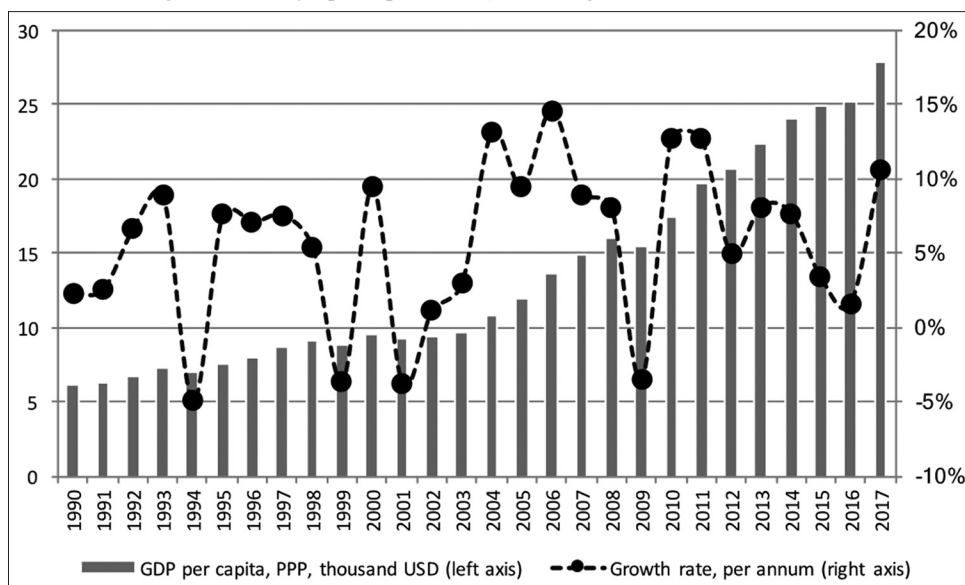
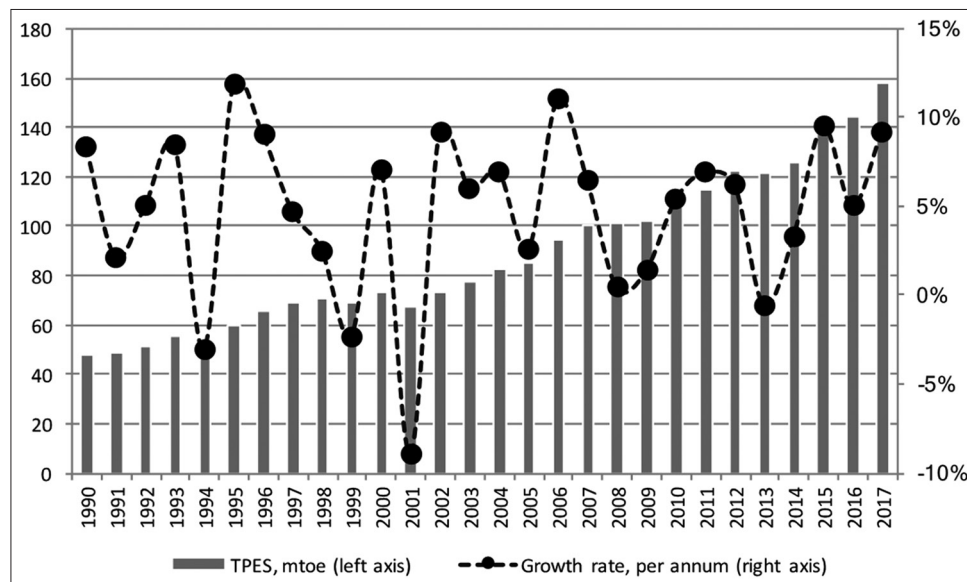


Figure 3: Total primary energy supply in Turkey from 1990 to 2017**Table 1: Structure of TPES of Turkey in 2016–2017**

Year, Unit	Oil	Natural gas	Coal	Nuclear energy	Hydroelectric	Renewables	Total
2016, mtoe	47.1	38.2	38.5	-	15.2	5.4	144.4
2016, share, %	32.7	26.5	26.6	-	10.5	3.7	100.0
2017, mtoe	48.8	44.4	44.6	-	13.2	6.6	157.7
2017, share, %	31.0	28.2	28.3	-	8.4	4.2	100.0

TPES: Total primary energy supply

It should be noted that there is a trend towards an energy intensity decrease in the Turkish economy. The use of energy per unit of added value in 2017 has slightly decreased as compared to 1990 and 2000. However, the dynamics of CO₂ emissions per unit of energy is unstable. This testifies to the need for modernization of the fuel and energy complex of Turkey, as well as rising up the share of low-carbon energy in TPES, such as natural gas, nuclear energy and renewable energy (Figure 4) (World Bank, n. d.).

There are no operating nuclear power plants in Turkey. However, the Akkuyu nuclear power plant is being constructed on the southern coast of Turkey. The station is being built according to the Russian project, which implies the consecutive commissioning of four power units with the latest VVER–1200 reactors with a total capacity of 4.8 GW. The commissioning of the first power unit is expected in 2023 (IAEA, 2018).

2. METHODS

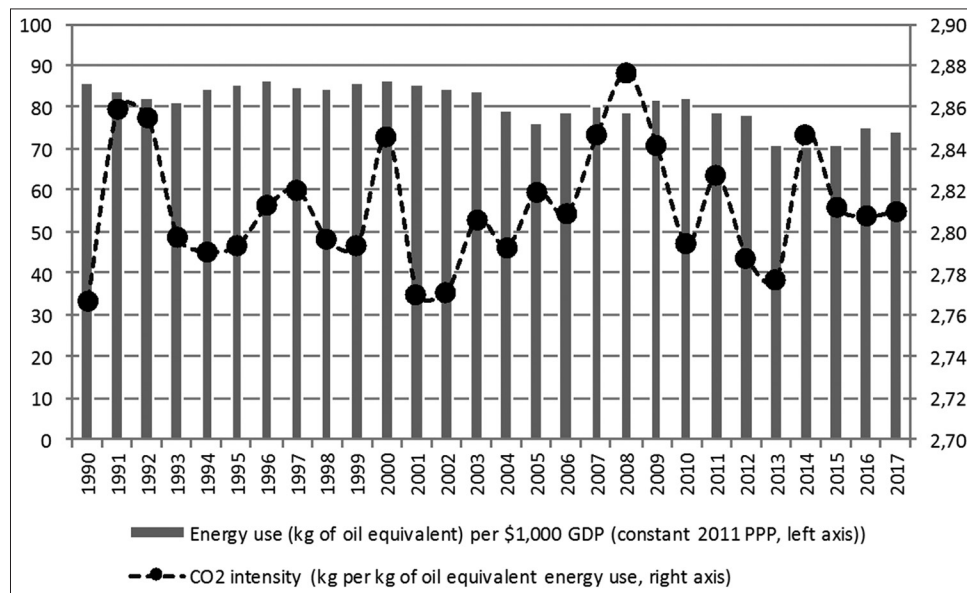
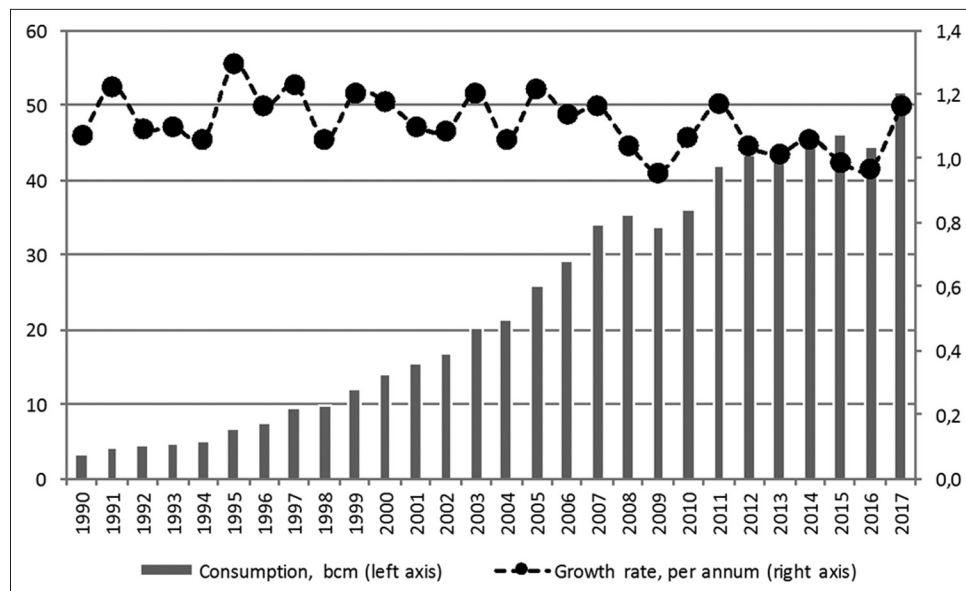
As noted above, natural gas has a significant share in the TPES of Turkey (28%). Its consumption reached 51.7 billion cubic meters in 2017, which is 4.3% higher than in 2016. In general, for 1990–2017 period natural gas consumption in Turkey has grown almost 16 times (Figure 5) (BP, 2018). At the same time, the growth rates of consumption remained generally stable at the level of 1.0–1.2% annually throughout the whole period observed.

Turkey imports natural gas from several sources: pipeline natural gas from the Russian Federation, Iran and Azerbaijan, and LNG.

Russia delivers gas to Turkey via two routes: the Blue Stream gas pipeline and the Western route. The Blue Stream natural gas pipeline is laid under the Black Sea from the Russian coast near Dzhubga (Beregovaya compressor plant) to the Turkish coast near Samsun (Durusu terminal). The gas pipeline operates from 2002 and has a capacity of 16 billion cubic meters per year. The length of the subsea section is about 400 km. In 2016, 12.9 billion cubic meters of natural gas were delivered via the Blue Stream gas pipeline, in 2017 - 15.8 billion cubic meters.

Russia also supplies gas to Turkey via the Western route that transits through the countries of Eastern Europe and as known as Trans-Balkan pipeline. Turkey receives Russian gas at the Malkoclar exit point (Bulgarian border). In 2016, the volume of supplies along the Western route reached 11.7 billion cubic meters in 2017 it reached 13.1 billion cubic meters.

Turkey imports about 20 billion cubic meters of natural gas per year from and about 15 billion cubic meters per year from Azerbaijan. The import of LNG to Turkey amounted to 7.6 billion cubic meters in 2016 and 10.1 billion cubic meters in 2017. Turkey buys LNG mainly from Algeria, Qatar and Nigeria. Deals are carried out both within the existing long-term contracts and in the spot market, especially during the seasonal maximum of prices for LNG, which leads to a significant increase in the cost of imports. There are three regasification terminals in Turkey: Marmara Ereğlisi - 22.0 million cubic meters per day, Aliaga - 24.5 million cubic meters per day, Aliaga FSRU - 14.1 million cubic meters per day. The existing capacities of the regasification terminals in

Figure 4: Energy intensity of the Turkish economy and intensity of CO₂ emissions in 1990–2017**Figure 5:** Natural gas consumption in Turkey in 1990–2017

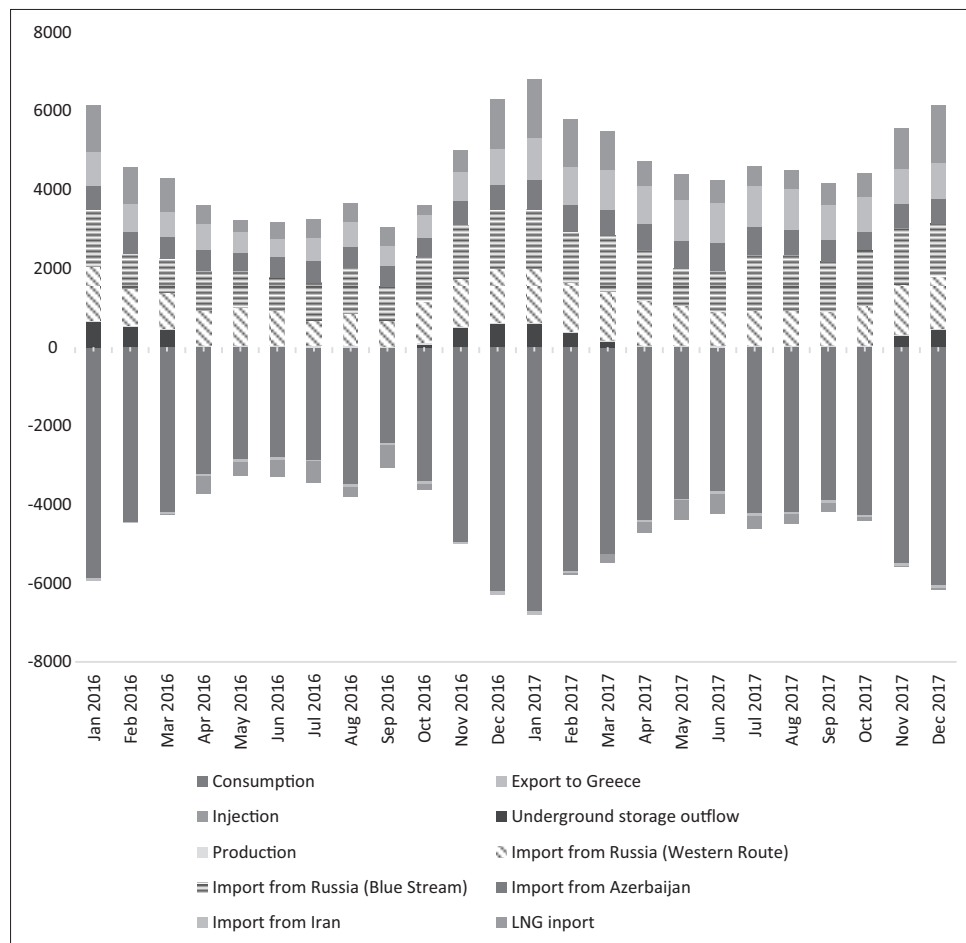
Turkey during the autumn-winter period are overloaded although in summer the load is significantly reduced. Generally, gas consumption in Turkey, and, consequently, the imports, shows a distinctly pronounced seasonality (Figure 6) (compiled from BOTAŞ, n. d.; ENTSOG Transparency Platform, n. d.; BP, 2017; Gazprom Export, n. d.).

Turkey plays an important role as a transit country for gas supplies and in the future, it can become one of the key gas hubs in the south-eastern part of Europe. However, the existing Turkish natural gas pipeline transmission system has a low capacity of not more than 250 million cubic meters per day, which is not enough for the transit of large volumes of natural gas.

At present, Turkey is a transit country for gas supplies to Europe from Azerbaijan through the system of gas pipelines in transit through Georgia. Deliveries are made through two pipelines: South

Caucasus Pipeline with a capacity of 9.0 billion cubic meters per year as well as Trans-Anatolian Natural Gas Pipeline (TANAP) with a capacity of 16 billion cubic meters per year and a length of 1807 km. TANAP was first launched in July 2018 and has not yet been put into production capacity. Both gas pipelines are laid from the Turkish-Georgian border to the Kipi entry point in Greece. At the Kipi point, the TANAP pipeline will have to connect to TAP (Trans Adriatic Pipeline) that has a capacity of 10 billion cubic meters per year and a length of 878 km. This system will transport gas from the Turkish-Greek border through Greece, Albania, along the bottom of the Adriatic Sea to Italy. The beginning of supplies to Italy through the TANAP - TAP system is expected in 2020 (Turkey approves ITGI Gas Pipeline Deal, 2017).

The construction of the TAP pipeline is scheduled to be completed in 2019–2020. The TANAP and TAP projects, together with the South Pipeline Capacity Expansion Project (by 15 billion

Figure 6: Turkey's gas balance in 2016-2017, monthly.

Source: EBRD considers \$500 mn trans-anatolian natural gas pipeline gas pipeline financing, 2017

cubic meters by 2021) will significantly increase the supply of Azerbaijani gas to Europe. At the same time, the implementation of projects aimed at increasing supplies from Azerbaijan is facing a number of problems. First of all, the long-term gas production in Azerbaijan does not correspond to the declared capacities of the pipelines. Until 2007, Azerbaijan was an importer of Russian and Central Asian natural gas, but with the Shah Deniz field launched, Azerbaijan has become a gas exporter. At the same time, in the old fields, as production is depleted, there has been a decline in supply, including the largest group of oil and gas fields Azeri-Chirag-Guneshli introduced into the development in the 1990s. At the same time, domestic consumption of gas continues to grow in Azerbaijan, and against the backdrop of the active development of gas exports, there is already a gas shortage in the domestic market of Azerbaijan (Khalova and Seferov, 2017). Obviously, in such conditions, the filling of these gas pipelines with Azerbaijani gas is a rather problematic issue.

A more promising project that allows Turkey to utilize the potential of a gas hub is the construction of the Turkish Stream gas pipeline. This is a new export pipeline from Russia to Turkey via the Black Sea. The capacity of the first line, intended for gas supplies directly to Turkish consumers, will be 15.75 billion cubic meters. The capacity of the second line, along which the gas will be delivered through the territory of Turkey to other European countries will be the same. The laying of the first line was successfully completed

in April 2018. The construction of the Turkish Stream is expected to be completed in 2018–2019.

The Poseidon gas pipeline project with a capacity of 20 billion cubic meters is intended for deliveries to Greece and Italy and is going to be connected with the Turkish Stream gas pipeline (second line). In April 2017, Turkey ratified the intergovernmental agreement on this project. In May 2017, PJSC Gazprom and Eni signed a preliminary agreement on the development of a southern route for the supply of Russian gas to Europe using the Poseidon gas pipeline and a corresponding change in the gas delivery point (World Bank, 2017). In June 2017, Gazprom, the Greek company Depa and the Italian company Edison (shareholders of the Poseidon project) signed the Cooperation Agreement on the organization of a southern route for the supply of Russian gas to Europe, which provides for the coordination of the companies' work on the implementation of the Turkish Stream project and the Poseidon project from the Turkish-Greek border to the Italian border.

To develop the potential of Turkey as a major gas hub, it is also necessary to increase the infrastructure for underground gas storage (UGS) and to increase the regasification capacity in order to boost LNG imports. Currently, the only UGS operating in Turkey is Silivri. It has a withdrawal capacity of 25 million cubic meters per day and injection capacity of 16 million cubic meters

per day. The active storage capacity of Silivri amounts to 2.6 billion cubic meters. Silivri UGS facilities are completely loaded. Given the limited capacity of its own UGS facilities, Turkey is forced to significantly increase the import of both pipeline gas (mainly from Russia) and LNG during the autumn-winter period.

3. RESULTS

In such conditions, Turkey is interested in the maximum development of the infrastructure for storage and regasification of natural gas. Currently, the following projects are being implemented to develop the infrastructure of regasification terminals (Table 2) (IAEA, 2018).

- Upgrading of the Marmara Ereğlisi terminal capacity to 13.5 billion cubic meters per year;
- Upgrading of the Aliaga terminal capacity to 14.2 billion cubic meters per year;
- Upgrading of the Aliaga FSRU terminal capacity to 7.3 billion cubic meters per year;
- The launch of a new floating Dordyol terminal with a capacity of 7.3 billion cubic meters per year (expected in 2018);
- The launch of the new Saros terminal with a capacity of 7.3 billion cubic meters per year (expected in 2018–2019).

Currently, two projects on UGS development are also underway: the construction of a Tuz Golu UGS facility and the expansion of the Silivri UGS facility (Table 3) (Argus, 2017). It is expected that the active storage capacity of Tuz Golu may reach 5.4 billion cubic meters by 2023, the injection and withdrawal capacity may amount to 60 million cubic meters per day. It is also planned to increase the active capacity of Silivri UGS to 4.6 billion cubic meters, the injection capacity may rise up to 45 million cubic meters per day and withdrawal capacity may top up to 75 million cubic meters per day.

4. DISCUSSION

The authors believe that Turkey can become the largest and most important gas hub in the South-East of Europe. At the same time, there will be opportunities to increase the volume and reliability of gas supplies both for Turkey itself and for European consumers. In addition, with the increase in transit volumes, the corresponding economic benefit for Turkey will grow. Apart from that, the growth of natural gas consumption in Turkey in exchange for coal will lead to a significant reduction in environmental impact. In addition, recent studies of Turkish economists report the high level of public interest to the problems of the energy policy of their country, as well as the climate change and environmental

protection (Ediger et al., 2018; Ozturk and Acaravci, 2013; Ulutaş, 2003). Nevertheless, in order to achieve these goals, it is necessary to solve several key tasks.

First, the current system of transport and gas storage in Turkey is not sufficiently developed and powerful. The Turkish side is taking active steps in this sector: The TANAP gas pipeline was built and put into operation, and the capacities of underground gas storage facilities are increasing. However, we believe that it is possible to ensure a more intensive and successful increase in the capacity of the Turkish gas transportation sector. For this, it is necessary to involve Russian technological and construction companies into the modernisation of the infrastructure of Turkey. Taking into account Russian companies' considerable experience, their high competencies and powerful engineering and technological base, they could provide substantial support and increase the efficiency of implementing infrastructure projects in the gas sector of Turkey.

In addition, as mentioned earlier, there are risks of a shortage of natural gas from Azerbaijan. In this case, we consider it possible and advisable to use more Russian gas for supplies to Turkey and Europe via all available and potential gas pipelines. The Turkish Stream project will play a crucial role in this task. We also believe that it is yet necessary to start considering the possibilities for further increase of export capacities to Turkey. It is worth noting that, at the request of the Turkish side in certain periods, the daily volumes supplied by the Blue Stream gas pipeline correspond to its maximum design capacity. This is due to the fact that Turkey is facing non-fulfillment of obligations on deliveries from Iran and Azerbaijan, and the Russian company PJSC Gazprom, in meeting the interest of Turkish counterparts, compensates for these shortages. Gazprom is also able to cover the peak demand growth in Turkey, which is associated with cold temperatures regularly observed there. Thus, further expansion of export capacities from Russia to Turkey is desirable for both sides.

5. CONCLUSIONS

The main conclusions of this review are as follows. Turkey is a large and dynamically developing state that has a strategically advantageous geographical position. High rates of economic growth in Turkey require an increase in energy consumption. At the same time, it is important to reduce CO₂ emissions and reduce environmental damage. In this situation, natural gas is the most preferred energy carrier. Today, natural gas accounts for about 1/3 of Turkey's TPES, about the same amount as for coal and oil.

Russia provides about 60% of Turkey's natural gas needs. Turkey imports gas from Russia via the Blue Stream gas pipeline and the Western route. Deliveries of pipeline gas to Turkey are also carried out from Iran and Azerbaijan.

Turkey has a significant potential for both growth in natural gas consumption and for becoming a major transit gas hub in the southeast of Europe. This is facilitated by the implementation of a number of major infrastructure projects in the gas sector: the construction of Turkish Stream gas pipeline, the construction and commissioning of the TANAP gas pipeline and the TAP project,

Table 2: Prospects for the development of gasification infrastructure in Turkey

Terminal	2017	2018	2019	2020	2021	2022	2023
Marmara Ereğlisi LNG	8.0	13.5	13.5	13.5	13.5	13.5	13.5
Aliaga LNG	8.9	11.3	11.3	11.3	14.2	14.2	14.2
Aliaga FSRU	5.1	7.3	7.3	7.3	7.3	7.3	7.3
Saros FSRU	0.0	7.3	7.3	7.3	7.3	7.3	7.3
Dordyol FSRU	0.0	7.3	7.3	7.3	7.3	7.3	7.3

Source: Turkey to boost gas entry capacity, 2017

Table 3: Perspectives of UGS development in Turkey

Parameters	2017	2018	2019	2020	2021	2022	2023
Tuz Golu							
Active storage capacity, billion cubic meters	0.3	0.6	0.6	0.9	2.2	3.4	5.4
Injection capacity, million cubic meters per day	15.0	30.0	30.0	30.0	60.0	60.0	60.0
Withdrawal capacity, million cubic meters per day	13.0	20.0	20.0	30.0	60.0	60.0	60.0
Silivri							
Active storage capacity, billion cubic meters	2.8	2.8	2.8	2.8	3.3	3.8	4.6
Injection capacity, million cubic meters per day	16.0	16.0	16.0	45.0	45.0	45.0	45.0
Withdrawal capacity, million cubic meters per day	25.0	25.0	25.0	50.0	75.0	75.0	75.0

Source: Turkey's BOTAS to boost gas storage capacity, 2017. UGS: Underground gas storage

the GTS and UGS facilities expansion in Turkey. However, the prospects of supplying significant volumes of gas from Azerbaijan are characterized by a high level of uncertainty. In this regard, we believe that the main direction of the development of the gas industry in Turkey can be strengthening of cooperation with Russian companies.

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