

# The role of the gas industry in the energy of the countries of Central Asia and Caspian region

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**Abstract.** The article provides an analysis of the energy sector of the countries in the region, identifying the current and prospective role of the gas industry within it.

## 1 Introduction

Central Asia and the Caspian region are significant both from an economic and strategic standpoint, particularly for Russia. The region holds substantial natural gas reserves, which largely determine the significant role of this fuel in the energy balances of most countries. Gas accounts for 65% of the total energy consumption in the region. Russia is actively trying to integrate with its old neighbors into a single economic space (Eurasian Economic Union, EAEU). Turkmenistan, Azerbaijan, Kazakhstan, Uzbekistan and Iran - all of them have significant hydrocarbon reserves (primarily natural gas), which has led to increased interest in importing from these countries to China and the European market over the past decade. In recent years, the situation has been changing: there have been disruptions in export deliveries from Kazakhstan, a decline in Turkmen gas exports to China during the heating season. In Uzbekistan, there has even been a shortage of gas to meet its own demand in the winter of 2022-2023. Azerbaijan's new projects aimed at the European market are becoming increasingly costly. In this situation, it is critically important for Russia to understand whether the Central Asian countries will be a serious competitor in the gas market in China in the near future, or a potential sales market.

## 2 The Role of Gas in the Energy Sector of the Region at Present

The combined proved reserves of gas in the considered countries, according to the Statistical Review of World Energy 2023 [1], amounted to 51.3 trillion cubic meters. However, the situation regarding gas demand and supply is heterogeneous among countries.

In Kazakhstan, the gas demand is around 46 billion cubic meters, covering over 40% of the primary energy demand. Notably, nearly half of the gas demand comes from the oil industry, used for gas injection and enhanced oil recovery (EOR) on oil fields. Another 7.1 billion cubic meters of gas are used for power generation, while the demand from end consumers is only 7.2 billion cubic meters. The country's future gas consumption depends

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on factors such as oil production levels, transition from coal to gas-based generation, and the pace of gasification. Regarding self-sufficiency, Kazakhstan produces 54 billion cubic meters of gross gas [2], with 30 billion cubic meters being marketable. The country imports 6 billion cubic meters and exports 16 billion cubic meters.

In Uzbekistan, gas covers 70-85% of the energy demand and is actively used in both power generation and by end consumers. For a long time, Uzbekistan relied on gas as a key fuel to drive its economy, even building a powerful GTL plant and promoting gas-powered transportation. However, in recent years, the country has faced accelerated depletion of reserves and transitioned from gas export to import in 2022.

Azerbaijan relies on gas for 66% of its primary energy consumption, with half of this being used in the power generation sector. The country is a net gas exporter, selling nearly 60% of its total gas production.

In Turkmenistan, gas serves as the primary energy source, accounting for 73% of the overall energy consumption. The country produces 78 billion cubic meters of gas, of which 40 billion are exported.

In Iran, gas also plays a pivotal role in the energy balance, covering almost 70% of the primary energy consumption, with nearly a third used in the power generation sector. Notably, despite having Caspian Sea reserves, Iran refrains from extracting gas due to project costs and the unsettled Caspian status. The main field from which the country meets the demand for gas is located in the south of the country - the South Pars field. This feature affects the country energy balance. To meet gas demand in the northern provinces, where transport infrastructure is limited and there's a constant terrorist threat, Iran must engage in swap operations, importing fuel from Turkmenistan and exporting gas to Azerbaijan.

### **3 Prospects for Gas Consumption Changes**

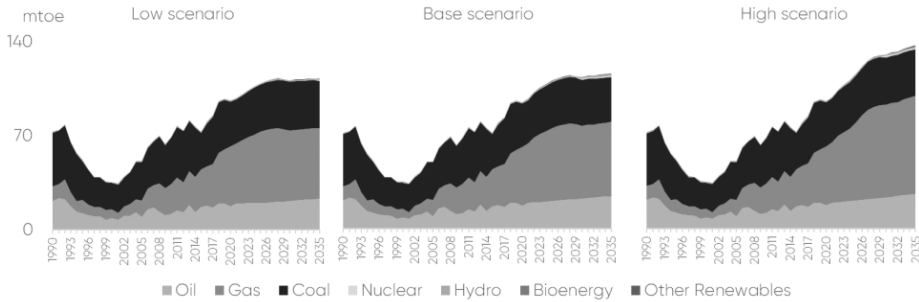
To determine the role of gas in the energy sectors of countries in the long-term perspective, a modeling complex called SCANNER was employed to construct long-term predictive fuel and energy balances for each country, considering changes in projected economic and demographic indicators, and the development characteristics of the fuel and energy complex and energy policies of the countries [3] [4] [5].

Three scenarios were developed during the process, representing different of population growth rates, economic growth rates, and energy intensity. UN population forecasts were used as demographic assumptions [6]. In the High scenario, the highest GDP growth rate was assumed, based on the achievement of national plans and strategies, and it was also assumed that a significant portion of reserves would be successfully explored and confirmed. The Base scenario assumed a natural deceleration of economic growth, with countries developing in the same direction as at present, and energy intensity and per capita energy consumption decreasing in accordance with natural trends. The Low scenario projected a significant slowdown in economic growth and, in terms of extraction projects, assumed production only from existing or new projects that already had accepted investment decisions.

For Kazakhstan, GDP growth rates ranged from 2.3% to 3.2% for 2020-2035, which are below retrospective growth rates. Considering our GDP forecast and population assumptions from the UN, a forecast of primary energy consumption was developed until 2035. Depending on the scenario, energy consumption levels in Kazakhstan are projected to be between 113 to 139 million tons of oil equivalent (mtoe) by 2035.

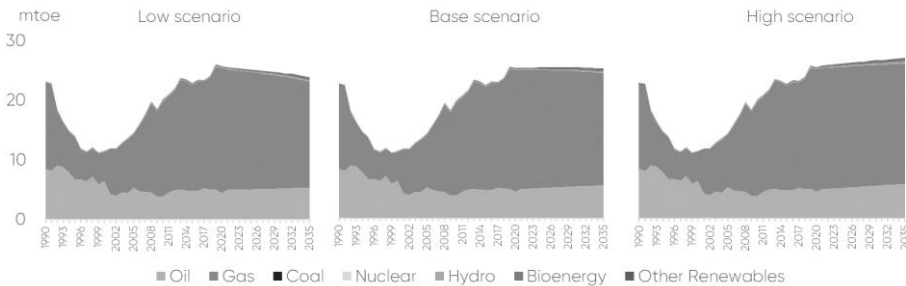
The country plans to introduce nuclear power capacity from 2030, which would contribute to 0.9 mtoe of energy demand in Base and High scenarios. In the Low scenario, capacity is assumed to be introduced no earlier than 2035. In terms of renewable energy development, the hydroelectric potential would contribute around 1 mtoe of energy

demand. In Base and High scenarios, there's partial implementation of the Republic's plans for renewable energy integration into generation. However, in the Low scenario, renewables would develop at significantly slower rates, losing out to traditional fuel sources. It's worth noting that a significant portion of the forecasted energy consumption is attributed to gas due to substantial gas reinjection. In the High scenario, projected oil production projects lead to increased gas demand, thus contributing to overall energy consumption growth. The calculation results are shown in Figure 1.



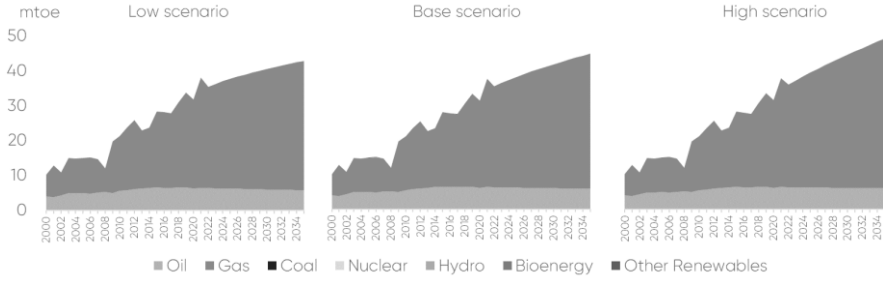
**Fig.1.** Forecast of primary energy demand in Kazakhstan until 2035.

For Azerbaijan, in the Base scenario, GDP growth rates are expected to be 1.6% for 2020-2035. In the High scenario, considering the country's long-term strategy goals until 2025, growth rates are projected at 2% over the forecast period. In the Low scenario, GDP growth rates would be 1.2%, assuming lower volumes of oil and gas extraction. Since the oil and gas complex contributes up to 38% of GDP, this would significantly impact the economy and energy consumption forecast. Total energy consumption levels, depending on the scenario, will be between 23 to 28 mtoe, with gas accounting for no less than 72% in all scenarios. The calculation results are shown in Figure 1.



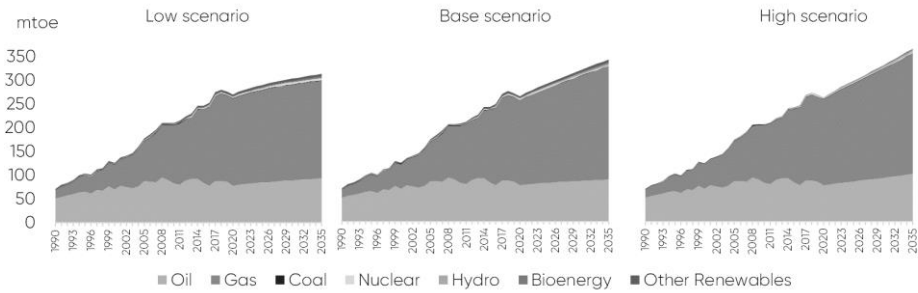
**Fig.2.** Forecast of primary energy demand in Azerbaijan until 2035.

For Turkmenistan, projected GDP growth rates ranged from 3.4% to 5% for 2020-2035. Considering calculated GDP, energy consumption levels depending on the scenario were forecasted to be between 29 to 37 mtoe. Turkmenistan's energy balance primarily comprises two types of fuel – oil and gas, with gas taking the majority share, ranging from 80% in 2020 to 87-88% in 2035.



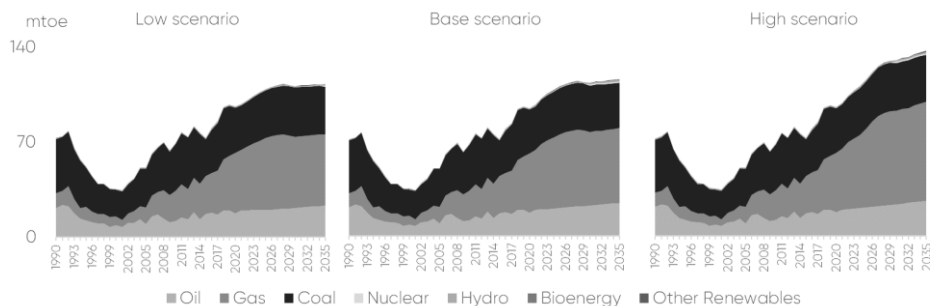
**Fig.3.** Forecast of primary energy demand in Turkmenistan until 2035.

For Iran, GDP growth rates are expected to range from 1.1% in the Low scenario to 2.3% in the High scenario. No radical changes in the energy balance structure are anticipated in any scenario, with natural gas remaining the key fuel. The highest gas demand is projected in the High scenario, which involves active economic development, new extraction projects, and increased exports. Total energy consumption would reach 378 mtoe in this scenario, with gas consumption reaching 317 billion cubic meters by 2035. Forecasting gas demand in Iran is uncertain due to sanctions pressure, which may or may not ease.



**Fig.4.** Forecast of primary energy demand in Iran until 2035.

For Uzbekistan, no stable relationships were found between economic and demographic indicators and primary energy consumption levels. Thus, a trend extrapolation method was employed to predict primary energy consumption, while also considering the country's national energy policy. In all three scenarios, gas remains the leading fuel throughout the forecast period. In Base and High scenarios, the introduction of nuclear power units and active renewable energy development are anticipated. In the Low scenario, economic development levels would prevent the introduction of nuclear power plants within the forecast period and limit the growth of renewable energy capacities. In all scenarios, the share of consumed coal increases, primarily driven by the power sector.



**Fig.5.** Forecast of primary energy demand in Uzbekistan until 2035.

## 4 Gas Supply: Resources and Limitations

The available gas resources largely determine the directions for the future development of the energy sector in the considered countries.

Iran ranks second in the world (after Russia) in proven gas reserves; however, its extraction potential is constrained by geopolitical factors. The country has been under sanctions for many years, restricting the export of pipeline gas to European countries (while neighboring Central Asian and Caspian countries largely meet their own needs). Furthermore, exporting gas to other markets requires access to LNG (liquefied natural gas) technologies, which Iran has been unable to acquire due to imposed sanctions.

In the Low Scenario, it is anticipated that extraction will grow at the rate of internal consumption growth, as trade restrictions remain in place. In the Base Scenario, a partial unlocking of Iran's LNG potential is expected through partnerships with Chinese companies (which currently lack large-scale LNG technology), leading to gas extraction reaching 339 billion cubic meters. In the High Scenario, the removal of nearly all restrictions enables additional LNG capacities, allowing gas exports to reach 120 billion cubic meters by 2035.

Turkmenistan has a significant uncertainty regarding its largest gas structure, Galkynysh. The field has not received a recognized international reserves audit, and available estimates of the country's resource base range from 10 to 50 trillion cubic meters. [7][8][9]. In the Low Scenario, it is assumed that the country will continue production at existing capacities without increasing reserves, resulting in a production of 75 billion cubic meters by 2035. Internal consumption will amount to 43 billion cubic meters, with the remaining volume earmarked for export. The Base Scenario assumes the development of Galkynysh's Phase 2, achieving a production level of 95 billion cubic meters by 2035, with exports reaching 49 billion cubic meters. The High Scenario envisions a gradual implementation of three phases of Galkynysh, coupled with offshore block extraction, boosting production to 125 billion cubic meters.

Azerbaijan's resource base is primarily represented by deepwater fields developed in partnership with Western companies by the national oil company SOCAR. The projects involved in the development will be enough for sustainable growth and maintenance of production for the period up to 2030, but then, in order to maintain the shelf of production, the commissioning of expensive ultra-deepwater projects will be necessary. The only monetization direction for these reserves is Europe, where all scenarios anticipate a general decrease in gas demand.

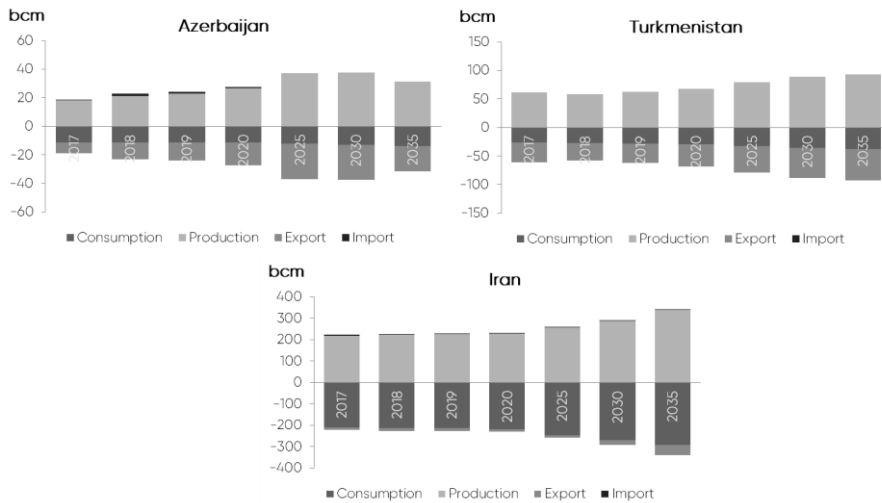
Uzbekistan and Kazakhstan have faced constraints due to rapid demand growth and limited extraction capacities, reaching a point where gas shortages are becoming evident, especially during winter periods.

In Uzbekistan, as in Turkmenistan, there is high uncertainty about the overall level of reserves. Current estimates vary between 0.8 and 1.86 trillion cubic meters. Uzbekistan's extraction has steadily declined in recent years, failing to cover its domestic demand and contractual obligations to China. There are opportunities to increase extraction capacity, primarily linked to the exploration of the Ustyurt oil and gas region.

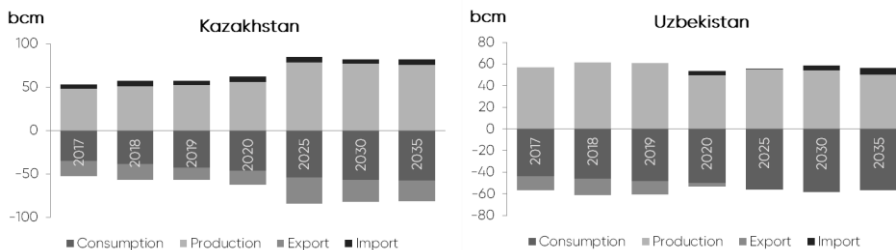
In the Low Scenario, only existing reserves are considered, while the High Scenario assumes the inclusion of all explored deposits. However, these would involve deep deposits with low-quality gas (high sulfur and CO<sub>2</sub> content), resulting in significantly higher extraction costs and bringing it to marketable condition costs to the current production in the Republic of Uzbekistan. The Base Scenario falls between the previous two scenarios.

In Kazakhstan, as mentioned earlier, the gas industry's situation is closely connected to decisions in the oil sector, affecting both gas demand and supply. The Low Scenario assumes the lowest oil demand due to slow global GDP growth, reducing the need for gas re-injection and freeing up production capacities for commercial gas. However, the global gas demand remains low, causing commercial gas production to rise until 2025, after which it starts decreasing. The High Scenario, based on high global oil demand, envisions Kazakhstan maximizing the extraction of liquid hydrocarbons. As a result, considering limited resource capacities, commercial gas production will start decreasing by 2025. The Base Scenario falls in between these two extremes.

Figures 6 and 7 present projected gas balances for Central Asian and Caucasus countries, considering the gas demand stated in the article and calculated gas extraction volumes.



**Fig. 6.** Natural gas balances forecast of Azerbaijan, Iran and Turkmenistan, bcm.



**Fig. 7.** Natural gas balances forecast of Kazakhstan and Uzbekistan, bcm.

## 5 Conclusions

Regarding the prospective role of gas in the energy balance of the region, it can be confidently stated that gas will remain the basis of energy supply for all countries. However, the prerequisites for diversifying the energy consumption structure are being created across all nations. Furthermore, there is room for a range of alternatives, including hydroelectric power, solar and wind energy, nuclear power plants, and coal. For Kazakhstan and Uzbekistan, a central premise lies in the strained gas balance and the low self-sufficiency in meeting future demand through domestic production. These countries are facing the end of the era of self-supplied cheap gas. For Russia, Uzbekistan has already become a new sales market (although currently supplies are carried out in small volumes), while calculations show that there is potential for increasing supplies. In the case of Kazakhstan, the likelihood of it becoming a new sales market for Russian gas is less, which, in the case of requests for supplies of Russian gas, requires an even more careful approach to the price terms of contracts, due to the threat of “re-export” of Russian gas to China. At the same time, Kazakhstan may be interesting as a transit link for supplies to China, especially in the absence of decisions on “Power of Siberia -2”.

Iran, Turkmenistan, and Azerbaijan retain good export potential in the foreseeable future. Yet, precisely this potential acts as an incentive to balance other fuels in order to free up additional gas volumes for export. It is important to consider that for Iran, sanctions, access to external financing, and technology availability remain the main limitations to realizing its export potential. Turkmenistan faces uncertainty in confirming its reserves and its ability to develop complex fields to increase gas production. At the same time, Turkmenistan is seen as Russia’s main competitor, both in the Chinese market and in the markets of Uzbekistan and Kazakhstan, and bilateral contracts are important here in order to prevent mutual dumping between Russia and Turkmenistan. Azerbaijan's export capabilities are fairly well understood within the framework of ongoing projects, and new capabilities will be determined by the successes of further geological surveys and demand in the European market. At the same time, it is important to take into account that Azerbaijani gas enters Europe through Turkey, where Russia plans to increase supplies and organize a “Turkish hub”, which, including due to the increase in supplies from Azerbaijan, will be oversupplied. This means that prices there will be low and it providing a motive for starting the negotiation process due to the prevention of similar situations.

A separate issue is the creation of a new architecture for a unified energy system among the region's countries, where all elements must complement each other. Gas can play an important balancing role in this context. Shortages in balancing, especially during the winter period, underscore the need for mutual gas purchases and coordination of gas deliveries between the countries of the region. This is crucial for supplying specific regions of countries that are distant from key production centers. For instance, Iran is interested in gas supply from Turkmenistan to its northern regions.

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