

New challenges for Uzbekistan's energy sector and the role of the gas industry

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Abstract. This article raises an important problem for the Republic of Uzbekistan of the shortage of energy resources caused by the depletion of proven reserves of natural gas, which is the basis of the country's energy balance. Within the scope of this study, utilizing the methodology developed by the Energy Research Institute of the Russian Academy of Sciences for forecasting fuel and energy balances, a projection of primary energy demand in the Republic of Uzbekistan until 2030 has been calculated. This projection is detailed by fuel types. Based on the obtained results, the requirement for natural gas until 2030 has been determined. Furthermore, using data on proven natural gas reserves, a projection of production capacities has been calculated. As a result, a set of measures has been proposed aimed at reducing risks associated with the energy security of the Republic of Uzbekistan.

1 Introduction

Since the dissolution of the USSR, the Republic of Uzbekistan has continued to build its energy policy with a focus on natural gas. This has been facilitated by large gas reserves discovered during Soviet times and relatively low extraction costs. Over the last 30 years, the share of natural gas in the primary energy consumption structure has not dropped below 70%, reaching its peak at 85% in 2020 [1]. The absence of significant oil and coal reserves has further increased the demand for natural gas, including in the transportation sector, due to fuel switching. Compressed natural gas has become a viable alternative to expensive oil product imports, especially given the rapid growth of the vehicle fleet. Only during a period 2018-2021, gas consumption in the transportation sector grew by 1.4 times, reaching a 10% share in final consumption. The slow pace of renewable energy capacity additions (which were costly 10-20 years ago), the lack of nuclear power plants, and challenges in expanding hydroelectric power, primarily due to seasonal water resource deficits in countries upstream of the rivers, have contributed to the growing demand for natural gas.

In addition to the increasing domestic consumption of natural gas, the high extraction volume allowed for monetizing the surplus through exports, primarily to China, partially subsidizing prices for domestic consumers. However, low gas prices within the country, coupled with continuously rising demand and high levels of non-payment for gas and

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electricity, led to growing losses in domestic supply. When export deliveries began to decrease, the economic situation in the gas sector significantly worsened. These factors have had a negative impact on investment volumes in geological exploration. As a result, over the past decade, natural gas reserves have been depleting rapidly, leading to a decline in production. The culmination of this situation was the long-anticipated energy crisis.

The abnormal cold weather experienced in the Central Asian region during the winter of 2022-2023 demonstrated the high degree of instability in the energy system of the Republic of Uzbekistan. The production levels, which used to be sufficient to meet demand during a typical winter in the region, fell short of covering the peaks caused by climate changes. For two weeks, residents of major cities in the country were left without electricity and heating, and all gas stations were closed. The majority of industrial enterprises had to halt their operations. According to the statement from the Ministry of Energy of Uzbekistan, the gas deficit during the winter period reached 20 million cubic meters per day [2]. The situation was further exacerbated by an incident at the Galkynysh gas field in neighbouring Turkmenistan, which led to the halt of gas exports to Uzbekistan.

Given the energy crisis experienced in the country, a critically important question today is to prevent the repetition and worsening of the situation witnessed during the winter of 2022-2023. To achieve this, it is necessary to understand how the demand for primary energy will change in the medium and long term, to what extent the country can meet this demand using its own resources, and from which sources the deficit can be covered if necessary.

2 Forecasting Energy Demand in Uzbekistan until 2030

As noted earlier, understanding the dynamics of demand is essential for mitigating risks associated with an energy crisis. In this research, a forecast of primary energy demand in the Republic of Uzbekistan until 2030 was calculated. The forecasting methodology for energy balance was developed by the Energy Research Institute of the Russian Academy of Sciences (ERI RAS), considering economic-demographic indicators and energy policy, which is extensively described in the organization's publications [3,4].

Traditional primary energy consumption forecasting approach involves extrapolating long-term sustainable trends that reflect the interdependence between key economic-demographic indicators (GDP volume and population size) and energy consumption volumes in retrospect. The relationship between primary energy consumption and the economy is characterized by the energy intensity of GDP – the ratio of consumed energy resources to GDP. The connection between energy consumption and population – the indicator of per capita energy consumption – is the ratio of consumed primary energy to the population.

However, Uzbekistan doesn't exhibit stable relationships between GDP and energy consumption, nor between primary energy consumption and population. Consequently, energy consumption levels for Uzbekistan were determined by extrapolating retrospective values of primary energy consumption, with the selection of a trend type (linear, logarithmic, exponential) that reflects the current energy policy of the country, while maintaining a significant approximation accuracy (above 0.8).

According to the calculations, the demand for primary energy in Uzbekistan is expected to increase by 8 million tons of oil equivalent (Mtoe) by 2030 compared to 2022, reaching a total of 56 Mtoe. The calculation results are shown in Figure 1.

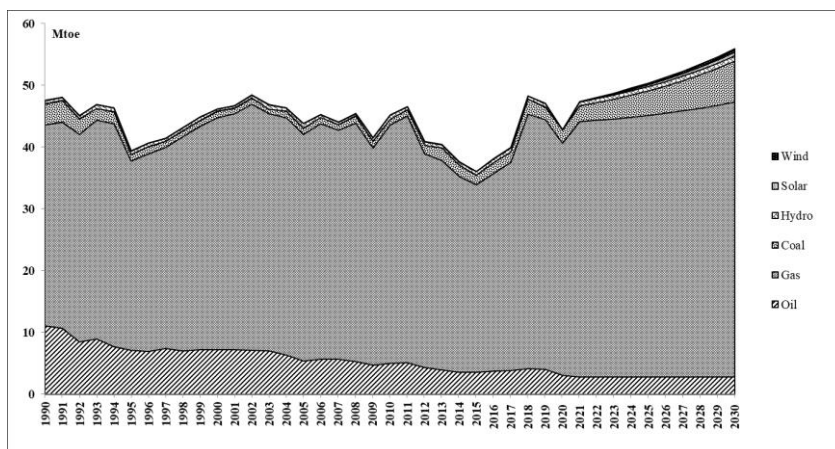


Fig.1. Forecast of primary energy demand in Uzbekistan until 2030.

In 2030 natural gas demand is forecasted to be at 45 Mtoe, accounting for 79% of the total primary energy demand. The continued transition to compressed natural gas due to the depletion of existing oil fields, increasing demand for electricity where a swift transition from gas to alternative fuels isn't feasible, and the growth of urban population with access to central gas supply in households contribute significantly to the gas demand.

Coal demand is expected to almost triple over the forecasted period, with its share in the primary energy consumption structure increasing from 6% in 2022 to 12% in 2030. One of the strategies to mitigate the risks associated with natural gas deficit, as seen by the Uzbekistan government, is to shift certain industrial facilities and local heating systems in the social sector to coal fuel [5]. Therefore, there is a substantial expected growth in coal demand that will compensate for the decrease in gas consumption in the medium term.

As part of the country's renewable energy policy, Uzbekistan plans to commission 4,300 MW of solar and wind power generation by 2030. This research assumes that all planned projects will be implemented on schedule, resulting in 1.2 Mtoe of renewable energy production in 2030. Additionally, the construction of new small and micro-hydroelectric power stations is planned.

In February 2019, Uzbekistan approved the Concept for the Development of Nuclear Energy in the Republic of Uzbekistan for the period 2019-2029, which aimed to construct and commission a nuclear power plant with a total capacity of 2.4 GW by 2030 [6]. The construction was supposed to start in 2022, with the first energy block of 1.2 GW operational by 2028. However, as of 2023, there is no information available regarding the start of construction. In this context, considering the construction timeline of the nuclear power plant (NPP), the possibility of commissioning the first energy block by 2030 is not being regarded as realistic.

Given the fact that natural gas is expected to continue dominating the primary energy consumption structure in 2030, the question of self-sufficiency in natural gas remains highly relevant. Therefore, it is necessary to assess Uzbekistan's resource base and forecast extraction capacities until 2030.

3 Extraction Capacities in Uzbekistan

The Republic of Uzbekistan is the second-largest natural gas producer in the region after Turkmenistan. The natural gas extraction in the country reached 48.9 Bcm in 2022, decreasing by 4% compared to 2021. The extraction has been declining over the last 10

years due to the absence of major new discoveries and the depletion of existing deposits (some fields in Uzbekistan have reached a depletion level of up to 90%).

Data on proven gas reserves in Uzbekistan are characterized by high uncertainty due to the lack of publicly available information on the replenishment dynamics of the mineral-resource base. Representatives of the Ministry of Energy claim that proven reserves in the country stand at around 1.86 trillion cubic meters [7], without specifying the assessment methodology. However, according to the Energy Institute Statistical Review of World Energy 2023, proven natural gas reserves in Uzbekistan do not exceed 0.8 trillion cubic meters. According to calculations by the Energy Research Institute of the Russian Academy of Sciences, based on available project information and proven reserves, the remaining proven natural gas reserves (category A+B+C1) at the end of 2022 at the level of 1 trillion cubic meters. All estimates for proven reserves of natural gas are shown in Figure 2.

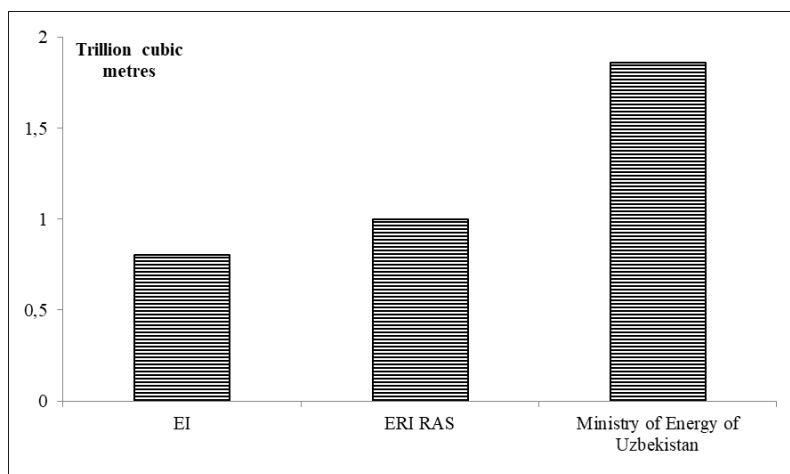


Fig. 2. Proven natural gas reserves in Uzbekistan based on various estimates, trillion cubic meters.

Uzbekistan can be divided into five oil and gas regions (in decreasing order of proven natural gas reserves):

1. Bukhara-Khiva region.
2. Ustyurt region.
3. Southwestern Gissar region.
4. Surkhandarya region.
5. Fergana region (for oil extraction).

The Bukhara-Khiva region is the most geologically explored oil and gas region, with natural gas extraction dating back to the mid-1950s. It's characterized by large mature fields that account for a significant portion of modern Uzbekistan's gas production. The remaining proven gas reserves in the Bukhara-Khiva region were estimated at around 0.5 trillion cubic meters at the beginning of 2023 [8], with 90% of this total coming from 10 fields developed by the national company Uzbekneftegaz, supplying 40% of Uzbekistan's gas production, and the "Kandym-Khauzak-Shady" license area of the LUKOIL Uzbekistan Operating Company, a subsidiary of PJSC LUKOIL.

The Ustyurt region holds the main hopes for increasing proven gas reserves in Uzbekistan. In 2004, following a joint geological-geographical study by the national company "Uzbekneftegaz" and British "Jebco Seismic Ltd," the total gas resources were estimated at 1.7 trillion cubic meters, of which only 395.6 billion cubic meters have been placed on the balance sheet so far. The distinguishing feature of the region's fields is their depth, with most resources located at depths exceeding 6,000 meters, making their development more expensive compared to the already operational productive areas. As of

2023, the Ustyurt region is engaged in extensive digital modelling and design work for drilling up to 6.5 km deep in areas such as Garbiy Kuyi Surgil, Kuyi Sharkiy Berdakh, Kelazhak, Aspantai, and Arslon [9].

The only significant field in the Surkhandarya region is the "25 Years of Independence," which is being developed based on the Production Sharing Agreement "Surhan Gas Chemical Operating Company." By 2023, proven reserves amount to around 100 billion cubic meters. Production is planned to commence after the launch of the gas processing plant in the field in 2025.

The fields in the Southwestern Gissar region were discovered in the Soviet era but were conserved due to funding shortages. Their industrial development only began in the 2000s. As of early 2023, the remaining proven gas reserves in the Southwestern Gissar region stand at 65 billion cubic meters, of which about 58 billion cubic meters are associated with the Southern Tandyrycha field, developed by Uzbekneftegaz and Lukoil Uzbekistan Operating Company, "Southwestern Gissar."

Summing up the available data on remaining proven gas reserves allows for an estimate of around 1 trillion cubic meters.

For further research, which involves forecasting production capacities, the assessment provided by the Energy Research Institute of the Russian Academy of Sciences will be adopted for the "Base Scenario," while the data from the Energy Institute and the Ministry of Energy of Uzbekistan will be treated as the "Low" and "High" scenarios, respectively. Within the framework of this study, an assumption has been made that the estimates of the Ministry of Energy of Uzbekistan refer to reserves, the economic viability of which has not been justified. This is primarily due to low fixed gas prices for end consumers within the country. Therefore, in the context of the production capacity forecast in the "High" scenario, active development of expensive gas is anticipated due to the depletion of cheap gas reserves in the "Low" and "Base" scenarios.

The results of calculating the forecasted production capacities for the Republic of Uzbekistan are presented in Figure 3 and show a range from 40 Bcm in the "Low" scenario to 53 Bcm in the "High" scenario by 2030, equivalent to 34 and 46 Mtoe, respectively.

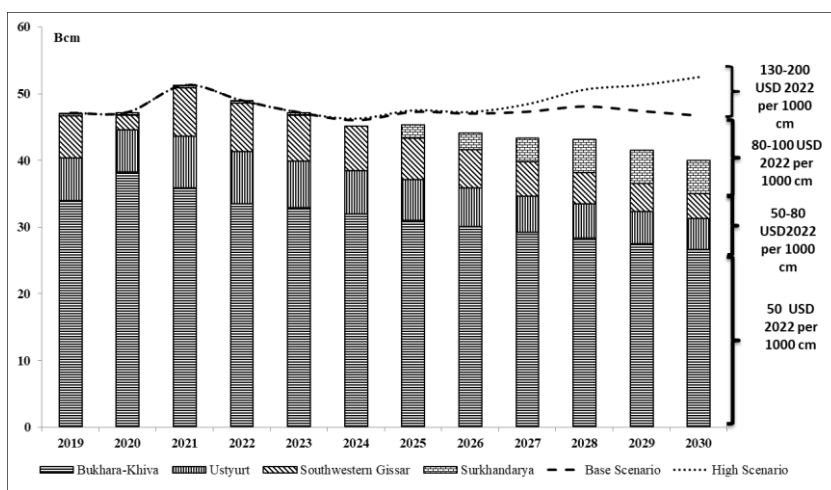


Fig. 3. Forecast of production capacities of the Republic of Uzbekistan by scenarios (columns - low scenario), Bcm.

Comparing production capacities with gas demand, it is projected that in 2030, under the "Low" scenario, there will be a gas deficit of 10.5 Mtoe, while in the "Base" scenario, the deficit is forecasted to be at 4 Mtoe. Only in the case of initiating the development of

more expensive gas reserves in the Ustyurt region by 2030, a gas surplus of 1.1 Mtoe is predicted.

4 Conclusions and Recommendations

Based on the calculated forecast of production capacities, the following conclusions have been drawn: it is evident that the domestic demand for natural gas can only be met through the initiation of the development of more expensive gas, with production cost ranging between \$130-\$200 per thousand cubic meters, excluding the cost of gas distribution to end consumers. However, it's important to acknowledge that the industrial development of this "new" gas may not commence before 2028. This indicates that:

- Uzbekistan will cease to be a gas exporter, at least during the period between 2023-2028, except for specific periods under favourable weather conditions.

- By 2030, Uzbekistan will need to import natural gas to cover the deficit, which could be up to 10.5 Mtoe. Only in the "High" production scenario is the country projected to meet its own demand.

Importing natural gas is possible from neighbouring countries, such as Turkmenistan, and from Russia. Considering that Turkmenistan is a major supplier of pipeline gas to China, it would make sense for them to base contracts on the parameters of Chinese agreements. Thus, for Uzbekistan to be competitive with alternatives, it should aim for prices around \$200 per thousand cubic meters. This pricing level aligns with gas production from closing fields within the country.

This marks the end of the era of cheap gas, upon which the entire energy system of the country is built. It's crucial to develop a new energy model.

Maintaining a policy of price regulation not exceeding the inflation rate until 2030 could lead to annual state budget expenditures on internal price subsidies rising from the current \$2022 1.2-1.5 billion in 2022 to \$2.5 billion. However, restrained prices will hinder energy efficiency incentives, hinder the development of inter-fuel competition, and gas exports will no longer be able to fill the budget. Therefore, solutions to raising gas prices gradually, while achieving cost recovery, must be considered.

This situation provides additional incentives for the development of renewable energy sources and accelerated negotiations for nuclear power plant construction. There are opportunities for expanding hydroelectric power usage. In the coming years, coal will play a significant role in meeting energy demand.

In the transportation sector, electric vehicles and hybrid cars are gaining more interest. This addresses the traditional challenge of importing expensive petroleum products, simultaneously improving emission rates and aligning with the gradually diversified power system balance.

To ensure the long-term sustainability of not only Uzbekistan's energy sector but also neighbouring countries', developing energy system integration with mutual balance "insurance" and cross-border energy flows based on production and demand characteristics in each country could prove to be a beneficial solution.

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References

1. Energy Institute (EI) Statistical Review of World Energy 2023, <https://www.energyinst.org/statistical-review>

2. Gazprom signed a contract for the supply of gas to Uzbekistan, <https://www.vedomosti.ru/business/articles/2023/06/16/980924-gazprom-kontrakt-uzbekistan> [in Russian]
3. T.A.Mitrova, V.A.Kulagin, A.A.Galkina, D.A.Grushevenko, E.V. Grushevenko, E.O.Kozina, World energy markets evolution and its consequences for Russia(Moscow: ERI RAS,2015)[in Russian]
4. A.A.Makarov, T.A.Mitrova, V.A.Kulagin, L.M.Grigoriev, Forecast for the development of energy in the world and Russia until 2040 (Moscow: ERI RAS,2014)[in Russian]
5. Decree of the President of the Republic of Uzbekistan, On measures to acceleration the introduction of renewable energy sources and energy saving technologies in 2023, February 16, 2023 No. PP-57, <https://lex.uz/ru/docs/6385720> [in Russian]
6. Decree of the President of the Republic of Uzbekistan, On approval of the concept of the development of nuclear energy in the Republic of Uzbekistan for the period 2019-2029, February 7, 2019 No. PP-4165, <https://lex.uz/docs/4194042> [in Russian]
7. Natural gas reserves in Uzbekistan are estimated at 1.86 trillion cubic meters, <https://www.gazeta.uz/ru/2021/08/10/gas-reserves/> [in Russian]
8. A.N.Bogdanov, P.V. Khmyrov, Dynamics of development of the raw material base of hydrocarbons in the Bukhara-Khiva region, Neftegazovaya geologiya. Theory and practice, **16. 4** (2021), http://www.ngtp.ru/rub/2021/33_2021.html [in Russian]
9. Uzbekneftegaz has revealed its plans for a 10-year exploration program to increase oil and gas reserves, <https://nuz.uz/ekonomika-i-finansy/1263521-uzbekneftegaz-raskryl-svoi-plany-po-10-letnej-programme-geologorazvedki-dlya-uvelicheniya-zapasov-nefti-i-gaza.html> [in Russian]