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Prospects for Development of the Gas Processing Industry in Uzbekistan

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ABSTRACT

Objective: *This article analyzes the current level of development, existing problems and promising directions of the gas processing industry in the Republic of Uzbekistan.* ***Method:*** *The study considers the possibilities of diversifying the industry, creating import-substituting products and increasing export potential through the production of polymers, liquefied gas, synthetic fuels and chemicals.* ***Result:*** *The fact that the export of natural gas is economically inefficient, the need to produce products with high added value through its local processing is justified. The issues of technological modernization, attracting foreign investment and optimizing existing production capacities are also analyzed.* ***Novelty:*** *The author puts forward practical proposals on advanced practices in the field of deep gas processing, mechanisms for making the industry competitive, and improving the investment climate.*

INTRODUCTION

In today's era of globalization, energy resources are becoming not only the main driver of economic development, but also a strategic factor ensuring the geopolitical independence and stability of countries. Natural gas occupies a special place among these resources, since it serves not only as a fuel, but also as a valuable raw material for the production of high-value chemical products - polymers, synthetic fuels, mineral fertilizers and other industrial products through deep processing [1]. In this regard, the development of the deep processing of gas is an important direction of economic diversification and industrialization for any country with large gas reserves [2].

The global gas processing industry is growing in importance. The global gas processing market was valued at $228.66 billion in 2024 and is projected to reach $430.84 billion by 2034, representing a compound annual growth rate (CAGR) of 6.54%. The main driver of this growth trend is the increasing global demand for natural gas in industry and power generation [3]. Today, natural gas accounts for a significant portion of global energy consumption and is considered a “clean” energy source with low environmental impact. Although the use of natural gas as a feedstock in the petrochemical industry accounts for only 6% of global gas consumption, the growth rate in this area is high [4].

China, the United States, and Middle Eastern countries (Saudi Arabia, Qatar) are leading the way in gas downstream processing, particularly in the production of petrochemicals and liquefied natural gas (LNG). These countries are successfully diversifying their economies by converting natural gas into higher-value products, rather than just using it as an energy source. In particular, large-scale gas-to-liquids (GTL) plants

in Qatar, as well as projects in South Africa and Uzbekistan, are playing a significant role globally [5].

Uzbekistan is among the countries with large reserves of natural gas. According to available data, proven natural gas reserves amount to 1.8 trillion cubic meters. This figure determines the country's potential in the regional and global gas market. Traditionally, Uzbekistan has used natural gas mainly as a fuel and exported a certain part of it as a raw material. However, in recent years, a sharp increase in domestic consumption, a slowdown in the pace of production at existing fields, and an increase in imports require a review of gas policy. In particular, in the first quarter of 2024, natural gas production decreased by 2.76%, while gas imports of $ 694.9 million in 2023 increased to $ 1.68 billion in 2024. This represents an increase of more than 33 times compared to 2020 [6].

Against the background of such changes, the formation of a local value chain through deep processing of gas, the production of import-substituting products, and the expansion of export potential have become urgent tasks. Therefore, in recent years, the President of the Republic of Uzbekistan Shavkat Mirziyoyev has adopted a number of decisions on deep reform of the oil, gas, and chemical industries, improving the investment climate, and introducing modern technologies [7]. In particular, the Resolution No. PQ-388 dated October 10, 2022 “On Approval of the Targeted Program for the Strategic Development of the Chemical and Gas-Chemical Industry”, the speech at the meeting on the oil and gas industry held on February 6, 2020, and the Decree No. PF-63 dated March 27, 2025 indicate that special emphasis is being placed on deep processing in this area. In particular, it is planned to implement 30 large investment projects worth $36.5 billion by 2030 [8].

Literature Analysis

The scientific and analytical literature on the development of the gas processing industry has extensively covered various economic, technological, and institutional aspects. Research in this area by foreign scientists, international organizations, and Uzbek economists complement each other in content [9].

For example, D. Yergin in his work “The New Map: Energy, Climate, and the Clash of Nations” pays special attention to the role of natural gas in the energy geopolitics of the 21st century and its role in shaping economic strategies. According to him, the leading countries in deep gas processing (USA, Qatar, Russia) see this sector as a means of reducing dependence on oil and diversifying the industry. The International Energy Agency (IEA) also analyzes in detail the economic efficiency and role of GTL (gas-to-liquids) technologies in a sustainable energy supply in its 2023 report [10].

Michael Porter's research on competitive strategy and cluster theory (e.g., "Competitive Strategy" and "The Competitive Advantage of Nations") shows how approaches can be used to create value chains, stimulate innovation, and increase competitiveness in the development of industrial sectors. This is an important theoretical basis for the formation of gas and chemical industry clusters in particular.

Also, L. Pirogova and S. Fedorenko emphasize the importance of deep processing technologies in increasing the export potential of gas and chemical products using the

example of the gas industry of the Russian Federation. They believe that by exporting gas not as raw materials, but as processed products, countries can increase export revenues several times [11].

Among the scientists of Uzbekistan, the work of economists who have conducted in-depth analytical work on the gas and petrochemical industries is particularly noteworthy, including M. Pardaev, R. Abdurakhmonov, A. Jurayev, and D. Eshchanov. In particular, M. Pardaev in his research on reforms and economic efficiency in the energy sector of Uzbekistan justifies the need to develop industrial clusters through deep gas processing. R. Abdurakhmonov, on the other hand, focuses on the socio-economic benefits of increasing the share of processed products in strengthening energy security [12].

Also, the collective monograph "Effective use of energy resources and innovative approaches", prepared by scientists from the Tashkent State University of Economics, analyzes international experiences in the field of gas processing and assesses the state of the existing infrastructure in Uzbekistan. This work also puts forward valuable proposals for the introduction of modern technologies, improving the investment climate, and expanding the range of products produced from gas [13].

RESEARCH METHOD

This article uses a mixed methods approach to analyze the prospects for the development of the gas processing industry in Uzbekistan. The main methods of the study are theoretical analysis, which studies the fundamental scientific literature on energy economics, gas processing technologies, petrochemical clusters and sustainable development, and uses inductive and deductive approaches. Statistical analysis collects data from official government bodies (Statistics Agency, Ministry of Energy, etc.) and international organizations (IEA, OPEC) to assess the current state of the gas processing industry in Uzbekistan. Economic and statistical methods are used to analyze trend analysis, growth rates and structural changes. The data are visualized using tables and graphs.

International experiences in deep gas processing and investments (Qatar, Saudi Arabia, USA, Russia) were studied, and best practices suitable for the conditions of Uzbekistan were identified in a comparative analysis. The collected data, analyses, and experience were synthesized, and conclusions and practical recommendations were developed for the sustainable development of the gas processing industry in Uzbekistan.

RESULTS AND DISCUSSION

The economic potential of the natural gas industry should be determined by the production of high-value products through processing, rather than selling it as a raw material. Today, most countries with oil and gas resources have chosen a strategy of transforming from a raw material exporter to a finished product producer by deep processing gas. This approach serves to increase export volumes, ensure economic diversification, and promote technological development [14].

What is added value? Added value is the increase in the economic value of a product at each stage of its production. In the deep processing of natural gas, this value chain is formed as follows:

Value chain stages:

1. Raw gas minimum value, mainly used to generate thermal energy.
2. Primary separation (drying, separating) methane, propane, butane are separated.
3. Liquefaction (LPG, LNG) is brought into a form convenient for transportation and export.
4. Chemical synthesis (reforming, GTL, DME) produces synthetic fuels and reagents.
5. Polymerization (ethylene, propylene) polyethylene, polypropylene, raw materials for the plastics, textile, and automotive industries.
6. Production of complex products - finished chemical products, packaging materials, building materials, see Table 1.

Table 1. Economic value chain and added value.

Product type	Recycling rate	Market price ($/ton)	Value added (relative to raw gas)
Raw gas	Low	40–50	1x
Liquefied petroleum gas (LPG)	Medium	150–300	3x – 6x
Polymers (polyethylene, propylene)	High	1500–2500	30x – 50x
GTL (synthetic diesel/gasoline)	High	1000–1300	20x – 25x
Fertilizers (ammonia, urea)	High	400–700	10x – 15x

It can be seen that if the price of a ton of raw gas is $50, the price of polymers obtained from it reaches $2,500. This means that it is possible to obtain 30–50 times higher economic profits by deep processing the gas than by selling it in its raw state.

In the context of Uzbekistan, while Uzbekistan currently has large gas reserves, it uses most of this resource for domestic consumption as fuel or exports it as raw material. This limits the opportunities for revenue generation at the higher levels of the value chain. For example:

1. Revenue from exporting 1 billion m^3 of gas as raw material is around $100–120 million;
2. It is from this volume of gas that it is possible to generate $1.5–2 billion in revenue through the production of GTL fuel or polymers.

The added value created by deep gas processing is not only an economic benefit, but also a key factor in technological development, integration between industrial sectors, export potential and energy security. In the conditions of Uzbekistan, the development of this sector should form a core part of the industrialization strategy.

The deep processing of natural gas plays an important role in the economies of developed countries. In recent years, in order to get the maximum economic benefit from energy resources, the United States, Qatar, China and other countries have been considering gas not only as a fuel, but also as a key raw material for the production of high-end industrial products. They have achieved great economic results through modern technologies, cluster systems, export-oriented production and the creation of local value chains.

US experience: technological leadership and the cluster model

The United States has the world's most advanced gas processing technology. The country's gas processing capacity is expected to reach 3.2 billion m³/day by 2023. Gas-chemical clusters in Texas, Louisiana, and California generate $60 billion in annual exports through polymer, GTL, and fertilizer production. Composition of gas-derived products in the United States (%)

a. Polymers: 45%
b. GTL: 25%
c. Fertilizers: 15%
d. LNG: 10%
e. Others: 5%

These figures show that the United States is focused on obtaining mainly high-value industrial products from gas, minimizing raw material exports.

Qatar's Experience: Becoming an Export Giant Through the GTL and LNG Industry

Qatar is one of the countries that has made deep processing of natural gas a centerpiece of its export strategy. Large plants such as Oryx GTL and Pearl GTL, located in the Ras Laffan Industrial City, produce more than 300,000 tons of GTL diesel, kerosene and naphtha per year. According to Qatar Energy reports, GTL products will bring the country more than $10 billion in revenue by 2023, see Table 2.

Table 2. Economic viability of Qatar GTL projects.

Project name	Capacity (million tons/year)	Jobs created	Annual revenue ($ billion)
Oryx GTL	0.16	1 100	2.1
Pearl GTL	1.6	3,500	8.3

As the Qatari experience shows, deep processing of gas in the form of GTL serves not only to generate income, but also to provide jobs, technological expertise, and export stability.

China's experience: covering domestic consumption and technological innovation

China has been developing its gas processing industry to a strategic level since 2000. By 2023, China will have more than 150 gas processing plants operating, producing 20 million tons of polyethylene and polypropylene per year. With this indicator, the country will meet more than 85% of its domestic polymer needs with its own products.

Chinese model

Natural gas → Chemical synthesis (ethylene, propylene) → Polymer products → Plastics industry, automotive industry, textiles → Domestic market + export.

This model has allowed China not only to reduce imports, but also to achieve independence in strategic sectors. Uzbekistan needs to learn from these experiences and make deep gas processing a strategic direction of its industrialization policy. In particular, it is urgent to establish exports of high value-added products, expand GTL projects, and form petrochemical clusters.

The experience of developed countries shows that the deep gas processing industry occupies a large share of GDP. For example, in countries such as Qatar, the USA, and Saudi Arabia, this share reaches 5–18%.

Potential in Uzbekistan:

1. Currently, the gas sector accounts for ~8% of GDP (Ministry of Energy, 2024).
2. If the volume of deep gas processing is increased to 10 billion m³ per year and higher-quality products are produced, the contribution to GDP can be doubled. Share of gas and chemicals in the industrial structure, % (2024)
   - Uzbekistan: 3%
   - USA: 9%
   - Qatar: 15%
   - Saudi Arabia: 12%

These table 3 show that Uzbekistan is still not able to use its vast economic potential in gas processing. By exporting gas not as a raw material, but as a processed product, foreign exchange earnings would increase several times:

Table 3. Benefits of gas processing.

Product type	Export of 1 billion m³ of gas ($ million)	Comparative export profit
Raw gas	100–120	1x
GTL fuel	900–1,200	~10x
Polymers	1,500–2,500	~15x–20x
Finished chemical products	3,000+	~30x

According to the Statistics Agency, Uzbekistan exported 4.4 billion cubic meters of gas in 2023. If this volume were further processed, it would have generated approximately $6–8 billion in revenue instead of the $500 million in 2023. This is an important factor in increasing foreign exchange reserves, reducing dependence on external debt, and ensuring the stability of the national currency.

The economic benefits of import substitution are the superiority of national products, stability of domestic prices and prevention of commodity shortages. Gas

processing plants are technologically complex systems, and their operation requires qualified labor resources. This:

1. Accelerates the training of specialists with medium and high qualifications in technical fields,
2. Forms new production clusters in the regions.

According to our analysis:

1. Every 1 billion m³ of deep gas processing 1,000–1,500 permanent jobs;
2. GTL plants (for example, "Oltin Yu'l GTL" in Uzbekistan) provide employment for more than 3,000 workers;
3. Clusters (transport, logistics, technical support, engineering) - create jobs in 4–5 related areas around each enterprise.

In the comprehensive development of the natural gas industry of Uzbekistan, it is important, first of all, to correctly assess the existing reserves and conduct a thorough analysis of their geological, economic and technological parameters. In this regard, we will conduct a comprehensive analysis of the current state of natural gas fields located in Uzbekistan, their utilization rate, production capacity, infrastructure, technical and economic indicators. This analysis will serve as an important scientific basis for identifying opportunities for effective use of existing resources, increasing the efficiency of fields and ensuring the stability of the gas industry, Figure 1.

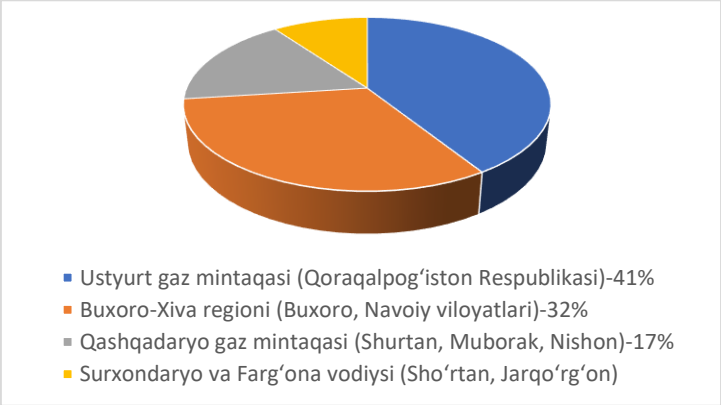

Figure 1. Territorial distribution of natural gas reserves in Uzbekistan.

This graphic data confirms that developing resources in different geographical locations reduces the likelihood that a crisis in one region will affect the entire system. The development of new fields (for example, in Fergana or Jizzakh) contributes to economic growth and creates jobs. Diversifying gas pipelines increases the reliability of supply [15].

According to the Ministry of Energy of the Republic of Uzbekistan and JSC "Uzbekneftegaz", as of 2024, the number of major natural gas producing fields in the country is limited, most of which are concentrated in a few large regional bases. In particular, the Shurtan field in the Kashkadarya region has an annual gas production capacity of 11 billion cubic meters and is one of the few large fields that is currently fully operational. Also, the Surgil field in Karakalpakstan is one of the economically active

fields with a capacity of 3.2 billion cubic meters and is currently operated by the Uz-Kor Gas Chemical joint venture. These fields occupy a leading position in the country's gas industry.

However, the situation of other large fields in the production system is not so stable. For example, the Gazli field in Bukhara region, despite its annual capacity of 5.5 billion cubic meters, is currently only partially active due to technological obsolescence and a decrease in natural pressure. Over the past 20 years, the natural gas pressure of this field has decreased by about 37 percent, which has led to an increase in production costs and a sharp decrease in extraction efficiency.

Similarly, the Zharkurgan deposit in Surkhandarya region, despite its production potential (2.1 billion m^3/year), is currently in a weak state in terms of production indicators. The technical infrastructure and equipment in these deposits were mainly commissioned in the 80s-90s of the last century and do not correspond to modern technologies.

In addition, the Aral Sea project in the Republic of Karakalpakstan is still in the exploration stage today, with the participation of major international companies such as CNPC and LUKOIL. Although this project is promising, it requires significant geological exploration and investment to reach full production in the coming years.

In general, about 35 percent of existing gas fields are technically and geologically obsolete, and in many of them the efficiency of extraction has significantly decreased. This negatively affects not only the volume of production, but also the efficiency of the infrastructure serving the entire sector. Therefore, updating the technical condition of fields, ensuring the continuity of production and attracting new fields to the industry remains an urgent strategic task for the sustainable development of the gas industry.

Uzbekistan's energy sector, in particular the natural gas production sector, has been undergoing significant structural changes over the past fifteen years. According to the State Statistics Committee, in 2010, the volume of natural gas produced in the country amounted to 65.9 billion cubic meters. However, this figure has been decreasing year by year. In 2015, the volume of production fell to 57.3 billion cubic meters, while in 2020 this figure decreased to 49.8 billion cubic meters.

The downward trend continued in 2022–2023, with 51.7 billion and 46.7 billion cubic meters of gas produced, respectively. In particular, in 2024, this figure decreased to 44.6 billion cubic meters. This represents a decrease of almost 32% compared to 2010. This situation, in turn, is explained by the technical and geological obsolescence of the fields, the slow introduction of modern technologies, as well as the lack of foreign investment in the sector.

In the first quarter of 2025, 11.3 billion cubic meters of gas were produced, which is 2.8% less than in the same period in 2024. This situation means that even with the existing fields operating, the volume of natural gas production continues to gradually decline. According to forecasts, if this pace is maintained throughout the year, the total volume by the end of 2025 could amount to about 45.3 billion cubic meters. This figure is

significantly lower than the maximum potential of the sector and poses a serious threat to the country's energy security.

Despite the significant reserves of natural gas in Uzbekistan, its deep processing potential has not been fully utilized. While the existing large gas processing facilities are currently operating, their production capacity utilization remains low. As a result, a large part of the produced gas is consumed as fuel in raw form or is exported after minimal processing. This leads to a loss of opportunities for obtaining value-added products from gas.

In particular, the Shurtan Gas Chemical Complex (Shurtan GKM) in Kashkadarya region has an annual gas processing capacity of 4.5 billion cubic meters, but only 70-80 percent of this capacity is actually being used. This complex is one of the few fully operational facilities, and it mainly produces polymer products such as polyethylene and polypropylene. However, its underutilization is due to existing logistical and technical constraints.

The Mubarak Gas Processing Complex (GPK), despite having an annual gas processing capacity of 3.0 billion cubic meters, is operating at only 50-60 percent. The main problem here is the obsolescence of technical equipment and insufficient maintenance. Also, low pressure in some sections of the pipeline network and interruptions in gas supply disrupt the continuity of the processing process.

Another strategic project is the Altyn Yul GTL plant. This facility is operating in test mode and its annual processing capacity is 1.5 billion cubic meters. Currently, only about 30 percent of the capacity is being used. Synthetic fuel, diesel, kerosene and other high-quality products are produced using GTL (Gas-to-Liquids) technology. However, the complexity of this technology, the lack of modern sensor systems and automated control tools prevent full production efficiency. The main reasons for the underutilization of production capacities at these facilities include:

1. Limited transport and logistics infrastructure, meaning the delivery system from gas fields to processing facilities is not functioning optimally;
2. Losses in gas pipelines, especially in long-distance pipelines, reduce the volume of gas delivered;
3. Lack of modern technical maintenance and control systems, meaning that automated, digital, and real-time monitoring systems have not been sufficiently implemented in enterprises.

The energy system of Uzbekistan still suffers from high levels of gas losses. According to the Ministry of Energy, there are losses in main pipelines on average up to 10%. These losses are primarily due to the physical and technological obsolescence of the gas infrastructure. For example, some gas transmission networks were built in the 1970s and 1980s, and their equipment with modern SCADA systems is being carried out slowly. As a result, part of the resources are being directly lost or not used effectively.

The operational efficiency of existing processing facilities remains low. For example, despite the annual capacity of the Shurtan gas and chemical complex of 4.5 billion m^3, its utilization rate is around 70–80%. Mubarak GPK, despite its capacity of 3 billion m^3, is

operating at only 50–60%. This is due to factors such as maintenance interruptions, logistical constraints, and insufficient gas pressure. The Altyn Yul GTL plant has not yet been able to operate at full capacity. Vertical integration - that is, the integration of all links in the chain from extraction to finished products - does not yet exist. This limits the possibility of extracting maximum value from resources.

Processing gas resources has not only economic, but also environmental advantages. Because direct combustion of gas sharply increases emissions. For example, the amount of CO_2 emitted into the atmosphere in Uzbekistan annually exceeds 150 million tons, a significant part of which is due to the direct combustion of natural gas. To ensure environmental sustainability, instead of "flaring" gas, emissions can be reduced by obtaining synthetic fuels, hydrogen or chemicals from it. The experience of the European Union countries is relevant in this regard, which have launched a plan to switch to burning natural gas exclusively through processing by 2030.

Despite the large number of regulatory documents adopted in the gas sector of Uzbekistan, there is no functional coherence among them. For example, in some cases, conflicts arise between the Law on Energy Efficiency and the regulations on gas production. In addition, tax breaks, subsidies, and technological grants for small and medium-sized enterprises specializing in gas processing are insufficient. The permit process remains complicated and lengthy for investors, especially foreign entities.

CONCLUSION

Fundamental Finding : The natural gas industry in Uzbekistan is one of the strategic sectors of the country's economy, and its effective operation is crucial for energy security and sustainable development of industrial sectors. However, in recent years, the decrease in production volumes, technological obsolescence, and insufficient utilization of processing capacities indicate that resources are not being used rationally. For example, while 63 billion m^3 of gas were produced in 2010, this figure is expected to be around ~44 billion m^3 in 2024. In the 1st quarter of 2025, only 10.9 billion m^3 were produced, confirming the stagnation in mining activities. **Implication :** Despite the existence of large processing facilities such as Shurtan, Mubarak and Altyn Yul GTL, they are not operating at full capacity. In particular, the Altyn Yul GTL plant is using only 30% of its capacity. This is due to transport and logistics constraints, disruptions in technical maintenance and the lack of sufficient reforms in the investment climate. At the same time, the fact that gas imports in 2024 reached $1.68 billion, while exports decreased, shows how economically relevant the deep processing direction is. **Limitation :** The stagnation in production, underutilization of existing infrastructure, and limited investment reform highlight current systemic barriers that hinder optimal performance of the sector. **Future Research :** Based on the analysis, the following can be suggested: it is necessary to modernize existing fields, prioritize deep gas processing, improve legal and economic mechanisms to attract foreign investment. It is also important to fully launch the processing infrastructure, expand the production of high-value products from gas—polymers, synthetic fuels, fertilizers and chemical components. Strengthening

cooperation between the public and private sectors, introducing digital monitoring and management systems for the sector, and training personnel with technological knowledge will serve the long-term sustainable development of the gas industry. If these measures are implemented, Uzbekistan will not only fully satisfy domestic needs, but also strengthen its position in the global gas market through the export of high-tech products.

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