Trends in natural gas exploitation in Algeria: between production challenges and consumption pressures

Tendances dans l'exploitation du gaz naturel en Algérie : entre défis de production et pressions de consommation

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Abstract:

The study aims to analyze patterns and trends in natural gas consumption in Algeria and identify the main factors influencing its use. It also aims to estimate future gas demand in the 2030 outlook, given that it is the first choice in the national energy consumption model, and one of the most important sources of electricity generation in the country.

The study found that annual growth rates for natural gas consumption are steadily rising compared to production rates, leading to a narrowing gap between production and consumption and, consequently, a decline in the surplus of natural gas destined for export. This portends serious changes that threaten the energy sector and the country's entire economy.

Keywords: *Natural gas; consumption; exports; electricity generation;*

Jel Classification Codes: Q 35; Q41

Résumé:

L'étude vise à analyser les tendances et les modèles de consommation de gaz naturel en Algérie et à identifier les principaux facteurs influençant son utilisation. Elle vise également à estimer la demande future en gaz dans les perspectives pour 2030, étant donné qu'il s'agit du premier choix dans le modèle national de consommation d'énergie, et qu'il constitue l'une des sources les plus importantes de production d'électricité dans le pays.

L'étude a révélé que les taux de croissance annuels de la consommation de gaz naturel augmentent régulièrement par rapport aux taux de production, ce qui entraîne un rétrécissement de l'écart entre la production et la consommation et, par conséquent, une baisse de l'excédent de gaz naturel destiné à l'exportation. Cela laisse présager de graves changements qui menacent le secteur énergétique et l'ensemble de l'économie du pays.

***Mots-clés** : gaz naturel ; consommation ; exportations ; production d'électricité ;*

Jel Classification Codes: Q 35; Q41

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1. INTRODUCTION

The hydrocarbon sector plays a pivotal role in the country's economic development strategy, as it is the main source of income, accounting for one-third of the country's gross domestic product, 60% of state revenues, and more than 97% of export earnings.

On the other hand, the country's energy landscape has remained unchanged for five decades, relying entirely on oil, natural gas, and their derivatives. Natural gas alone accounts for 60% of the total primary energy produced in the country, surpassing all other energy sources. This is because it is a clean and easier-to-use source, not to mention the availability of huge reserves of this resource.

With domestic demand for gas continuing to rise as a result of the country's urban expansion, coupled with stagnant production capacity over the last two decades, the gap between production and consumption continues to narrow, especially since domestic energy consumption exceeded exports for the first time in the country's history in 2019. This threatens to exacerbate the national energy balance, especially since Algeria has been accustomed for decades to exporting its surplus hydrocarbon production to secure its hard currency revenues.

-Research problem:

Algeria is experiencing increasing pressure in the hydrocarbon sector, particularly with regard to natural gas, due to the rapid growth in domestic demand for gas compared to slower growth in production. This is causing it to face accelerating challenges that could threaten its energy security and its global position among the major exporters of natural gas. This leads us to pose the following question:

- What are the current and future trends in natural gas consumption in Algeria?

- Research hypotheses:

Based on the above question, the following hypotheses can be proposed:

- Despite Algeria's abundance of natural gas and oil resources and its proximity to the European market, its total dependence on fossil fuels exposes it to considerable risks.
-Algeria faces several challenges in the field of natural gas, namely increasing external consumption rates on the one hand, and boosting production capacity to meet domestic demand for gas and electricity on the other.
- Natural gas will remain the main source of energy supply in the country for years to come, unless other clean, reliable, and less expensive energy sources are found.

-Research objectives:

Through this research, we seek to achieve the following objectives:
- To highlight the importance of natural gas as an excellent alternative energy resource in supporting the national economy through the revenues generated by its exports and supplying local sectors with their energy needs.
-To demonstrate the country's enormous potential in the field of hydrocarbons, including oil and natural gas.
- To highlight the scale of the challenges facing the natural gas sector in Algeria, considering the geopolitical developments surrounding the gas sector and changes in the international market.
- Research methodology: To answer the research question and achieve the research objectives, we rely on a descriptive statistical approach in the parts of the research related to presenting data on natural gas production and consumption and describing the challenges facing the energy sector at the national level. We also rely on an analytical approach by collecting information and statistics to interpret economic variables related to the production, consumption and export of natural gas from official national sources, understanding developments in the energy system locally and internationally, and studying the consequences of following this system on the Algerian economy, to arrive at results that can be used to evaluate the energy policies followed and attempt to correct them.

2. The economic importance of natural gas in production:

Algeria has an excellent geographical location that qualifies it to be a major player in the development of the natural gas industry. In addition to its

use as a source of energy to meet domestic consumption, it is a raw material for petrochemical and large basic industries, not to mention its export either in raw form or after liquefaction. However, it is the cleanest of the traditional energies and the most responsive to the requirements of sustainable development.

2.1. Developments in natural gas reserves in Algeria: Algeria is a gas-rich country par excellence and one of the world's leading producers and exporters of natural gas, having established a sophisticated domestic gas industry. Gas was first discovered during the colonial period in 1956, in the Hassi R'mel field, which became the main gas field supplying the domestic market and exports abroad (hasani, 2025). This giant field is the fourth largest in the world in terms of production and accounts for 57% of Algeria's gas reserves. During the 1970s and 1980s, Algeria sought to establish partnerships with the largest leading companies in the hydrocarbon sector for exploration, drilling, and production activities, which increased its proven reserves. This strengthened its position on the global energy map.

In 1971, Algeria had 6.4% of the world's total proven natural gas reserves, amounting to 3,000 billion m3, ranking fourth after the Soviet Union, the United States, and Iran. Five decades later, in 2021, Algeria's proven gas reserves reached 4,500 billion m^3, accounting for 2.4% of global reserves. Despite the growth in its proven reserves, its share of global reserves declined, as did its ranking as the tenth largest reserve in the world. This was due to global reserves tripling since 1971, as a result of numerous discoveries in some countries, which enabled them to join the ranks of natural gas-producing countries. Meanwhile, the growth of Algerian gas reserves has been modest, meaning that their rate of increase has been lower than the rate of increase in global reserves. The following table shows the development of Algeria's proven natural gas reserves during the period 1980-2022.

Table (01): Development of natural gas reserves in Algeria for the period (1980-2025). (billion m3)

Years	1970	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025
Proven natural gas reserves	3000	3700	3500	3300	3700	4501	4502	4504	4504	4504	4504

Source: BP Statistical Review of World Energy, full report 2021. p 14

The table shows a significant increase in proven gas reserves from 1970 to 1980, reaching 3,700 billion m3, before declining to 3,300 billion m3 in 1990 at a rate of 10.8%, then increasing again from the 1990s to peak at around 4,504 billion m3 from 2000 to 2025. It should be noted that the volume of proven reserves has remained stable for a quarter of a century, contributing 2.56% of global natural gas reserves for 2025, according to figures from BP.

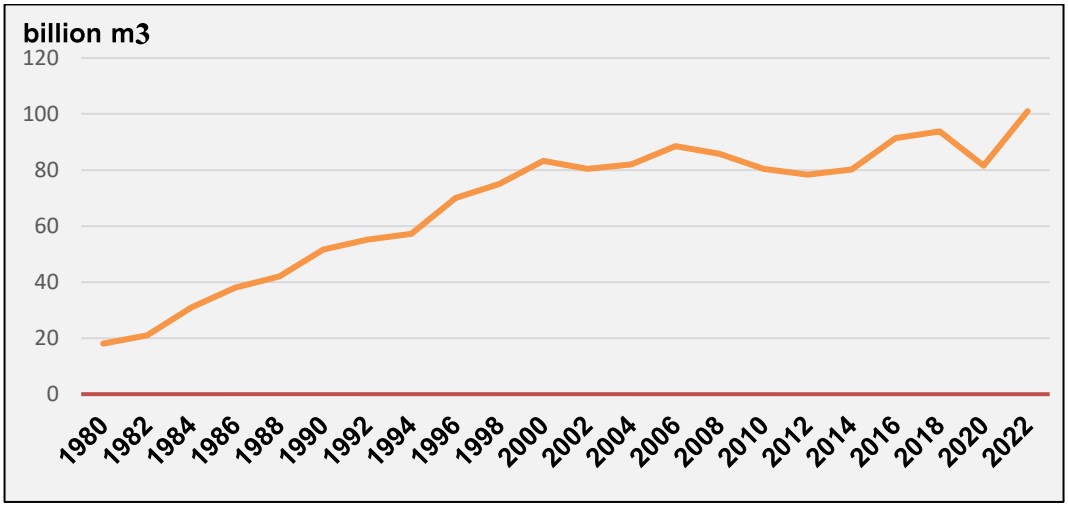
2.2. Marketed natural gas production: Over the years, Algeria has acquired considerable capabilities and experience in the field of natural gas production and manufacturing, enabling it to capitalize on its natural gas resources, particularly liquefied natural gas (LNG), for which it ranks fourth globally among LNG exporting countries and possesses the largest gas liquefaction unit in the world. (mohammed Hamza Bengrina, 2022)

Raw natural gas production is concentrated in the southern and central Sahara, mainly in the fields of Hassi R'mel, Gassi Touil, El Ghara, Al Hamra, Ghard El Nas, and others. After extraction, the remaining gas is reinjected into the same field to increase pressure or enhance oil recovery, or it is flared to dispose of it.)Abderezzak(2022 ،. The rest is transported through pipelines for either domestic consumption or export.

The development of natural gas production is subject to changes in domestic consumption levels, as well as the volume of external demand for gas through contracts concluded with customers. Its importance has increased, especially after the decline in Russian gas exports to the European Union, prompting Algeria to try to develop its production capacity by increasing partnership contracts related to exploration, extraction, and

production with international companies in the field of hydrocarbons (Hendi, 2023). Figure 2 shows the development of marketed natural gas production in Algeria.

Figure (1): Development of marketed natural gas production in the period 1980-2022 (billion m3)



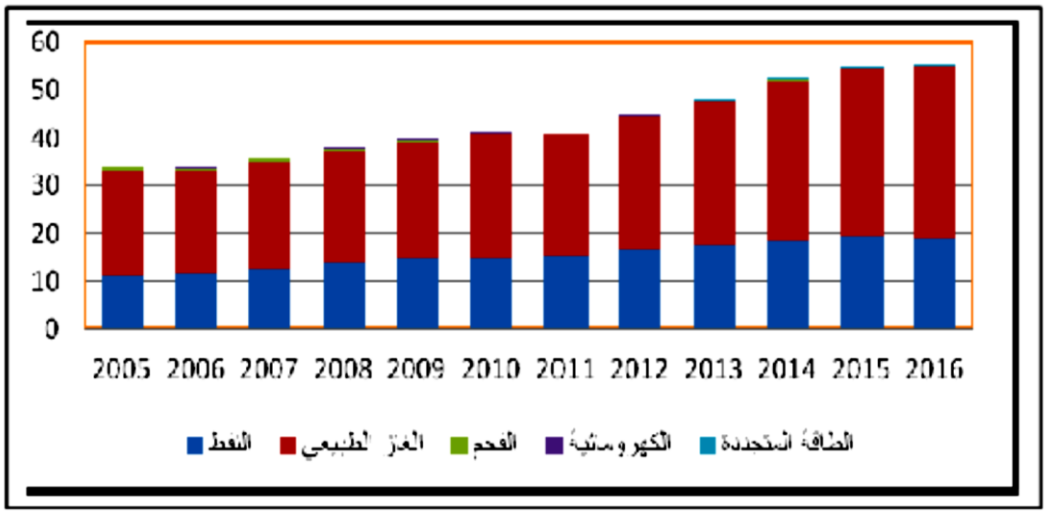
Source: British Petroleum (BP), Statistical Review of World Energy 2022, p. 12.

The figure shows a continuous development in natural gas production, which rose from 18.04 billion m3 in 1980 to 96.6 billion m3 in 2000, before declining again in 2009 due to the global financial crisis, reaching 81.5 billion m3 in 2020. Due to the coronavirus crisis, before recovering again after the global economy recovers and exceeding the threshold of 100 billion m3 to reach 105.5 billion m3 in 2023, which is a logical increase given the improvement in prices on international markets and the increase in domestic demand. On the other hand, Law No. 19-13 of 2019 (Algeria, 2019) gave new impetus to the hydrocarbon sector to overcome the stagnation that had affected research and exploration, by granting extensive concessions to foreign companies and simplifying the tax system. This reflects the prevailing trend in the country's production policy towards exploiting its natural gas potential and acquiring additional capacities, while giving priority to meeting the domestic market's gas needs before exporting.

3. - The place of natural gas in the national energy consumption model and its areas of use: Natural gas is one of the main pillars of the national energy balance in terms of production, consumption, and exports. Algeria has therefore focused its attention on meeting domestic gas consumption as part of its national energy policy, assigning national companies to ensure energy supplies to the population and vital sectors through its management, transport, and distribution, namely Sonelgaz. (mohammed Hamza Bengrina, 2022)

3.1. Evolution of the share of natural gas in the national energy consumption balance: Natural gas dominates most of the primary energy consumption share, accounting for 73.5% of total domestic consumption in 2021, while oil accounts for 25% of consumption. While coal accounts for 1.7%. Renewable energies (solar, wind, and hydroelectric) represent 0.2% of the primary energy mix. This dominance is due to its multiple uses in industry and power stations. It is also the primary fuel used in households and is considered the preferred and least polluting fuel in the transport sector (Sari Nasre ddine, 2022). The following figure shows the share of natural gas in Algeria's total primary energy consumption.

Figure (2): Evolution of the share of natural gas consumption in the primary energy balance (million tons)



Source: Hisham Labza, The current and future situation of marketed natural gas production and its place in the national economy - A quantitative

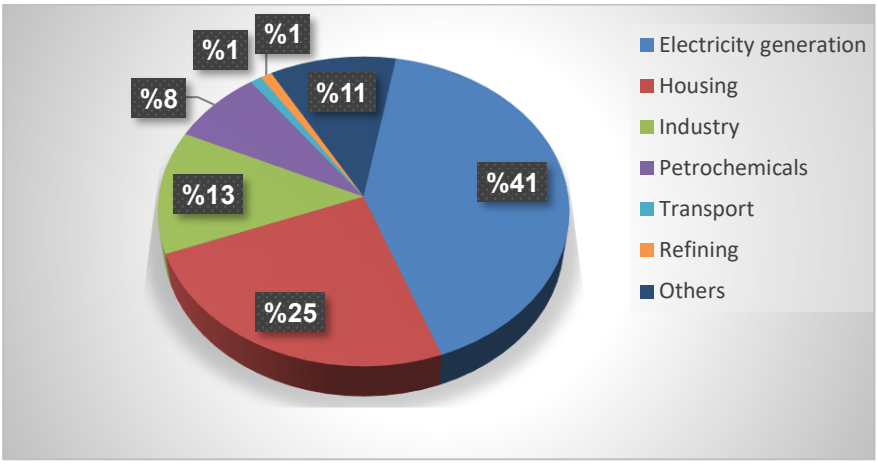
analytical study - The case of Algeria, PhD thesis, Algeria, p. 37.

In the same context, the share of natural gas consumption in the primary energy budget rose to about 66.7% of total national consumption in 2023, after its share did not exceed 53% in 1980, as a result of increased consumption by individuals and institutions due to population growth and economic expansion, In addition, the number of natural gas and combined cycle power plants has increased (99% of all power plants run on natural gas). National consumption of natural gas reached approximately 28.8 billion m3 in 2011 and is expected to exceed 46 billion m3 in 2024. This represents an annual growth rate of 5%, which is a worrying rate and calls for a review of the national natural gas consumption system and the adoption of measures to preserve this resource and guarantee future generations' right to access it.

3-2- Areas of natural gas use (by sector): Natural gas stands out as one of the most important alternatives to oil, especially after the rise in global oil prices and the taxes imposed on activities using coal and oil as part of environmental protection policies. Natural gas has therefore become the most suitable resource as it is clean, cheap, and lower in greenhouse gas emissions, in addition to being easy to transport, store, and use. This has made it a source of energy and a raw material in many industries, as evidenced by its use by sectors in electricity generation, petrochemicals, and oil refining, as well as transport and others. (Hendi K. , 2023)

The following figure shows the distribution of natural gas use by the consumer sector.

Figure (3): Distribution of natural gas consumption by user sector



Source: Prepared by the researcher based on data from the official CREG website creg.gov.dz

Natural gas needs are distributed according to multiple uses. The figure shows the most important gas-consuming sectors as follows:

- Electricity generation sector: Algeria's electricity system consists of an extensive network covering approximately 99.8% of the population, aided by the urban expansion that cities have witnessed since the 1990s and the accompanying improvement in the transmission network. Electricity and distribution between different regions (Echchikh Norreddine, 2021), in addition to some independent networks set up to supply remote and mountainous areas with electricity.

Electricity generation tops the list of consumer sectors in Algeria, accounting for more than 41% of total domestic consumption. This is due to its use as fuel in power stations that rely on gas turbines and combined cycle, as well as steam turbines, as it is the most cost-effective fuel and produces the least environmentally polluting emissions, in addition to its production efficiency compared to other fuels. (Hendi k. , 2023) Consequently, natural gas accounts for 97% of electricity production in Algeria.

On the other hand, electricity production has seen continuous growth over the last three decades thanks to the efforts made by the state to provide this resource and ensure its energy security. National electricity production has increased over the last three decades at a growth rate of 6.1%. Therefore, the government is attempting to implement intensive programs to develop renewable energy capacities for electricity generation and reduce the

burden on natural gas. (Lebza, 2013)

- Residential sector: The residential sector accounts for a quarter of the natural gas consumed in the country. It includes the domestic, agricultural, and service sectors. Overall, its consumption of natural gas is constantly increasing due to demographic growth and the rise in the number of housing units delivered annually, with a consequent increase in natural gas requirements. (Rahmouni, 2019). Consequently, the number of Sonelgaz customers is constantly increasing, whether they are residents or institutions active in various sectors, with the national natural gas coverage rate rising from 46% in 2010 to around 66% in 2024.)Abderezzak(2022 ،Meanwhile, natural gas is replaced in areas not connected to the network by butane and propane, making Algeria's coverage rate one of the highest in the world despite its vast geographical area and diverse terrain.

-Petrochemical industry: Algeria has pursued a petrochemical industry that relies mainly on natural gas, based on high-value-added processing projects for the manufacturing industry, in addition to supplying the agricultural sector with raw materials extracted from natural gas and oil. (Achour, 2004). Through refining processes, with petrochemical products accounting for only 4% of the refining industry.

On the other hand, natural gas supplies the petrochemical industry by entering the manufacturing process as a raw material and an ideal energy source due to its low cost. The Skikda and Arzew complexes are two important industrial hubs that supply other industrial units with the necessary materials, thereby strengthening the relationship between industry and other sectors. While the production of some units depends on foreign partnerships for the exchange of technologies and experiences, petrochemical products in Algeria can be divided into the following industries: the chemical industry for basic metals such as carbon gas, nitrogen and ethylene; the fertilizer and pesticide industry such as phosphate, ammonium and ammonium nitrate; the industrial resins industry, such as polyethylene and polyvinyl chloride, the plastics industry, such as plastic pipes and boxes, basic organic chemistry, such as methanol, aromatics and ethylene, the fats and dyes industry, and the pharmaceutical, detergent, preservative and other products industry.)Fateh ، (2011

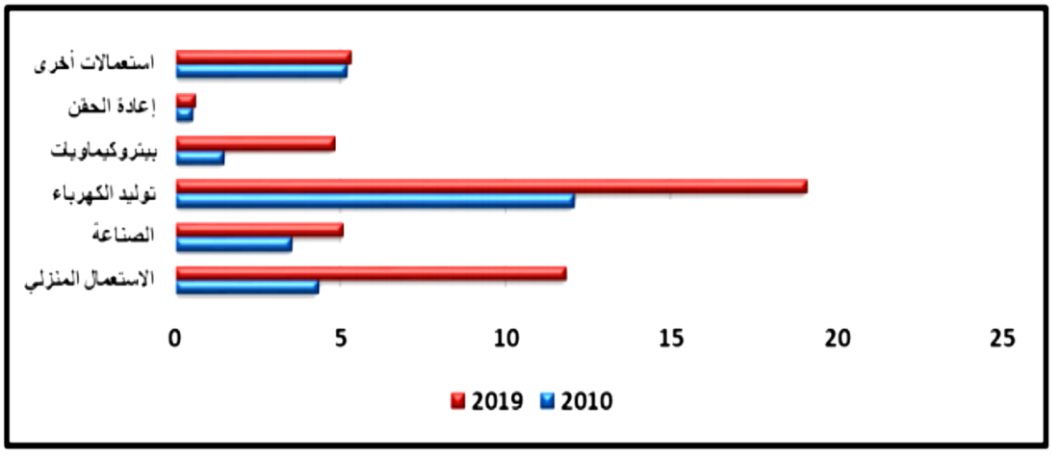
- Transport sector: The role of natural gas in Algeria is increasing through its policy aimed at encouraging energy substitution in the sector by introducing liquefied natural gas and liquefied petroleum gas to relieve

pressure on other types of fuel, especially after the rise in global oil prices and the emergence of gas as the best and cleanest alternative ever. (Lebza, 2013)

It should be noted that this is a global trend, but it has become increasingly prominent in countries with abundant natural gas reserves, such as Algeria and the Middle East, while the use of gas-powered cars has risen particularly in Europe and South America due to environmental concerns and high crude oil prices (Lebza, 2013).

As for Algeria, it has adopted a practical program to introduce natural gas as a fuel for petrol-powered cars. By 2022, it will have converted 45,000 petrol vehicles to liquefied petroleum gas through installation workshops distributed across 52 provinces, with the state covering 50% of the installation costs, for a total subsidy of 1.75 billion dinars. and 100,000 conversions will be launched by the end of 2023, with an aid amounting to 2.8 billion dinars. These conversions will save 225 million liters of petrol annually and avoid the emission of more than 500,000 tons of carbon dioxide. (Norreddine, 2024). Figure 5 shows the evolution of natural gas use from 2010 to 2019.

Figure 4: Evolution of natural gas use by sector (2010-2019) (billion m3)



Source: Belkheir Arab Mohamed, Determinants of Algerian natural gas exports to Europe – A benchmark study using the ARDL autoregressive distributed lag model for the period (2010-2019), Journal of Economic and Financial Studies, University Centre of Aflou, 2021, p. 92.

4- Current and future trends in natural gas exploitation in Algeria:

4-1- National natural gas consumption patterns: Algeria focuses on prioritizing the domestic market's natural gas needs, which is clearly reflected

in the evolution of its consumption, while the surplus is exported to the international market. All consumer sectors have seen growth in demand for gas over time, in contrast to marketed natural gas production, which has fluctuated in recent years, as shown in the following table:

Table (02): Development of natural gas consumption and marketed production for the period (2000-2021). (billion m3)

Years	2010	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Marketed production	85،46	86،06	82،43	83،3	84،58	94،95	96،6	97،47	89،98	84،6	105،04	101،44
Domestic consumption	27،1	32،21	32،53	37،21	40،3	40،45	41،82	45،14	46،4	45،03	49،56	51،82
Exports	57،36	52،33	47،37	44،19	43،51	53،97	54	51،42	42،78	39،46	54،97	49،14

Source: GECF. Annual Statistical Bulletin. 7th Edition (2023). P: 48, 49.

Domestic gas consumption has risen steadily over the period from 2010 to 2022, with gas consumption doubling between 2010 and 2023, averaging around 3.7% growth during the period under review. (BP, 2022). This was accompanied by fluctuations in national gas production growth, due to certain circumstantial events affecting the production process, such as price fluctuations on the international market, the ageing of fields, and a lack of investment. (Abdelhamid, 2023)

On the other hand, annual consumption in 2019 reached around 46.6 billion m3, exceeding exports for the first time in three decades. This was repeated in recent years, namely in 2022 and 2023, (BP, 2022) Meanwhile, marketed gas production remained volatile, and as a result, the ratio of consumption to marketed production exceeded the 50% threshold, with a notable decline in production and consumption in 2020 due to the coronavirus pandemic, only to rise again a year after the crisis.

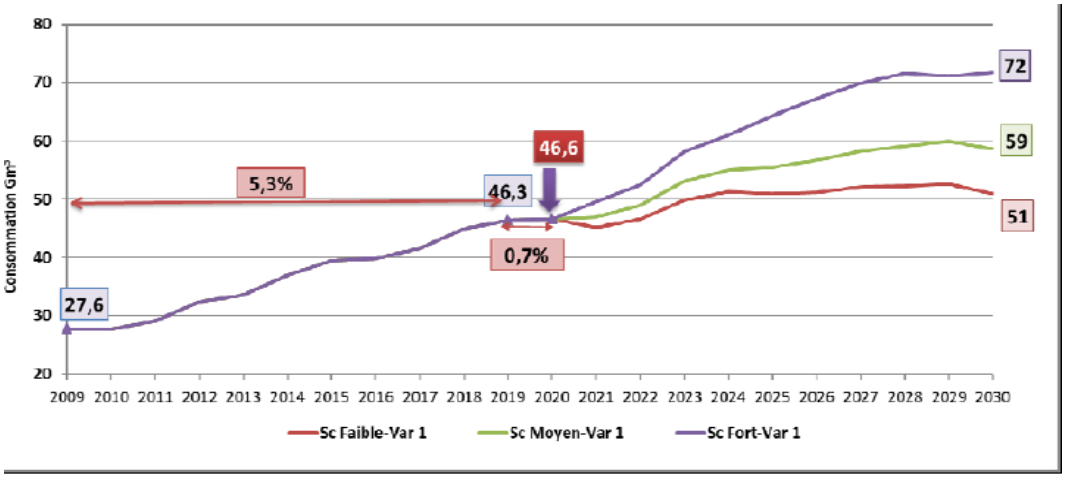
4-2- Natural gas demand forecasts for 2030:

Decision-makers need to know the future state of the country's energy landscape in order to achieve the goals set out in national strategic plans, so that they can achieve economic development based on the energy sources

that must be provided to the various sectors. (Enaki, 2018)

On the other hand, natural gas consumption data includes its use as fuel in various economic activities and domestic uses, excluding quantities that are burned or reinjected into wells. According to the Electricity and Gas Regulatory Commission, demand for gas in the national market is moving in three main directions, each of which represents a specific scenario, as illustrated in the figure below.

Figure (5): Future scenarios for the development of natural gas consumption in the 2030 outlook



Source: (CREG, 2019)

In general, natural gas consumption depends on three main factors Population growth, through an increase in the number of housing units delivered annually, and the resulting increase in natural gas and electricity needs. (Rahmouni, 2019) and economic growth related to the development of the industrial fabric, particularly gas-intensive industries such as iron and steel, cement, and others, in addition to the role played by domestic gas prices in changing consumption patterns. It is worth noting that Algeria has pursued a policy of energy price subsidies since its independence. The aim is to provide social assistance to the middle classes, not to mention encouraging the industrial sector to contribute to economic growth.

Algeria is expected to experience the fastest growth rates among African countries in natural gas consumption. Overall, under normal circumstances, the average growth rate of gas consumption is expected to reach around 2.7% during the period 2025-2030. In terms of the selected and

modified scenarios, we distinguish between:

According to the high growth scenario, which represents the option of expanding consumption of gas and its derivatives, national gas consumption will rise to 74 billion m3, reaching an estimated growth rate of 4.5% per annum. In the baseline scenario, national consumption will rise to 60 billion m3 at an estimated annual rate of 2.3%.

In the low-growth scenario, in which the government gradually raises natural gas and electricity prices, national natural gas consumption will rise to 53 billion m3, with a modest growth rate of 1% per annum. This will be reflected in a reduction in excessive gas consumption, contributing to the release of more natural gas for export. (Enaki, 2018)

5. Conclusions:

Natural gas plays a pivotal role in ensuring energy supplies and is an important financial resource in securing national income from exports. This explains its growing importance in the national energy mix in terms of both production and consumption. This role is expected to continue in the coming decades to achieve a balance between sustainable energy and economic considerations. However, excessive consumption of natural gas may lead to the depletion of this resource and potential negative risks to the economy.

Results: Based on the above, the following conclusions can be drawn:

- Natural gas accounts for half of Algeria's total primary energy production and 40% of the value of Algerian hydrocarbon exports. This makes it the most important source of energy both domestically and internationally.
- Natural gas prices in the domestic market are low compared to their counterparts in global markets, so any increase in consumption represents a shortfall in state revenues.
- Annual growth rates in gas consumption have exceeded annual growth rates in production, narrowing the gap between production and consumption. If demand for natural gas continues at the same pace without government intervention to rationalize consumption, domestic demand will trend upwards to meet sectoral needs, which will be offset by a decrease in the share of gas exports. This portends more serious changes for the future of the sector,

which could have dire consequences for the country. This confirms the validity of the second hypothesis.

- Natural gas consumption in Algeria has experienced the fastest annual growth rates compared to other primary sources, growing at an average annual rate of 3.7% between 2010 and 2023.
- Electricity production depends on natural gas for 97% of its contribution. This is particularly important as gas contributes to reducing emissions. Despite the increase in electricity use in recent years, the government continues its efforts to ensure energy security.
- The domestic gas consumption model is based on three key variables: population, economic growth, and domestic gas prices, which are among the most important factors shaping the domestic consumption system and essentially determining current and future trends in gas demand in the country.
- Natural gas is expected to contribute the largest share of all other primary energy sources to the projected increase in energy consumption between 2025 and 2030. It will therefore continue to dominate, alongside oil, the energy mix consumed in Algeria until 2050. This confirms the validity of the third hypothesis.
- The policy of subsidizing natural gas prices and selling it at low prices has encouraged excessive consumption and cost the state treasury huge sums that the government may not be able to commit to in the future. Furthermore, providing natural gas at below its real price hinders any competition that may arise from new or renewable technologies entering the market.

Recommendations: Based on the above findings, the following suggestions can be made:

- The pattern of natural gas consumption must be reviewed to meet the growing demand for it in light of fluctuating production and stable reserves for two decades due to the ageing of large fields characterized by high production intensity.
- Given the energy landscape in Algeria, it is necessary to conserve energy resources by rationalizing consumption and increasing the efficiency of gas and electricity use through investment in increasing production capacity and developing energy demand mechanisms.

- Policies should be adopted that focus on reforming the gas and electricity subsidy system through the gradual and then complete elimination of natural gas price subsidies, redirecting them to benefit middle-income families. This should be done in accordance with the principle of supporting individuals rather than prices.
- The government should periodically monitor developments in natural gas demand to ensure that the gap between production and consumption is maintained, as this difference is what guarantees that it can meet domestic demand and export abroad.
- Moving towards diversifying energy sources, especially renewable energy sources, will pave the way for energy transition and reduce the burden on gas and oil, not as an alternative to fossil fuels, but to provide gas for export and contribute to boosting sources of income.

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