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Article

# Saudi Arabia's Strategy in Associated Natural Gas Investment and its Impact on Industrial Transformation (1980-1985): A Historical Analytical Study

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**Abstract:** Natural gas is a cornerstone of national economies and a primary source of clean energy that supports sustainable development. Saudi Arabia's Vision 2030 has spearheaded serious efforts to optimize investment in this sector. This study aims to review Saudi Arabia's strategy for investing in associated natural gas and its impact on industrial transformation (1980-1985). It serves as a historical and analytical study of the Kingdom's ambitious natural gas investment strategy, examining its impact on maintaining a clean environment and supporting decision-makers in promoting sustainable economic development. The study focuses on analyzing the policies and strategies adopted by the Kingdom to develop the natural gas sector, enhance integration between the energy and industry sectors, support industrial cities, measure the industrial impact of this strategy, and evaluate its role in achieving sustainability. The study's main idea stemmed from recognizing the importance of natural gas investment in achieving the desired industrial transformation in the Kingdom and the resulting economic diversification. This involves encouraging a reduction in reliance on oil as the primary source of manufacturing and revenue, and exploring vital alternatives such as associated natural gas. The study raises the question of the positive and effective relationship between natural gas investment and industrial growth, examining the period between 1980 and 1985 and whether there are benefits to investing in it within industry. It also explores the extent to which natural gas contributes to reducing production costs and creating job opportunities. The study focused on analyzing the period between 1980 and 1985, which represents a turning point in the Kingdom's policy towards associated natural gas. Therefore, the descriptive and inductive methods were used to gather data. The results demonstrated the Kingdom's significant and distinctive interest in investing in associated natural gas as a crucial development resource and an alternative energy source for achieving economic prosperity and sustainable development. The study recommends working on the regional connection of the natural gas transmission network due to its economic and political importance. It also recommends urging the intensification of government initiatives to involve the private sector in the energy and petrochemical industries.
**Keywords:** NA

## 1. Introduction

Saudi Arabia faces a future strategic challenge represented by the need to diversify the national economy and reduce dependence on oil as a primary financial source. The Kingdom seeks to develop solutions within the Kingdom's Vision 2030, which was adopted by Crown Prince Mohammed bin Salman in 2016. Among these solutions is the investment of natural gas wealth as one of the most important resources that can contribute to supporting growth and industrial transformation at low costs, diversifying the national economy and financial revenues alike.

Natural gas is a very important fossil energy to distinguish it from other conventional energies—such as oil, coal and others—not polluting the environment widely. That its manufacture has existed for thousands of years, and therefore the handling of it is known and very inexpensive. Natural gas contributes to sustainable development and achieving its goals. Moreover, it serves that development in its economic aspect by providing employment positions from projects established on the basis of its investment. This serves to achieve the optimal use of natural resources to ensure that future generations get benefits out of that. It also serves development on its industrial side, especially with regard to petrochemical industries, which are based on the theory of structural transformation by moving from rentier economies (Oil and crude gas revenues) to productive economies based on industrial diversification and stimulation of manufacturing industries.

The Kingdom had to accelerate the investment of its natural gas for certain developments. These developments are noticed in the transformation of many agricultural countries into industrialized countries, the wide spread of individual and public means of transport, the impact of the industrial sector on the agricultural sector, which has entered the mechanization phase, and the wide use of fertilizers, pesticides and other petrochemical products. Undoubtedly, as it is known that the associated gas fields in the Kingdom represent a huge economic wealth and an environmental opportunity, therefore, the transition from flaring this gas to processing and exploitation is the core of the modern energy strategies adopted by the country's leadership. This investment contributes to supporting the petrochemical industries, providing clean fuel for electricity generation, combating climate change, and achieving the sustainable development goals which are among the most important desired goals.

Vision 2030 confirms the inevitability of this investment, which began in the early 1980s. It is a vision that insists on reducing dependence on oil as the primary source of income, supporting industrial transformation to achieve integration between the energy and industrial sectors, expanding the production of alternative energy sources and increasing the added value of the petrochemical industry. Consequently, the Saudi Aramco Company changed its strategy from being the largest oil exporter to becoming one of the largest energy exporters of all kinds. This means that it has succeeded in utilizing the available gas resources to contribute to building a diversified and sustainable national economy.

**Statement of the Problem and Research Questions:**

The main idea of the study revolves around the extent of the contribution of natural gas investment in achieving industrial transformation in the Kingdom and the resulting diversification in the national economy by reducing dependence on oil as a primary source of manufacturing industries and financial revenues. The problem of the present study has raised a number of questions that can be drawn through the following points:

1. Is there a positive and effective relationship between natural gas investment and industrial growth by looking at what was done between 1980 and 1985?
2. What impact did the Kingdom's natural gas investment strategy have on industrial transformation during the study period?
3. To what extent can natural gas in Saudi Arabia help reduce production costs and create jobs?
4. How does the natural gas investment strategy enhance the environmental sustainability process aimed at achieving the Kingdom's Vision 2030?

**Research Objectives:**

This study aims to analyze Saudi Arabia's ambitious strategy in natural gas investment, study its impact in conservation on a clean environment, and support decision makers in making their decisions in promoting sustainable economic development. The study also aims to support research on industrial transformation projects, localization of petrochemical industries, and diversification of the national economy within the framework of the Kingdom's Vision 2030. The study focuses on analyzing the policies and strategies adopted by the Kingdom to develop the natural gas sector, promote integration between the energy and industrial sectors, support industrial cities, measure the impact of that industrial strategy and assess its role in achieving sustainability.

**Significance of the Study:**

The significance of this research project stems from the increasing role of natural gas as a more efficient energy source and less environmental impact (reducing carbon emissions). In addition, it is being a key input in the manufacturing and petrochemical industries, and even supports future advanced industries. Moreover, investment in it enables the creation of thousands of direct and indirect jobs. The research is expected to link gas strategy to industrial transformation in a modern Saudi context and enhance scientific understanding of the role of natural gas in reducing industrial costs, increasing competitiveness and achieving environmental sustainability.

**Limits of the Study:**

The study time limits were chosen between 1980 and 1985 because they represent the stage of transformation in the Kingdom's policy towards associated natural gas, in which gas has effectively moved from being a waste product to a resource managed within a clear economic and industrial policy. In 1980, projects began to collect and process associated gas and directed in an orderly manner to feed power plants and basic industries. The year 1985 was the end of that stage after the completion of the first operational structure of the gas investment system and the emergence of its results. This period of time does not represent a general time frame, but reflects the stage of establishment and activation of the associated gas investment policy, making it the most appropriate period to analyze the origins of this policy and its crystallization in its historical context.

**Study Method:**

The nature of the study subject and the objectives it seeks to achieve required reliance on the descriptive approach and the inductive approach in collecting scientific material such as historical and scientific information, figures and graphs from various sources and references, especially reports Aramco and others. Then they were arranged, classified, reformulated and conceptualized. Data collection relied on the analytical and comparative approach by exploring or analysing the collected data, mainly those from official sources. Furthermore, industrial indicators were analysed, literature and scientific explanations were reviewed. Ultimately, the most important findings were summarised and the most prominent possible recommendations that correspond to the current reality and future prospects were stated, too.

**Structure of the Study**

This study is structured according to the following outline:

- Introduction: Provides an introductory background to the study topic, defines the research problem, and outlines the research questions, objectives, significance, scope, and methodology. It then presents the structure of the study and concludes with a review of the most relevant literature.
- Section 1: The Strategic Foundations of Natural Gas Investment in the Kingdom
    - First: The reality of natural gas prior to 1980.
    - Second: The state’s motives for investing in associated gas.
- Section 2: Implementation Mechanisms of the Gas Investment Strategy
    - First: The Master Gas System (MGS).
    - Second: Infrastructure (pipeline network, processing plants, and industrial cities).
- Section 3: Impact of Gas Investment Strategy on Industrial Transformation (1980-1985)
    - First: The establishment of petrochemical industries
    - Second: The implications of the strategy for the national economy and the international evaluation of the Saudi experience
- Conclusion:

- Key findings
- Recommendations

Previous studies: It is no exaggeration to claim that this study is the first of its kind in its field. Numerous publications, scientific research studies, and academic dissertations dealing with energy and natural gas topics were limited to scattered references to them, without examining the nature of the strategy pursued by the Kingdom in leveraging associated natural gas, or the impact of that strategy on the industrial transformation the country has witnessed since the early 1980s. Among the most prominent previous studies with limited relevance to this research are:

1. Al-Abdullah (2000), a peer-reviewed article: The Role of Oil and Gas in the New Century of the Third Millennium.
2. Wallis and Agakou (2002), Joint Peer-Reviewed Article: Future Developments in LNG Manufacturing Technology.
3. Al-Lababidi (2004), a peer-reviewed article: The Natural Gas Industry in the Arab Countries.
4. Abdel-Moati (2014), a peer-reviewed article: The Role of Natural Gas in Achieving Sustainable Development in Arab Countries.
5. Qaham and Sharqraq (2016), a joint peer-reviewed article: The Green Economy for Facing Environmental Challenges and Creating Job Opportunities.
6. Al-Harbi (2021), a doctoral dissertation: Energy Policies and Their Impact on Economic Diversification.
7. Al-Otaibi (2022), a master's thesis: The Role of Natural Gas in Supporting Industrial Development.
8. Nagmoushti and Maizi (2022), a joint peer-reviewed article: Achieving Sustainable Development in Algeria Relying on Natural Gas.
9. Al-Zahrani (2023), a master's thesis: The Relationship Between Energy Consumption and Industrial Growth.

All these previous studies emphasize the importance of natural gas wealth in supporting the manufacturing industry, but they did not directly link this between the national strategy and industrial transformation, which this study seeks to address and clarify the details.

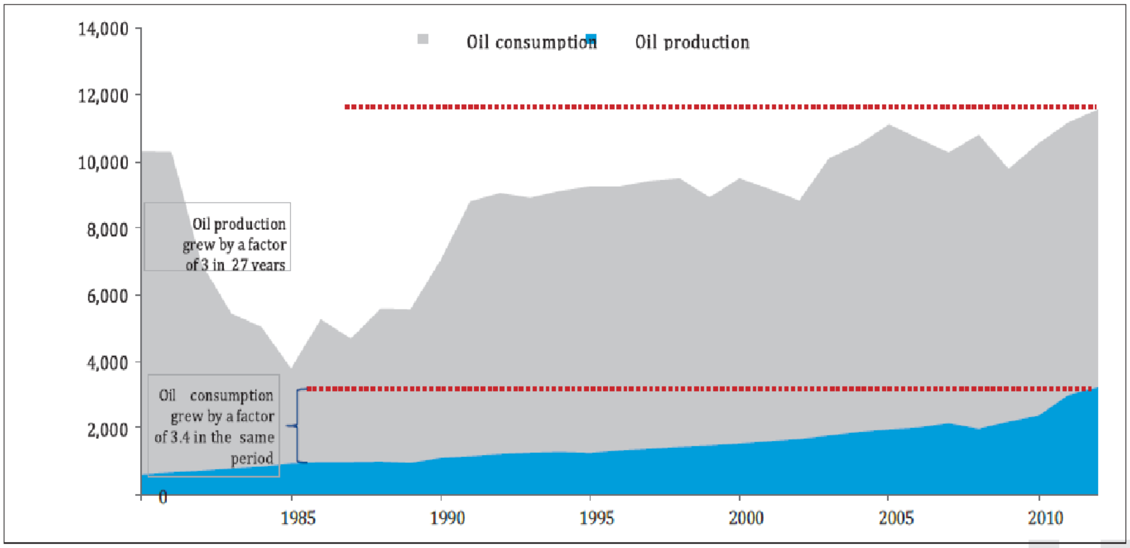
Section 1: The Strategic Foundations of Natural Gas Investment in the Kingdom

First: The reality of natural gas before 1980:

The actual exploitation of oil began when it was discovered in 1859 in Pennsylvania, USA. With the advances in technology, exploitation of oil began to replace coal due to its availability at cheap prices, and due to the flexibility of its exploitation compared to coal (Burnan, 2007, p 33). In the Arabian Peninsula—and in Saudi Arabia in particular—oil was discovered in the 1930s, but large-scale production only began after the Second World War (Group of researchers, 2014, p 19). Figure 1 shows the production and consumption of crude oil in the Kingdom between 1980 and 2012.

**Figure 1**

*Production and Consumption of Crude Oil in the Kingdom between 1980 and 2012*



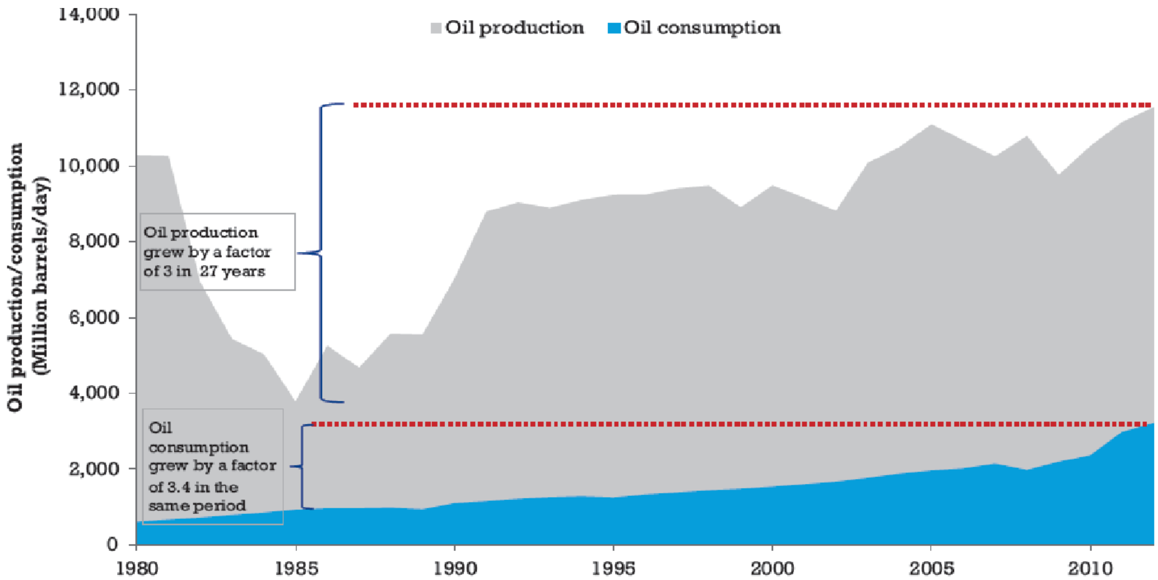

Natural gas was not of interest, as the discovery of a gas well instead of oil during the exploration process represented a loss for the investor, and to get rid of it was flaring . With technological and scientific development and changes in global market forces, attention and reflection began on how to exploit this important resource to meet the growing demand for it as a clean fuel compared to coal and other energy sources (Lombart, 1990, P. 170). It has therefore become a key pillar of the global and Arab energy industry, especially with international commitments to eliminate routine gas flaring by 2030 (British Petroleum, 2005, P. 20).

Natural gas does not exist in nature uniformly, but appears in different geological forms that determine the way to extract and exploit it economically. In the fields there are two types of gas: associated gas or non-associated gas (free gas). The associated gas is the self-contained gas in crude oil reservoirs, where it is either dissolved in oil under the influence of dissolved gas, or clustered over oil in the form of gas cap inside the same geological reservoir. It is automatically produced as a by-product during the oil extraction process (Jamali, 1978, p. 34). The global reserves of associated natural gas were about 15% (Burnan, 2007, p. 110). On the other hand, the non-associated gas (known as "free gas") is a gas that is solely located in independent gas reservoirs that do not contain commercial quantities of crude oil. It is produced independently of oil. It is primarily developed and produced to meet market needs for natural gas, both for domestic consumption and for export (IRT, 1966, p. 60).

This basic classification of associated and non-associated natural gas fields is not just an academic distinction, but the nature of the presence of gas inside the reservoir directly affects the methods of production and processing of each type. Moreover, that nature is reflected in the economic feasibility of gas projects, and the infrastructure required to transport and exploit gas in both types of fields (Stevens, 1997, p. 168). It attracts huge capital in the field of investment, due to its industrial intensity as well as the use of accurate and advanced technology in order to overcome all the problems of its industry (Burnan, 2007, p. 24). Most of the natural gas reserves in Arab countries are from non-associated gas, which accounts for about two-thirds of all Arab reserves (The Gulf States and Algeria), while the remaining third is gas associated with oil production (Burnan, 2007, p. 34). Figure 2 is a graph showing the position of Saudi Arabia among the best countries in terms of natural gas reserves in the world.

**Figure 2**

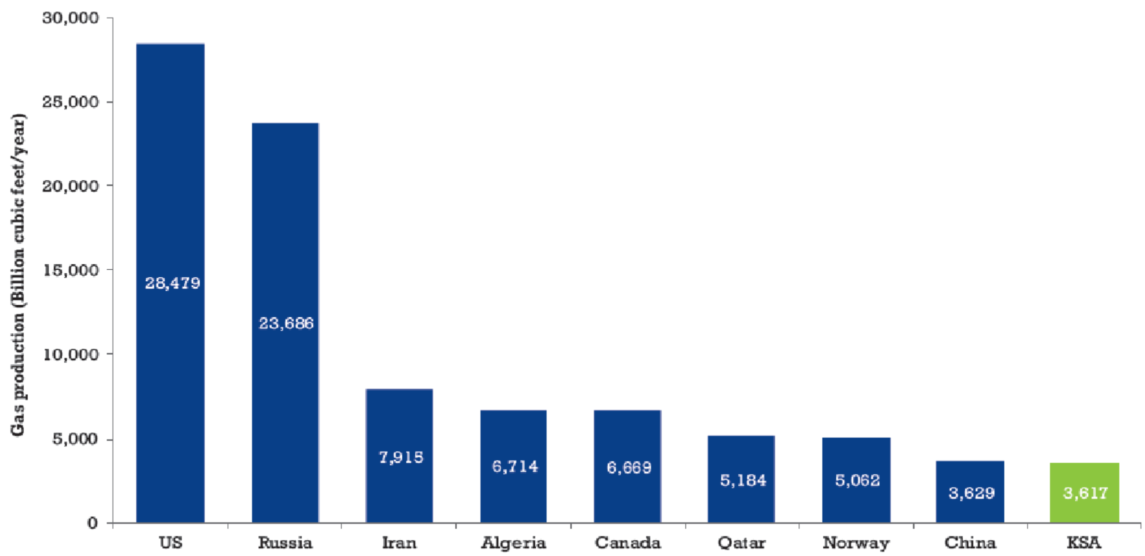
*Saudi Arabia position among natural gas reserves countries in the world*




Saudi Arabia has the fifth largest natural gas reserves after Russia, Iran, Qatar and the United States with an estimated 288 trillion cubic feet. Saudi Arabia produces about 3,615 billion cubic feet of natural gas annually, equivalent to about 3% of global production. Most of this domestically produced gas is consumed mainly for power generation (Group of researchers, 2014, p. 20). Prior to the 1980s, natural gas production in the Kingdom was associated with crude oil production since the early 1950s. Aramco has used limited quantities of Aramco fuel as fuel for Aramco plants or injected it back into the ground as a way to maintain pressure in the Ghawar and Abqaiq oil fields. Additionally, quantities of that gas was distributed to a number of local industries and energy companies (Lawton & Arthur, 1982, p. 21). In the mid-1970s, only about 15% of the gas produced, or about 1.5 trillion cubic feet per year, was used, but this rate rose to 42% by 1982. The growth in net production is mainly due to the Ghawar field after the establishment of the Master Gas Gathering (MSG) project (Bergendahl, 1985, p. 20). The aforementioned Ghawar field is the largest onshore field in the Kingdom of Saudi Arabia, while the Safaniya field is the largest offshore field in the Arabian Gulf (Group of researchers, 2014, p. 19). Figure 3 is a chart showing Saudi Arabia's position among the world's top natural gas producing countries.

**Figure 3**

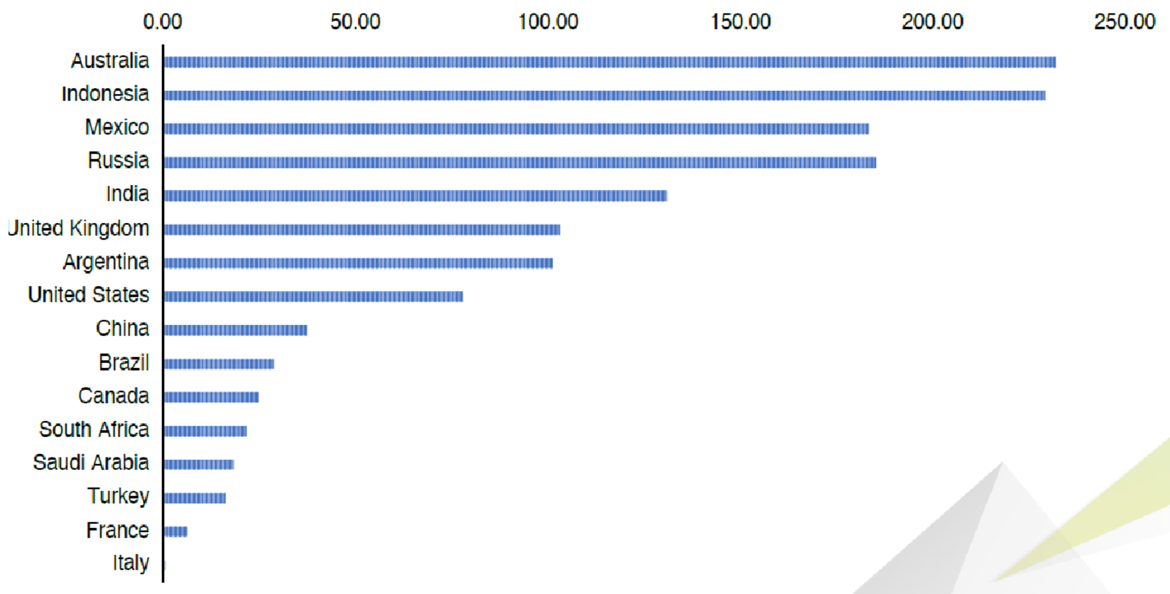
*Saudi Arabia's Position among the world's Top Natural Gas Producing Countries*




Before the establishment of the master gas collection project in 1982—before the beginning of the radical shift in the Kingdom's energy policy—the associated natural gas was flared in large quantities as a result of the absence of infrastructure. World Bank reports estimated that the rates of gas flaring in the Kingdom during the 1970s were among the highest globally, with the loss of a large proportion of the gas produced without economic exploitation (World Bank, 2022, p. 2). Due to the lack of a market for this type of gas, the collection and treatment of gases was not economically feasible at that time (Lawton and Arthur, 1982, p. 21). Flaring rates gradually declined during the 1980s as a result of the implementation of capture and processing policies, with flaring volumes decreasing by more than 60% during the decade, while production increased by nearly 60%. This demonstrates a clear inverse relationship between increased natural gas production and decreased flaring rates. A comparison between some countries of the world in the amount of gas flared in cubic feet per barrel of oil produced is shown in Figure 4. This reflects the significant shift in resource utilization efficiency and the success of the policy of redirecting gas from a wasted resource to a productive element (Saudi Aramco, 2019, p. 2).

**Figure 4**

*Gas Flared Amount in Cubic Feet per Barrel of Oil Produced among Countries*

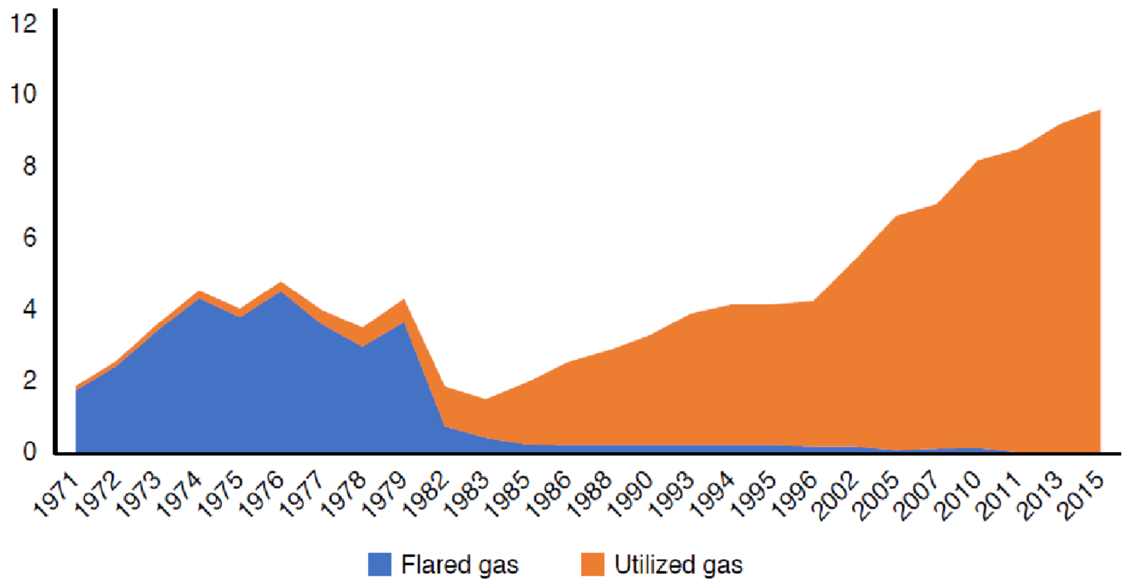



**Second: The state's motives for the investment of associated gas**

The development of energy consumption of all kinds is a double-edged weapon. On the one hand, it guarantees sustainable development, which preserves for future generations their right to benefit from natural resources without depleting them. On the other hand, energy consumption has a negative impact on the environment, as it emits stuck or evaporated particles that affect the environment and human health. Proceeding from this equation, it has become a major concern for decision makers in different States and the wider international community to achieve two main objectives: ensuring the security of energy supply and reducing the emission of polluting gases to the environment. With a view to achieving these goals and winning the bet of sustainable development, decision makers have been guided by the exploitation of natural gas of both associated and non-associated. Saudi Arabia was one of the first Arab countries to invest in associated natural gas since 1980. Investment policy has undergone a profound structural shift from a traditional pattern of associated gas disposal through flaring to a strategic model based on its investment as an economic asset supporting industrial development (Saudi Aramco, 2020, p. 3). Figure 5 displays the natural gas utilization and flaring in Saudi Arabia in billions of cubic feet per day.

**Figure 5**

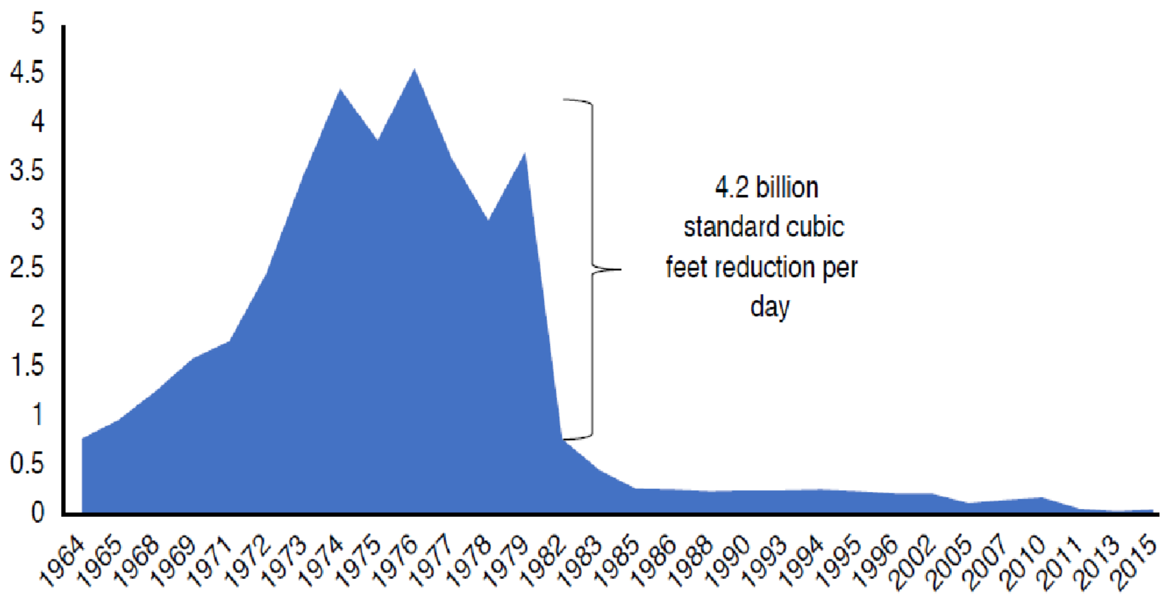
*Utilizing and Flaring Natural Gas in Saudi Arabia*




This transformation came in the context of five-year development plans aimed at maximizing the use of resources and reducing waste. This phase contributed to the establishment of an integrated gas system that is considered among the largest in the world (British Petroleum, 2005, p. 22). This system has preserved the "added value" of gas by utilizing it as a primary feedstock in petrochemical industries, electricity generation, and water desalination (Saudi Aramco, 2020, p. 3; Bergendahl, 1985, p. 20), as well as other direct and indirect economic benefits. Figure 6 shows the amount of natural gas flared in the Kingdom of Saudi Arabia in billions of cubic feet per day.

**Figure 6**

Amount of Natural Gas Flared in Saudi Arabia in billions of cubic feet per day




The motives behind this strategic decision were many, perhaps the most important of which were the following:

1. Cleanliness of natural gas industries compared to other traditional energies: Natural gas is used in many industrial sectors, including mining, aluminium industry, chemical and petrochemical industries. Countries resort to natural gas in order to create added value in the national economy instead of exporting it in the form of ore (Saudi Vision 2030. 2016, p. 3). Despite these benefits, natural gas is the cleanest and most sustainable energy source. The percentage of carbon dioxide emissions per unit of energy produced by natural gas is 57%, while it is 100% in coal and 71% in oil. The pollution caused by natural gas is only 60% less than that caused by coal (Al-Mashhadani, 2014, pp. 132-133). The liquefied petroleum gas (GPL) produced from natural gas by the process of separating the gases from it and used as fuel is more used compared to other fuels due to the abundance of supply and distribution facilities and the multiple uses. It is characterized by its limited impact on the environment. It does not contain sulfur and lead or benzene aromatic substances. Furthermore, its use does not lead to the emission of stuck or evaporated particles affecting the environment and human health (Purnan, 2007, p. 35). Finally, using it reduces carbon dioxide emissions by 83%, thereby enhancing ozone layer protection and environmental conservation (Kosi & Marentani, 2000, p. 67).

2. Abundance of associated natural gas in the Kingdom: The largest conventional onshore oil field in the world is the Ghawar field located in the Eastern Province. Since 1981, it has been producing huge quantities of associated natural gas collected, transported and processed through the "Master Gas System" project (Saudi Arabian oil company, 2019, p. 133). The field "Safaniya" located in the Arabian Gulf is the largest offshore field in the world. It was exploited in 1957. Like the Ghawar field, it produces associated natural gas. The reserve of this gas field is estimated in thousands of billions of cubic meters (Group of researchers, 2014, p. 19). The Marjan offshore field produces both associated and non-associated natural gas. The production is up to 2.5 billion cubic feet of gas per day (Saudi Aramco, 2019, p. 3). These fields have become the backbone of the Saudi energy industry, and even of the global energy industry because they contribute a huge percentage of total global demand for both oil and natural gas.

3. Depletionable: With the abundance of production, however, natural gas (associated and non-associated) is a very limited natural wealth, the subsoil stores infinite quantities of it. The quantities extracted are depleted and not compensated in other quantities, so it must be considered "scarcity element" and its introduction into the composition of the sale price along with the total other costs. This is expressed in “rents of scarcity,” and this rent rises whenever the price of natural gas rises as an indication of the importance of its demand. The price of gas in light of strong competition can not be equal to the marginal cost (the cost of making a unit of increase of the commodity) for production (Wrigert, 2005, p. 69). Therefore, it is imperative for decision makers to invest this scarce commodity to bring the national economy better material returns because dependence on the export of crude oil and gas without industrial investment does not guarantee stable financial revenues for the country. The oil and gas market is experiencing severe political and economic fluctuations. On the other hand, OPEC—of which Saudi Arabia is a founding member—cannot control global prices because non-OPEC countries have increased their production to meet global demand, and disagreements have even arisen between the member states themselves (Group of researchers, 2014, p. 22).

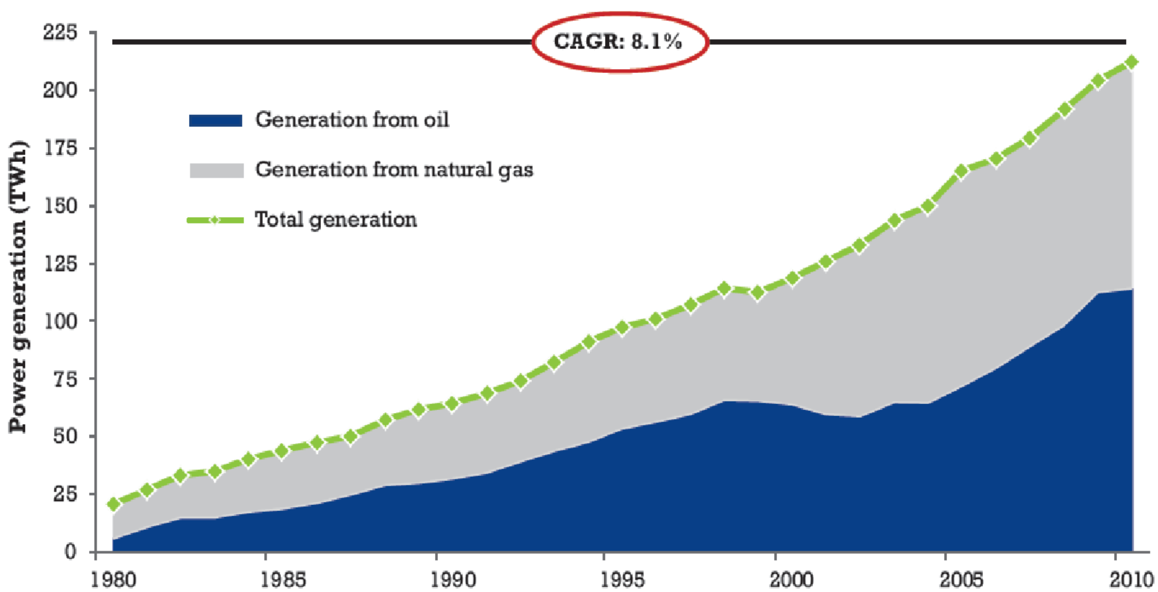
4. Technological development: The hydrocarbon industry, including the natural gas industry, is based on technically and technologically developed, sophisticated and advanced production methods and equipment. Unfortunately, this industry is monopolized by international companies, which makes them impose their policies on this sector all over the world and thus reap significant profits (Brandt & Wilson, 1987, p. 38). The natural gas industry was the most difficult and expensive hydrocarbon industry. Thus, it is costly that not all countries could afford (Nagmoush Maizi, 2022, p. 377). However, due to technological development and the speed of its availability between countries changed the matter in the gas industry for the better and easier. This change allowed the Kingdom to obtain a technology in investment cooperation with international companies that provided them with the required high skills and techniques, special training and necessary advanced educational achievement (Saudi Aramco, 2018, p. 2). On the other hand, the use of natural gas in transportation has been limited in the world, including the western world (Europe and America), but then

technological development discovered what is known as "oxygen fuel," which is the most important source of natural gas because it contains important elements involved in its composition. The oxygen fuel was used as a fuel for cars or enhanced in terms of pollution and thermal value as well as the safety of the engine (Cousy & Marentani, 2000, p. 67). Due to the characteristics and advantages of this fuel and its positive effects on reducing air pollution, in addition to its economic efficiency, it has expanded its use as an enhancer for automotive fuel. Hence, the use of this type of fuel was approved in the United States in 1988. Two years later the United States Senate approved the Clean Air Act (CAA), which encouraged the use of oxygen fuel as a good car fuel enhancer (Burnan, 2007, p. 66). Then this fuel spread and the average growth in global demand for it reached about 22% annually at the beginning of the late eighties. Global consumption of it reached about 15 million tons in 1995, and then it reached about 17 million tons in 1997 (Abu Al-Naja, 1996, p. 87).

5. Increasing the consumption of electric energy: The need for this energy, essential to modern life, has compelled the Kingdom to resort to natural gas for its supply. Electricity use is steadily increasing due to technological advancements that have led to the emergence of inventions essential for daily life, such as refrigerators, air conditioners, digital devices, and others. This is in addition to the massive electricity requirements of major industrial projects (Naghmoush Maizi, 2022, p. 392). Electricity consumption in Saudi Arabia increased more than tenfold between 1980 and 2010, making the Kingdom the nineteenth largest consumer of electricity in the world (Group of researchers, 2014, p. 17). The diagram in Figure 7 illustrates the sources of electricity generation in the Kingdom of Saudi Arabia and their volume over thirty years.

**Figure 7**

*Sources of Electricity Generation in the Kingdom of Saudi Arabia*




Conversely, the use of natural gas as fuel for power plants has increased since the early 1970s, following scientific advancements in research programs related to the development of open-cycle gas turbines (OCGTs) and steam turbines (STs). This led to the introduction of natural gas as a fuel for power plants, replacing oil and its derivatives, due to its physical and chemical properties that facilitate the use of these turbine technologies (Junecher, 1990, p. 77). This increase is also driven by economic factors—in terms of scientific efficiency and technical factors such as the speed of installing natural gas-fired power plants, which reduces costs and accelerates the commissioning process—as well as the leading role of natural gas in electricity production compared to other fuels, due to its environmental advantages (Davies, 1994, p. 21). Power plants using natural gas do not emit sulfur dioxide, which causes acid rain and respiratory problems for humans and other living organisms (Abu Ras, 1993, p. 25).

Likewise, natural gas-fired power plants are more suitable in arid or water-scarce regions. These areas do not require significant amounts of water for cooling equipment (Touimer, 1999, p. 160), which is perfectly suited to the desert environment of Saudi Arabia. Therefore, natural gas in the Kingdom provides an estimated 44% of the fuel needs for electricity generation (Group of researchers, 2014, p. 18).

6. Investment decline in the nuclear energy sector: The number of nuclear plants in the world tripled between 1973 and 1984, and global consumption of nuclear energy rose from 46 million oil equivalent in 1973 to 145 million oil equivalent in 1979, an increase of 216% (Burnan, 2007, p. 37). The increased reliance on electricity generation after the high price of oil after the first oil shock that hit the world when the Arab countries refrained from selling oil to western countries in 1973 (Abdullah, 2006, p. 232). However, investment in nuclear energy began to fade due to the increased radiation risks to environment, ocean and humans, especially after the famous Chernobyl accident in 1986 (Al-Alfi, 2022, p. 633). Furthermore, the industrialized countries have been somewhat unsuccessful in controlling the costs of nuclear power production, especially in electricity (Al-Dar, 2005, p. 54). On the other hand, there were problems of storage of residual use of nuclear fuel that cannot be recycled or disposed of (Burnan, 2007, p. 56).

There are many other motives that have driven the Kingdom's government to invest in associated gas. Yet, the primary motivation remains the Kingdom's determination to fully, reliably, and safely utilize this rare and non-renewable natural resource. This is to ensure the well-being of future generations, in accordance with a sustainable development plan that began in the early 1980s and continues to this day with steady progress.

**Section 2: Implementation Mechanisms of the Gas Investment Strategy**

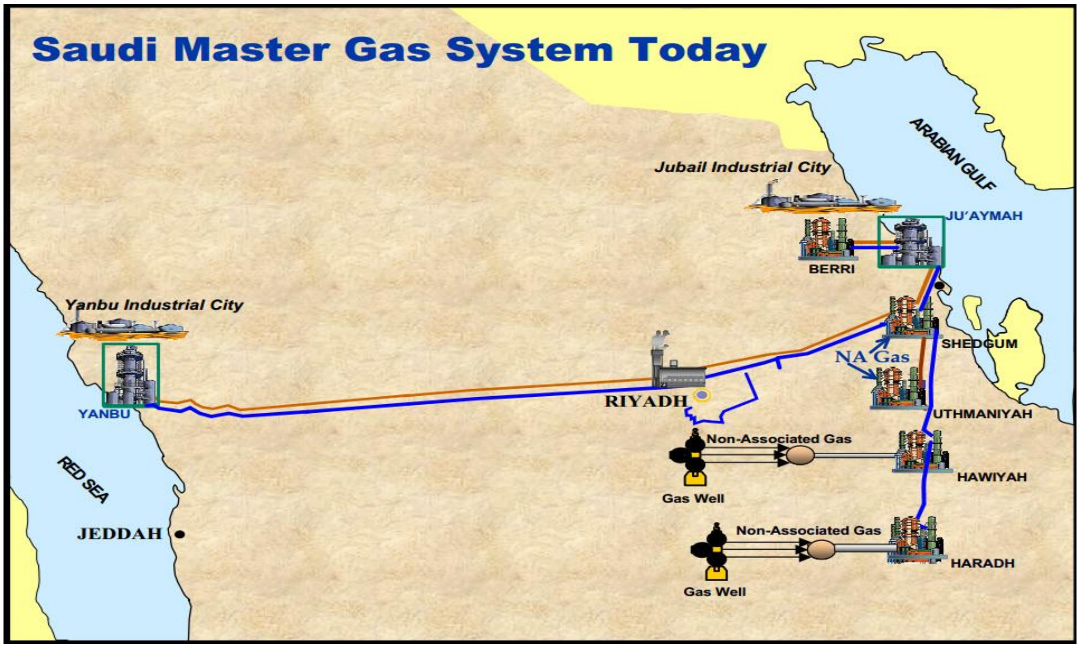
**First**: Master Gas System (MGS) project

Countries possessing large reserves of natural gas have worked to pay attention to this wealth and value it by raising investment rates in this field and preparing to enter strong competition. Scientific and technological progress has helped to grow this sector and eliminate obstacles that have been a stumbling block to its development by introducing modern methods and ways, especially in the field of transportation and gas conversion (Girand, 1987, p. 104). Natural gas penetration into the global energy budget and its availability on the market encouraged its consumption and substitution for other sources of energy for environmental and other economic considerations (Burnan, 2007, p. 44).

The idea of optimal utilization of associated natural gas in the Kingdom began in 1959 when Aramco began to develop the system of collecting, transporting, distributing and employing associated natural gas to extract what is known as "natural gas liquids" (NGL). It is a comprehensive term used to describe some light hydrocarbon components extracted with oil. Then the fruits of this initial effort began to appear in 1961 when Aramco began exporting liquefied petroleum gas (LPG) (Lawton and Arthur, 1982, P. 21). Following this success, the Saudi government decided within the framework of the second five-year plan (1975-1980) to launching a massive industrial program based on large-scale gas collection and processing. The government took a decision in 1975 to build a project called "Master Gas System" (MGS). MGS is an expanded and highly integrated gas system capable of processing 3.5 billion cubic feet of gas per day. Moreover, it is relied upon to achieve the prospective industrial program (Lawton and Arthur, 1982, p. 21). The project's implementation unfolded in a series of carefully planned and phased steps. The foundational phase, from 1975 to 1982, involved establishing the infrastructure for collecting associated gas from major fields in the Eastern Province – such as the Ghawar and Abqaiq fields – and connecting it to processing centers. This was followed by the expansion phase, which began in 1982 and ended in the mid-1980s, extending the network to industrial complexes in Jubail Industrial City, leading to the subsequent improvement and integration phase (Saudi Aramco, 2020, p. 3). Figure 8 shows a diagram illustrating the "Master Gas System" project after its completion and the start of production.

**Figure 8**

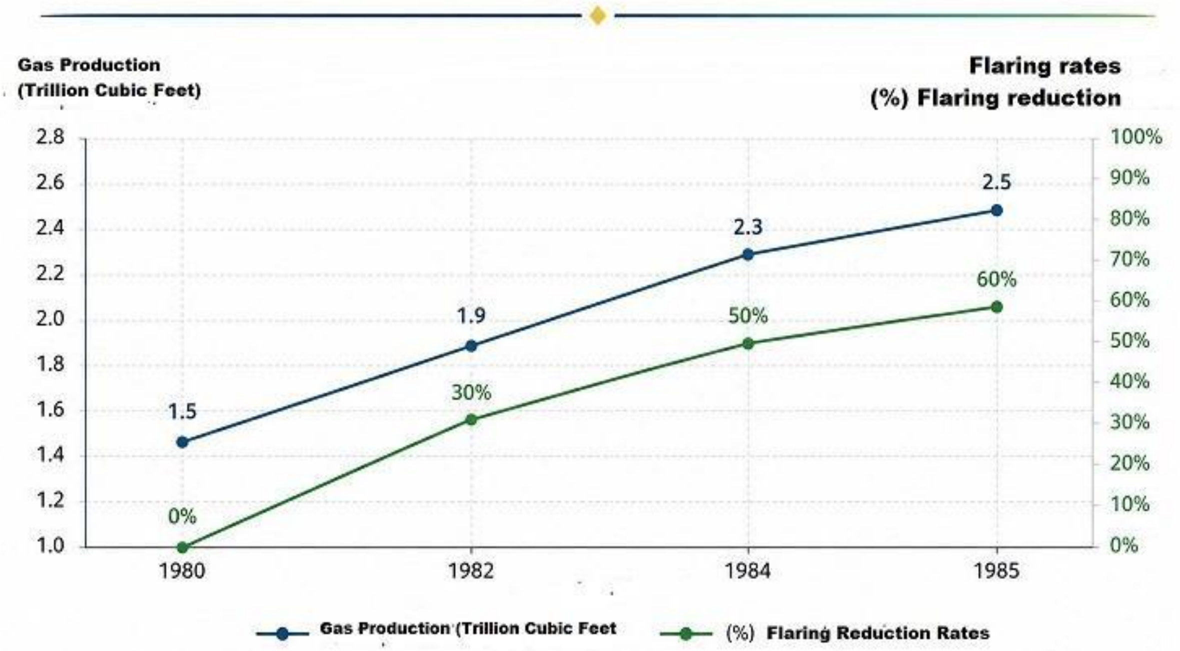
*Saudi Arabia Master Gas System Project*




The project cost US $12 billion to be completed (Bergendahl, 1985, p. 20). The central turning point in the Kingdom's energy policy, as it moved from the politics of "get rid of gas" by flaring it to the policy of "collection, transport and investment" of this important resource. Therefore, it was turned into a strategic production entrance that ensures the stability of supplies to the industry and reduces the amount of waste by flaring. Over the years, the project has been able to produce and process nearly 537000 barrels of natural gas liquids per day. Moreover, the quantity of 11.5 tons of sulfur was produced and procced per day (Bergendahl, 1985, p. 20), making the Kingdom the world's largest exporter of natural gas liquids (Lawton & Arthur, 1982, p. 21). Figure 9 shows the inverse relationship between gas production and reduced flaring rates during the period between 1980 and 1985.

**Figure 9**

*Inverse Relationship between Gas Production and Reduced Flaring Rates*




The implementation, design, construction, and operation of the project in its vast network were spearheaded by Saudi Aramco, which contracted with numerous leading international companies, employed tens of thousands of engineers, technicians, and workers, and imported two million tons of advanced equipment and materials (Lawton and Arthur, 1982, p. 24). Petromin, the Saudi Arabian company, handled the marketing of the project's products and was already responsible for the domestic distribution of various petroleum products and some of the export marketing of crude oil (Lawton and Arthur, 1982, p. 25). Engineering expertise from international companies such as Bechtel and Fluor was utilized in the design, construction, and knowledge transfer. The Saudi government provided financial support, strategic guidance, and contract review through the Ministry of Petroleum and Mineral Resources and the Supreme Council for Petroleum and Minerals (Group of researchers, 2014, p. 32). This institutional collaboration reveals an early adoption of the "international technical partnership" model, which combines national sovereignty and international expertise to accelerate the building of productive capacities (Saudi Aramco, 2018, p. 2).

Using international technical partnership, the Kingdom has aimed to achieve high technology transfer, build national human capacity, develop manufacturing industries and enhance the competitiveness of the national economy (Saudi Vision 2030. 2016, p. 3). In addition to opening global markets for Saudi industrial products, analysis of these objectives reveals—when compared to the previous phase which focused on resource extraction without processing—a strategic shift towards investing in knowledge and technology as pillars of industrial development. This intersects with the objectives of Saudi Vision 2030 in localizing industry and promoting innovation (World Bank, 2005, p. 2).

The period 1980-1985 witnessed the practical implementation of this partnership within the master gas system project. Industrial joint ventures have been established in this field. For example, Yanpet (Yanbu Saudi Petrochemicals) was established in partnership with Exxon Mobil in 1980. Sharq East (Oriental Petrochemicals) was established in partnership with Shell in Jubail Industrial Area in 1981. Moreover, there were other different establishments along with other joint ventures like Mitsubishi (SABIC, 2023, p. 2). These agreements included strategic clauses that included sharing ownership, technology transfer, training national cadres, regulating marketing and exports, and ensuring the provision of industrial values gas. This reflects—when compared to traditional concession agreements—a shift from a model of technical dependency to a model of equitable partnership based on national capacity-building (World Bank, 2005, p. 3).

To sum up, the MGS project has marked a historic turning point in the Kingdom's policy towards associated gas during the early 1980s. It is a structural turning point in the path of Saudi industrial development in which dealing with this important wealth has gone from being a by-product flared for disposal to a strategic resource entering integrated industrial value chains. With granting that, the two industrial cities in Jebel and Yanbu were fed with energy and natural gas liquids. Furthermore, the associated gas was used in the local industry, especially petrochemical, in the generation of electricity, in the desalination of seawater (Bergendahl, 1985, p. 20), and in other important sectors in the life of the individual and Saudi society.

**Second**: The infrastructure of the project (pipe network, processing plants, industrial cities)

The realization of the Kingdom's strategy in the associated natural gas investment through the MGS project required the ambitious implementation of a set of enabling works that included the development of gas transmission pipeline networks, the construction of processing plants, and the construction of industrial cities under the supervision and implementation of Saudi and foreign companies. Some of these companies are stated below:

1) Pipelines: Pipelines are a key pillar in the oil and gas sector because of their pivotal role in transporting crude oil and its derivatives efficiently and safely. Since the discovery of oil in the Kingdom in 1938, pipelines have played an active role in transporting crude oil from fields to coastal ports for shipment abroad and transporting oil from offshore wells to storage tanks and export ports (Lawton and Arthur, 1982, p. 26).Those pipes were the Tapline (The Trans-Arab Pipeline) built by Aramco between 1947-1950. It extends for 1,664 kilometres through Jordan, Syria and Lebanon to reach the Mediterranean Sea, and has an operational capacity of 500,000 barrels per day (Bergendahl, 1985, p. 20). Yet, this line has been abandoned since the mid-1970s due to the Israeli occupation of some Syrian territories and the establishment of the Lebanese Civil War (Al-Anzi & Al-Mutlaq, 2020, pp. 33-34).

After the implementation of the MGS project, Aramco established a huge network of pipelines that extended to thousands of kilometres to connect the fields to processing and consumption centres, where the length of this network exceeded three thousand kilometres during the mid-1980s. This allowed the transfer of large amounts of ethane and natural gas liquids efficiently and link them to emerging industrial cities (EIA, 2021, p. 2). This network is two pipelines, one for crude oil (It is a petroleum pipeline linking the oil fields in the Eastern Province and the port of Yanbu, reaching a length of about 1,202 kilometres, and a capacity of about 1.85 million barrels per day (Bergendahl, 1985, p. 20). The other line of natural gas is running side by side from oil fields in the eastern region along the Arabian Gulf, passing through the middle of the Arabian Peninsula to the industrial city of Yanbu on the Red Sea coast (Lawton and Arthur, 1982, p. 27). The line for transporting natural gas liquids is 295,000 tons of solid iron pipe, with a length of 1,170 kilometres, and a capacity of about 270,000 barrels per day of natural gas liquids and ethane (Bergendahl, 1985, p. 21). This line connects gas processing plants in the Eastern Province to gas liquids retail and export facilities in Yanbu Industrial City and its port. It was completed in a period less than 20 months, specifically in July 1980, since it began work in November 1978 (Lawton and Arthur, 1982, p. 27). Figure 10 is a picture displaying a part of some of the huge pipes that make up the MGS project.

**Figure 10**

*A Part of the Huge Pipes Making up the MGS Project.*

The importance of these pipelines lies in that they bring Saudi energy exports either oil or gas closer from particularly western markets. On the other hand, they reduce the likelihood of supply bottlenecks in the Gulf region (Lawton & Arthur, 1982, p. 28). Additionally, they contribute to the transportation of natural gas liquids via processing plants to existing plants in the Jubail and Yanbu regions (Lawton & Arthur, 1982, p. 29). To sum up, the set of these pipelines is considered a part of building a diversified Saudi economy based on a solid foundation of operational efficiency that supports petrochemical and other secondary industries, increases the exploitation of gas resources, enhances energy security, and facilitates the movement of oil and gas exports.

2) Processing plants: Industrial facilities specialized in the separation of components of associated natural gas and its processing and conversion into industrial usable materials, where they represent a pivotal link in the value chain between production and end use. Those plants in the Kingdom were linked to the project of investing natural gas through the MGS project and was a key instrument in it within an integrated production system (Saudi Aramco, 2020, p. 3). The most prominent of these plants have been established in the Eastern Province near strategic production sites, such as Othmani plants (processing about 270,000 barrels per day), and the Shedqam plant (processing about 270,000 barrels per day), the Barre plant (processing about 71300 barrels per day (Bergendahl, 1985, p. 20). All these plants are among interconnected network connecting fields to processing centres and industrial cities (Saudi Aramco, 2018, p. 2) through more than 2400 kilometres of gas pipelines (Lawton & Arthur, 1982, p. 24). Saudi Aramco has designed, constructed, operated and developed these plants with international engineering expertise, which helped accelerate implementation and increase operational efficiency. Moreover, Aramco took over the management of operations and the follow-up of maintenance and expansion (Saudi Aramco, 2020, P. 3), as it went through multiple stages since its establishment in the early eighties (IEA, 2018, p. 3).

At the processing plants, natural gas components (methane, ethane, propane, pentane, butane, gasoline and other gas liquids) are separated, purified from sulphur and carbon dioxide compounds, compressed, transported and formulated as petrochemical industry values (IEA, 2018, p. 3; Bergendahl, 1985, p. 20). These plants have been operated from 1980 to 1985 based on basic industrial control systems (Process Control Systems), and on safety systems that provided a reliable level of operation compared to conventional methods (Saudi Aramco, 2018, p. 3). These systems, in terms of types and forms, vary between integrated main plants, primary processing plants linked to both oil and gas fields, and compression, transport and support facilities. This type of design reflects flexibility and responsiveness to the different production locations (Saudi Aramco, 2020, p. 3).

The number of plants reached 34 (Lawton & Arthur, 1982, p. 24). Among the most prominent of these plants is the main Yanbu plant, which is one of the largest in the world. It processes up to 270,000 barrels of natural gas liquids per day for export in two independent fractionation lines (so that if one is undergoing maintenance, the other continues to operate) since August 1982. It also supplies ethane as a feedstock for the petrochemical complex in that area. The complex produces about 450,000 tons per year of polyethylene and ethylene, most of which is for export (Lawton and Arthur, 1982, p. 29), loaded onto ships with a capacity of up to half a million tons (Lawton and Arthur, 1982, p. 24).

Industrial cities: Industrial cities are defined as planned spatial units dedicated to the incubation of industrial activities within an integrated environment of infrastructure, logistics and organizational services, allowing the clustering of factories and associated activities in a single geographical scope that achieves productive efficiency and operational integration. These cities are based on the principle of industrial clustering, which aims to strengthen links between different industries, reduce production costs, and increase competitiveness by providing shared services such as energy, water, transportation, and communications (World Bank, 2005, p. 3). This concept of establishing industrial cities—compared to the traditional industrial model based on the dispersal of factory locations—demonstrates a qualitative shift towards organizing production within an integrated spatial framework, where industry is no longer an activity separate from its surroundings, but rather has become part of an interconnected system that includes supply chains and supporting services (IEA, 2018, p. 3).

As processing plants, industrial cities have been directly linked to the associated natural gas investment project through the MGS, the industrial feedstock has formed the basis of the factories of those cities by supplying processed gas through the national gas network (Saudi Aramco, 2020, p. 3). The first objective of which was to produce heavy and petrochemical industries and provide refined petroleum products and manufactured goods for export and domestic use in order to reduce the Kingdom's economic dependence on crude oil exports and industrial imports (Lawton and Arthur, 1982, p. 22). These industrial cities also aimed to realize the principle of "value chains" by transforming natural resources into value-added industrial products by providing an integrated productive environment to diversify the economy and enhance the role of industry in GDP (Saudi Vision 2030. 2016, p. 3). Furthermore, these cities contribute in creating jobs, developing human capital, and providing an attractive investment environment that supports technology transfer and national capacity-building (World Bank, 2005, p. 3). As a strategic tool for economic development, these cities not only provide sites for factories, but also build integrated production systems that contribute to the integration of energy, industry and services, making them a central element of modern industrial policies.

During the period between 1977 and 1979, Jubail Industrial City emerged on the Arabian Gulf with an area of 900 square kilometres and Yanbu Industrial City on the Red Sea with an area of 150 square kilometres (Lawton and Arthur, 1982, p .33). As the two most important industrial cities during the transformation phase of the 1980s, they were established under the supervision and follow-up of the Royal Commission for Jubail and Yanbu within a strategic vision aimed at building integrated industrial culsters directly linked to energy resources and infrastructure, thus enhancing operational efficiency and reducing production costs (Royal Commission for Jubail and Yanbu, n.d. p. 2; Saudi Vision 2030, 2016, p. 3). The two industrial cities have undertaken the development of integrated infrastructure that includes power grids, oil refineries (refining more than 1 million barrels per day), petrochemical, fertilizer plants (producing 4 million tons per year of petrochemicals and fertilizers), cement, steel and rolling (Lawton and Arthur, 1982, p. 20). On the other hand, these cities run the management of water facilities, ports and logistics. Furthermore, they work on for attracting industrial companies and operating factories, especially in the petrochemical sector led by national companies such as SABIC (Saudi Basic Industries Company) and others (IEA, 2018, p. 3). Over the years, this has led to a significant transition in the Saudi economy from a rentier economy based on the export of crude to a more diversified and sustainable industrial economy. Thus, these two cities have become global production centres in the fields of petrochemicals and energy.

In a nutshell, the establishment of the infrastructure for the MGS project, including the pipeline network, processing plants, and industrial cities, has had profoundly positive economic, industrial, environmental, and structural impacts on the Kingdom. Gas flaring has been significantly reduced. Harmful emissions have been greatly decreased. A stable feedstock supply has been provided for heavy and petrochemical industries. The development of diverse downstream sectors has been accelerated. The economic structure has been reshaped from a rentier to a value-added industrial one. Furthermore, thousands of job opportunities have been created for Saudi citizens. All these positive effects are primarily the result of a wise vision of the ruling leadership, which has gradually contributed, within a long-term development framework, to building a solid Saudi industrial base.

**Section 3: Impact of Gas Investment Strategy on Industrial Transformation (1980-1985)**

**First**: The establishment of petrochemical industries

The petrochemical industry is a manufacturing industry that aims to convert raw materials into other forms that increase their use for more productive or consumer purposes (Purnan, 2007, p. 24). The petrochemical industry aims to convert and manufacture petroleum commodity products into various petrochemical commodity products, which promise dozens, including agricultural fertilizers, detergents, pesticides, dyes, plastics, synthetic tissues and many others. The industry began to emerge since the 1930s in some western countries such as Germany, England and the United States of America (Burnan, 2007, p. 28). Petrochemicals (hydrocarbon-sourced chemicals) contribute 85% to 90% to global chemical production, the rest being inorganic chemicals. Petrochemicals account for 75% of global organic chemicals production (Saadi, 1985, p. 96).

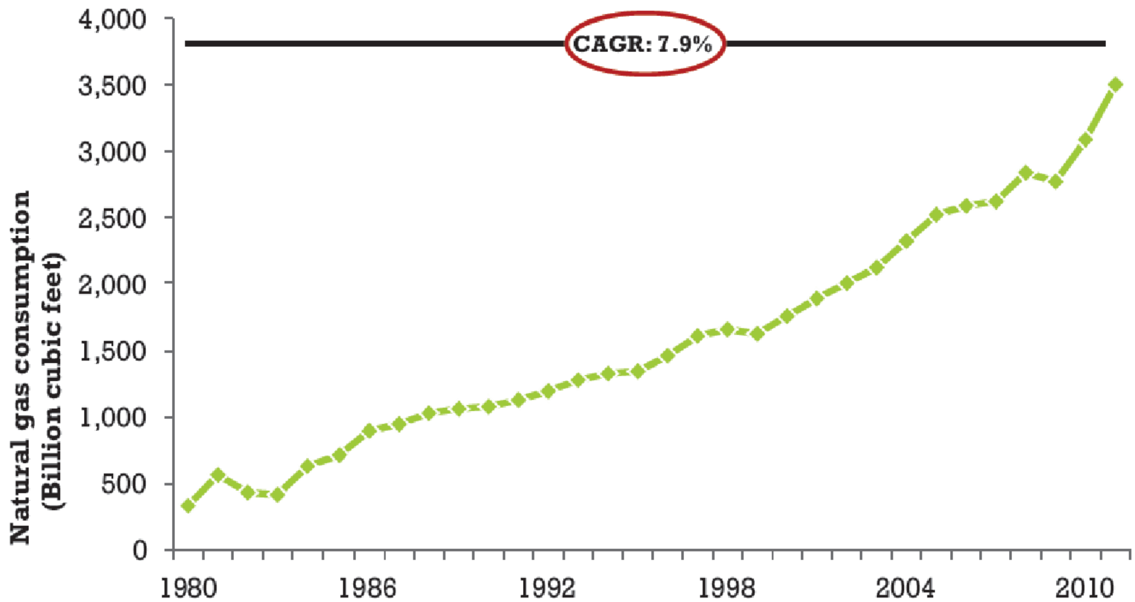
It is known that the petrochemical industry is constantly changing and developing due to continuous research and studies, as well as the development of manufacturing methods, in order to reduce and control production costs, and the creation of products that were not traded in the market. The number of petrochemical compounds produced commercially in 1980 has reached more than seven thousand compounds (Organization of Arab Petroleum Exporting Countries, 1994, p. 3). In its early stages of emergence, this industry was relying on coal and petroleum as a raw material. With the development of research and the efforts of important companies in the oil sector to exploit the associated natural gas instead of flaring it, that gas occupied its place in the global energy budget at the end of the 1970s, and began to expand its uses, especially in the field of petrochemical industry (Burnan, 2007, p. 69).

One of the most important factors in the dependence of this industry on associated natural gas is the scientific and technological progress, as well as the economic situation in developing the uses of natural gas in industries in general and in the petrochemical industry in particular. Gas provides petrochemical factories with the fuel and feedstock—raw materials used to supply industrial processes—essential for their operations (Saadoun, 1997, p. 24). Furthermore, operating costs are lower when using gas as feedstock compared to other energy sources (such as oil and coal). For example, the operating costs for producing one ton of ethylene in the Gulf Cooperation Council (GCC) countries, which rely on natural gas (ethane) as both fuel and feedstock, are three times lower than the operating costs in Western Europe and Japan for producing one ton of ethylene using oil (OAPEC, 1989, p. 84).

Since natural gas is an essential component of heavy industries, including petrochemicals, most producing countries aspire to build their own industries rather than simply export their own gas to provide power to industries of other countries. This is what the Kingdom did when it increased its consumption of gas in the industrial field from 9.5 billion cubic meters in 1980 to 20.3 billion cubic meters in 1985. This consumption is more than doubling in five years, so the Kingdom's contribution to the total consumption of Arab countries of natural gas in 1985 amounted to 27.3% (Nada & Samhan, 2004, p. 44). The Saudi petrochemical industry has become one of the most developed and profitable industries in the world (Group of researchers, 2014, p. 19). Figure 11 is a graph illustrating the steady increase in Saudi Arabia's natural gas consumption over thirty years.

**Figure 11**

*The steady Increase in Saudi Arabia's Natural Gas Consumption over Thirty Years*




With the progress in the completion of the MGS project, the steady development began in the size of the infrastructure of the manufacturing sector, including the petrochemical industry. Gas contributed to support the expansion of this industry that was led by the company SABIC. Thus, its production has increased from a few million tons per year in the early 1980s to more than ten million tons per year by the end of the 1980s. That was due to the expansion of its exports of petrochemical products to world markets (SABIC, 2023, p. 3). SABIC was able to achieve a global presence within a short period of time thanks to its ability to invest gas feedstock in the production of high value-added industrial goods (Saudi Vision 2030. 2016, p. 3). Table 1 illustrates the development of industrial indicators related to natural gas during the 1980s.

**Table 1**

*Development of Industrial Indicators Related to Natural Gas during 1980s*

| Development of industrial indicators related to natural gas | | |
|---|---|---|
| Late 1980s | Early 1980s | Indicator |
| 10+ million tons | ~3 million tons | Petrochemical production |
| 10% ~ | 6% ~ | Industry contribution to GDP |
| Very high | Low | Gas processing capacity |

During the period 1980-1985, several petrochemical factories were established. They relied on the MGS project to provide the necessary gas energy for their activity, including:

1) A petrochemical complex in Jubail Industrial City, established in 1982 by SABIC in a joint venture with Pecten, a subsidiary of the British company Shell. The complex includes annual production lines for ethylene (656,000 tons), styrene (295,000 tons), industrial ethanol (281,000 tons), ethylene dichloride (454,000 tons), caustic soda (377,000 tons), chlorine (333,000 tons), and ethylbenzene (327,000 tons). The complex cost approximately \$2.9 billion. (Bergendahl, 1985, p. 23; Lawton and Arthur, 1982, p. 37).
2) The "nitrogen fertilizer" factory in Jubail Industrial City, which was established by "SABIC" and "Al-Jubail Fertilizer Company" in joint cooperation with the "Taiwanese Fertilizer Company". Construction of the factory began in 1982 with a financial investment estimated at approximately 350 million dollars. Then production began the following year with an annual production capacity of approximately 300 thousand tons

of liquid ammonia, and approximately 500 thousand tons of urea (Bergendahl, 1985, p. 22; Lawton & Arthur, 1982, p. 38).

3) The methanol plant in Jubail Industrial City, established by SABIC and Al-Bazi Saudi Company in partnership with a Japanese consortium led by Mitsubishi Gas, produces 600,000 tons of methanol annually. This project was completed in 1983 at an investment cost of $300 million (Bergendahl, 1985, p. 22). Also in Jubail, another methanol plant was established in 1984 by the National Methanol Company (Ibn Sina) in partnership with SABIC and in cooperation with the American company Celanese Corporation. This plant produces the petrochemical with a capacity of approximately 650,000 tons per year. The cost of establishing this plant was estimated at around $400 million (Bergendahl, 1985, p. 24).
4) The ethylene plant in Yanbu Industrial City was established in 1983 by SABIC and the Saudi Petrochemical Company (YAMPET) in joint venture with Mobil Oil. The plant includes an ethylene production unit with a capacity of 450,000 tons per year, a low-density polyethylene production unit with a capacity of 200,000 tons per year, a high-density polyethylene production unit with a capacity of 90,000 tons per year, and an ethylene glycol production unit with a capacity of 200,000 tons per year. The plant cost approximately $2.5 billion (Bergendahl, 1985, p. 23).

Several other petrochemical plants in the industrial cities of Jubail and Yanbu produce, in varying proportions, petrochemicals used in the manufacture of vinyl, antifreeze, adhesives, bleach, disinfectants, and plastic products (Lawton & Arthur, 1982, p. 38). Some of these plants were under construction in 1982. Most of these plants began actual production in 1985, collectively producing millions of cubic meters and tons of methane, ethane, glycol, ethanol, styrene, polyethylene, sulfur, and other chemical and petrochemical materials and liquids annually (Bergendahl, 1985, p. 22). Ethane was used domestically as fuel and a feedstock for petrochemicals, while natural gas liquids and sulfur were exported (Lawton & Arthur, 1982, p. 23). Sales of the Saudi petrochemical industry were projected to exceed five billion US dollars annually starting in 1982. As a natural consequence of the primary industrial sectors, secondary companies would utilize the products of these sectors as raw materials for manufacturing goods (Lawton & Arthur, 1982, p. 38). This underscores the effectiveness and success of the Kingdom's natural gas investment strategy. The accompanying and the non-accompanying, early 1980s.

**Second**: The implications of the strategy on the national economy and the evaluation of the Saudi experience internationally

Since the early 1980s, countries possessing natural gas reserves have begun to focus on and capitalize on this resource by increasing investment in the sector and preparing to enter the fiercely competitive market. Scientific and technological advancements have facilitated the growth of this sector and overcome obstacles to its development by introducing modern methods, particularly in gas transportation and processing. The increasing presence of natural gas in the global energy mix and its availability in the markets have encouraged its consumption and its replacement of other energy sources for environmental, economic, and even political reasons. The Kingdom of Saudi Arabia was among the countries that expanded their investment of the enormous oil revenues it received in the early 1980s. Revenues from oil and natural gas exports in Kuwait, Qatar, Saudi Arabia, and the UAE reached $206 billion in 1980 and $104 billion in 1982 (Bergendahl, 1985, p. 16) in the associated natural gas sector. This has led to a gradual industrial transformation, achieving high added value instead of exporting it as a raw material. It has also made steady progress towards a more diversified economy (SABIC, 2023, p. 3). Table 2 illustrates the impact of the associated natural gas investment strategy on the national economy during the period between 1980 and 1985.

**Table 2**

Impact of Associated Natural Gas Investment Strategy on the National Economy

| A correlational analysis of gas investment policies, their implementation tools, and their economic results in the Kingdom during the period between the years (1980-1985 AD) |
|---|

| Economic Impact | Direct results | Implementation Tool | Politics |
|---|---|---|---|
| Improving Resource Efficiency | Reduced flares | Master Gas System | Reduce flaring |
| Supporting Industry | more efficient gas transportation | Pipeline Network (+3000 km) | Infrastructure development |
| Attracting Investment | industrial growth | Low-Cost Gas | Preferential pricing |
| Diversifying the Economy | increased production | Establishment of Petrochemical Plants | Localization of industry |
| Global Competitiveness | improved efficiency | Technology Transfer | International partnerships |

The most significant strategic impact of the Kingdom's investment in low-cost associated natural gas on the national economy was the establishment and support of the petrochemical industry, spearheaded by SABIC. This sector experienced rapid growth during the 1980s, evidenced by the abundance of petrochemical products manufactured by Saudi factories and complexes. This underscores the strategy's success in achieving its primary objective of industrial transformation. The most prominent positive effects on the national economy can be summarized as follows:

1- Supporting the diversification of the national economic base, as the contribution of the Saudi industrial sector to GDP rose from approximately 6% in the early 1980s to nearly 10% by the end of the decade (Ministry of Energy, 2021, p. 2). This resulted from the expansion of industries related to associated and non-associated natural gas.

2- Achieving a significant and sustained reduction in associated gas flaring rates, exceeding 60%. This was a result of integrating it into the production and processing system and transforming it into an efficient production element, which contributed to reducing economic losses by maximizing added value and increasing the efficiency of resource utilization between production sites and industrial consumption centers. This represented a transition from an extractive economy to one based on strategic infrastructure (EIA, 2021, p. 3). Table 3 shows the development of natural gas production and the decrease in flaring rates in the Kingdom during the period between 1980-1985.

**Table 3**

*Development of Natural Gas Production and the Decrease in Flaring Rates*

| Gas production development and reduced flaring rates (1980-1985) | | | |
|---|---|---|---|
| Significance | Percentage reduction in fat flaring (%) | Gas production (trillion cubic feet) | Year |
| Pre-transformation phase | 0% | 1.5 | 1980 |
| Initiation of policy implementation | 30% | 1.9 | 1982 |
| Infrastructure expansion | 50% | 2.3 | 1984 |
| Transformation maturity | 60% | 2.5 | 1985 |

3- Achieving an advanced level of industrial integration, where value chains from natural gas production to petrochemical industries and then to downstream industries were linked in an integrated and interconnected system. Together, the system contributed to the steady growth of the industrial sector (Ministry of Energy, 2021, p. 2), as it succeeded in the profitable marketing of natural gas liquids abroad (Lawton and Arthur, 1982, P. 25), reduced the country’s dependence on imported manufactured goods, and provided new opportunities for the Saudi private sector to manufacture and market them locally and abroad (Lawton and Arthur, 1982, p. 31).

4- Enhancing the attractiveness of the investment environment by attracting significant foreign investment to the Kingdom. The infrastructure of the "Master Gas Gathering" project has contributed to providing low-cost energy and creating the necessary conditions for implementing several joint ventures with international companies in the petrochemical sector and other industrial sectors such as iron, steel, and metals. This, after years of collaboration with Saudi companies, has led to the transfer of industrial and technological knowledge, achieving an advanced level of industrial integration, and enhancing national production efficiency (SABIC, 2023, p. 2).

5- Developing technical, engineering, and technological capabilities, and improving national operational and administrative efficiency by training thousands of qualified national personnel to work in the energy sector and related industries. This has led to the localization of activities related to these fields and the creation of hundreds of thousands of job opportunities for Saudi men and women (Saudi Aramco, 2020, p. 3; Ministry of Energy, 2021, p. 2).

6- The investment in associated natural gas has enabled access to an efficient and sustainable energy system. The amount of oil required for local electricity generation has been reduced, resulting in economic benefits that have accelerated the refining, processing and marketing sector strategy, creating value across the hydrocarbon chain and working on future plans to maximize the value of the Kingdom's hydrocarbon resources in the best responsible and sustainable way (Lawton and Arthur, 1982, p. 34).

7- The period of time between the years 1980-1985 represented a pivotal foundational stage in the history of the energy sector in the Kingdom, as it redefined the role of natural gas (associated and non-associated) from a wasted resource to a strategic pillar in industrial development. It established an economic model based on sustainability and maximizing the return on resources, a model that today forms one of the main pillars of the national transformation path (Royal Commission for Jubail and Yanbu, p. 2).

Regarding the international evaluation of the Saudi experience in its strategy for investing in associated natural gas, it has received clear international acceptance and praise. This is indicated by the large number of international energy companies that rushed to the Kingdom to invest in the field of energy and petrochemical industries after the launch of the “Master Gas Gathering” project in the early 1980s (Saudi Aramco, 2020, p. 3). Among the most important of these huge international companies were Shell, Exxon Mobil, Mitsubishi, and many others. The Saudi Aramco and SABIC companies led the negotiations with many countries to conclude agreements that enabled them to obtain the technology and skills they needed from the West to create and manage huge and complex projects such as refineries, chemical plants, and steel factories, and to market their products abroad (Lawton & Arthur, 1982, p. 34).

These international partnerships—which demonstrate the extent of the Saudi experience's international success—have diversified, ranging from joint ventures for establishing joint factories and technology partnerships for knowledge transfer to investment and financing partnerships, as well as operational partnerships for managing industrial projects. This diversity reflects the flexibility of the strategy, which has enabled the Kingdom to leverage international partnerships to serve various stages of the industrial chain, from production to processing, manufacturing, and marketing (IEA, 2018, p. 3).

Furthermore, analyzing this transformation within a comparative international framework reveals that the Saudi experience intersects with the models of other countries, such as South Korea and Singapore, which have relied on partnerships for technology transfer. However, the fundamental difference lies in the fact that the Kingdom has employed these partnerships within a natural resource-based economy, directing them toward maximizing the added value of oil and gas, while those countries have relied on export-oriented manufacturing based on human resources (Bergendahl, 1985, p. 22). The Saudi experience also differed from many oil-producing countries that continued to flare gas during the 1980s and did not rely sufficiently on international technical partnerships. The Kingdom moved early to adopt an investment model based on exploiting its oil and gas wealth in industrial transformation instead of merely exporting it as raw materials. This transformation was not just a circumstantial response but rather the foundation of a long-term development path that contributed to building an advanced industrial base, raising production efficiency, enhancing product quality, and expanding industrial exports, which helped transform the Kingdom into one of the major players in this sector globally (IEA, 2018, P. 3; SABIC, 2023, p. 3).

In conclusion, it can be noticed that the success of the Kingdom of Saudi Arabia's experience in investing in associated natural gas during the period between 1980 and 1985 is primarily due to the integration of planning policies with the infrastructure and institutional framework that enabled the transformation of these strategic directions into tangible developmental results. The "Master Gas Gathering" project was a cornerstone for the redeployment of natural resources within a long-term development framework. This led to the achievement of sustainable long-term economic effects, contributed to shifting the economy from an extraction-based to a manufacturing-based phase, established an advanced stage of industrial transformation, and facilitated the recovery of a significant portion of those massive investments through the increasing profits from downstream industries, particularly petrochemicals. The impressive results of this strategy continue to bear fruit for the Kingdom on various financial, economic, social, and even political levels. This will further strengthen Saudi Vision 2030 in building a diversified Saudi economy based on knowledge, industry, efficiency, and integration among its various sectors, capable of distributing wealth and progress throughout the country.

## 2. Conclusion

After the detailed presentation of the Kingdom's strategy in investing in associated natural gas in the period between 1980 and 1985 and the impact of that strategy in establishing the petrochemical industries and achieving industrial transformation, the most important findings are revealed below:

1- The Kingdom has paid attention to the energy sector to strengthen the industrial base of the national economy and expand its infrastructure to meet the needs of rapid population growth.

2- The transformation of associated natural gas investment was not based on a single policy, but it was the result of an integrated package of overlapping policies that worked within a unified strategic framework.

3- The Kingdom was able to value its gas wealth by reducing the flaring of gas associated with oil due to the investments directed to this process.

4- The infrastructure of the "Master Gas Collection" project was established in the Kingdom before 1982 and the infrastructure was completed during that year with the completion of the basic elements of the system and its entry into integrated operation.

5- The year 1982 marked a turning point in the Kingdom's strategy for investing in associated natural gas, after which the transition began from simply collecting and processing the gas to employing it in various energy and industrial sectors, especially the petrochemical industry.

6- The massive Master Gas Gathering Project has contributed to increasing the daily processing capacity of associated natural gas to several billion cubic feet since the mid-1980s, enabling the Kingdom to absorb most of that gas instead of flaring it.

7- The Master Gas Gathering Project has enabled the use of associated gas in many vital sectors, including electricity generation, water desalination, petrochemicals, fertilizers, cement, steel, and metals, etc.

8- The associated gas investment strategy revealed a radical shift in the Kingdom's policy, transforming this natural resource from a limited secondary resource into a strategic industrial input that supports the establishment of multiple downstream industries.

9- The associated gas investment strategy achieved a balance between localizing technical, engineering, and technological knowledge and leveraging the global expertise of renowned energy companies.

10- International partnerships in the field of associated natural gas investment in the Kingdom have worked to reduce the technological gap, localize technical knowledge within the national economy, and accelerate industrial transformation.

11- The pipeline network established by the Master Gas Gathering Project has played a significant role in supporting petrochemical industries and enhancing the efficiency of natural gas resource utilization.

12- The industrial cities of Jubail and Yanbu played a role in supporting the shift towards manufacturing, becoming platforms for redeploying resources within diverse industrial activities that align with the objectives of Vision 2030.

13- The petrochemical industries in the Kingdom have laid a solid foundation for the country's future economic development and have made manufacturing a tool for sustainable development.

**Recommendations**:

1) Working on the regional interconnection of the natural gas transport network due to its economic and political importance.
2) Intensifying government initiatives to involve the private sector in the energy sector and petrochemical industries to give it an opportunity to participate in economic development.
3) Restructuring the industrial sector to increase its productivity, especially in the field of petrochemical industries.
4) Intensifying the process of attracting foreign investments to localize technology through international companies with high expertise in the field of energy and related industries.
5) Working on to provide and develop alternative energy sources (solar energy, wind energy, waste conversion energy, geothermal energy) to become the main sources of energy generation necessary for civil and industrial consumption.
6) Providing exceptional incentives for renewable energy projects and eliminate obstacles that prevent from increasing investments in this area.
7) Rationalizing energy consumption and reduce energy losses through an intensive information campaign targeting all age groups.

## References and Sources

### First: Arabic References


**أبو النجا**، حمدي. (1996). إضافات وقود محركات البنزين، مجلة النفط والتعاون العربي، 22 (78)، الكويت.

**أبو راس**، رشاد. (1993). التوربينات الغازية في مولدات الكهرباء المستعملة، مجلة النفط والتعاون العربي، 19(68). الكويت.

**الألفي**، أحمد عبد السيد. (2022). حادث انفجار محطة تشيرنوبيل للطاقة النووية في 26 أبريل 1986م، مجلة الدراسات الإنسانية والأدبية، 26. جامعة كفر الشيخ.

**أيرت**، أوليفر. (1996). التوجهات الرئيسية لأسواق الغاز الطبيعي، مجلة النفط والتعاون العربي، 22 (79). الكويت.

**بورنان**، إبراهيم. (2007). الغاز الطبيعي ودوره في تأمين الطلب على الطاقة في المستقبل: حالة الجزائر، رسالة دكتوراه غير منشورة، كلية العلوم الاقتصادية وعلوم التسيير، جامعة الجزائر.

**الجمالي**، أسامة. (1978). أوجه الاستفادة من الغاز الطبيعي المصاحب للنفط المحافظة عليه في الأقطار الأعضاء في منظمة الأقطار العربية المصدرة للنفط، مجلة النفط والتعاون العربي، 4 (2). الكويت.

**جونيشر**، جون بيير. (1990). الغاز الطبيعي توليد الطاقة الكهربائية تعاون مستمر من خلال خيار الدورة الموحدة، مجلة النفط والتعاون العربي، 16 (87). الكويت.

**الدار**، حسام جبر. (2005). هل دخلت الطاقة عصر جديد: تقرير ندوة أكسفورد السادسة والعشرون للطاقة، مجلة النفط والتعاون العربي، 31 (112). الكويت.

**ديفيز**، غيد ر. (1994). الطاقة من أجل كوكب الأرض، مجلة العلوم الأمريكية، ترجمة: مؤسسة الكويت للتقدم العلمي، 10 (12). الكويت.

**ستيفنز**، بول. (1997). الطاقة في الخليج تحديات وتهديدات، مركز الإمارات للدراسات البحوث الاستراتيجية، أبو ظبي.

**سعدون**، عبد الوهاب. (1997). صناعة البتروكيماويات الخليجية على مشارف القرن الحادي العشرين: تحديات وآفاق، مجلة النفط والتعاون العربي، 23 (81). الكويت.

**السعدي**، أحمد نجيب. (1985). الصناعة البتروكيماوية، مجلة النفط والتعان العربي، 6 (11). الكويت.

**عبد الله**، حسن. (ط2). (2006). مستقبل النفط العربي. بيروت: مركز دراسات الوحدة العربية.

**العنزي**، مطر عايد وماجد صلال المطلق. (ط1). (2020). التابلاين ودوره التنموي في منطقة الحدود الشمالية، القاهرة: منشورات جدل للنشر والتوزيع.

**كوسي**، بولا وإكسافيي مرنتاني. (2000). بدائل وقود السيارات، مجلة النفط والتعاون العربي، 26 (92). الكويت.

**المشهداني**، بان علي حسين. (2014). الآفاق المستقبلية للغاز الطبيعي في سوق الطاقة العالمية مع إشارة خاصة لدولة قطر، مجلة العربي للعلوم الاقتصادية والإدارية، 8 (31). الكوفة.

**منظمة الأقطار العربية المصدرة للنفط**:

- الدائرة الفنية. (1989). استخدام الغاز الطبيعي في الصناعة البتروكيمياوية في المنطقة العربية الوضع الحالي والتوقعات المستقبلية، وقائع الندوة الثانية حول استغلال الغاز الطبيعي في الوطن العربي. الدوحة. 10-14 ديسمبر 1989.

- دائرة الشؤون الاقتصادية. (ط1). (1994). آفاق الصناعة البتروكيماوية في الوطن العربي، محور مؤتمر الطاقة العربي الخامس المنعقد بين يومي 7-10 مايو 1994. القاهرة.

**نغموش**، أمينة وجزيرة معيزي. (2022). تحقيق التنمية المستدامة في الجزائر بالاعتماد على الغاز الطبيعي، مجلة وحدة البحث في تنمية الموارد البشرية، 17 (3). جامعة 8 ماي قالمة، الجزائر.

**ونادة**، طيب ومشعل السمحان. (2004). البتروكيمياويات: تصنيعها واستخدامها وتطورها في الأقطار العربية. مركز أبحاث ودراسات البترول. الكويت.

**Second: Romanizing Arabic References**

**Abū al-Najā**, Ḥamdī. (1996). iḍāfāt wqwd mḥrkāt albnzyn, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 22 (78), al-Kuwayt.

**Abū Rās**, Rashād. (1993). altwrbynāt alghāzyh fī mwldāt al-kahrabā' al-musta'malah, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 19 (68). al-Kuwayt.

**Al-Alfī**, Aḥmad 'Abd al-Sayyid. (2022). ḥādith infijār Maḥaṭṭat tshyrnwbyl lil-Ṭāqah al-nawawīyah fī 26 Abrīl 1986m, Majallat al-Dirāsāt al-Insānīyah wa-al-adabīyah, 26. Jāmi'at Kafr al-Shaykh.

**Ayrt**, Ūlīfir. (1996). al-Tawajjuhāt al-ra'īsīyah li-aswāq al-ghāz al-ṭabī'ī, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 22 (79). al-Kuwayt.

**Būrnān**, Ibrāhīm. (2007). al-ghāz al-ṭabī'ī wa-dawruhu fī ta'mīn al-ṭalab 'alá al-ṭāqah fī al-mustaqbal: ḥālat al-Jazā'ir, Risālat duktūrāh ghayr manshūrah, Kullīyat al-'Ulūm al-iqtiṣādīyah wa-'ulūm al-tasyīr, Jāmi'at al-Jazā'ir.

**Al-Jamālī**, Usāmah. (1978). awjuh al-istifādah min al-ghāz al-ṭabī'ī al-muṣāḥib lil-Nafṭ al-Muḥāfaẓah 'alayhi fī al-aqṭār al-a'ḍā' fī Munaẓẓamat al-aqṭār al-'Arabīyah al-Muṣaddirah lil-Nafṭ, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 4 (2). al-Kuwayt.

**Jwnyshr**, Jūn Pierre. (1990). al-ghāz al-ṭabī'ī tawlīd al-ṭāqah al-kahrabā'īyah ta'āwun mustamir min khilāl khiyār al-dawrah al-muwaḥḥadah, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 16 (87). al-Kuwayt.

**Al-Dār**, Ḥusām Jabr. (2005). Hal dkhlt al-ṭāqah 'aṣr jadīd : taqrīr Nadwat Uksfūrd al-sādisah wa-al-'ishrūn lil-Ṭāqah, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 31 (112). al-Kuwayt.

**Dyfyz**, Ghayd R. (1994). al-ṭāqah min ajl Kawkab al-arḍ, Majallat al-'Ulūm al-Amrīkīyah, tarjamat: Mu'assasat al-Kuwayt lil-Taqaddum al-'Ilmī, 10 (12). al-Kuwayt.

**Stīfinz**, Būl. (1997). al-ṭāqah fī al-Khalīj taḥaddiyāt wa-tahdīdāt, Markaz al-Imārāt lil-Dirāsāt al-Buḥūth al-Istirātījīyah, Abū Ẓaby.

**Sa'dūn**, 'Abd al-Wahhāb. (1997). ṣinā'at albtrwkymāwyāt al-Khalījīyah 'alá mashārif al-qarn al-ḥādī al-'ishrīn : taḥaddiyāt wa-āfāq, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 23 (81). al-Kuwayt.

**al-Sa'dī**, Aḥmad Najīb. (1985). al-ṣinā'ah al-batrūkīmāwīyah, Majallat al-nafṭ wālt'ān al-'Arabī, 6 (11). al-Kuwayt.

**Abd** Allāh, Ḥasan. (ṭ2). (2006). Mustaqbal al-nafṭ al-'Arabī. Bayrūt: Markaz Dirāsāt al-Waḥdah al-'Arabīyah.

**Al-'Anzī**, Maṭar 'Āyid wmājd Ṣallāl al-Muṭlaq. (Ṭ1). (2020). altāblāyn wa-dawruhu al-tanmawī fī minṭaqat al-ḥudūd al-Shamālīyah, al-Qāhirah : Manshūrāt jadal lil-Nashr wa-al-Tawzī'.

**Kwsy**, Būlā w'ksāfyy mrntāny. (2000). Badā'il wqwd al-sayyārāt, Majallat al-nafṭ wa-al-ta'āwun al-'Arabī, 26 (92). al-Kuwayt.

**Al-Mashhadānī**, Bān 'Alī Ḥusayn. (2014). al-Āfāq al-mustaqbalīyah llghāz al-ṭabī'ī fī Sūq al-ṭāqah al-'Ālamīyah ma'a ishārah khāṣṣah li-Dawlat Qaṭar, Majallat al-'Arabī lil-'Ulūm al-iqtiṣādīyah wa-al-idārīyah, 8 (31). al-Kūfah.

**Munaẓẓamat al-aqṭār al-'Arabīyah al-Muṣaddirah lil-Nafṭ**: al-Dā'irah al-fannīyah. (1989). istikhdām al-ghāz al-ṭabī'ī fī al-ṣinā'ah albtrwkymyāwyh fī al-Minṭaqah al-'Arabīyah al-waḍ' al-ḥālī wa-al-tawaqqu'āt al-mustaqbalīyah, waqā'i' al-nadwah al-thāniyah ḥawla istighlāl al-ghāz al-ṭabī'ī fī al-waṭan al-'Arabī. al-Dawḥah. 10-14 Dīsimbir 1989.

**Munaẓẓamat al-aqṭār al-'Arabīyah al-Muṣaddirah lil-Nafṭ**: Dā'irat al-Shu'ūn al-iqtiṣādīyah. (Ṭ1). (1994). Āfāq al-ṣinā'ah al-batrūkīmāwīyah fī al-waṭan al-'Arabī, miḥwar Mu'tamar al-ṭāqah al-'Arabī al-khāmis al-mun'aqid bayna yawmay 7-10 Māyū 1994. al-Qāhirah.

**Nghmwsh**, Amīnah wa-Jazīrat Mu'ayzī. (2022). taḥqīq al-tanmiyah al-mustadāmah fī al-Jazā'ir bi-al-i'timād 'alá al-ghāz al-ṭabī'ī, Majallat Waḥdat al-Baḥth fī Tanmiyat al-mawārid al-basharīyah, 17 (3). Jāmi'at 8 Māy Qālimah, al-Jazā'ir.

**Wnādh**, Ṭayyib wmsh'l al-Samḥān. (2004). albtrwkymyāwyāt : tṣny'hā wa-istikhdāmuhā wa-taṭawwuruhā fī al-aqṭār al-'Arabīyah. Markaz Abḥāth wa-dirāsāt al-batrūl. al-Kuwayt.

**Third: Foreign References**

**Brandt**, RL and Wilson TR: Capacity ,complexity and flexibility: the evolution of global refining 1970 to 1986 east – west resource, sytens institute, 1987.

**Bergendahl**, Goran: Petroleum Investment in the Arabian Gulf, Oxford Institute for Energy Studies, F5, 1985.

**British Petroleum**: statistical review of world energy, Full Report, June 2005.

**Energy Information Administration** (EIA), Statics Report, February 2021.

**Girand**, A.: Boy de la Tour: géopolitique du pétrole et du gaz, éditions techinp, Paris, 1987.

**Group of researchers**: Kingdom of Saudi Arabia, Energy Sector Report, Gulf Research Center, Jeddah, 2014.

**International Energy Agency** (IEA), December 2018.

**Lawton**, John and Arthur Clark: Foundations: The Keystone, Aramco World Magazine, November/December 1982, Volume 33, Number 6.

**Lombart**, j.: Nouvelle technologie dans le traitement des ambiances, Association Algérienne de l'industrie du gaz (AAIG), 1990.

**Royal Commission for Jubail and Yanbu**, website, n.d.

**Ministry of Energy** (Saudi Arabia), 2021.

**Touimer**, R.: Coût et Tri génération dans le dessalement de l'eau de mer et la climatisation urbaine centralisées, Association Algérienne de l'industrie du gaz (AAIG), Alger, 1999.

**SABIC**, 2023.

**Saudi Aramco**, 2018.

**Saudi Aramco**, 2019.

**Saudi Aramco**, 2020.

**Saudi Vision** 2030, 2016.

**Saudi Arabian oil company**: Global Medium Term Note Programme, April 2019.

**wrigert**, Jean line: La vie aperesle pétrole, éditions autrement, Paris , 2005.

**World Bank**, 2022.