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Problems of the Natural Gas Market in Iraq and Their Repercussions on Local Production and Demand

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Abstract: Natural Gas ıs one of the most ımportand of eneragy sources worldwide and its relevance has increased in recent years because of its various import and uses and its uses fit with the global interest of Green Energy and clean Environment. Iraq own age at amount of the potential gas with about 6% of the Arab world and of 1.7% of the world potential gas. Yet, the Iraq production of the natural gas has been very low since 2003. Production was a bout (11.4) cubit trio how meter as annual average for the period 2003-2007.This amount meets only 15% of the Iraqi domestic consumption with about 64% of this production has been unused and burned annually. At the same time, Iraq is forced to import increasingly a big amount of natural gas to meet its local demand with very low quality of gas and tough terms. The result shows a huge waste in the production of the nature gas in Iraq with a very low investment for using and development the production process. This wasted and burned gas could have been used for local market or for exporting the outside to improve the Iraqi gross domestic product (Gdp).The natural gas process and operation to improve the efficiency of using this important resource with the necessity of importuning of infrastructure of the natural gas section in the Iraqi rental economy.

Keywords: Natural Gas, Production, Consumption, Natural gas barrels.

1- Introduction and Research Problem

1-1 Introduction

The natural gas is considered one of the most important energy resources internationally and locally in Iraq. The demand for the natural gas has increased in the world markets in a tremendous way recently because of its cleanness and multi- uses. Additionally, it copes with the world orientation towards using clean or green energy and to reduce the resources of pollution. Flaring and consuming of natural gas do not pollute the environment for it flares in a complete way and does not leave behind any ash. Natural gas constitutes 25% of the consumed energy in the world. It comes in the third rank after oil and coal. In Iraq, the possible capacity of the undiscovered natural gas is huge, and it reaches 322 trillion cubic feet, which equals approximately 9.3 trillion cubic meters. Iraq possesses a big gas wealth; the proven reserves of gas in Iraq is around 3170 billion cubic meters that puts the country in the twelfth rank internationally and the fourth in the Arab world after Qatar, United Arab Emirates, and Algeria.

However, the natural gas production in Iraq remains very low after 2004 that it reaches 11.4 billion cubic meters yearly as an average during (2003-2007). This amount is not enough even to satisfy the local needs. Simultaneously, the biggest part of the produced gas is flared without using it locally: 64% of natural gas is flared that equals 700 cubic meters daily. The used natural

gas in the markets does not exceed 7% of the total production of the natural gas, which reaches 16577 billion cubic meters in 2009. Iraq comes in the second rank internationally after Russia in flaring associate gas that accompanies oil production process. As of the reserves, Iraq comes in the twelfth rank internationally natural gas with 132 trillion cubic feet (as a specified amount). According to the estimates of The World Bank, Iraq flares 16 billion cubic meters of gas daily that classifies it as the third top 20 countries internationally in flaring gas.

1-2 Research Problem

Despite the increasing use of natural gas locally and internationally, as it is one of the clean energy resources, it is used for multiple purposes, and it has a low-cost production, Iraq's production of natural gas witnesses a huge, increasing waste**.**

Iraq has an increasing demand for electricity that makes it import increasing amounts of natural gas from the neighboring countries, Iran in particular. The imported gas is of the worst quality, and the conditions of the importing are very severe that leads to deform the market of the natural gas in Iraq and to have a negative impact on the production unit's performance in different sectors of the national economy, especially the sector of electricity and energy production. This impact is the research problem. The research aims at analyzing and shedding light on this impact and to specify efficient mechanism to reduce the deformation of the natural gas's market in Iraq.

1-3 Research Goals

The goals of the research are:

1. Introducing natural gas's market in Iraq and the deformations of its production and usage.
2. Specifying the waste amount in production and money in the process of producing and distributing natural gas.
3. Specifying the investment rates in the natural gas market and the possibility of developing this investment to increase total production.

1-4 Research Hypothesis

The research hypothesizes that there is a huge, increasing waste in producing and using natural gas that affects the quality of the natural gas's market and causes a low investment rates that means losing the opportunities of developing the quality of the natural gas's market.

1-5 Research Methodology

The research uses the methodology of analysis, inductive reasoning, and statistical analysis, depending on the primary and secondary data available on producing and using natural gas. Then, the researcher analyzes data, conducts conclusions, and conducts recommendations.

2- Natural Gas

Natural gas is deemed one of the important and basic energy resources in the world. It exists in nature, either within petrol (oil) locations or by itself. Natural gas is one of the clean energy resources that does not cause pollution to the environment. It flares completely and does not leave behind any ash, and it does not make the poisonous carbon monoxide that is one of the main pollutants. The natural gas has a high calorific value that reaches (11000-12000) kilocalories for each kilogram that means that it is extremely higher than any calorific value of other fuel resources such as wood (4700-5100) kilocalories for each kilogram, coal (6000) kilocalories for each kilogram, and kerosene (10000) kilocalories for each kilogram. In addition to the natural gas's high calorific value, the natural gas's prices are stable in the world market, and it is easy to transport and distribute through safe pipe nets for long distances.

As it is known, natural gas is composed of gas carbohydrates that are constituted of carbon and hydrogen that represent oil components that are highly dispersal. It contains methane (CH_4), 95% of its components are ethane, and different rates of propane, butane, and hexane in the form of

gases and fumes. Natural gas also contains different rates of impurities, depending on gas types and its traditional and non-traditional resources.

Natural gas plays a major role in developing future world energy. Particularly, it helps in achieving several goals in the field of energy in the twenty first century such as providing the services necessary for economic and social development and decreasing the negative effects on the world climate and environment in general (Economides & Wood, 2009, p.12).

2-1 Resources, Types, and Components of Natural Gas

Studies and evidence indicate that earthquakes that occur in earth layers release gases that contain hydrocarbon compounds like ethane that is the main component of the natural gas, and they are from non- biological sources. While studies and scientific beliefs indicate that the natural traditional energy from earth like oil and coal are exhausted resources and will be consumed quickly and increasingly soon. There is evidence that shows there is a huge amount of natural gas in the depths of the earth, and if it is extracted from the earth, it will cover the needs of the world for a thousand years.

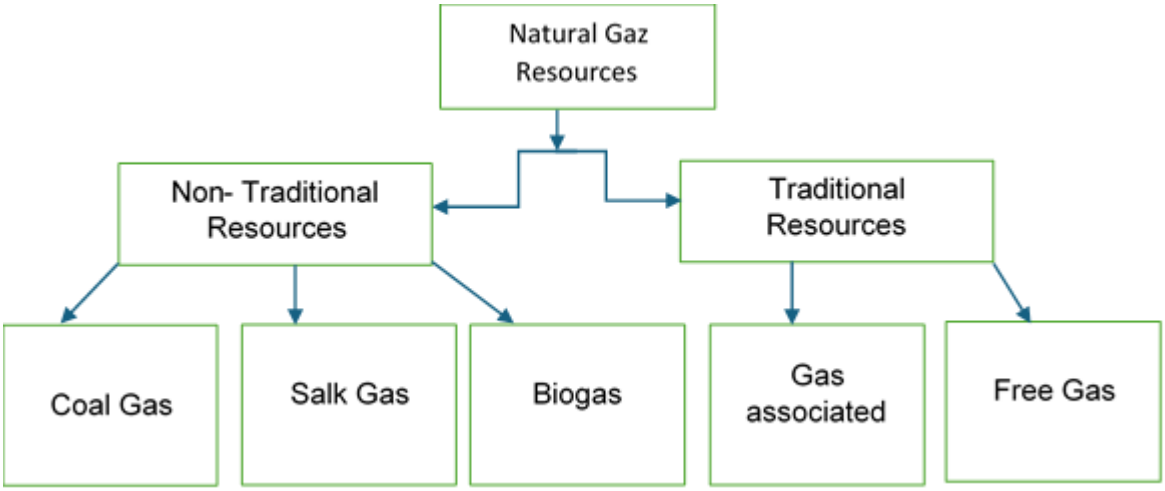
Natural gas's resources can be classified to traditional and non- traditional resources that are represented by:

A-Natural gas wells, this gas is called free gas that exists in free fields under earth, and it.

Is Mostly a dry gas.

B- Associated gas that accompanies the crude oil at the time of extracting it from earth. It is Separated in gas separation stations (processing gas). This is the type of the Iraqi Natural gas. The non- traditional resources include the natural gas produced from coal and Shale gas and the gas released from the organic fermentation, as it is shown in Figure (1).

Figure (1)



Resource: The Researching

Natural gas is a mixture of hydrocarbon compounds that consist of carbon and hydrogen released from natural gas wells. It is a light, dry gas that does not contain a high rate of heavy hydrocarbon compounds. This gas is preferable in production and consumption processes, in contrast to the released gas (associated gas) from the oil wells that has a high rate of condensates and oil liquids; it is heavier than the gas of oil wells (free gas).

2-2 The Natural Gas in Iraq

Iraq is the second biggest country in the world of producing oil in OPEC after Saudi Arabia. Iraq is the fifth country in world reserves of oil; it possesses 143 billion barrels of oil reserves that equals 18% of the world oil reserves, this is in addition to the production of associate gas released during oil production processes that is not used properly as most of it is flared without

using it (Sulaiman et. al, 2023, p.5). Iraqi natural gas constitutes around 25% of the consumed energy in the world; it comes in the third rank after oil and coal. Iraq owns a great wealth of natural gas. Iraq is in the twelfth rank internationally and the fourth in the Arab world after Qatar, United Arab Emirates, and Algeria. The natural gas in Iraq is associate gas that exists in oil wells and constitutes 70% of the oil, free gas constitutes 20%, and the rest (cap gas) constitutes 10%. The natural gas in Iraq provides 15% for the needs of energy consumption; Iraq has a wide net of pipes that transports natural gas to 1527 miles of distance.

A- The Potential and Proven Reserves of Natural Gas in Iraq

Formal statistics indicate that the potential reserves of the natural gas in Iraq that are not discovered are very huge, and the amount may reach 332 trillion cubic feet that equals 9.3 trillion cubic meters. 83% of it exists in the Southern fields in Iraq, and the rest (17%) exists in the Northern and Middle fields. Free gas constitutes 4.6 trillion cubic meters of these reserves (Laith and Jaffar, 2018, p.90), which constitutes around 49.5% of the potential reserves. Associate gas, on the other hand, constitutes 4.7 trillion cubic meters, and the rest 51.5% is dissolved gas in the potential oil undiscovered reverses that are around 240 billion barrels of crude oil. The rate of associate gas to extracted oil in the Southern fields is double in comparison to its rate in the Northern and Middle fields. This shows the huge amount of natural gas, especially in the Southern fields. Moreover, this natural gas is a good type that has very low rates of sulfur in comparison to the gas in the Northern fields that is characterized by its acid nature as it contains 7.2% of hydrogen sulfide (H_2S).

The proven reserves of natural gas in Iraq are about 3170 billion cubic meters in 2000, and this is in the fifth rank in the Arab world that equals 6% of Arab reserves of natural gas, 3.4% of OPEC reserves, and 1.7% of world reserves. The proven reserves of natural gas in Iraq constitutes of 630 billion cubic meters of free gas that equals 20%, 2240 billion cubic meters of associate gas that equals 70%, and 300 billion cubic meters of cap gas, which covers oil in some oil fields, which equals 10% of the total reserves. This indicates that the Southern fields portion of the reserves (potential proven) is about 60%, most of it is associate gas, and the Northern fields portion is 40%, most of it is free gas existed in the independent gas fields or in the gas domes of the oil fields that is called (cap gas). All cap gas is located in the Northern and Middle fields except one cap that was discovered in the Southern fields within the gas layer that covers oil (Adel, 2012, p.8). Because most of the Iraqi natural gas is associate gas that is connected with oil production, the production of the natural gas in Iraq is affected directly by oil production. Accordingly, the fluctuations in producing and extracting oil directly affect the production of natural gas. Cap gas is produced as an addition to the associate gas used in generating electricity and in different industries due to the need of generating electricity, especially in the peak load.

The proven reserves of gas are very huge in Iraq, but gas's production is impossible in the present time because of the backward infrastructure. For this reason, developing gas industry in Iraq requires expanding the infrastructure of gas. It is necessary to do geological exploration in parallel with developing a suitable infrastructure, concerning the main gas pipes and distribution. This is in addition to developing locations of gas storage under earth. There are 10 free gas fields in Iraq: 5 of them are located in the east and northeast Iraq. These fields contain 300 billion cubic meters as fixed reserves. Although Iraq is in the twelfth rank in world gas reserves, gas production fails in coping with the quick increasing need to electricity. The local production in Iraq equals 43% of the natural gas; however, the local gas supply fails in managing the issue of energy security because The Ministry of Oil focuses on increasing oil production rather than benefiting from the associate natural gas (Istabnian and Redan, 2022, p. 8).

B- Natural Gas Production

Most of the natural gas produced in Iraq is associate gas that relates to crude oil production. The natural gas is produced in two main areas in Iraq: the Southern and Northern areas. Since associate gas relates to crude oil production, the fluctuations in oil production affect directly the

fluctuations in natural gas production. Natural gas production witnesses' similar changes in crude oil production. Natural gas production has increased continuously since 1980. North Gas and South Gas Companies were established and stared their work since then, and the investments of natural gas production have increased from 11.4% in 1980 with 1.3 billion cubic meters of marketed natural gas to be 5.5 billion cubic meters in 1998. However, most of the produced gas was not marketed; the rate of the marketed gas was 7% only of the produced gas.

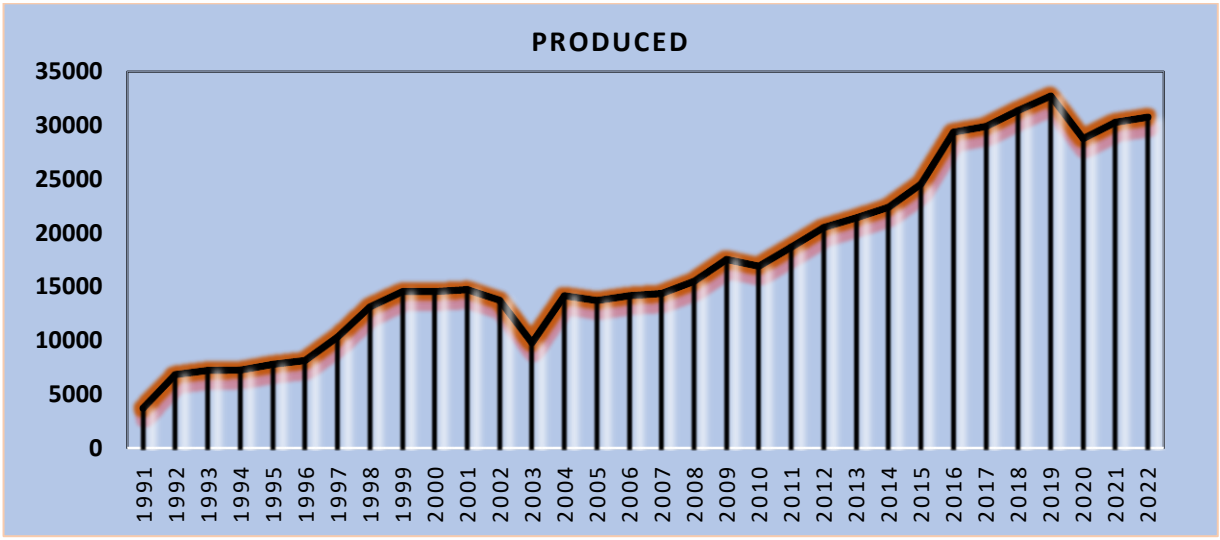
Table (1) and Figure (2) show that the amounts of natural gas have increased to reach 3720 million cubic meters in 1991to be 14723 million cubic meters in 2001. In spite of the big decrease in production in 2003 to be 9781 because of the American invasion of Iraq and the decrease of natural gas investment because the factories of gas processing stopped for the same reason, there was a continuous increase, although flagging, in gas production to reach 29870 million cubic meters in 2017 with a yearly growing average of 0.079% to increase in 2019 and reach 32699 million cubic meters and then to lower to 28738 million cubic meters in 2020 with a decrease rate of 0.12%. The amount of natural gas production reached 30730 million cubic meters in 2022.

Table (1): Amount Of Natural Gas In Iraq During (1991-2022) (Million Cubic Meter)

Percentage Of West %	Flared	Investment percentage	Used	Produced	Year
15.1	563	85	3157	3720	1991
8.6	590	91	6260	6850	1992
8.6	621	91	6617	7238	1993
8.1	590	92	6666	7256	1994
13.3	1039	87	6757	7796	1995
8.1	660	92	7480	8140	1996
18.0	1854	82	8474	10328	1997
26.6	3493	73	9632	13125	1998
31.3	4555	69	10009	14564	1999
31.1	4520	69	10023	14543	2000
29.0	4272	71	10451	14723	2001
24.3	3341	76	10417	13758	2002
43.7	4272	57	5542	9781	2003
23.6	3341	51	7213	14171	2004
30.9	4239	52	7083	13723	2005
49.2	6958	49	6979	14152	2006
46.2	6640	51	7372	14370	2007
46.2	7173	60	9275	15516	2008
39.9	6998	58	10140	17520	2009
37.0	6241	55	9313	16887	2010
39.5	7380	48	8991	18692	2011
37.0	7574	42	8520	20496	2012
45.4	9701	42	8954	21386	2013
53.6	11976	40	8981	22364	2014
50.7	12432	36	8851	24513	2015
45.6	13383	40	11612	29326	2016
52.4	15662	44	13231	29870	2017
56.5	17714	46	14522	31358	2018
50.9	16639	47	15453	32699	2019
58.6	16834	52	14812	28738	2020
57.0	17258	52	15737	30275	2021
46.1	14173	52	16254	30730	2022

Resource: Central Organization For Statistics (Oil Statistics 2022)

Figure (2): Natural Gas Production In Iraq During (1991-2022) (Million Cubic Meter)

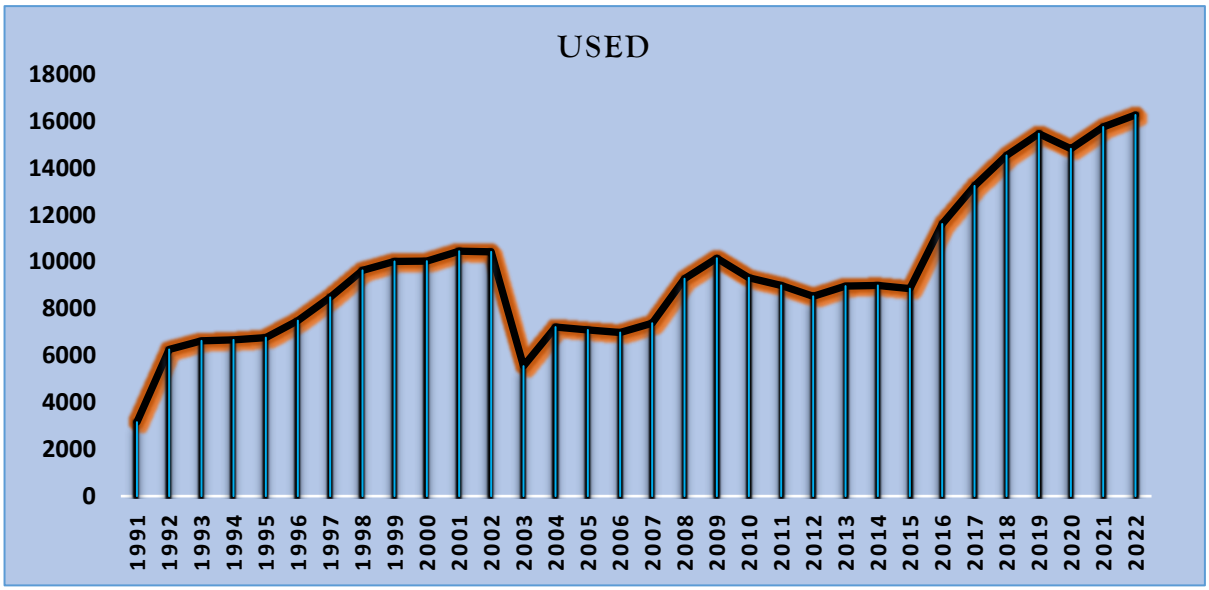


Resource: Prepared By The Researching According To Table (1) Column (2)

C- Consumption and the Local Need of Natural Gas in Iraq

Iraq uses the natural gas to cover its needs of energy but in average rates. Using natural gas in Iraq constitutes 15% only of its use of energy from its different resources, oil and its different derivatives. It is considered a low rate in comparison to other Arab countries like United Arab Emirates and Saudi Arabia. Table (1) and Figure (3) show an increase in natural gas usage in the period 1991-2022, although in low rates. Consumption of natural gas has risen from 6260 million cubic meters in 1992 to reach 10417 million cubic meters in 2002 and then lowered to reach 5542 million cubic meters in 2003 because of the American invasion of Iraq. This amount has increased gradually to become 10140 million cubic meters in 2009, to become 13231 million cubic meters in 2017, and then to become 16254 million cubic meters in 2022 with a growing rate of 0.058% for the period (2003-2007).

Figure (3): Natural Gas Consumption In Iraq During (1991-2022) (Million Cubic Meter)



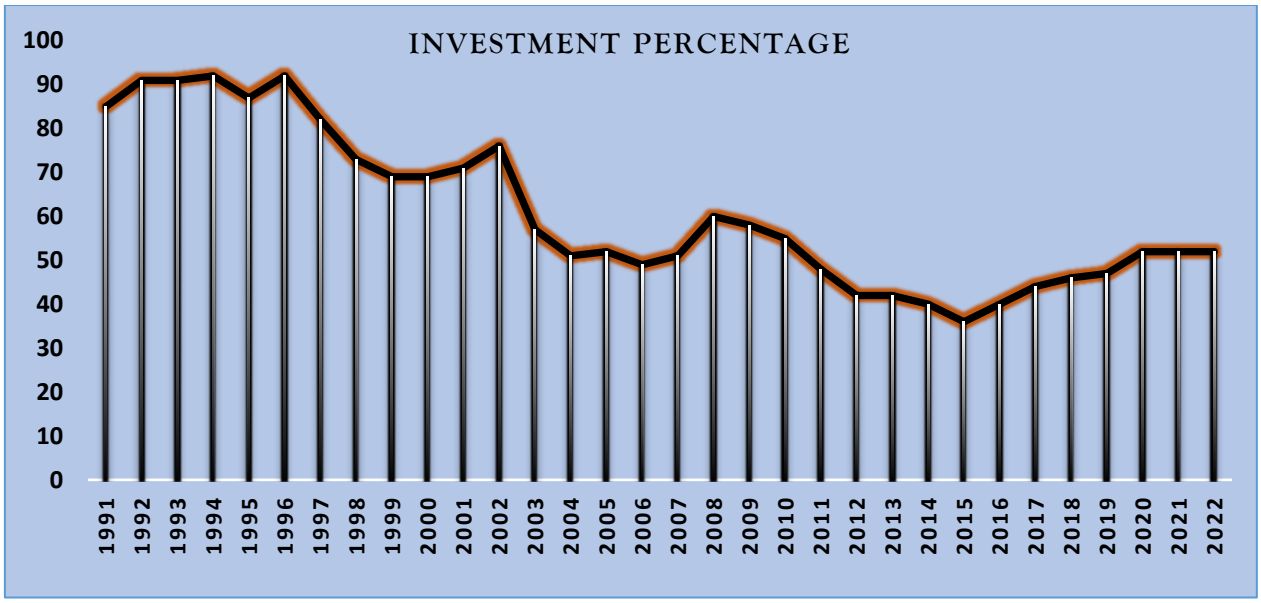
Resource: According To Table (1) Column (3)

D- Investment Rate of Natural Gas

As we said before, and according to Table (1) and Figure (4), the rates of using natural gas were high during the period (1991-2002) and the rates of using flared gas were clearly low. In contrast, the rates of used or invested natural gas were continuously and rapidly low during the

period (2003-2017). The rate of using natural gas was around 85% of the real produced amount that was 3720 million cubic meters in 1991, and it rose in 1996 to be 92% and then to lower in 2002 to be 76%. The reason of that was the low investment rates in oil fields because of the economic blockade on Iraq during the 1990s till 2003, when gas was used to generate electricity. This period achieved a growing rate of 42% for the period 1991-2002. After that, the usage rates of natural gas were getting continuously and rapidly low. The rates lowered to 57% in 2003, 51% in 2007, and 44% in 2017, while they rose to reach 52% in 2020, 2021, 2022.

Figure (4): Investment Of Natural Gas In Iraq During (1991-2022) (Million Cubic Meter)



Resource: According To Table (1) Column (4)

3-Wasting Associate Gas and Flaring It

Natural gas is the gas that is dissolved in crude oil under earth that requires separating it from oil when it comes above the surface. It is possible that the wasted or flared amounts of natural gas increase; the flared gas in the oil fields can be classified into two types:

First: The flared gas that can be invested represented by the hydrocarbon gas that are flared in the oil locations; they are dry gas and wet gas LPG (Khadim and Rashid, 2020, p. 19).

Second: The flared gas that cannot be invested is the gas that is flared and cannot be invested in gas factories, including carbon dioxide CO_2 and sulfur H_2S. With the crisis of flaring the natural gas in Iraq and its negative effect on political and economic environment and hindering the projects of electricity and other economic projects, Iraq is obliged to depend mainly on the Iranian gas; 35% of gas that is used in electricity production in Iraq depends on the Iranian gas, besides importing electricity from Iran.

3-1 Treating Natural Gas Flaring

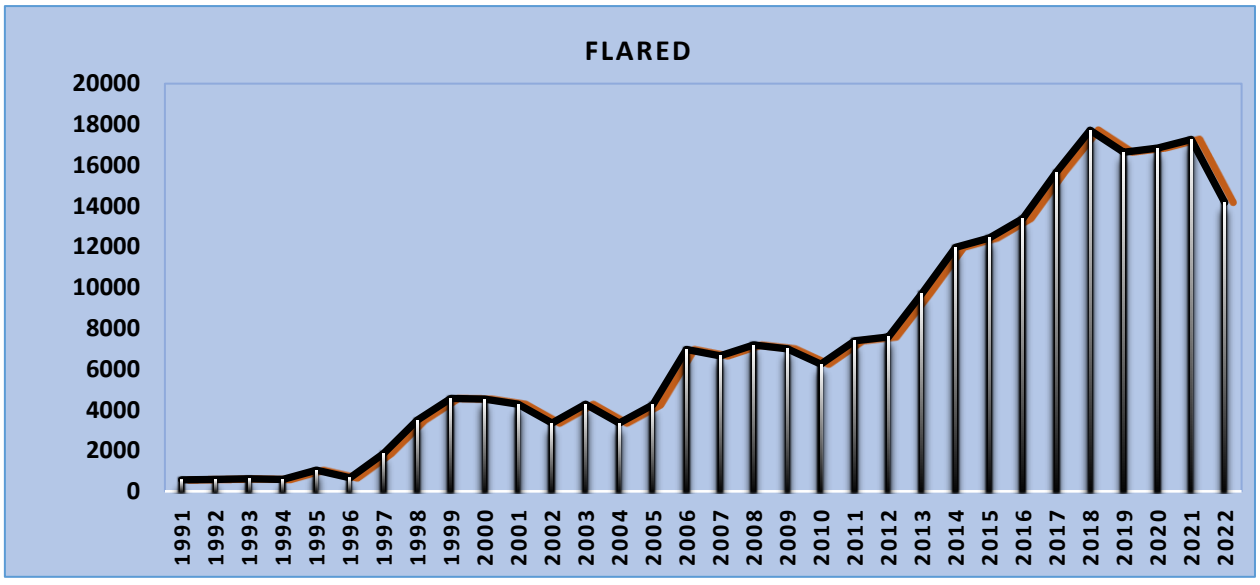
The technology of using associate gas is complicated and producing natural gas costs a lot. The economic and political effects lead to a great waste in the flared natural gas. Treating natural gas flaring and lowering it requires treatments and solutions concerning the designs of the existing oil fields projects. Doing that may rise the production of gas, especially after collecting data from the past the present, analyzing them, and building facilities to collect gas from the fields, connect processing stations to the local need, and increase the capacity of fueling centers that are close to the local consumption centers (Hussain, 2018, p.10). It is important to separate the flared amounts and to make assumptions about associate gas; this is in addition to putting policies, plans, and procedures for the traditional and the non-traditional processes of flaring the natural gas through evaluating the economic and technical risks such as managing natural gas flaring.

3-2 The Flared Natural Gas

Despite the increasing production of the natural gas in Iraq, most produced amounts are not marketed. Instead, they are flared. The rate of the marketed gas was no more than 7% of the real production of natural gas, which is 14171 billion cubic meters in 2004. Iraq is in the third rank of the top countries in flaring gas. The total flared gas reached 15662 billion cubic meters till 2017, and the average flared amount yearly was 5090 million cubic meters in the period (2003-2007) that was 64% of the average production amount in the year for the same period that was 13239 million cubic meters.

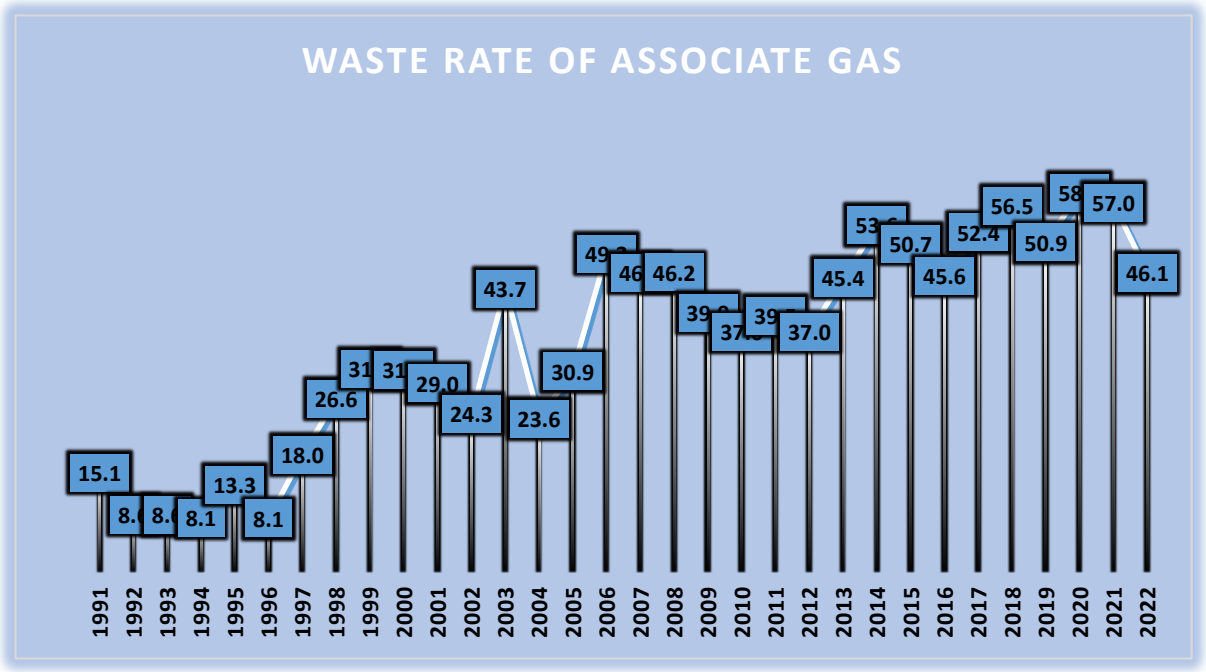
Table (1) and Figures (5) and (6) indicate that the flared gas is in a continuous increase from 1998 till now. The amount of flared gas reached 4272 million cubic meters in 2003, that is about 43.7% of the produced gas. This amount became 6998 million cubic meters in 2009 to be 39.9% of the produced gas. In 2017, this amount reached 15662 million cubic meters to be 52.4% of the produced gas, while the flared gas reached 17714 million cubic meters in 2018. This shows high rates of the flared gas during this period to reach 17258 million cubic meters in 2021, while it lowered to be 14173 million cubic meters in 2022 with a growing yearly rate of 0.092% for the period (2003-2007). The gas amount that is flared without benefiting from it locally or marketing it in the world markets, are increasingly in need of natural gas, shows a great waste that is unjustified in the rentier economy and unilateralism like the Iraqi economy that is characterized to be a rentier economy that depends directly on oil resources exported to the world markets. Meanwhile, Iraq imports big amounts of natural gas from foreign countries like Iran under severe importing conditions, and the imported gas is of the worst quality. Iraq adheres to these severe conditions to satisfy the needs of the local market in Iraq with its different production service sectors and factories, especially in the field of electricity generation. The latter suffers from a big shortage of gas that has a negative effect on the generated amounts of electricity. That is why electricity always faces continuous crises, especially in the seasons and peak times. Purchasing gas from Iran to generate electricity is not something economic, and it is considered a waste of financial resources that are spent on fields that they themselves should be productive financially and with quality.

Figure (5): Flared Natural Gas In Iraq During (1991-2022) (Million Cubic Meter)



Resource: According To Table (1) Column (5)

Figure (6): Waste Rate Of Associate Gas In Iraq During (1991-2022) (Million Cubic Meter)



Resource: According To Table (1) Column (6)

Conclusions

1- Although Iraq has a big wealth of natural gas, it has the tenth rank internationally and the fourth rank in the Arab world, its production of natural gas remains very low, and it does not provide more than 15% of energy consumption needs of Iraq. Iraq's production of natural gas was 11.4 billion cubic meters yearly in the period (2004-2007).

2- A huge amount of natural gas that is produced in Iraq is flared. Iraq is considered the third. top 20 internationally in the high rates of gas flaring. This is a huge, unjustified waste that can be used to satisfy the needs of Iraq and even to export the surplus. 64% of the yearly production of gas with an average of 700 cubic meters daily is flaring, and only 7% of the total Iraqi production is marketed.

3- The potential and proven reserves of natural gas are very big. Iraq is in the fifth rank in the Arab world proven reserves, and this constitutes 6% of the Iraqi reserves, 3.4% of the OPEC reserves, and 1.7% of the world reserves of proven natural gas.

4- There are serious deformations in the production and consumption of natural gas markets. that have a negative effect on the production quality and the consumption of the production units. These deformations are seen as a great financial and economic waste of an important natural production resource in Iraq. This leads Iraq to import an increasing amount of gas from the neighboring countries, which is of a bad quality and under severe import conditions that cost Iraq a lot of money. This loss can be avoided if investment rates in the produced and associated gas are increased.

5- A huge waste rate and a low investment rate characterized the period (2003-2022). Waste rate of the produced gas reached 57% in 2022, and the investment rate was 40% only in the same year, while it was high in 1991 with a rate of 85%.

Recommendations

1. Amidist the distortions of the production and consumption of natural gas's markets and The huge waste that has had negative effects on the gas's production and usage quality, new

policies and plans should be developed to improve the production and usage of this important resource, which, in turn, enhances the quality of gas production. and consumption.

2. The necessity of setting plans and strategies to benefit from natural and associate gas in An effective and efficient way that saves the country huge amounts of money spent on Importing the natural gas, satisfies the needs of the markets, and supports the local production of Iraq.
3. Improving the infrastructure of producing and consuming natural gas and benefiting from the production of the associate gas that accompanies the production of oil. This will enhance the contribution of the oil and gas sector to the national economy, which is considered as a rentier economy completely.
4. Setting policies, programs, and a consumption and production plan to increase the efficiency of using oil, its derivatives, and the natural associate gas in a way that fits the local market's needs of oil derivatives and natural gas instead of spending money on importing the natural gas and different oil derivatives yearly.
5. Benefiting from the international experiences, especially the countries that have similar capabilities to set a proper, successful investment policy.
6. It is necessary to continue having joint projects with the biggest world gas companies to increase the exploration of free gas and develop it to satisfy the local needs and secure the possibilities of gas export.

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