

EGYPT GAS EXPORT POTENTIAL UP TO 2050 & REGIONAL GAS POLICIES

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INTRODUCTION

Although having around 3.5 billion barrels of oil and 2.2 trillion m³ proved gas reserves, Egypt is facing with the crisis of meeting the demands of its domestic market. Mainly due to increasing in-country consumption volumes, Egypt has lost its position of being an energy exporter in 2014.

In contrast to these negative strides, new offshore gas discoveries again can change all the scenarios, and so Egypt's plans to be an exporter after 2020.

In intercalary years, new discoveries in Egypt offshore increase the importance of Eastern Mediterranean resources. A plenty of reserve estimations and potential about the region's hydrocarbon resources, development scenarios, gas export strategies, Israel, Cyprus and Lebanon's situations have been declared here and there.

However, questions of curiosity arise as:

- What will be the actual export potential of Egypt?
- Will it change all the gas balances in the region and European markets?
- What are the chances of transporting Egypt gas to Europe via Turkey, if a solution through Cyprus is unachieved?

Above questions will be subjected in this study. For starters, gas reserves, new discoveries and the fields to be developed, production-consumption-export potential estimations of Egypt will be analyzed. Analyses will yield evaluation of regional gas policies by including Turkey's role in the future dynamics.

GAS RESERVES & EGYPT'S CURRENT SITUATION

The country is known as having around 2.2 tcm of proved gas reserves. This amount is expected to increase after more tests and drillings to be completed in the new explored fields.

The main milestone in Egypt's gas market is to develop newly discovered fields and the fields to be discovered. However political instability, low levels of oil prices, unsolved political disputes in the region, financial/economic problems in the country and high investment requirements for deep offshore fields complicate the situation. As a result, handling this milestone becomes the main energy strategy of the country.

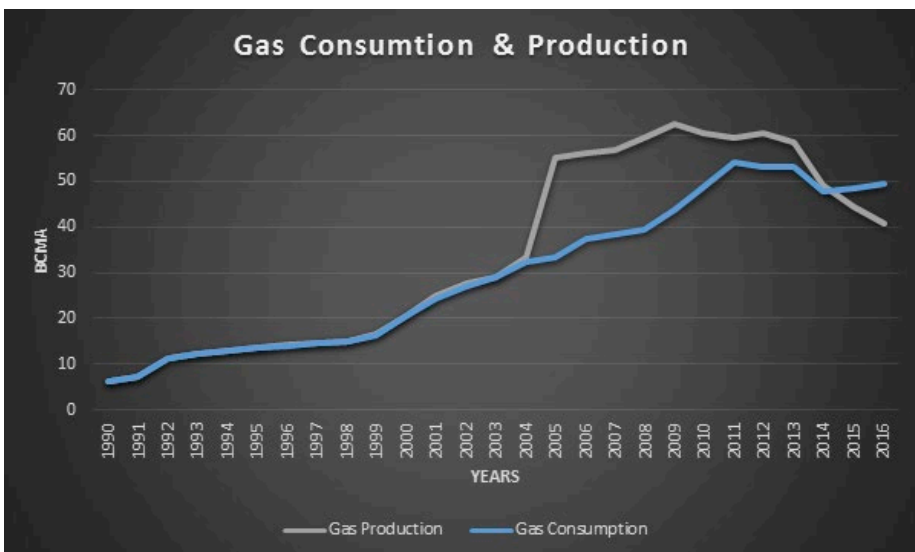
Not to mention, financial situation of the country getting worse and Egypt is trying to complete the due economic reforms to be able to get 12 billion \$ loan from IMF, which typically means bogging down while trying to jump out of the swamp. Additionally, the country has around 3 billion \$ of overdue payments to the due foreign investors. Indeed, such environment makes experts fear additional delays in the development periods of the new discoveries.

Although having plenty of reserves, Egypt due to high increase in domestic demand, became a gas importer instead of being an exporter. Gas is the dominant energy resource in the country's primary energy consumption with a rate of more than 50%. And sadly, the strategies followed by the due authorities show that, this rate will continue to increase (Hence, gas being domestic and cheaper).

In addition, in the electricity markets, with higher than 75% of gas usage to generate power puts natural gas as again the dominant energy resource.

In order to handle the negative gas balance and meet the domestic demand via imports, Egypt delivered 2 floating storage & reclassification units (FSRU) with capacities 5.7 bcma and 7.7 bcma. In addition to these volumes, the country was planning to open a tender for a third FSRU with a capacity of 7.8 bcma; however, due to the current balance projections and the financial situations had to delay the tender.

The charts on Graph 1 below summarizes the annual consumption and production rates of Egypt. As can be observed from the charts, around 2004's Egypt has become a gas exporter and in 2014 has lost its position to be a net importer.



Graph 1: Egypt's Annual Gas Production & Consumption.

As currently being a gas importer country, Egypt's main goal should be to develop its new discoveries to be able to meet the increasing demand. That's why in the next part, those new discoveries and the due discovered but not developed fields are going to be defined.

NEW GAS DISCOVERIES & FIELDS TO BE DEVELOPED

There are around 50 discovered but not developed (onshore and offshore) gas fields in Egypt's territories. These fields can be observed on Map 1 below. As seen from the map, Zohr is the most important and largest field among the other discovered fields in Egypt within the last decades.

In addition to Zohr Field, West Nile Delta area, Atoll and Selamet can be accepted as the other important discoveries for the last years.



Map 1: Discovered But Not developed Gas Fields in Egypt. Zohr field is located far in the north.

Table 1 gives the estimated / officially declared reserves of the due important gas discoveries.

Field / Group	Reserves (bcm)
Zohr	628
Notus	22
Tao, Kamose, Setiplio	10
WND	140
Abu Sir, El King, El Max, Al Bahig	23
Mina, Silva	20
Rahamat	9
Sienna Up	17
Idku	20
Atoll	42
Baltim SW	28
Ringa	17
Myas, Asfour, Abu Seif	12
Taalab	20
Salmon	20
Salamat	63
Satis	15
Tennin	35
TOTAL	1,141

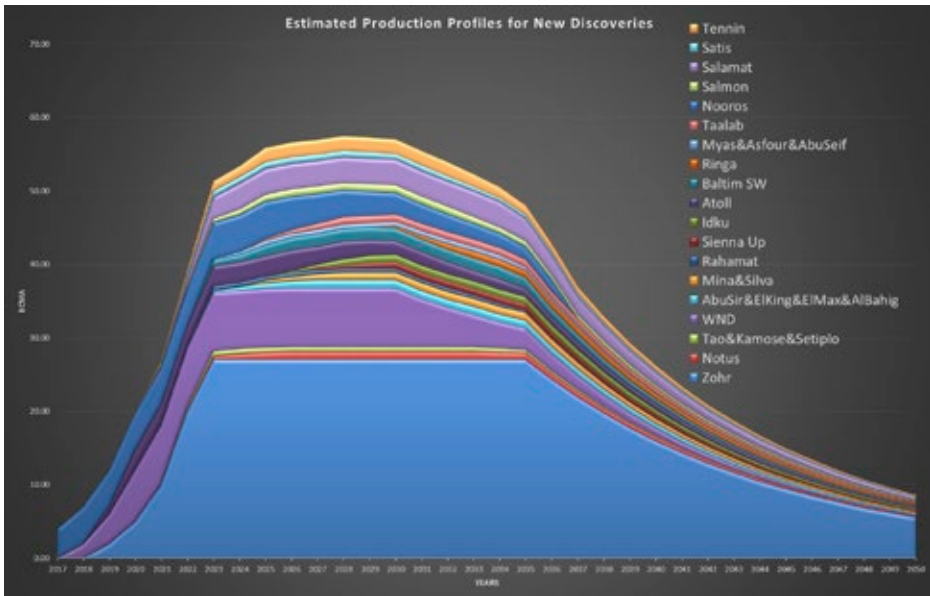
Table 1: Discovered but not developed gas fields and reserves in Egypt.

Note that; The West Nile Delta (WND) project comprises 11 gas discoveries, which are Giza, Fayoum, Libra, Maadi, Polaris, Ruby, Taurus, Viper, Taurus Deep and Hodoa.

Table 1 suggests that Egypt has around 1.1 trillion cubic meters of gas reserves to be developed and produced. However, at this point the question is how these reserves will be able to be developed and how those developments will reverberate in the gas balances of Egypt?

ESTIMATED PRODUCTION PROFILES FOR NEW DISCOVERIES

With the estimated reserves of each field (or field group), by considering the regional properties, operators financial and technical capabilities and the benchmarking results, production profiles have been tried for estimation and the results of estimations are presented in Graph 2.



Graph 2: Estimated production profiles for new discoveries.

Note that:

- Although Nooros field is an already developed gas field, hence going to effect the total gas balance of Egypt, its profile also is added to the cumulative equation.
- For all other estimations;
 - For each field, production is assumed to be done technically in full capacity. No market, transportation limitations are taken into consideration.
 - Development plans and plateau rates are evaluated to reach nearly the %90 (or higher) of the due reserves in 20 years.
 - In addition, some public statements about the due projects are to be taken under consideration. However, for some fields it has understood that; with the declared production profiles by due companies exceeds the gas in place volumes. So, those declarations which no scientific base, are not taken under consideration.
 - Decline rates are assumed by benchmarking the current producing fields in the region. And for bigger structures (reserve volumes), decline rates are assumed to be lower.
 - For smaller fields, plateau periods are assumed to be lower, hence, less investment is expected to keep the plateau period longer.
 - Commercial – political – security and international oil & gas price issues to be able to produce these fields are not taken into consideration.
 - Only the financial and technical capabilities of the due operators of the fields are taken into consideration to estimate the possible (nearest) development period of the due field.

- All fields are assumed to be produced up to the life of the field by not considering the economical limitations to abandon or license periods. Only for the international operators' fields, the profiles are designed to get maximum possible & commercial recovery in the minimum period (which is 20 years of license time).

Videlicet, by adding the currently producing Nooros field into consideration, Egypt's new discoveries will have a potential of adding up around 55 bcma extra peaked supply for the Egypt's gas equation. However, after 2035's with the increasing decline in the production levels might hit Egypt as a slap in the face.

CONSUMPTION ESTIMATIONS

After estimating the contribution of the new discoveries into Egypt's gas production, consumption profiles should be prepared in order to define the gas balance of the country.

So, before estimating the gas consumption profiles, in the concept of country's energy policies, Egypt has decided to:

- Develop all discovered gas fields as soon as possible,
- Stabilize the investment environment of the country for the foreign companies,
- By upgrading the distribution systems and encouraging the shift of power plants, increase the domestic gas consumption,
- By this way, swelling the gas utilization rate in the countries' energy equation (where gas is the most abundant domestic energy resource),
- Again become an LNG exporter, with the surplus gas after meeting the domestic demand.

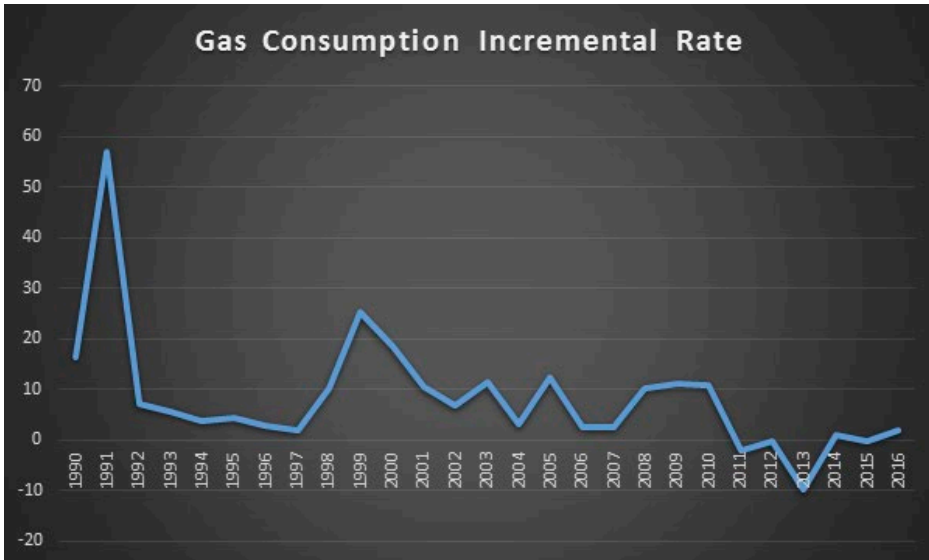
Which basically means; produce more gas and then increase the consumption.

These policies are expected to result in a sharp increase in the gas consumption values.

In addition, high population growth rate is the main directing element in the consumption balances.

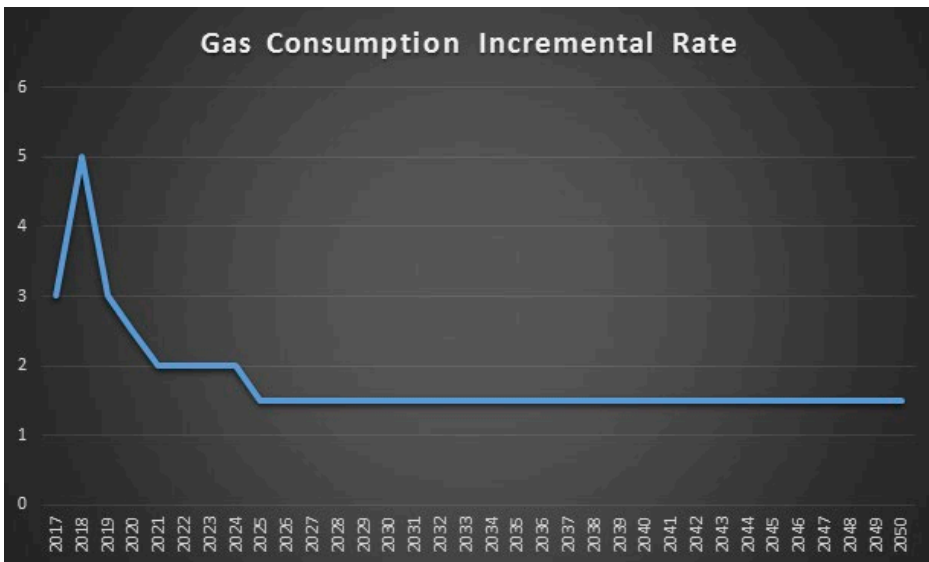
By keeping these in mind, while evaluating the current gas consumption incremental rates of the country, as seen in Graph 3:

- Effects of the Arab Spring in the country can be observed from the decline in the incremental rate of gas consumption.
- The increase observed in 2016 is expected to continue in 2017.



Graph 3: Egypt's gas consumption incremental rate (1990 – 2016).

Then, while estimating the future profiles, as seen in Graph 4:

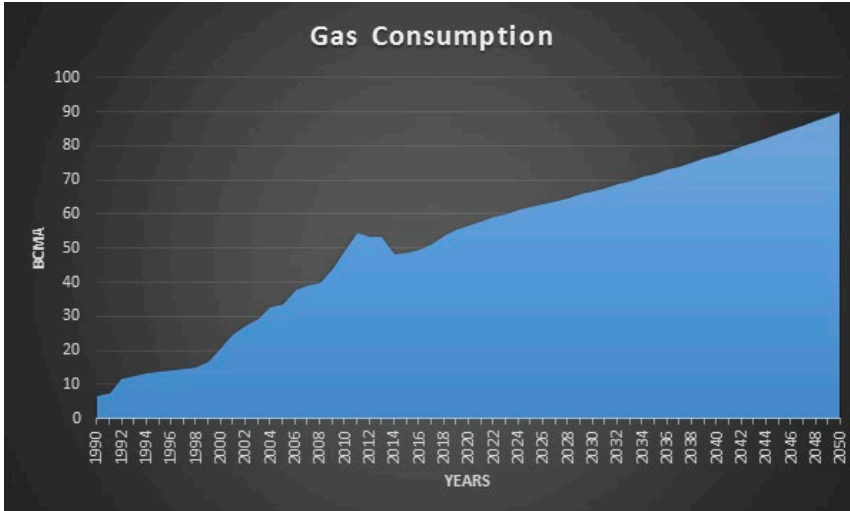


Graph 4: Egypt gas consumption incremental rate (2017 – 2050).

- After 2018 with the demanded precautions in energy efficiency and population growth rate, gas consumption incremental rate is assumed to be declined.
- After 2024 the incremental rate is assumed to be stable at 1.5 % ratio (By considering a more stable Egypt).
- This scenario can be accepted as the most optimistic scenario for gas consumption of Egypt. Hence for such unstable and poor country, it is not easy to apply effective

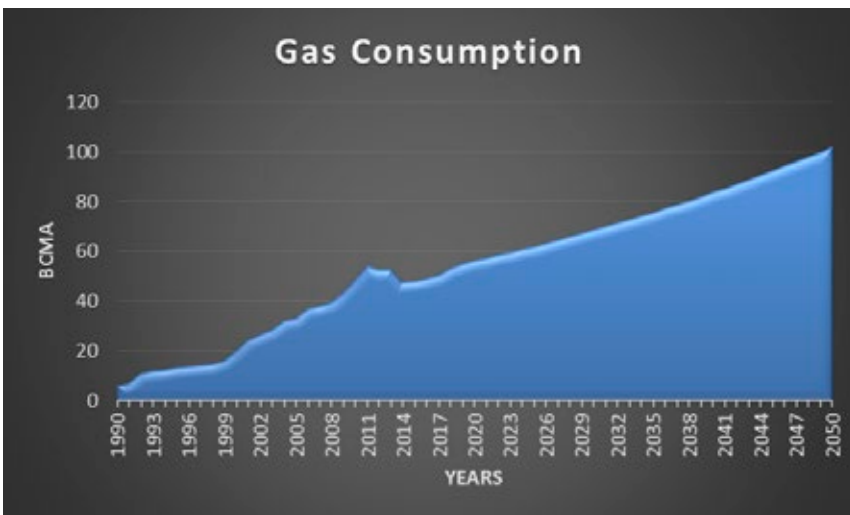
precautions to balance the increasing energy demand. While the hunger to consume energy is growing in the industry and social areas.

Then, with those incremental rate estimations, the total gas consumption profile of the country, up to 2050, can be observed in Graph 5:

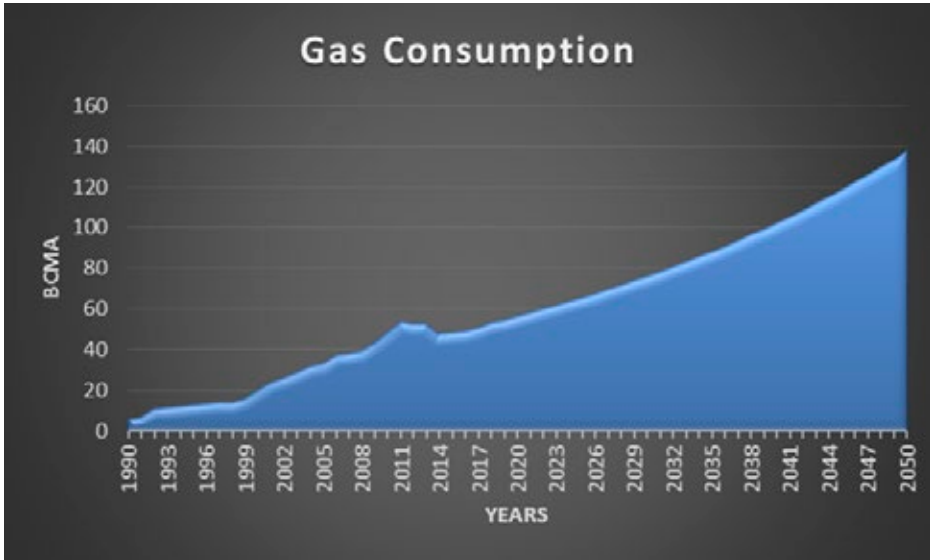


Graph 5: Gas consumption profile of Egypt up to 2050 (with an incremental rate of 1.5% annually after 2024).

In this scenario as shown in Graph 5, Egypt's total gas demand will be around 90 bcm in 2050. However, this scenario seems as the most optimistic one, by considering the population growth and the hunger of the industry after the Arab Spring effects. That's why, two more scenarios with annual gas consumption incremental rates of 2% and 3% are studied below.



Graph 6: Gas consumption profile of Egypt up to 2050 (with an incremental rate of 2% annually after 2024).



Graph 7: Gas consumption profile of Egypt up to 2050 (with an incremental rate of 3% annually after 2024).

As can be observed from the graphs of the other scenarios, with an annual gas consumption incremental rate of 2% (after 2024), 2050 Egypt gas demand is calculated to be around 100 bcm. And for 3% the demand volume rises up to around 140 bcm for 2050.

These factors also have to be considered during the estimation of the total gas export potential of Egypt.

GAS EXPORT POTENTIAL UP TO 2050

After defining the consumption scenarios up to 2050, in order to estimate the Egypt’s annual gas export potential, equation below is considered for calculations:

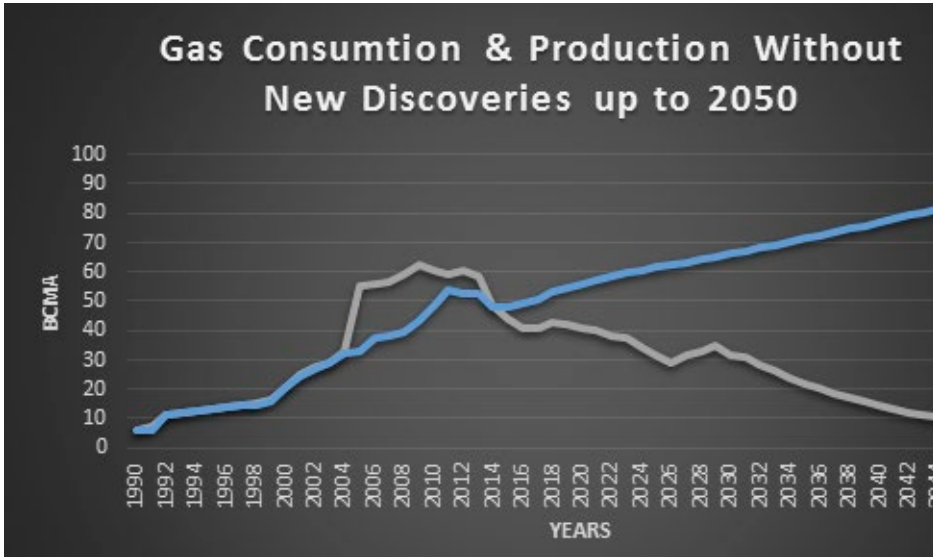
$$\text{Gas Export Potential} = \text{Gas Production (Current Fields + New Discoveries)} - \text{Gas Consumption}$$

Note that;

- As mentioned above, Nooros field is considered as a newly discovered field in this scenario. And its production is added to the new discoveries’ production profiles graph.
- After 2025, by assuming the new due discoveries are developed and as a result, the financial situation of the country will get better; enhanced recovery techniques are thought being used for lowering the decline in the total production in the existing (old) fields.
- While there are no small size new onshore discovery assumptions, and new enhanced oil recovery projects, the average decline of the existing gas fields is taken as 8%.

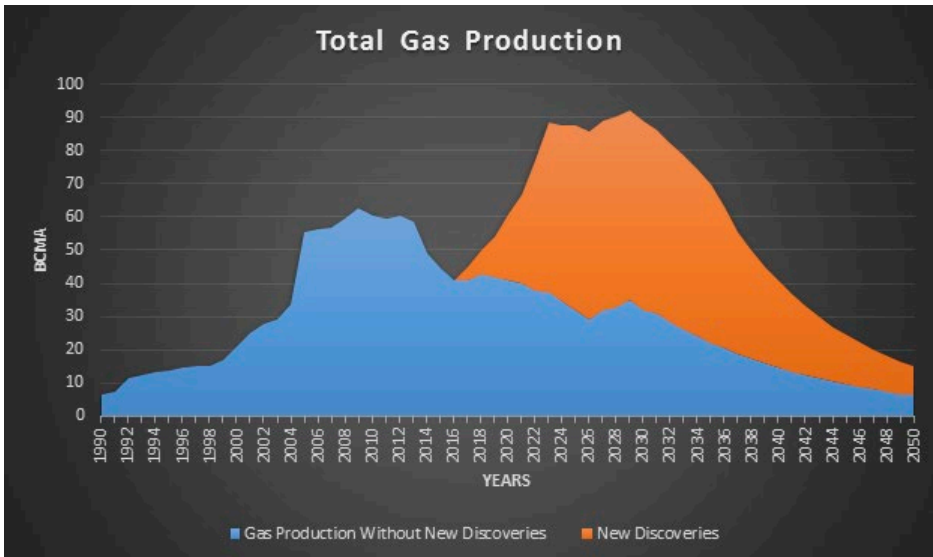
(Where 8% decline is again an optimistic approach.

Then, Graph 8 clarifies the most optimistic gas consumption and production -without the development of new discoveries- rates of Egypt.



Graph 8: Gas consumption & production rates without new discoveries up to 2050.

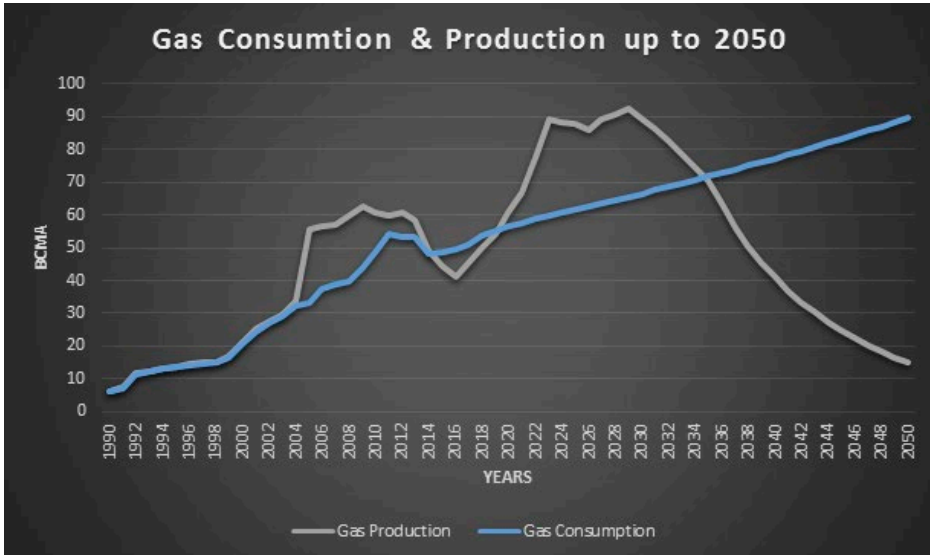
After adding the production expected to come from the new discoveries to the current producing fields of Egypt, then the total annual gas production volumes are given in the Graph 9:



Graph 9: Egypt total gas production including new discoveries & current fields.

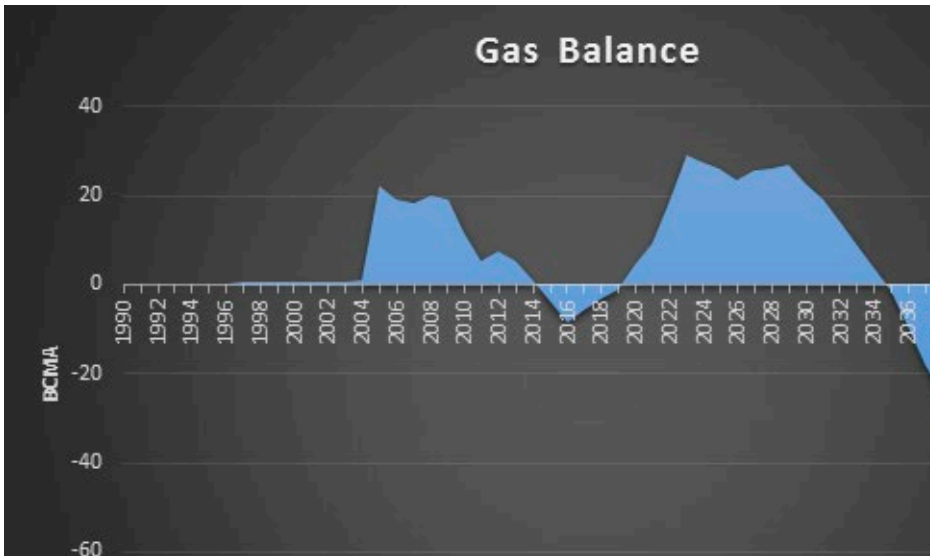
Where Egypt seems to have more than 80 bmca gas production rates between 2023

and 2032. And while adding this total production graph, the total consumption will be as given in Graph 10:



Graph 10: Egypt total gas production & consumption.

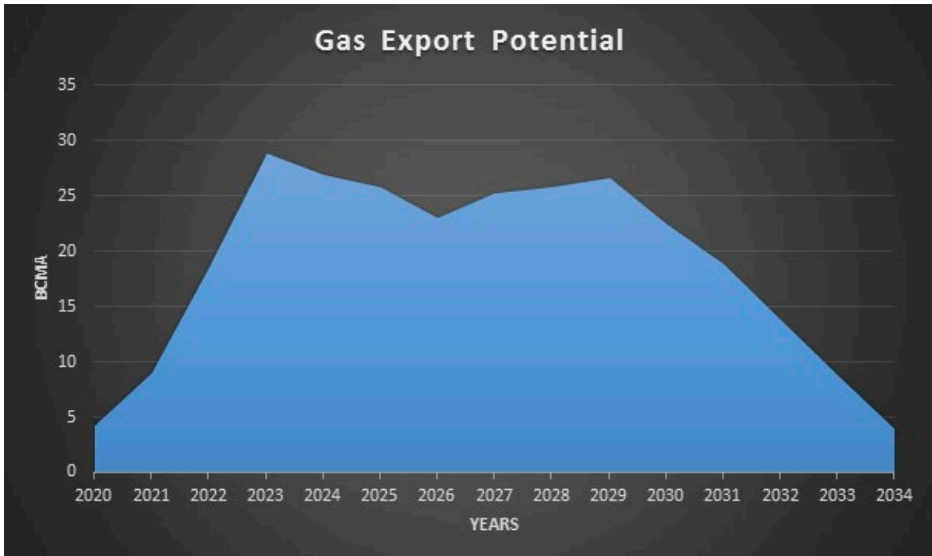
Then, after extracting the consumption from the total production, gas balance graph is prepared as seen in Graph 11.



Graph 11: Egypt's gas balance.

Videlicet, Egypt has an around 20 bcma (and a little more) surplus between 2022's and 2032's and again a huge increasing deficit after 2035's in its gas balance.

Then, the export potential of the country is given in Graph 12:



Graph 12: Egypt gas export potential (for annual consumption incremental rate is 1.5%).

As can be observed from the Graph 12, in the most optimistic scenario, Egypt will totally have around 283 bcm gas to export and the average peak rate can be accepted over 25 bcma.

However, while taking the domestic gas consumption annual incremental rate as 2%, then as shown in Graph 13; total gas to export volume will be around 260 bcma and the average peak rate can be accepted below 25 bcma.



Graph 13: Egypt gas export potential (for annual consumption incremental rate is 2%).

In addition, while taking the domestic gas consumption annual incremental rate as 3%, then total gas to export volume will be around 224 bcma and the average peak rate can be accepted below 20 bcma. And export potential becomes zero after 2032. Which means, Egypt will be an importer again after that year.



Graph 14: Egypt gas export potential (for annual consumption incremental rate is 3%).

Only new huge discoveries can change the prepared scenarios. And the total export potential of Egypt seem unlikely to influence the global markets.

ENOUGH INFRASTRUCTURES TO EXPORT?

In order to export its surplus gas to the global markets, Egypt has 2 domestic LNG facilities and 2 export pipelines. LNG export plants are IKDU ELNG Plant with a capacity of around 10 bcma and Damietta LNG Plant with a capacity of 6.8 bcma. In addition, the export pipelines are Arish–Ashkelon pipeline to Israel with a capacity of 9 bcma and the Arab Gas Pipeline with a capacity of 10.3 bcma to Jordan. However, the export pipelines may require maintenance works to be utilized with the due capacities. Moreover, for the pipeline exports, due markets’ demands also have to be considered as Israel is going to be an exporter during the same period. That is to say, there seems to be market constrains for the pipeline exports.

However, the current infrastructures seem as nearly enough with the current conditions.

NEW INFRASTRUCTURES?

In addition to existing LNG facilities and pipelines, there are some other options for Egypt to export its energy resources via new (or extended) infrastructures, which will be a possible underwater electricity line to Southern Cyprus and the possible extension of Arab Gas Pipeline.

CYPRUS ELECTRICITY LINE?

As can be understood from the title, in this option, which has already been signed by the due authorities, Egypt is planning to produce electricity from its surplus gas and export the production via underwater cables to the Southern Cyprus.

This option can be considered as possible. However, the main milestones to handle are the market risks in the Southern Cyprus and the financial problems of the both sides.

As for the further steps, Egypt is working on the possible electricity export to Crete and then to Greece after a successful start by exporting electricity to Cyprus first. However, in those steps also, there are important risks which make the project commercially unfeasible. Those risks are the small market size of Crete, where such a big investment seems redundant and EU's electricity markets' average prices, where Egypt's production has no chance to recess by considering the high transportation costs. In addition, all due sides have financial problems to handle such an expensive project.

EXTENSION OF ARAB GAS PIPELINE TO TURKEY?

There is a possibility of extending the Arab Gas Pipeline from Syria to Turkey. However, the situation of Syria and the political conflicts between Egypt and Turkey are the main milestones of the idea.

Political conflicts between Turkey and Egypt can be solved in the near term but there are huge security risks in Syria that is unlikely to be resolved.

By the way this option can be suspended for the midterm scenarios.

CYPRUS GAS PIPELINE?

Egypt has signed an agreement with Southern Cyprus for an import pipeline from Aphrodite field with a capacity of 8 bcma. However, while considering the existing export infrastructures of Egypt, there seems no free capacity to handle Aphrodite gas. So, Aphrodite investors or the Egypt government has to construct a new LNG export facility, which makes the transportation costs higher.

That's why, this option does not seem to be viable.

ISRAEL GAS TO EGYPT

After due offshore discoveries (such as Leviathan) being developed, surplus gas of Israel also have been considered to be transported to Egypt's LNG facilities (via Arish–Ashkelon pipeline) and then to be exported. However, because of the main obstacles placed by the unknowns about the free LNG capacity of the existing terminals and political instability in Egypt, the idea to transport the Israeli gas via Egypt's ports has been cancelled.

By the way, it is known that Israel's total export potential -after subtracting the consumption and the agreed volumes to sale- is not high enough to require more free ca-

capacity in Egypt's LNG facilities. That's why, in the future, there may be a 3 or 4 bcm portion for Israel. So, the idea can stand a chance to be a solution.

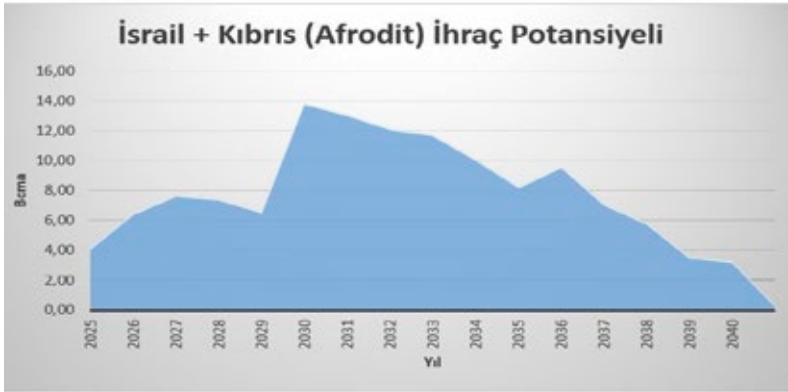
REGIONAL GAS POLITICS

After estimating the long term export potential of the most important gas possessing country in the Eastern Mediterranean: Egypt's, to analyze the potential of the region, total estimated reserves have to be identified.

As mentioned above, total proved gas reserves of Egypt is around 2.2 trillion m³. As the second highest gas reserves bearing country, Israel has around 1 trillion m³ proved gas reserves. At last Southern Cyprus with the only Aphrodite field has around 0.1 trillion m³ proved gas reserves. So, the total proved gas reserves in the region is around 3.3 trillion m³. By comparing with the Russia, the total proved reserves of the Eastern Mediterranean is around 10% of Russia.

Then what about the total estimated gas export volume of these countries?

For the export potential of Southern Cyprus + Israel (where Israel's total consumption and the agreed sales volumes are subtracted from the projected production volumes) Graph 15 summarizes the situation up to 2050.



Graph 15: Israel + Cyprus total gas export potential (Reference: <http://www.tespam.org/ki-bris-sorunu-cozulse-turkiyeye-ne-kadar-gaz-gelecek/>).

By adding the Egypt's export potential (the optimistic one) into this scenario:



Graph 16: Eastern Mediterranean gas export potential up to 2050.

So, as seen from Graph 16:

- If new huge fields cannot be discovered, the export potential of the region will become zero in 2042's.
- The peak values are around 25 bcma for nearly 10 years, which cannot be taken as vitally important for the global gas markets.
- In the near term, Lebanon offshore and Cyprus exploration activities may change the scenarios.
- However, in the current situation, there is no need to exaggerate the region's potential.
- In addition, from the sight of European markets, in terms of finance or the capacity, Eastern Mediterranean cannot be a rival for Russia.

So, is there a possibility of the Eastern Mediterranean gas to be transported to Europe via Turkey?

By neglecting the political conflicts and only considering the technical and commercial aspects, the Eastern Mediterranean gas can be transported to Europe via pipelines through Turkey. However, there will be market price risks while trying to struggle with the Russian gas sales.

In addition, being the supply volumes not stable (such as around 25 bcma for 10 years and then fall into 5 bcma levels) discomforts the long term design and investment environments.

For the rest, Egypt will not be a part of such transportation project, hence it already has existing free LNG capacities in the country. And also, Turkey will not let such federal solution in Cyprus, which will restrict its sovereignty in the area.

Cyprus conflict?

The conflict does not seem to be solved by pushing from the sight of energy policies and insubstantial pledges of Turkey being an energy center by disclaiming its rights over Cyprus and transporting the gas of Leviathan and Aphrodite.

Other roots via pipeline or electricity?

Scenarios	Risks
Aphrodite gas to Egypt	Free LNG capacity and market risks
Aphrodite gas to Egypt via Israel	Free transportation capacity, free LNG capacity and market risks
Aphrodite gas to Greece	Commercially not possible
Aphrodite gas to Israel	Free transportation capacity and market risks
Egypt electricity to Cyprus	Possible but finance risks
Egypt electricity to Greece	Commercially not possible
Aphrodite gas to be liquefied in a new facility in Cyprus then being exported	Commercial, technical and financial risks
Aphrodite gas to Turkey	Only political conflicts

Table 2: Some export scenarios and risks.

As mentioned in Table 2, Southern Cyprus does not have many choices to maneuver with. The best option is to sale its gas to Turkey. From the Egypt’s sight, the electricity export to Southern Cyprus and only some amount of gas volumes to be exported if there is any free capacity in its due LNG facilities can be subjected.

Lebanon & Syria Offshore?

There may be an important potential in Lebanon and Syria offshore. For Lebanon, if there is no other unexpected delays in the due tenders, exploration periods will start and the results will be observed in 2-5 years. For Syria, security risks and in-country conflicts have to be solved before starting the exploration step. So, there is minimum of 10 years to make clearer estimations.

By the way, for both countries, Turkey and Europe (through Turkey) will be the best feasible market options.

Cyprus New Discoveries?

After the discovery of Zohr Field, there are new expectations around the Egypt boundaries. And the new licenses have been agreed with some eastern companies (including Qatar Petroleum) near Zohr. From the geological sight, there are possibilities, hopes and also many unknowns which will affect the results. And those results may not meet the expectations.

In addition, some parts of the 10th, 11th and 6th blocks –those Southern Cyprus government has given to the due companies illegally- are occupying the Turkish boundaries. And there are huge conflicts among the disputed territorial waters.

Turkish spurt over the exploration activities in the due region will be another important issue by considering the politics.

It’s early to say anything about the results of the due illegal blocks of Southern Cyprus –while there are no seismic studies in the region- but the best and convenient choice for the Southern Cyprus seems to develop its discovery after 2040’s. Or to officially join the Turkish side!

FROM THE SIGHT OF TURKEY?

From the sight of Turkey;

- Initially there is no important volumes of gas in the region to help Turkey's strategy to be a gas transit hub
- By the way, Cyprus and other potential countries need Turkey as a transit gas and market to develop the due/possible fields.
- Any of the energy issues cannot be used as a leverage to solve the Cyprus conflicts against the Turkish rights.
- There is not any option for Egypt to transport its export potential to Turkey via an offshore pipeline through Cyprus or EU through Turkey.
- Egypt's export potential is limited and will be on the wane after 2035's.
- Turkish boundaries are officially being occupied by some international oil companies and the Southern Cyprus Government.
- Turkey has to intercept this and firmly focus on its exploration spurt in the region.

RESULTS

As being mentioned above, Egypt is going to be an exporter once again between the years 2020 and 2035's. However, the increasing hunger in the domestic consumption will not let the country to maximize its export potential. In addition, the financial and legislative situations also have some risks for the foreign investors.

Egypt's most important target is to develop all the new discoveries in the country with the international investors. Although by assuming this goal being able to be a gain, the discovered structures are not as big as dreams for being the biggest supplier of Europe and global markets. While the peak export potentials are around 26 bcma.

By considering the estimated export potentials, Egypt's current infrastructures are nearly enough to meet the demand. However, there seems no available capacity to handle extra gas from Cyprus or Israel.

In addition, the export volumes are not as high as meeting the need to feed the European hunger. There is no chance for Egypt to compete with Russia in the European markets.

Egypt is again going to be a gas exporter in the near future. As a result, black clouds will come back over Egypt if the findings from the new research areas is not able to compensate the expectations.