SMOOTHENING THE GAS DEMAND AND SUPPLY SCENARIO

THE CASE FOR REALISTIC PLANNING TO IMPROVE CONFIDENCE IN GHANA'S GAS MARKET AND REDUCE RISKS ON PUBLIC FINANCES

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1.0 Introduction

The importance of natural gas to Ghana is established to be enormous; for power generation and in recent times, for industrial growth. In the electricity sector, more than 50% of demand rely on thermal plants which can use natural gas, the cheapest among the fuel options. The Ghana Grid Company (GRIDCo) estimates that the growth in generation and demand on the grid will depend largely on thermal plants, estimated to reach about 2700MW by 2022. The commitment of government therefore has been to increase the availability of natural gas to allow fuel switching from diesel, Residual Fuel Oil (RFO), Heavy Fuel Oil (HFO), light crude oil etc. The industrial consumption largely remains aspirational. Today, only about 8mmscfd of gas is consumed by industry in Ghana. There are existing businesses that can switch to the use of gas, but they remain impacted by either access to transmission infrastructure or the economics of the fuel.

Ghana looks to two sources for supply of gas; imports and domestic production. The imports will come from Nigeria through the West Africa Gas Pipeline (WAGP) and Liquefied Natural Gas (LNG). The domestic sources are expected to come from producing oil and gas fields in the short to medium term, and the long term, from additional investments in the offshore basins of Ghana to discover more oil and gas resources.

In the past, the Nigeria gas was not reliable mainly on account of pipeline attacks and debt from default in payments for gas supplied to VRA. This situation, coupled with high demand projections from the energy commission, brought to the fore policy decision to diversify the imports through LNG. In recent times, supply has been fairly stable under a new arrangement to offtake gas through the issuance of letters of credit (LC). In addition, government is proceeding with two LNG projects which continue to send mix signals to the finances of government and the investors in the local gas market. This is fuelled by the potential of oversupply of gas which poses risk to the cash flows of the local suppliers.

In 2017, ACEP released an advisory paper[1] on the LNG projects that were on the horizon against projected demand for electricity. Electricity demand at the time was primarily the most potent option for gas utilization. The Centre saw a big risk with long term commitments to LNG supply which the country was considering. The potential cost to Ghana was estimated to be in excess of $6.8 billion. This paper is a follow up to re-examine the gas supply scenario for Ghana to account for new dynamics in the gas market and consolidate the perspectives of industry and relevant stakeholders in the gas market.

1.1 Objective of the Study

This study assesses the demand and supply scenarios for gas in Ghana and whether demand plans can meet the supply of gas.

Specifically, the study seeks to;

1. Provide a realistic view of the time of use of gas need of Ghana
2. Provide an analysis of the costs, benefits and risks associated with limited as well as excess gas supply
3. Analyse options available for Ghana in terms of gas usage and provide guidelines on the best option for Ghana
4. Provide information for all stakeholders on the risks of both limited and excess supply of gas

In preparation for the study, the Africa Centre for Energy Policy (ACEP) reviewed available public information on the Ghana's gas industry. ACEP also met with government officials, regulators and industry participants, including producers and consumers, and potential gas users. While all these discussions remain confidential, the information and understanding gained from these discussions have provided useful background information for the study.

[1] Liquefied Natural Gas (LNG) Supply to Ghana: The Politics and the Reality. Available at https://new-acep-static1.s3.amazonaws.com/publications/Advisory+Paper+on+LNG+2017.pdf

2.0 The International Gas Market and the Basis for Global Gas Industry Development

For several decades, oil and natural gas have become the most important primary energy sources for most countries and continues to enjoy an important standing in the structure of global energy consumption. Oil consumption accounts for 34% of global primary energy consumption, with natural gas accounting for 23%, and coal 28%.[2] The United States Geological Survey (USGS) provides a resource basis for further development of the global natural gas industry. Their assessment show that the globally, technically recoverable resources of conventional oil (including natural gas liquids) are 255 billion tonnes, and the globally, technically recoverable resources of conventional natural gas are 462 trillion cubic metres. For unconventional gas resources (coalbed gas, tight gas and shale gas) and the future of its exploration and development, the appraisals put the global remaining technically recoverable resources at 328 trillion cubic metres.[3] This implies that oil and natural gas will continue to dominate the structure of global primary energy consumption for the foreseeable future.

Several reasons can be adduced for the rapid development of the global gas market. The recent ability of the US to produce gas from unconventional sources using 'fracking' technologies has contributed immensely to the growth in the supply side and impacted on market prices of the global gas industry. Before that, the development of Liquefied Natural Gas (LNG) improved the tradability of natural gas beyond the limitations of conventional trade through pipelines. This allowed gas to be moved across oceans which was not possible in the early years of gas trade. Floating and Storage Units (FSUs) and Floating, Storage and Regasification Units (FRSUs) for LNG, which are available for leases, have also eliminated the need for large upfront investments in onshore regasification and storage facilities for gas importers. This has made the import and sale of Liquefied Natural Gas (LNG) on a cargo-by-cargo basis easier, in place of the previous predictable and long-term contracts between producers and buyers.

The use of gas will continue to rise to reduce the importance of oil, which is significantly used to fuel automobiles. Increasingly, natural gas has become versatile and pushing its adoption to greater limits. Gas resources are favoured for their environmental benefits of emitting significantly lower levels of carbon. In most countries today, gas has significantly replaced crude oil-fired generation turbines. In Asia and parts of South America, the use of gas for transportation is rising to reduce the consumption of petrol and diesel.[4] The growth in electric vehicles means more gas generated electricity will be required to charge the cars.

The impact of these and other developments in the industry have kept international prices of gas at a level that makes natural gas a competitive energy option for most

[2] BP Statistical Review of World Energy 2018

[3] Chengzao, J., Yongfeng, Z., & Xia, Z. (2014). Prospects of and challenges to natural gas industry development in China. *Natural Gas Industry B*, *1*(1), 1-13.

[4] Shi (2018). *Natural gas in East Asia's Energy transition*

countries. Therefore, in many countries today, there is gas available on the market at competitive prices for various applications. Countries in temperate regions of the world demand gas for space and water heating, cooking, electricity generation and application for petrochemicals and industrial heating. Most African countries have very low or negligible demand for gas for these purposes. The primary demand for gas is for electricity production, though in recent times some countries such as Nigeria have started the production of fertilizers and other petrochemical products.

In sub-Saharan Africa, electricity supply is often unreliable and erratic, with a huge mass of the population without access to electricity. Indeed, the Africa Development Bank's *New Deal on Energy for Africa* reports that over 645 million Africans have no access to electricity. The continent also records the lowest power consumption per-capita with an estimated 181 kWh per annum, compared with 13,000 kWh and 6,500 kWh in US and Europe respectively[5]. Bridging this energy gap is expected to be influenced by the growing demand for cleaner sources of power; largely renewables and gas, which is the cleanest in the hydrocarbon family.

The result of the electricity access problem is the fact that it undermines investments, economic growth and job creation. Jobs, lives and investments are lost from the unreliable supply of electricity. The impact of increased energy use and economic growth of an economy is an almost settled debate in literature. Bacon and Kojima (2016)[6] observe that generally, adequate supply of energy is an antecedent to economic development. Increased electricity access has been heavily linked to increases in income, consumption and employment.

Given the importance of reliable energy supply to economic growth, the development of a gas industry in Africa can be a major contributory factor to satisfying the primary energy needs of the continent. Several African countries like Mozambique, Egypt, Tanzania, Nigeria, and recently Ghana are significantly endowed with rich gas reserves, most of which are yet to be developed to their full potential. This presents the possibility for the development of domestic gas markets for cheap, flexible gas-fired electricity production in these countries, and for export.

3.0 Overview of the Gas Industry in Ghana

Like many other sub-Saharan African countries, Ghana's primary demand for natural gas is to produce electricity, with some generally low demand industrial application. With the increasing unreliability of the hydro plants due to changing rainfall patterns, it became imperative to look for other reliable, affordable and sustainable power generation sources. Consequently, the country focused on introducing thermal plants into its generation mix. These plants were initially powered by liquid fuels (HFO, LCO) but were over time made to run on gas as a cheaper alternative. Thus, gas market development in Ghana is anchored on electricity generation to provide reliable,

[5] The New Deal on Energy for Africa, AfDB
[6] Bacon and Kojima (2016)

affordable and sustainable power to propel economic growth and development.

Ghana started using natural gas to boost its power generation in 2009 by importing natural gas from Nigeria through the West Africa Gas Pipeline (WAGP), an offshore gas pipeline connecting Takoradi and Tema in Ghana with Nigerian gas fields. This has however not been without challenges of unreliable supply of gas, which partly contributed to the long spell of power crises in the country from 2012 to 2015. Subsequently, Ghana began the commercialization of its own resources from discovered oil and gas fields in the Western Basin of the country.

Three large offshore oil and gas fields are in production in the Western Basin. One of the fields is the Jubilee field with associated gas reserves estimated at 490 Billion cubic feet (Bcf) out of which about 100Bcf has been consumed. This leaves about 100Bcf of remaining free Foundation Gas Volume from the field. The rest are Tweneboa-Enyenra-Ntomme (TEN) fields with associated gas reserve of 363 Bcf and the Sankofa field with non-associated gas reserves of 1,107 Bcf. Other proven discoveries which are yet to be developed include the Mahogany and Teak discoveries with total reserves of 130 Bcf which will be developed as part of the Greater Jubilee Full Field. ENI Ghana as part of its Akoma exploration prospect, has recently announced the discovery of more gas and condensate in Cape Three Points – Block 4, with pre appraisal estimates of between 550 and 650 Bcf of gas.[7] The Pecan Field operated by Aker has gas fields estimated at an average of 669bcf (P50 estimate). At the time of developing Ghana's Gas Master Plan (GMP)[8] most of the domestic gas resources were under development. Therefore, the plan projected the need for LNG imports in the short term to augment gas supply. The dynamics are not the same today. Domestic sources are currently enough to meet demand for gas in the short to medium term.

There is also the potential for more gas reserve discoveries as Ghana rolls out an aggressive programme to encourage exploration for both onshore and offshore fields. Six exploration blocks were put out for awards through an open contracting process; both competitive bidding and direct negotiation. This was to ensure that capable companies are awarded the blocks. The outcome of the process may not be as expected, as some of the prequalified super majors pulled out of the process. However, most of the companies who are going through the process are tested companies such as Tullow and ENI. Again, the super majors are still around negotiating for blocks. This could be important for the future gas supply outlook.

The three producing fields can produce at least 315mmscfd; 180mmscfd from Sankofa, about 135mmscfd from the Jubilee and TEN fields. These domestic potentials have been suppressed to less than 100mmscfd through the early part of 2019 because of inadequate infrastructure to transmit the gas to demand centres. It is significant to note however, that the financial consequences of failing to consume all of the gas could not be

[7]Eni announces Akoma discovery in CTP-Block 4, offshore Ghana [Accessed here: https://bit.ly/2vZ4opk on 14/05/2019]

[8] Gas Master Plan, 2016

suppressed. The Sankofa gas is being paid for, though the full volume is not being consumed because of the "take or pay" commitment from the government (see ACEP paper on OCTP gas utilisation)[9]. The companies who do not have the take or pay arrangement governing gas production are often told to suspend production or reinject their associated gas at no cost to the state because the economics of those projects hinge on oil production.

"It is significant to note however, that the financial consequences of failing to consume all of the gas could not be suppressed"

The situation is impacting negatively on investment attraction and the attractiveness of the gas market to existing investors. In the recently submitted Plan of Development (PoD) submitted by Aker Energy, the company is proposing to reinject the associated gas to optimize oil production. Though justification was given for gas reinjection to optimise oil production, the fears of the company of the instability in the gas market cannot be discounted in analysing the attitudes of the investors; Aker is quoted in the PoD as "*There is a situation with surplus of gas to the domestic market for the coming years. This market situation represents a challenge for stable and predictable offtake of the Pecan associated gas, as well as determining the gas sales price*". Arguably, the investor sees the risk with contemplating gas export to the domestic market, which remains unstable and risky.

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3.1 Gas demand scenarios in Ghana

Currently gas is mainly used for power generation. About 97 percent of gas supply is used for power generation while the remaining is for industrial utilisation. The industrial demand is thus currently very low with only a few ceramics producers taking the gas.

The Ghana Gas Master Plan identifies other potential industrial uses of gas, including the textile, cement, steel, paper and fertilizer industries but there has been very little effort to stimulate demand from these industries. The plan carefully categorised the options of gas utilisation according to their risk levels of possible adoption in the country. The power sector was noted to be the most urgent demand and economically attractive option for Ghana. Gas for cement and clinker production was rated the second most attractive option if Ghana could economically build the needed gas infrastructure to link limestone deposits to gas sources.

[9] ACEP's Comments on the OCTP Utilization Challenges (2019). Available at https://s3.amazonaws.com/new-acep-static1/publications/ACEPs_COMMENTS_ON_THE_OCTP_GAS_UTILIZATION_CHALLENGES.pdf

The third option was for Ghana to consider supplies to industrial clusters that could implement cogenerations, i.e. the use of gas for electricity and the residual heat for other industrial processes. Compressed Natural Gas (CNG) was also proposed for large fleet of commercial buses and taxis. There was also recommendation for the use of gas for capital intensive industries such as urea, methanol and aluminium which are a high-risk option due to their high capital investment requirements. The Plan therefore could not recommend them for implementation during the formative stages of the gas market. Certain global and local factors were identified as risks to the options for fertilizer in particular. These include the required low gas price, competition from fertilizer producers and subsidies provided by governments in those markets globally.

The conclusions of the Gas Master plan (GMP) remain largely relevant today. However, there are emerging realities that shape certain fundamental assumptions. For example, the assumptions for domestic supply anticipated a high case scenario of about 210mmscfd for Sankofa gas. This is currently about 300mmscfd with additional investment on the production infrastructure and 246mmscfd without further investment, as indicated by the company to government. Also, Aker Energy may not commercialise the Hess gas as anticipated in the GMP. Aker is proposing oil optimisation strategy that applies the available gas for reinjection, which ACEP is largely convinced that it is as a result of poor market conditions, as also confirmed by Aker in their PoD.

4.0 Projections of Gas Demand in Ghana

4.1 Power demand

Actual electricity demand for 2016 and 2017 were 2087MW and 2077MW respectively (Energy Commission, 2018).[10] The estimated demand for 2018 was about 2200MW, averaging statistics from the Ghana Wholesale Electricity Market Bulletins. Based on the daily demand statistics from the Ghana Grid Company (GRIDCo) the Energy Commission, ACEP estimates that the average power demand by the end of 2019 will be approximately 2436MW. Using these values, the thermal power projections were extended to the year 2030 using the exponential smoothing method. Exponential smoothing is a forecasting method that predicts future values based on a weighted linear combination of past observations, taking into consideration the seasonality and the trend of the data. In exponential smoothing, the older observations decay exponentially, resulting in lower weights while more recent observations are given higher weights. This was used in order to smoothen distortions in planning and forecasting as have been observed with Energy Commissions' projections. In 2014 for example, Energy Commission projected a 10% annual growth rate in energy demand. This would have pushed current demand to about 3100MW in 2019 instead of the

[10] Energy outlook 2018

current situation of about 2400MW which is 700MW short of aspiration.

Table 1 presents projected demand for thermal energy from 2019 to 2030. Based on the results of the projections using the Exponential Smoothing Method, three scenarios are projected; the base case (or most likely), the lower case (the pessimistic) and the upper case (the optimistic) scenarios. The lower case and upper case scenarios were obtained from the lower and upper limits of the 95 percent confidence intervals for the estimation of the projected power demand. For the purpose of this analysis, the lower case scenario was ignored. As observed from the table, demand for total power (hydro and thermal) is expected to range between 3700MW and 3900MW by the end of 2030. On the assumption that hydro power generation is to be constant for the period under review (an average of 1120MW), it is projected that average demand for thermal energy can increase up to between 2400MW and 2800MW, with the most likely scenario being approximately 2600MW.

Table 1 also presents the projected gas needs for thermal energy from 2019 to 2030. These values are based on the assumption that thermal plants run solely on natural gas. For the base case, gas needs can rise up to 494mmscfd by 2030, all things being equal. Gas needs for thermal for the upper case scenarios can rise up to 534mmscfd.

It is important to note that these projections are rather conservative and have not taken into account two major factors that have the ability to suppress the growth of grid energy demand. Firstly, the potential for increased renewable energy penetration which is fuelled by reducing costs of renewable energy technologies and the increasing awareness of this reality. In addition, self-generation is increasingly becoming an alternative for commercial users as a hedge against high end user tariffs, which is expected to further increase with upward tariff adjustments. This concern, is even expressed by the Energy Commission of Ghana as they indicated that:

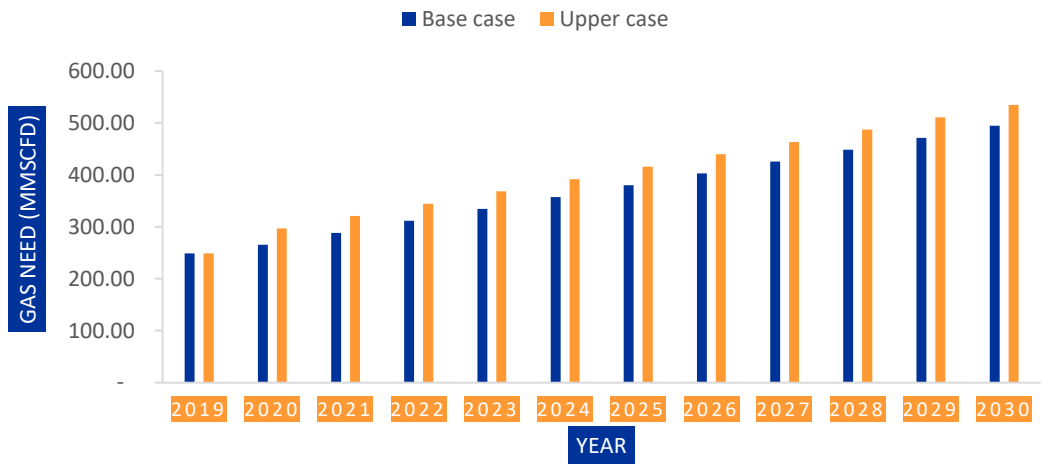
"The relatively high end-user tariff is likely to have contributed to the significant surge in the installation of alternative or captive or self-electricity back-up generation largely by the non-residential and industrial customers of the utilities. The said customers apparently found the self back-up generation more cost-competitive compared to the grid as their cumulative electricity consumption units exceeded 300 units per month during the year and thus making it more attractive for the switch at that consumption level. If this trend continues, it could worsen the income and profitability of the existing electricity utility companies." (Energy Commission, 2018).

Table 1: Projected energy demand

Year	Total power demand (MW)		Projected thermal power demand (MW)		Gas demand for thermal power (Mmscfd)	
	Base case	Upper case	Base case	Upper case	Base case	Upper case
2019	2436	2436	1316	1316	248.69	248.69
2020	2525	2690	1405	1570	265.58	296.78
2021	2646	2817	1526	1697	288.47	320.64
2022	2768	2943	1648	1823	311.36	344.48
2023	2889	3069	1769	1949	334.25	368.3
2024	3010	3195	1890	2075	357.14	392.1
2025	3131	3321	2011	2201	380.03	415.89
2026	3252	3447	2132	2327	402.93	439.66
2027	3373	3572	2253	2452	425.82	463.41
2028	3494	3698	2374	2578	448.71	487.16
2029	3616	3823	2496	2703	471.6	510.89
2030	3737	3949	2617	2829	494.49	534.61

Conversion Factor: 1000MW of power per day = 188.88mmsfcd of gas
Source: ACEP's projections

Fig 1: Projected gas demand for power from 2019 to 2030



4.2 Gas supply statistics

In 2018, total gas supply came from four major sources namely the Jubilee Fields, TEN Fields, the West African Gas Pipeline (WAGP) and the Sankofa Fields. Supply scenarios are presented in two forms; base case scenario and upper case scenario. Table 2 presents gas supply scenarios from 2019 to 2030.

Base case scenario

For the base case scenario, The Jubilee and TEN fields can cumulatively supply an average of 135mmscfd of gas which is limited by the capacity of the Atuabo Gas Processing Plant while the WAGP can supply

a downside average of approximately 60mmscfd. Sankofa has the potential of providing up to 246mmscfd out of which 171mmscfd is the contracted take or pay volume and an additional volume of 75mmscfd. The extra 75mmscfd is available for smoothening supply constraints from other sources. With these assumptions in place, readily available supply of gas is about 441mmscfd from 2019.

Upper case scenario

Recent Akoma discovery on the Block Four by ENI with pre-appraisal estimate between 500 and 650Bcf has the potential of producing 100mmscfd of gas. If the market conditions support the economics of the discovery, this could come on stream by 2023. Upon additional investments, further development of the Sankofa fields can also go up to 300mmscfd. Further investment in processing capacity of Atoabo gas processing plant can increase Jubilee and TEN supply to 225mmscfd by 2023. In addition, the Tweneboa Non-Associated Gas (TNAG) development has proven non-associated gas reserves and can supply gas up to 60mmscfd by 2023 subject to increased demand and project economics. Depending on further developments in Nigeria, WAGP plans to do a low case average volume of 92mmscfd by the end of 2020 and plans to increase this to 120mmscfd by 2023.

Though subjective, these developments are set to increase the supply of gas to over 750mmscfd by 2023. The potential for domestic gas is even higher as activities increase in offshore basins and at the same time, onshore exploration begin on the back of new data acquired by the GNPC are set to begin.

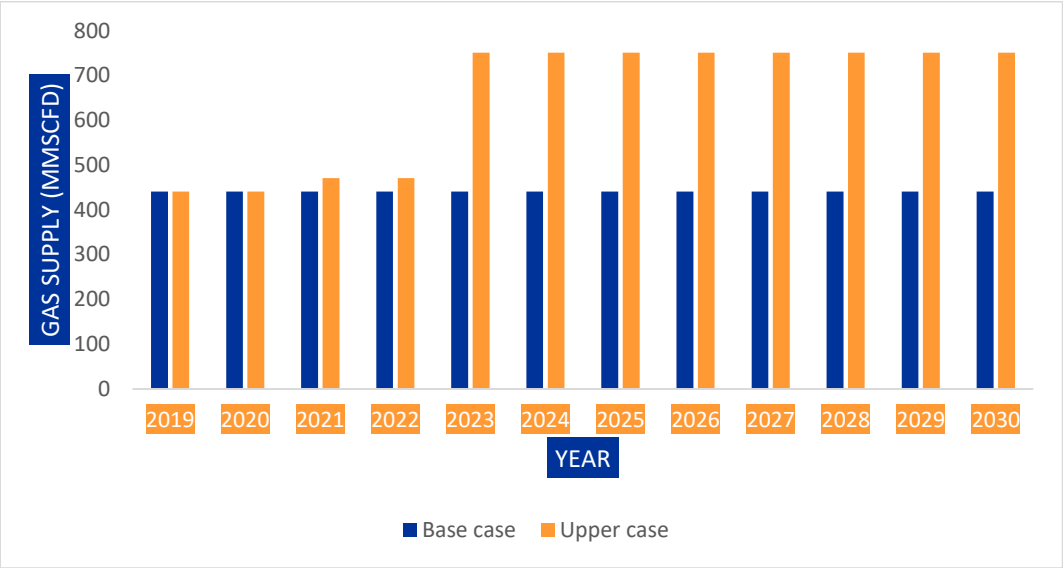
The base case and high case scenarios are still conservative to account for inadequate data on the production profile of the various fields. Any downward deviation is however compensated for by other fields such as Greater Jubilee, the Deepwater Tano and the South Deepwater Tano fields.

Table 2: Gas supply scenarios

	Base case				High case			
Year	WAGP	SGN	Jubilee/TEN	Base case total	WAGP	SGN / Akoma[a]	Jubilee/TEN	High case total
2019	60	246	135	441	60	246	135	441
2020	60	246	135	441	60	246	135	441
2021	60	246	135	441	90	246	135	471
2022	60	246	135	441	90	246	135	471
2023	60	246	135	441	120	346	285	751
2024	60	246	135	441	120	346	285	751
2025	60	246	135	441	120	346	285	751
2026	60	246	135	441	120	346	285	751
2027	60	246	135	441	120	346	285	751
2028	60	246	135	441	120	346	285	751
2029	60	246	135	441	120	346	285	751
2030	60	246	135	441	120	346	285	751
2031	60	246	135	441	120	346	285	751

[a] SGN and Akoma are both operated by ENI and Akoma is scheduled to be in operation from 2023
Source: ACEP's projections

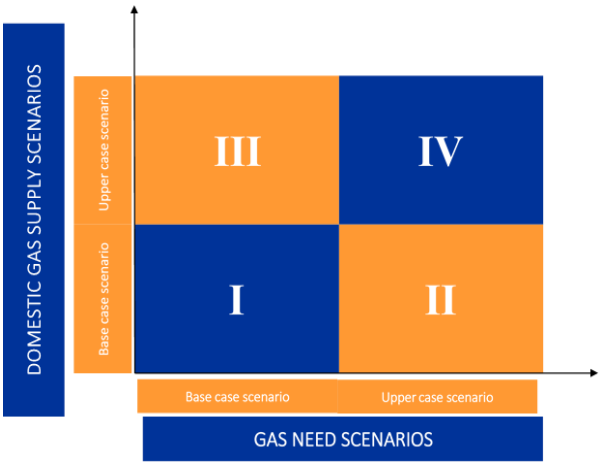
Fig 2: Gas supply projections from 2019 to 2030



4.3 Excess gas projections

Figure three provides four different scenarios within which the context of excess gas can fall. The cases are described in terms of the scenarios of gas need and gas supply. The ensuing subsections present an analysis of each of the four scenarios in terms of excess gas supply.

Fig 3: Gas demand and supply scenarios



Case I

Case one provides a situation where the supply and gas needs are at the base case. In this scenario, we consider domestic gas supply at current levels without further increase in production. This scenario is therefore most conservative scenario for gas supply and gas needs. Gas needs projections are based on projected power demands using the exponential smoothing technique. The volumes of excess gas decreases at a faster rate for this case. Ghana experiences excess supply of gas from 2019 till 2027. In 2028, Ghana will require about 7mmscfd of gas and this shall increase to about 53mmscfd in the year 2030. This means, that current gas supply can meet baseline demand projections till 2027.

Case II

In case two, the gas need is projected to be at its maximum level (based on upper limits of the confidence interval) and is linked with gas supply at the base level. Rates of decline for this scenario also shows a decreasing

trend which occurs at a faster rate. Ghana can rely on current gas sources for this scenario up till the end of year 2026. From 2027, the country will require additional gas to augment its current supply. This will increase from 22mmscfd in 2027 to about 93mmscfd by the end of 2030.

Case III

Case three provides details of a situation where gas needs is given at the base period against an upper case scenario of gas supply. For this situation, Ghana has enough supply capacity which can provide the needed amount of gas needed for power supply. Within the period under review, maximum excess gas occurs in 2023, giving an approximate amount of 400mmscfd of excess gas. In 2030, which records the highest level of power demand for the period under review, excess gas stands at over 250mmscfd.

Case IV

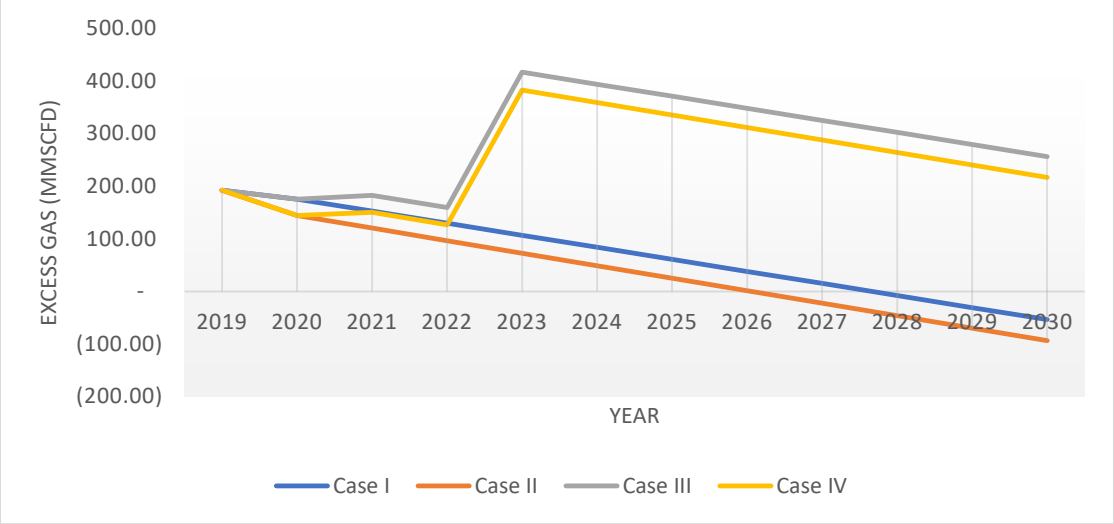
In case four, both gas supply and gas needs are estimated at their high case scenarios. The distribution of excess gas supply for this scenario is similar to that of Case III, with the difference arising as a result of the volumes of excess gas. Maximum excess gas volumes also occur in 2023, with a volume of 382 mmscfd. Also, by 2030, the value of excess gas stands at over 216mmscfd.

Table 3: Excess gas supply from 2019 to 2030

Year	Excess gas cases (Mmscfd)			
	Case I	Case II	Case III	Case IV
2019	192.31	192.31	192.31	192.31
2020	175.42	144.22	175.42	144.22
2021	152.53	120.36	182.53	150.36
2022	129.64	96.52	159.64	126.52
2023	106.75	72.70	416.75	382.70
2024	83.86	48.90	393.86	358.90
2025	60.97	25.11	370.97	335.11
2026	38.07	1.34	348.07	311.34
2027	15.18	(22.41)	325.18	287.59
2028	(7.71)	(46.16)	302.29	263.84
2029	(30.60)	(69.89)	279.40	240.11
2030	(53.49)	(93.61)	256.51	216.39

Source: ACEP's projections

Figure 4: Projected excess gas from 2019-2030



Industrial gas need and excess gas supply

Gas supply in excess of power sector demand will have to be absorbed by industry. Albeit this is a possibility, the projections indicate that the amount of gas supplied in excess far outweigh the current industrial demand for gas especially in Cases III and IV. Information from key stakeholders, including state owned companies pegged industrial demand for gas at 8mmscfd as of 2018. Industrial gas need is projected to 2030 at a 10% demand growth rate. Using these rates, Ghana will demand additional gas from 2027 in Case I and 2026 in Case II.

Table 4: Industrial gas need and excess gas supply

Year	Gas need for industry (MMscfd)	Excess gas supply (Mmscfd)			
		Case I	Case II	Case III	Case IV
2019	8.80	183.51	183.51	183.51	183.51
2020	9.68	165.74	134.54	165.74	134.54
2021	10.65	141.88	109.71	171.88	139.71
2022	11.71	117.93	84.81	147.93	114.81
2023	12.88	93.86	59.82	403.86	369.82
2024	14.17	69.68	34.73	379.68	344.73
2025	15.59	45.38	9.52	355.38	319.52
2026	17.15	20.92	-15.81	330.92	294.19
2027	18.86	-3.68	-41.28	306.32	268.72
2028	20.75	-28.46	-66.91	281.54	243.09
2029	22.82	-53.43	-92.72	256.57	217.28
2030	25.11	-78.60	-118.72	231.40	191.28

Source: ACEP's Analysis

The petrochemical industry is identified to be the industry that can readily absorb excess gas. Government plans to attract investment for the construction of the first fertiliser manufacturing plant in Ghana.[11] Total fertilizer consumption as at 2018 stood at approximately 310,000 metric tonnes, which denotes a 35% decline from the 2017 consumption of approximately 440,000 metric tonnes (Africa Fertiliser, 2019).[12]

However, there are macroeconomic conditions that could impact the cost competitiveness of fertilisers that will be produced in Ghana making the construction of a fertiliser plant less feasible under the current gas market condition. First is the issue of price. The current adjusted weighted average cost of gas (AWACOG) does not make the petrochemical industry competitive as compared with the price of gas from neighbouring fertiliser producing African countries like Nigeria with a regulated price of $3.3/ MMBtu (transportation cost of $0.83 and commodity price of $2.5).

It is even more important to note that the current market players have a locked in price of about $1.5 to $2, a price negotiated before the introduction of regulated prices. The government of Ghana will have to highly subsidise the price of gas for the fertiliser producers by at least $4.49 per MMBtu which translates to about $140 on production subsidy per tonne to bring Ghana's fertiliser production at competitive terms relative to price, without accounting for the scale of similar projects in the sub region and their implication on a free trade area, which Ghana has been a major champion. Total subsidy per 2018 demand of about 300,000 tonnes will amount to approximately $43million every year. This does not account for the existing government subsidies on fertilisers which was about GHS 345.24 million from 2008 to 2013.

"The government of Ghana will have to highly subsidise the price of gas for the fertiliser producers by at least $4.49 per MMBtu which translates to about $140 on production subsidy per tonne to bring Ghana's fertiliser production at competitive terms relative to price, without accounting for the scale of similar projects in the sub region and their implication on a free trade area, which Ghana has been a major champion. "

4.4 Views from industry stakeholders

The risk of excess gas is shared by most industry players that ACEP reached out to in the course of this study. The perception of the supply of gas in excess of what it demands currently and in the foreseeable future is a real occurrence and it could have

[11] https://africanharvesters.com/2018/09/10/ghana-fertilizer-expansion-programme-ghana-ocp-group-sign-mou-on-fertilizer/
[12] https://africafertilizer.org/Ghana/#tab-id-2

dire financial consequence. For example, committing to a 12-year take or pay agreement of 250mmscfd of LNG will compound the financial challenges faced in the energy sector and would go to increase the financial burden on consumers.

Due to the huge capital investments that characterise the gas value chain, investors negotiate with governments to guarantee their investments, usually in the form of take-or-pay clauses in the gas sales agreements which is a measure of the confidence and or risk in the market. If the country is not able to off-take the gas, the investors still get their due, but this leaves huge financial liabilities for the government. This was what happened in the case of the Sankofa Gye Nyame field operated by ENI, where the country was paying about $32million monthly for unutilised gas from October 2018 for failing to build the infrastructure to off-take the gas on time. This has reduced to about $25 million due to increase demand of gas from OCTP. The amount of money used in paying for the take or pay contracts that would occur as a result of the purchase of LNG which would result in excess gas can be channelled to other useful priority areas.

Moreover, in the view of some industry watchers on the power generation side, the country is already paying capacity charges due to the take-or-pay agreements signed in the various power purchase agreements (PPAs) due to the inability to grow demand for power to meet installed capacity. Thus, having excess gas supply in the system will mean paying for unutilized gas from different sources and this will put undue pressure on the country's finances.

An excess gas supply scenario poses the risk of increased debt in the power sector and defeat the mitigation actions to strengthen the power sector value chain which is currently debt-laden. The distributors of electricity were unable to pay the power generators for power distributed which led to the injection of private sector recently. This caused power generators' inability to pay for fuel consumed for power generation. Even without gas obligations, these debts have already piled up and continues to accumulate, threatening the ability of the Energy Sector Levies Act (ESLA) to deal with it. Table 5 outlines some of the views expressed by the industry stakeholders.

Table 5: Views shared by state agencies and private investors

State Agencies (SA)
"what we have heard about the gas coming in is a cause for concern especially beyond 2021. I mean the take or pay payments alone in a year can build a thermal plant. We are a poor country, so we have to be careful what we do." (SA)
"on the power side we have take-or-pay already and so the take or pay on the gas is just going to compound it. It is like you are being killed twice." (SA)
"I think there is not a very strong competitor to the power side. The power side is the major consumer of gas. We need to find external users. We've gone into this discussion ever since we heard of the coming of LNG" (SA)
"One of the best alternatives is to be able to export the gas. But it's not that easy. First of all, you have to critically plan it. The biggest challenge to exporting gas is our pricing. If you check the prices in the sub region, you will find that our prices are extremely high in the sub region." (SA)
Private Investors (Inv)
"as it is now things in the sector are quite fragile. I mean ESLA was launched with a lot of fanfare and all, but I don't want to say typically, but unfortunately after two years you don't even talk about it anymore. There's no transparency about how the money is being used to improve this whole cash flow situation. So, the excess gas in my estimation is probably coming to compound the problems we have." (Inv 3)
"the domestic gas supply as of today is enough to cover all the requirements. It means that we will be in the condition not to use liquid fuel anymore and potentially not to use imported gas from Nigeria anymore. The country requires 2500MW of power, more or less. Out of that, about 30 to 40% is produced by hydropower system. The rest is coming from thermal with a significant portion still liquid so in the next few months the liquid will definitely be replaced by the gas with the power relocating to the West. That is an important step. The other important step in our view is to maximize the gas conversion in the west and step by step replace the Nigerian gas with the Ghanaian gas. And in our view, it's the goal the country should have because at the moment, the country is not able to use all the domestic gas. It will have a significant cost reduction in the energy bill. Because much of the cost of the domestic gas is the cost that goes back to the country itself." (Inv 1)
"The problem is that you know that ECG is not respecting the debts with regards to the VRA. For example, VRA is not able to pay for the gas. The gas supplier is unable to pay upstream. So, the value chain is not working. The liquidity is not there. At the moment it is not penalising our project because of the structure of the security package in place. It was one of the prerequisites for us if we decided to invest in a capital-intensive project." (Inv 3)
"At the moment we don't see a compelling case for imports. Ghana has strong potential for gas and oil and ifyou need a backup option at least you already have a pipeline from Nigeria." (Inv2)
"…conversations with the people involved in [power] demand planning indicates that the rate at which they were expecting demand to pick up especially after the tariff reduction hasn't been up to the projections so there are concerns there." (Inv 3)
"There were some projections for electricity consumption ...but I think for now the economy is not expanding as they envisaged, and there's a lot of power theft too. So, I don't think they are able to really measure very well what the consumption is. It's not increasing as they forecasted initially." (Inv 2)
"gas always requires market to use the gas supply and if you don't have market then it means you have to effectively discount the value of the asset and you forget about it." (Inv 1)

5.0 Conclusions and recommendations

The transition from liquid fuels to gas for power generation is important for Ghana especially in terms of cost savings. However, Ghana has had challenges with supply, infrastructure and payments in attempts to ensure a robust gas market with reduced risk to the investor and the country. On the supply side, Nigeria has not met its volume obligations and attempts to supply LNG since 2012 have proved unsuccessful in the most needful period. Delays in the completion of the needed gas infrastructure to commercialise Jubilee gas contributed to the long spell of *Dumsor* in Ghana. This repeated itself in ensuring that there is transmission infrastructure to offtake Sankofa gas. The supply of gas from Nigeria also accumulated debts which subsequently led to the demand of Letters of Credits (LCs) before gas is supplied. Government recently has had to pay millions of dollars every month for unutilised gas due to its inability to complete a gas infrastructure on time, leading to a sweep on the escrow account for the OCTP project. The struggle to comply with payment obligations continues even till today and the escrow has not been re-established.

Without a proper policy direction, Ghana will fail to reap the benefit that underscores the transition from liquid fuels to gas. Projections made in the study have shown that Ghana can make use of its domestic gas infrastructure for its needs at least for the next four to five years. With recent discoveries that have been made on the oil fields, and government's push for aggressive investments in the upstream sector, the potential of domestic gas volumes to increase is a high possibility.

A major limitation of this study was the inability to obtain the supply profiles of the gas sources in Ghana for the projected period, making gas supply assume a uniform volume over the projected period. Gas volume projections are not uniform on a year on year basis due to the dynamics that may be present and yet unknown in the fields. However, as noted earlier, the scenarios are smoothened by the additional capacities from other fields, making these conservative projections possible. This notwithstanding, Ghana has greater odds of obtaining higher volumes of gas than the projected volumes. Based on the findings and the views of industry stakeholders, the study outlines the following recommendations:

1. The first effort of government should be to wipe the excess domestic gas by encouraging existing power plants to switch from using liquids such as HFO and RFO to generate electricity. This will bring relief on the take or pay commitments of government.
2. Government must engage broadly with investors and sector agencies to enhance planning and gas supply arrangements to encourage foreign investment in the upstream sector to optimise government's aspiration for aggressive exploration. Poor planning and unrealistic projections can affect market confidence and risk levels, leading to continuous demand for take or pay arrangements for both domestic production and importation of gas.
3. Ghana does not need the importation of LNG through long

term contracts. During unanticipated downtimes or shortfalls in gas supplies, Ghana can rely on liquid fuels which is easier to store. Also, enough investments have already been made in dual fuel plants which must serve a useful purpose. The cost of liquid fuel as a short-term security measure is relatively lower than LNG as backup. Ghana needs to focus on debt reduction rather than accumulation which appears unavoidable with additional gas from LNG.

4. Government must prioritise the supply of cheapest domestic gas production which will provide electricity at the cheapest cost for households and industry. This can go a long way to realise government's plans for industrialisation as Ghana's electricity prices become more competitive.
5. Government must insist on taking DWCTP gas in line with the Petroleum Agreement to ensure improved gas supply for the domestic market. Improved market strategy is also required to assure the investors of returns which could be jeopardised by efforts to prioritised external gas supply.
6. Government must pursue the clean-up of the power distribution subsector. Actors in this part of the value chain must be closely monitored to achieve the desired results. Otherwise, debt accumulation within the power value chain will continue to escalate and impact on the gas market which is anchored on the power sector. Increasing competition from self-generation and renewables requires an optimal distribution system to drive down the grid tariff to ensure that the excess capacity can be absorbed in the near future.

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