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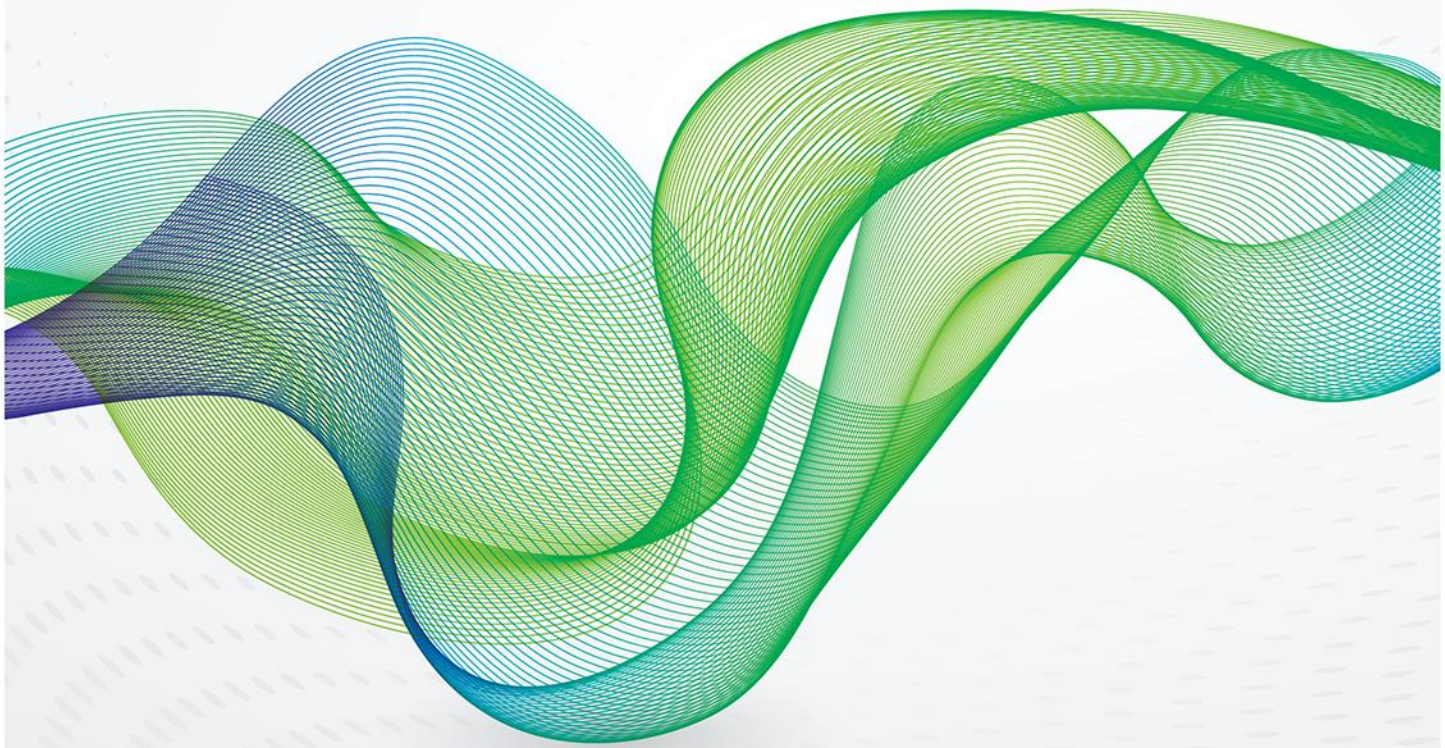
Does Ghana need LNG?



OIES ENERGY COMMENT

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In an OIES Energy Insight[1] published at the beginning of 2018, the prospects for LNG coming to Ghana were assessed. The paper concluded the prospects were relatively poor at the time, despite the numerous potential projects, because of financing and infrastructure issues, as well as the question whether Ghana actually needed LNG given the growing domestic production and imports from Nigeria by pipeline. However, some three years later, the facilities at Tema are almost ready to receive imported LNG. The terminal received its floating regasification unit (FRU), built by Jiangnan Shipbuilding, in January 2021. The LNG FRU is designed for a regasification capacity of around 1.7 mtpa and is contracted to operate for approximately 20 years. The FRU will work in conjunction with a dedicated storage vessel (FSU), which is the newbuild 180,000 m^3 Vasant 1, and arrived at Tema port on May 26, having delivered just one cargo from Darwin in Australia to Yung An in Taiwan in February. The Vasant 1 is on a charter until July 1 2022[2], and will then be replaced with an alternative FSU[3].

However, Ghana could well be pipped at the post to be the first Sub-Saharan African country to import LNG. Senegal received the 125,000 m^3 Karmol LNGT Africa FSRU, in late May, carrying a partial cargo to be used in the commissioning process. The first full LNG delivery is set for July from Shell, according to the Turkish operator Karpowership who own the floating power plant[4].

This Comment looks again at the prospects for LNG into Ghana, considering the growth in domestic production, continued imports from Nigeria and the prospects for gas demand in the country.

Background

Ghana began consuming gas in 2009, albeit at low volume, as the West African Gas Pipeline (WAGP) started up, delivering gas from Nigeria – see Figure 1. This was supplemented in 2014 when the Jubilee field came on stream, followed by TEN in 2017 and Sankofa in 2018 – see Figure 2 for location of the fields.

WAGP is owned and operated by the West African Gas Pipeline Company (WAPCo) Limited, which in turn is owned by Chevron (36.9%), Nigerian National Petroleum Corporation (NNPC) (24.9%), Shell (17.9%), Takoradi Power Company Limited (16.3%), Société Togolaise de Gaz (2%), and Société BenGaz (2%). The pipeline is 678 km long and links into the existing Escravos-Lagos pipeline at the Nigeria Gas Company's (NGC) Itoki Natural Gas Export Terminal and then proceeds to a beachhead in Lagos. From there it moves offshore to Takoradi, in Ghana, with gas delivery laterals from the main line extending to Cotonou (Benin), Lome (Togo), and Tema (Ghana). The pipe was initially supposed to carry a volume of 160 mmscfd and peak over time at a capacity of 470 mmscfd.

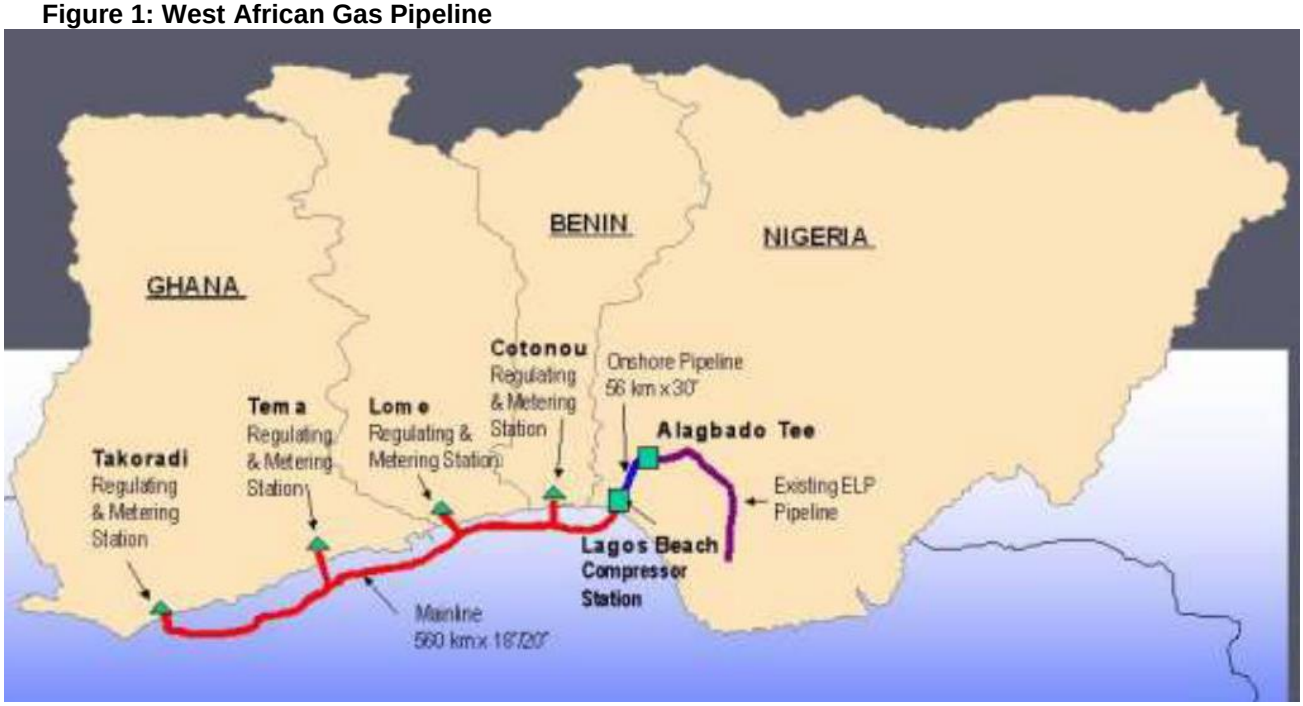
The Jubilee and TEN fields are operated by Tullow Oil. Jubilee was discovered in 2007 and is an oil field with associated gas. Tullow has a 35.48% share and partners with Kosmos (24.08%), Anadarko (24.08%), GNPC (13.64%), and Petro SA (2.73%). The TEN field is predominantly oil with associated gas but there is also some non-associated gas. The TEN partners are the same as for Jubilee but with different shares: Tullow (47.18%), Kosmos (17%), Anadarko (17%), GNPC (15%), and Petro SA (3.82%).

The Sankofa field is a joint venture comprising: Eni (44.44%), which is also the operator; Vitol (35.56%); and GNPC (20%). The field is mainly non-associated gas so is a more reliable gas supply than the fields which are predominantly associated gas.

The Ghana gas market can be considered as two distinct areas where the main thermal power plants are located. The area around Tema, which is close to the country's capital Accra – the East region or enclave – and the area around Takoradi – the West region or enclave – which has Aboadze to the east and Sanzule to the west – see figure 2.

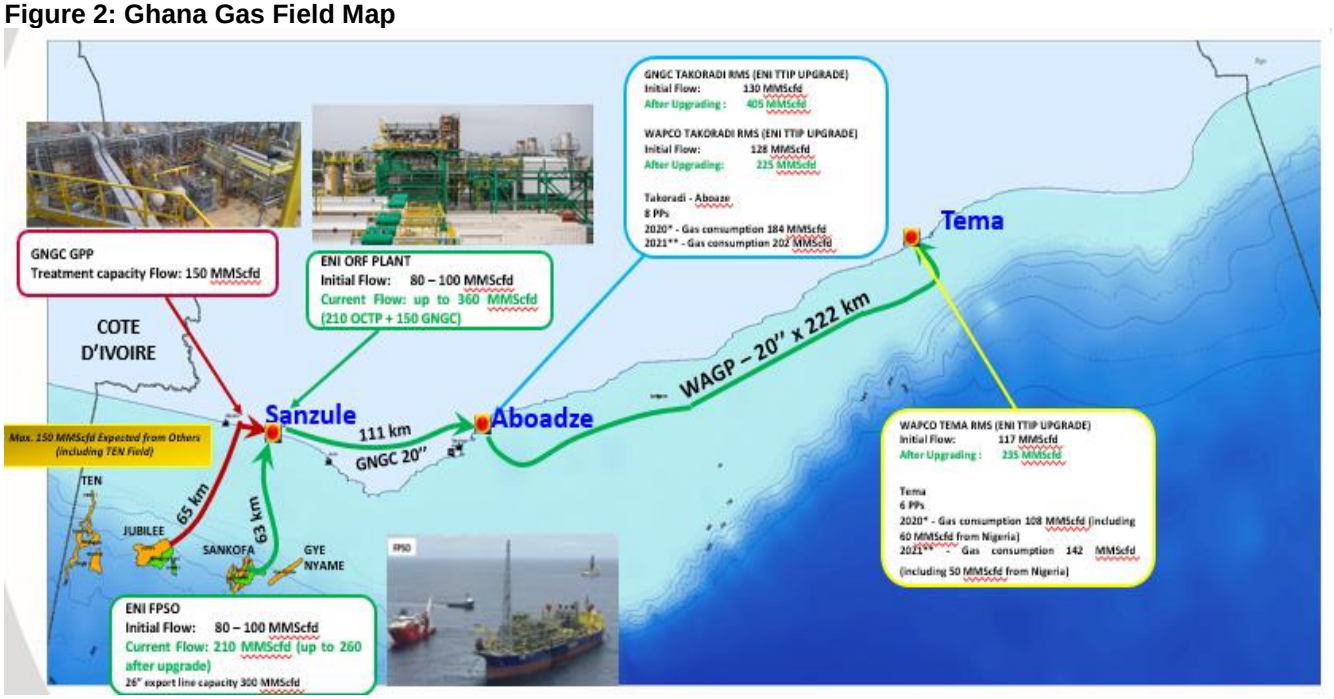
[1] Future Prospects for LNG Demand in Ghana, Fulwood.M and Bros.T, OIES January 2018
[2] Source: Kpler
[3] https://www.offshore-energy.biz/ghanas-tema-lng-terminal-to-get-first-cargo/
[4] Argus LNG Daily, June 17 2021, Argus Media

Figure 1: West African Gas Pipeline



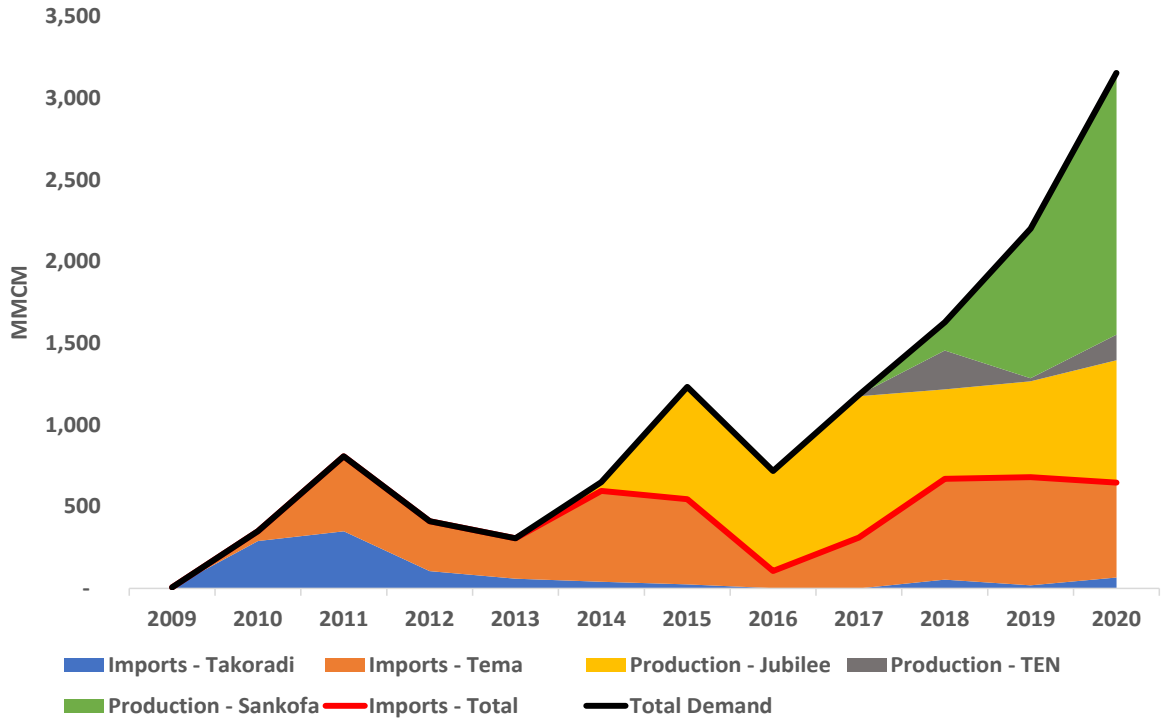
Source: West African Gas Pipeline Authority (WAGPA)

Figure 2: Ghana Gas Field Map



Source: Eni

Figure 3: Total Ghana Supply



Source: WAGP, Ghana PIAC Reports

Imports along WAGP from Nigeria were delivered in the early stages to both Takoradi and Tema. The flow of gas was only one way from Nigeria and the Tema and Takoradi markets were not interconnected and could only offtake gas from the WAGP. Volumes on the WAGP were interrupted in 2012 and didn't resume until 2013 when a ship was hijacked and its anchor dragged across the pipeline, rupturing it. In 2016, volumes to the Volta River Authority[5] (VRA) at Tema were interrupted because of non-payment of invoices. Imports from Nigeria, however, have been consistently below the contracted levels of 123,612 MMBtu/day, since the Nigerian supplier – Ngas – have called almost permanent force majeure since the pipeline reached full commercial operations at the end of 2011, blaming supply and infrastructure issues in Nigeria[6]. Between 2012 and 2017, the peak year for imports was 2014, while the average was just over 60,000 MMBtu/day. Since 2018, volumes have been higher, averaging over 70,000 MMBtu/day in 2019. 2020 volumes were slightly lower but that reflected extensive pigging operations in the first few months of the year[7].

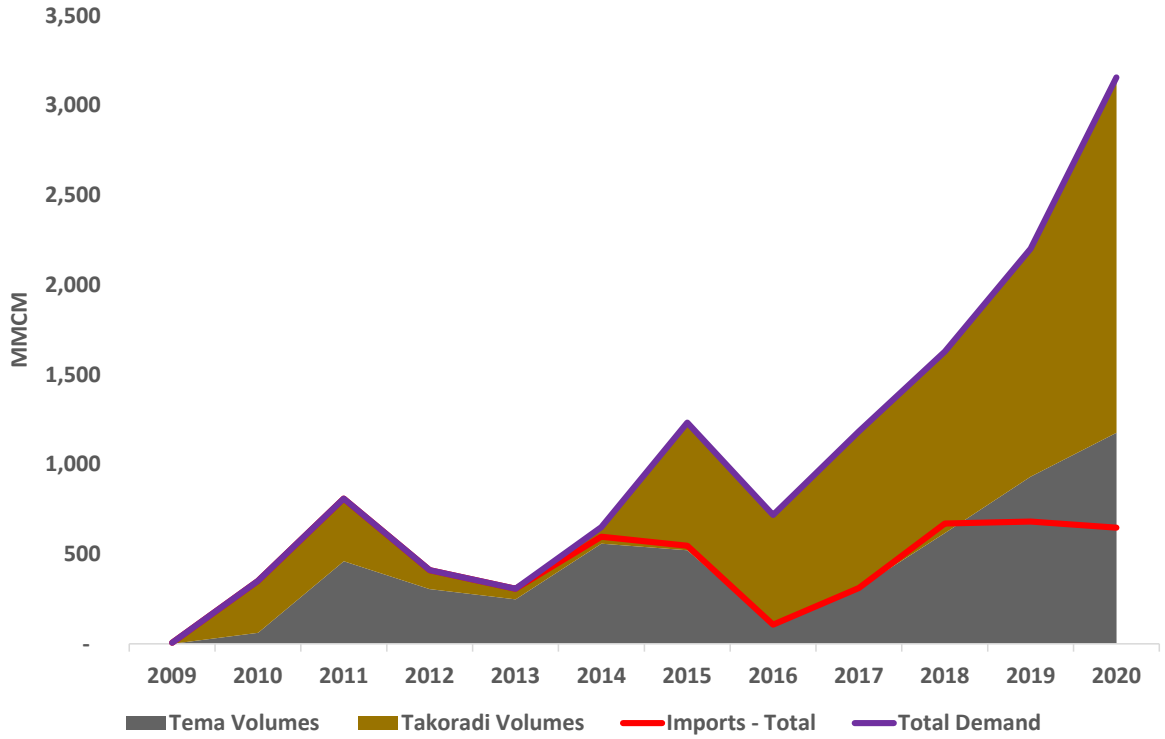
In 2018 the Jubilee, TEN and Sankofa fields in the Takoradi area were connected to the WAGP system and reverse flow[8] began to bring volumes from Takoradi to Tema. This allowed a significant rise in production from the Sankofa field, and, together with increasing imports from Nigeria, increased Ghana gas consumption from 122,000 MMBtu/day in 2017 to 325,000 MMBtu/da in 2020.

Until domestic production began in Ghana the majority of the imports went to the Tema area and the power plants in Takoradi burnt light crude oil (LCO). Most of the Tema plants, but not all, could also largely burn oil as a backup. Once production started up at Jubilee, all the imported gas was consumed at Tema and the domestic production at Takoradi. However, as shown in Figure 4, the volumes consumed at Tema rose above the total imports once the reverse flow interconnection was made in

[5] Volta River Authority is the state-owned power generator of both hydro and thermal plants.
[6] Force majeure was supposed to have been lifted this year but reportedly negotiations are ongoing.
[7] Source: WAGP
[8] The reverse flow project included a short pipeline connection to the WAGP Takoradi R&M station from the Ghana gas system, to create an entry point, but also the expansion of the Tema R&M station to receive up tp 240 mmscfd. The project was funded by GNPC and undertaken by ENI.

2019 at Takoradi. In 2020, the average flow of domestic Ghana gas production from Takoradi to Tema was just over 60,000 MMBtu/day, which is just above the capacity booking the GNPC (Ghana National Petroleum Corporation) have on the WAGP, for the reverse flow from Takoradi to Tema. However, these volumes were also impacted by pigging operations in early 2020. In the last six months of 2020, volumes averaged just under 85,000 MMBtu/day and in the first four months of 2021, the average was just under 110,000 MMBtu/day – 60,000 under the firm capacity booking and the balance interruptible.

Figure 4: Ghana Gas Consumption



Source: WAGP, Ghana PIAC Reports

Total gas production[9] in Ghana in 2020 was just under 260,000 MMbtu/day, of which 165,000 was from Sankofa, 77,000 from Jubilee and 16,000 from TEN. Sankofa is almost at the expected level, while Jubilee production was at its second highest annual level, and close to expectations. TEN was also at a higher level than normal but below the anticipated levels at the time of field development.

Electricity Generation

Most of the gas produced and imported is consumed in the power sector, with some additional consumption by industry in the West (Takoradi) enclave, and also gas used in the processing plants. Thermal power plants represent some 70% of the dependable capacity. In 2020, thermal plants generated some 63% of total electricity production. Total electricity generation has almost doubled between 2010 and 2020 – an annual average growth rate of 7.1%. Some of this rising generation in the last three years has been exported, mainly to Burkina Faso.

In 2021, all the thermal plants will be able to burn gas since the AKSA plant has been converted to use gas as well as Heavy Fuel Oil (HFO). The Bridge Power and Early Power plants have been commissioned and will enter full operations in 2021.

[9] PIAC 2020 Report. This is gas production exported from the offshore fields, after flaring and reinjection.

Table 1: Ghana Thermal Power Generation for 2021

Plant Description	Location	Fuel	Nameplate Cap (MW)	Dependable Cap (MW)	Generation 2020 (GWh)	Gas Consumed 2020 (MMBTU)
TAPCO (T1)	West	LCO/Gas	330	300	1,087	9,074,910
TICO (T2)	West	LCO/Gas	340	320	1,193	10,564,047
TT1PP	East	LCO/Gas	110	100	427	5,310,005
TT2PP	East	Gas	80	70	90	869,884
KTPP	East	Gas/Diesel	220	200	368	3,915,969
Ameri	West	Gas	250	230	1,283	8,789,571
CENIT	East	LCO/Gas	110	100	711	8,099,758
Sunon Asogli	East	Gas	560	520	2,905	11,350,911
Karpower	West	Gas/Diesel	470	450	3,128	25,826,036
AKSA	East	HFO/Gas	370	330	398	
Genser	East	Gas	22	18	511	5,101,989
Cenpower	East	LCO/Gas	360	325	568	2,835,096
Twin City	West	LCO/Gas	203	202	196	1,676,366
Bridge Power	East	LPG/Gas	154	145		
Early Power	East	LCO/Gas	144	140	10	
	East		2,130	1,948	5,988	37,483,611
	West		1,593	1,502	6,888	55,930,930
	Total		3,723	3,450	12,876	93,414,541

Source: Ghana 2021 Electricity Supply Plan, Ghana Energy Commission

The East (Tema) enclave had 52% of the dependable capacity in 2020, as Bridge Power and Early Power were not operational, but only 46% of actual generation. The percentage of gas consumed was lower since some plants generated using alternative fuels for part of the year.

Total electricity generation in 2020 was just under 20,000 GWh, this is expected to rise to 21,265 GWh in 2021[10], and to 28,550 by 2026 – an increase of some 45% over 2020 or 6.4% average annual growth, similar to the last 10 years. The 2021 Electricity Supply Plan includes some additional small hydro and solar but almost all the current committed increase in generation will come from gas-fired power. The only additional gas-fired capacity planned to come onstream is from the second and third phases of Early Power increasing capacity to 400MW. The existing and committed projects would be sufficient to meet rising demand until 2024 but additional capacity would be needed thereafter – up to another 400MW by 2026. The 2021 Electricity Supply Plan suggested that this additional capacity could come either from a thermal plant at Kumasi which is in central Ghana, and could be connected either to Takoradi or Tema by pipeline, or from plant in the Accra area, supplied from Tema with a much shorter pipeline. The additional capacity is more likely to come from new plant in the Accra Area because Kumasi PP is part of a larger gas infrastructure project called the Western Corridor Gas Infrastructure Development Project and this may be more long term.

Gas Outlook

Gas demand in Ghana will be driven by the rise in electricity generation. Based on a 45% increase by 2026[11], this would see a rise in gas demand from the 2020 level of 3.15 bcm (325,000 MMBtu/day) to some 4.6 bcm (470,000 MMbtu/day). The power plants in the Takoradi area operated at a higher utilisation rate in 2020 than those in the Tema area at around 52% to 41% - for those plants fully operational. Some of the older plants in the Takoradi area have had operational issues but the newer ones, including the Karpowership are operating at high utilisation rates and are very much base load plants. Over time we assume that the utilisation of the Takoradi plants rises to some 60% but that any

[10] Ghana 2021 Electricity Supply Plan, Ghana Energy Commission

[11] This is the same as the rise in electricity demand but allows for the reduction in oil burn in power to offset any rise in renewables.

new power generation capacity is added at Tema. The table below shows a base case projection for the Ghana supply-demand balance.

Table 2: Base Case Supply – Demand Balance

MMBTUD	2019	2020	2021	2022	2023	2024	2025	2026
a Ghana Production	157,398	258,819	275,000	275,000	275,000	280,000	280,000	280,000
b Takoradi Demand	131,575	204,274	173,633	208,359	212,445	216,530	220,615	224,701
c Export to Tema (a-b)	27,667	61,356	101,367	66,641	62,555	63,470	59,385	55,299
d Tema Demand	96,243	121,323	171,367	161,641	182,555	203,470	224,385	245,299
e Tema Shortfall (d-c)	68,576	59,967	70,000	95,000	120,000	140,000	165,000	190,000
f Nigeria Imports	68,576	59,967	65,000	70,000	70,000	70,000	70,000	70,000
g Available for LNG (e-f)			5,000	25,000	50,000	70,000	95,000	120,000

Source: Author's estimates

Ghana production is assumed to rise with more Jubilee and TEN production and a small rise in Sankofa to capacity. Once Takoradi demand is satisfied from production the balance is transferred to Tema to meet power generation demand in the East enclave. Total gas demand is driven by the 45% rise in electricity demand to 2026.

The Tema shortfall is the Tema demand less the gas shipped from Takoradi, and up until now this has been met by imports from Nigeria, but once the LNG facilities are operational then it could also be met by LNG imports[12]. Nigeria imports are assumed to be 70,000 MMBtu/day longer term, which is around the level of the last nine months of 2020. This, however, is below the ACQ of the Nigerian contract of 123,212 MMBTU/day and also the 75% TOP quantity, although this contract has been in pretty much permanent force majeure since 2011. The 70,000 MMBtu/day assumption is based on either continuing force majeure or a renegotiated ACQ at a lower level.

After the allowance for Nigerian imports the residual is the volume available for LNG. Assuming 80 mmcm of regasified LNG per cargo these volumes only represent a couple of cargoes/year in 2021 and 2022 but rising by 2026 to 15 cargoes/year.

There are clearly a number of uncertainties and key assumptions to be made in respect of the growth of gas demand, the level of domestic production, the potential level of imports from Nigeria as well as the balance of demand between the West and East enclaves. Without LNG any gas shortfall, as in the past, can be supplemented through the burning of HFO or light crude oil (LCO).

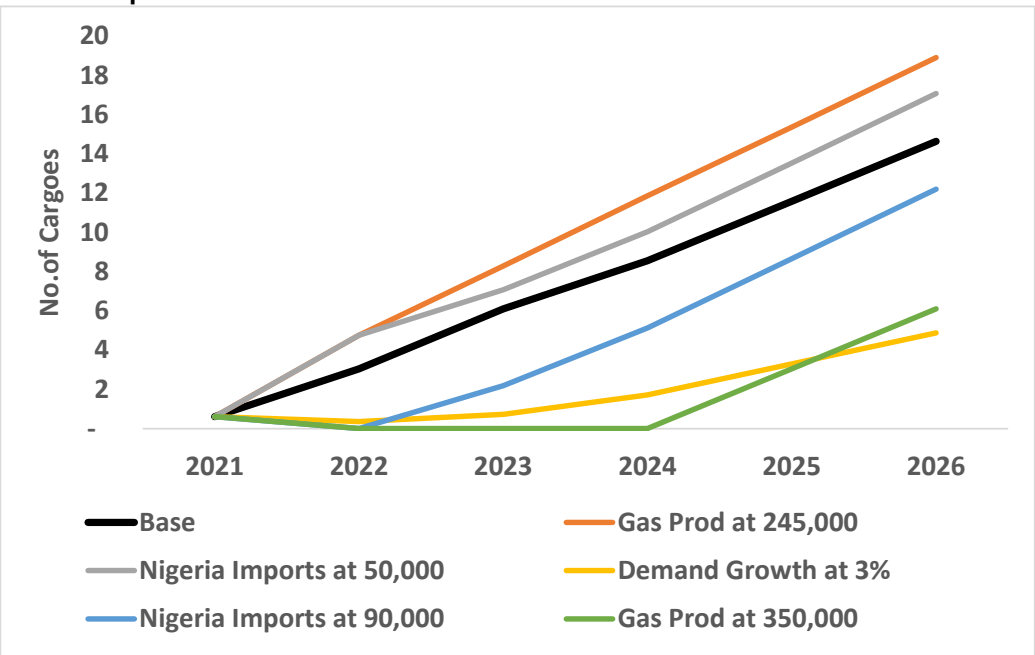
Figure 5 considers a number of alternative sensitivities. In the Base Case, the number of cargoes starts at around 1/year, rising to 9 by 2024 and to 15 by 2026. 8 cargoes/year is some 700 MMCM or 0.5 MTPA. On the upside, lower gas production or lower imports from Nigeria increases the LNG requirement by between 2 and 4 cargoes/year from 2024 onwards. Conversely, lower demand or Nigeria imports up at 90,000 MMBtu/day, which is the take-or-pay level, reduces the number of cargoes, significantly in the case of 3% demand growth rather than 6% demand growth. Demand growth remains an area of key uncertainty, especially if the electricity demand growth also requires the building of new power plants. However, if local demand growth is not forthcoming there is the possibility of increasing exports of electricity to neighbouring countries through the West African Power Pool.

The 2021 Energy Outlook for Ghana assumed that Sankofa would produce at 180 mmscfd – this translates into 190,000 MMBtu/day – and that Jubilee and TEN would produce 120 mmscfd (130,000 MMBtu/day). The facilities and fields actually have the capacity to deliver more gas – Sankofa capacity is 210 mmscfd and could be upgraded to 260 mmscfd and the Atuabo gas processing plant can process up to 150 mmscfd. However, increases to these levels, especially once Jubilee's delivery of "free" gas (some 200 bcf) comes to an end possibly as early as 2023, would require new commercial agreements, which have not yet been progressed.

[12] The 2021 figures are in part extrapolated from the early month figures. Over 100,000 MMBtu/day is being transported from Takoradi to Tema and the Nigerian imports are around 60,000 MMBtu/day. This suggests that either demand for gas in Takoradi may be lower than last year with some of the power plants operating at low utilisation rates, or gas production has increased significantly to meet rising demand.

If the domestic production increased to 350,000 MMBtu/day (220 from Sankofa and 130 from Jubilee/TEN), then LNG may not be needed until 2025. If, in addition to the higher domestic production, Nigeria imports were also increased to 90,000 MMBtu/day then the need for any LNG imports would be zero in the next 5 years. Lower domestic production, however, at 245,000 MMBtu/day could see significantly more LNG cargoes required – over 10 cargoes/year by 2024.

Figure 5: **LNG Import Sensitivities**



Source: Author's estimates

However, Ghana's desire to import LNG is very different from other countries who are recent new LNG importers such as Malta, Gibraltar and Myanmar. All these countries have dedicated power plants linked to the LNG imports so LNG is baseload and the economics can make sense. For Ghana it is more diversity of supply, which is not a bad thing, but can be expensive. The Valant 1 FSU is on a charter until July 2022, reportedly at a charter rate in the low $20,000 a day[13] – significantly below current market levels, especially given it is a new-build vessel. It is understood the lower rate is linked to the vessel's speed limitation of 12 knots, making it less attractive on the standard market. The FRU also has to be paid for or chartered and if that was at a similar rate then a total of $50,000 a day would amount to some $18 million/year. Around 6 cargoes/year are needed to get the cost/MMBTU down to $1, which is reasonably cost effective. At 2 cargoes/year, the effective cost is over $3/MMBTU, which is starting to make LNG look very expensive, once the commodity cost of LNG is included – currently $9 or $10 – and whatever costs are charged for the upgraded port facilities and the pipeline connections to the power plants.

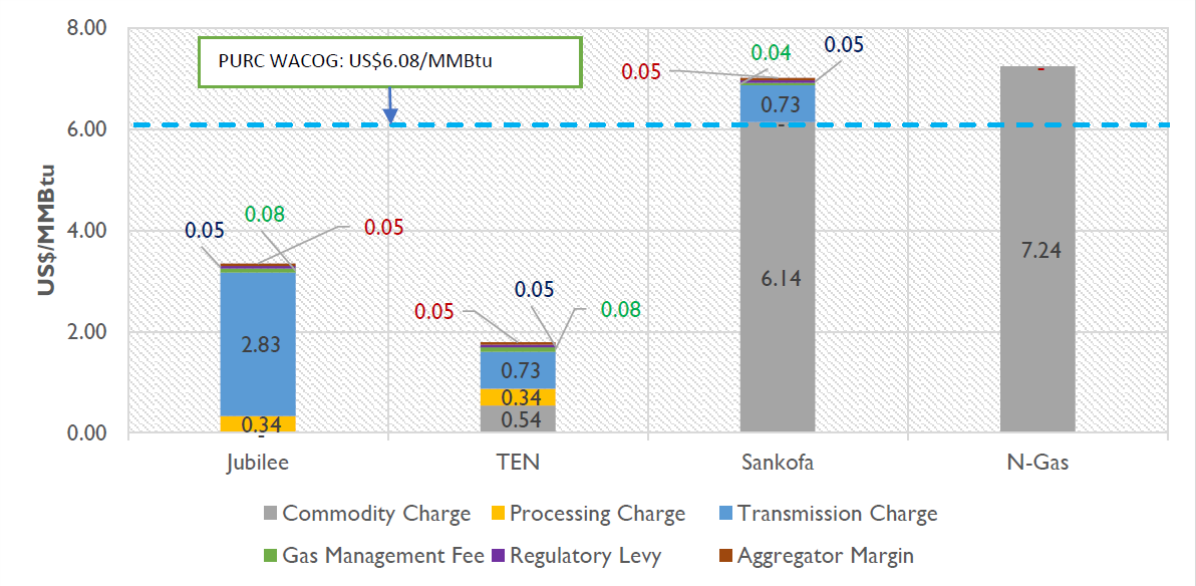
Pricing

The price of lean gas from both domestic and import sources for power generation is a weighted average delivered cost determined by the Public Utilities Regulatory Commission (PURC). The Weighted Average Cost of Gas (WACOG) for power generation in 2020 was US$6.08/MMBtu. For non-power use, the price is determined on bilateral terms between the Ghana Natural Gas Corporation[14] (GNGC) and the consumer. Figure 6 shows the commodity price and service charges of gas used to determine the WACOG from four sources - Jubilee, TEN, Sankofa and N-gas for power plants that utilise natural gas. Jubilee gas has the lowest commodity charge among the sources. This is because

[13] https://www.icis.com/explore/resources/news/2021/04/26/10632516/fsu-heads-to-ghana-as-tema-lng-project-nears-start
[14] GNGC is a subsidiary of GNPC

the initial 200 bcf is delivered free to the government of Ghana as part of the conditions of the petroleum agreement. Thus, PURC WACOG, based on 60,000 MMBtu (Jubilee), 15,000 MMBtu (TEN), 170,000 MMBtu (Sankofa) and 60,000 MMBtu (N-Gas) was US$6.08/MMBtu effective 1st July 2019.

Figure 6: Ghana WACOG 2020



Source: Ghana Energy Outlook 2021, Ghana Energy Commission

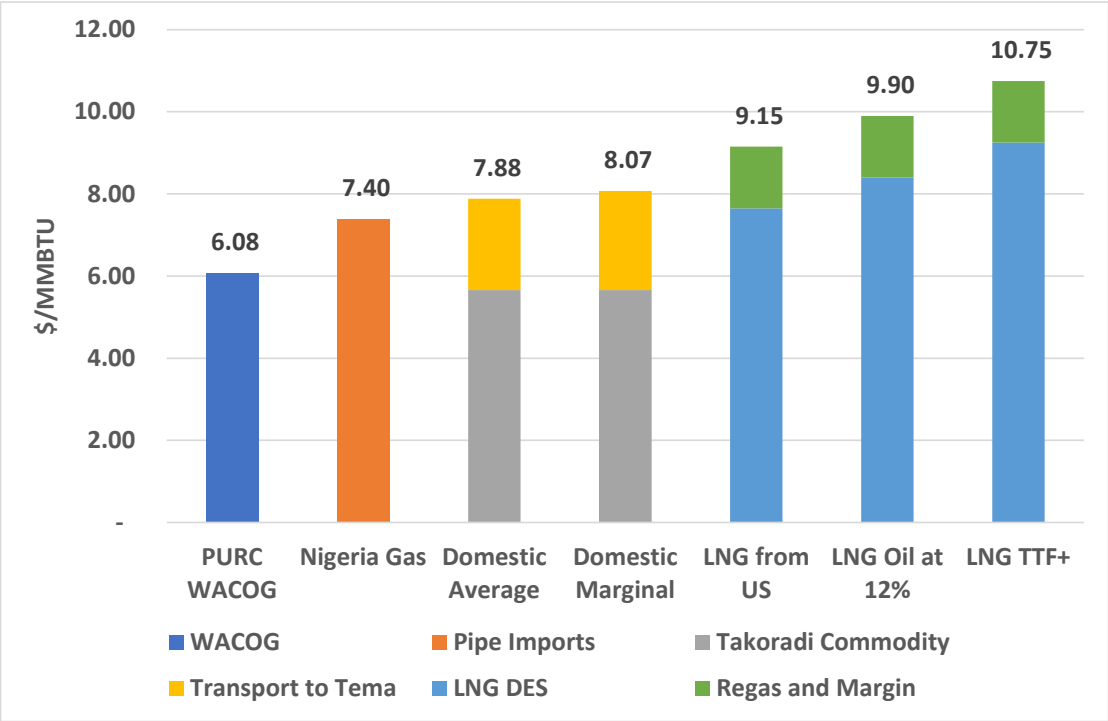
The effective "free" Jubilee commodity price is offset by the apparently higher transmission charge, assumed by the PURC so the notional Jubilee price is $3.35, compared to TEN at $1.87, Sankofa[15] at $7.01 and NGas at $7.24. However, these prices were set by PURC in July 2019 and do not include all the current costs in the gas value chain, apart from any changes in weightings. A key omission is the transmission charges to move gas from Takoradi to Tema using the WAGP[16]. The average charge (firm and interruptible) in 2020 for Takoradi to Tema transmission was $2.17. In 2021 the total firm tariff is some $2.10 (covering 60,000 MMBtu/day) and the interruptible tariff $2.41. The estimated 2021 volume from Takoradi to Tema is around 100,000 MMBtu/day, giving an average tariff of $2.22. The average price from NGas for Nigerian gas in 2021 is estimated at some $7.40[17].

Adjusting the weightings for the estimated volumes by source in 2021, and the new Ngas price, would give a WACOG of $6.02, slightly below the PURC 2020 WACOG although higher than the $6.08 in 2019 and 2020. However, adding on the 100,000 MMbtu/day average transmission charge of $2.22 for the Takoradi to Tema volumes, gives a revised WACOG of $6.66/MMBtu, when these additional costs are averaged over the total gas consumed.

These calculations represent the average cost. More relevant for a comparison with imported LNG is the delivered cost at Tema on an average or marginal cost basis. Currently the average and marginal cost of gas from Nigeria is $7.40 since the contract is still operating under force majeure, so the total cost is variable. However, if the contract was operating as it is meant to, then out of the $7.40, around $3.60 is made up of capacity charges, with the variable or marginal costs being $3.80. For domestic gas from Takoradi, the WACOG of domestic production only is $5.66. Adding the average transmission charge of $2.22 gives an average cost of $7.88 at Tema. On a marginal basis, using interruptible transportation this would rise to $8.07, if the WACOG of domestic gas was used or to $9.42 if Sankofa[18] was the marginal gas price.

[15] The Sankofa price represents a "net" price after deducting royalties and the GNPC share of the sale. The Ghana Government also receives tax revenues
[16] Source: WAGPA
[17] Source: WAGPA
[18] Sankofa is mainly non-associated gas so can be flexed to meet demand

Figure 7: Delivered Cost of Gas to Tema



Source: PURC, Author's estimates

LNG is being supplied to the Tema plant through a long-term contract with Shell. The pricing terms are not known publicly, but Shell has access to LNG from the US, Trinidad and Nigeria in the Atlantic Basin plus Egypt. Shell's supply from the US could come from Cheniere's Sabine Pass facility, under 20-year long term agreements. These are priced at 115% of Henry Hub plus a liquefaction fee – which was $2.25MMBtu for the first train and $3.00 for supply from later trains. Then there would be the shipping cost on top of that. The shipping cost is estimated to be around $1.20 at current charter rates and oil prices and with Henry Hub at $3, that would give a delivered ex-ship (DES) price of some $7.65 (with the higher liquefaction fee). Adding a supplier margin and the costs of the FSU and FRU of, say, $1.50 (based on more than 6 cargoes/year plus a supplier margin), would give a price for regasified LNG of maybe above $9. Alternatively, the LNG could be priced as a percentage of the Brent oil price. At the current level of $70/barrel, this could range from a DES price of $7, using a 10% slope to Brent, to just under $10 using a 14% slope, plus the $1.50 added on for the costs of the FSU and FRU. With a 12% slope to Brent the total price would be almost $10. Another possibility might be to link the price to the European spot price – TTF – plus an additional margin for the larger shipping costs from the US to Ghana as opposed to US to the Netherlands. TTF prices are currently $10+ but only a year ago they were less than $2 as Covid-19 hit the global economy. Based on the TTF forward curve for 2022 – currently at $9.25 – this gives a delivered Tema regasified price of just under $11.

At current prices, whether Henry Hub linked, oil linked or even based on spot prices in Europe, LNG looks expensive compared to both domestic gas delivered to the Tema area and also to gas from Nigeria which, at $7.40/MMBtu under the current contract, looks to be the cheapest on both an average and marginal basis. Regasified LNG would be in the $9 to $11 range, and domestic gas from just under $8 to the mid $9 range, depending on the measure chosen, for gas delivered to Tema.

Issues and Conclusions for Ghana

There is a wide range of uncertainty in terms, not only of gas demand, but also supply sources to meet the demand in Ghana. At first sight, with a growing level of domestic production and more stable imports from Nigeria, the market looks well supplied and the need for LNG to be imported can be questioned,

at least for the next few years. The range of demand for LNG into Ghana could be somewhere between zero – with a combination of much higher domestic production, possibly higher imports from Nigeria, and/or weaker demand growth – to 15 or more cargoes by 2025, which is 1.2 bcm or 0.9 mt – if domestic production particularly does not increase and demand growth remains strong. The key uncertainties and issues are:

- Electricity demand in Ghana has been growing consistently at 7% per annum in the last 10 years and this growth rate is expected to broadly continue over the next 5 years or so. With gas having almost completely displaced oil in the power generation mix, gas demand growth could be expected to at least match the growth in electricity demand. However, much slower growth in electricity demand would lead to a significant reduction in the amount of gas required 5 years ahead.

- Domestic gas production is now running at record levels with the reverse flow capability from Takoradi to Tema fully operational. Sankofa volumes look to be running at the contract levels and Jubilee and TEN associated gas volumes are also higher. However, with the "free" gas from Jubilee expected to come to an end in 2022 or 2023 at the latest, commercial agreements would need to be put in place for the supply of gas from Jubilee post 2022. Additional commercial agreements would also be required for further Sankofa gas to reach the 210 mmscfd current capacity or the expanded 260 mmscfd capacity. It was reported recently[19] that Tullow and its Partners have submitted a 10-year firm gas supply proposal to deliver over 500 bcf of "low cost and reliable gas to Ghana for the long term". If the 500 bcf is over 10 years then this is 135 mmscfd, which is well above current Jubilee production levels. Increasing domestic production from the existing facilities is not the same in terms of investment requirements as developing new fields. Some concern has been expressed[20] that the IEA's Net Zero Pathway[21], by suggesting that no new investment in oil and gas facilities is required if their suggested pathway is to be achieved, may put off investors in African oil and gas developments. However, this would not be likely to impact the expansion of the existing production facilities.

- The gas contract from Nigeria remains in force majeure. The ACQ is for 123,212 MMBtu/d, with a take-or-pay level of 75%, but volumes have been well below contracted quantities. In the first 6 months of 2021, Nigerian imports have been running at around 60,000 MMBtu/d. The force majeure is supposed to be lifted this year but the buyer – VRA – has requested negotiations with the Nigerian seller – Ngas – to reduce the contract volumes to a more manageable level, given the ability to receive gas at Tema from Takoradi. However, lower volumes would probably come at a higher price, since, the current price netted back to the wellhead, is thought to be well below the price that the gas could be sold for in Nigeria. Lower volumes, therefore, might see another $1 or so added to the delivered gas price.

- While the contract price for the supply from Shell to the LNG plant in Ghana is not known, if it is around the "market" prices discussed above, then the delivered price to the power plants of regasified LNG, including the FSU and FRU costs, could be in the $9 to $11/MMBtu range – significantly above the current delivered prices to customers in Tema (including the Takoradi to Tema transportation charges). LNG, therefore, looks like an expensive option for gas for Ghana, especially if additional gas production is available domestically, or even from Nigeria. However, LNG does provide supply diversity, which is always useful in any market. The usefulness of this diversity does depend, though, on how flexible the Shell LNG supply contract is, particularly whether the LNG volumes have to be delivered to Ghana, with a take or pay commitment, or whether the contract allows for diversion of cargoes to other markets, at the buyer's option.

With gas demand rising in Ghana, on the back of rising electricity demand, at first sight LNG could be required in increasing volumes over the next few years. However, domestic production volumes are now at record levels and imports from Nigeria are now more stable and reliable. In addition, it appears

[19] Ghana Business and Financial Times, June 29 2021.
[20] https://www.naturalgasworld.com/africa-to-bear-brunt-of-gas-investment-cuts-tema-lng-head-gas-in-transition-89691
[21] Net Zero by 2050, Paris, international Energy Agency

that domestic production could be increased significantly from Sankofa and Jubilee, and at significantly lower prices than for delivered regasified LNG. In that case, very little LNG would be required, if any at all, for another 3 years or so, and the contracted cargoes would be delivered to other markets. However, increasing domestic production from Sankofa, and maintaining or increasing Jubilee production, requires not only the timely negotiation of commercial agreements, but also realistic expectations on price by both buyers and sellers. As this gas will, in effect, end up being consumed at Tema, the delivered price would need to be competitive with not only LNG but also gas delivered from Nigeria.

Implications for Other Markets

If Ghana is the first market in Sub Saharan Africa to import LNG, then other markets that have been considering importing LNG will look on with interest to see how successful it might be. However, as already noted, Ghana is very different from many other recent and potential projects around the world. Ghana already has both imported and domestic gas, which could meet the projected rise in demand, certainly over the next 5 years. Ghana's decision to import LNG reflects a desire to diversify supply, in part due to the uncertainty over imports from Nigeria, whereas many other projects, e.g. Malta and Gibraltar, have introduced LNG for specific power plants, often displacing oil, or even for new build power plants. The latter are also accompanied by specific contractual arrangements linking the LNG to the specific power plants. The structure in Ghana is very different with the LNG being sold by Shell to GNPC, who act as the aggregator of gas supply in Ghana from domestic production as well as the LNG. GNPC then sell on the gas to power plants in the Tema area. The risk is that a variable supply of LNG to Ghana and potential problems relating to the chain of contractual arrangements could mean that the importation of LNG is seen as less than a success, sending a message to other countries that LNG is not reliable, when the real lesson is that Ghana probably doesn't need the LNG in the first place.