



**Africa
Centre for
Energy Policy**

LIQUEFIED NATURAL GAS (LNG) SUPPLY TO GHANA: THE POLITICS AND THE REALITY

AN ADVISORY PAPER FOR THE GOVERNMENT



August, 2017

1.0 Background

Gas to power has been trending globally given the benefits it has of being cheaper and cleaner compared to other fossil fuels. Ghana signed up to the West Africa Pipeline Project (WAGPP) in recognition of the important role gas could play in the power sector. The initial contracted volume of gas was 120 million standard cubic feet (mmscfd). After completion of the project, Nigeria could not deliver the contracted volume from first gas in December 2008. In 2012 Nigeria Gas supply was cut as a result of an accident in Togo where the pipeline was severed by the anchor of a ship. At the same time, Ghana's domestic gas supply could not be delivered on time. The Jubilee field was expected to herald domestic gas supply by the end of 2012. This could not be achieved because of technical and financial reasons. Ghana struggled in many instances to satisfy the conditions for the disbursement of the Chinese Development Bank (CDB) loan facility and timely disbursement of counterpart funding by government itself.

In 2012 the power crisis started as a result of gas supply curtailments from Nigeria and Jubilee. The push for alternative supply of gas heightened and Liquefied Natural Gas (LNG) supply through the use of Floating Storage and Regasification Unit (FSRU) was highly considered by government through private capital. The Energy Commission (EC), the technical adviser to government, by 2013 had licensed seven (7) companies to develop LNG projects. Notwithstanding, there remains an indecision over the supply of LNG to Ghana which has lasted for more than 5 years.

Initially, the fear of gas glut blighted any seriousness to consider LNG. The general assumptions were that domestic supply of gas could reach 350mmcfd; beyond the Jubilee gas, Ghana also expected additional gas from the Tweneboah-Enyenra-Ntomme (TEN) field, the Sankofa-Gye-Nyame (SGN) fields, and the Mahogany-Teak-Akasa (MTA) field. Moreover, Nigeria gas could be restored to at least the contracted volume of 120mmcfd, pushing total gas supply in excess of 450mmcfd, which would be enough to power about 2600MW of gas turbines. Therefore, based on those assumptions and projected demand for electricity, an LNG commitment was risky for government. As a result, none of the seven (7) companies licensed by the Energy Commission to supply LNG since 2012 have progressed beyond the license to commission an LNG facility.

The outcome of the indecision on LNG and over reliance on Nigeria gas contributed to the long period of power supply deficit which affected the health of the Ghanaian economy between 2012 and 2015.

From 2015 to date, government has renewed seriousness to procure LNG. In 2015, the government signed contracts with West Africa Gas Limited (WAGL). The Ghana National Petroleum Corporation (GNPC) also signed an LNG supply agreement with Kaheel Investment of Dubai in 2016, the second after an agreement with Quantum gas Limited was signed before 2015. The government is also considering an LNG supply agreement with Blystad Energy Management (BEM).

In this policy paper, ACEP has analysed the cost of Ghana's indecision on LNG supply and the unending politics which risk the sustainability of the power sector.

2.0 How Much Did Gas Contribute to the Energy Crisis between 2012 and 2015?

The challenges of the power sector have evolved over time to be summarized in the sector's lexicon as Technical, Financial and Managerial. However, fuel security was a primary factor which escalated the challenges beyond control in 2012 and the years after. The cessation of gas supply from Nigeria rendered thermal plants like Asogli, Mine Reserve Plant (MRP), and Tema Thermal 2 Plant (TT2P) redundant. A ship's anchor severed the West Africa Gas Pipeline in August 2012 in the territorial water of Togo. It took one year for gas to be restored, against the expectation of a short term fix. After the pipeline was fixed, the supply levels remained below the contracted minimum. This put significant pressure on Volta River Authority's (VRA) dual fuel plants and the hydro plants to generate the power demanded by the country.

The immediate response was that VRA had to switch its dual fuel plants from gas to more expensive Light Crude Oil (LCO) without commensurate tariff to compensate for the additional cost incurred in procuring LCO. This trended to the point where VRA's credit worthiness was eroded against rising oil prices on the international market. At the same time,

the stress on the hydro plants resulted in over-drafting of the dams which necessitated significant drop in output. Bui Authority issued a statement to say that *“The exceedingly high level of generation support that the Bui Generating Station has been providing for the national electricity grid since the inauguration of the Bui plant has caused the Bui reservoir level to fall to the minimum operating level of 168 metres above sea level (masl)”*.¹ The dams were politically managed until they operated below minimum levels.

Owing to the pressure on VRA to generate power from the dual fuel thermal plant, the VRA missed some scheduled maintenance timelines. This affected the plants, resulting in avoidable faults which compounded the power problems.

It is therefore without argument that gas supply curtailment was central to the genesis and protraction of the power crisis in Ghana between 2012 and 2015.

3.0 Risk aversion against the resultant cost to Ghana

A typical cost of LNG facility, using FSRU, could range between \$400Million to \$600million depending on scale, siting and existing infrastructure for evacuation of gas to demand centres. This is the potential risk that Ghana faced in the event that the investment became unnecessary, assuming all the plans for domestic gas and Nigeria gas supply materialised. The power sector would have had to absorb the cost in that scenario. However, this scenario paints a significant cost burden in the absence of a counterfactual analysis of the cost associated with the eventuality that all plans for domestic gas and gas from Nigeria did not materialize.

All the analyses on the need for LNG around the time Ghana needed to take a decision failed to analyse the cost on the Ghanaian economy of potential failure of the gas supply plans from domestic sources and Nigeria through WAGP. The World Bank projected that Ghana may not need LNG beyond 2017 when domestic supply from Jubilee, TEN and Sankofa were expected

¹ <http://www.graphic.com.gh/news/general-news/bui-power-reduces-generation.html>

to come on stream and therefore LNG may not be necessary.² This was based on assumption that LNG could take up to 4 years to be delivered, which further assumed that LNG projects signed up for could coincide with the timing for adequate domestic gas supply. This assumption failed to recognise that the delivery of LNG through an FSRU could be fast-tracked and achieved within 18 months.

The Energy Commission (EC) was quite emphatic in its 2012 Energy Outlook for Ghana that LNG was necessary and demanded commitment from Government to mobilise investment in the shortest possible time. The Commission recommended *“Government should proactively create incentives to encourage investment in LNG regas facility built **at her coast** at the shortest possible time. An investment workshop for stakeholders where the government entities including Ghana Investment Promotion Centre and the Ministries of Energy and Finance can table the economic and investment incentives that the government could offer would be very essential”*. Between 2012 and 2014, LNG could have been delivered on a fast-track basis. Unfortunately, the EC’s very important signal to the government failed to get the needed attention.

Had the advice of the EC been heeded, and had the Ministry investigated the cost of inaction to the country, the power sector will not be as highly indebted as it is today. ACEP estimates that the power sector lost \$1.042 billion in revenue in 2014 and 2015 due to load shedding. A 2015 report by the Institute of Statistical Social and Economic Research (ISSER) also puts the cost of load shedding on the Ghanaian at between US\$320 million and US\$924 million annually. No analysis has been able to quantify loss

ACEP estimates that the power sector lost \$1.042 billion in revenue in 2014 and 2015 due to load shedding

of human lives, property and businesses that permanently collapsed. Again, as at the first quarter of 2017, the energy sector was estimated to be in \$2.4 billion debt. The VRA, for example, which made profits in 2011 would have collapsed with its current debt burden if it

² Sunil et al (2013). Energizing Economic Growth in Ghana: Making the Power and Petroleum Sectors Rise to the Challenge. Available at <http://documents.worldbank.org/curated/en/485911468029951116/Energizing-economic-growth-in-Ghana-making-the-power-and-petroleum-sectors-rise-to-the-challenge>. Accessed on 7/25/2017 at 3:53 PM

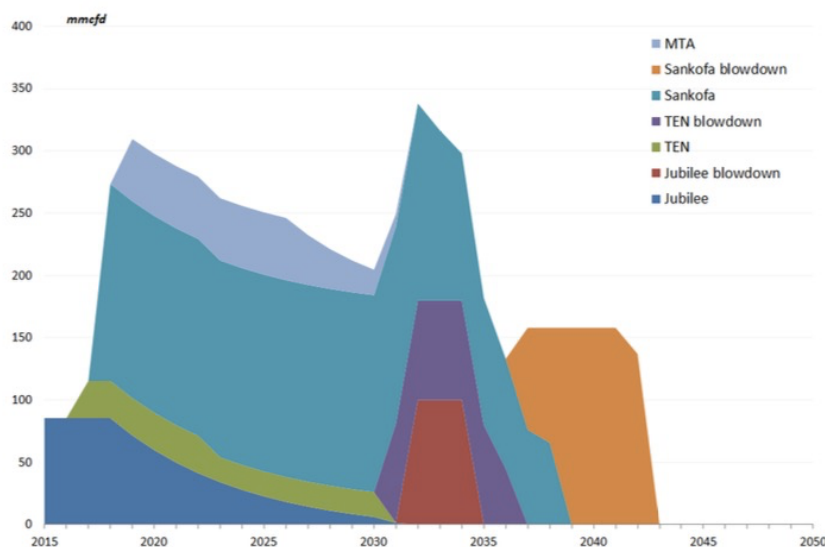
were a private company.

The cost of taking a \$600 million investment risk in LNG would have amounted to three pesewas per kilowatt-hour (Kwh) on electricity for five years to cover investment and interest. This is far negligible compared to what Ghanaians are paying today, following the redemptive measure to rescue the energy sector through the institutionalisation of the Energy Sector Levies Act (ESLA). The ESLA imposes levies on electricity consumption to the tune of 3 pesewas/Kwh, and on petroleum products to the tune of 28 pesewas per litre over a five-year period. These come to a total of 31 pesewas. The indecision to bring in LNG therefore imposes an avoidable extra burden of 39pesewas on consumers of electricity and petroleum products.

4.0 Gas supply scenario and the need for LNG

In 2015 it became increasingly clear that domestic sources of gas remained inadequate in the medium to long term even with the addition of TEN and Sankofa gas. The 2015 gas masterplan put expected total domestic supply to peak around 300mmscfd in 2020 when the MTA field comes online (figure 1). But this is expected to decline until 2030 when supply is expected to rise again upon introduction of the Jubilee and TEN blowdown.

Figure 1: Domestic gas supply scenario in Ghana



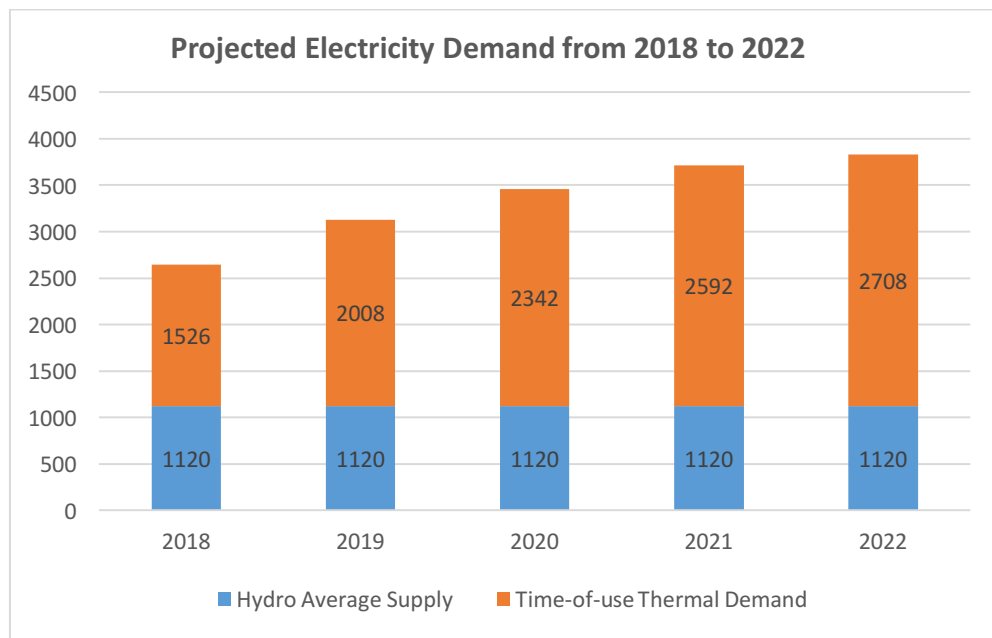
Source: Ghana Gas Master Plan 2015

The government had a renewed commitment to facilitate private investment in LNG to augment domestic sources. But again, the assumption still lingers that by 2018, the total

domestic gas supply could exceed 300mmcf. The Sankofa field is expected to produce the largest volume of 180mmcf while the Jubilee gas could stabilise in the region of 100mmcf, with additional 50mmcf from TEN fields. These domestic sources will be enough to power time-of-use projected demand from thermal plants in 2018 (assuming expected gas production from the domestic producing fields are realized). Also, the risk posed by potential supply of contracted volume from Nigeria under the take-or-pay arrangement injects much nervousness into the decision to procure LNG.

GRIDCo projects that in 2018, the demand for electricity will be about 2600MW, which will largely be met by hydro and thermal sources. As presented in figure 2, electricity demand is expected to grow over the period between 2018 and 2022. Hydro is projected to supply an annual average of 1,120MW during that period. This means that thermal generation will significantly account for the difference in demand growth which will rise from 1500MW in 2018 to 2700MW in 2022. This indicates that security of gas supply is important to ensure that the thermal plants can generate the needed power, at the cheapest cost, to meet demand.

Figure 2: Projected Electricity Demand, 2018-2022



Source: GRIDCo, 2017³

³ Presentation at Ghana Energy Summit, 2017

Given the uncertainty in the gas supply market, both the Energy commission and GRIDCo have recommended the importation of gas through LNG facility. ACEP believes this recommendation is accurate to the extent that the three domestic sources will still not provide enough security of supply, and Nigeria gas still remains unreliable and a risk to the economic fortunes of the country. If one of the domestic fields undergoes maintenance for example, there will be significant volume reduction in supply.

5.0 How much LNG is required?

ACEP has been monitoring the renewed commitment by government to import LNG since 2015. In this process the Centre conducted gas needs assessment of the country and cautioned that the trend in domestic gas supply required not more than one LNG contract by government. At the time, government was considering two LNG projects using FSRU; the West African Gas Limited (WAGL) project (sponsored by Sahara and the Nigerian National Petroleum Corporation (NNPC)), and the Quantum Power (QPR) project (sponsored by a joint venture involving UK and Ghanaian investors, and GNPC). The WAGL proposed to supply 180 mmscf per day, whilst QPR proposed 250 mmscf per day. Parliament subsequently approved the WAGL project even though the cost to the nation was higher than that of QPR.

The GNPC also entered into another agreement with Kaheel Investments, a company registered in Dubai. This was baffling to the extent that GNPC is in a partnership with QPR to supply the same product against the reality that Ghana needed only one LNG project. However, with a change in government in 2017, the Kaheel project seems to have dissipated with the transitions.

The three projects will be remembered for the controversy that ensued after Honourable Boakye Agyarko, current Minister for Energy, insisted at his vetting that Ghana needed only one LNG project and yet, the previous government signed three. The minister vindicated ACEP's position and was therefore expected to initiate processes to ensure that only one FSRU was contracted with due regard for value for money, capacity of the investor to invest in an LNG facility, and the risks to government finances. The process of taking the decision has been slow, but perhaps compensated for by the savings seen by the current processes of reviewing the contracts. ACEP can confirm that facility-use-charges seen on revised proposals sent to

the ministry presents annual savings of \$15million and \$63million on QPR and WAGL respectively. Currently another company, Blystad Energy Management, has joined the competition to increase the number of companies to four.

6.0 Briefs on the four LNG projects

The analysis is sequenced on the time the companies approached government or an agency of state.

6.1 Quantum Power (QPR) Project

This project had initial 20-year period for amortization which has been revised to 10 years in response to the directive of the Ministry to limit the contract period for the proposals to 10 years. It is a Build, Own, Operate and Transfer (BOOT) arrangement between Quantum Power (QPR) and GNPC which will see the infrastructure transferred to GNPC after the cost of the project is amortized.

The requirement on Ghana is for GNPC to offtake the use of an FSRU with the flexibility to be active in the procurement of LNG either through GNPC's own arrangement, or an arrangement between the government of Ghana and governments of LNG producing countries.

QPR is proposing a facility user charge of \$1.3 per MMBtu for a 10 year levelized volume of 250mmscfd. This constitutes \$0.17 reduction of the initial proposal of \$1.47 on the 20-year timescale, translating to an annual savings of \$15.5million. The initial siting of the project at 12km offshore has however been reduced to 5km offshore.

6.2 West African Gas Limited (WAGL) Project

This project is sponsored by Sahara Energy and The Nigeria National Petroleum Corporation (NNPC). This project has a composite arrangement for the supply of FSRU and LNG. The initial proposal by WAGL has been revised for the provision of FSRU from \$2.2 per MMBtu to \$1.5 per MMBtu. This translates into a savings of about \$63 million annually on their revised project. WAGL got parliamentary approval for a Gas Sales Agreement (GSA) with government in October, 2016 which locked-in minimum LNG price of \$7.15 per MMBtu indexed against

Brent crude oil. The formula approved by parliament stipulates that LNG prices will be equal to \$7.15 at a Brent price of below \$40/bbl. When Brent Price is between \$40 and \$80/bbl, LNG price will be 8% of Brent plus \$3.98. When Brent is above \$80/bbl the LNG price will be 10% of Brent plus \$2.35. The WAGL project has also been converted into a BOOT project in the current proposal to allow government to own the FSRU after 10 years.

6.3 The Kaheel Group Project

GNPC entered into another agreement with the Kaheel Terminal Investment (owned by owners of the Ameri Group) to provide another LNG facility using FSRU in the western Region of Ghana. This arrangement is surprising in light of the fact that all anticipated domestic gas supply are located in the Western Region and exceeds the gas requirement of existing power plants. Notwithstanding, GNPC, ceased with the realities of the gas supply scenario, entered into the Kaheel contract in October 2016.

It is clear from the action of the Ministry of Energy in recent times that the Kaheel project is not one of the options being considered. ACEP will therefore skip analysis of the details for this agreement.

6.4 Blystad Energy Management (BEM) Project

The addition to the number of companies interested in delivering LNG is BEM. It is a partnership between BEM and its local Partner, West Coast Ghana Gas (WCGG). The solution proposed by BEM is similar to that of WAGL in terms of siting and LNG procurement. BEM proposes locating its facility at the Tema Port. The technology however differs in configuration. BEM's solution comprises of two vessel configuration of Floating Regasification Unit (FRU) and Floating Storage Unit (FSU). This means that at any time there will be two vessels docked at the port, and a third vessel during delivery of LNG into the FSU. This will require significant expansion of the Port to provide the right manoeuvrability, and limit the impact on port traffic.

The pricing for BEM is also composite, proposing to supply equipment (FRU/FSU) and the commodity. The price for facility use is quoted at \$1.38 per MMBtu while that of LNG supply is arrived at using Brent indexed formula. At a Brent price above \$60 the LNG price will be

12.5% of Brent price minus \$0.82 per MMBtu. And at a Brent Price below \$60 the LNG price will be \$7.5% of Brent price plus \$2.18 per MMBtu.

7.0 Key Dynamics of the 3 Proposed Options (QPR, WAGL and BEM)

The table below explains the key subtleties that define each of the proposals, given a leveled tenure of 10-years and 250mmscfd supply volume. All the projects also provide for a BOOT model.

Table 1: Comparison among the four LNG projects

	QPR	WAGL	BEM	Comments
Siting	The FSRU will be sited 5km offshore Tema, moored in position to supply LNG through undersea pipeline to the shore.	The FSRU will be berthed at the Tema Port, requiring Deep dredging and construction of Breakwater.	This is similar to WAGL's requirement and may require bigger expansion of the port to provide manoeuvrability for a third vessels during LNG intake	Siting at the Port is a more popular and conventional solution in the use of FSRUs. However, out of Port solutions are tested and viable. The choice of either In-Port or Offshore site should rather be informed by contextual determination. There is currently a study by Genesis and Technip which suggests that high pressure gas cannot be safely evacuated from the build-up area of the Tema Port. GE's Early Power was denied the opportunity to construct their LPG pipeline for same reason. The expansion work for the FSRU could provide benefits for other uses. However, this may not be necessary considering that siting the FSRU in the Port could be risky, and also that there is already an ongoing \$1.5 billion

				expansion of the Port by Ghana Ports and Harbour Authority (GPHA) which will provide similar benefits that an FSRU-based expansion may bring.
Pricing-Equipment Use	\$1.3	\$1.5	\$1.38	QPR provides the cheapest option followed by BEM and WAGL. However with BEM's pipeline cost not known yet, its price could end up to be more expensive at the final estimation.
LNG Price	QPR does not offer LNG supply. However GNPC presented a price of \$5.85 ⁴ to AfDB from its preliminary negotiations	When Brent is < \$40/bbl, LNG Price = \$7.15. When Brent is between \$40 and \$80 /bbl, LNG Price = \$8% of Brent + \$3.95; and when Brent is greater than \$80/bbl. LNG Price = 10% Brent + 2.35. Therefore in today's terms LNG will be equal to \$8.1092⁵	When Brent is above \$60/bbl, LNG Price = 12.5% Brent + (-0.82), and when Brent is equal to or below \$60/bbl, LNG Price = 7.5% Brent + 2.18, In today's terms LNG price will be \$6.07925⁶	QPR provides the optionality for government to negotiate for its LNG supply. The other two provide composite facility and commodity agreement. The composite arrangement increases the take or pay risk for Ghana on both LNG procurement and facility use.
Delivered LNG	\$7.15/MMBtu	\$9.61/MMBtu	\$7.46/MMBtu	QPR and BEM present lower figures of \$7.15 and \$7.46 respectively. This provides Quantum a \$0.31/MMBtu price

⁴ This price is used for the analysis though prices are cheaper today than quoted by GNPC in December 2016.

⁵ Based on Brent price of \$51.99 as of August 2, 2017 as reported by Bloomberg

⁶ ibid

				advantage over BEM, representing an annual savings to Ghana of \$28.3 million. However Brent indexation subjects the pricing of LNG to the volatility of the crude oil price and does not account for the analysis in section 8.0 below.
Risk/ liability over a 10year period	1,186,250,000	8,769,125,000	6,807,250,000	The composite equipment and LNG supply heightens the take or pay risk for Ghana at \$8.8billion and \$6.8 billion on WAGL and BEM respectively. The \$1.2 billion risk on the QPR allows government to negotiate less risky government to government LNG supply.
Timing of First Gas after financial close	Quarter 3 in 2018	Quarter 3 in 2018	Quarter 1 in 2019	The timing for the In-Port solutions look conservative given the dredging and breakwater construction required. Especially when the studies to confirm the extent of work needed have not been done by BEM and WAGL.

Source: ACEP, 2017⁷

8.0 Why Ghana Needs a Facility Use Agreement (FUA) and Not a composite FUA and LNG supply.

Ghana needs the flexibility to take advantage of the falling LNG price trend. The indexation of gas price to the Brent does not reflect the global trend in the LNG market. LNG prices have been falling to defy projected increase by IMF and the World Bank. Japan which consumes a

⁷ ACEP's compilation based on project proposals submitted by the three companies to the Government.

third of the global LNG recently outlawed LNG resale restriction to allow their importers to sell contracted LNG supply on the market. This is in response to current market dynamics where new supplies from US and Australia are influencing price reductions. Again Qatar is set to increase LNG exports to 100 million metric tons from 70 million metric tons against projected demand stagnation in Europe. At the same time, the United states is increasing exports from shale gas revolution. The development in Africa even supports an open planning for the procurement of LNG. Tanzania, Mozambique and Senegal will soon inject more gas onto the market through LNG, given the big discoveries in those countries.

It is therefore not justifiable for government to approve a locked-in LNG price for 10 years. The commodity is assuming a market of its own and therefore price benchmarking against Brent crude is discouraged. Ghana should therefore rely on Government to Government negotiations to support GNPC to procure LNG cheaply.

9.0 Recommendations

ACEP appreciates the challenges the Government of Ghana has faced over the years in deciding on the need for an LNG facility. The gas supply scenario definitely poses some risk which demands very careful analysis on mitigation measures. ACEP therefore makes the following recommendations to the government in its assessment of the need for LNG:

1. **LNG is needed** - Ghana needs LNG to provide extra gas supply security even in 2018, when local supply could be just enough for the time-of-use demand scenario. Indigenous supply is still not diversified enough to provide confidence for uninterrupted supply from the fields.
2. **Nigeria Gas** - We observe that gas supply from Nigeria does not hold any reliable promise. The suppliers have not delivered on foundational volume over the years, largely influenced by growing demand for gas in Nigeria and export of LNG. The current supply of only about 9mmscfd doesn't give any assurance for the future. NNPC, which is a major player in the WAGPP, is now exploring opportunity to export LNG to Ghana through WAGL. This arrangement could be the death warrant for the WAGP if the LNG business presents higher revenue to NNPC than through the WAGP. Government should therefore take the necessary steps to revoke the take-or-pay

agreement under the WAGP with NNPC to relieve Ghana of some risks associated with the importation of LNG.

3. **Location of the LNG Facility** - There are contentions about the suitability of the Tema Port for the siting of the LNG facility. Regardless of how remote the risk may be, ACEP recommends that siting of the facility outside the Port should be considered. The reason is that, the Port is a major revenue basket for the state and any activity that risks the size of revenue from the Port should be considered carefully. The fiscal challenges of the country will worsen if the Port doesn't function as required. There is no reason for Port activities to suffer when there are viable alternatives.
4. **Government should reserve the right to procure LNG** – the current trend in the LNG market presents an opportunity for Ghana to take advantage of the falling prices, negotiate stable prices, not be subjected to the volatility in the crude oil market, and in effect make greater savings.
5. **Scalability** - Gas demand scenario for Ghana is largely influence by the power sector. This leaves the country largely unable to estimate future demand by other sectors. Against the much talked about industrialisation agenda of the government, the procurement of LNG facility should be able to account for gas needs that cannot be assessed in the short term. The remedy is to ensure that the facility that will be contracted has the potential to scale up supply with attendant benefits from economy of scale rather than two LNG facilities which will be more expensive. Scalability is not being considered currently under any of the proposals.
6. **Managing the risk of potential gas glut** - the Ghana Gas Master Plan identifies other potential industrial uses of gas, including the textile, cement, steel, paper and fertilizer industries. There is the need for a proactive policy shift to activate those demands. This will align with Ghana's industrialisation agenda and ensure that gas drives industry with its climate benefits.
7. **QPR is recommended**- on the strength of the three main proposals and available information used for this analysis, ACEP is of the view that the QPR project presents greater value on the strengths of price, siting, and optionality for Ghana to procure its own LNG.
8. **Parliaments should seek independent opinion on contracts**- the saving made by the Ministry of Energy on the WAGL contract is a good indication that parliament needs

independent technical review of long term contracts. WAGL has reduced its facility use fee from \$2.2 per MMBtu to \$1.5 per MMBtu. This new proposal saves Ghana \$63 million annually (or \$630 million for 10 Years) on the use of WAGL's FSRU if it is allowed to go ahead. The implication is that parliament could not assess the cost burden against the market value of the project. The composite savings on Equipment supply and LNG could be in the region \$1.8 billion and \$2.6 billion when compared to the other proposals.

9. **Introduce competitive bidding for future LNG contracts** - ACEP proposes that future contracts should be subjected to the Procurement Act to ensure that there is fairness, transparency, and competitions for such contracts. That way, the company with the best value to Ghana will be selected.

10. Conclusion

ACEP is of the view that the financial risk of importing LNG is lower than the risk of not importing it. Ghana's energy sector is suffering today because the country lacked the boldness to take risks at the time some analysts estimated domestic supply of gas would be enough for power generation. LNG will provide greater security of supply with diversity of sources. It is in this respect that ACEP recommends that the government should facilitate the procurement of an LNG facility, critically considering the scalability, timing, cost, and siting of the project.