



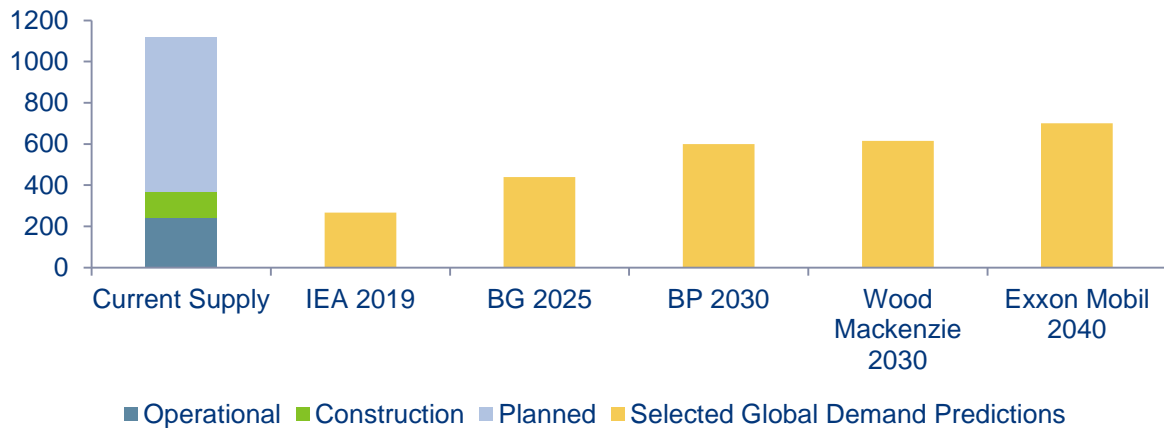
The Potential Impact of LNG on African Gas to Power

Introduction

The 18 month (at time of writing – March 2016) low oil price environment has had spillover effects onto the global hydrocarbons and Liquefied Natural Gas (“**LNG**”) markets. LNG, through its direct (e.g. Brent-linked) and indirect linkages to oil pricing, has suffered from the sustained drop in oil prices. For the upstream sector, the low oil price environment has reduced cash flows and slashed upstream investment. For the LNG market, this paper will argue the position is more nuanced. On the one hand, a number of future LNG projects have been deferred (e.g. Browse LNG most recently). However, both of those trends may or may not reduce future gas production (US Shale gas continues to produce and Iran will soon re-enter the global markets).

Following the crude oil price fall since September 2014, gas prices have also decreased significantly since the end of 2015, for three main reasons:

- I. Long-term gas supply contracts indexed to crude oil prices have dropped in line with falling oil prices (although “slopes” may defer the impact),
- II. Asian LNG importers (China, Japan, South Korea) have started decreasing their gas imports due to slower economic growth, and;
- III. New LNG projects being brought online between now and 2020 will represent up to 40% (130 MTPA) of today’s existing production. Significantly, a proportion of this production will be US domiciled and based upon Henry Hub pricing (a non-oil linked formula)



¹Figure 1: LNG Supply Forecast

The increase in global LNG supplies is by extension impacting upon domestic natural gas markets; for example supporting gas to power or gas to industry. Over the past decade LNG has emerged as a useful primary or alternative resource for diversifying and securing energy supplies through fueling gas-to-power. A good example of this is Egypt, which turned to importing LNG after problems with its domestic gas sector.

The prospect of major increases in LNG supply over the 2014 – 2018 period will increase LNG market liquidity (although much of it is purchased under term contracts and may be subject to resale restrictions) and sheer supply volumes, resulting in continued pressure on LNG prices and offers the potential for increased adoption of LNG as a feedstock for gas-to-power. Below is an example of the two processes in action, showing the scale of price falls over the last two years



Figure 2: LNG Landed Prices March 2014



²Figure 3: LNG Landed Prices January 2016

¹ Source: IEA; BG; BP; Wood Mackenzie; Exxon Mobil; Standard Bank

² Federal Energy Regulatory Commission

Implications of low gas prices for Africa

Can Africa benefit from what are expected larger volumes of natural gas at lower prices than in the 2010-2015 period? An obvious target is that increased LNG supplies can support an expansion of gas-fired power, especially base load Combined Cycle Gas Turbine (“**CCGT**”) technology.

According to BP, Africa will have the highest compound annual growth rate (“**CAGR**”) for oil and gas consumption over the next 20 years whilst having the lowest existing energy consumption base. The projected growth in consumption is driven by urbanisation, which is expected to reach proportions that will allow for the creation of major cities (populations >5 million) and mega trade corridors around the continent. As an example, in West Africa, Nigeria is expected to record a 4.5% CAGR in urban population growth. Similarly, Tanzania, is continuing its fast population growth. From 11m (1963) to 45m (2012), Tanzania is projected to reach 100m in 2035 and 200m by 2100. These are highlights but Sub-Saharan Africa’s population as a whole is expected to show a 2.5% CAGR increase between 2015 and 2020, recording around 1 billion inhabitants in 2020.

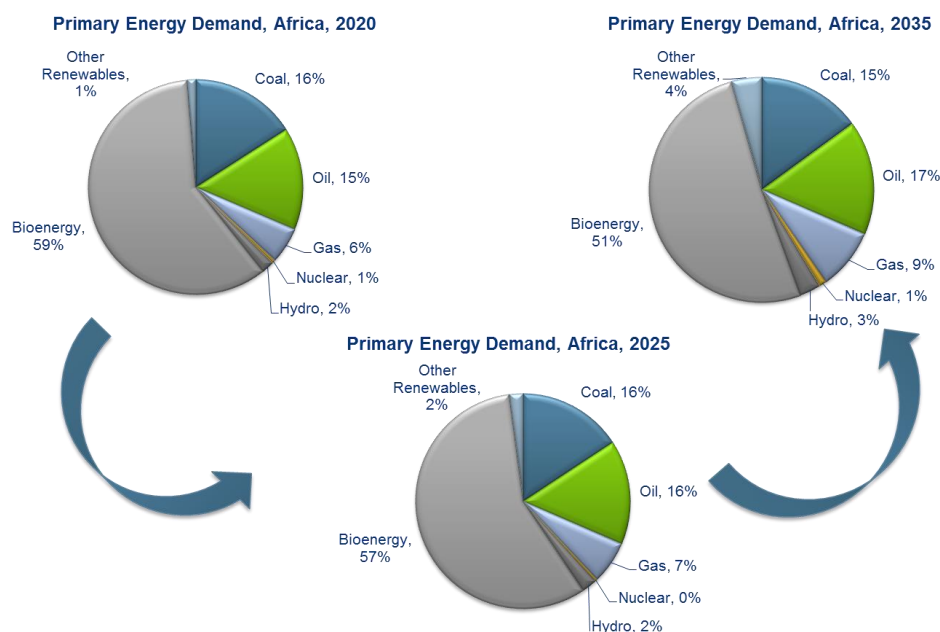
However, given Africa’s well-known existing power deficit, there is an even greater urgency to address the current and future power supply, transmission and distribution needs. The average electrification rate in sub-Saharan Africa is 32%; urban electricity access is 59% and rurally 16%. All need to be increased. Therefore, the proven nature of OCGT and CCGT technology coupled with the increased global volumes of LNG and potential for subdued future prices appear to offer an opportunity for African gas to power to grow.

The Benefits of Gas to Power

Africa has significant natural gas reserves, with increasing numbers of countries joining the list of countries that have discovered resources. For countries lacking domestic gas today, importing LNG for gas to power projects has become feasible (for the above reasons). Several large populous and/or more industrially advanced countries such as Egypt, Morocco, South Africa, Nigeria, Ghana and Ivory Coast are expected to increasingly depend on gas for power production (as shown below).

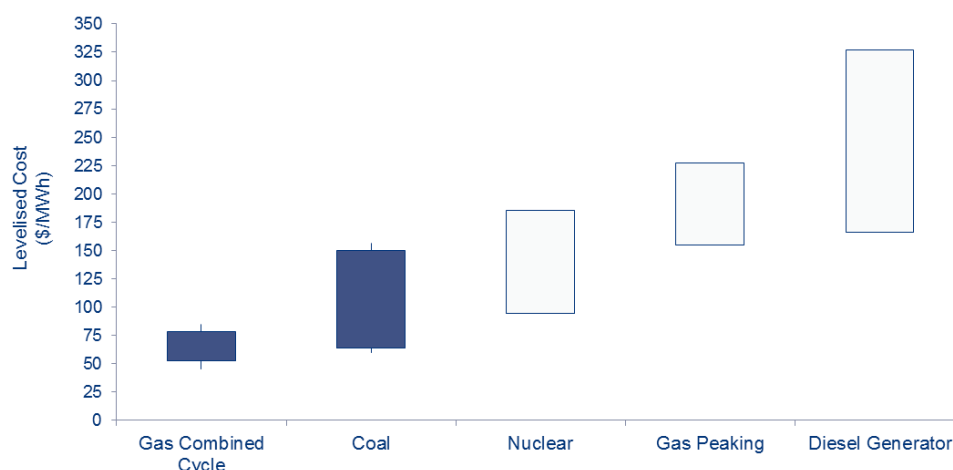
Following the recent COP 21 Paris Climate Change agreement - which delivered a broad plan to slow global warming - gas is increasingly viewed as a complementary and bridging resource towards a long-term dominant renewable energy power scenario (Why? It is comparatively clean, efficient and proven in relation to coal and oil fired technology and quicker and easier to implement than nuclear). Similarly, COP 21 (as well as the OECD the month before) also hamstrung new build non-super critical coal projects by limiting future funding channels (this is most likely to affect coal dependent markets such as South Africa and Botswana). This indirectly benefits gas-to-power projects as they can provide base load to replace new power generation from coal not built following ongoing changes (per Figure 4).

Figure 4: Primary Energy Demand Africa



At March 2016, several African countries plan to import LNG: Ghana, Ivory Coast, Benin, Morocco, Senegal, Namibia and South Africa are in varying stages of importing LNG (primarily for domestic power generation). Most of these countries are considering using Floating Storage and Regasification Units (“FSRUs”) as the mode of import, which are more flexible, involve limited capex incurrence (compared to land-based terminals) and can become operational much faster than land-based terminals. Therefore, the Authors surmise that gas-to-power will be the main anchor sector for the development of a domestic and regional gas economy in sub-Saharan Africa (prior to such time as domestic gas resources can be unlocked to supplant LNG).

A key driver of the growth in LNG demand for gas-to-power by African countries is LNG's current competitiveness relative to diesel-fired power per Figure 5.



³Figure 5: Levelised Cost of Energy Comparison - Conventional Energy (2015)

In countries such as Nigeria, Angola and more recently South Africa, diesel is often used as a short-term solution to compensate for the lack of base load power. Using Heavy Fuel Oil (“HFO”) or diesel to run base load power plants is comparatively expensive, inefficient and polluting. Diesel power stations are primarily used to meet peaking power demand or as a back-up solution. It is therefore expected that these countries will provide further opportunities to develop a gas-to-power industry if they can access affordable sources of gas in locations proximate to power infrastructure.

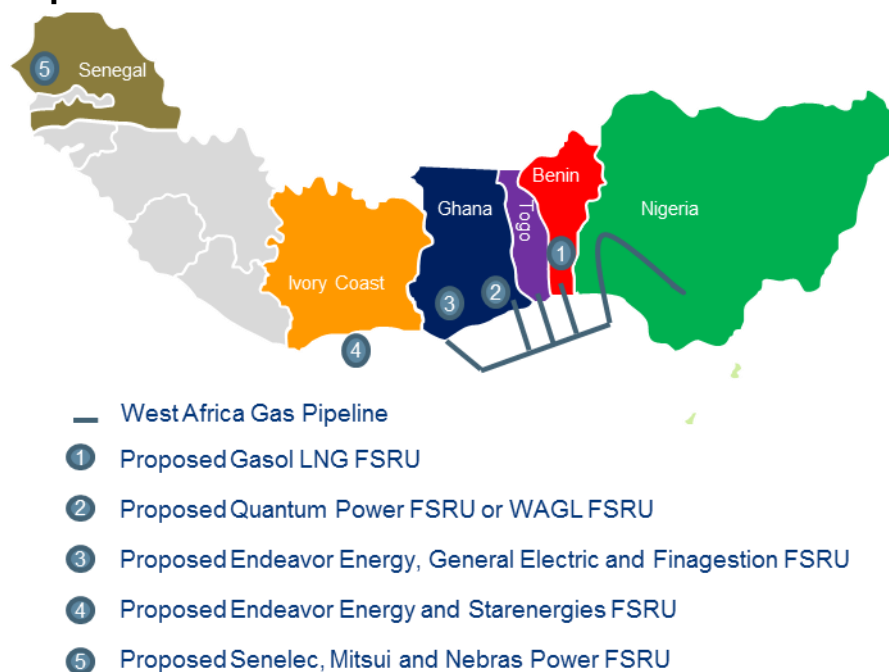
Developments in North Africa

Energy consumption in Egypt has been rising and domestic gas production falling, turning Egypt from an energy exporter to a net importer and leading the Government to buy LNG to head off the country's energy crisis. Prior to the recent Zohr gas discoveries (30 Tcf gas in place) Egypt had approximately 2 Trillion Cubic Meters (“Tcm”) of gas reserves. However, due to domestic policies which constrained investment in exploration by capping natural gas prices at US\$2,65 / MMBTU, Egypt swiftly moved from being self-sufficient and a net Oil & Gas exporter (the 1990s saw a ‘gas glut’) to a net importer. Accordingly, Egypt began importing LNG in April 2015 in order to ease its chronic natural gas feedstock (for power generation) shortages and has gradually increased LNG imports to a monthly high of 540m Bcm in November 2015. Egypt's power sector is the largest consumer of gas and accounts for 57% of national gas consumption. At year-end 2015, Egypt had two FSRUs located at Ain Sokhna. In a bid to free up gas for consumption in other sectors (chiefly residential and fertilizer), Egypt is expected to issue a tender for a third FSRU in Q1 2016. With three FSRU's at port Ain Sokhna, Egypt could become a major importer of LNG by the end of 2016.

³ Lazard 2015

Currently Morocco imports 95% of its energy needs. Algeria's Sonatrach supplies 640mcm (Million cubic meters) of gas under a 10 year contract which started in 2011 to Morocco through the Algerian pipeline exporting to Spain (the pipeline passes through Northern Morocco). Morocco plans to import 2 mtpa of LNG starting in 2020 as part of the phase one of its LNG import plan with the second phase expected to be imports of 3.5 to 4 mtpa by 2025. In October last year, three companies were shortlisted for the supply of LNG.

Developments in West Africa



⁴ Figure 6: Proposed West Africa LNG projects

In West Africa, several gas-to-power projects are under development. In countries such as Ghana and Cote D'Ivoire hydropower potential has reached its limits and with no viable coal options, natural gas is the next best option to meet generation needs.

In Cote D'Ivoire, Endeavor Energy has partnered with local company Starenergie2073 for the 375 MW LNG-to-power Songon Independent Power Producer ("IPP"). The IPP will be developed close to Abidjan. According to Wood Mackenzie, this IPP will include the development of purpose-built LNG import infrastructure and an FSRU. Cote D'Ivoire has domestic gas; however the production of domestic gas is declining, forcing Cote D'Ivoire to explore the FSRU option. Recent explorations on the coast of Cote D'Ivoire have shown that there is potential to develop more offshore reserves. However, this is not an immediate opportunity.

In Senegal, state-owned utility Senelec has signed a preliminary deal with Japan's Mitsui and Qatar's Nebras Power to build an FSRU and 400 MW power station. However, Senegal's proposed LNG-to-power project is less advanced. Senegal's objective is to boost the country's growth through a steady power supply at a competitive cost (the country is presently largely dependent on HFO and diesel to fuel its power plants).

⁴ Interfax; Woodmac; Petroci; Senelec; Standard Bank

Ghana was the first country in sub-Saharan Africa to turn to LNG to meet its gas shortage. Three FSRU projects are proposed along Ghana's coast at two separate sites. Quantum Power and WAGL (Sahara/NNPC) have proposed separate developments at Tema (each involving Golar), whereas Endeavour Energy/GE are leading a development at Takoradi (also involving Shell and Excelebrate Energy).

Similarly, in Benin, London-listed Gasol which has signed a long-term cross-border agreement to supply 2.8 million cubic metres of gas per day to Ghana's Volta River Authority from an FSRU, which it plans to install in Cotonou harbour in adjacent Benin.

Developments in Southern and Eastern Africa

Many energy systems in Southern and Eastern Africa have been built around hydro and thermal generation. However successive years of mild and extreme droughts have depleted water reservoirs inflicting countries that rely on hydro and coal fired power with chronic power shortages. These countries need to diversify their power mix.

South Africa is Africa's largest power market (with over 40 GW installed). However, an aged coal-dominated fleet is increasingly unreliable and the country has been short of power since 2007. In April 2015, the Minister of Energy Tina Joemat-Petterson announced her Department has started to engage in a process to design a Gas to Power procurement programme for a combined 3,126MW allocation. South Africa is expected to import LNG from the three sites: Saldanha, Coega and Richards Bay.

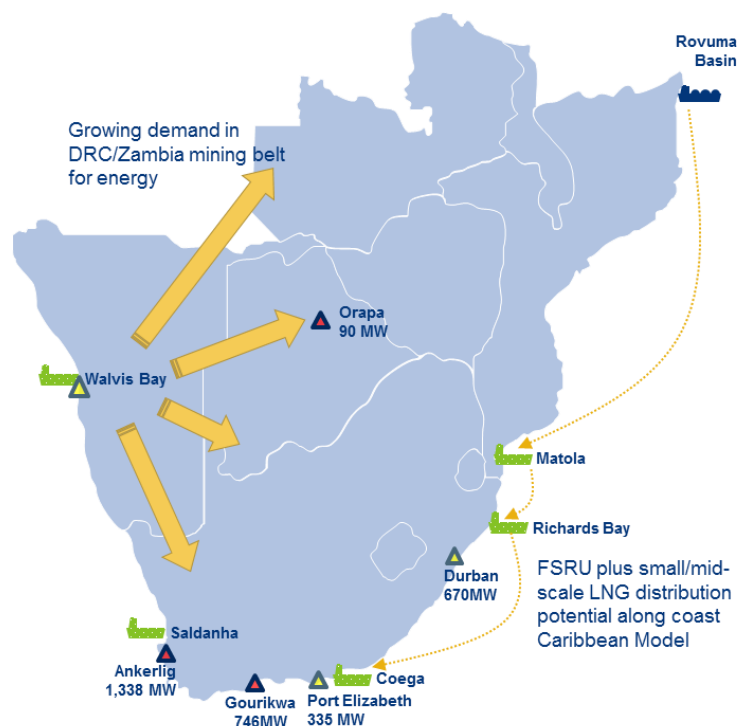


Figure 7: Proposed Southern Africa LNG Projects

In Namibia NamPower's open 250 MW power tender was awarded to Xaris Energy, including FSRU at Walvis Bay. The Kudu gas field is also set to supply gas to a 850MW CCGT.

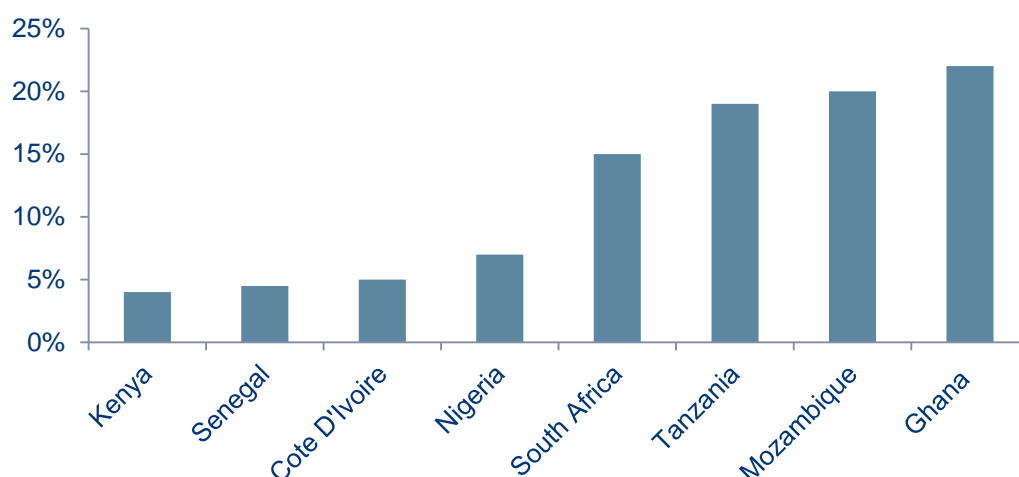
Mauritius is also looking to import LNG, Mauritius Ports Authority has hired Royal HaskoningDHV to look into possibilities for Port Louis to import LNG. The Central Electricity Board ("**CEB**") is contemplating to set up a 135-150 MW thermal power plant based on CCGT technology at Les Grandes Salines in the Port Louis harbor vicinity. The CEB expects electricity demand in Mauritius to increase from 459 MW in 2015 to reach 574 MW in 2022. To meet this growth in demand the CEB intends to run a CCGT plant on light diesel oil (gasoline) in the initial phase of its operation for about 3 to 4 years, and later change over to LNG once it becomes available in Mauritius. The plant will consist of two gas turbines (2 x 50 MW) and one steam turbine (1 x 50 MW). The CEB is expected to appoint a consultant to advise them on the project, with a target to start the project in 2018.

Based on the progress of current developments in, East Africa is expected to become a significant oil and gas player post 2020. The large gas discoveries in Mozambique and Tanzania are likely to lead into the growth in gas-to-power within the region. Mozambique is expected to import LNG from Matola as a feedstock for gas-to-power whilst it awaits for domestic gas from the Rovuma Basin. Both Mozambique and Tanzania already has gas-to-power plants in Ressano Garcia and Ubongo respectively.

Kenya plans to build a 700MW gas-to-power plant at Dongo Kundu. Before the discovery of 1.8 Tcf of gas in onshore block 9 by Africa Oil Corp, Kenya was expected to import 1 mtpa of LNG from Qatar Gas off the port of Mombasa. According to the Ministry of Energy and the Kenya Pipeline Company as it stands Kenya is expected to complement gas from block 9 with imports of LNG.

Policy and Financial Considerations

The procurement of LNG is linked to commodity and currency risks (always in USD or USD-linked and linked to oil price movements (% of Brent) and / or Henry Hub price movements). Transactions including the purchase of LNG will require the participation of the state in one or many roles either as a guarantor or a gas aggregator.



⁵Figure 8: Annualised Currency Volatility 2015

African currencies are among the most volatile basket of currencies globally. Currency volatility in Africa is a result of high import bills, trade deficits, budget deficits and credit downgrades. With a number of African countries being net importers this volatility can stem from external shocks too. The twin challenges of a low commodity cycle and a historic El Nino in Africa is likely to lead to large movements in African currencies as governments and central banks apply different policies to respond to currency movements. With most countries looking to preserve foreign currency reserves it is imperative that the countries considering purchasing LNG for gas-to-power programs ensure that the Power Purchase Agreements (PPA's) designed hedge the risks attached to the purchase of LNG as a feedstock for gas-to-power.

Country	Sovereign Ratings
Kenya	B+
Senegal	B+
Cote D'Ivoire	Ba3
Nigeria	B+
South Africa	BBB-
Tanzania	N/A
Mozambique	CC
Ghana	B-

⁶Figure 9: Sovereign Ratings 2015

⁵ Bloomberg; Standard Bank 2015

Furthermore the purchase of LNG and the attached swings in prices could result in liquidity risks for the aggregator or the state. With a number of African countries having sub Investment grade credit ratings the liquidity risk is elevated as countries have limited ability to borrow on international markets. Another real risk that importers face is foreign currency shortages as seen in Nigeria over the past year. Since most African countries are not diversified and reliant on exports of commodities, this risk is likely to remain prevalent until commodity prices start rising.

Conclusion

Three emerging trends can be seen with regards to gas-to-power in Africa:

1. The fastest increasing trend in Africa will be importing LNG to offset maturing domestic gas production and maintain supply. This has notably been the case for traditionally gas producers such as Egypt and Cote D'Ivoire;
2. The second trend will be new gas producing countries turning to LNG to increase gas supply security whilst ramping up gas production. Included in this list of countries is Ghana and Mozambique; and
3. The final trend is the replacement of Heavy Fuel Oil (HFO) or diesel to meet peak power demand or as a back-up solution. South Africa, Senegal, Morocco and Namibia are expected to be countries where this opportunity will lie. Long term replacement of installed capacity

A key question in the foreseeable future is how and whether the large gas discoveries on the East African coast (Mozambique and Tanzania) and the resource potential held off the coast of South Africa and West Africa (Senegal, Mauritania and Cote D'Ivoire) will kick start a regional gas market and small scale LNG projects which will support the further development of gas-to-power projects.

⁶ Bloomberg 2015