Pipeline to POWER

WAGP Gas-to-Power Policy Recommendations

U.S. CHAMBER OF COMMERCE
U.S.-Africa Business Center

Africa Expert Network

TABLE OF CONTENTS

Executive Summary 3

State of Play 6

Regional Trends (excerpt) 8

Sector Focus 11

Power to Drive Industry: Manufacturing in West Africa 11

ECOWAS Initiatives: WAGP and WAPP 13

Gas Production in West Africa Today 14

Nigeria 15

Côte d'Ivoire 16

Ghana 17

Opportunity 18

Nigeria 18

Côte d'Ivoire 19

Ghana 20

Other ECOWAS Members 21

Barriers and Bottlenecks 22

Sustainable Financing 23

Pricing Regimes 23

Financing Options 24

Resource Mobilization 24

Payment Securitization 25

Infrastructure Operations and Security 26

Limited Infrastructure 26

WAPCo Initiative 27

Security 27

Regulatory Structure 28

Bureaucratic Structure 28

Corruption 28

Petroleum Industry Bill 29

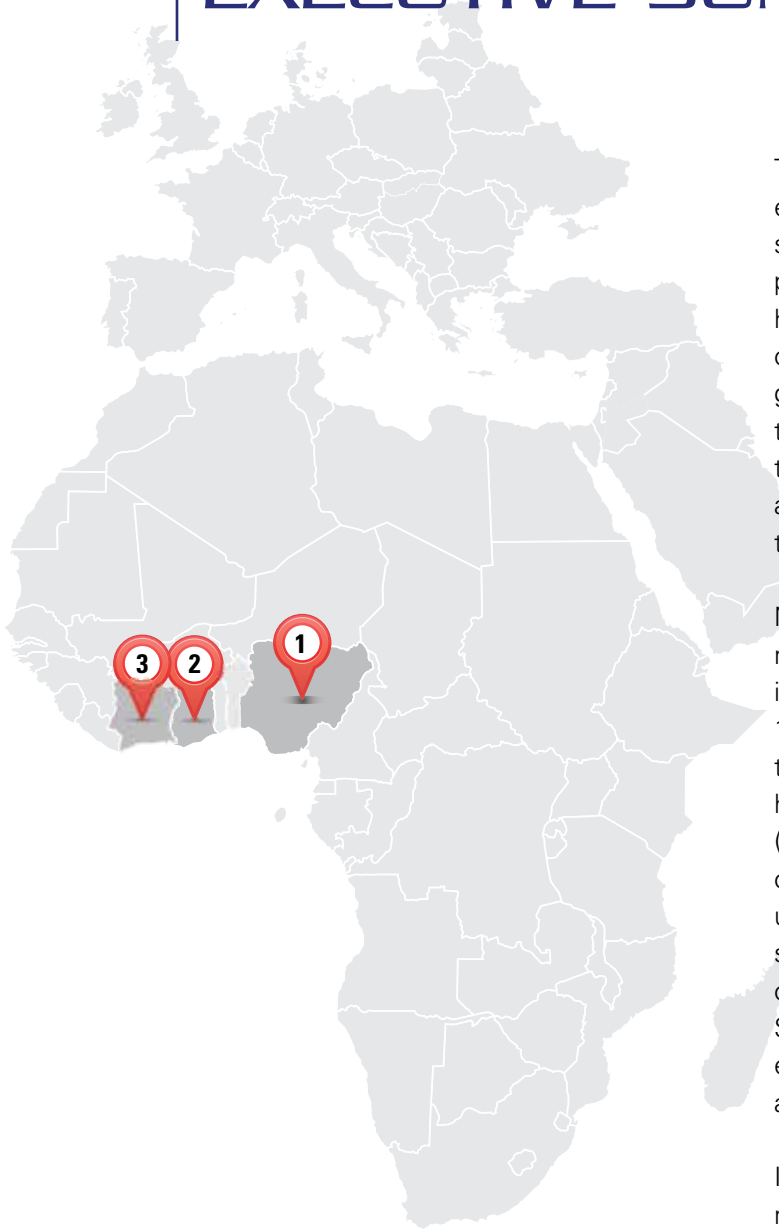
Policy Recommendations 30

References 32

Endnotes 34

Glossary of Acronyms 36

EXECUTIVE SUMMARY



1 Nigeria's Proven Reserves: **180** Tcf
Estimated Potential Reserves: **600** Tcf

2 Ghana's Proven reserves: **800** Bcf
Estimated Potential Reserves: **5** Tcf

3 Côte d'Ivoire Proven Reserves: **1** Tcf
Estimated Potential Reserves: unknown

The steady economic growth West Africa has experienced over the last decade is slowly subsiding. In particular, low commodity prices and China's economic slowdown have stunted growth in oil-rich countries. To overcome these challenges and sustain high growth rates, West African countries need to think innovatively and creatively about how to harness the potential of existing untapped and underutilized resources. A sector of tremendous promise is natural gas.

Nigeria is the eighth-largest natural gas reserve holder in the world and the largest in Africa. The country has proven reserves of 180 trillion cubic feet (Tcf) that are projected to supply gas for 100 years. In addition, Ghana has proven reserves of 800 billion cubic feet (Bcf), and Côte d'Ivoire has proven reserves of 1 Tcf. Unlike oil, gas reserves are largely unexplored, leaving a strong possibility of significant discoveries in member countries of the Economic Community of West African States (ECOWAS). In Nigeria, experts estimate that unexplored reserves could amount to 600 Tcf.

If harnessed, West Africa's extensive gas reserves could help meet the region's existing and future energy demands. An indicator projecting the increase in energy demand is the population growth rate. Sub-Saharan Africa is expected to see a population increase of 1 billion by 2050; but the region produces the same amount of energy as Belgium for approximately 960 million more people. These numbers suggest that energy demand will increase significantly as populations expand and move higher in the economic ladder. Some experts posit that electricity demand could increase as much as fourteen fold by 2050.

Policy Recommendations

Regional Organizations (ECOWAS and WAPP):

1. **Assess Potential and Suppressed Demand**
   > Initiate a study on the impact of domestic and regional price increases on potential and suppressed gas demand in ECOWAS member states.

National Governments of ECOWAS Member States:

1. **Manage and Simplify the Expanding Bureaucracy**
   > Encourage the establishment of country-level Task Forces to evaluate the natural gas regulatory institutions within each country and consider changes to streamline their roles and responsibilities and increase institutional efficiency.
   > In Nigeria, enable oil and gas rights to be negotiated and awarded within a single contract.
2. **Spur Domestic Resource Mobilization**
   > Allocate a greater percentage of pension funds for gas sector-related projects, particularly as Nigeria undergoes pension fund reforms enabling investment in alternative sectors.
3. **Develop Pipeline Network**
   > Increase investment in spur lines (extensions from central gas pipelines) to expand infrastructure to domestic regions not currently connected to the gas grid.

Limited access to gas, coupled with an unreliable supply of gas, discourages the establishment of new business and forces existing businesses to rely on other forms of energy. For example, in 2013, Nigerian businesses and individuals reportedly spent N3.5 trillion on backup generators, and in 2015, Ghanaian businesses suffered rolling blackouts that stalled economic output. Insufficient power supply costs the region in lost productivity—a cost that will only be compounded if gas supply cannot keep up with demand. These shortages may become more costly as industrial demand grows from 13% of total electricity demand to 45% by 2030. In order to meet demand, West Africa will need to attract substantial amounts of foreign investment; however, the existing regulation of the industry is stonewalling investors' commitment.

Unlike oil production, natural gas development requires a long-term, committed buyer even before the investment in infrastructure is made. This is because gas cannot easily be put on the international market. Such long-term investment commitments can be difficult to incentivize in West Africa due to economic, political, and security risks, such as commodity price shocks, uncertainty around the Nigerian Petroleum Bill, and instability in the Niger Delta. Furthermore, if a company decides to invest, barriers to entry and bottlenecks including sustainable financing, infrastructure operations and security, and the existing regulatory structure impede the ease of doing business.

4. **Support Revenue Collection Infrastructure**
   > Evaluate reforms of public utility companies in other developing states, such as India's phased reform program of the power sector in 1998, to establish revenue protection measures for billing and collection.
   > Develop and improve the metering system on national grids with the use of new technology, such as electronic meters with data logging devices and the capability to transmit data through a satellite communications system.
   > Provide simplified mechanisms for customer payment such as mobile payment options.
   > Require publication by utility companies of a widely available plan for meeting existing debt obligations to gas and electricity suppliers.
5. **Break Up the Nigerian Petroleum Industry Bill**
   > Expedite gas sector reforms by segmenting the Petroleum Industry Bill (PIB) to address the gas sector independently from the highly controversial oil sector.

Private Sector and U.S. Government:

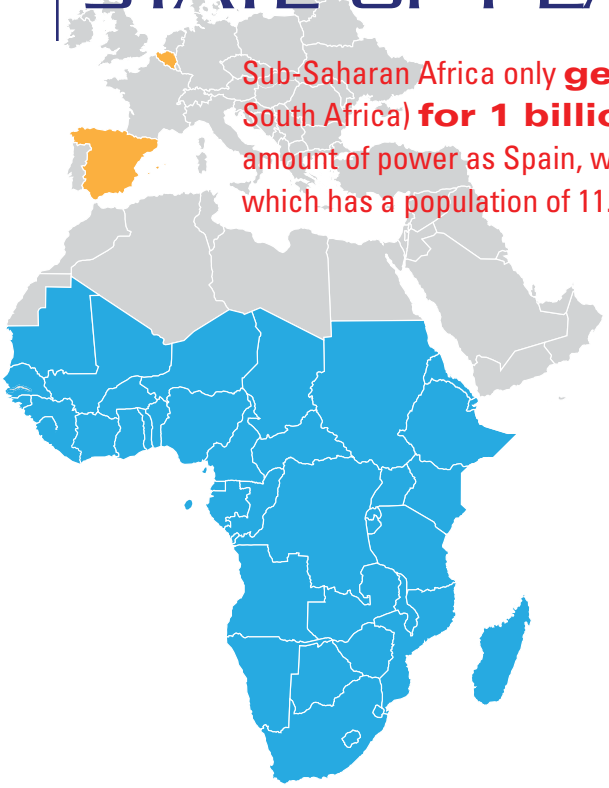
1. **Facilitate Domestic Financing Capabilities**
   > Sponsor a Department of Energy workshop on capacity building for local governments and companies on project financing with the intent to expand cooperation and lending from local banks.

The monetization of natural gas requires high cost infrastructure along the supply chain. While national and regional infrastructure exists, much more is needed. Nevertheless, new ventures between state-owned and private entities are limited by the poor funding track records of governments. Moreover, expanding bureaucracies and limited mobilization of resources often result in costly project delays. Local banks are also ill-equipped to finance such large projects, forcing international investors to look for funds elsewhere. Compounding investors' financial concerns is regional insecurity, which could lead to the destruction of infrastructure. Finally, tightly regulated gas and electricity prices are preventing viable returns to investors.

If any of the aforementioned challenges were addressed, West Africa could be a step closer to reaping the economic benefits of gas. The region is endowed with extensive natural gas reserves which have the potential to drive economic growth; but, ECOWAS countries need to rethink the management of the industry if they are to experience the benefits. To help achieve this goal, Pipeline to Power provides an in-depth analysis of current production, opportunities, and barriers and bottlenecks. And most importantly it proposes concrete and achievable policy recommendations to ECOWAS governments and private sector partners.

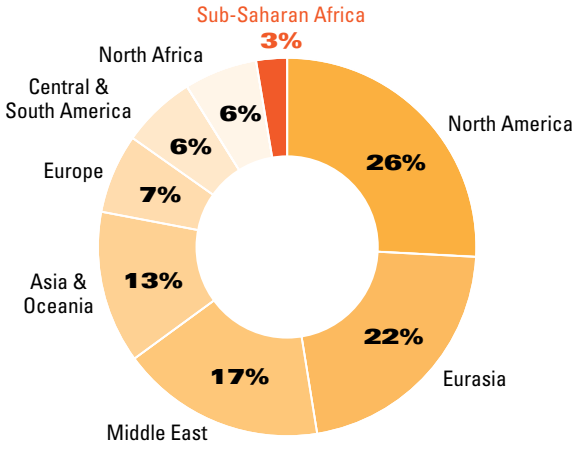
STATE OF PLAY

Sub-Saharan Africa only **generates 90 GW** (half of which is in South Africa) **for 1 billion people**—approximately the same amount of power as Spain, which has a population of 45 million or Belgium, which has a population of 11.2 million



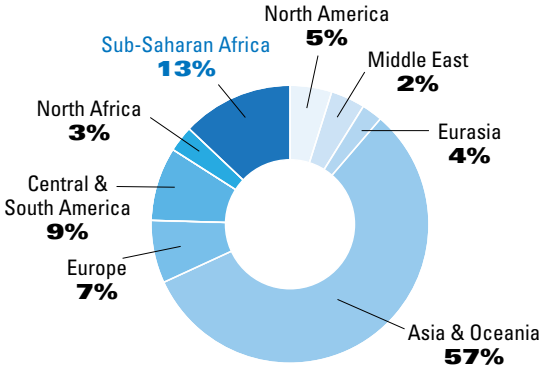
Global Dry Natural Gas Production, http://www.eia.gov/pressroom/presentations/howard_08012013.pdf

Natural Gas Production 2014 (Bcf)

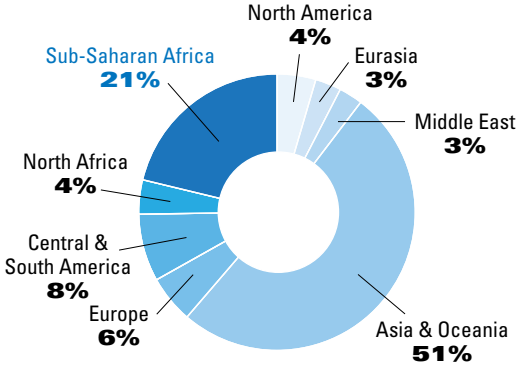


Sub-Saharan Africa produces 1% of global dry natural gas for approximately 15% of the world's population

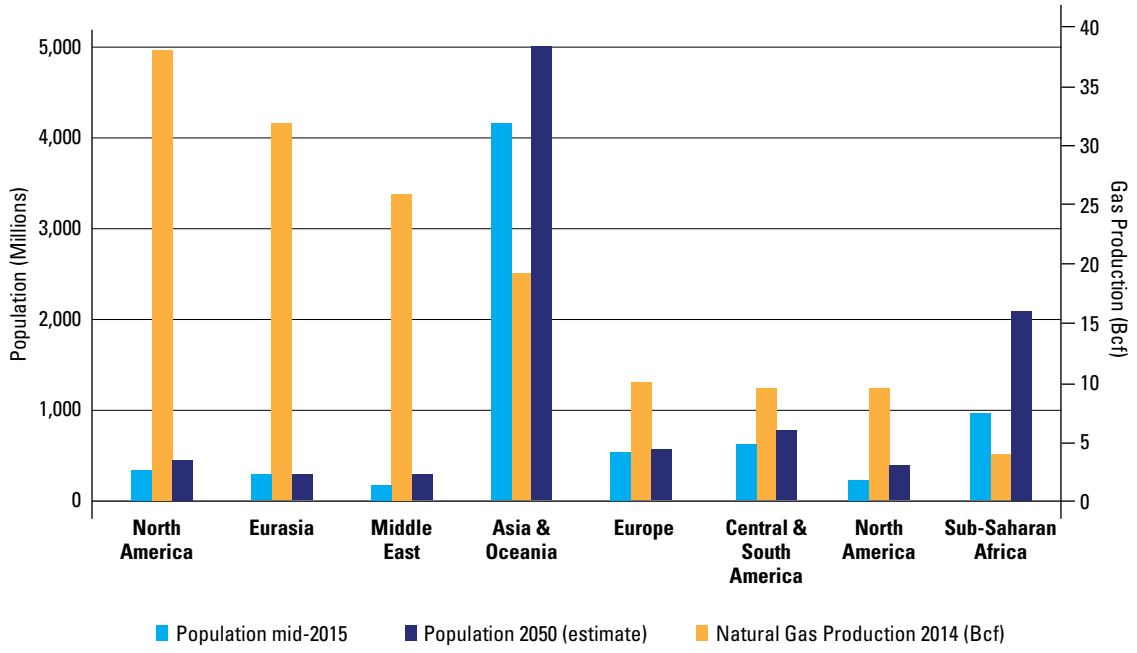
Population Mid-2015



Population 2050 (estimate)



Gas Production Relative to Population by Region



Regional Trends (excerpt)

Sub-Saharan Africa (SSA) is expected to see a 1 billion population increase by 2050, yet it is the smallest producer of natural gas in the world. The region produces the same amount of power as Belgium, which serves 90 times fewer people. In addition, South Africa produces over half of all power on the continent, despite other countries' discoveries of extensive natural gas reserves. The lack of power supply costs the region in lost productivity, and the cost is only expected to be compounded if the power supply cannot keep up with rising energy demands. Experts estimate that the region will need to invest $42 billion a year to meet demands.

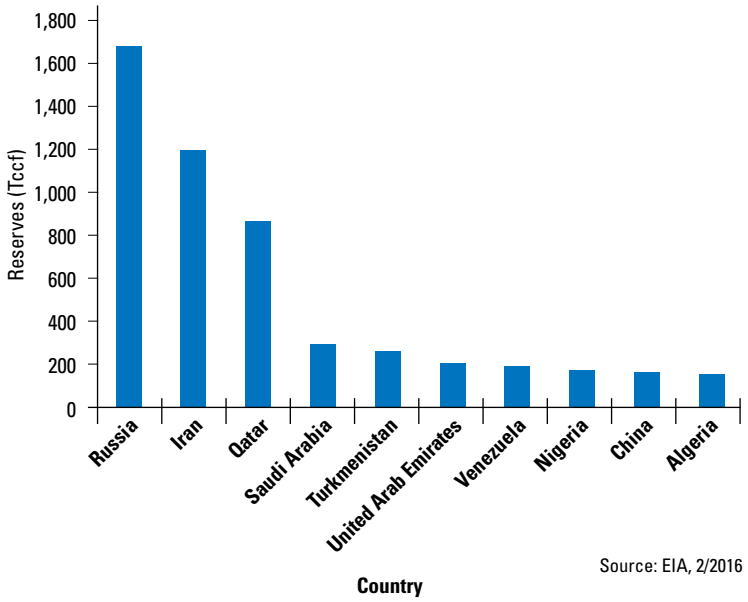
In West Africa, electricity demand is urgent as states experience frequent and long-lasting power outages. In Ghana, power outages lasting up to 24 hours have been common for several months, stalling economic output, putting small companies out of business, and leaving families in the dark. Major firms such as The Coca Cola Company and gold mining businesses are having their electricity supply cut for days at a time. As a result of industrial shutdowns, the government cut growth forecasts to 3.9%, the lowest since 1994. Local and international companies list unstable electricity supply as one of their biggest obstacles to doing business throughout West Africa. Since the 1980s, ECOWAS has taken several steps to develop natural gas production as well as gas to power generation systems. Despite the construction of the West Africa Gas Pipeline (WAGP), the creation of the West Africa Power Pool (WAPP) and several other national and regional initiatives to expand natural gas production and power generation, ECOWAS members still face energy shortages that hinder economic and production growth.

Among ECOWAS states, unmet electricity demand reached 46% of all demand in 2014. These unmet demands will be further exacerbated as electricity demand from industrial consumers continues to grow in the region. Moving beyond electricity generation, natural gas production is also necessary for light and industrial manufacturers as well as for fuel distributors. Unmet power demand in West Africa is not for lack of natural gas reserves. Proven natural gas reserves exist in Nigeria, Côte d'Ivoire, and Ghana. Nigeria is the eighth-largest gas reserve holder in the world and the first in Africa, boasting an estimated 180 trillion cubic feet (Tcf) of proven reserves.

Some experts posit that if targeted and deliberate steps were taken to explore for natural gas, Nigerian reserves could be as high as 600 Tcf. Moreover, Côte d'Ivoire has roughly 1 Tcf of proven reserves and Ghana has 800 Bcf.

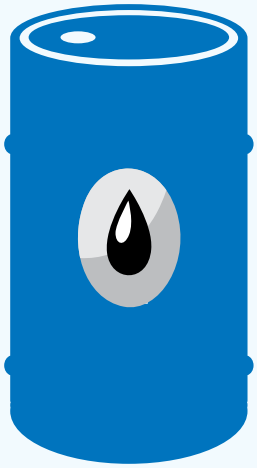
QUICK FACTS
SSA produces as much **power** as Spain or Belgium.
SSA population will increase to **3.2b** by 2100.
Natural gas represents at least **29%** of power generation in Africa.
SSA will need **$42 billion** in investments per year to meet energy demands.
Nigeria holds the **8th** largest gas reserves in the world.

10 Countries with Largest Proven Natural Gas Reserves



Source: EIA, 2/2016

Measuring Gas



Tcf
Trillion Cubic Feet

Bcf
Billion Cubic Feet

Mcf
Million Cubic Feet

Despite extensive reserves and electricity demand, marketable natural gas production in West Africa has fallen short of regional expectations over the past two decades. As Nigeria has the largest reserves, several countries are dependent on the country to power their power plants and industrial zones. Nigeria's WAGP export levels have fluctuated constantly from 29 Bcf in 2011to 14 Bcf in 2012 and to 21 Bcf in 2013. The WAGP is only operating at one-third of its capacity. As a result, countries such as Benin, Togo, and Ghana aren't receiving the natural gas necessary to supply power generation plants and industrial zones.

One of the major issues preventing the production of marketable gas is the regulation of the Nigerian gas market. It is often cheaper to reinject gas into a reservoir or flare it, rather than turn it into a marketable product for the domestic market or for export. In 2014, Nigeria flared 11.27% of its total gas production, amounting to an estimated $860 million loss of potential revenue.

Alternatively, approximately three times as much gas was reinjected. While flaring has been banned in several countries because of the negative environmental effects, in 2011 Nigeria was the second-largest contributor to flaring globally, accounting for 11% of all flaring, behind Russia at 27%.

The grid-connected capacity of West African countries was estimated at only 10 gigawatts (GW) in 2010, of which more than half is fueled by gas and 90% was provided by Nigeria, Ghana, and Côte d'Ivoire. By 2015, the level of installed grid capacity is expected to increase to 20 GW; yet, supply is still lagging behind demand. In February 2015, Ghana was forced to order a small fleet of emergency barges to generate electricity during a months-long power crisis, and in May, only 5 of Nigeria's 23 power plants were functional, causing a near shutdown of industry.

Strong relationships exist between GDP, electricity consumption, electrification rates, and electricity supply. A lack of power inhibits

growth by forcing commercial, industrial, and residential sectors to turn to costly generators that run on diesel or gasoline. Generator power is on average four times the price of grid power, vastly increasing the costs for major industrial producers, mobile phone companies, and even banks. In some countries, power shortages have shaved off one-quarter of a percentage point of annual per capita GDP growth rates.

To meet existing and future energy demands, experts estimate that Africa will need 60 GW to 250 GW of additional capacity by 2050, of which a large portion will be gas powered. McKinsey and Company estimates that gas will account for 40% of the electricity generated after 2020. In terms of financing, the African Development Bank estimates that roughly $12.3 billion per year will be needed in West Africa. As a result of growing demand, there are increased incentives to use natural gas to support growth in the power sector, particularly due to large reserves in Nigeria, Ghana, and Côte d'Ivoire.

Sector Focus

Industry	Labor-Intensive	Capital-Intensive
Crop Production	X	
Textile, Apparel, and Footwear	X	
Food, Beverage, Tobacco	X	
Pulp & Paper	X	
Mining and Quarrying		X
Transportation and Services		X

Power to Drive Industry: Manufacturing in West Africa

Power deficits are a real and consistent problem in West Africa and have presented a significant barrier to industry growth across the region A recent survey of Nigerian companies found that 42% of surveyed companies cited lack of electricity as one of the top three constraints to growth.[1] The Nigerian government found that generator fuel is the highest of all intermediate inputs in the manufacturing sector, and increasing in cost.[2] Industry is forced to rely on expensive back-up diesel generation and must operate below full capacity; however, increased access to consistent, on-grid sources of electrical power, could spur industry productivity and growth, and in turn create employment. Increased access to power would be transformative for African manufacturing.

A stronger manufacturing industry focusing on value-added products is particularly important for inclusive economic growth in the region. Manufacturing tends to be labor-intensive and export-focused, enabling economies to become more resilient to economic shocks such as low commodity prices. Examples of labor-intensive manufacturing industries include textiles, automobiles, food and beverage, and paper production. The need for job growth in manufacturing is especially significant due to the large expected population growth in the region. Improved access to power can assist in manufacturing growth. Across Africa, GDP per capita is closely correlated with per capita electricity consumption.

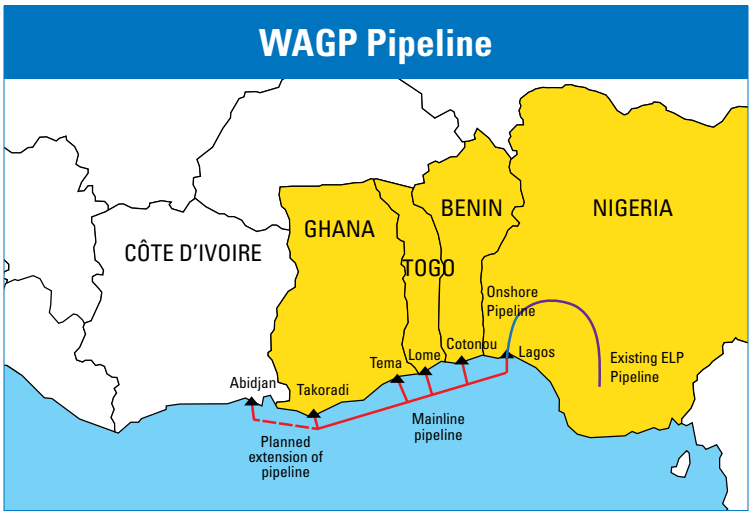
Manufacturing in both Nigeria and Ghana comprised 6% of GDP in 2013.[3] Although still a small segment of GDP, the industry is slowly growing. Apart from the cement industry which is now split from other manufacturing sectors after the official GDP rebasing, Nigerian manufacturing is mostly comprised of small and medium enterprises (SMEs). The food, beverage, and tobacco industry comprised the largest percentage of manufacturing in the country. In 2012, the industry employed over 300,000 people. Pulp, paper, and paper products employed just over 200,000 people in the same year.[4] In Ghana, the government has focused on the textile industry as a means for jumpstarting economic growth, as well as for instilling national pride, although the industry has faced challenges due to piracy and stiff competition from neighboring countries. Finally, although light manufacturing clearly creates employment opportunities, certain capital-intensive industries requiring large power resources can have an even greater effect within the national economy.

The largest segment of GDP in West Africa continues to be agricultural production, including crop production, livestock, forestry and fishing. Agriculture comprised 22% of the economies of both Ghana and Nigeria in 2013 and is by far the largest employer.[5] While the

majority of the West African agricultural sector continues to be small-scale farms without improved seeds and fertilizers, the country is encouraging the adoption of commercial practices such as the use of synthetic fertilizers. Significant quantities of primarily natural gas are used in the production of fertilizers such as urea and methanol. Greater use of fertilizer has multiplier effects for the broader economy, as fertilizer use results in improved soil productivity and increased agricultural yields for farmers, as well as increased choice for consumers.

ECOWAS Initiatives: WAGP and WAPP

ECOWAS is an important vehicle through which major regional power projects are coordinated and financed. There are several projects under way to extend gas and electricity distribution, including a **1,300 km** interconnection line across **4 states**. While ECOWAS can support infrastructure to connect countries and facilitate agreements to distribute electricity regionally, national and private gas producers are responsible for increasing the production of gas.



Since the 1980s, the Economic Community of West African States (ECOWAS) has taken a number of steps to develop natural gas production as well as gas to power generation systems. In 1982, ECOWAS members proposed a natural gas pipeline across West Africa as a key regional economic goal. By 1995, the heads of state of Benin, Ghana, Nigeria, and Togo signed an Agreement for the Development of WAGP, with an official WAGP Treaty signed in January 2003. Later that year, they formed the West African Gas Pipeline Company (WAPCo), a joint venture between public and private sector companies from the four countries. Pipeline construction commenced in 2005; commercial operation launched in 2011.

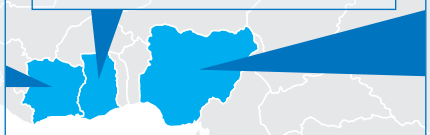
WAGP is a 681 km pipeline with the capacity to transport 470 Mcf of gas per day. Eighty-five percent of the purified natural gas transported from Nigeria's Itoki Natural Gas Export Terminal to delivery points Cotonou, Benin; Lome, Togo; and Tema and Takoradi, Ghana is used for power generation. Major customers include Volta River Authority's (VRA's) Takoradi Thermal Power Plant in Ghana and CEB of Benin and Togo. Nigeria's WAGP export levels have fluctuated constantly from 29 Bcf in 2011 to 14 Bcf in 2012 and to 21 Bcf in 2013. Because WAGP operates at about one-third of its capacity, states aren't receiving the gas necessary to supply power generation plants and industrial zones.

In 2006, ECOWAS created WAPP to ensure regional power system integration and a regional electricity market. WAPP covers 14 of the 15 ECOWAS countries as well as 26 member companies involved in the generation, transmission, and distribution. But power infrastructure in the region still limits access to electricity. A number of projects are under way to build the regional electricity market, including plans to construct a 1,300 km interconnection line across Côte d'Ivoire, Guinea, Liberia, and Sierra Leone by Transco CLSG.[6]

These plans are essential as electricity demand in WAPP countries is expected to increase by nearly 6 times by 2020 and 14 times by 2050. This is significant as thermal energy supplies 64% of power in ECOWAS states while hydro accounts for only 31% of power supply. Natural gas is necessary to supply existing and future power plants throughout West Africa.

Gas Production in West Africa Today

In West Africa, natural gas is reinjected into reserves, flared, purified for domestic use, and processed into secondary products for export. Nigeria predominantly reinjects and flares natural gas or produces liquefied natural gas (LNG) for export to **Benin, Togo,** and **Ghana. Côte d'Ivoire** produces natural gas for domestic gas-to-power stations, which then export electricity to **Ghana, Burkina Faso, Benin, Togo,** and **Mali. Ghana** produces a small amount of natural gas for internal use, but has yet to commence large-scale industrial production of its natural gas reserves.



Ghana:

> Jubilee oil field, operated by a Tullow Oil-led consortium, produces roughly 140 Mcf of associated gas per day for supply to Atuabo gas processing plant Atuabo produces liquefied petroleum gas and also supplies roughly 50 Mcf of gas per day to thermal power generators in Aboadze.

> The OCTP Development Plan will begin extraction of gas from nonassociated gas reserves in Gye Nyame, Sankofa Main, and Sankofa East.

Côte d'Ivoire:

> Côte d'Ivoire's gas companies, led by the National Oil Company Petroci, produce roughly 220 Mcf of gas per day.

> Petroci, Foxtrot International, and other partners are developing offshore production in Marlin and Manta gas fields on Block CI-27.

> Gazelle Gas Field, discovered in 1988 on Block CI-202, is awaiting production.

> *Source for Gas Fields: http://www.petroci.ci/index.php?numlien=32*

Nigeria:

> Bonga field, operated by Shell Natural Gas, Esso Exploration & Production Nigeria, and other partners, was Nigeria's first deep-water development in depths of more than 1,000 meters. The project has a gas export facility of 150 Mcf per day.

> Bonny Island LNG facility, operated by Nigeria LNG Ltd, has six liquefaction trains with the production capacity of 22 million tons per year or 1,056 Bcf/yr of LNG and plans to construct a 7th liquefaction train.

> Brass LNG Ltd, a consortium of NNPC, Total, and Eni plan to open a new LNG facility.

ECOWAS:

> The WAGP runs from Nigeria's Itoki Natural Gas Export Terminal to delivery points Cotonou, Benin; Lome, Togo; and Tema and Takoradi, Ghana.

> Penspen plans to begin a formal feasibility study of the potential extension of WAGP to other ECOWAS states.

Nigeria

Production

Nigeria is the largest producer of gas in West Africa, extracting 2.54 Tcf of gas in 2014

According to the Nigerian National Petroleum Corporation (NNPC), Nigeria extracted 2.524 trillion standard cubic feet (Tcf) of natural gas in 2014.[7] Of this, 289.6 billion standard cubic feet (Bcf) was flared, representing 11.47% of the total production. Using the Nigerian Gas Company's price of $3 per 1,000 standard cubic feet (scf) of gas, this flaring resulted in a $868.8 million loss of potential revenue. Alternatively, 643.81 billion scf was reinjected.

Following flaring and reinjection, Nigeria produced 1.88 Tcf of dry natural gas, which is an increase from the production of 1.35 Tcf of dry natural gas in 2013 reported by the U.S. Energy Information Administration (EIA). According to the NNPC, dry natural gas was utilized for fuel in domestic consumption (154.37 Bcf), sold to third parties (712.3 Bcf), sold to the NGC (178.447 Bcf), and used by Indorama Eleme Petrochemical Ltd, a former subsidiary of NNPC that is a Poly-Olefins producer for fuel and feedstock (11.01 Bcf and 38.8 Bcf).

Management and Major Players

The NNPC was created in 1977 to oversee the regulation of the oil and natural gas industry. The majority of its projects are funded through joint ventures between international oil companies (IOCs) and the NNPC, where the NNPC is the majority shareholder. Other projects are managed through a production-sharing contract with IOCs. Natural gas has predominantly been supplied by joint ventures (JVs) with **Shell, ExxonMobil, Chevron, Total,** and **Eni,** with **Shell** playing a major role in the supply to Nigeria's sole LNG facility, Soku plant.

It is more profitable for companies to export LNG to Europe and Asia than sell gas for domestic consumption.

Concerning domestic consumption alone, the EIA reported that Nigeria consumed 490 Bcf of dry natural gas in 2013, roughly 36% of its production. This natural gas is supplied to a range of natural gas-fired power plants. Despite government plans to construct more power plants to replace flaring, there is a shortage of natural gas supply for power generation due to the competition of exports. For producers, it is more profitable to export gas than to sell it to the domestic market at a lower price for power generation. As a result, a majority of Nigeria's exported natural gas is processed into LNG, and a much smaller amount is exported via the WAGP to Benin, Togo, and Ghana.

There is only one LNG facility in Nigeria to facilitate gas export, while the WAGP allows remaining gas to be exported to ECOWAS countries.

Nigeria's marketed natural gas is exported as LNG. The only existing LNG facility in Nigeria is on Bonny Island and operated by Nigeria LNG Ltd, owned by NNPC (49%), Shell (25.6%), Total (15%), and Eni (10.4%). The facility has

six liquefaction trains with the production capacity of 22 million tons per year or 1,056 Bcf/yr of LNG.

The NNPC reports Nigeria processed 391.37 Bcf of dry natural gas into LNG for export in 2014. However, the EIA reports that Nigeria exported 800 Bcf of LNG in 2013, accounting for 7% of global trade, which would imply a significant drop in LNG exports between the two years.[8] The majority of these exports are going to Asia and Europe, with increasing demand for LNG exports by ECOWAS members.

The rest of Nigeria's marketable natural gas is exported via the West Africa Gas Pipeline. In WAGP's first year of commercial operation, Nigeria exported 29 Bcf of gas via WAGP; however, exports fell to 14 Bcf in 2012 due to shutdown for repairs of the pipeline from August 2012 to July 2013. While exports rose again in 2013 to 21 Bcf, WAGP operates at about one-third of its capacity.

Development Plans

ECOWAS is undergoing a feasibility study for the expansion of WAGP.

The Bonny Island LNG facility has planned a seventh train, which would increase capacity to 1,440 Bcf/yr of LNG. In addition, Brass LNG Ltd, a consortium of NNPC, Total, and Eni, plans to open a new facility with two liquefaction trains maintaining a capacity of 480 Bcf/yr. However, the project is in the early engineering phase and is already several years behind schedule.

In February 2015, ECOWAS signed a contract with Penspen, an international energy services company, to begin a formal feasibility study of the current WAGP system performance and its potential extension to other ECOWAS states.[9] Plans were also announced in 2009 for the construction of a Trans-Saharan Natural Gas Pipeline to export gas from Nigeria to Niger, Algeria, and Europe. But little progress has been made due to security and financing issues, and any expansion of WAGP or a new pipeline would require an increase in the amount of natural gas extracted and processed for export in Nigeria.

Côte d'Ivoire

Production

Three plants are responsible for generating two-thirds of total electricity.

In 2013, Côte d'Ivoire's gas companies, led by the National Oil Company Petroci, produced 220 Mcf of gas per day, of which 70% was used for electricity production.[10] As of 2015, 67% of Côte d'Ivoire's electricity was generated from thermal power utilizing natural gas with three plants responsible for generating two-thirds of total electricity.[11] In addition, Côte d'Ivoire exports electricity to several ECOWAS members, including Benin, Togo, Burkina Faso, and Ghana. The government has made commitments to export more electricity to new members of WAPP, an ECOWAS institution to ensure regional power system integration.

Development Plans

The government is investing in offshore production.

To meet these commitments, the government and its partners are investing roughly $1 billion in offshore production. Petroci, Foxtrot International, and other partners are developing offshore production in Marlin and Manta gas fields on Block CI-27 through the installation of new production platforms and the drilling of seven new wells. As Côte d'Ivoire's most productive area, Block CI-27 averaged 142.6 Mcf per day or 70% of the country's total gas production in 2014. With the additional investments, Christian Sage, Foxtrot's managing director, expects it has secured production for at least 10 years.[12]

Ghana

Production

Jubilee oil field is responsible for all gas production in Ghana.

Ghana produces natural gas at Jubilee oil field, and development plans are in motion to expand production to Sankofa and Gye Nyame fields. Jubilee field, located offshore and operated by a consortium led by Tullow Oil, produces roughly 140 Mcf of natural gas per day.[13] Gas is supplied to Atuabo gas processing plant in Western Ghana, a project completed in August 2014 and largely financed by the Chinese Development Bank. The plant supplies roughly 50 Mcf of gas per day to the nearby thermal power generators in Aboadze operated by the VRA power utility.[14] The Atuabo gas plant also produces roughly 3,000 tonnes of liquefied petroleum gas.

Development Plans

The OCTP development plan would provide enough gas to continuously supply Ghana's thermal power sector until 2036.

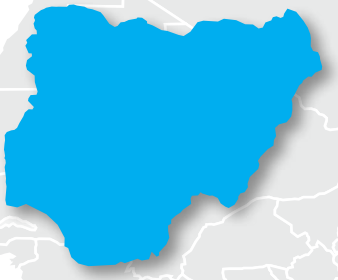
The Offshore Cap Three Point (OCTP) development plan has been announced for Sankofa and Gye Nyame fields by partners Vitol (37.78%), Eni (47.22%), and the Ghana National Petroleum Company (GNPC) (15%). The project aims to begin oil and gas production with nonassociated gas reserves from Gye Nyame, Sankofa Main, and Sankofa East estimated to reach 1.5 Tcf.[15] Natural gas will be processed and transported via a dedicated pipeline to onshore gas receiving facilities located near the village of Sanzule on the western coast. From there, gas will be compressed and injected into WAGP for transport to industrial consumers in Ghana.

The engineering design of the project is complete, and the first oil and gas production is expected to begin in late 2017 to early 2018. If the OCTP development plan is successful, the gas from these fields would be enough to continuously supply Ghana's thermal power sector until at least 2036.[16] In addition, the Ministry of Energy expects the gas to support more than 700 MW of new power generation in 2017. In August 2015, the GNPC complemented this project with the appointment of Mitsui & Co, a Japanese trading company, for the assessment of the construction of a second processing plant for natural gas from the Tano basin.[17] The plant would be expected to produce 250 Mcf of gas daily.

OPPORTUNITY

Due to growing demand for natural gas to generate power, deliver industrial heating, fuel vehicles, and provide feedstock for manufacturing of fertilizers, there are **many opportunities for local and international investors to enter the market**. If ECOWAS member states continue to focus on power generation and initiate reforms that improve the business climate for the natural gas market, opportunities will abound at several points upstream and downstream along the value chain.

Nigeria



Nigeria's Seven Energy has taken steps to expand its gas operations. After raising $225 million in 2014, the company has been granted a $495 million loan from a banking consortium of First Bank, Ecobank, United Bank for Africa, Union Bank, FCMB, FBG Bank UK, and Union Bank (UK). With these funds, Seven Energy plans to acquire new blocks and invest in infrastructure needed for distribution through its affiliate Accugas Ltd. As a result, gas production is expected to grow beyond its output of 21.7 million cubic feed per day (MMcfd) in the last quarter of 2014 and 43.9 MMcfd in the first quarter of 2015, making gas available to additional downstream clients.

The World Bank plans to lend the Nigerian government $350 million to support the Nigeria Electricity Transmission Access Project (Netap). While only 35% of the population is connected to the grid and the transmission capacity is at 4,800 MW, Netap aims to increase capacity to 13,000 MW by 2020.

Chevron and NNPC are developing Escravos GTL plant, a $10 billion facility that will convert 325 Mcf of gas per day into 33,200 barrels (bbl) per day of liquefied petroleum gas (LPG), principally synthetic diesel for cars and trucks. Further downstream, investment is necessary to build LPG refilling plants and terminals so that communities can refill their LPG cylinders used as cooking gas.[18]

The Bottom Line

In Nigeria, thermal power plants dependent on natural gas generate at least 70% of the country's electricity needs, which amounts to roughly 10,000 MW.[19] At present, demand for electricity is more than triple Nigeria's capacity, with power production falling far below the 2012 peak of 4,500 MW.[20] Within two years, demand by industries and power plants is forecast to more than double to 5 Bcf a day.[21]

The Nigerian government is implementing its Gas Master Plan, which includes a long-term privatization process. The government plans to facilitate $15 billion – $20 billion in investments into gas processing, petrochemicals, fertilizer production, and gas-fired power plants.[22] In addition to these commitments, the president of the Nigerian Gas Association, Bolaji Osunsanya, stated that the country needs to attract $55 billion in investments to resolve the continued shortages of natural gas to power stations.[23] Investments will be necessary along the entire value chain, but particularly in production, power generation, transmission, and distribution. International companies can enter at any part along the value chain through joint ventures with the government, consortiums, or independently.

Côte d'Ivoire

By 2030, natural gas demand will grow by more than 17 times current demand.

Songon Power Plant

Texas-based Endeavor Energy, backed by private equity firm Denham Capital, announced a Joint Development Agreement with local independent power producer (IPP) Starenergie 2073 to build Songon thermal power plant near Abidjan. Endeavor, with financial support from GE and Finagestion, will import LNG, construct a floating storage and regasification unit, and develop infrastructure for transport to onshore GE turbines. The project is expected to produce 360 MW by 2017, 560 MW by 2018, and 1,100 MW by 2019.

Yaoure Gold Project

Amara Mining plans to invest $450 million in its 100%-owned Yaoure Gold Project. Initial feasibility studies and economic assessments show positive results. Amara plans to begin construction of the mine by 2016. The gold mine would have a 12-year life span, producing 300,000 ounces of gold per year beginning in 2017. The new project will require power stations, providing one example of how gas-powered plants rather than diesel-fueled power generation can reduce operational costs for new industries.

Gazelle Field

Gazelle oil and gas field, located in Block CI-202, is owned by Vioci Petroleum (87%) and Petroci (13%) and is expected to hold 92 Bcf of gas. An initial development plan was approved in December 2011 and a revised plan in October 2014. The final investment decision is expected in 2015, with first production expected in 2016. Phase One of the project is estimated to cost $200 million, with the IFC providing $20 million, Vitol providing $50 million as a development loan, and the remaining provided by banks.

The Bottom Line

Due to the growing sector, Côte d'Ivoire's national oil and natural gas company, Petroci, projects that the industry will demand 850 Mcf per day of natural gas by 2030, which is more than 17 times demand in 2015.[24] The company expects that the majority of the demand will be met by natural gas reserves, which will supply electricity to the mining, manufacturing, and food processing operations.

In March 2015, Côte d'Ivoire requested LNG imports from Nigeria to supplement these energy demands.[25] This is an opportunity for Nigeria to shift LNG exports away from the Asian market to closer neighbors that don't have access to Nigerian gas via the WAGP. LNG shipping companies as well as investors in LNG regasification facilities would benefit from increased LNG exports from Nigeria to Côte d'Ivoire and other West African nations.

Ghana

With LPG demand expected to grow by 10% annually over the next few years, domestic LPG production, processing plants, and LPG refineries present a vast opportunity for investment.[26]

Urea Plant

India and Ghana revived plans in late 2014 for a JV for a urea plant, after an attempt in 2010 failed due to no committable natural gas. The 2010 project involved $1 billion to produce a facility with the capacity to produce 1.2 million metric tons of urea per year. The two parties are discussing a JV option similar to the successful Oman Indian Fertiliser Company to facilitate fertilizer production with Ghana's new gas resources.

The Bottom Line

Ghana needs 244 Mcf of gas per day to supply gas-fired power plants and reinject gas into oil fields. By 2018, the country will need more than 800 Mcf per day for power plants due to a growing demand from industrial consumers and the LPG sector.[27] With the launching of the Offshore Cape Three Point (OCTP) development plan in Ghana to increase production, there are future opportunities along the natural gas value chain.

Increased natural gas production will also allow Ghana to decrease dependence on crude oil imports for power generation and LPG imports that support Ghana's consumption of 260,000 tons of LPG a year. Ghana's VRA has extra costs of nearly $55 million every three weeks to purchase crude oil to run power generation plants due to shortages of gas from WAGP. Increased WAGP imports or domestic production would decrease these costs and allow VRA to invest this money in additional generation plants.

Sahara Royal Gold Refinery

Through a PPP, Sahara Royal Gold Refinery launched the country's second gold refinery that will refine two-thirds of Ghana's gold production in Atiwa. At present, nearly 100% of Ghana's 4.4 million ounces of raw gold produced per year is exported. The government continues to encourage investment in refineries to add value to gold before export.

Kpone Independent Power Plant (KIPP)

Cenpower Generation Ltd awarded Group Five Power International a contract to design, build, and commission a power plant in Kpone in the Tema Industrial zone. The $410 million plant has received the majority of its debt financed by African banks and African financial institutions. The thermal plant will produce 230MW and directly supply the Electricity Company of Ghana.

Offshore Gas Pipelines

As the OCTP Development Plan advances production of Sankofa, Gye Nyame, and Dzatagas fields, gas infrastructure will be necessary to connect these fields to onshore gas processing and power plants.

Other ECOWAS Members

WAPP Plan: CLSG Subprogram

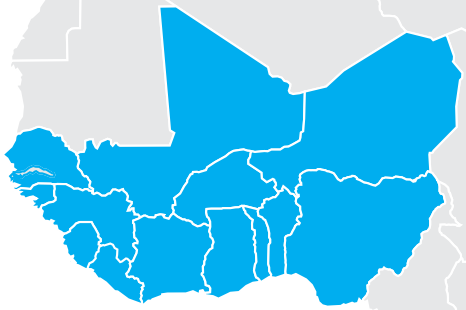
The WAPP Plan is divided into several subprograms, including the Côte d'Ivoire-Liberia-Sierra Leone-Guinea (CLSG) Power System Re-development Subprogram. Transco CLSG, set up by WAPP, is leading one project within the CLSG Subprogram, a connection line for Mano River Union countries, Côte d'Ivoire, Liberia, Sierra Leone, and Guinea.[28] The World Bank, AfDB, the European Investment Bank, and the German Export Bank are providing $374 million over 25 years for the 1,300 km power line that is expected to increase access to low-cost electricity to 24 million inhabitants.

Togo: Carbonated Phosphate Project

In September 2015, the Togolese government awarded Elenilto, controlled by Israeli billionaire Jacob Engel, an international tender to develop phosphate mining and a fertilizer plant near Lome.[30] In partnership with Wengfu, a leading international phosphate and fertilizer group with experience in China, Elenilto will produce phosphate concentrates and develop a downstream phosphoric acid and fertilizer plant. The phosphate layers are just 30 km from the port in Lome connected to WAGP, allowing the company to maintain low operating costs due to the proximity to the WAGP port. Similar projects near WAGP endpoints would benefit from more consistent gas exports to avoid high-cost diesel generators.

Africa Power Transmission Corridor

Construction is ongoing for the 2,000 km long West Africa Power Transmission Corridor that connects Guinea, Guinea Bissau, Gambia, Sierra Leone, Liberia, Côte d'Ivoire, and Ghana.[29] The Corridor project, worth $1.2 billion, aims to ensure low-cost energy and energy security to several WAPP members. With a capacity of 1,000 MW, the corridor will make Ghana's thermal potential and other nations' hydropower potential available to other ECOWAS countries. Following its completion, increased energy capacity will be available to supply industrial zones in several West African states.



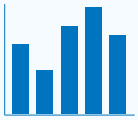
The Bottom Line

According to the ECOWAS Master Plan, electricity demand, including from mines, is projected to increase fivefold by 2030, to 250 TWh.[31] But, the region is unable to meet these extreme demands with Etienne Bailly, project director at Transco CLSG, estimating that to plug the power deficit, power generation must increase from 10,000 MW to 26,000 MW and 4,000 km of transmission lines to 16,000 km.[32] While each nation has plans to develop energy generation through gas-powered plants or renewables, there is also a need to expand infrastructure that connects power pools. IEA estimates that roughly half of the Sub-Saharan Africa population who lack access to electricity would gain access through grid extension.[33] Investments are possible in regional gas pipelines, but they are particularly necessary in electricity transmission lines that expand and connect national power systems as well as connect to downstream industrial zones.

The development of new gas resources and transmission networks also presents the opportunity for the development of downstream production in special industrial zones. These zones can be constructed around gas-processing facilities to combine them with generation, gas-intensive industry, and export facilities. This model would be particularly effective if local gas prices remain low and companies would earn more profit by utilizing the resource for the production of exports of higher value-added goods.[34]

BARRIERS AND BOTTLENECKS

Financing difficulties related to the lack of a **sustainable gas price, infrastructure and security challenges,** and the **existing regulatory regime** in several ECOWAS member states have limited the rapid expansion of the natural gas industry in West Africa. Identifying and resolving the existing barriers and bottlenecks are necessary to increase natural gas production so that companies both upstream and downstream can develop and support GDP growth throughout the region.



Sustainable Financing

> Existing regulated gas and electricity prices are preventing viable returns to investors.

> Local and international investors are hesitant to provide financing due to the security, political, and economic risks in Nigeria.

> The NNPC JV structure for IOCs, along with NNPC funding delays, has limited growth.

> Inefficient tax collection and domestic revenue mobilization stymies investment.

> Inadequate downstream payment securitization has led to large arrears.

Infrastructure Operations & Security

> Current pipeline network is insufficient to transport gas from production to downstream users.

> Transmission and distribution network is limiting national and regional access to power grid.

> Insufficient safety measures along pipelines could result in destruction.

> International oil companies are divesting onshore and shallow water assets due to security concerns in Nigeria, particularly in the Niger Delta.

> Destruction along the pipeline network has continuously halted production and transportation.

Regulatory Structure

> A complicated regulatory structure results in overlapping responsibilities and complex processes.

> Corruption and poor management impede investor trust in the sector.

> Nigeria's controversial PIB is stalling reforms in the gas industry.

Sustainable Financing

Financing options for companies in the gas sector are limited.

Since natural gas cannot easily enter an international market, production requires long-term financing mechanisms. West Africa's financing and investment capabilities, though, have been severely limited due to economic risk profiles and poor resource mobilization, forcing companies to take on large risks in financing their own projects through equity. In addition, the absence of a cost-competitive gas price has inhibited investor returns. The price regime of natural gas in major gas-producing countries is stonewalling the levels of investment in the sector. It is failing to incentivize investment in gas infrastructure by balancing gas supply costs and the project risk profile for producers with gas demand valuations by end users. In particular, the Nigerian price cap on natural gas in the domestic market incentivizes producers to target the export market.[35] As a result, investments are far below the needed level in natural gas exploration, production, processing, and utilization for feed gas or power.

Pricing Regimes

One of the factors that reduces the incentives for investment is the lack of a cost-reflective gas price. In Nigeria, the government has progressively raised the price of domestic gas from 5 cents per Mcf to $1 in 2010, $1.50 in 2011, $2 in 2013, and finally $2.50 in late 2014, with an additional 80 cents for transportation costs. Despite these attempts to encourage investment in the domestic value chain, gas producers are demanding further increases of $5 to $7, bringing the domestic price on par with international prices.[36] The president of the Nigerian Gas Association, Bolaji Osunsanya, said that government has to raise prices to attract an estimated $55 billion of needed investments.[37] The industry seems open to change with Chairman Sam Amadi of NERC who said that it will consider endorsing contracts above the regulated rate between a "willing buyer and willing seller."[38]

In contrast, Ghana has more flexible domestic market price regulation. In 2012, Ghana's Ministry of Energy, with the assistance of a Gas Pricing Committee, released a study providing a framework for price negotiations between buyers and sellers, taking into consideration gas supply costs and gas demand valuations by different users.[39] It determined that the government through the GNGC would hold a monopoly over the midstream of the sector, purchasing from producers and selling to end users. While this approach solves some problems, it could also pose some oversight challenges—specifically as it concerns the extent to which purchase and sell prices accurately reflect market prices. The report set detailed rules for the purchase price for nonassociated gas, associated gas, and LNG from producers by the GNGC. First, the purchase price for nonassociated gas must compensate upstream producers for costs of production for sale to all markets with an acceptable rate of return on capital invested. For associated gas, the purchase price must guarantee that the cost of oil and gas production is recovered with an acceptable rate of return on capital invested. Finally, the LNG purchase price in terms of $/MMbtu must be as close as possible to the WAGP landing price. On the side of end users, the aggregator (GNGC) must sell gas at no less than import parity price to all users. After this minimum price is determined by the GNGC

and the Public Utilities Regulatory Commission, customers may negotiate a price greater than or equal to the minimum for available gas. At present, domestic buyers such as the VRA buy gas from Atuabo at roughly $2.90 per Mcf.[40]

In the gas industry, privatization and pricing regulations shape the incentives for and against flaring, production for domestic use, and production for export. Government frameworks addressing these issues must be wary of the impact on total gas production as well as the sustainability of the gas value chain from production to generation to consumption. Therefore, a reevaluation of pricing for gas and electricity, as well as mechanisms for revenue collection described here, is essential to the success of the gas industry. For example, the Nigerian Electricity Regulatory Commission (NERC) is evaluating proposals submitted by electricity distribution companies on the state's electricity rates.[41] NERC's tariff increase for ratepayers in early 2016 could also help to address price sustainability.

Financing Options

Financing options for companies in the gas sector are limited. Local banks lack adequate training and the capacity to support largescale investments in the sector, particularly high-risk, capital-intensive investments. As a result, international players are forced to rely heavily on state funds, private equity, and external funding in terms of partially available debt from third parties, which are all difficult to secure. For example, private owners are able to utilize sources such as the Power and Airline Intervention Fund managed by Nigeria's Bank of Industry (BOI). The fund aims to fast-track the development of electric power projects by providing long-term loans to private sector companies for new power projects or working capital to existing power projects. International financing organizations such as the International Finance Corporation, the World Bank, AfDB, the European Investment Bank, and the German Export Bank also play major roles.

The high economic and political risks in the region also deter local and international institutions from financing major projects. West African nations are facing commodity price shocks as well as large current account deficits. More specifically, several JVs between government and private companies have poor track records with inflated operational costs and outstanding debts along the gas value chain. Moreover, in Nigeria, the oil and gas sector is facing uncertainty on future regulations related to the PIB.

Resource Mobilization

Domestic financing also plays a role in the natural gas sector, particularly in areas where governments are central in the industry and privatization is minimal. In Sub-Saharan Africa, taxes and utility charges account for roughly 80% of total spending on the energy sector; however, three-quarters of this public spending is allocated to operations and maintenance rather than to investment.[42] This financing is also limited by weak tax systems in the region and large gaps between budget allocation and actual expenditures on the energy sector. Nigeria's revenue-to-GDP ratio was one of the lowest in the world at 1% in 2013. West African nations need to modernize tax systems, improve tax policy, and develop more efficient tax collection mechanisms. Severe oil price swings have also hampered government funding capabilities. In 2015, the Nigerian government reduced the NNPC's funding budget for JVs by 40%, restricting its ability to meet equity commitments under JVs that are required for international companies to enter the oil and gas sector.[43]

There have been signs of progress of domestic resource mobilization with examples of pension fund investments into energy infrastructure, including by the Nigeria Social Insurance Trust Fund. In addition, Ghana's Social Security and National Insurance Trust took over a power plant as an active investment strategy. To further encourage investment, governments in the region are also liberalizing the market

In 2015, NNPC reduced its funding budget for JVs by 40%.

through privatization and unbundling state-owned generation, transmission, and distribution companies. In 2010, Nigeria's National Electric Power Authority broke up 17 state-owned generating and distribution companies, selling them through a tender process.[44]

The Nigerian government is taking the privatization process a step further in portions of the value chain to minimize government financing pressure and mobilize private sector resources. The Nigeria Liquefied Natural Gas (NLNG) company is majority privately owned by international oil companies, with the NNPC owning 49%. This is an example of the NNPC divesting more of its equity in JVs to the private sector in order to increase capital availability. Buhari reportedly released a letter calling for this model to be expanded to a few JVs and production sharing contracts with oil and gas firms, reducing NNPC stake in partnerships to below 50%.[45]

Industry members believe that private ownership along several points of the value chain will only grow in coming years. In a PriceWaterhouseCoopers report published in July 2015 on the power and utilities sector in Africa, 74% of survey participants say there is a medium to high probability that the private sector will own and operate more than half of generation by 2025.[46] But they have lower expectations for the privatization of the distribution and transmission sectors.

Payment Securitization

Gas and electricity companies face major operational challenges, particularly in securing payment downstream. Outstanding payments for gas and electricity at market have dissuaded gas companies and financial institutions from investing in upstream production and have even led to threats of curbing natural gas supply. WAGP claims that Ghana has not paid its gas bills for more than a year, and as a result, the Nigerian Gas Company has warned Ghana's VRA of impending supply cuts.[47] The sector requires infrastructure for payment securitization, such as metering electricity consumption and mechanisms for revenue collection to secure outstanding and future payments.

The Ghanaian industry faces high levels of debt due to failure of payment along the value chain. The VRA is Ghana's major power generation company, wholly owned by the Government of Ghana. VRA's gas-fired generation plants in Tema and Aboadze owe $130 million for gas transported by GNGC, $82 million to WAGP, and $100 million to Nigeria Gas. But the VRA is owed millions by independent power producers (IPPs). IPPs claim they are unable to pay because they are owed by the Electricity Company of Ghana (ECG), which further claims the government owes it for years of missed payments.

Ghana, similar to its neighbors, lacks accurate metering on national grids, compounding the ability of electricity companies to collect electricity payments and pay upstream producers. As a result of the pricing regime and inadequate collection structures along several portions of the value chain, the VRA is $312 million in debt, putting power generation firms in danger of shutting down and discouraging production of gas.

The Ghanaian case is one example of the greater need to invest in revenue collection infrastructure to ensure that payments from consumers are collected by distribution companies and then distributed to public and newly private power plant operators and gas suppliers. Without such mechanisms, upstream gas companies will be operationally unsustainable and financial institutions will remain wary of upstream investing due to inabilities to generate returns on their long-term investments.

Infrastructure Operations and Security

Infrastructure connectivity is lacking in Northern and Central Nigeria

Limited Infrastructure

Natural gas infrastructure networks, particularly main and spur pipelines, are limited throughout the ECOWAS region. While WAGP connects Nigeria, Ghana, Benin, and Togo, internal pipeline structures require additional investment. In Nigeria, infrastructure dominates the southern part of the country, but connectivity is lacking in the northern and central regions. The Nigerian Gas Company (NGC) operates the main pipeline network with the Alakiri-Obigbo-Ikot Abasi Pipeline System in the East and the Escravos-Lagos Pipeline System in the West, transporting from the Niger Delta to Lagos to WAGP. Spur lines, which connect out from the main lines, are minimal.

Beyond pipelines, highly costly infrastructure is necessary at several points along the supply chain to monetize gas. As Ghana initiates gas production, infrastructure requirements include gas drilling, processing and treatment plants, liquefaction plants, compression stations, onshore and offshore pipelines, pressure reduction stations, regasification plants, power stations, transmission and distribution networks, and a range of light and heavy industries. Infrastructure at each of these points is lacking for a variety of reasons, including access to financing, investor confidence in downstream returns, security concerns, and corruption and poor project management.

Beyond this, gas infrastructure networks are expensive ventures that often require a mix of state-owned and private international players to share risks and rewards. Projects can range from multibillion-dollar international gas pipelines or LNG facilities to over $50 million small-scale projects. The cost of power plants also ranges based on size with conventional combined cycle gas-powered plants to simple cycle combustion plants. Power transmission and distribution across large distances are also expensive. The Organisation pour la Mise en Valeur du fleuve Gambie (Gambian River Basin Development Organization or OMVG) Power System Development Subprogram, which includes the construction of 1,667 km of transmission lines, 15 substations, and 2 dispatching centers, requires over $700 million in investments from a range of international backers, including the International Development Association and the African Development Bank (AfDB).

This infrastructure is essential to developing the gas sector in the region. For example, Sankofa, Gye Nyame, and Dzata gas fields in Ghana will require pipeline networks to onshore gas processing plants and power plants. Transmission networks are also underfunded and underdeveloped throughout ECOWAS. As mentioned, Etienne Bailly, project director of the Implementation Unit of the WAPP Transco CLSG, stated the need for expansion of transmission lines from 4,000 km to 16,000 km to connect electricity generation with downstream consumers. While this process is under way with WAPP, the high costs of transmission lines and the accompanying infrastructure of substations and dispatching centers are exemplified by the OMVG program.

WAPCo Initiatives

Following a 2007 incident in which a ship's anchor destroyed a portion of the WAGP, WAPCo initiated a damage prevention program and public awareness program. Offshore pipelines are at risk of anchoring, ship anchor drag, bottom trawling, illegal fishing methods such as the use of dynamite, and mining.[48] WAPCo has taken steps to protect the WAGP by informing coastal communities about dangers, trenching the two branches of the pipeline in Togo and Benin under the sea bed, and creating a 1 nautical mile Exclusion Zone along either side of the pipeline. But new pipelines in the extension of WAGP or development plans along the coast of Ghana and Côte d'Ivoire are open to risk if protection measures are not put in place.

Security

Security concerns, as well as maritime damage risk, have resulted in repeated destruction to pipelines and other gas infrastructure. Despite initiatives by the Nigerian government to prevent sabotage as well as the damage prevention program run by WAPCo, national and regional pipelines are often temporarily shut down with repairs taking weeks to months.

In November 2008, Shell was forced to cut off natural gas supplies to the Soku gas gathering and processing plant in Nigeria to repair pipeline damages caused by local groups siphoning condensate.[49] In May 2015, the Nigerian government blamed pipeline destruction for the worst electricity shortages in years. The Power Ministry said that as of April 3, 2015, the country was generating 4,500 MW on the grid, but this drastically fell to 2,800 MW due to destruction of pipelines.[50]

Shell Petroleum Development Company (SPDC), Royal Dutch Shell's Nigerian joint venture, was forced to declare a force majeure on natural gas supplies to the Nigeria Liquefied Natural Gas (NLNG) Company on August 4, 2015.[51] This declaration temporarily released the company from any contractual obligations to customers due to circumstances outside its control, The force majeure was the result of a discovered leak on the Eastern Gas Gathering System 1 pipeline that supplies Nigeria's LNG export terminal on Bonny Island. While Shell reportedly continued supply to the NLNG plant through other pipelines, it may have rescheduled some shipments with customers owing to the leak.

A Shell spokesman reported that the leak was the result of a crude theft connection, which was installed by people who thought the line was transporting crude oil rather than natural gas. Theft and sabotage are common along Shell's pipelines supplying Bonny Island. On September 1, the company declared yet another force majeure, but on crude oil exports via two major pipelines, including the Trans Nigeria Pipeline. In the SPDC case, the force majeure was lifted on August 22. Nearly monthly shutdowns of various pipelines in the region because of leaks or theft continue to reduce gas supply to LNG export terminals and power generators. The Nigeria Gas Company, a subsidiary of the NNPC, said that the country has lost millions of dollars due to persistent vandalism of the pipeline network, likely by former rebels in the Niger Delta who vowed to sabotage pipelines if President Goodluck Jonathan lost his reelection bid.[52]

Regulatory Structure

The government has to raise the price of domestic gas to attract the **$55 billion** of needed investments in the sector.

As West African nations discover vast natural gas resources, government institutions are expanding rapidly to deal with potential new growth prospects. Yet the ballooning bureaucracies have lacked focus and coordination, often resulting in overlapping mandates and unclear communications with the private sector. Corruption has been pervasive, and poor management has resulted in scandal and questionable contracting practices.

Bureaucratic Structure

Expanding bureaucracies are complicating the natural gas sector in Nigeria, Ghana, and Cote d'Ivoire and threaten to do so in other ECOWAS member states that discover gas reserves in the future. In Nigeria alone, gas production is managed by the NNPC, and more specifically by the National Petroleum Investment Management Services, the Gas Aggregator Company of Nigeria, the Nigerian Gas Company (NGC), and the Nigeria Liquefied Natural Gas Company (NLNG). Beyond these regulatory agencies, there are many government actors in electricity generation, transmission, and distribution. Coordination between organizations is often lacking, convoluting the implementation of a Gas Master Plan.

Rights to natural gas are also complicated by the institutional structures in the gas sector in Nigeria. The Nigerian government awards Oil Exploration Licenses, Oil Prospecting Licenses, and Oil Mining Licenses typically to companies in a JV with the government under a Production Sharing Contract. This allows investors to explore and produce oil, but it doesn't grant them a right to gas. If natural gas is discovered, the investors must negotiate a gas development agreement with the NNPC. Since nearly all gas development in Nigeria is from associated oil and gas fields, this confounds the ability to acquire rights to gas for production.

Corruption

Corruption and poor project management have delayed projects and discouraged international investment within the oil and gas industry. An independent investigative report by the Natural Resource Governance Institute revealed a $32 billion corruption scandal in which the NNPC has provided no public accounting for over a decade of oil revenues. Mismanagement extends throughout the oil and gas sector, dissuading foreign and regional investment.[53] During a workshop organized by the Nigerian Association of Petroleum Explorationists, the chairman of the Nigeria Electricity Regulatory Commission (NERC), Dr. Sam Amadi, said that corruption in the awarding of contracts and a lack of integrity in project funding have delayed completion of the East-West gas pipelines.[54]

In Nigeria, President Buhari's administration has taken early steps to tackle corruption in the oil and gas sector. Buhari dissolved the entire board and executive directors of NNPC and appointed Emmanuel Kachikwu, former executive vice chairman of Exxon-Mobil Africa, as the new managing director. In addition, Buhari appointed himself minister of oil and split the NNPC into two entities to separate independent regulation and investment and appointed himself minister.

The NNPC has taken steps to increase transparency by publishing monthly accounts and reviewing contracts with JV partners.

Petroleum Industry Bill

Reforms meant to foster the domestic gas market in Nigeria through the Downstream Gas Bill have been held up due to their bundling into the controversial Petroleum Industry Bill. The Downstream Gas Bill contained several essential components such as the establishment of the Gas Regulatory Commission (GRC), a regulatory agency responsible for licensing actors along the gas value chain. The GRC would also be responsible for commercial regulation, including determining the gas transportation tariff, third-party access rules, and competition, consolidating the regulation of the industry under one government agency.

PIB components related to oil are preventing the passing of PIB and, as a result, the improvement of the commercial and regulatory structure of the Nigerian gas industry. The uncertainty of PIB's future is increasing regulatory uncertainty for investors, further adding to political and economic risk in the sector.

POLICY RECOMMENDATIONS

Regional Organizations (ECOWAS and WAPP):

1. **Assess Potential and Suppressed Demand**
   - > Initiate a study on the impact of domestic and regional price increases on potential and suppressed gas demand in ECOWAS member states.

National Governments of ECOWAS Member States:

1. **Manage and Simplify the Expanding Bureaucracy**
   - > Encourage the establishment of country-level Task Forces to evaluate the natural gas regulatory institutions within each country and consider changes to streamline their roles and responsibilities and increase institutional efficiency.
   - > In Nigeria, enable oil and gas rights to be negotiated and awarded within a single contract.

2. **Spur Domestic Resource Mobilization**
   - > Allocate a greater percentage of pension funds for gas sector-related projects, particularly as Nigeria undergoes pension fund reforms enabling investment in alternative sectors.

3. **Develop Pipeline Network**
   - > Increase investment in spur lines (extensions from central gas pipelines) to expand infrastructure to domestic regions not currently connected to the gas grid.

4. **Support Revenue Collection Infrastructure**
   - > Evaluate reforms of public utility companies in other developing states, such as India's phased reform program of the power sector in 1998, to establish revenue protection measures for billing and collection.
   - > Develop and improve the metering system on national grids with the use of new technology, such as electronic meters with data logging devices and the capability to transmit data through a satellite communications system.
   - > Provide simplified mechanisms for customer payment such as mobile payment options.
   - > Require publication by utility companies of a widely available plan for meeting existing debt obligations to gas and electricity suppliers.

5. **Break Up the Nigerian Petroleum Industry Bill**
   > Expedite gas sector reforms by segmenting the Petroleum Industry Bill (PIB) to address the gas sector independently from the highly controversial oil sector.

Private Sector and U.S. Government:

1. **Facilitate Domestic Financing Capabilities**
   > Sponsor a Department of Energy workshop on capacity building for local governments and companies on project financing with the intent to expand cooperation and lending from local banks.

REFERENCES

- African Development Bank Group. *Addressing Africa's chronic power problems and implementing regional trade will require spending in power infrastructure, amounting to some $41 billion per year.* http://www.infrastructureafrica.org/key-msg/sector/addressing-africa%E2%80%99s-chronic-power-problems-and-implementing-regional-trade-will-requi accessed August 2015.
- African Development Bank Group. *Africa's chronic power problems have escalated into a crisis affecting 30 countries. This tolls heavily on economic growth and productivity.* http://www.infrastructureafrica.org/key-msg/sector/africa%E2%80%99s-chronic-power-problems-have-escalated-crisis-affecting-30-countries-crisis--1 accessed August 2015
- African Development Bank Group. *Côte D'Ivoire President launches West African Energy Leaders Group.* June 2015.
- African Development Bank Group. *Urbanization in Africa.* http://www.afdb.org/en/blogs/afdb-championing-inclusive-growth-across-africa/post/urbanization-in-africa-10143/ accessed August 2015.
- African Review. AfDB grants US$193 million for Mano River Union energy project. November 11, 2013.
- Africa Progress Panel. Power People Planet. Seizing Africa's Energy and Climate Opportunities. Africa Progress Report 2015. Geneva, Switzerland.
- Anayo Korie. *Ivory Coast seeks LNG supply from Nigeria.* Daily Independent. March 17, 2015.
- Babatunde Adeyemo. *West Africa Power Pool. Presentation prepared for South Asia Regional Workshop on Competitive Energy Markets.* Colombo, Sri Lanka. March 2014.
- Bassey Udo. *Nigeria's energy crisis worsens; only 5 of 23 power plants functional – NERC.* Premium Times. Abuja, Nigeria. May 2015.
- *Bubbling Up.* The Economist, May 2014.
- Chijioke Ohuocha. *Electricity: West Africa plans regional power market bridge electricity gap.* The Africa Report. June 2015.
- Daniel J. Graeber. *Ghana to make economic strides with natural gas.* United Press international, January 2015.
- Ecobank. *Middle Africa Briefing Note. Energy, Oil and Gas.* 26 February 2014.
- Ecobank. *Middle Africa Market Update. Energy.* July 28, 2015.
- Emele Onu. *Nigeria Eases Grip on Gas Prices to Boost Power-Plant Supply.* Bloomberg Business. June 26, 2015.
- *Ghana to reduce Nigeria gas purchases.* The Oil & Gas Year. Accra, October 2014.
- Gas Strategies Information Services. *The Gas Strategies Interview: Bolaji Osunsanya, CEO of Oando Gas & Power and president of the Nigerian Gas Association.* Gas Strategies Group. July 2015.
- Ghana Statistical Service. *Gross Domestic Product 2014.* http://www.statsghana.gov.gh/docfiles/GDP/GDP_2014.pdf. April 2014.
- Henry Oqua. *New tariff for Nigerian gas begins January 1, 2015.* Premium Times. Abuja, Nigeria. November 11, 2014.
- International Gas Union. *Access to Sustainable Energy for All With Gas.* Prepared for a Gas Training Seminar. Abidjan, Côte d'Ivoire, November 2013.
- International Monetary Fund. *Africa Rising: Harnessing the Demographic Dividend.* Working paper by Paulo Drummond, Vimal Thakoor, and Shu Yu. WP/14/143.
- International Renewable Energy Agency (IRENA) (2015). *Africa Power Sector: Planning and Prospects for Renewable Energy.* Asami Miketa and Nawfal Saadi. IRENA, Abu Dhabi/Bonn.

- International Renewable Energy Agency (IRENA) (2013a). *West African Power Pool: Planning and Prospects for Renewable Energy*, IRENA. Abu Dhabi/Bonn.
- KPMG. *Oil and Gas in Africa. Africa's Reserves, Potential and Prospects.* KPMG Africa Limited, South Africa, 2013.
- KPMG. *Manufacturing in Africa, Sector Report*. https://www.kpmg.com/Africa/en/IssuesAndInsights/Articles-Publications/General-Industries-Publications/Documents/Manufacturing%20in%20Africa.pdf. 2014.
- Kunle Kalejaye. *Absence of Gas-to-Power policy, others truncates 6000mw generation – NERC.* Biztellers. Abuja, Nigeria. July 20, 2015.
- Kwasi Kpodo. *Ghana orders emergency barges to address power crisis.* Ed. Emma Farge and David Clarke. Reuters, Accra: February 2015.
- Marina Tolchinsky. *Côte d'Ivoire needs natural gas to satisfy electricity demand. Global Risks Insights. February 24, 2015.*
- *Programme for Infrastructure Development in Africa.* West Africa Power Transmission Corridor. Program factsheet. http://www.au-pida.org/west-africa-power-transmission-corridor accessed August 2015.
- McKinsey & Company. *Brighter Africa: The growth potential of the sub-Saharan electricity sector.* McKinsey Report. February 2015.
- McKinsey Global Institute. *Africa at work: Job creation and inclusive growth*. http://www.mckinsey.com/insights/africa/africa_at_work. August 2012.
- Morgan Winsor. *Nigeria's Power Supply Drops From Pipeline Vandalism, Rising Temperatures and A Fragile Infrastructure.* International Business Times. May 1, 2015.
- *Nigeria lost $868.8 million to gas flaring in 2014 – NNPC*. Naija 247 News. July 2015.
- Nigeria National Bureau of Statistics. *Labor Statistics*. http://www.nigerianstat.gov.ng/nbslibrary/social-economic-statistics/labour.
- *Nigeria ranked behind South Africa, Morocco and Ghana in LPG usage*. Naija 247 News. July 31, 2015.
- Oscarline Onwuemenyi. *ECOWAS mulls extension of West Africa Pipeline network.* The Guardian, July 2015.
- Patrick Atuanya. *NPDC incompetence crimps oil and power output*. Business Day. June 28, 2015.
- Pauline Bax and Moses Mozart Dzawu. *Worst Blackouts in Decade Spur Ghana Opposition Protests*. Bloomberg Business. February 2015.
- Penspen. *ECOWAS and Penspen Sign Contract for a Feasibility Study for the Extension of the Gas Pipeline Network in West Africa*. June 2015.
- Programme for Infrastructure Development in Africa. *Interconnecting, integrating and transforming a continent*. August 2012.
- Reuters. *Ghana appoints Mitsui & Co as key partner for gas production*. August 2015.
- *Shell declares force majeur on Nigerian pipeline.* The Oil & Gas Year. Abuja, Nigeria. August 7, 2015.
- SPTEC Advisory. *West Africa. Strong Development in upstream oil and gas.* January 2015.
- *Time to stop gas flaring in Nigeria.* Daily Independent. April 2015.
- Tom Jackson. *How Africa gets power to 620 million people could have a huge influence on our world.* First published by ENSIA. July 2015.
- U.S. Energy Information Administration. *Country Analysis Brief: Nigeria.* EIA, Washington, DC, Last updated February 27, 2015.
- Vitol. *Ghana, Vitol and Eni announce transformational gas project for Ghana.* January 2015.
- West Africa Gas Pipeline Company. *Damage Prevention Program.* http://www.wagpco.com/ accessed August 2015.
- Yinka Ibukun. *Nigeria Needs to Raise Gas Prices to Bridge $55 Billion Gap*. Bloomberg Business. April 21, 2015.

ENDNOTES

1 http://www.mckinsey.com/insights/africa/africa_at_work

2 http://www.nigerianstat.gov.ng/nbslibrary/social-economic-statistics/labour

3 http://www.statsghana.gov.gh/docfiles/GDP/GDP_2014.pdf, http://www.theguardian.com/global-development/datablog/2014/apr/07/nigeria-becomes-africa-largest-economy-get-data

4 http://www.nigerianstat.gov.ng/nbslibrary/social-economic-statistics/labour

5 http://www.nigerianstat.gov.ng/nbslibrary/social-economic-statistics/labour, http://www.statsghana.gov.gh/docfiles/GDP/GDP_2014.pdf

6. http://www.theafricareport.com/West-Africa/electricity-west-africa-plans-regional-power-market-to-bridge-electricity-gap.html

7. http://naija247news.com/2015/07/nigeria-lost-868-8-million-to-gas-flaring-in-2014-nnpc

8. http://www.eia.gov/beta/international/analysis_includes/countries_long/Nigeria/nigeria.pdf

9. http://www.ngrguardiannews.com/2015/07/%E2%80%8E%E2%80%8Eecowas-mulls-extension-of-west-africa-gas-pipeline-network/17 and http://www.penspen.com/europe-africa/ecowas-and-penspen-sign-contract-for-a-feasibility-study-for-the-extension-of-the-gas-pipeline-network-in-west-africa

10. http://www.theafricareport.com/West-Africa/oil-and-gas-Côte-divoires-foxtrot-aims-to-secure-gas-output-for-next-decade.html

11. http://globalriskinsights.com/2015/02/Côte-divoire-needs-natural-gas-to-satisfy-electricity-demand

12. http://www.reuters.com/article/2014/09/24/ivorycoast-natgas-foxtrot-idUSL6N0RP4XL20140924

13. http://www.theoilandgasyear.com/news/ghana-to-reduce-nigerian-gas-purchases

14. http://sptec-advisory.com/SPTEC_Advisory-West_Africa_2014_News_Review.pdf

15. http://www.upi.com/Business_News/Energy-Resources/2015/01/27/Ghana-to-make-economic-strides-with-natural-gas/2331422363508

16. http://www.vitol.com/ghana-vitol-and-eni-announce-transformational-gas-project-for-ghana

17. http://af.reuters.com/article/investingNews/idAFKCN0QI0PA20150813

18. http://naija247news.com/2015/07/nigeria-ranked-behind-south-africa-morocco-and-ghana-in-lpg-usage

19. EIA Report, p. 17.

20. http://www.theafricareport.com/West-Africa/energy-nigeria-56-bn-power-plants-sell-off-stalls-on-gas-shortages.html

21. http://www.ecobank.com/upload/20150728124328178774EJNC7qfXBD.pdf

22. http://app-cdn.acwupload.co.uk/wp-content/uploads/2015/06/APP_REPORT_2015_FINAL_low1.pdf, p. 83.

23. http://businessdayonline.com/2015/06/npdc-incompetence-crimps-oil-and-power-output

24. http://globalriskinsights.com/2015/02/cote-divoire-needs-natural-gas-to-satisfy-electricity-demand

25. http://dailyindependentnig.com/2015/03/ivory-coast-seeks-lng-supply-nigeria

26. http://www.ecobank.com/upload/2014022603240770570QhVuNrxU5S.pdf, p. 2.

27. http://www.ecobank.com/upload/2014022603240770570QhVuNrxU5S.pdf

28. http://africanreview.com/energy-a-power/power-generation/afdb-grants-us-193-million-for-mano-river-union-energy-project and http://africanreview.com/energy-a-power/power-generation/afdb-grants-us-193-million-for-mano-river-union-energy-project and http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Multinational_-_C%C3%B4te_d%E2%80%99Ivoire-Liberia-Sierra_Leone_and_Guinea_Electricity_Networks_Interconnection_Project__CLSG__-_Appraisal_Report.pdf

29. http://www.au-pida.org/west-africa-power-transmission-corridor and http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/PIDA%20note%20English%20for%20web%200208.pdf, p. 17.
30. http://www.reuters.com/article/2015/09/08/elenilto-idUSnBw085848a+100+BSW20150908
31. http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_Power_Sector_synethesis_2015.pdf, p. 15.
32. http://www.theafricareport.com/West-Africa/electricity-west-africa-plans-regional-power-market-to-bridge-electricity-gap.html
33. http://app-cdn.acwupload.co.uk/wp-content/uploads/2015/06/APP_REPORT_2015_FINAL_low1.pdf, p. 88.
34. McKinsey report, p. 33.
35. http://nigeriangasassociation.org.ng/wp-content/uploads/2015/07/GSIS_201507_osunsanya.pdf
36. http://www.premiumtimesng.com/business/energy-business/170940-new-tariff-for-nigerian-gas-beginsjanuary-1-2015.html
37. http://www.bloomberg.com/news/articles/2015-04-21/nigeria-needs-to-raise-gas-prices-to-lure-55-billioninvestment
38. http://www.bloomberg.com/news/articles/2015-06-25/nigeria-will-ease-grip-on-gas-prices-to-boostelectricity-supply
39. http://www.reportingoilandgas.org/wp-content/uploads/Natural-Gas-Pricing-Policy-for-Ghana-Master-Final.pdf
40. http://www.ghanaweb.com/GhanaHomePage/business/Gas-pricing-policy-a-disincentive-to-investment-ACEP-387371
41. http://www.thisdaylive.com/articles/nerc-begins-review-of-discosproposed-electricity-tariffs/223938
42. APP report, p. 93.
43. http://www.euromoney.com/Article/3455363/Sub-Saharan-Africas-national-oil-companies-have-bigambitions-but-funding-remains-a-challenge.html
44. http://www.euromoney.com/Article/3455363/Sub-Saharan-Africas-national-oil-companies-have-bigambitions-but-funding-remains-a-challenge.html
45. http://www.dailymail.co.uk/wires/reuters/article-3272411/Nigeria-revamps-oil-exploration-firms-stepreform.html
46. http://www.pwc.com/en_GX/gx/utilities/publications/assets/pwc-africa-power-utilities-survey.pdf, p. 29.
47. http://www.bloomberg.com/news/articles/2015-10-12/nigeria-may-curtail-ghana-natural-gas-supplyover-debts
48. http://www.wagpco.com/index.php?option=com_content&view=article&id=63&Itemid=129&lang=en
49. http://www.eia.gov/beta/international/analysis_includes/countries_long/Nigeria/nigeria.pdf
50. http://www.ibtimes.com/nigerias-power-supply-drops-pipeline-vandalism-rising-temperatures-fragile-1904622
51. http://www.theoilandgasyear.com/news/shell-declares-force-majeure-on-nigerian-pipeline/
52. http://www.ibtimes.com/nigerias-power-supply-drops-pipeline-vandalism-rising-temperatures-fragile-1904622
53. http://www.premiumtimesng.com/news/headlines/187783-nigeria-lost-over-n6-4-trillion-to-corruptionridden-nnpc-oil-sales-nrgi-report.html
54. http://biztellers.com/2015/07/%E2%80%8Eabsence-of-gas-to-power-policy-others-truncates-6000mwgeneration-nerc

GLOSSARY OF ACRONYMS

AfDB:	African Development Bank
BOI:	Bank of Industry (Nigeria)
Bcf:	Billion cubic feet
CLSG:	Côte d'Ivoire-Liberia-Sierra Leone-Guinea
ECOWAS:	Economic Community of West African States
ECG :	Electricity Company of Ghana
GRC:	Gas Regulatory Commission
GNPC:	Ghana National Petroleum Company
GW:	Gigawatts
IFC:	International Finance Corporation
IOC:	International Oil Companies
IPPs:	Independent power producers
JV:	Joint-Venture
LNG:	Liquefied Natural Gas
LPG:	Liquefied Petroleum Gas
MW:	Megawatts
McF:	Million cubic feet
NERC:	Nigeria Electricity Regulatory Commission
Netap:	Nigerian Electricity Transmission Access Project
NGC:	Nigerian Gas Company
NLNG:	Nigeria Liquefied Natural Gas Company
NNPC:	Nigerian National Petroleum Corporation
OCTP:	Offshore Cape Three Point
OMVG:	Organisation pour la mise en valeur du fleuve Gambie (Gambian River Basin Development Organization)
PIB:	Petroleum Industry Bill
SPDC:	Shell Petroleum Development Company
SCF:	Standard cubic feet
TcF:	Trillion cubic feet
EIA:	U.S. Energy Information Administration
VRA:	Volta River Authority
WAGP:	West Africa Gas Pipeline
WAPCo:	West African Pipeline Company
WAPP:	West African Power Pool

U.S. CHAMBER OF COMMERCE
U.S.-Africa Business Center

Africa
Expert
Network

U.S. Chamber of Commerce
1615 H Street, NW
Washington, DC 20062-2000
www.uschamber.com