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WEST AFRICA POWER TRADE OUTLOOK

POWER AFRICA SENIOR ADVISORS GROUP PROGRAMME

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PREFACE

This Outlook was developed by the Tony Blair Institute for Global Change (TBI) in partnership with Power Africa in early 2018 through engagement with Governments, Utilities, the private sector and development partners throughout West Africa, as part of the Power Africa Senior Advisors Group programme. The projections presented in this Outlook are based on the most accurate inputs available at the time, and do not reflect subsequent developments. It would be prudent for this analysis to be updated at least every 2 to 3 years, and TBI is committed to sharing the analytical tools and approach used with regional institutions such that they can take this work forward.

TBI's data collection was initially undertaken by Francis Elisha. The lead authors of the current version were Sergio Portatadino and Gareth Walsh, with extensive support provided by wider teams at TBI and USAID; with contributions from Katharine Coons, Delphine Hennegrave, Ulrik Kristensen, Poppy Lindsley, Yomi Ogedegbe, Federico Pontoni and Rebecca Stetter. The design and layout were completed by Melissa Pickard and Mensa Vas. TBI would like to extend its deepest gratitude to all those who have supported the development of this Outlook including:

- USAID's Power Africa team and in particular representatives at the West Africa Regional Economic Growth Office Rockfeler Herisse and Emmanuel Moteng, as well as staff throughout the region for their vital support and insightful contributions;
- The Government officials throughout the region who were so generous with their time and insights;
- Other development partners and private sector actors who provided robust feedback when required.

INTRODUCTORY REMARKS

Securing the low-cost power needed to drive industrialisation and economic growth is at the front of mind for many of the Presidents and Prime Ministers I meet across the continent. Because of this, I am proud of my Institute's partnership with the U.S Government's Power Africa initiative and the progress that has been made in driving much needed investment into the continent's power sector.

However, challenges remain. In my discussions with political leaders across West Africa, many struggle with insufficient or unreliable power supply, whilst others are beginning to worry about excess capacity. It is becoming increasingly clear to them that a challenge on this scale requires a regional as well as a national approach, and that trading power is becoming increasingly important.

The recently concluded West Africa Power Pool Masterplan sets out a long-term vision for integrating the power systems of the region which will both reduce the cost of energy and increase its reliability. The establishment of a fully functional regional power market is already underway, with extensive coordination amongst ECOWAS member states in areas such as investment, regulation and system operations. Once established, the market is likely to have a transformative impact on the economies in the region, but it will require political leadership and cooperation to be achieved.

Each step towards such transformative change is important, and this Outlook presents some immediate ones toward a more integrated regional power system: it proposes a transactions-driven approach whereby actual cross-border power trades are pursued directly.

Specifically, potential power trades between countries in the region have been identified, based on our analysis and engagements with leaders and regional institutions. Such trades would deliver almost immediate mutual benefits to trading countries, while significantly lowering the overall cost of power supply and increasing its availability. From my conversations with Heads of State in the region, there is a marked interest in realizing such benefits rapidly as part of their political programmes, and the Outlook is meant to guide them in this regard.

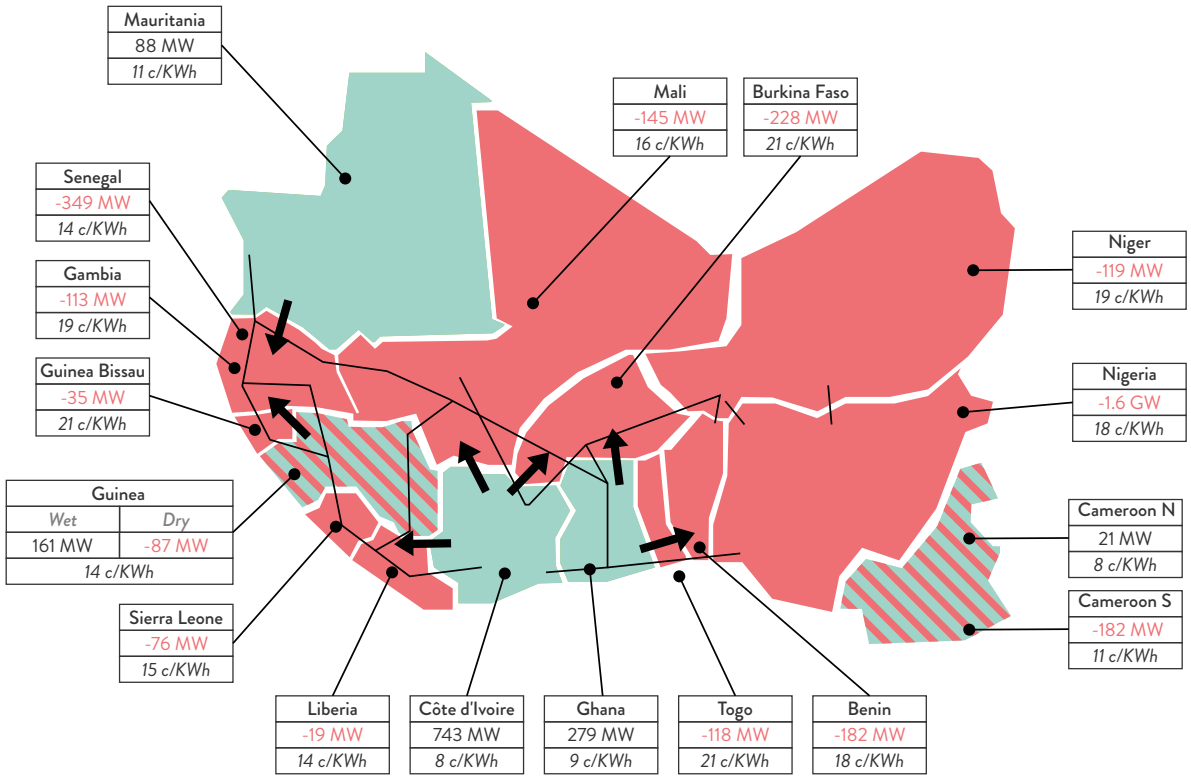
My Institute is currently providing embedded advisory support to eight Governments across West Africa. In many of these countries, our embedded advisors along with our Energy Practice are helping Governments incorporate this regional perspective into their decision making. Our long-term partnership with Power Africa has allowed us to develop our analysis and engage with Governments, utilities and regional institutions around regional trade perspectives, as represented in this Outlook.

Regional integration will also pave the way for increased investment at regional scale; the vision set out in the West Africa Power Pool Masterplan is that around 16 GW of solar power from as yet unidentified projects could come onstream, balanced by the vast hydro resources, particularly in the north of the region. I hope that this West Africa Power Trade Outlook can contribute to securing the political buy-in to advance the first, transactional steps to making this a reality.

Tony Blair
Executive Chairman of the
Tony Blair Institute for Global Change
Former Prime Minister of Great Britain and
Northern Ireland

FIGURE 1

Regional Picture: 2022 Anticipated off peak surpluses / Deficits and Long run production costs



FOREWORD

Power Africa is a U.S. Government-led initiative launched in 2013 with the goal of doubling electricity access in sub-Saharan Africa by adding more than 30,000 megawatts (MW) of electrical generation capacity and connecting 60 million homes and businesses to on- and off-grid power solutions. To date, Power Africa has leveraged over USD $54 billion in commitments from the public and private sectors, and supported the completion of 120 projects, compromising 10,218 MW assisted to reach financial close. The USAID-coordinated, 14 US agency project, counts 2,769 of those MW as already online and powering residential, commercial, and industrial activities across the continent.

In West Africa, Power Africa is currently tracking more than 120 additional power generation projects with potential completion by 2030. The power produced by these projects could drive economic growth and transform lives. To achieve this goal, major investment will be needed in the regional transmission system to get power where it's needed – including across borders and to reduce costs by tapping into regional resources. To that end, Power Africa has developed its Transmission Roadmap to 2030, which identified priority cross-border infrastructure and mapped-out a way forward for address specific policy and financing gaps.

It is clear that simply building new transmission infrastructure is not enough. The utilization of existing transmission lines interconnecting countries is low and the barriers to trade are largely political, including non-cost reflective country to country trade agreements, non-payment, and development of costly domestic generation plants when cheaper imports are available. West African decision makers must have both a regional and national perspective in order to reap the benefits of increased regional interconnectivity, including the potential for an estimated $30 billion in savings through mutually beneficial power trade, and the potential for large-scale regional solar development.

The West Africa Power Outlook is intended to support political leaders and decision makers in identifying and reaching the opportunities made possible through regional power system integration. It reaffirms Power Africa's commitment to enabling effective, low-cost power systems that can drive economic growth and create the large-scale markets needed to open-up fresh investment opportunities on the continent. The document itself is NOT a prospectus or guidance to investors.

The report is the result of extensive consultations with our partner Governments across West Africa and ECOWAS agencies, as well as in-depth data collection and analysis conducted with the Tony Blair Institute for Global Change. While the content is not intended as investment advice, we are hopeful that the Outlook will contribute to advancing power trade in West Africa and provide leading examples of developing power markets at scale for the continent more widely.

Andrew M. Herscowitz
Coordinator for Power Africa

Daniel Moore
Regional Mission Director I West Africa

1. EXECUTIVE SUMMARY

BACKGROUND

Significant investment is underway to develop the infrastructure for generation, transmission and distribution of power across West Africa. However, several countries are set to have a surplus of generation capacity, whilst others are likely to continue to suffer from power deficits. In this context, the potential gains from cross-border power trade, both in terms of increased availability and cost-effective value-chains for power production and consumption, are enormous.

TBI and Power Africa have partnered to analyse this potential and to engage with leaders and development partners in the region to help make such power trade happen. On the basis of the analysis and engagements already undertaken, the West Africa Power Trade Outlook presents a regional perspective to existing and planned power capacity, identifies key enablers to make trade happen, and makes recommendations for continued development partner support.

REGIONAL OUTLOOK

A regional approach to the development of the power system needs to be adopted, through which opportunities to trade power are developed and gas supply is considered at a regional rather than at a national level.

Advances are needed both upstream, to safeguard gas supplies to the region, and in cross-border power trade to move power from countries with surplus low-cost power to those where power availability is limited, or prices are high. An optimistic but achievable level of market integration where countries trade bilaterally until 2025 and a liquid market exists afterwards, underpinned by adequate gas availability, could collectively provide around $32 Billion of benefit to the region throughout the next decade.

Modelling undertaken by TBI assessed the likely power surpluses and deficits as well as costs of power production in each of the 14 countries that comprise the West Africa Power Pool as well as Cameroon and Mauritania over the next decade. This analysis was based on information obtained through in-depth engagement with Ministries, Utilities and other stakeholders across the region. These national models were then aggregated to understand the regional impacts of changes in gas availability and power trade.

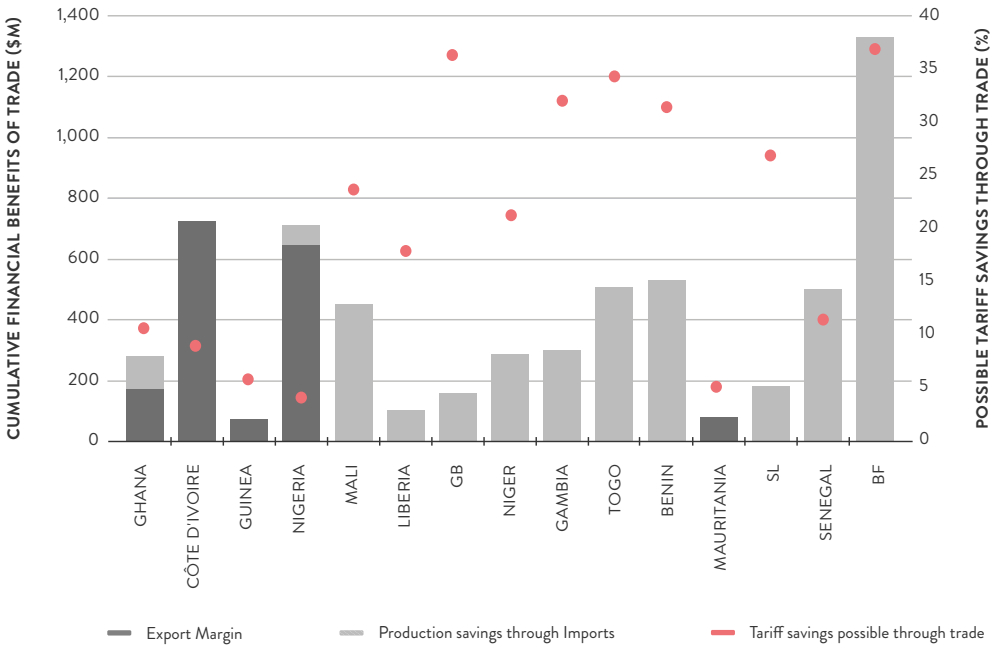
From a **gas supply perspective**, key coastal countries (Nigeria, Benin, Togo, Ghana, Côte d'Ivoire and Senegal) will need to secure additional gas supplies, both for domestic use and to profit from exporting power into the regional market. This increased gas availability will likely come from a combination of three sources:

1. Increased domestic production from existing and new gas fields in Côte d'Ivoire, Senegal and Ghana;
2. Liquified Natural Gas (LNG) imports under consideration by Togo, Benin, Senegal and Ghana; and
3. Improving the gas transmission infrastructure in the region, both domestically within Nigeria to provide reliable power to generation plants and regionally through the West Africa Gas Pipeline, which has been negatively impacted recently by commercial and technical issues.

From a **power trade perspective**, significant benefits could be achieved during the next decade by transmitting power throughout the region on the existing and planned interconnectors.

In the following figure , trading benefits are represented in two ways:

- Along the left axis are the cumulative financial benefits for each country over the period 2020-2025, in turn divided into revenues from export and savings from displacing costly liquid fuel generation or meeting demand that would otherwise have to be met by costly captive generation;
- Along the right axis are the trading benefits as the equivalent reduction of the unit cost of production. For example, Côte d'Ivoire could save thanks to trading up to USD 700 million until 2025, or in other words its unit cost of production would decrease by 9% on average.



In addition to addressing the gas supply issues described above, trading would be enabled by:

1. The timely delivery of key regional interconnectors;
2. The delivery of around 15 GW of planned generation projects;
3. Identifying and advancing opportunities for regional trade; and
4. Advancing work on critical pre-requisites for trade at a regional and national level.

Regional interconnectors and existing trade: Eight major interconnections already exist, linking Nigeria to Niger and Benin, Côte d'Ivoire to Ghana, Burkina Faso and Mali, Ghana to Togo and Burkina Faso, and Mali to Senegal. The utilisation of these lines averages around 50%, with only the exports from Nigeria operating at close to full capacity (in part, it is a consequence of the liquidity issues within the Nigerian power sector, which make exports more financially attractive). The low utilization on the other lines can be explained by three key commercial and political factors:

- Solvency issues on the side of the purchaser mean bills go unpaid;
- Internal political drivers pushing for domestic generation, even when imports would be more cost-effective.
- The existence of legacy "political" Power Purchase Agreements (PPAs), which often do not make economic sense for the seller and provide little more than a "best efforts" guarantee that power will be provided to the buyer. The region is set to become far more interconnected, with every country within the West Africa power pool expected to be interconnected by 2022.

Generation capacity expansion: In parallel with the expansion of the regional network, around 15 GW of new generation capacity is planned by the Governments across West Africa throughout the next decade.

80% of this new generation capacity will come from gas and hydro projects (45% and 35% respectively) with the remainder set to come from solar (13%), coal (6%) and liquid fuels (<1%). From an investment opportunity perspective, it is worth noting that these planned projects would result in solar contributing around 6% of installed capacity by 2030, well below the rate suggested by the WAPP Regional Masterplan, implying that advances in regional power trade could provide an opportunity for around 16 GW of additional investment in well-planned, competitively tendered solar, above and beyond the set of projects currently in the pipeline. A regional planning perspective will allow for large-scale investment opportunities.

In the short term, the new generation capacity will not be distributed evenly, with most countries anticipating either surpluses or deficits of low-cost power[1]. By around 2022, these surpluses will be concentrated in Ghana and Côte d'Ivoire (underpinned by new investments in gas generation and the development of domestic gas resources), and to a lesser extent Guinea, where the largely hydro-based generation investment plan will result in large surpluses of power during the wet season but deficits during the dry season. The ability of Nigeria, Togo and Benin to meet their power requirements without resorting to costly liquid fuels will be heavily dependent on whether the gas transmission issues both within Nigeria and along the West Africa Gas Pipeline can be addressed.

The biggest changes to this regional picture by 2025 will likely be as a result of gas availability. Senegal is expected to become self-sufficient in low-cost power through the development of its domestic gas fields. If Nigeria is able to address its own gas supply challenges (as well as other issues such as financial liquidity within the sector) it could transition to become a major potential power exporter by 2025 with around 3 GW of power available to export outside the evening peak (exporting this power at 10 c/KWh could generate profits of around a billion dollars a year for Nigeria).

With greater interconnection will come an increasing need for countries to collaborate, taking a regional perspective, both on power trade and managing the system but also on investment. For example: Ghana and Côte d'Ivoire must collaborate to some extent on the sale of power to their neighbors (such as Mali and Burkina Faso); otherwise there is a risk that each could enter into long term contracts for gas provision or generation capacity that cannot be utilised.

ENABLERS OF REGIONAL TRADE

In addition to simply identifying the trading opportunities, significant work is required to establish the enabling environment through which trade can take place. TBI has examined these enablers across five key dimensions. The findings are summarised in the following.

Institutional Readiness relates to ensuring that the institutions (WAPP and ERERA at regional level and those at national level) are functioning and empowered and that coordination between them and other stakeholders is clear and functional. At the regional level, ECOWAS could take a greater role in providing political guidance and oversight, whilst ERERA seems understaffed.

Regulatory Readiness relates to the definition and enforcement of the relevant rules and legal documents required to facilitate trade such as Third-Party access to the network, standard PPAs and transmission tariffs. Despite the under-resourcing of the regional regulator, progress has been made in developing many of these documents, but most are yet to be utilized in the real world. There is significant scope for donors and other partners to apply these documents as they support real trades such as that set to take place between Guinea, Senegal, The Gambia and Guinea Bissau along the OMVG line.

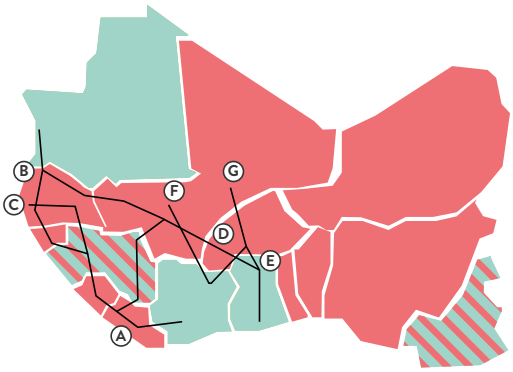
Operational Readiness is defined as the readiness of the utilities and other market participants to be able to handle power flows in a stable and reliable manner across the new integrated regional system. The critical gaps in this respect are the detailed development of a grid code and procedures setting out standards to coordinate the approach to issues such as operational planning, handling outages and providing frequency and voltage stabilization, and then capacitating the utilities to operate in line with these standards.

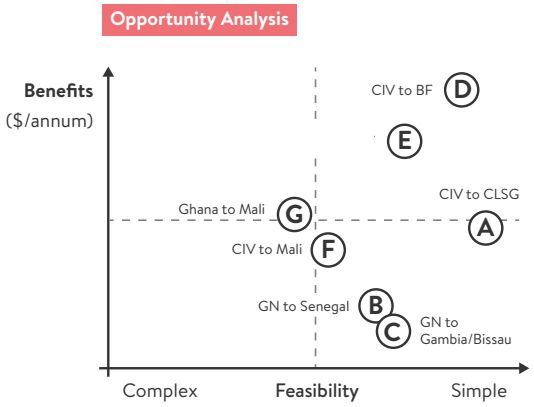
Commercial Readiness relates to the capability of WAPP members and regional utilities to economically and efficiently engage in commercial energy transactions. This is a function of three key factors: the cost reflectiveness of tariffs[2], the accounting system and the financial health of national utilities. Without solvent utilities, sellers may find trade too risky due to challenges in receiving payments for power. This issue has already been raised by a number of Governments requesting that Multilateral Banks put in place repayment guarantees before they begin to sell power to some of the less solvent utilities.

Infrastructural Readiness is the availability of assets allowing for trades (power plants, transmission lines and dispatch centres).

TRANSACTIONAL SUPPORT

The modelling undertaken for this report provides a unique lens through which potential short-term trading opportunities can be observed. A list of possible trades has been developed with potential benefits totaling around $1 Billion a year in 2022 to both the seller and buyer countries (the seller through utilizing otherwise idle generation assets, the buyer through meeting unmet demand or replacing the cost of burning liquid fuels with lower-cost imports). These short-term trading opportunities can be grouped into two logical clusters:





#	From	To	Peak Power (MW)	Potential Trade Volumes (GWh)	Potential Trade Benefits ($m/year)	Year interconnector ready	Feasibility
A	CIV	CLSG	145	948	122	2020	● ● ● ● ○
B	GN	Senegal	350	125	21	2021/22	● ● ● ○ ○
C	GN	Gambia/G. Bissau	110	125	22	2021/22	● ● ● ○ ○
D	CIV	BF	230	1,615	296	Existing	● ● ● ● ○
E	Ghana	BF	150	990	182	Existing	● ● ● ○ ○
F	CIV	Mali	150	1,005	130	Existing	● ● ● ○ ○
G	Ghana	Mali	150	990	150	2023?	● ● ○ ○ ○

1. **The integration of the Western Coast**. There is potential for a sub-regional series of trades between Senegal, The Gambia, Guinea Bissau, Guinea, Sierra Leone, Liberia, and Cote d'Ivoire. Whilst Guinea might be the most obvious supplier of the northern countries, its actual surplus will depend on the real demand of its mining sector, which could absorb much of the excess production created by the commissioning of the Souapiti power plant. A second factor to consider for Guinea is the seasonality of its hydro plants, which see its output reduced during the dry season. As a consequence, Guinea in our Baseline Scenario has only 125 GWh of excess supply in 2022 that could either be allocated to the Gambia or to Senegal and entirely concentrated in the wet season. However, Guinea could compensate by importing additional electricity during the dry season from Côte d'Ivoire in order to be able to offer a flat "base load" power to its customers and to increase its overall export by more than 300 GWh/year. The result would be a macro-transaction involving up to seven countries from Côte d'Ivoire to Senegal, for a total of approximately 1,200 GWh of electricity traded and an overall benefit of $170m per year.

2. **Regional gas powers exporting to Burkina Faso and Mali**: Both Mali and Burkina Faso have a significant pipeline of solar projects, however these alone will not provide the stable 24-hour power they need, and, without trading, each would still need to burn costly diesel and heavy fuel oil. Both countries are fortunate in that they will be able to receive power from both Ghana and Côte d'Ivoire. The collective benefits of this trade for all countries combined would be around $450m per year. However, Côte d'Ivoire and Ghana must collaborate (as well as compete) for these markets in order to avoid committing to long-term gas import agreements to service regional power exports, which may not materialize.

TBI, in partnership with Power Africa, is adopting a transactional approach to advancing trading opportunities in both of these clusters; both to deliver the benefits associated with the trade and provide the wider benefit of creating a replicable approach to supporting at political, commercial and technical levels that could support future trades.

CONCLUSIONS

1. **Political leaders must understand the opportunities and benefits power trading presents** if they are to prioritise it above the many challenges they face. Options for achieving this include:

    - Sharing a detailed opportunity analysis for each country with relevant political leaders to identify the short-term transactions they could enter into along with the benefits in terms of financial savings and security of supply;
    - Dedicating time at the ECOWAS Heads of State meetings to present simple analysis such as that presented in this Outlook and foster conversations on trading opportunities.

2. **Delivery of transaction-centric action plans to increase political accountability:** Fostering the political understanding set out above is the start, but subsequently this political understanding needs to be translated into accountability and in turn translate buy-in into delivery. Action plans need to be developed on a transactional basis, indicating what is required of all stakeholders in order for the electrons and money to start flowing. Linking these action plans with an analysis of the benefits of the trades will be particularly powerful, allowing the cost of delays in delivery to be clearly articulated.

3. **Financial backing is needed to accelerate trust:** For many countries, imports will be the most cost-effective approach to bringing new power onto their system; such trades would also be financially beneficial to larger countries, several of which are facing a possible oversupply situation. However, both potential importer and exporter countries cite a lack of confidence in their neighbors as a barrier to trade: exporters worry about receiving payments, whilst importers are concerned about being cut off. Bilateral guarantee products similar to those employed to de-risk generation investments need to be explored.

4. **Take a regional approach to gas supplies:** Securing gas supplies to the region is critical; sufficient gas would save around $120 Billion as compared to restricting gas at today's levels. Countries must explore regional solutions to the gas challenge such as addressing the challenges within the West Africa Gas Pipeline or investigating the feasibility of regional initiatives to develop gas fields or import LNG.

5. **Establish a transactions-oriented "Market Delivery Unit":** Both the analytical work required to help Governments identify power trading opportunities and the coordination support to their delivery must be provided through the mandated regional institutions. This could be achieved through the establishment of a new transactions-oriented "Market Delivery Unit" tasked with supporting countries to both identify and deliver trading opportunities. Its role would include:

    - Providing analysis to help identify trading opportunities and then senior political outreach to explore and secure buy in;
    - Developing and coordinating the delivery of transaction-centric plans;
    - Sharing status, risks and issues with those at a national level empowered to unblock them;
    - Sharing analysis and status with ECOWAS and using its convening power to address issues where required.

2. BACKGROUND AND PURPOSE

2.1. INTRODUCTION

Access to electricity in West Africa remains limited and the price is high. According to World Bank estimates, the average cost across the 14 countries of Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Guinea- Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, The Gambia and Togo is $0.25 per kilowatt hour, more than twice the global average. Part of this cost stems from the fact that nations in the region have so far dealt with energy problems independently, trying to match national demand with domestic generation.

But energy resources are not evenly distributed: some countries have found gas reserves that allow them to produce cheap and flexible electricity; some have important solar generation potential, which is useful to cover daily demand; others have relevant hydrogeological resources that can be used to produce clean power over 24 hours; and others have no particular resource or advantage in power generation and are obliged to build thermal power plants or import expensive liquid fuels, such as heavy fuel oil or gasoil.

In addition to an uneven distribution of resources, West African nations have experienced difficulties in planning the evolution of their energy markets. As a result, some countries have ended up with an excess of (costly) unused generation capacity, while others have a deficit of production, with a share of their national demand that remains unmet.

These challenges are exacerbated by the relatively low levels of regional trade in energy. In West Africa, such trade accounts for only about 3% of energy production a year. Because of this and other hurdles such as planning and infrastructure, just under half of people in West Africa are without access[3].

The long-term solution to this resource imbalance is the creation of a common energy market, in which power is easily traded from areas of surplus or low costs to areas of deficit or high costs. Through this approach, the overall cost of production would be minimized, because the cheapest sources would be used regardless of their geographical location and countries with excess production could sell power to those in deficit until the overall system is balanced.

In reality, integrating 14 countries into a single common day-ahead energy market is some time off. Bilateral trade is a more realistic opportunity in the short term with countries entering into mutually beneficial agreements. This bilateral stage is critical to build confidence in regional power trade among countries for which the concept is new, and security of supply concerns dominate. But it could also save the countries billions of dollars and provide export markets needed to facilitate further investments in countries endowed with low-cost resources such as gas and investment-friendly environments.

2.2. THE INSTITUTE'S ENERGY PRACTICE

This report was developed in partnership with Power Africa by the Energy Practice of the Tony Blair Institute for Global Change. The Institute aims to help make globalization work for the many. We do this by helping countries, their people and their governments address some of the most difficult challenges in the world today.

The Institute's Energy Practice is currently providing shoulder-to-shoulder support to energy ministers and other leaders across Africa, combining expertise in supporting government delivery with energy expertise to support planning, financing and implementing energy investments, and the reforms needed to establish sustainable power sectors. The practice is currently supporting seven governments in areas such as regional power trade, utilizing domestic gas resources, power system planning and enabling the off-grid market.

The Institute has strong political connections throughout West Africa and teams are currently working at the highest levels of government in eight of the 14 West Africa Power Pool (WAPP) countries (see figure 2): providing direct energy support in Senegal, Guinea, Sierra Leone, Liberia, Togo and Nigeria, as well as working in Côte d'Ivoire and Ghana.

FIGURE 2

Footprint and example engagements in the Energy Sector

Guinea:

Centre of Government programme since 2011. Embedded support at Ministry of Energy and Project delivery

- Established and supported **delivery unit responsible for 240 MW Kaleta dam**
- Established regulator

Sierra Leone:

Centre of Government programme since 2008. Embedded support at Ministry of Energy since 2012:

- Cross Government **support for PPA negotiations** (statehouse, Ministries, P Sector)
- Coordinated **power sector reforms** including the establishment of collection accounts to advance first major IPP
- Drive political consensus for **enabling regulatory and fiscal changes for solar Home system Market**

Liberia:

Centre of Government programme since 2010. Embedded support at Ministry of Energy since 2013:

- Implementation unit of **Mt. Coffee Hydro** project
- Set up and supporting **Rural Energy Working Group** to expand off grid sector
  Support to sector reform including: tariffs, unblocking T&D projects & connecting large (commercial) users.

West Africa Power Pool:

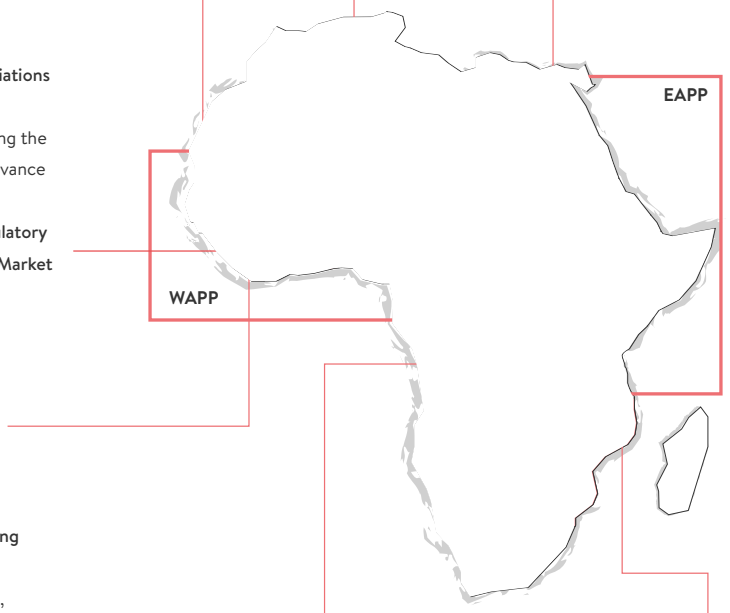
Institutional and analytical support since 2017:

- Detailed **regional modelling** to identify circa $30Bn of benefits through power trade
- Political engagement across the region to communicate **opportunity** and facilitate political dialogue and understanding on trade
- **Gas modelling** for key countries to identify impacts of different gas roadmaps on power prices and trade potential

Rwanda:

Centre of Government programme since 2008. Embedded support at Ministry of Energy since 2012.

- Analytical and political support to **investment planning**
- Coordination of **Utility reform**
  Development and delivery of **Rural Electrification strategy**



East Africa Power Pool:

Institutional and analytical support since 2016:

- Development of **Short term action plan**, used to secure $20m in funding
- Regional supply and demand analysis identifying **$6Bn in trade savings**
- Political **trade facilitation**

Mozambique:

Centre of Government programme since 2015. Embedded support at Ministry of Energy since 2017.

- Political adoption of **Masterplan and Rural Electrification Strategy**
- **Gas** to Power roadmap

Countries where TBI have supported the Energy Sector

Countries where we work elsewhere across Government

2.3. OVERVIEW OF THE STUDY

2.3.1. Work undertaken to date

In November 2017, in partnership with Power Africa, the Tony Blair Institute for Global Change commenced an analysis of the opportunities that trading in West Africa presented and the challenges that would need to be addressed to realise these opportunities. Over the subsequent 12 months, over 50 stakeholders were engaged, including ministers, utilities, the private sector and development partners to complete this assessment.[4]

The assessment was organized in three phases:

A) Modelling and Analysis

A review was undertaken of the power flows through the existing interconnectors and research was undertaken to understand the political, commercial and technical barriers to trade that exist today. Strategic modelling was undertaken of each of the power systems in West Africa to build up a regional picture of the evolution of surpluses and deficits from 2020 to 2030, including national production costs, and potential trading opportunities.

B) Detailed Stakeholder Engagement

In-depth consultations with Governments and other stakeholders were conducted in the following countries: Benin, Ghana, Senegal, Guinea, Côte d'Ivoire and Nigeria. During these engagements the preliminary results of the model were shared, and the following objectives were achieved:

- Awareness was raised at political levels in the countries of the potential benefits of regional power trade;
- The regional modelling was further refined;
- An enhanced understanding was developed of the political, commercial and technical barriers to future trade and some of the potential solutions;
- The long list of potential trades was refined based on this understanding.

C) Market Readiness and Gaps Analysis

Building upon the opportunities identified and national level insights learned through the first two phases, this stage consisted of a deeper analysis of the enablers to trade at a regional and transactional level. It also included an assessment of the current set of donor support and the identification of critical gaps; recommending enhancements in the way coordination is undertaken. This analysis was undertaken from the following perspectives:

- Institutional;
- Regulatory;
- Operational;
- Commercial;
- Infrastructural.

2.3.2. Structure of the report

The report - the West Africa Power Trade Outlook - is structured as follows:

- Chapter 1 is the executive summary, presenting the main findings of our analysis;
- Chapter 2 presents the background and purpose of the study;
- Chapter 3 presents in detail the regional analysis including an overview of the trading opportunities, based on the results of our model and an appraisal of the gas availability;
- Chapter 4 summarises potential areas of international donor support to regional power trade.

2.3.3. Next steps

The next stage of TBI's engagement to support regional power trade in collaboration with Power Africa will build upon the regional supply and demand analysis, national insights and gaps assessment to provide practical assistance to advancing critical priority trades and will consist of:

- On-the-ground assistance to countries to put in place and implement plans to deliver priority transactions in the short term, realising millions of dollars of savings for the countries involved and helping lay practical foundations for the regional market in the longer term;
- Institutional support to the delivery of functioning power trade agreements: discussion with governments and development partners about the potential creation of a transactions-oriented Market Delivery Unit (MDU).

3. REGIONAL ANALYSIS

3.1. APPROACH TO MODELLING

The analysis presented in this report has been produced using the Institute's Strategic Regional Model, populated with key inputs such as projected demand, capacity additions, resource availability and costs.

In summary the model works as follows:

- **National level inputs** are provided such as demand profiles and projections, resource availability and costs, and generation plant commissioning dates.
- **National production** is simulated by "dispatching" the available plant during three periods: an evening peak; a shoulder or day time period; and a night period.
- **Outputs are calculated at a national level:** long-run production costs, surpluses / deficits and resource and plant utilization are then calculated for each country.
- **Trade simulation and regional model:** finally, the results are aggregated in order to produce a regional perspective and simulate and calculate the potential benefits of trading. It is worth noting that surpluses and deficits displayed in this report are indicated primarily in MW away from the evening peak for the following reasons:
  - Decision makers in the region tend to think in MW rather than GWh since it is at this level investment needs are identified, and Government targets set;
  - A volume GWh does not capture the link with the time of day (e.g. countries' import requirements are likely to be most acute during the evening peak; however, this is the time when export availability from countries in surplus is also likely to be most limited);
  - The purpose of the analysis is to identify high volume bilateral trading opportunities.

Additionally, all figures for surpluses and deficits are exclusive of liquid fuels. The purpose of the model is to identify trading opportunities, and if a country is dependent on liquid fuels away from the evening peak, imported power is almost always going to represent a lower cost option.

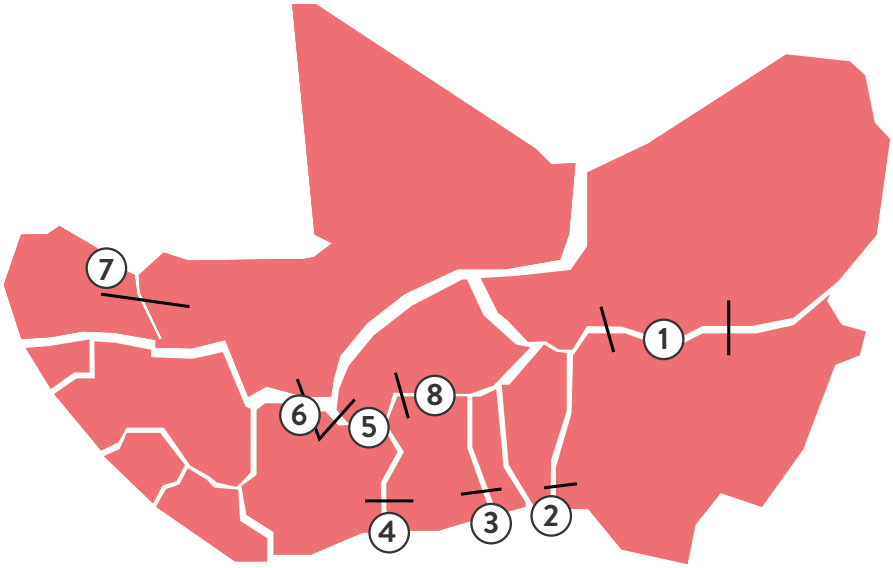
Finally, it is worth noting that this is a relatively simple strategic tool intended to be used to:

- Help countries understand the regional context and their own opportunities for import and export;
- Help countries identify, at a high-level, their domestic investment requirements such as power or gas infrastructure; and
- Allow countries to compare the likely financial impacts of different scenarios: for example, the timing of investment or securing additional gas resources. The model does not replace the need for detailed domestic or regional master planning.

3.2. EXISTING TRADE

There are seven major interconnectors currently in existence linking countries across West Africa (see figure 3), while an eighth link (Ghana-Burkina Faso) was inaugurated in October 2018.

FIGURE 3: INTERCONNECTION LOCATION MAP



① **Nigeria - Niger**
Katsina - Gazoua (132 kV)
Birnin Kebbi - Dosso (132 kV)

② **Nigeria - Benin**
Ikeja West - Sakate (330 kV)

③ **Ghana - Togo**
Akosombo - Aflao (161 kV X2)

④ **Côte D'Ivoire - Ghana**
Riviera - Prestea (225 kV)

⑤ **Côte d'Ivoire - Burkina**
Ferké - Kodeni (225 kV)

⑥ **Côte d'Ivoire - Mali**
Ferké - Sikasso (225 kV)

⑦ **Mali - Senegal**
(225 kV)

⑧ **Ghana - Burkina Faso**
Bolgatanga-Ouagadougou (225 kV)

However, the volume of power exchanged through these lines averaged less than 50% of the available capacity during 2017, largely as a consequence of political and commercial issues. Table 1 illustrates the usage pattern through these lines and describes the nature of the transactions.

The current barriers to trade can be considered in three categories:

- Solvency issues on the side of the purchaser mean bills go unpaid and power sold reduces;
- Internal political drivers pushing for domestic generation, even when imports would be more cost-effective.
- The existence of legacy political PPAs, which often do not make economic sense for the seller and provide little more than a "best efforts" guarantee that power will be provided by the supplier.

TABLE 1: UTILIZATION OF LINES IN THREE WEST AFRICAN TRANMISSION ZONES

Line	Capacity	Utilization (2017)	Utilization Pattern (Jan - Nov '17)	Comments
Zone A: Ghana, Burkina Faso, Togo, Côte d'Ivoire				
③ **Ghana - Togo** Akosombo - Aflao (161 kV X2)	216 MW	14%		Drop in exports from Ghana to Togo (8c$/kWh), primarily a consequence of CEB'S poor repayment history.
④ **Côte d'Ivoire - Ghana** Riviera - Prestea (225 kV)	280 MW	17%		Declining utilization to both countries transitioning into surplus.
⑤ **Côte d'Ivoire - Burkina** Ferké - Kodeni (225 kV)	113 MW	58%		Exports from CI restricted due to PPA structure: • 10c$/kWh to 50 MW; then • 31c$/kWh above 50 MW
⑥ **Côte d'Ivoire - Mali** Ferké - Sikasso 225kV	80 MW	46%		*Trade from Côte d'Ivoire to Mali* - 11c$/kWh Recent agreement made to boost trade by 15MW
Zone B: Mali - Senegal				
⑦ **Mali - Senegal** Manantali - Matam (225 kV)	250 MW	16%		Bidirectional usage. But the line utilization is restricted to transmit each country's respective generation share from the Manantali dam. Limited trade.
Zone C: Nigeria - Niger - Benin				
① **Nigeria - Niger** Katsina - Gazoua (132 kV) Birnin Kebbi - Dosso (132 kV)	80 MW	60%		Utilization of exported lines to Benin (11 cS/kWh) and Niger (7 c$/kWh) remained high in part because of the revenue issues with Nigeria's DISCOS.
② **Nigeria - Benin** Ikeja West - Sakate (330 kV)	210 MW	85%		

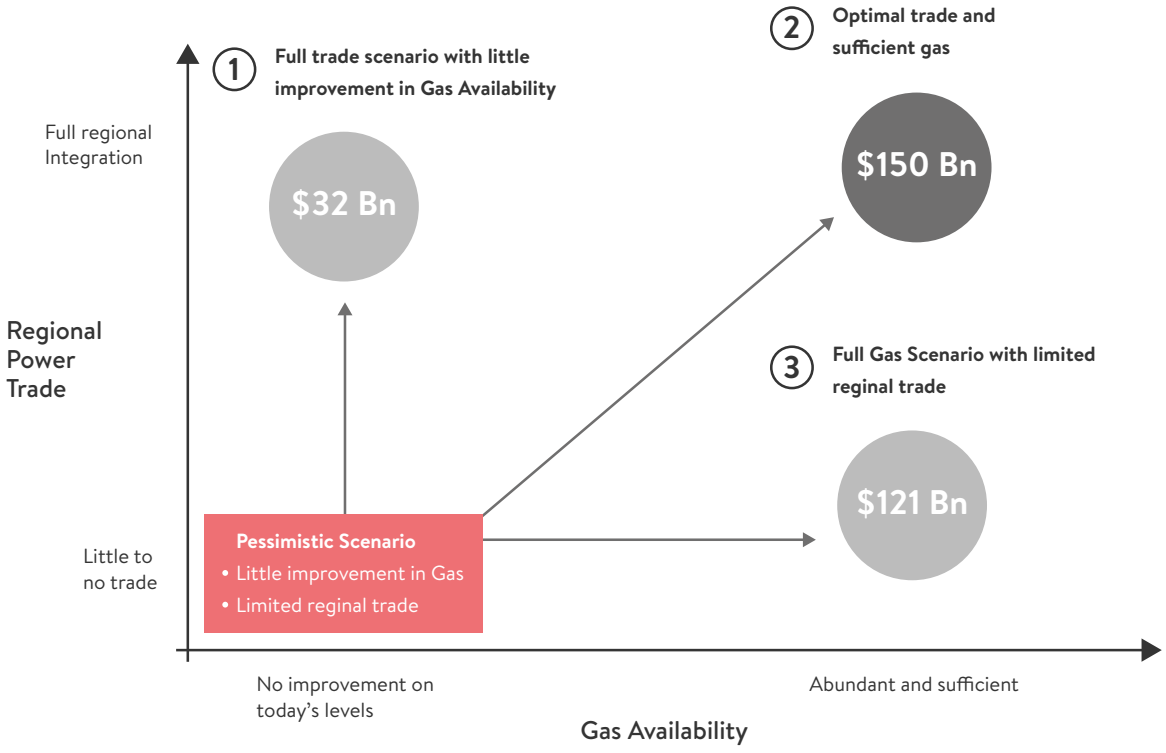
Only Nigeria has been using its interconnections with a high utilization rate, and this is in part a consequence of the liquidity issues within the Nigerian Power sector, which make exports more financially attractive than meeting the demand of the domestic distribution companies.

3.3. TWO STRATEGIC PRIORITIES: NATURAL GAS AND POWER TRADE

The region faces two critical strategic challenges:

- Securing sufficient gas resources which could save around $121 billion by providing sufficient gas for coastal countries to not only satisfy their own demand, but to also produce power for export to the smaller coastal and inland countries;
- Increasing power trade which could save the region around $32 billion over the coming decade, by bringing low-cost power from areas of surplus to areas of deficit. If both regional power trade is developed, and sufficient low-cost gas is secured, the total benefits for the region would total around $150 billion (see figure 4).

FIGURE 4: FOUR SCENARIOS FOR REGIONAL POWER TRADE AND GAS AVAILABILITY

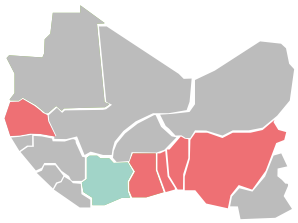


3.4. NATURAL GAS AVAILABILITY AND THE WEST AFRICA GAS PIPELINE

Figure 5 indicates both the financial benefits that could be achieved through increased gas availability as well as the impact additional gas would have on a net average import or export requirements by 2025.

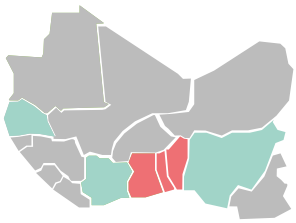
FIGURE 5: FINANCIAL IMPACTS AND IMPACTS ON POWER BALANCE OF GAS AVAILABILITY

Low Gas Scenario



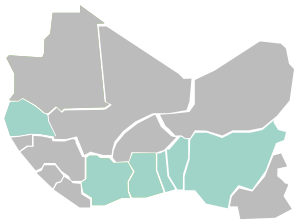
	2025 BALANCE	ASSUMPTIONS
Nigeria	-5 GW	Available Gas does not exceed current record (1496mcfd)
Côte d'Ivoire	+600 MW	Existing fields depleted; no new developments
Senegal	-300 MW	No Gas developed
Ghana	-1 GW	Existing fields deplete; no new developments; no Gas in WAGP
Benin	-200 MW	No gas in West African Gas Pipeline (WAGP)
Togo	-120 MW	No gas in WAGP

Baseline Scenario



BENEFITS (FROM LOW GAS)	2025 BALANCE	ASSUMPTIONS
+$84 Bn	+3.3 GW	80% of Gas requirements till 2025 then 400Mmcfd
+$540 m	+1 GW	Additional Gas from Foxtrot tie back and Vitol
+$4 Bn	Balanced	Gas from Greater Tortue comes onstream 2022
+$8.6 Bn	-200 MW	TEN and Jubilee extension go ahead; WAGP at today's level
+$700 m	-200 MW	WAGP maintained at today's level
+$640 m	-100 MW	WAGP maintained at today's level

High Gas Scenario



BENEFITS (FROM LOW GAS)	2025 BALANCE	ASSUMPTIONS
+ $95 Bn	+3.3 GW	100% of Gas requirements met immediately
+$380 m	+1.5 GW	LNG from 2023 in place of domestic additions
+ $2 Bn	+250 MW	LNG from 2021 in place of domestic gas
+ $14.7 Bn	+900 MW	TEN and Jubilee extension go ahead; expanded WAGP meets remaining gas requirements
+ $3.3 Bn	+70 MW	WAGP meets all gas requirements
+ $1.4 Bn	+30 MW	WAGP meets all gas requirements

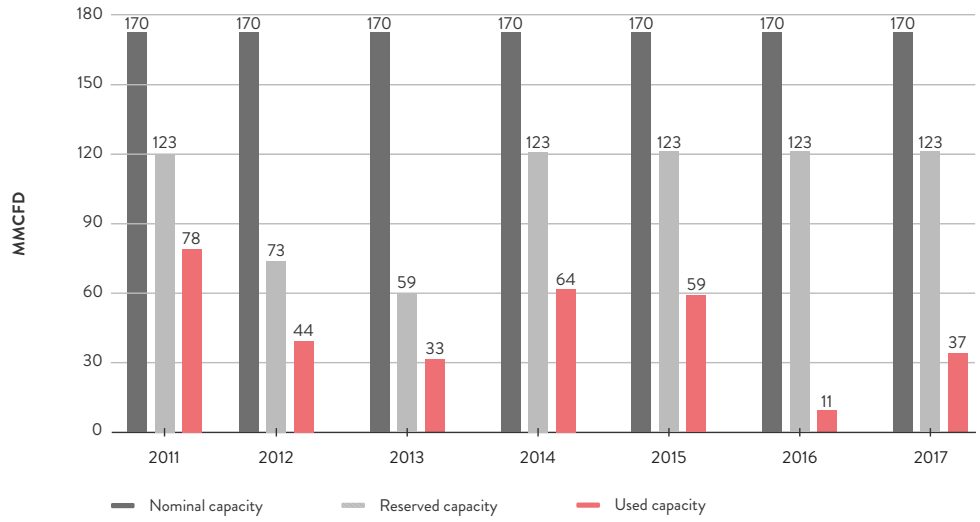
- It is in Nigeria where the financial benefits of securing gas supplies in the long run are most marked; the cost of a failure to secure additional gas beyond today's consumption levels throughout the next decade would be around $95 billion. The baseline scenario in our model for Nigeria is that around 80% of the country's gas requirements will be met until 2025, by which time the major gas supply challenges will have been addressed.
- Both Côte d'Ivoire and Senegal could most cost-effectively meet their internal power demand through domestic production (Foxtrot and Vitol in the case of Côte d'Ivoire and Greater Tortue in the case of Senegal). Both countries could equally import LNG, however most likely at a higher cost than the development of domestic fields.
- The development of the TEN and Jubilee extension fields in Ghana would save the country around $8 billion over the next decade as compared to no increase in domestic availability. However, significant additional savings (a further $6 billion) could be made if the current supply challenges impacting the West African Gas Pipeline (WAGP) are addressed.

- Benin and Togo are both currently suffering financially as a consequence of the supply issues in the WAGP. A complete end to the supply of gas would cost them around $1.3 billion over the next decade; conversely, were the issues to be addressed and the gas to begin flowing at high and predictable volumes they would save around $5 billion. A possible solution for gas supply to Ghana, Benin and Togo is to address the challenges faced by the West Africa Gas Pipeline (WAGP).

The West Africa Gas Pipeline

This pipeline was built with the aim of exporting Nigeria's gas to its neighbor countries and is managed by a dedicated company, called WAGP Co, based in Accra, Ghana. It is regulated by the WAGPA Authority, based in Abuja, Nigeria, which represents the four countries currently involved in this project (further details can be found in Appendix II). Unfortunately, the pipeline is being utilized below its potential despite the clear benefits it could provide to Benin, Togo and Ghana (see figure 6).

FIGURE 6: HISTORICAL TRADING ON THE WAGP, 2011–2017 SOURCE: WAGPA 2018



There are three key reasons for this:

Gas Resource Availability

- Domestic demand in Nigeria for gas has increased more than the production, thus reducing the gas availability for WAGP;
- Producers arbitrage potential between Nigeria's domestic market, WAGP and export (LNG).

Payment Issues

- The Ghanaian purchaser (VRA) has usually defaulted on payments, although these arrears are now being addressed with the support of the Ghanaian Government.

Security Issues

- Vandalism is one of the biggest concerns. WAGPA is working to secure the maritime zone of the pipeline.

Addressing these challenges would see enormous savings for Ghana, Benin and Togo and mitigate against the need, in the short term at least, for them to pursue other import options such as LNG. If the challenges are addressed there would be scope for expansion of the WAGP by around 2025 to satisfy the additional domestic demand of Ghana, Benin and Togo.

Figure 7 illustrates the potential demand for gas through the West Africa Gas Pipeline to satisfy the domestic power demand of Ghana, Benin and Togo[5], whilst figure 8 illustrates the impact of Ghana importing sufficient gas to export 500 MW and 1 GW of power.

FIGURE 7: HISTORIC AND REQUIRED MM SCF/D FROM WAGP, 2011–2030

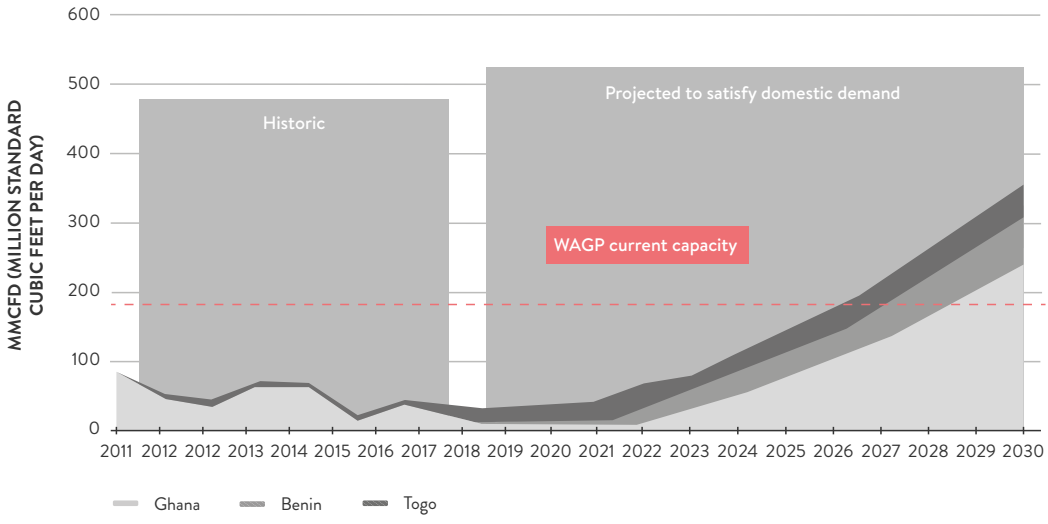
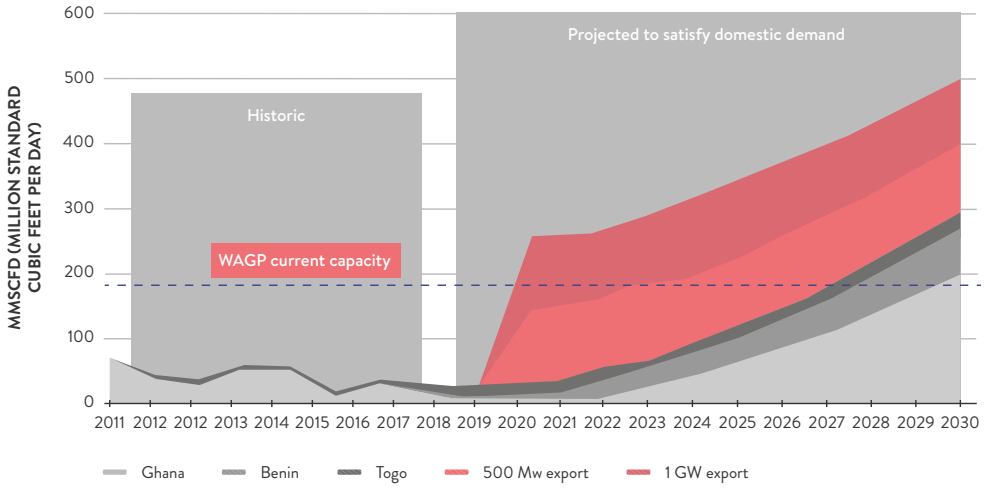


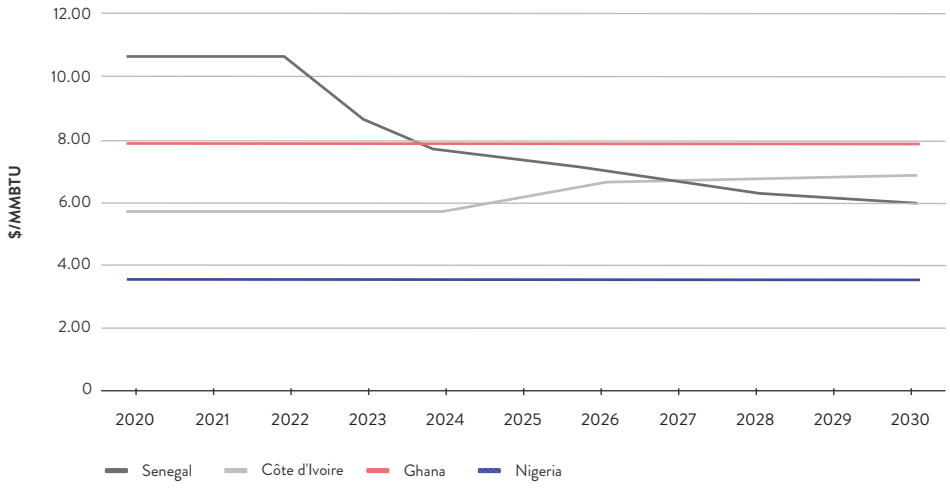
FIGURE 8: THE POTENTIAL IMPACT OF GHANA SECURING GAS TO EXPORT 500 MW OF POWER ON UTILIZATION OF THE WEST AFRICA GAS PIPELINE



However, as we will explore in the next section on regional power trade, any Ghanaian ambitions to become a large exporter of power need to be examined in the context of its competition with neighboring Côte d'Ivoire, which is also set to have surplus generation capacity.

Figure 9 shows the expected evolution of domestic gas prices in selected countries, as assumed in our model.

FIGURE 9: PREDICTED EVOLUTION OF DOMESTIC GAS PRICES FOR ELECTRICITY GENERATION, 2020–2030

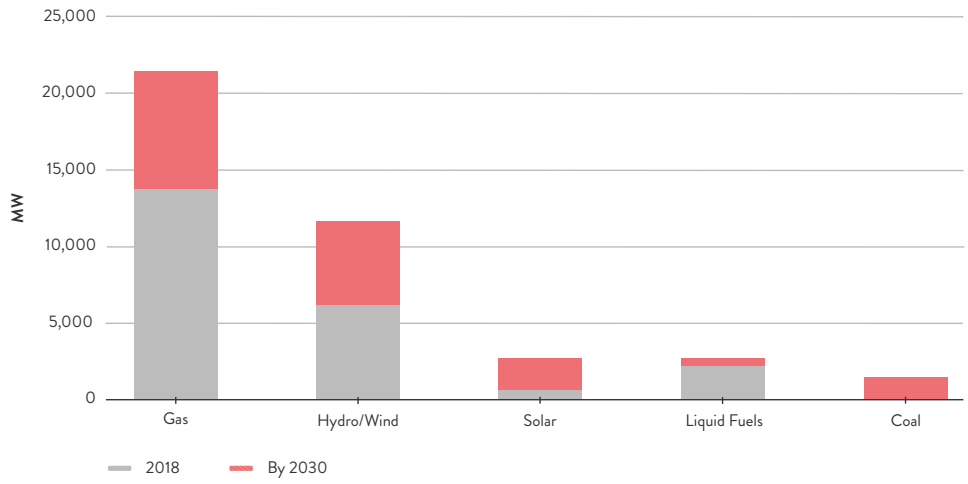


3.5. REGIONAL POWER INVESTMENTS AND TRADING OPPORTUNITIES

3.5.1. AGGREGATION OF EXISTING PLANS

A detailed assessment of planned generation investments across the region has been undertaken and the projected capacity increases are described in figure 10.

FIGURE 10: CURRENT AND PROSPECTIVE INSTALLED CAPACITY IN THE WAPP BY SOURCE (IN MW)



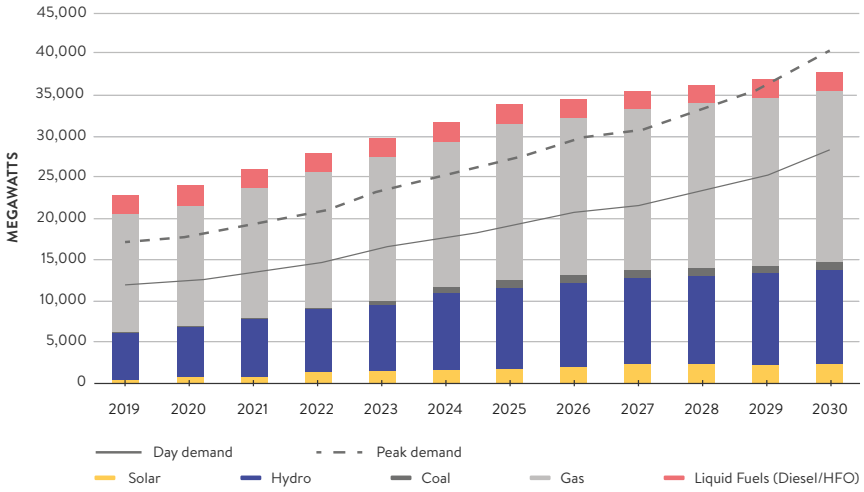
AGGREGATE REGIONAL INSTALLED CAPACITY (MW)

Technology	2018	Additions	2030	% Growth
Coal	0	935	935	-
Liquid fuels	2,102	149	2,251	7%
Solar	362	1,983	2,345	549%
Hydro / Wind	5,515	5,854	11,369	106%
Gas	14,100	15,694	20,874	48%
Total	22,079	15,694	37,773	71%

Some important observations are:

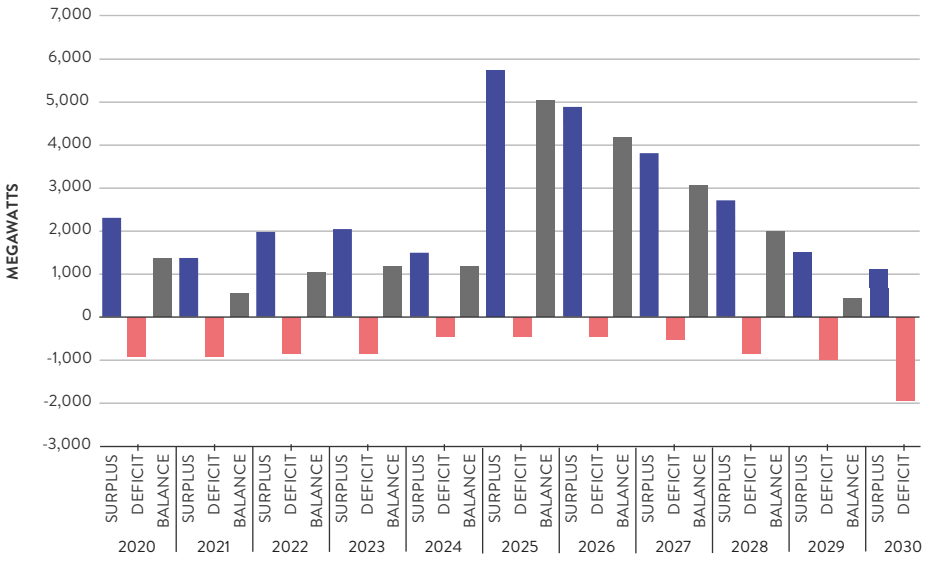
- Gas- and hydro-based generation will dominate capacity additions based on current plans, growing at around 50% and 100% respectively;
- While installed solar capacity is set to increase six-fold, this is well below the optimal level of solar proposed for the system through the draft regional master plan, suggesting that there is significant scope for around 15 GW of additional, well planned and tendered low-cost solar projects in the region. The consequence of this investment is that installed capacity will be above demand for most of the next decade (see figure 11).

FIGURE 11: PREDICTED INSTALLED CAPACITY AND DEMAND IN WEST AFRICA, 2019–2030



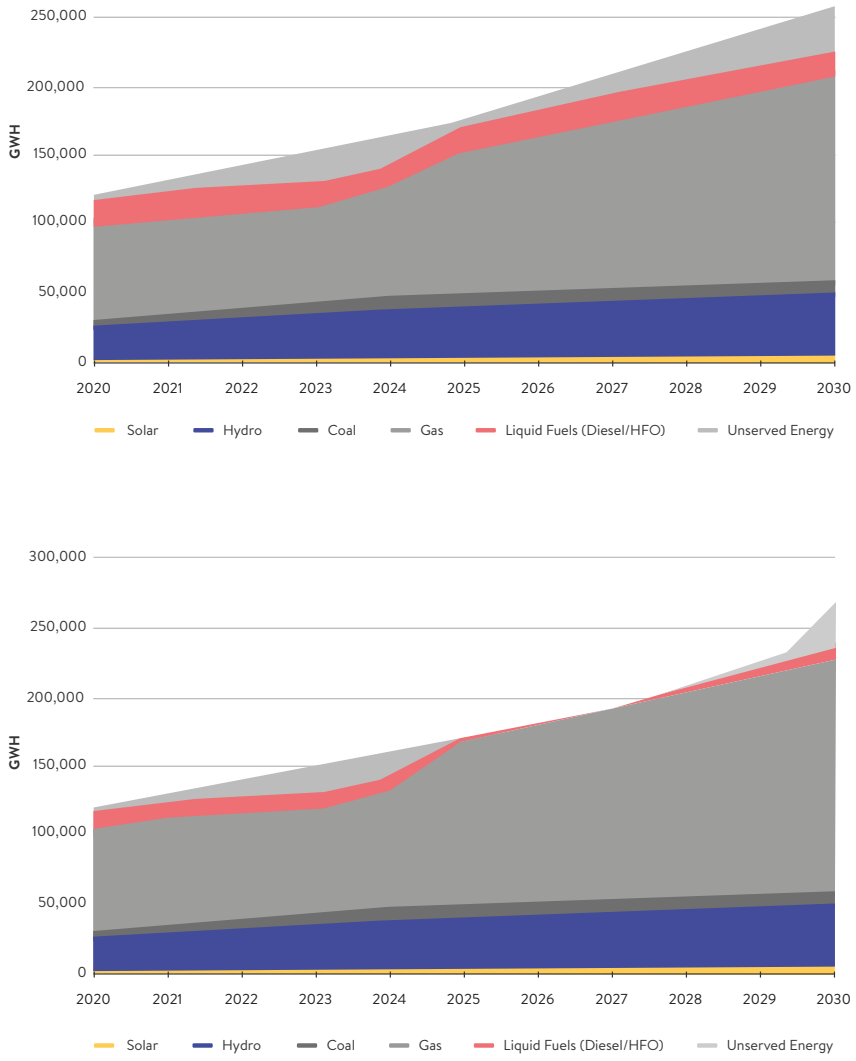
It is also instructive to examine the effective power available when resource constraints such as limitations in hydrology or gas availability are accounted for.

FIGURE 12: SYSTEM SURPLUSES AND DEFICITS (DRY SEASON)



On aggregate, there would be sufficient capacity to meet the region's energy demand without the need for liquid fuels (at least until 2029), assuming that currently planned projects get completed. However, if trade did not take place, much of this capacity would be underutilized, as countries such as Côte d'Ivoire and Guinea would end up in excess, while countries such as Burkina Faso and Niger would continue to rely on costly liquid fuels. Peak demand in 2020 would be around 18,000 MW; by 2028, this would have surpassed 43,000 MW. Figure 12 illustrates the total of the average non-peak surpluses and deficits across the region. Below we show the evolution of electricity generation in the case of isolated dispatch and in the case of trade.

FIGURE 13: ISOLATED DISPATCH (LEFT) AND REGIONAL TRADE (BILATERAL UP TO 2025 AND LIQUID DAY AHEAD AFTER)



3.5.2. TRADE PERSPECTIVE: **2022**

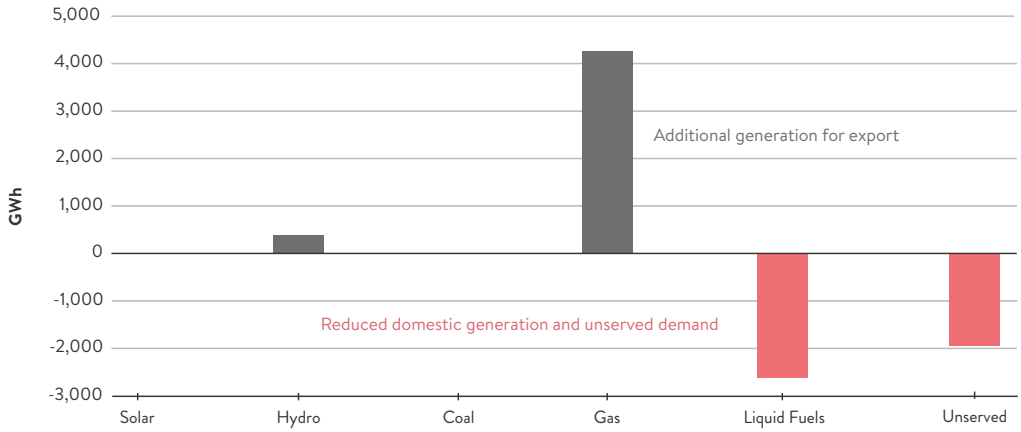
By 2022 only three countries are expected to have the potential to be significant year-round exporters: Côte d'Ivoire, Ghana and Mauritania[6], each of whom will be reliant on natural gas.

Guinea's supply and demand balance will be seasonal because of heavy reliance on large hydro projects: with a wet season surplus (July to December) and a dry season deficit (January to June). Nigeria, under our baseline scenario, is assumed to continue to suffer from transmission issues affecting domestic power and gas transit translating into underutilised generation capacity. All the other countries are potential importers, with three largest markets being those without access to the sea and so limited to fuel import prospects: Mali, Burkina Faso and Niger.

This regional overview gives an idea of the importance of trading, in particular for importing countries that could replace expensive or inefficient diesel- or HFO-based generation (often up to 30 US cents / kWh) with cheaper import (10-14 cents/kWh) to cover their demand and make huge savings.

Figure 14 shows the possible effect of bilateral trade on the electricity generated and dispatched in the Region. Côte d'Ivoire, Ghana and Mauritania together could export more than 4,000 GWh per year. This would displace almost 2,500 GWh of liquid fuels and it would reduce unserved energy by almost 20% in the region.

FIGURE 14: VARIATION OF REGIONAL GENERATION DUE TO TRADE IN 2022



3.5.3. TRADE PERSPECTIVE: **2025**

The outlook to 2025 is much harder to predict with uncertainty around demand, resource availability, and the generation capacity additions that will have been added by then.

Aside from generation investments, the biggest change in the outlook is the assumption that Nigeria will have addressed its gas availability issues by this point and will pivot to become a major potential exporter. Figure 15 shows the possible effect of bilateral trade on the electricity dispatched in the Region. Bilateral trade would enable more than 10,000 GWh of electricity exchanges, 65% of which would be from increased gas-fired generation. Moreover, Niger and Mauritania would start exporting coal. This would displace almost 5,000 GWh of domestic generation based on liquid fuels and it would reduce to zero the unserved demand at a regional level.

FIGURE 15: VARIATION OF REGIONAL GENERATION DUE TO TRADE IN 2025

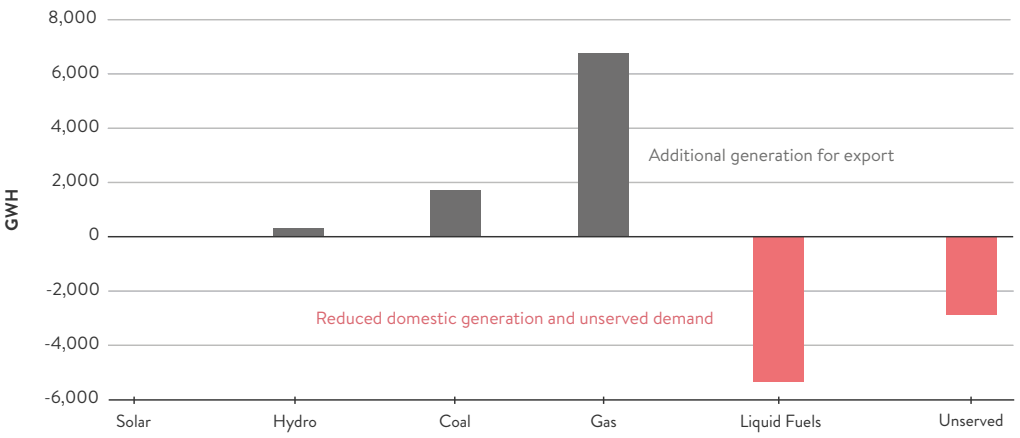


FIGURE 16: POSITIONING OF THE DIFFERENT COUNTRIES IN 2022, WITH POTENTIAL EXPORT FLOW

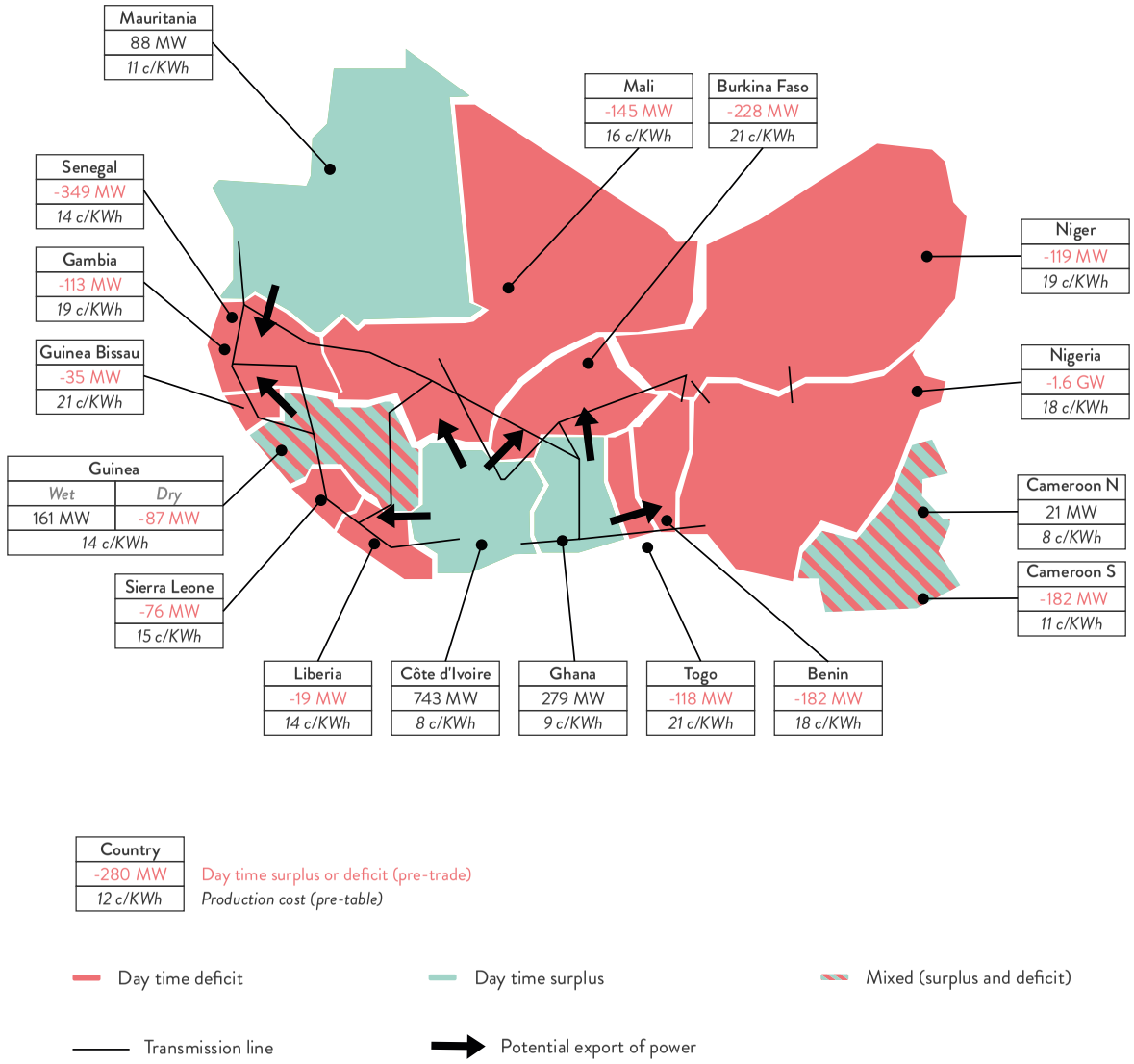
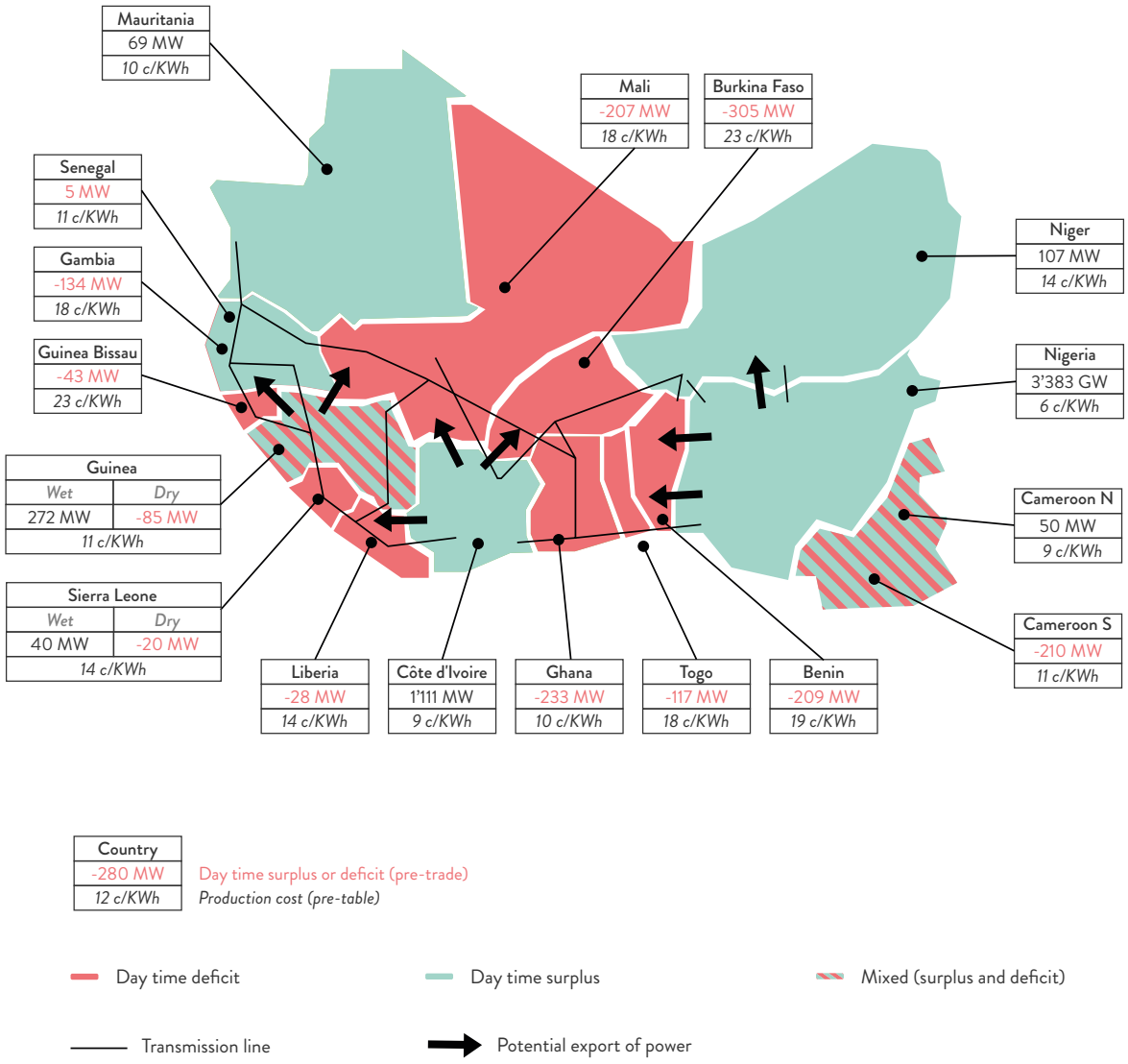


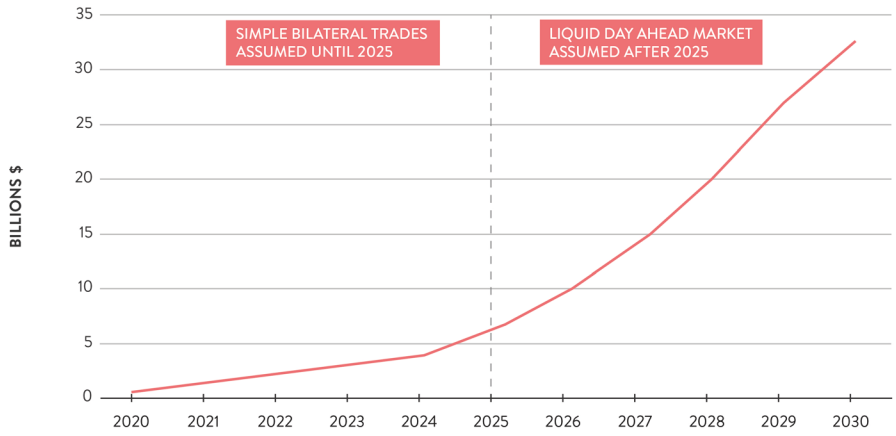
FIGURE 17: POSITIONING OF THE DIFFERENT COUNTRIES IN 2025, WITH POTENTIAL EXPORT FLOW



3.5.4. THE REGIONAL BENEFITS OF TRADE

At the regional level, we estimate that around $32 billion of savings could be achieved through power trade over the next decade. This is the aggregate of benefits expected to accrue through both displacing costly liquid fuels and generating revenue for power plants that would otherwise be idle at times during the day and the year.

FIGURE 18: CUMULATIVE BENEFITS OF TRADES FOR THE OVERALL WAPP REGION, 2020–2030



The calculation of trade savings was undertaken by considering the decade in two phases:

- Bilateral trades between 2020 and 2025: during this period, it has been assumed that trades would be on a bilateral basis and imports would be used to both meet supply deficits and displace the use of liquid fuels.
- Liquid market from 2025: from 2025, it has been assumed that a liquid market is in place and the savings are the difference between operating the region as a single system versus operating it as several small systems. In addition to the financial savings, the environmental benefits of this reduction would be significant, amounting to a saving of around 23 million tonnes of fuel oil, which is the equivalent of the annual consumption of diesel vehicles in the UK.

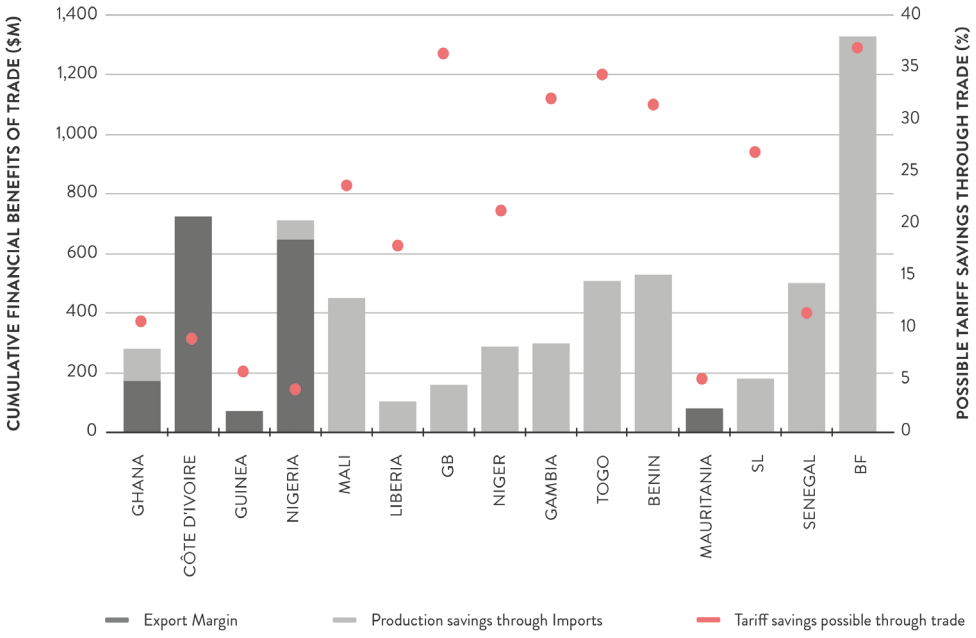
3.5.5. NATIONAL IMPLICATIONS

Every country in the region will benefit from trade. Exporters such as Ghana, Côte d'Ivoire, Guinea and Nigeria will collect revenue from otherwise idle generation plants, whilst importer countries will replace costly liquid fuels with imports.

In figure 19, trading benefits are represented in two ways:

- Along the left axis are the cumulative financial benefits for each country over the period 2020-2025, in turn divided into revenues from export and savings from displacing costly liquid fuel generation or meeting demand that would otherwise have to be met by costly captive generation;
- Along the right axis are the trading benefits as the equivalent reduction of the unit cost of production. For example, Côte d'Ivoire could save thanks to trading up to USD 700 million until 2025, or in other words its unit cost of production would decrease by 9% on average.

FIGURE 19: POTENTIAL BENEFITS FROM BILATERAL TRADING UNTIL 2025



Côte d'Ivoire is set to dominate power export potential in the region, thanks to available gas reserves (it is expected to produce around 200 Million Cubic Feet per day) and surplus generation capacity (~960 MW of new Combined Cycle Gas Turbine (CCGT) capacity will go online by 2022).[7] The average cost of production in Côte d'Ivoire will be relatively low for the region, (8 cents/kWh), largely as a consequence of the availability of relatively low-cost gas.

Trading opportunities: This cost is significantly lower than that of the importing countries, thus representing a serious incentive to trade for both the exporter and the potential importers, namely Burkina Faso and Mali in the north, and the "CLSG countries"[8] in the west.

Burkina Faso and Mali will need gas-fired power, especially during the evening peak (up to 220 MW and 140 MW respectively) and even in case they were to develop additional solar potential. Burkina Faso, in particular, is expected to have a very high unit pre-trade cost of power (21 cents/ kWh) because of a reliance on liquid fuels. Replacing this with imported power could save up to $100m a year.

Sierra Leone, Liberia and Guinea, will be connected via the CLSG line. Côte d'Ivoire could provide balancing services to Liberia (in the range of 10-20 MW), steady export to Sierra Leone (up to 70 MW) and supply Guinea during the dry season (up to 87 MW in 2022). Collectively they will utilize the full capacity of the 145 MW rated line.

Trading opportunities: All in all, if Côte d'Ivoire were to export all of this power at a price of 10 c$/kWh, it would be able to make a cumulative gain of $320 million as exporting margin[9], which would become $430 million at a selling price of 12 cents/kWh.

The main contender of these markets will be **Ghana**, which has a generation mix similar to Côte d'Ivoire's. However, under the baseline gas scenario, Ghana would not have enough domestic gas to underpin a strong and constant export of power.

Trading opportunities: additional gas supplies would need to be secured, if Ghana were to become a large regional exporter and leverage the surplus generation capacity anticipated by 2022. As a rule of thumb, for every 500 MW of export, Ghana would need to secure around 100 MMCF/d. The potential sources of such gas provision include: accelerating the exploitation of domestic resources, importation via the West Africa Gas Pipeline and developing LNG import infrastructure. In each case, considerable care must be taken to sign up financially-backed export agreements to mitigate first and foremost against the risk that Ghana is left with costly take-or-pay charges for gas it cannot consume.

Guinea is set to have a seasonal surplus, during which power could be exported to neighboring countries: particularly The Gambia, Guinea-Bissau and, to a certain extent, Senegal. The long run costs of Guinea's hydro resources are around 10 cents/KWh, meaning that power may need to be sold at below the long run cost in order to secure export markets (considering Côte d'Ivoire's 8 cent long run costs).

Trading opportunities: During the dry season, Guinea is set to suffer from significant drops in the availability of its hydro output, making it reliant on costly liquid fuels. During this time, it may also look to import power from Côte d'Ivoire.

3.5.6. KEY SHORT-TERM TRADING OPPORTUNITIES (2022)

A long list of transactions was developed which collectively could create benefits of around $2 Billion a year by 2022. This list was then screened on the basis of:

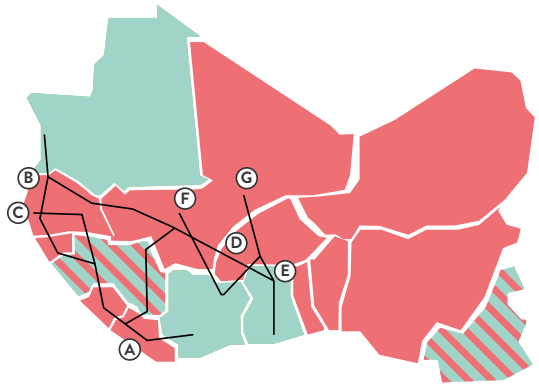
- Financial benefits each transaction could provide; and
- Readiness, given the market readiness and political willingness of countries involved.

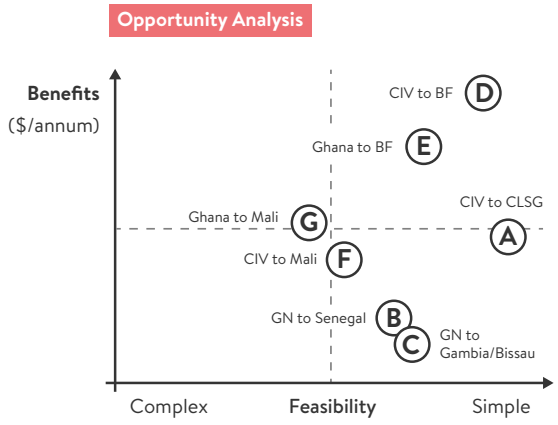
The results of this analysis are illustrated in figure 20.

These short-term transaction opportunities can be grouped into two logical clusters:

1. **The integration of the Western Coast**. There is potential for a sub-regional agreement between Senegal, The Gambia, Guinea- Bissau, Guinea, Sierra Leone, Côte d'Ivoire and Liberia. Under this, the seasonable output of large hydro projects in Guinea, Sierra Leone and Liberia could be balanced with gas generated power from Côte d'Ivoire to produce a relatively low-cost energy mix for the sub- region, exploiting the synergies between gas and hydro power. This sub-regional agreement could enable trade of around 1,200 GWh/year and produce an overall benefit of $170 million.[10] Whilst this remains a medium-term aspiration, practical first steps would be to facilitate bilateral trades as building blocks, such as from Guinea to Senegal or Côte D'Ivoire to Liberia and Sierra Leone.
2. **Regional gas powers exporting to Burkina Faso and Mali**. Both Mali and Burkina Faso have a significant pipeline of solar projects, however these alone will not provide the stable 24-hour power these countries need, and, without trading, each would still need to burn costly diesel and heavy fuel oil. Both countries are fortunate in that they will be able to receive power from both Ghana and Côte d'Ivoire. The collective benefits of this trade for all countries combined would be around $450 million per year. However, it is important that both Côte d'Ivoire and Ghana collaborate as well as compete for these markets in order to avoid committing to long term gas import agreements to service regional power exports, which may not materialise.

FIGURE 20: OPPORTUNITY ANALYSIS OF POTENTIAL TRANSACTIONS BY 2022





#	From	To	Peak Power (MW)	Potential Trade Volumes (GWh)	Potential Trade Benefits ($m/year)	Year interconnector ready	Feasibility
A	CIV	CLSG	145	948	122	2020	● ● ● ● ○
B	GN	Senegal	350	125	21	2021/22	● ● ● ○ ○
C	GN	Gambia/G. Bissau	110	125	22	2021/22	● ● ● ○ ○
D	CIV	BF	230	1,615	296	Existing	● ● ● ● ○
E	Ghana	BF	150	990	182	Existing	● ● ● ○ ○
F	CIV	Mali	150	1,005	130	Existing	● ● ● ○ ○
G	Ghana	Mali	150	990	150	2023?	● ● ○ ○ ○

Credit: Getty images

4. RECOMMENDATIONS

4.1 FOSTER POLITICAL UNDERSTANDING AND LEADERSHIP

Whilst the technical aspects of power trade should be left to the utilities, regulators and other institutions with the relevant mandate, political leadership is required to set the direction and ensure the many complex activities remain coordinated.

A pre-requisite for such leadership is that political leaders understand the opportunities and benefits which trade presents. This could be addressed in a number of ways:

1. Dedicating time at the ECOWAS Heads of State meetings to present high-level analysis such as that presented in this outlook and foster conversations between Heads of State on trading opportunities.
2. Sharing a detailed opportunity analysis for each country with relevant political leaders to identify the short-term transactions they could enter into along with the benefits in terms of financial savings and security of supply.

4.2 DELIVERY OF "TRANSACTION CENTRIC" ACTION PLANS TO INCREASE POLITICAL ACCOUNTABILITY

The establishment of a regional trading market will require a vast and diverse array of activities to take place, the majority of which will need to be done by national institutions such as utilities and regulators. Without high level political ownership within the countries this will simply not happen. Fostering the political understanding set out above is the start, but subsequently this political understanding needs to be translated into accountability and in turn translate buy-in into delivery.

Action plans need to be developed on a transactional basis, indicating what is required of all stakeholders in order for the electrons and money to start flowing. These Action plans need to be shared with, and owned by, political leaders who can use the power of their office to unblock the challenges that will inevitably materialize along the way. Linking these action plans with an analysis of the benefits of the trades will be particularly powerful, allowing the cost of delays in delivery to be clearly articulated.

Without key regional activities such as tariff methodologies, and operating codes being linked to clear national benefits and specific transactions, it is difficult to see a case for National Governments prioritizing them above the multitude of other priorities they have.

4.3 PROVIDE FINANCIAL BACKING FOR THE POWER TRADES TO ADDRESS TRUST ISSUES AND ACCELERATE MARKET DEVELOPMENT

For many countries, imports will be the most cost-effective approach to bringing new power onto their system; this is particularly true for smaller countries with limited domestic resources. Such trades would also be financially beneficial to larger countries, several of which are facing a possible oversupply situation.

However, both potential importer and exporter countries cite a lack of confidence in their neighbors as a barrier to trade: importers express concern that the country supplying them could cut supplies, turning the lights off, whilst exporters express concern that importing countries may not pay for the power they purchase. These trust issues need to be addressed, particularly if trade is to move from the opportunistic (a way of addressing short term imbalances) to the strategic through which investment decisions (and decisions on long term fuel imports) are made with trade in mind.

Guarantee products such as the World Bank's Partial Risk guarantee have proven effective at giving investors' confidence to develop generation capacity where the utility debt levels poses a repayment risk. Similar products need to be introduced to mitigate the risks to trade.

4.4 TAKING A REGIONAL APPROACH TO GAS SUPPLIES

Securing gas supplies to the region is critical; sufficient gas availability would save around $120 Billion as compared to restricting gas at today's levels. However, demand for gas at the level of an individual country will often be below that required to make investment in capital-intensive gas infrastructure such as LNG facilities a viable proposition. Donors must play a role in supporting countries to coordinate to find regional solutions to the gas challenge such as addressing the challenges within the West Africa Gas Pipeline or investigating the feasibility of regional initiatives to develop gas fields or import LNG.

4.5 CREATION OF A TRANSACTIONS-ORIENTED DELIVERY UNIT

Both the analytical work required to help Governments identify power trading opportunities and the coordination support to their delivery must be provided through the mandated regional institutions. This could be achieved through the establishment of a new transaction-oriented "Market Delivery Unit" tasked with supporting countries to both identify and deliver trading opportunities. Its role would include:

- Providing analysis to help identify trading opportunities and then senior political outreach to explore and secure buy in;
- Developing and coordinating the delivery of transaction-centric plans;
- Sharing status, risks and issues with those at a national level empowered to unblock them;
- Sharing analysis and status with ECOWAS and using its convening power to address issues where required.

APPENDIX

FIGURE 21: TIMELINE OF THE WEST AFRICA GAS PIPELINE

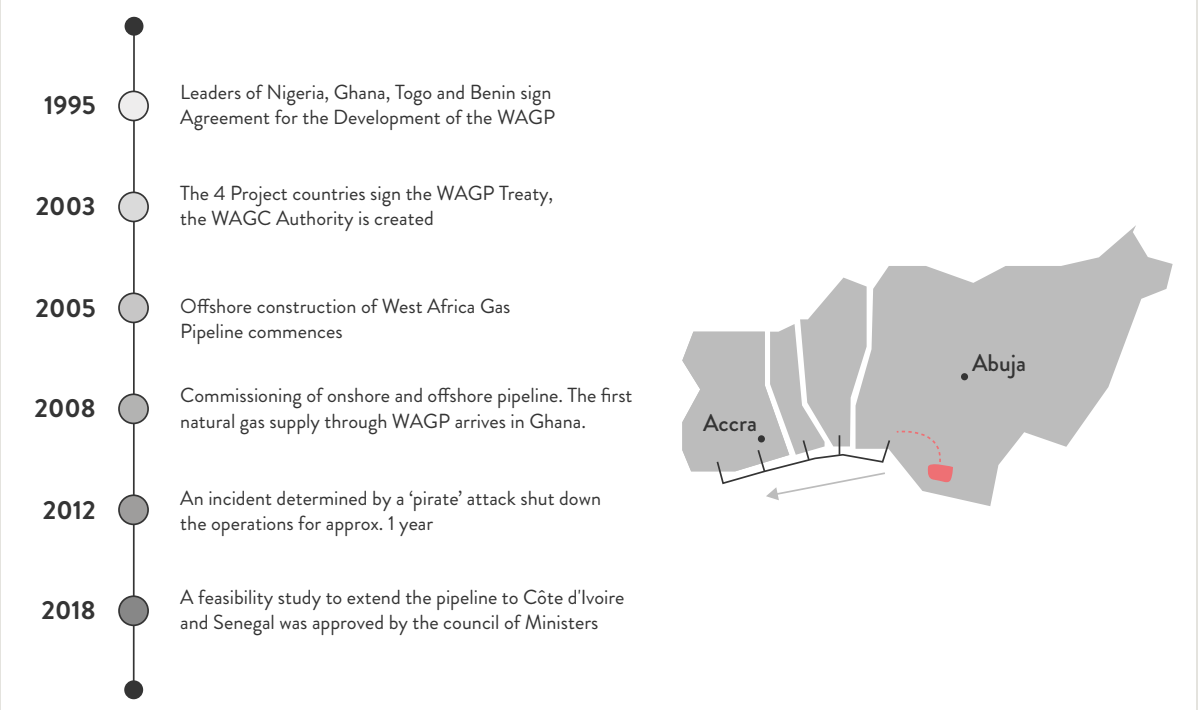
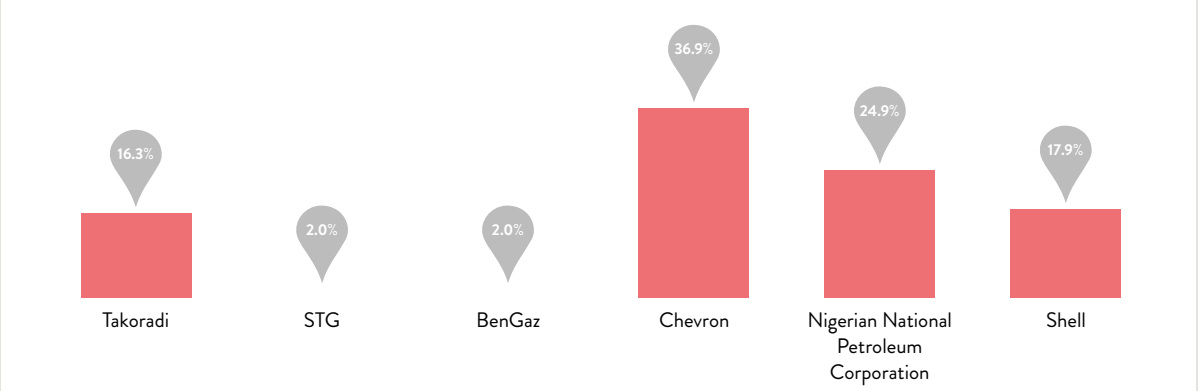


FIGURE 22: SHAREHOLDING STRUCTURES OF THE WEST AFRICAN PIPELINE



Credit: TBI

NOTES

1 Defined as Non-Liquid Fuel based.

2 Both wholesale and retail.

3 Source: The World Bank.

4 WAPP is an agency made up of public and private generation, transmission and distribution companies in 14 countries in the Economic Community of West African States (ECOWAS): Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, The Gambia and Togo.

5 Predicated on the assumption that Gas from domestic gas fields remain at around 300 MCF/d (+- 20) as declines in the Jubilee fields are offset by the TEN and Jubilee extension whilst Sankofa produces a steady 170 MCF/d during the period.

6 Note that Mauritania is outside the WAPP zone.

7 Specifically, the power plants of Songon, Ciprel V and Azito IV.

8 Côte d'Ivoire, Liberia, Sierra Leone and Guinea.

9 This margin does not include the cost of transport, which is considered as a sunk cost, since the debts linked to the construction of the lines will have to be reimbursed by the countries anyway.

10 Assuming a trading price of 10 c$ / kWh.

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