Update of the ECOWAS revised master plan for the development of power generation and transmission of electrical energy

Final Report

Volume 5: Priority Investment Program and Implementation Strategy

December 2018

Financing

European Union
11th EDF Regional Indicative Programme
Financing agreement EDF/2017/ 039-384

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TECHNICAL DOCUMENT

Our ref.: **WAPP-MP/4NT/0626321/004/06**
TS:
Imputation: P.011966/0004

INTERNAL

Client:

Project: **ECOWAS MASTER PLAN FOR THE DEVELOPMENT OF REGIONAL POWER GENERATION AND TRANSMISSION INFRASTRUCTURE 2019-2033**

Subject: VOLUME 5: Priority Investment Program and Implementation Strategy

Comments:

REV.	YY/MM/DD	STAT.	WRITTEN	VERIFIED	APPROVED	VALIDATED
06	2019 01 15	FIN	*F. Sparavier *L. Charlier *L. Bouzat	*J. Dubois	*J. Dubois	
05	2018 12 14	FIN	*F. Sparavier	*J. Dubois	*J. Dubois	
04	2018 12 14	FIN	*F. Sparavier	*J. Dubois	*J. Dubois	

*This document is fully completely signed on 2019.01.15

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ACRONYMS

ADB	*Asian Development Bank*
AFD	*Agence française de développement*
BIO	*Biomass Plant*
CAPEX	*Capital Expenditure*
CAPP	*Central Africa Power Pool*
CC	*Combined Cycle*
CEB	*Communauté Electrique du Bénin*
CEET	*Compagnie Energie Electrique du Togo*
CFB	*Circulating Fluidized Bed*
CIE	*Compagnie Ivoirienne d'Electricité*
CI-ENERGIES	*Côte d'Ivoire Energies*
CLSG	*Côte d'Ivoire – Liberia – Sierra Leone – Guinea loop*
COAL	*Coal*
COD	*Commercial operation Date*
CSP	*Concentrated Solar Plant*
CUE	*Cost of Unserved Energy*
DAM	*with Dam*
(D)DO	*Ordinary Diesel*
DFI	*Development finance institutions*
DI	*Diesel group*
DNI	*Direct Normal Irradiation*
DSO	*Société de distribution d'électricité (Distribution System Operator)*
EAGB	*Electricidade e Aguas da Guine-Bissau*
ECOWAS	*Economic Community of West African States*
EDG	*Electricité de Guinée*
EDM	*Electricité du Mali*
EDSA	*Electricity Distribution Supply Authority*
(E)ENS	*(Expected) Energy Not Served*
EGTC	*Electricity Generation and Transmission Company*
EIB	*European Investment Bank*
ERERA	*Ecowas Regional Electricity Regulatory Authority*
EU	*European Union*
EUR (or €)	*Euro*
FCFA	*Francs CFA*
FSRU	*Floating Storage and Regasification Unit*
GDP	*Gross Domestic Product*
GENCO	*GENenration COrporation*
GHI	*Global Horizontal Irradiation*
GO	*Gasoil*
GRIDCo	*Electricity Transmission Company of Ghana*

GT	*Gas Turbine*
GWh	*Giga Watt heure*
HFO	*Heavy fuel oil*
HRSG	*Heat Recovery Steam Generator*
HYD	*Hydroelectric plant*
ICC	*Information and Coordination Center*
IEA	*International Energy Agency*
IFI	*International Funding Institution*
IMF	*International Monetary Fund*
IPP	*Independent Power Producer*
IPT	*Independant Power Transporter*
IRENA	*International Renewable Energy Agency*
JET	*Jet A1*
LCO	*Light Crude Oil*
LCOE	*Levelized Cost of Electricity*
LEC	*Liberia Electricity Corporation*
LFO	*Light Fuel Oil*
LHV	*Low Heating Value*
LNG	*Liquefied Natural Gas*
LOLE	*Loss of Load Expectation*
LOLP	*Loss of Load Probability*
MMBTU	*Million British Thermal Unit*
MMCFD	*Million Cubic Feet per Day*
MRU	*Union de la Rivière Mano (Mano river Union)*
N/A	*Not Available*
NAWEC	*National Water and Electricity Company*
NBA	*Niger Basin Authority*
NDC	*National Determined Contribution*
NG	*Natural Gas*
NIGELEC	*Société nigérienne d'électricité*
NTP	*Notice to proceed*
O&M	*Operation & Maintenance*
OC	*Open Cycle*
OECD	*Organisation for Economic Co-operation and Development*
OLTC	*On Load Tap Changer*
OMVG	*Organisation de Mise en Valeur du fleuve Gambie*
OMVS	*Organisation de Mise en Valeur du fleuve Sénégal*
ONEE	*Office National de l'Electricité et l'Eau Potable (Morocco)*
OPEX	*Operating Expenditure*
PC	*Pulverized Coal*
PPA	*Power Purchase Agreement*
PPP	*Private Public Partnership*
PSS	*Power System Stabilizer*
pu	*per unit*

PV	*Photovoltaic plant*
RES	*Renewable Energy Sources*
ROR	*Run of river*
SAIDI	*System Average Interruption Duration Index : Indicateur de la durée moyenne de coupures sur le système*
SAIFI	*System Average Interruption Frequency Index : Indicateur de la fréquence moyenne de coupures sur le système*
SBEE	*Société Béninoise d'Energie Electrique*
SENELEC	*Société nationale d'électricité du Sénégal*
SOGEM	*Société de Gestion de l'Energie de Manantali*
SONABEL	*Société nationale d'électricité du Burkina*
ST	*Steam Turbine*
SV (or VS)	*Standard Value*
SVC	*Static Var Compensation*
TCN	*Transmission Company of Nigeria*
TSO	*Transmission System Operator*
USD (or US$ or $)	*US Dollar*
VRA	*Volta River Authority*
WAGP(A)	*Western Africa Gas Pipeline (Association)*
WAPP	*West Africa Power Pool*
WT	*Wind Farm*

1. INTRODUCTION

1.1. Context

The Economic Community of West African States (ECOWAS) is a regional community with a surface of 5.1 million of square km which represents about 17% of the African continent. With a population of more than 300 million inhabitants in 2017, ECOWAS Member States are home to about one-third of the population of sub-Saharan Africa.

ECOWAS has been created with a mandate of promoting economic integration in all fields of activity of the constituting countries. The fifteen-member countries making up ECOWAS are Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal and Togo. The ECOWAS treaty (also known as treaty of Lagos) established the Community during its signature in Lagos (Nigeria) on May 28th, 1975.

One of the most important steps of economic integration in the field of energy was the creation, in 2006 of the Western African Power Pool (WAPP). The WAPP promotes the integration of the national power systems of the fourteen inland countries into a unified regional electricity market with the ultimate goal of providing, in the medium and long-term, a regular and reliable energy at competitive cost to the citizenry of the ECOWAS region

However, the region, which is characterized by a great diversity in terms of culture, language, demography and resources, faces enormous challenges in providing access to sustainable energy for its population. But the 15 ECOWAS Member States are driven by a common desire to offer "affordable, reliable, sustainable and modern energy for all", as per the three main goals of the Sustainable Energy for All (SE4All) initiative, launched by the United Nations Secretary-General.

West-African countries have a great opportunity to reach their objectives thanks to the vast untapped potential in renewable energy (including solar, wind, bioenergy and hydro-power). The Energy Transformation will happen both on-grid and off-grid. It involves the development of mini-grids with hybrid power generation, centralized and decentralized renewable projects potentially coupled with a more flexible demand side, enabled by storage and smart-metering technologies.

Several initiatives like the *African Renewable Energy Initiative* and the *ECOWAS policy on Renewable Energy* support this transformation. However, such a revolution requires financing, leadership and international cooperation. In this context the West African Power Pool is playing a significant role by supporting the development of major energy projects in the region.

1.2. Objectives of the project

The West African Power Pool promotes cooperation and supports the development of regional projects. In 2012, the Authority of the ECOWAS Heads of State and Government approved, through Supplementary Act A/SA.12/02/12, a list of 59 Priority Projects for the subregion that emanated from the update of the ECOWAS Revised Master Plan for the Generation and Transmission of Electrical Energy prepared by Tractebel.

Considering the evolution of

- the energy landscape,
- the socio-economic context of West Africa over the last 5 years and
- the difficulty in mobilizing public and concessional financing in the sub-region,
- the development of the power system in West Africa deviated from what was foreseen in 2011. A lot of challenges affect the utilities efficiency on several aspects including financial, regulatory, technical and organizational points of view.

Another key parameter which should affect the energy development roadmap of WAPP region is the expected increase penetration of Renewable Energy Sources (RES). Thanks to the significant decrease of costs and increased willingness for the transition to sustainable energy, many WAPP countries have revised their RES targets and launched RES projects.

Consequently, while some flagship generation and transmission projects were developed in the region, some of them are still under development or were strongly delayed while, in parallel new non-anticipated projects emerged.

In this context, the study presents four different main objectives:

- Assessing the **implementation status** of the priority projects identified in 2011, understanding the main challenges and barriers to the development of these projects and identifying the lessons learned that will be taken into account when updating the Master Plan;
- Identifying the **main challenges and critical factors** affecting the performance of utilities in their activities as a public service and proposing a new action plan and mitigation measures to address these constraints in a long-term perspective;
- Assessing the opportunities and constraints for the deployment of **Renewable Energy Sources** in the sub-regional power system (potential, economics, grid constraints…);
- Presenting a clear, comprehensive and coherent view of the future development of power generation and transmission facilities with a list of **priority projects** for West Africa that takes into account the new drivers of electricity generation and consumption, while integrating the current development of the power system at national and regional level and while providing recommendations for facilitating the implementation of the projects.

This will lead to an **update of the ECOWAS Master Plan for Generation and Transmission of Electrical Energy**, a comprehensive study providing a rational basis for decision making and implementation in the power sector.

1.3. Organisation of the report for the update of the ECOWAS revised master plan for the development of power generation and transmission of electrical energy

The report is divided into five main volumes corresponding to the five main deliverables of the study.

VOLUME 1: Executive Summary

Volume 1 is the synthesis of the Final Report of the update of the revised ECOWAS Master Plan. It contains the main recommendations of the study concerning the future development of the electricity generation and transmission infrastructures as well as a list of priority projects and the implementation strategy of these projects.

VOLUME 2: State of play of the current situation of the electricity system and perspectives

Volume 2 consists of a synthesis of data collected and assumptions used in the context of this project, and in particular for the update of the generation and transmission master plan.

VOLUME 3: Challenges and Action Plans for electricity Companies

Volume 3 aims at presenting the main challenges and critical factors affecting the performance and the sustainability of utilities members of WAPP and at recommending a new action plan and mitigation measures to address these critical factors from a transversal perspective...

VOLUME 4: Generation and Transmission Master Plan

Volume 4 is devoted to the results of the generation and transmission master plan: It presents a robust and economically optimal development plan while taking into account the current state of the energy sector in West Africa and opportunities for developing renewable energy sources in the region while ensuring the technical stability of the interconnected system

VOLUME 5: Priority Investment Program and Implementation Strategy

Volume 5 focuses first on carrying out a review of the implementation of the ECOWAS 2012-2025 Master Plan and assessing the causes of the gaps between what was initially planned and what was concretely achieved, allowing some effects to be taken into consideration for the development of the 2017-2033 updated master plan. Then, a new list of priority investment projects is drawn up on the basis of the generation-transmission master plan and a strategy is recommended for the progressive implementation of these projects.

1.4. Objectives of Volume 5

This volume aims at presenting a priority investment program built on the basis of generation and transmission master plan developed for the WAPP countries and presented in Volume 4.

The investment program includes the generation and transmission projects considered as decided by member countries and which have a regional vocation as well as the candidate projects which, by their size and their characteristics will allow the development of a reliable and durable electrical system in west Africa. In this report, a short description of each project is provided with its characteristics, estimated cost and progress.

In addition, this Volume presents a strategy for implementing this investment plan, drawing on lessons learned from the approaches adopted for previous projects.

2. REVIEW OF THE PRIORITY INVESTMENT PLAN 2012-2025

In 2012, the Authority of the ECOWAS Heads of State and Government approved, through Supplementary Act A/SA.12/02/12, a list of 59 Priority Projects for the subregion that emanated from the update of the ECOWAS Revised Master Plan for the Generation and Transmission of Electrical Energy prepared by Tractebel.

A schedule of the implementation of the Master Plan was established to ensure meeting the demand in the region. The schedule was organized in three investment phases:

- **Phase 1:** commissioning in the period 2012 – 2018
- **Phase 2:** commissioning in the period 2019 – 2021
- **Phase 3:** commissioning in the long term, after 2021

This plan corresponds to an energy mix based essentially on thermal and hydro power generation including a 10% share of renewables (excluding hydro), which corresponded to a voluntarist approach at the time of plan definition.

2.1. Priority project commissioned during the period 2012-2018

Among the generation and transmission projects selected in the priority investment plan in 2011, 4 generation projects and one transmission projects were commissioned these last five years.

In addition, two transmission projects have a commissioning date in 2018 and are about to be commissioned.

2.1.1. Hydroelectric power plant of Félou (OMVS)

The hydroelectric power plant of Félou, located in Mali, has a power of 60 MW for an energy of 350 GWh per year. The cost of the project is 210 MUSD. Work began in 2009 and the project was put into service in 2013.

The project faced difficulties linked with political stability in the area at the time of construction and with the security measures required at site which were eventually the object of claims from the contractor.

2.1.2. Line Ségou (Mali) - Ferkessédougou (Côte d'Ivoire)

The project consists of a 225 kV line between Segou (Mali) and Ferkessédougou (Côte d'Ivoire), with a length of 370 km and an estimated cost of 175 MUSD. This project has been carried out under an EPC contract signed in direct procurement with the support of the ExIm Bank of India. The construction was completed in 2012. This line is the first line to synchronize the ex-zone A (Mali-Senegal-Mauritania) and the former zone B. Its commissioning created stability issues leading to the need to operate the network of Mali in 2 non-synchronous pockets: an area around Segou supplied by import from Côte d'Ivoire and another area supplied by the Manantali site.

The lessons learned and the difficulties faced during the execution of this project are:

- The synchronization of the 2 main zones must be done by a synchronizing link strong enough to avoid stability problems. This will have to be taken into account in the prioritization of projects in the coming years.
- Difficult contract negotiations as they were led in parallel of the technical studies completion
- A higher contract price due to the direct procurement approach
- Difficult discussions at the time with partners from the WAPP since the line was included in the regional roadmap for network development
- Security issues on the Cote d'Ivoire part at the time of construction

On the other hand, positive feedback and the success factor were:

- The availability of financing thanks to the collaboration with the ExIm Bank of India
- The quick commencement of the works thanks to the direct procurement approach
- The synergy found in project management due to the single loan arrangement for both countries
- The transfer of knowledge from the Ivorian personnel to the Malian personnel as part of the joint project management
- A win-win project for both countries in a context of electricity supply crisis in Mali at the time

2.1.3. Soubré Hydropower plant (Côte d'Ivoire)

The Soubré hydroelectric power plant has a capacity of 270 MW and an average annual production of 1120 GWh. The estimated budget was 620 MUSD. The project has been commissioned in 2017 and the installed capacity has increased to 275 MW due to the addition of a pumped storage plant.

This project constituted the beginning of a new era in terms of hydroelectric development in Côte d'Ivoire after about 30 years during which no hydro projects were launched. The main challenges faced in achieving this project were linked to the challenging realization time schedule and the relocation of population (mainly two villages).

2.1.4. Kaléta Hydropower plant (Guinea)

This is a hydroelectric power plant with a capacity of 240 MW located on the Konkouré River 140 km from the capital Conakry. The hydroelectric plant has a total production guaranteed of 946 GWh per year. The development of the project was initially envisaged as part of the loop OMVG. Finally, the construction work was launched by the Government of Guinea as part of an EPC contract with the CWE company based on funding from Exlm Bank of China. The project was put into service in 2015.

The main challenge has been the rapid mobilization of funding in front of the importance of unmet demand in Guinea. Collaboration with a Chinese contractor to mobilize funding from Exlm Bank of China has allowed a quick start of construction.

Moreover, the Ebola crisis occurred during the period of construction, but the project's teams remained mobilized allowing for the works to be carried without delay.

2.1.5. Mount Coffee Hydropower plant (Liberia)

The project consists of the rehabilitation and expansion of the Mount Coffee hydroelectric power plant located on the Saint Paul River, 27 kilometers from the capital Monrovia. The Mount Coffee plant was commissioned in 1973 with a capacity of 64 MW. The project seeks to rehabilitate and expand the capacity of the plant to 88 MW. The project budget is 357 MUSD.

The project ended in August 2017. The plant started producing electricity again after more than 25 years of standstill.

The main challenges and difficulties were the following:

- The construction was stopped for a year due to the occurrence of the Ebola crisis. The remobilization of the contractor induced additional costs.
- Meeting the conditions for disbursements of each loan agreement has been time-consuming in a context where several IFIs were involved

2.1.6. 330 kV North – South axis (Ghana)

The project consists of a 330-kV line linking Aboaze to Bolgatanga with a distance of 640 km.

The scope of the project has been extended to the connection of the South – North axis: Aboadze – Kumasi – Bolgatanga. Intermediate 330 kV substations are also planned at Tamale and Dunkwa. In the future, the connection at Tamale will allow for a direct link with the median backbone.

The contract for the construction of the line between Aboadze and Kumasi was signed in 2015 with the support of funding from the Exlm Bank of South Korea. The section between Kumasi and Bolgatanga is carried out with the support of the AFD.

The commissioning of the line is scheduled for 2018.

One of the main difficulties of the project has been the land acquisition and land owner compensation process.

2.1.7. Interconnection Bolgatanga (Ghana) - Ouagadougou (Burkina Faso)

It is a project of a 225-kV line between Bolgatanga (Ghana) and Ouagadougou (Burkina Faso), with a length of 210 km (of which 37 km on the Ghanaian territory), and an estimated cost of 156 MUSD.

The project is being built with a commissioning date in the second semester of 2018. Connection tests have been launched during the summer 2018.

This project faced delays essentially due to the resistance of residents during the land acquisition process for the Bolgatanga substation in Ghana.

The project had to be modified to create the Bolgatanga II substation located outside of the urban area initially considered. This modification induced delays due to the time required for designing the new substation once the land rights were secured.

This line is however essential to guarantee electricity supply to Burkina Faso.

2.2. Gap Analysis with the 2012 - 2025 Master Plan

In addition to the five projects commissioned from 2012 on, a number of other projects are currently under construction or were granted for a fund. However, some projects are currently not part of the WAPP priority list of projects anymore for some reasons:

- In Guinea, the Kassa hydropower project was abandoned because the artificial water damming would encroach on the Trans-Guinean railway project between the Simandou mining sites and the deep-water port project in the South of Conakry;
- In Ghana, the country's gas potential and natural gas imported from Nigeria by the West Africa Gas Pipeline is now fully exploited thanks to the recent development of numerous combined cycle projects by independent producers. Therefore, in the short and medium term, the development of a large thermal project is no longer relevant and the Aboadze project is currently suspended but could be developed in the long term.
- The development of a very high voltage network in Nigeria (760kV) is no longer in development as the 2017 update of the national master plan now takes into account the reinforcement of the network by 330 kV double circuit lines.

The effective progress of the plan can be analyzed as:

- The number of projects commissioned in the three phases of the plan,
- The number of projects funded / under construction.
- The number of projects in progress of being funded
- The number of projects for which their progress point is earlier.

The graph below presents the summary of the progress of generation projects

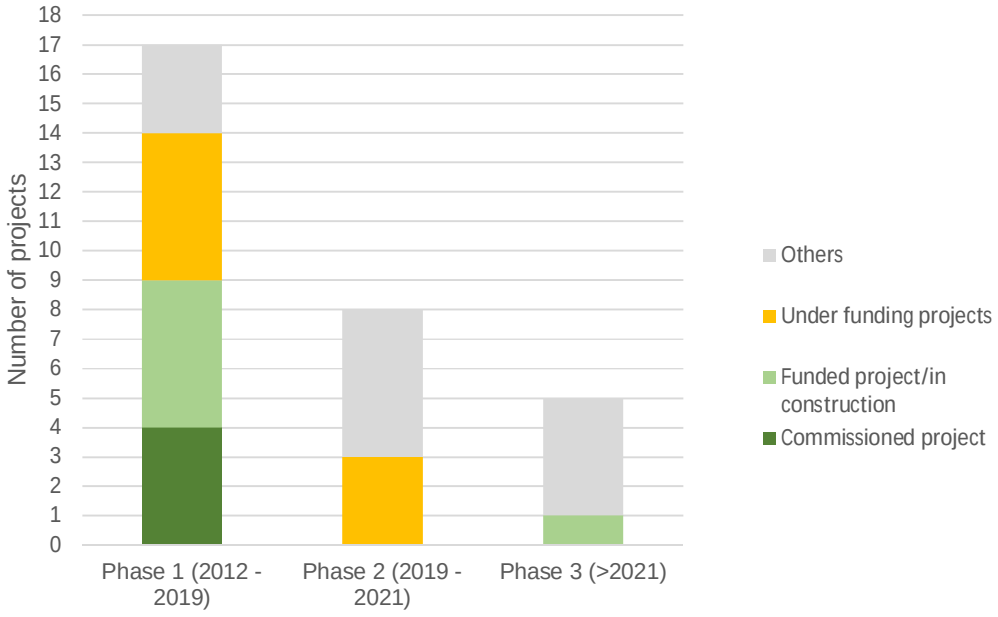


Figure 1: Summary of the status of the generation projects

Thus, on the 17 generation projects planned for Phase 1:

- 4 are in service
- 5 are fully funded
- 5 are looking for funding
- 3 are still under study or have not been studied yet.

The graph below presents the summary of the progress of the transmission projects:

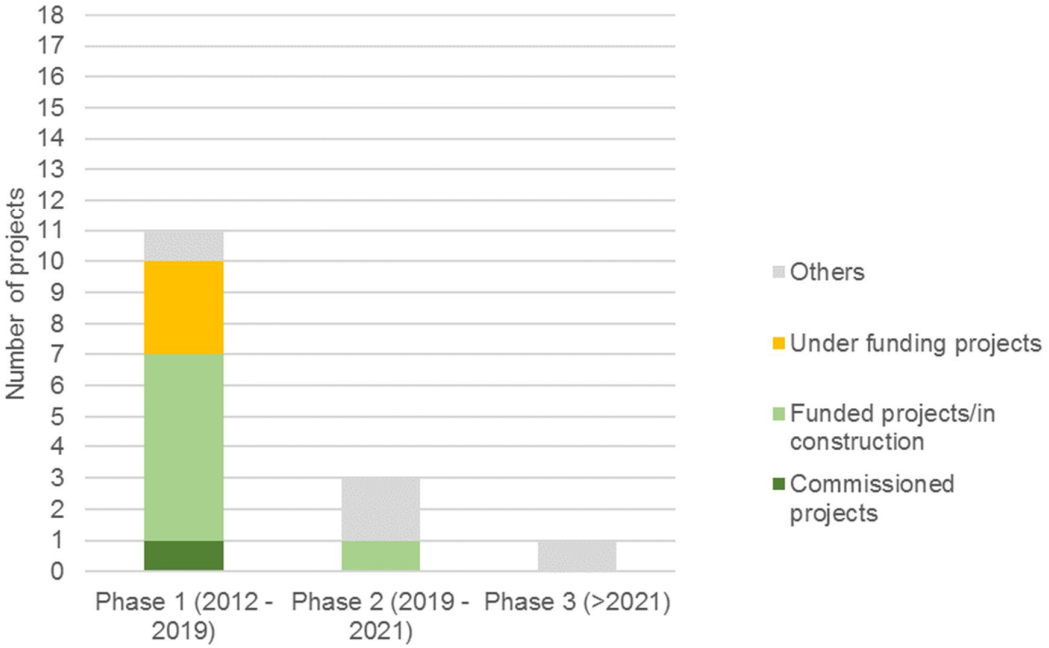


Figure 2: Summary of the status of the transmission projects

Thus, on the 12 transmission projects planned in phase 1:

- 1 is put into service,
- 8 are fully funded
- 2 are looking for funding.
- 1 is still under study or has not been studied yet.

It is clear that **the development of projects in the region** is broadly in line with the roadmap established in the framework of the 2012 - 2025 Master Plan. For the period 2012 - 2019, only:

- 3 out of 17 projects for generation and
- 1 out of 11 projects for transmission

currently show a real delay in their development as the search for funding has not been started.

It therefore appears that the **Master Plan is relatively well monitored** and that, overall, coordination between the countries involved is relatively well achieved.

The projects commissioned and for which funding has been mobilized (green categories) for the 2012-2019 period currently represent:

- half of the projects for the generation and
- two thirds of transmission projects.

This reflects a relatively encouraging level of progress in the roadmap of the previous Master Plan. It should be emphasized here that the delay that can be observed on the projects remains low considering the scale of the projects for the economy of the countries concerned. On a similar scale, projects of comparable size in Europe, for example, show delays that are sometimes much larger.

2.3. Feedback on challenges and success factors in the development of priority projects

Interviews with actors in the sector of electricity from each country allowed to collect feedback on the difficulties encountered in the development of the priority projects of the 2012-2025 Master Plan. A synthesis of these returns is proposed below, highlighting:

- lessons from the previous master plan
- factors contributing to the success of the project,
- factors exogenous to the electricity sector that could impact the project development,
- factors endogenous to the electricity sector that could impact the project development.

2.3.1. Lessons from the previous master plan

From the point of view of how the master plan was planned in 2011, a number of limitations were observed, including:

Too low consideration for renewable resources in the sub region.

In 2011, the development of renewable energy in sub-Saharan Africa was in its infancy. Given the resources of gas and hydropower on the continent, the economic indicators of the time would not warrant the development of these new renewable energy on a large scale. Given these elements, the development of renewable energy (including solar) was only envisaged in 2011 to reduce energy dependence of landlocked regions.

Seven years later, the cost price of renewable technologies (and in particular solar PV) has experienced a such decrease that the global energy paradigm is impacted. In West Africa, many independent producers (IPPs) show today their interest in the development of solar projects in most of the countries concerned.

It is therefore essential to take these resources into account in the updated Master Plan, as well as their impact on the system (operational constraints, storage need).

An approach exclusively based on economic aspects (lower cost approach) without taking into account the notion of risk.

The Master Plan established in 2011 was an ambitious master plan. It was based on a series of flagship projects which commissioning depended on exogenous factors, which by its nature could not be controlled by the Member of the WAPP corporations. Thus, the project development of Maria Gleta in Benin and Aboadzé in Ghana were, in this context, justified by the availability of gas in the WAGP pipeline. Experience has shown that the absence of alternatives to Nigerian natural gas slowed the development of these critical projects for the sub region.

It is therefore essential for the current Master Plan to consider the risk and develop a Master Plan based on least regret rather than at a lower cost.

An overly optimistic implementation schedule

The theoretical implementation schedule, regularly bound by countries eager to see the projects realized in a very short time collide, in many cases, operational difficulties:

- research of funding,
- negotiation and management of specific contracts,
- administrative procedures,
- environmental constraints,
- opposition from the population…

which delay the implementation of projects and affect the realization of the master plan in which projects are often interdependent. Considering the real constraints in the process of implementation, it is therefore important for the development of a Master Plan realistic and achievable.

Operating constraints not enough taken into account

While the power systems of the 14 countries were still islanded 15 years ago, the last decade has been characterized by the commissioning of many interconnections and still others are being built.

Thus, in 2015, the commissioning of the line between Ferkéssedougou Côte d'Ivoire) and Mali (Sikasso) marked the connection between the former Zone B (Mali, Senegal, Gambia, Guinea Bissau, Guinea, Sierra Leone, Liberia) and former Zone A (Côte d'Ivoire, Burkina Faso, Ghana, Togo, Benin, Niger, Nigeria).

The commissioning within three years of the CLSG line and the OMVG loop will lead to the interconnection of the 14 countries of the sub-region.

The WAPP interconnected system offers a multitude of current and future opportunities for the exchange of electrical energy. Nevertheless, the operation of such a network creates new challenges for operators.

Thus, currently, the network of the CEB (Togo-Benin) is operated in 2 pockets, one connected to Nigeria, the other to Ghana. This split is necessary because the connection of these two regions causes oscillations of critical frequencies in the regional system. Specifically, frequency control in Nigeria is problematic and operating limits are not being met. The challenge is partly related to the large size of the Nigerian network compared to neighboring countries. Frequency deviations in Nigeria have a significant impact on the frequency of the system and operational limits are no longer met. A synchronization study has however been carried out and the implementation of the recommendations of this study should allow the coupling of the two networks.

In the same way, the Malian network is also operated in two pockets for stability issues, the 150kV network of the country has not been sized to ensure the junction between the 2 large interconnected networks. Thus, the 150kV line Bamako-Segou is open, part of the network is connected to Côte d'Ivoire and the other part is connected to the Manantali network.

Also, the development of the interconnected network cannot be optimal if it does not include strict recommendations for its operations.

A too generic implementation strategy

To be effective, the implementation strategy must be based on the situation in the country in terms of geopolitical stability, legal and regulatory framework and financial situation of the energy sector. In addition, the specificities of projects require a personalized approach to promote their implementation. This approach justifies the identification of critical factors affecting the electricity sector in different countries.

2.3.2. Success factors

Below are presented some success factors in the development of the priority projects of the previous Master Plan.

The implication and the institutional support from the Economic Community of West African States (ECOWAS)

The development of regional projects benefits from the support of ECOWAS in particular through its specialized agencies:

- the West African Power Pool (WAPP);
- the ECOWAS Regional Electricity Regulatory Authority (ERERA);
- the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE);

This support is clear for:

- the preparation and signature of agreements between countries for the development of regional projects during the Council of the ECOWAS Ministers;
- the mobilization of funds for the study and the construction of regional projects with international financing institutions;
- the preparation and coordination of regional projects;
- the sharing of knowledge and lessons learned among the ECOWAS countries through the organization of specialized training sessions and the development of regional centres for training and excellency.

Models of regional collaboration under experimentation with the support of regional organizations and international financing institutions (IFIs)

Three major interconnection projects involving various countries and the support of several IFIs are under development, at different stages of progress. For each of these projects, a specific organization has been set up with the aim at coordinating the project development among various countries and preparing the technical and commercial framework for the operation stage:

- The OMVG 225 kV loop in The Gambia, Guinea, Mali and Senegal:
- Besides the national contributions, financing has been mobilized with eight IFIs. The financing is retroceded to the OMVG by the four countries involved.
- A dedicated project team has been constituted within the OMVG.
- The power purchase agreements are established bilaterally between countries.

- It should be noted that the OMVS experience (setting up a project management company - SOGEM, energy sharing mechanisms) was taken into account in the setting up of the OMVG loop project.

- The CLSG interconnection in Côte d'Ivoire, Liberia, Sierra Leone and Guinea:
- The "Transco CLSG" SPV has been created to take charge of the project development and its operation once commissioned, requiring the adaptation of the legal framework are national level.
- Financing have been retroceded by the States to Transco CLSG.
- A commercial framework has been established to remunerate Transco CLSG for the services of electricity transmission.
- It should be noted that the experience of SOGEM (difficulties encountered in the contract with a private operator for the operation and maintenance of the Manantali project) has been taken into account in the institutional setup of TRANSCO CLSG and the CLSG project.

- The North Core interconnection between Benin, Burkina Faso, Niger and Nigeria:
- Compared to Transco CLSG, a mixed solution has been adopted regarding the organization framework, with the creation of joint project management unit based in Abuja.
- Discussions are on-going to define the commercial framework for the exchange of electricity through this interconnection.

It is to be noted that these organizational schemes are under implementation. More complete lessons learned may be drawn at a later stage, once the projects have been commissioned and operated, and that the commercial framework has been tested.

This being said, positive feedback may already be put forward regarding the following aspects:

- The coordinated interface with IFIs to mobilize the larger part of the financing;
- The integrated project management approach for technical design, procurement of works and construction schedule monitoring
- The centralized monitoring of the implementation of the environmental and social action plans at national level

Strong social pressure resulting in the support of flagship projects at the highest political level

The social demand for access to energy services - and especially electricity - is particularly strong in West Africa. This demand therefore puts pressure on electoral commitments and consequently on the involvement of the executive power in flagship projects. It therefore appears that when projects are supported at the highest level of executive power, these tend to be developed within tight deadlines.

An electricity sector driven by Chinese ambitions in the region

The development of the sector is favoured by the strong involvement of Chinese export finance agencies such as ICBC and Exlm Bank of China. For a certain number of projects included in the master plan, their development has gone through Chinese export financing, which has allowed to significantly progress on the construction of projects.

This observation can be extended to other examples of bilateral collaborations such as the implication of the Exlm Bank of India in a certain number of transmission line projects under construction.

2.3.3. Exogenous factors to the electricity sector

Below are presented some exogenous factors that have an impact on the development of the priority projects of the previous Master Plan.

Impact of health crisis

The Ebola health crisis has affected the region from 2013 to 2015, affecting particularly Guinea, Sierra Leone and Liberia.

This crisis has led to a slowdown in the work of some projects such as the rehabilitation of Mount Coffee in Liberia. The crisis has also had an economic and financial impact on the affected countries and thus on their ability to mobilize funding for the projects.

Development of energy mix affected by the cycle of primary energy in the international market prices

The sharp increase in the price of petroleum products until 2014 has hit hard the financial balance sheet of the electricity companies; especially those for which the share of thermal capacities in the mix was important. Interest in hydropower projects grew.

On the other hand, the petroleum products price drop from 2015 has led to a poorer competitiveness of hydroelectric projects, which may have called into question certain projects.

Development of a portfolio of solvent and electro-intensive customers impacted by the price of mining products on the international market

In line with the drop-in petroleum product prices since 2015, the price of mining products followed the same trend. This phenomenon has hampered the development expected of mining companies in the region such as Rio Tinto in Guinea for example. This slowdown in the development of mining companies has led to a slackening of the electricity sector's electricity demand, which is also coming from solvent customers.

Primary energy supply impacted by large-scale technical hazards

The West Africa Pipeline Damage (WAGP) in 2012, causing its shut down for a year, deprived the importing countries (Benin, Togo, Ghana) of a low-cost gas supply. The consequences were the development of emergency measures to respond quickly to the demand.

Political crises

Security issues caused by the presence of armed forces at power generation or oil and gas extraction sites are also challenges that directly affect the electricity sector. This type of constraint has, for example, been encountered in northern Nigeria in the region of extraction fields.

2.3.4. Endogenous factors at the electricity sector

Below are presented some endogenous factors that have an impact on the development of the priority projects of the previous Master Plan.

Limited sources of funding and low financial health of companies

Despite a significant increase in the resources of the multilateral institutions for the regional projects, the availability of financial resources did not allow the development of all the projects from the previous Master Plan. In addition, the use of PPP projects has been very limited.

The financial weakness of electricity companies has significant consequences:

- Difficulty in mobilizing funding for project development;
- The difficulty of developing electricity import and export agreements due to the lack of solvency of buyers;
- The difficulty of financing measures to mitigate the environmental and social impacts of projects at the expense of the electricity company.

Coordination between regional and national planning to improve

It has been frequently observed that the priority project of the WAPP Master Plan are not reflected in the national master plans. It is especially the case for regional generation projects whose justification relies on offtake commitments from various countries.

This situation is a cause for confusion regarding the electricity sale opportunities for regional projects since national master plans consider alternative sources of supply to meet the demand. The mobilization of financial partner is thus rendered more complicated.

Areas of improvement in the collaboration with IFIs

The stakeholders of the West African electricity sector consulted as part of this study underline the essential role played to this date by the IFIs in the development of the priority projects of the 2012 – 2025 WAPP Master Plan. Nevertheless, they point out areas of improvement in this collaboration in light of the lessons learned in the projects carried out so far. In the frame hereafter are summarized some of the suggestions shared during the interviews performed:

- The national and regional stakeholders underline the importance for IFIs to involve early on technical resources in the follow-up of projects. When it is not the case, the review for non-objection by IFIs can trigger technical discussions which could have been in some cases anticipated at earlier stages of the study.

- The process of review for non-objection by IFIs is sometimes perceived as time-consuming, in particular when located on the critical path of the project preparation schedule.
- Fulfilling the conditions for disbursement of the loan agreements is a process that requires time and resources from the utilities and administrations. In the case of large projects where several IFIs are mobilized, an optimization may be found in harmonizing the demands of IFIs in the definition of the conditions for disbursement.
- The mobilization of a national funding for the mitigating measures related to the environmental and social impacts of projects and to the compensation of the persons affected by the project is a critical step in the development process. A collaboration with IFIs on a possible financing on these aspects is seen as an area of improvement to accelerate projects.

Contracting and contract monitoring capacities to be reinforced

The lack of experience in drafting and negotiating contracts specific to the electricity sector has emerged as a difficulty and a source of significant delays. This is particularly the case for concession and purchase contracts.

An inadequate regulatory and institutional framework for the efficient mobilization of the private sector

It appeared that the processing of spontaneous offers by independent power producers (IPP) lacked a framework. The following difficulties have been noted:

- No grid code,
- Lack of evaluation procedure for tenders in case of spontaneous tenders,
- Absence of negotiation leverage to improve financial conditions,

Infrastructures in natural gas of insufficient capacity

The lack of guarantees regarding the supply of fuel (gas in particular) has made the development of certain gas-fired power plants difficult. This has, for example, been the case (among other difficulties) for Maria Gleta's project in Benin. Countries wishing to develop gas-powered assets are therefore wondering about the creation of FSRU.

Important operating constraints that slow down trade between countries

Currently, the interconnected West African power system faces significant operating constraints. Thus, the network is operated in pockets islanded of each other despite the physical presence of the interconnections because the aspects related to the operation of the interconnection and the operational consequences of the synchronization of these pockets have not been sufficiently anticipated.

Difficult coordination of procedures related to the environmental and social impacts in the preparation of projects

The environmental and social impact assessment studies are deemed valid for a period of about three years, especially because the number of people affected by the projects often tends to increase over time. It happens that studies need to be updated as the duration of the project preparation has exceeded the validity period of the studies.

The update of social and environmental studies can end up being a delaying factor in the project development. The anticipation of these procedures, and in particular the mobilization of an additional financing to carry out the studies, is critical.

Difficult security of land tenure due to the culturally collective property regime

The process of obtaining the right of enjoyment of the land may, in certain cases, lead to complex procedures. These slowdowns are the result of:

- social difficulties in resettling populations,
- organizational difficulties in compensating the affected population.

These endogenous difficulties are more extensively detailed in the report identifying the challenges and critical factors affecting the electricity companies in the WAPP area.

3. PRIORITY PROJECTS FOR THE PERIOD 2019-2033

The findings of the various studies carried out have allowed to identify a development plan that is realistic, economically optimal, and integrating technical, environmental and financial constraints. From this development plan the priority list of regional generation and transmission projects has been established in the light of the following criteria:

- A minimum size of 150MW;
- A major role in the sustainable development of the sub-region;
- A regional vocation (location, sharing of energy between border countries, importance at regional level).

In addition, in order to compile this list, the lessons learned from the previous master plan were taken into account and an inventory of the projects that had been identified in the priority investment plan in 2011 was carried out.

Finally, it is important to clarify that the projects identified in the priority investment plan, while essential for the optimal development of the sub-region, are not sufficient to meet the demand of all 14 West African countries. Other projects of national importance have been highlighted in this study and are presented in a comprehensive way in volume 4 of this report, which is devoted to the optimal master plan. In particular, **many renewable energy projects** appeared as essential for the sustainable development of the sub-region. More specifically, many small-scale PV projects are proposed in this master plan, reaching a huge volume of installed capacity. Despite their size, these projects should be supported at the regional level. In this context, the consultant recommends, in addition to the traditional priority projects, the monitoring and support for renewable projects developed in the subregion so as to achieve the target integration rates recommended in this master plan (see Section 5 Action plan for the WAPP).

The following sections present the projects decided and the projects to be developed in a priority way in the sub-region for the different temporal horizons, namely:

- The short-term horizon (2018-2022)
- The mid-term horizon (2023-2029)
- The long-term horizon (from 2030)

For each of the proposed priority projects, a brief description of the power plant or the interconnection line is presented, as well as a short economic analysis and a note on the environmental impact of the infrastructure. The status of the project (studies and/or works) is also described, as well as the implementation strategy according to the development modes described in section 5.4.

Finally, the justification of the project according to three major trends that are

- the Integration of renewable energy,
- the contribution to the development of an electricity market in the sub-region
- the improvement of security of supply

is presented for each project

3.1. Priority Projects at short-term (2018-2022)

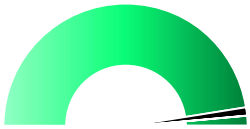
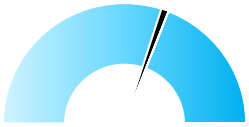
3.1.1. Decided projects

3.1.1.1. GOUINA HYDROPOWER PLANT (OMVS)

Description of the project

The Gouina hydropower plant is located 80 kilometers upstream of the Kayes town in Mali. The project, carried by the SOGEM, has an installed capacity of 140 MW, an expected average annual producible of 650 GWh and a guaranteed producible of 565 GWh. The cost of the project is to 462 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The Gouina plant will actively participate to the sustainable development of the region as a substitute for the thermal generation issued from fossil fuels	This project developed as part of the OMVS will be integrated into the regional electricity market through the sharing of energy between the Member States of the OMVS	Although the improvement of reliability is not the primary objective of this project, it could contribute by providing flexibility necessary for the system when integrating large volume of intermittent renewable energy

Progress of the project

In 2013, the construction contract was awarded with an estimated duration of work of 4 years. However, the start of work has been delayed. The commissioning is planned for the 2020.

Studies	Funding	Construction	Commissioning
			2020

Challenges

Significant delays were found: seven years have elapsed between the financing commitments obtained from the donors (November 2009) and the ratification of the financing agreements (November 2016). This delay is largely due to the disbursement conditions, which were not fulfilled at the same time by the three states and which required decisions at the highest political level. As an example, it was difficult to get an agreement on the location of the project's bank account.

Impementation Stategy

The SOGEM awarded a construction contract for the development of this project – EPC Contract

Responsible Institution for the development

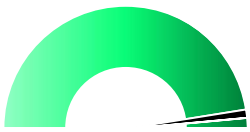
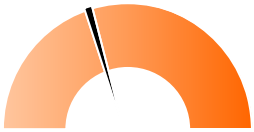
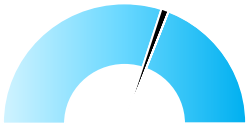
OMVS (SOGEM)

3.1.1.2. SOUAPITI HYDROPOWER PLANT (GUINEA)

Description of the project

It is a hydroelectric power plant with an installed capacity of 450 MW, a guaranteed producible of 2016 GWh per year and a cost of 1350 MUSD. The Souapiti reservoir allows a flow regularization that optimizes the production of the Kaleta plant.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
In addition to further reducing the use of fuel-fired plants the will participate to the regulation of Kaléta, promoting optimal use of regional hydroelectric resources	Although currently being developed to meet national electricity needs, this project could be the subject of an electricity exchange agreement with neighboring countries as soon as the OMVG loop is put into service.	In addition to the fact that this project will help to reduce the unserved energy in Guinea, it could, over the longer term, bring flexibility to the system when this prove necessary to support the integration of renewable energy.

Progress of the project

The project is currently under construction. Commissioning of the first group is foreseen in 2020 and the complete delivery of the work in 2021.

Studies	Funding	Construction	Commissioning
			2020

Challenges

A first challenge was the adaptation of the original design of the scheme to limit the social impacts. The reservoir level for the final project is 20 meters less than the originally proposed level.

Moreover, the speed of mobilization of funding and the launch of the construction has been a priority for the Government of Guinea.

Implementation Strategy

A Special Purpose Vehicule has been created between the State of Guinea and the Chinese company CWE, each party owning 50% of the SPV. A concession contract has been signed with the SPV for the development and operation of Souapiti. The financing has been obtained form the ExIm Bank of China and from the own funds of the SPV. It is to be noted that the funds of the State of Guinea for its participation in the SPV could be gathered from valuing its participation in the Kaleta project company. – **Concession**

Responsible Institution for the development

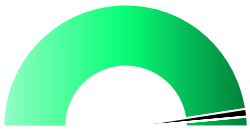
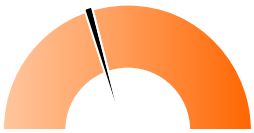
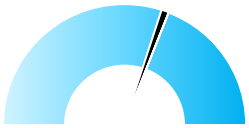
Guinea

3.1.1.3. GRIBO POPOLI HYDROPOWER PLANT (CÔTE D'IVOIRE)

Description of the project

Il It is a hydroelectric power plant with an installed capacity of 112 MW and a cost of 345 MUSD on Sassandra river.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The producible of Gribo-Popoli will substitute thermal energy for demand supply	Considering the structure of the ivorian power system, this project could supply neighbouring countries through the different interconnections	Additional power available to supply local and regional demand and complementarity with variable renewable energies

Progress of the project

Technical studies have been achieved and social and environnmental analyses and resettlment action plans are ongoing.

Studies	Funding	Construction	Commissioning
			2021

Implementation Strategy

The project is being developed by CI-Energies through an EPC contract with Sinohydro. Financial discussions are ongoing with the Exlm Bank of China – EPC Contract

Responsible Institution for the development

CI-Energies

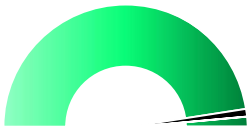
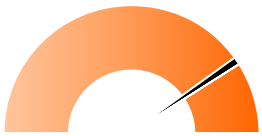
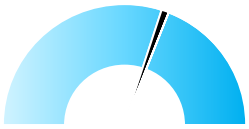
Final version

3.1.1.4. SAMBANGALOU HYDROPOWER PLANT (OMVG)

Description of the project

It is a hydroelectric power plant with an installed capacity of 128 MW for a guaranteed producible of 402 GWh per year. The estimated budget is of 454 MUSD. The project is envisaged as part of the realization of the 225 kV OMVG loop to provide electricity to the member countries.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The power plant of Sambangalou will allow avoiding each year avoid the generation of 402 GWh of electricity coming from fossil fuel	Being part of the OMVG, this project is naturally developed in the context of a regional market, allowing the sharing of production between the Member States of the OMVG.	Like any reservoir, this project could bring the storage capacity necessary to the system, particularly when the rate of integration of non-dispatchable renewable energies will become significant

Progress of the project

The project studies were carried out.

Studies	Funding	Construction	Commissioning
			2022

Impementation Stategy

The OMVG signed a proposed EPC + financing with a contractor but the contract did not succeed and the tender was finally relaunched. The project is currently the subject of further discussions for development under an EPC + financing contract.

Responsible Institution for the development

OMVG

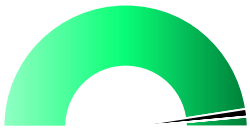
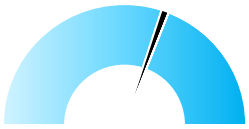
Final version

3.1.1.5. ZUNGERU HYDROPOWER PLANT(NIGERIA)

Description of the project

The Zungeru project is a hydroelectric plant with a capacity of 700 MW for an energy produced of 3019 GWh per year. The estimated budget is 1200 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This major project will allows possible to diversify the energy mix of Nigeria, today largely dominated by thermal generation	The location of Zungeru at the border with Benin suggests opportunities for trade in the sub-region	Given the solar and wind potential in northern Nigeria, the flexibility offered by Zungeru will ensure, at long-term, the safety electrical system

Progress of the project

The plant is under construction and the date of commissioning is scheduled for 2022.

Studies	Funding	Construction	Commissioning
			2022

Challenges

The challenges faced in the development of this project are:

- Security problems with the intervention of armed groups making it difficult to access careers.
- Difficulties of social dimension on the resettlement of displaced populations.

Impementation Stategy

The project is being developed by the CNEE Co – Sinohydro consortium with 75% financial support from China's Exim Bank and 25% from Nigerian funds. – EPC Contract

Responsible Institution for the development

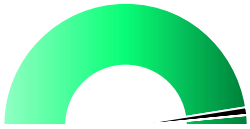
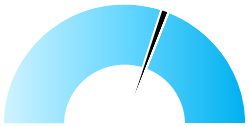
Nigeria

3.1.1.6. FOMI HYDROPOWER PLANT (GUINEA)

Description of the project

It is a hydroelectric project in multiple purposes with a capacity of 60 to 90 MW (estimated cost: 620 MUSD).

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The Fomi project will further reduce the share of electricity from thermal plants in the energy mix of the country and the sub-region	Fomi is located at a node in the network, close to Mali and Côte d'Ivoire. There are therefore many opportunities for regional sharing of the energy produced	Like other hydroelectric projects, one of the roles expected for this plant is the contribution to storage capacity in the presence of intermittent renewable energy

Progress of the project

The project is currently being investigated considering (i) the impact of upstream and downstream, (ii) the needs for irrigation downstream and (iii) the production of electricity. The study is funded by the World Bank and involves the Niger Basin Authority.

The project has also been studied by Yellow River Engineering Company (YREC) which presented its results end of 2017.

Studies	Funding	Construction	Commissioning
			2022

Implementation Strategy

Discussions are underway for the development of the PPP by YREC project based on funding from Exlm Bank of China or other lenders - **PPP Scheme**

Responsible Institution for the development

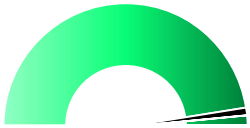
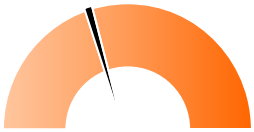
Guinea

3.1.1.7. WIND FARM SENEGAL

Description of the project

This is a decided project for a wind farm of 150 MW at Taiba N'Diaye developed by Lekala and to be put into operation in three phases 50 MW in 2019, 2020 and 2021 for an estimated cost of 230 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This project will further increase the rate of renewable energy integration in Senegal	Although no agreement has been issued for the sharing of wind energy produced in Senegal with the neighboring countries, the current and future network of Senegal and in particular the OMVS and OMVG loops will allow these exchanges.	Given its intermittent behavior, the project will have a limited contribution to securing the electrical supply of the sub-region

Progress of the project

Feasibility studies for this project have been completed. The financing agreement was finalized in July 2018: Funding from OPIC, the US development finance institution and EKF, the Danish export credit agency.

Studies	Funding	Construction	Commissioning
			2019-2021

Implementation Strategy

EPC Contract

Responsible Institution for the development

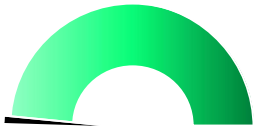
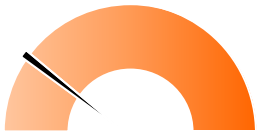
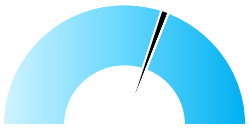
Senegal

3.1.1.8. AZITO II THERMAL POWER PLANT (CÔTE D'IVOIRE)

Description of the project

It is a 253 MW combined cycle to be built in the region of Abidjan for a total cost of 302 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	Given the structure of the Ivorian internal network, this project can be used to supply the neighboring countries via the different interconnections	This project aims to improve the security of supply of Côte d'Ivoire and importing countries (Mali and Burkina Faso) in view of growing demand

Progress of the project

Studies	Funding	Construction	Commissioning
			2020

Implementation Strategy

The project could be developed through an IPP procurement, following the example of previous thermal generation projects such as Azito or Ciprel. - IPP Procurement

Responsible Institution for the development

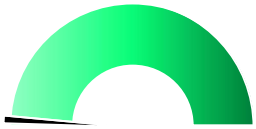
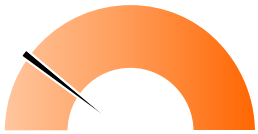
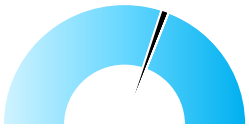
Côte d'Ivoire

3.1.1.9. CIPREL IV THERMAL POWER PLANT (CÔTE D'IVOIRE)

Description of the project

It is a 412 MW combined cycle to be built in the region of Abidjan for a total cost of 536 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	Given the structure of the Ivorian internal network, this project can be used to supply the neighboring countries via the different interconnections	This project aims to improve the security of supply of Côte d'Ivoire and importing countries (Mali and Burkina Faso) in view of growing demand

Progress of the project

Studies	Funding	Construction	Commissioning
			2021

Implementation Strategy

The project could be developed through an IPP procurement, following the example of previous thermal generation projects such as Azito or Ciprel. - IPP Procurement

Responsible Institution for the development

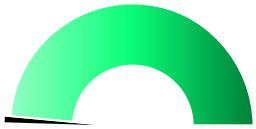
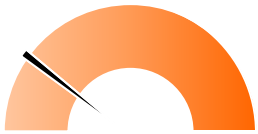
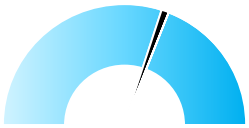
Côte d'Ivoire

3.1.1.10. EARLY POWER THERMAL POWER PLANT (GHANA)

Description of the project

It is a 300 MW combined cycle to be built in the south of Ghana for a total cost of 390 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	Given the structure of the Ghanaian internal network, this project can be used to supply the neighboring countries via the different interconnections	This project aims to improve the security of supply of Ghana and importing countries (Togo-Bénin and Burkina Faso) in view of growing demand

Progress of the project

Studies	Funding	Construction	Commissioning
			2019

Implementation Strategy

The project is being developed by an independent power producer – IPP framework.

Responsible Institution for the development

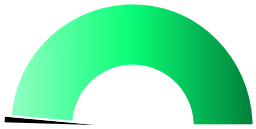
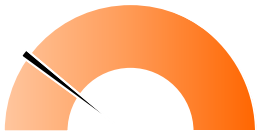
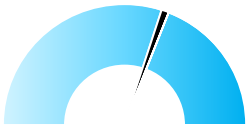
Ghana

3.1.1.11. GPGC THERMAL POWER PLANT (GHANA)

Description of the project

It is a 170 MW combined cycle to be built in the south of Ghana for a total cost of 221 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	Given the structure of the Ghanaian internal network, this project can be used to supply the neighboring countries via the different interconnections	This project aims to improve the security of supply of Ghana and importing countries (Togo-Bénin and Burkina Faso) in view of growing demand

Progress of the project

Studies	Funding	Construction	Commissioning
			2019

Implementation Strategy

The project is being developed by an independent power producer – IPP framework.

Responsible Institution for the development

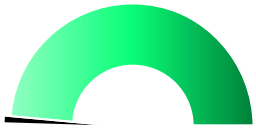
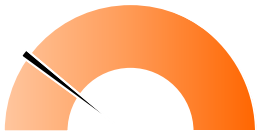
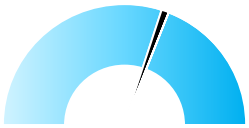
Ghana

3.1.1.12. AMANDI THERMAL POWER PLANT (GHANA)

Description of the project

It is a 240 MW combined cycle to be built in the south of Ghana for a total cost of 312 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	Given the structure of the Ghanaian internal network, this project can be used to supply the neighboring countries via the different interconnections	This project aims to improve the security of supply of Ghana and importing countries (Togo-Bénin and Burkina Faso) in view of growing demand

Progress of the project

Studies	Funding	Construction	Commissioning
			2019

Implementation Strategy

The project is being developed by an independent power producer – IPP framework.

Responsible Institution for the development

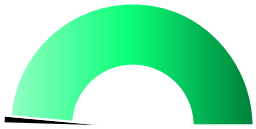
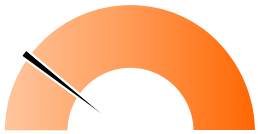
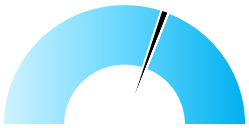
Ghana

3.1.1.13. ROTAN THERMAL POWER PLANT (GHANA)

Description of the project

It is a 330 MW combined cycle to be built in the south of Ghana for a total cost of 429 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	Given the structure of the Ghanaian internal network, this project can be used to supply the neighboring countries via the different interconnections	This project aims to improve the security of supply of Ghana and importing countries (Togo-Bénin and Burkina Faso) in view of growing demand

Progress of the project

Studies	Funding	Construction	Commissioning
			2022

Implementation Strategy

The project is being developed by an independent power producer – IPP framework.

Responsible Institution for the development

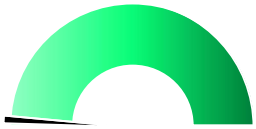
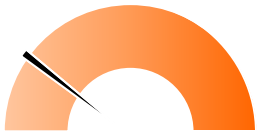
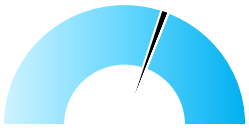
Ghana

3.1.1.14. KADUNA THERMAL POWER PLANT (NIGERIA)

Description of the project

It is a 215 MW thermal plant to be built in the south of Nigeria for a total cost of 280 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	This project is essential, not only for satisfying the local demand but also to meet the volume of exchanges contracted with neighbouring countries (Togo-Benin)	Considering the lack of generation in Nigeria, this project will contribute significantly to the improvement of security of supply

Progress of the project

Studies	Funding	Construction	Commissioning
			2019

Implementation Strategy

EPC Contract

Responsible Institution for the development

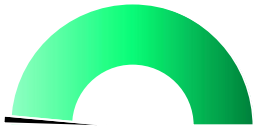
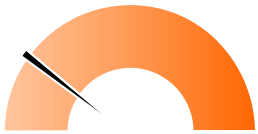
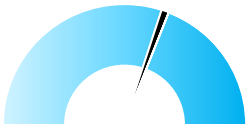
Nigeria

3.1.1.15. OKPAI THERMAL POWER PLANT (NIGERIA)

Description of the project

It is a 450 MW thermal plant to be built in the south of Nigeria for a total cost of 585 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	This project is essential, not only for satisfying the local demand but also to meet the volume of exchanges contracted with neighbouring countries (Togo-Benin)	Considering the lack of generation in Nigeria, this project will contribute significantly to the improvement of security of supply

Progress of the project

Studies	Funding	Construction	Commissioning
			2020

Implementation Strategy

EPC Contract

Responsible Institution for the development

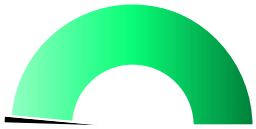
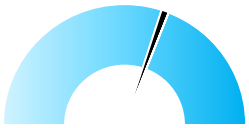
Nigeria

3.1.1.16. SALKADAMNA COAL POWER PLANT (NIGER)

Description of the project

The plant is composed of 4 steam turbines of 50 MW each which will make use of local reserves of coal for an estimated total cost of 573 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	The vocation of this project is to be shared through the North Core	Considering the lack of generation in Niger, this project will contribute significantly to the improvement of security of supply

Progress of the project

Niger is currently seeking a private partner and funding for the construction of the plant. An attempt to develop was made in 2014 with Sources California Energy.

Discussions are underway with new private partners regarding project implementation.

Studies	Funding	Construction	Commissioning
			2021

Challenges

The major challenge identified by actors of the project is the difficulty of obtaining financing for coal-fired thermal projects from financial institutions.

Implementation Strategy

The strategy followed is a public-private partnership - PPP

Responsible Institution for the development

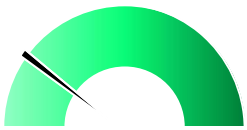
Niger

3.1.1.17. COASTAL BACKBONE PROJECT: INTERCONNECTION VOLTA (GHANA) - LOMÉ (TOGO) - SAKÉTÉ (BENIN)

Description of the project

This project is a 330 kV line part of the "Coastal Backbone" interconnection project, following the coast between Nigeria and Côte d'Ivoire. It will link Volta (Ghana), Lomé (Togo) and Sakété (Benin) for a total of 340km (122 MUSD).

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Although it is not its first objective, the coastal backbone will support renewable energy exchanges (hydro and solar) when these projects will have been developed	The finalization of the coastal backbone will establish a major regional market between the five countries in the south of the sub-region	Thanks to the new interconnection between Ghana, Togo and Benin, the three countries will be able to share their reserve and thus improve the security of supply on both sides.

Progress of the project

The construction of the line in Ghana was completed in November 2014. The section located in Togo and Benin are under construction with a forecasted commissioning in 2019.

Studies	Funding	Construction	Commissioning
			2019

Challenges

For the section located in Ghana, the main issue was the process of identifying and compensating rightful land owners during the land acquisition process.

For the section located in Togo and Benin, various difficulties were faced:

- The main difficulty was mobilizing the financing for construction due to the poor financial health of the CEB
- The procurement process was difficult: the contractor eventually selected should not have been shortlisted for not meeting the criteria related to the financial capability of the firm. Following a discussion with the lenders, it was kept on the shortlist to reinforce competition.
- The contractor was not able to meet the milestones of the construction schedule. The owner's representatives observed that the contractor had a strategy of aggressive contract management that did not serve the project well.

- Claims in the process of compensating land owners led to delaying the completion date of the land acquisition process. In direct application of the ADB loan agreement conditions, the loan disbursements were temporarily stopped. Consequently, the payment to the contractor had also to be stopped causing an additional delay in the construction schedule and claims from the contractor. The situation was difficult to solve due to a certain inertia in the exchanges between the ADB and the governmental authorities, decisions being made at a high level.

Implementation Strategy

EPC Contract

Responsible Institution for the development

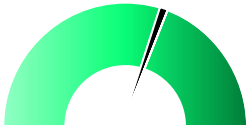
Togo, Benin and Ghana

3.1.1.18. STRENGTHENING OF IVORIAN NETWORK: FERKESSÉDOUGOU–BOUNDIALI – LABOA LINE

Description of the project

The project consists of a reinforcement of the existing 90kV network with a 225 kV line between Ferkessédougou, Boundiali and Laboa, a length of 310 km, for an estimated cost of 115 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The Ferke-Boundiali-Laboa link will allow the sharing of the renewable energy produced in the North of the country	Although this is a national project, this line will allow the direct connection of the CLSG network with Mali and Burkina Faso, increasing the opportunities for exchange	The new line will help securing the Ivorian and consequently the sub-regional system, looping the 225kV network in the country

Progress of the project

Construction is currently underway. The commissioning of the Boundiali – Laboa section is expected in the course of the year 2018. Full commissioning of the work is planned for 2019

Studies	Funding	Construction	Commissioning
			2019

Challenges

The main challenges in carrying out this project were the difficulties encountered in finalizing the financing agreements with the ExIm Bank of India and the delays of the contractor in carrying out the work.

Implementation strategy

EPC Contracts

Responsible Institution for the development

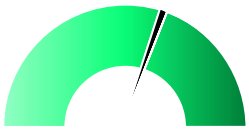
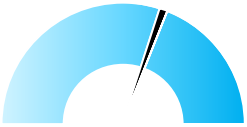
Côte d'Ivoire

3.1.1.19. LINE 225 KV KAYES (MALI) – TAMBACOUNDA (SENEGAL) (OMVS)

Description of the project

It is a 225kV line between Kayes (Mali) and Tambacounda (Senegal), with a length of 288 km. The estimated cost is to 94 MUSD. This line is associated with the implementation of Gouina's hydroelectric development project.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The new line will be a key element for the Integration of renewable energy by allowing the evacuation of the hydroelectric energy	This transmission line developed within the framework of the OMVS is a vector of the regional electricity market in the sense that it will allow to transport hydroelectric power and thus increasing trade between Senegal and Mali	The new axis will connect the Tambacounda region to the interconnected network and so will secure the Senegalese network in its eastern part

Progress of the project

The SOGEM launched the call for bids for the construction of the line on IDA funding (World Bank). The date of submission of the offers took place in May 2018.

Studies	Funding	Construction	Commissioning
			2020

Challenges

A success factor for the project was the pre-financing of the feasibility studies and environmental and social impact studies by SOGEM, in anticipation of the corresponding disbursements under the IDA loan agreement. This approach was made possible by the good financial health of the SOGEM.

A difficulty raised by SENELEC is the need for better coordination in the integration of the networks of OMVS and OMVG with the grid of national operators, in particular from the point of view of stability studies.

Implementation Strategy

EPC Contract

Responsible Institution for the development

OMVS

3.1.1.20. CLSG INTERCONNECTION

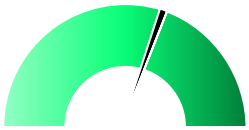
Description of the project

This is a 225kV line with a length of 1303 km, at an estimated cost of 517 MUSD. The line connects Côte d'Ivoire with Guinea Sierra Leone and Liberia.

Heads of State of the four countries involved signed a treaty in 2012 establishing the Ad-hoc company Transco CLSG which is responsible for the realization and operation of the project. A commercial framework has been established providing the remuneration of Transco CLSG for the electricity transmission service.

The line is currently foreseen in simple circuit but the study recommends the deployment of the second circuit in the same time as the first one (see section 3.1.2.3).

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Given the volume of hydroelectric projects in development in each of the 4 countries crossed by the CLSG interconnection, this project will inexorably play an important role in their integration	When connecting 3 countries electrically islanded to the interconnected WAPP network, this project acts as a major player in the development of a regional electricity market.	The sharing of energy generation will significantly reduce unserved energy in the different regions connected to the CLSG line (Guinea Nord and Guinea South-East Liberia and Sierra Leone)

Progress of the project

Funding has been mobilized, electricity purchase (PPA) and transport Service (TSA) contracts have been signed and work is underway. The first circuit of the line is scheduled to be put into service for 2020. The tension of certain sections is foreseen at the end of 2019.

Studies	Funding	Construction	Commissioning
			2020

Challenges

The main challenges for the development of this interconnection were:

- The time needed to adjust national legislative frameworks to enable the creation of Transco CLSG and the handover of funding an ad hoc company
- The setting up of the required guarantees for advance payment and obtaining the letters of credit have created a delay of several months at the beginning of the project.

On the other hand, this model of regional collaboration facilitated the development of the project on the following points:

- Coordination with funding institutions
- Integrated project management for technical design, contracting and follow-up of the work schedule
- Centralized monitoring of the management of environmental and social action plans at the national level

In the long run, a more complete feedback should be carried out during the operational phase and in the implementation of the commercial framework.

Implementation strategy

Concession to a SPV

Responsible Institution for the development

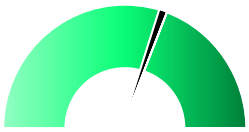
WAPP/Transco CLSG

3.1.1.21. 225KV OMVG LOOP

Description of the project

This project concerns the construction of a 225 kV loop connecting the OMVG member states. This loop has a length of 1677 km, and its estimated cost is to 722 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
With the development of the OMVG loop being motivated by the sharing of hydroelectric power, this project actively participates in the integration of these projects	The OMVG loop will participate in connecting Guinea, Gambia and Guinea Bissau to the interconnected network of the WAPP, which gives the project a major role in the development of a West African electricity market.	Le projet permettra d'interconnecter l'ensemble des pays de la zone B et créera un lien entre les 2 jonctions Zone A- Zone B que sont la boucle CLSG et l'interconnexion Mali-Côte d'Ivoire

Progress of the project

The technical studies of the project were completed in 2006. The environmental and social impact assessment were also carried out but had to be updated during the period of financing mobilization.

The financing was gathered with the support of eight IFIs. The construction of the loop has begun and the commissioning of the first stretches are foreseen for June 2019. The complete commissioning of the loop will be achieved in 2020.

Discussions continue to finalize the trade framework for electricity exchanges.

Studies	Funding	Construction	Commissioning
			2020

Challenges

The main challenges faced during the development of the OMVG loop were:

- The mobilization of financing for construction works
- The time required for the countries to retrocede the financing to the OMVG
- The necessity to update the environmental and social impact studies
- The process of land acquisition and land owner compensation which was the source of additional delays in certain parts.
- The coordination between the development of the interconnection and the development of national networks. For example, the line between Ziguinchor and Tambacounda in Senegal will soon be achieved, approximately one year ahead of its connection to the OMVG loop.

It is important to mention that the triggering factor for the development of the project was the start of the Kaleta hydropower scheme construction by Guinea and the confirmation by Guinean Authorities of the availability of part of the production for export through the OMVG loop.

Implementation strategy

EPC Contracts and country financing retroceded to OMVG

Responsible Institution for the development

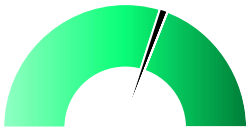
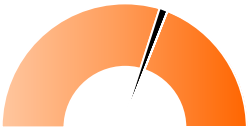
OMVG

3.1.1.22. PROJET MANANTALI- BAMAKO (MALI)

Description of the project

The project consists of a 225 kV line between Bamako and Manantali (317 km and roughly 85 MUSD).

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This project will allow to share hydro and solar energy between East and West	This project concerns the reinforcement of a national network but it will contribute to reinforce East-West exchanges	The project is essential to ensure operationnal security of Mali especially and the region generally

Progress of the project

The project supported by OMVS and a funding was found at AFD. Preliminary studies have already been done

Commissioning is envisaged in 2021.

Studies	Funding	Construction	Commissioning
			2021

Implementation Strategy

EPC Contract

Responsible Institution for the development

Mali, OMVS/Sogem

3.1.1.23. GUINEA-MALI INTERCONNECTION

Description of the project

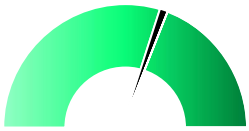
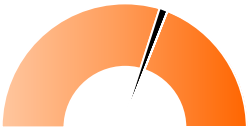
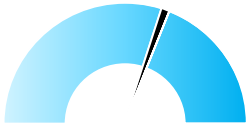
The components of the Guinea-Mali interconnection project are:

- Line 225 kV Linsan – Fomi
- Line 225 kV N'Zérékoré – Fomi – Bamako

The total cost of the project is estimated at 436 MUSD.

Final version

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This project will allow the sharing of hydroelectric power in the Fomi region and will de facto contribute to its integration	This new axis increases transmission capacity between Guinea and the rest of the region (especially the Northern part)	The new interconnection will bring redundancy in the transfer capacity and thus improve the security of the system

Progress of the project

The section Linsan – Fomi is the subject of a construction contract with the company CWE and financed by the Exlm Bank of China. Work is being started.

The section N'Zérékoré – Fomi – Bamako is managed at the WAPP level with implementation units created in each country. A bidding process for the selection of a consulting engineer for the procurement of construction of the line was initiated in January 2018. The funding of the work is also being mobilized to international donors (BAD, Had EIB, World Bank, IDB, BOAD, ebid).

Studies	Funding	Construction	Commissioning
			2021

Challenges

The main difficulties encountered are the following:

- The time required to meet the conditions for disbursement of the loan agreements with the IFIs and the retrocession of the financing to the WAPP
- Environmental and social impact assessment was delayed due to the Ebola crisis in the region.

Implementation Strategy

EPC Contract under multilateral financing

Responsible Institution for the development

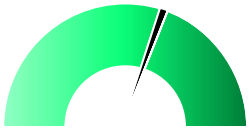
WAPP, Mali, Guinea

3.1.1.24. NORTH CORE PROJECT

Description of the project

The project consists of a 330 kV line connecting Niamey (Niger), Birnin Kebbi (Nigeria), Malanville (Benin) and Ouagadougou (Burkina Faso), with an estimated cost of 541MUSD for 832km of line.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Although the development of the North Core was initially not motivated by the Integration of renewable energy, it will inevitably contribute to support the evacuation of solar-based energy to be developed in the regions crossed by the line	The increase of transfer capacity between the four countries concerned by the North Core will increase the opportunities for trade between these countries	Given the unserved energy rate observed in the areas crossed by this project, the improvement of security of supply will be one of the flagship benefits linked to this development. It will also ensure a new connection between Nigeria and the rest of WAPP reinforcing operational security

Progress of the project

The project has been the subject of a feasibility study in 2007. This study has been updated in 2016. Funds have been mobilized at the World Bank, the ADB and the AFD and additional funding are in discussions with the European Union. The loan agreement with ADB has been signed and the agreement with the World Bank is scheduled to be submitted for approval by the Board of Directors in September 2018. The AFD loan agreement will also be finalized by September.

The institutional framework of the project has been defined with the creation of a joint management unit based in Abuja and working with national project teams based in each country. The commercial framework is under discussion. Meetings between the project's stakeholders were held to this regard in February and April of 2018.

Line demarcation activities are underway and local consultations are being organized. Commissioning is now planned for 2022.

Studies	Funding	Construction	Commissioning
			2022

Challenges

The project development has been delayed by the definition of an institutional framework acceptable to all parties. The creation of an SPV has been envisaged but based on the lessons learned from the Transco CLSG project, this approach was eve ntually not followed because it was deemed that the necessary adjustment of the national legal frameworks would have considerably delayed the development process.

Implementation Strategy

EPC Contracts EPC coordinated by a joint project management unit

Responsible Institution for the development

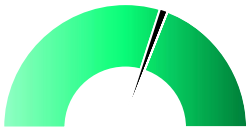
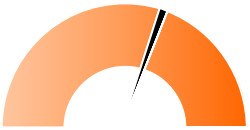
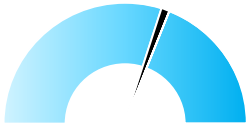
WAPP, Nigeria, Niger, Bénin, Burkina Faso

3.1.1.25. INTERCONNECTION PROJECT KAYES (MALI) - KIFFA (MAURITANIE)

Description of the project

The project consists of a 225 kV and 420 km line between Kiffa (Mauritanie) and Kayes (Mali) for an estimated comst of 184 MUSD. Coupled with the Kiffa-Nouakchott (Mauritanie) section , this project will close the loop between Senegal, Mali and Mauritania.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This project will allow to share hydro and solar energy between the three countries	Considering the fact that this project is the reinforcment of existing interconnection links, the development of a regional market is not the top priority but it will contribute to this anyway	While closing the loop between the three countries, the project will reinforce the operational security of the system

Progress of the project

The project supported by OMVS is currently in the process of seeking funding. Preliminary studies have already been done

Commissioning is envisaged in 2022.

Studies	Funding	Construction	Commissioning
			2022

Implementation Strategy

EPC Contracts with financing

Responsible Institution for the development

Mali, OMVS/Sogem

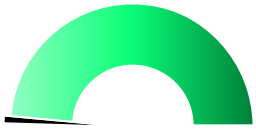
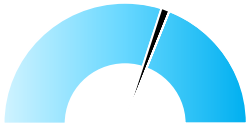
3.1.2. Other priority projects

3.1.2.1. MARIA GLÉTA THERMAL POWER PLANT (BENIN)

Description of the project

The thermal power plant located in Maria Gléta in Benin is a 450 MW project with an estimated budget of 585 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The Maria Gleta project is essential to ensure the energy independence of the Togo-Benin region, but it does not directly contribute to the integration of renewable energy in the sub-region	The location of the project should allow the export of thermal energy to the Northern countries to complement solar energy.	In the short term, the project will reduce the amount of unserved energy in the countries. It will offer an electric energy stack with a high availability rate and little exposed to climatic hazards.

Preliminary economic analysis

In the interconnected system, gas-fired power plants define the marginal cost of the system. Indeed, when heavy fuel-fired power plants have been replaced by cheaper options, gas will become the most expensive option in operation. That being said, the development of thermal power plants remains essential to enable the lower cost and reliable supply of electrical demand in the sub-region.

Considering the following assumptions for the combined cycle power plant of Maria Gleta

Lifetime	30
Date of commissioning of the first turbine	2022
Installed Capacity [MW]	450
Investment cost [MUSD/MW]	1.3
Variable operating costs [USD/MWh]	3.2
Specific consumption [KJ/kWh]	6 901
Location	Benin South

Table 1: Assumptions for economic analysis [Maria Gleta]

As well as the results of the master plan in terms of the utilization rate of the plant

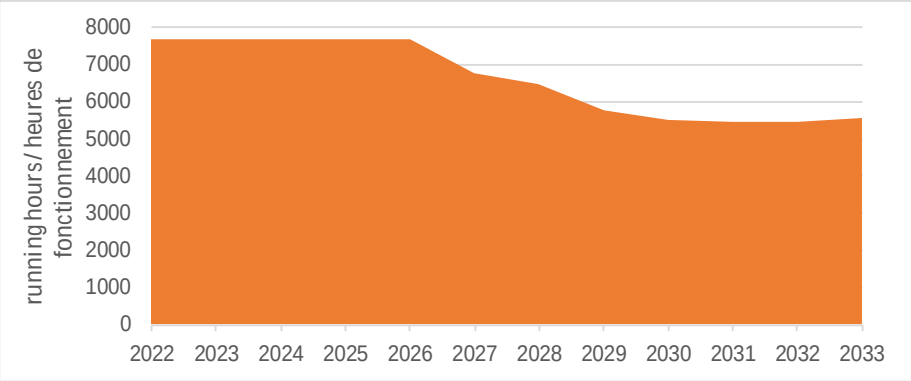


Figure 3: Utilization rate of the plant (Operating hours equivalent at max power) [Maria Gleta]

The selling price at the output of the machine should be set at 75 USD/MWh to achieve an internal rate of return of 10%.

Preliminary environmental analysis

Due to the implementation of the project in the peri-urban area, impacts on noise and air quality are expected during the construction phase and during the operation phase. With regard to the air quality aspects, the operation of the plant with both heavy fuel oil and natural gas will not create any health risks. During the construction phase, the main task will be to properly manage the storage and handling of oils, hydrocarbons, solvents, waste, etc. to prevent leakage and spills to soils and wild deposits, with the subsequent risk of polluting groundwater and surface water; especially since the local population feeds on water with wells. With regard to the social aspects, the main negative aspects are the expropriations of dwellings which will be necessary to the right of the influence of the future plant. Indeed, 1181 people will have to be displaced as part of the construction project of the plant; which constitutes a major impact. These land acquisitions and relocations must be carried out in accordance with a resettlement action plan that must be implemented and implemented before the construction phase begins.

Progress of the project

The complete project underwent a tender for a development in PPP, won by the AFC. In this timeline, it is expected that the developer is in charge of securing the fuel supply. The AFC must reassure the project's partners regarding the reliability of the supply.

The AFC is currently in the process of obtaining financing. The objective is to have a first gas turbine commissioned in the short-term, before the development of the complete project (2*150MW gas turbines and a steam turbine of the same capacity) in the medium-term

Studies	Funding	Construction	Commissioning
			2022

Challenges

The project was first delayed due to the withdrawal of the first awardee of the tender, replaced by the AFC.

The main challenge lies in the development of fuel supply, in a context where the volumes imported from Nigeria by the West African gas pipeline are not regular. Moreover, the infrastructure to deliver the gas to the site of Maria Gléta is currently not sized for the complete project.

Finally, even though potential offtakers have confirmed their commitment regarding the purchase of electricity, the national development plan does not consider the perspective of a supply from Maria Gleta (regional). This situation creates confusion as to the commercial opportunities for the sale of the project's production.

Implementation Strategy

PPP

Responsible Institution for the development

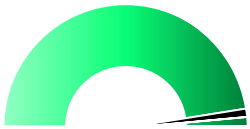
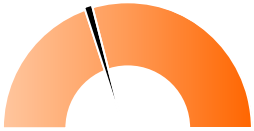
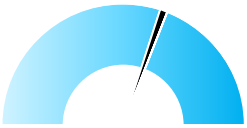
WAPP

3.1.2.2. BOUTOUBRE HYDROPOWER PLANT (CÔTE D'IVOIRE)

Description of the project

The Boutoubré hydropower plant, located on the Sassandra River in Côte d'Ivoire, is a 150 MW project for a producible of 908 GWh (estimated cost of 862 MUSD).

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Benefiting from the regulation of Soubré, the Boutoubré project is particularly interesting for the sub-region because it allows the generation of hydropower at lower cost	The location of the project near the CLSG line also allows for a sharing of hydroelectric production with Sierra Leone and Liberia	In terms of security of supply, the project can carry out two missions which are: the reduction of the unserved energy volume and the supply of storage capacity to the interconnected system

Final version

Preliminary Economic Analysis

The Boutoubré hydropower plant is one of the most profitable hydroelectric projects in Côte d'Ivoire. It accumulates high available energy (utilization factor of 5800 hours per year) and a cost per MW installed in the low range of hydroelectric projects (3200 KUSD/MW). In this context, it appears as economically justified to satisfy demand in the subregion. The Net Present Value of the project, considering a discount rate of 8% and a remuneration at the country's marginal cost is 46 MUSD.

These results were obtained with the following hypotheses for Boutoubré:

Lifetime	40
Commissioning date of the first turbine	2022
Average annual energy produced [Gwh]	908
Investment cost [MUSD/MW]	3.2
Location	Côte d'Ivoire South

Table 2: Assumptions for economic analysis [Boutoubre]

As well as the results of the master plan in terms of the country's marginal cost.

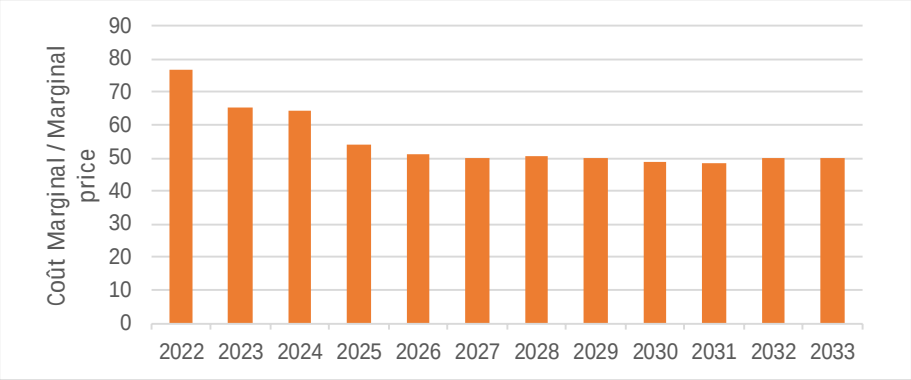


Figure 4: Average marginal cost [South Côte d'Ivoire]

The selling price at the output of the machine should be set at 57 USD/MWh to achieve an internal rate of return of 10%.

Final version

Preliminary Environmental analysis

The site of the hydroelectric project of Boutoubré is about fifty kilometers from the National Park of Tai, a UNESCO World Heritage site, and Nearby Immediate Nature Park of Gaoulou, preserved Forest. Thus, the fauna and flora of the latter will have to be the subject of special measures, in order to limit the environmental impact of the project. As the site is currently poorly populated, the human impact should be limited. With the dam and slowing down of the water, or even its stagnation, the consequences on the water quality will be major, stemming from a consequent modification. In a second step, the decomposition of the plants will increase the eutrophication of the waters. These changes can have downstream impacts on vegetation and on the whole of biodiversity. The impact on the fauna will be moderate: construction, and especially the introduction of water, would destroy terrestrial species, mainly insects and small mammals and especially their biotopes. Accidents during the work are more than probable, and the impact of the construction is therefore to be considered as negative. Good prevention will be necessary for the workers and the population. The presence of the lake can lead to a change in the prevalence of diseases in relation to water (malaria, onchocerciasis...), which also represents a negative impact in terms of health. In conclusion, the implementation of the dam will have a certain impact on the environment of the region, particularly in terms of water quality, but this impact remains controllable. A thorough study of the environmental aspects will have to confirm these elements during the feasibility study of the plant.

Progress of the project

After the construction of Soubré, the Chinese public company Sinohydro works on three other projects, which represent a cumulative capacity of 500 megawatts among which Boutoubré project which is in the development phase. The prefeasibility studies for this project are in the process of being implemented.

Studies	Funding	Construction	Commissioning
			2022

Implementation Strategy

EPC Contract

Responsible Institution for the development

Côte d'Ivoire

3.1.2.3. SECOND CIRCUIT OF THE CLSG INTERCONNECTION

In order to allow optimal operation of the interconnected network, the second circuit of the CLSG line should be put into service at the same time as the first one.

To this end, funding research should be started as soon as possible.

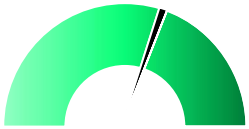
3.1.2.4. INTERCONNECTION BOLGATANGA-BOBO-SIKASSO

Description of the project

The project is a 330kV line linking Bolgatanga (Ghana), Bobo Diolasso (Burkina Faso), and Sikasso (Mali), with a total length of 555 km (estimated cost: 341 MUSD).

The Bobo-Sikasso section should be put into service quickly (together with the OMVG loop and the CLSG loop) as it is required for the synchronization of the interconnected network. Before the commissioning of this line, the loss of some critical interconnections in the network causes instabilities and loss of synchronism.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This line will allow the exchange of solar energy between the different countries crossed	As this line aims at strengthening an existing section, the development of the electricity market is not the priority of the project	Operational security is the number 1 criterion for the Bobo-Sikasso section which is essential for the synchronisation of the interconnected network as predicted in 2022

Economic analysis Preliminary

The section Bobo-Sikasso is mainly justified for questions of reliability, in order to ensure the operational security of the interconnected network.

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (341 MUSD for the 555 km section of 330kV line between Mali, Burkina Faso and Ghana), taking into account the energy flowed annually as simulated under the development plan (approximately 1800GWh) and considering a discount rate of 10%. This cost amounts to 3.9 cUSD/MWh/km for the Bolga-Bobo-Sikasso line. The cost is justified for safety conditions.

Environmental analysis Preliminary

This line should not pass through any forest nor natural reserve. Impact on fauna and flora should therefore be relatively limited. The overall environmental impact of the construction of this line will be all the more that the area will have already been impacted by other lines. It appears that it will be possible to avoid the passage over dwellings almost on the whole route. Only around important cities and villages, and during passages with a strong relief, there is a risk of having to move certain houses. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

The project was the subject of a feasibility study in 2010 which considered a structure in 330 kV. As part of the discussions with the EIB for the financing of the project, an alternative in 225 kV was studied.

The project is currently under consideration and must take into account the evolution of national networks, particularly at the level of the Bolgatanga II substation. In addition, discussions are underway regarding the contract for environmental and social studies following a request for endorsement by the consultant exceeding the thresholds acceptable to the stakeholders. The situation is now blocked on this point.

It should be noted that the contracts for the construction works have been awarded for the section between Sikasso and Bamako in Mali because of the interest of the line for the malian national network. The corresponding decrees were adopted in the Council of Ministers dated of 7 March 2018.

Studies	Funding	Construction	Implementation In service
			2022*

* It is strongly recommended to accelerate the construction of the section Bobo-Sikasso (ideally 2022) to ensure the safe operation of the WAPP interconnected system

Challenges

The main difficulties encountered as reported by the project's actors are:

- The initial project changes agreed upon in discussions with funders who have required studies
- The need to take into account in the study of the evolution of the national networks which took place while the project was lagging behind
- Contractual lock for the environmental and social impacts studies of the project

Implementation Strategy

EPC Contract

Responsible Institution for the development

WAPP, Mali, Burkina Faso, Ghana

3.2. Medium-term priority projects (2023 - 2029)

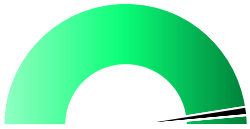
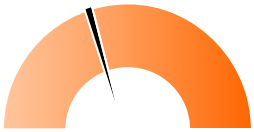
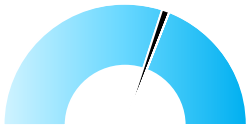
3.2.1. Decided projects

3.2.1.1. AMARIA HYDROPOWER PLANT (GUINEA)

Description of the project

It is a hydroelectric power station with a capacity of 300 MW, located on the Konkouré River, downstream from Souapiti/Kaleta and offering a pluriannual reservoir. The plant will have a production warranty of 1435 GWh per year and an estimated value of 600 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Like other hydroelectric projects in the country, Amaria will strongly contribute to reducing the use of fossil fuels in the sub-region	Although developed for national purposes at first, the energy produced could be shared with the neighboring countries via the OMVG loop	As with other dams, one of the expected roles of Amaria in terms of securing supply is the contribution of Storage capacity to the system

Progress of the project

Project has been the subject of a study of preliminary design (APS) in 2017.

Studies	Funding	Construction	Commissioning
			2023

Implementation Strategy

A concession agreement of BOT type is under discussion with the TBEA company as part of a mining project for which the company has the concession, which will receive a portion of the energy produced.

Concession (BOT)

Responsible Institution for the development

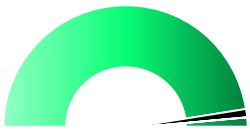
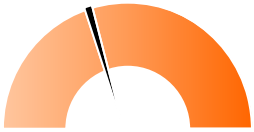
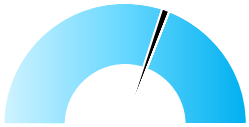
Guinea

3.2.1.2. BUMBUNA II HYDROPOWER PLANT (SIERRA LEONE)

Description of the project

The project consists of the extension of the existing plant to add 143 MW to the existing capacity of 50 MW. The cost of the project reaches 358 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
After Bumbuna I, this project will further significantly increase the rate of renewable energy integration in Sierra Leone	Due to its proximity to the CLSG network, the sharing of Bumbuna hydroelectric power with neighboring countries, including Liberia, could be envisaged.	In addition to providing flexibility, the Bumbuna II power plant will have an important role in securing the country's electricity supply.

Progress of the project

The power purchase agreement was signed in August 2017 with developer Joule Africa for a period of 25 years. The construction must begin mid-2018 and be completed in 2023.

Studies	Funding	Construction	Commissioning
			2023

Implementation Strategy

Concession

Responsible Institution for the development

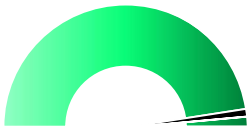
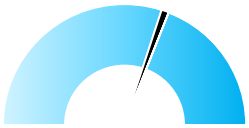
Guinea

3.2.1.3. LOUGA HYDROPOWER PLANT (CÔTE D'IVOIRE)

Description of the project

Il It is a hydroelectric power plant with an installed capacity of 246 MW and a cost of 647 MUSD on Sassandra river.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The producible of Louga will substitute thermal energy for demand supply	Considering the structure of the ivorian power system, this project could supply neighbouring countries through the different interconnections	Additional power available to supply local and regional demand and complementarity with variable renewable energies

Progress of the project

Detailed studies still to be done

Studies	Funding	Construction	Commissioning
			2023

Implementation Strategy

EPC contract envisaged between CI-Energies and Sinohydro, under Exim Bank of China financing (to be confirmed) – **Contrat EPC**

Responsible Institution for the development

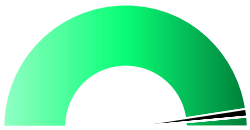
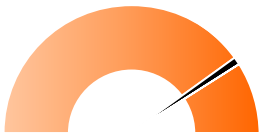
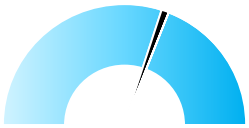
Côte d'Ivoire

3.2.1.4. KOUKOUTAMBA HYDROPOWER PLANT (OMVS)

Description of the project

It is a hydroelectric power plant in Guinea with a capacity of 294 MW and a guaranteed annual production of 455 GWh/yr. The cost of the project is estimated at 689 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The Koukoutamba power plant will allow the reduction of fossil energy consumption in Guinea and in other countries of the OMVS	As a result of its development within the framework of the OMVS, this project naturally aims to take part to the regional electricity market	Improving the security of supply is an additional benefit of the project, in particular by providing flexibility to the system

Progress of the project

The feasibility studies of the project have been made. The project has been the subject of a tender for a construction type EPC + funding, in which it requested bidders to offer financing options. Contract negotiations are currently starting with the selected candidate.

A study of environmental and social impact of the project is underway with funding from the World Bank.

Studies	Funding	Construction	Commissioning
			2024

Implementation Strategy

EPC Contract + financing

Responsible Institution for the development

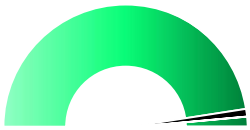
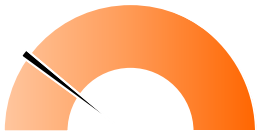
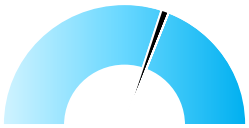
OMVS

3.2.1.5. MAMBILLA HYDROPOWER PLANT (NIGERIA)

Description of the project

The Mambilla hydroelectric power plant project initially had an installed capacity of 2,600 MW for a guaranteed production of 11,214 GWh per year and an estimated project cost of 4 MMUSD. The power of the plant has been revised upwards to 3050 MW for a project cost of 5.8 MMUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This major project will significantly increase Nigeria's renewable energy integration rate, currently largely dominated by thermal-derived energy	Despite its size, and given the national energy needs, the location of Mambilla, far from the borders with the other countries of the subregion makes it difficult to share the energy produced.	Given its size, the Mambilla reservoir will be able to serve as energy storage in the sub-region, thus participating in securing the supply

Progress of the project

The contract for construction was awarded in 2017 as part of a joint venture between governmental authorities and a Chinese contractor. The commissioning date is foreseen in 2024.

The start of construction is pending the mobilization of the contractor at site.

Studies	Funding	Construction	Commissioning
			2024

Implementation Strategy

PPP

Responsible Institution for the development

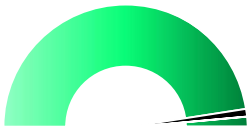
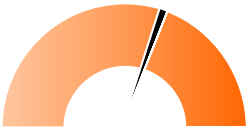
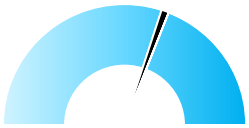
Nigeria

3.2.1.6. ADJARALLA HYDROPOWER PLANT (TOGO AND BENIN)

Description of the project

The project consists in the increase of the hydroelectric capacity of the existing power plant of Adjaralla on the Mono River, on the border between Benin and Togo. This joint project between the two countries consists of the construction of a dam with a capacity of 147 MW and an average annual production of about 264 GWh (reduced compared with production originally scheduled for 366 GWh), for a total cost of 333MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
With the exception of the generation from Nangbeto, Togo and Benin are almost exclusively fueled by thermal-based electricity (domestic or imported). The development of Adjaralla will allow the transition to more renewable source energy in this region	The location of Adjaralla, on the border between Togo and Benin, gives the project a regional dimension and therefore participates in the development of a sub-regional market	The development of an additional project in the CEB network is necessary to increase the energy independence of the two countries, to reduce the exposure to the availability and price of fossil resources and to secure the electricity supply

Progress of the project

In 2015, Sinohydro Africa group has signed a memorandum of understanding for the project construction. The financing of the works was discussed with the ExIm Bank of China.

The funding of Benin's part was mobilized and a loan agreement was signed on May 30th, 2016 for Togo's part. The contractor started works at site.

The IMF then issued a negative assessment of Togo's loan agreement in view of the country's external debt. In this context, Togolese Authorities had to suspend the works.

Studies	Funding	Construction	Commissioning
			2026

Challenges

The major challenge in the implementation of the Adjaralla hydroelectric project was the fragile financial situation of Togo which prevented him to mobilize his portion of the financing.

The decision to develop the Adjaralla dam dates back from 1988. Prior to the loan agreement with the ExIm Bank of China, the financing was under discussion with a group of International Financing Institutions among which the World Bank, the ADB, the AFD and the IDB. In this context, the major source of delay was the incapability of Togo and Benin to mobilize own funds for the mitigation measures of the project's environmental and social impacts.

Additionally, the payment of the Contractor's anticipated mobilization before the finalization of the loan agreements is now a contractual issue.

Implementation Strategy

EPC Contract (on hold)

Responsible Institution for the development

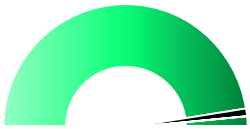
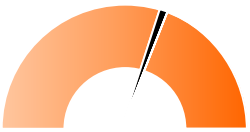
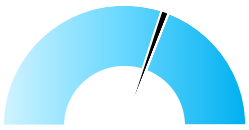
Togo and Benin

3.2.1.7. TIBOTO HYDROPOWER PLANT (CÔTE D'IVOIRE/LIBERIA)

Description of the project

The project is a hydroelectric plant located at Tiboto, with a capacity of 225 MW and an average annual production of 912 GWh. The cost of the project is estimated at 599 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Like other hydroelectric projects, the main objective of Tiboto is the substitution of fossil-fuel energy with renewable electricity	Given the location of the project on the border between Côte d'Ivoire and Liberia, the sharing of hydroelectric power between these two countries will go through the development of a market	In addition to lower-cost energy input, the Tiboto hydroelectric project could provide flexibility in the interconnected system.

Progress of the project

A memorandum of understanding was signed with Eranove for the development of the project in 2014. The project is still at the stage of study.

The project is intended to serve the demand in Côte d'Ivoire and Liberia. The

development of the project is delayed due to:

- A load consumption growth below forecasts;
- The delay in the realization of the interconnection CLSG;
- The development of distribution networks below the forecast.

Studies	Funding	Construction	Commissioning
			2028

Implementation Strategy

Concession

Responsible Institution for the development

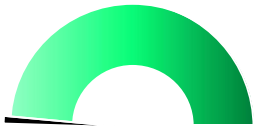
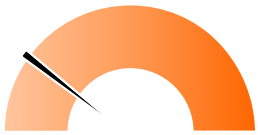
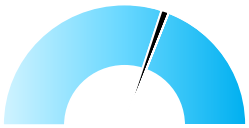
WAPP, Côte d'Ivoire and Liberia

3.2.1.8. ALAOJI II THERMAL POWER PLANT (NIGERIA)

Description of the project

It is a 285 MW thermal plant to be built in the south of Nigeria for a total cost of 370.5 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	This project is essential, not only for satisfying the local demand but also to meet the volume of exchanges contracted with neighbouring countries (Togo-Benin)	Considering the lack of generation in Nigeria, this project will contribute significantly to the improvement of security of supply

Progress of the project

Studies	Funding	Construction	Commissioning
			2025

Implementation Strategy

EPC Contract

Responsible Institution for the development

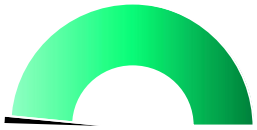
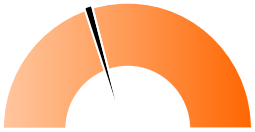
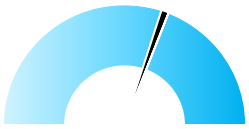
Nigeria

3.2.1.9. SAN PEDRO COAL POWER PLANT (CÔTE D'IVOIRE)

Description of the project

The plant is composed of 2 groups of 350 MW each which will use imported coal and for which the estimated investment cost reaches 1900 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Due to its thermal nature, this project does not contribute directly to the sustainable development of the sub-region	Given the structure of the Ivorian internal network, this project can be used to supply the neighboring countries via the different interconnections	Considering the lack of generation in the region, this project will contribute to the improvement of security of supply

Progress of the project

Discussions are underway with private partners regarding project implementation.

Studies	Funding	Construction	Commissioning
			2026-2029

Challenges

The major challenge identified by actors of the project is the difficulty of obtaining financing for coal-fired thermal projects from financial institutions.

Implementation Strategy

EPC Contract

Responsible Institution for the development

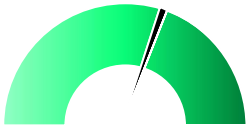
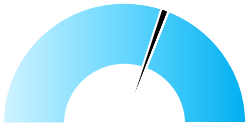
Côte d'Ivoire

3.2.1.10. LINE LINSAN (GUINEA) – KOUKOUTAMBA (GUINEA) – BOUREYA (GUINEA)– MANANTALI (MALI) (COMPONENT OF THE PROJECT MANANTALI II OF OMVS)

Description of the project

The project is a line 225 kV double circuit line of 462km connecting Linsan (Guinea), Koukoutamba (Guinea), Boureya (Guinea) and Manantali (Mali), with an estimated cost of 166 MUSD. The realization of this line is conditioned to the construction of the Koukoutamba hydroelectric power plant.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The new line is closely linked to the development of hydroelectric projects of OMVS	As part of the OMVS project, this line will be a vector of the regional electricity market by allowing to increase trade between Guinea and Mali	Although not being the primary function of this line, it will provide redundancy in interconnections and thus increase security of supply

Progress of the project

The development of the project is on hold, pending the mobilization of financing and the project construction of Koukoutamba.

An additional study is on-going to check the connection of the Guinean network with the OMVS network.

Studies	Funding	Construction	Commissioning
			2024

Implementation Strategy

EPC Contract

Responsible Institution for the development

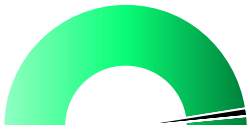
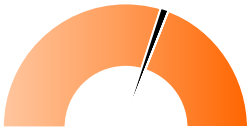
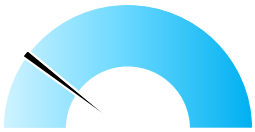
OMVS

3.2.1.11. LINE BUCHANAN (LIBERIA)-SAN PEDRO (CÔTE D'IVOIRE)

Description of the project

It is a project of line 225-kV between Buchanan (Liberia) and San Pedro (Côte d'Ivoire), a length of 400km, and an estimated cost of 101 MUSD. This line is in particular required for the evacuation of the generation of Tiboto hydropower plant.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The main mission of the new line is to evacuate hydroelectric power from Tiboto and therefore contribute to the Integration of renewable energy into the system	This line will strengthen the exchange capacity between the Liberia-Sierra Leone area and Côte d'Ivoire and increase the market opportunities between these countries	The redundancy offered by this new line of interconnection will increase the safety of the electrical system

Progress of the project

The line has not been the subject of recent study.

Studies	Funding	Construction	Commissioning
			2028

Implementation Strategy

This project could be developed through an **EPC Contract**

Responsible Institution for the development

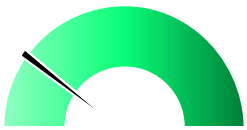
WAPP, Côte d'Ivoire and Liberia

3.2.1.12. COASTAL BACKBONE PROJECT: INTERCONNECTION ABOADZE (GHANA) – BINGERVILLE (CÔTE D'IVOIRE)

Description of the project

This project is part of the "Coastal backbone" interconnection project, following the coast between Nigeria, Benin, Togo, Ghana and Côte d'Ivoire. It would link Aboadze (Ghana) to Bingerville (Côte d'Ivoire). It has an estimated cost of 190 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Although it is not its first objective, the coastal backbone will support renewable energy exchanges (hydro and solar) when these projects will have been developed	The finalization of the coastal backbone will establish a major regional market between the five countries in the south of the sub-region	Thanks to the new interconnection between Ghana and Côte d'Ivoire, the two countries will be able to share their reserve and thus improve the security of supply on both sides.

Progress of the project

Developments in the planning of the transmission network of Côte d'Ivoire have led to review the preliminary design of the interconnection. The line is designed in 330 kV from Dunkwa to Bingerville and passes there in 400 kV to reach Akoupe.

The funding intentions have been met. A financing part has been acquired from the KfW and the EU and the last part is being discussed with the EIB.

Studies	Funding	Construction	Commissioning
			2029

Challenges

- The major change induced by the introduction of the 400 kV network into the Ivorian master Plan has led to shifting the implementation of the project to adapt the technical design
- The analysis of environmental and social impacts also led to a change in the project

Implementation Strategy

EPC Contract

Responsible Institution for the development

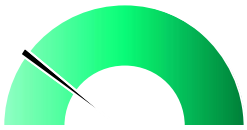
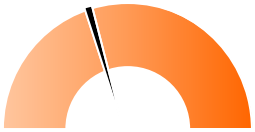
Ghana and Côte d'Ivoire

3.2.1.13. INTERCONNECTION LINE BOUNDIALI (CÔTE D'IVOIRE) – BOUGOUNI (MALI)

Description of the project

This project, whose route remains to be confirmed, aims on the one hand to strengthen the exchange possibilities between Côte d'Ivoire and Mali and on the other hand to connect the mining loads located in the region to the interconnected network. The 225kV line is 330 km long at an estimated cost of 96 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Given the expected development of solar energy in the area, the line will promote the integration of renewable although it is not its primary purpose	The line will allow increasing trade between Côte d'Ivoire and Mali	From the point of view of safety, the new line will have the reliability of supply of the load located on the route as main benefit

Progress of the project

Currently only preliminary analyses have been carried out for this line

Studies	Funding	Construction	Commissioning
			2029

Implementation Strategy

EPC Contract

Responsible Institution for the development

- Mali and Côte d'Ivoire

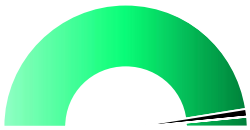
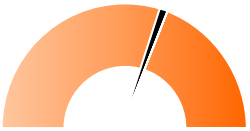
3.2.2. Other priority projects

3.2.2.1. 150 MW SOLAR PROJECT IN BURKINA FASO

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in Burkina Faso.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Given the solar potential of Burkina Faso and the downward trend in the cost of PV solar technologies, the development of large-scale projects is justified in reducing the dependence on fossil fuels in landlocked countries	The PV Solar project was sized with a regional scope, some of the energy produced being devoted to the export to neighboring countries, and in particular Côte d'Ivoire and Ghana	Given the intermittent nature of solar resources, no major role can be attributed to PV project in improving the security of supply

Preliminary Economic analysis

The development of solar projects in Burkina Faso is doubly interesting: on the one hand solar irradiation in the country is optimal for the development of such energy, and on the other hand the alternatives for the electricity generation are little and extremely costly, resulting in a particularly high marginal cost in the sub-region.

In this context, and given the reduction in the cost of photovoltaic panels, solar projects appear to be highly profitable in the country. The LCOE of the 150MW project put into service in phases from 2022 will be 48 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 13 MUSD.

These results were obtained with the following assumptions for the solar project in Burkina Faso:

Lifetime	25
Commissioning date of the first phase	2022
Average annual producible [GWh/MW]	1.7
Location	Burkina Faso

Table 3: Assumptions for economic analysis [Solar PV Burkina Faso]

As well as the results of the master plan in terms of the country's marginal cost.

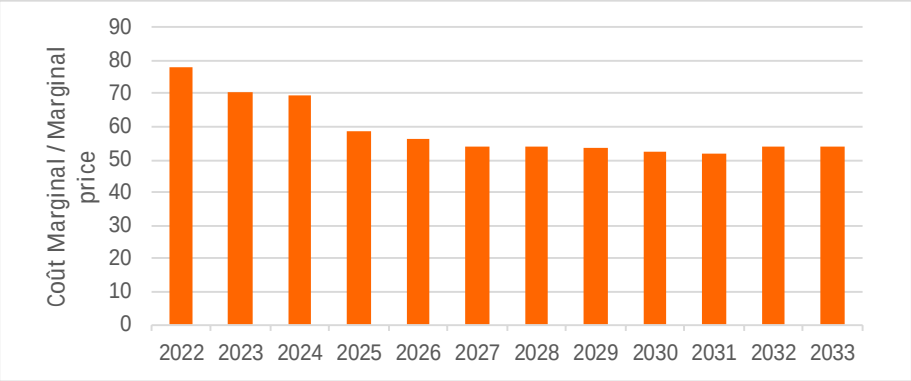


Figure 5: Average marginal cost [Burkina Faso]

Preliminary environmental analysis

A preliminary environmental analysis was carried out as part of this project's prefeasibility study. The sites of Kodéni, Pa and Ouagadougou East have been proposed for the installation of three respective components of 50 MW, corresponding to a ground surface of 75 to 150 hectares respectively. The sites are not close to any protected, forested, floodplains (or water) or urban areas. Other proposed sites have the same advantages, which severely limits the impact on the environment of such a project. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification). Overall, the expected impacts of solar projects at the environmental level are relatively limited.

Progress of the project

The prefeasibility study of the project has been carried out in 2017 and a financing for the feasibility and grid integration study has been obtained with the World Bank. The selection of a consultant for the study will be shortly launched.

The mobilization for financing for the construction is under way. It is foreseen to prepare an IPP framework for the tendering of the project, following-p on the successful experience of the “Scaling Solar” program in Senegal.

The date of commissioning will be after 2020 (First phase of 50MW in 2022).

Studies	Funding	Construction	Commissioning
			2022-2024

Challenges

The mobilization of financing is rendered more difficult by the fact that the project is not integrated in the national strategy for the development of the electricity sector.

Implementation Strategy

A tender for IPP is foreseen with the support of the World Bank - **IPP procurement**

Responsible Institution for the development

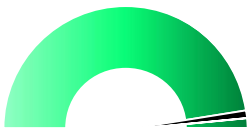
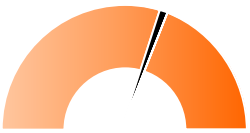
WAPP, Burkina

3.2.2.2. 150 MW SOLAR PROJECT IN MALI

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in Mali.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Like Burkina Faso, Mali appears to be a flagship country for the development of large-scale solar projects, allowing for the supplanting thermal generation.	The size of the project gives it a regional scope. Exports of electricity from solar origin will have to be the subject of trade contracts between the different countries of the region	Knowing that the peak load is in the evening in the majority of the countries of the subregion, the contribution of this project to the improvement of the reliability of the system is almost nil.

Preliminary economic analysis

Mali has limited hydroelectric resources and thermal options are costly because they require the import of heavy fuel oil from coastal countries. Therefore, the development of solar projects in the country is a very interesting option, especially since the country has a significant potential throughout its territory.

In this context, and given the reduction in the cost of photovoltaic panels, solar projects appear to be highly profitable in the country. The LCOE of the 150MW project put into service in phases from 2022 will be 48 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 7MUSD.

These results were obtained with the following assumptions for the solar project in Mali:

Lifetime	25
Commissioning date of the first phase	2022
Average annual producible [GWh/MW]	1.7
Location	Mali Sikasso

Table 4: Assumptions for economic analysis [Solar PV Mali]

As well as the results of the master plan in terms of the country's marginal cost.

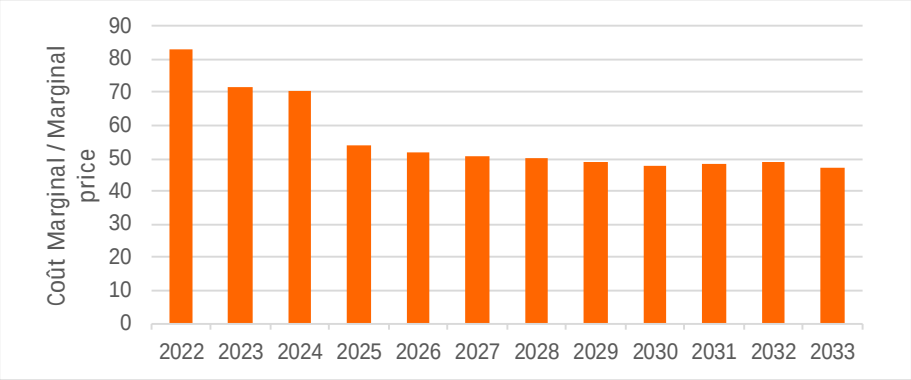


Figure 6: Average marginal cost [Mali-Sikasso]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the low density of land use in Mali, with many desert (or semi-desert) areas, the environmental impact does not seem to be a major limiting criterion. Many sites away from protected, forested, flooded (or water) or urban areas could be considered. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification). For reference, the environmental study of the Ségou Solar Project 33 MW provides a plan for the management of waste and hazardous materials in the construction phase, as well as measures to mitigate the physical, biological and human environment in the short and long term.

Progress of the project

The feasibility study of the project is on-going and includes the comparison of alternatives between solar PV and concentrated solar plants. A meeting with a delegation of representatives from ECOWAS, IRENA and the ADB was recently held to discuss the project development. This project is also supported by the World Bank.

The date of commissioning will be after 2020 (First phase of 50MW in 2022).

Studies	Funding	Construction	Commissioning
			2022-2024

Challenges

The coordination and the communication between teams from EDM and WAPP has not always been fluid on this project. Misunderstandings have occurred at times between the development of the regional project and the development of the national projects of Ségou, Kita, Sikasso and Koutiala which account for a total capacity of 158 MW.

In particular, the documents regarding the planning strategy at the national scale dos not take in account the regional project in their perspectives of generation capacity increase.

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

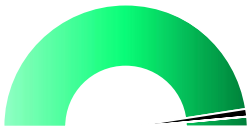
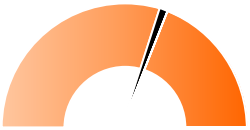
WAPP, Mali

3.2.2.3. 150 MW SOLAR PROJECT IN CÔTE D'IVOIRE

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in the North-West of Côte d'Ivoire.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This renewable project will allow avoiding thermal generation in the sub-region	The North of Côte d'Ivoire is or will be connected to all neighbouring countries through 225kV lines, allowing sharing solar energy	Given that the peak load is in the evening in most countries of the sub-region, the contribution of this project to improving the reliability of the system is almost zero.

Preliminary economic analysis

Given the country's limited natural gas reserves, there is considerable interest in diversifying the country's sources of electricity supply in order to reduce the cost of electricity on the one hand and guarantee security of supply on the other hand.

In this context, and given the reduction in the cost of photovoltaic panels, solar projects appear to be highly profitable in the country. The LCOE of the 150MW project put into service in phases from 2022 will be 52 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 2.5 MUSD.

These results were obtained with the following assumptions for the solar project in Côte d'Ivoire:

Lifetime	25
Commissioning date of the first phase	2022
Average annual producible [GWh/MW]	1.6
Location	North of Côte d'Ivoire

Table 5: Assumptions for economic analysis [Solar PV Côte d'Ivoire]

As well as the results of the master plan in terms of the country's marginal cost.

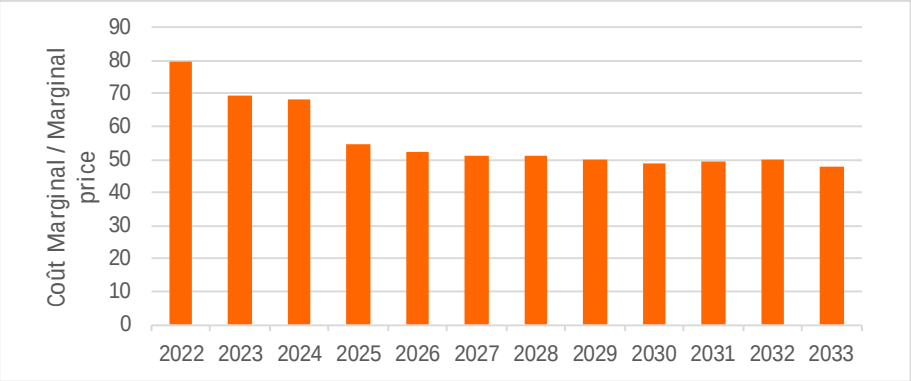


Figure 7: Average marginal cost [North of Côte d'Ivoire]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the low density of land use in the North of Côte d'Ivoire, the environmental impact does not seem to be a major limiting criterion. Many sites away from protected, forested, flooded (or water) or urban areas could be considered. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

At that stage no specific studies have been launched yet. The date of commissioning will be after 2020 (First phase of 50MW in 2022).

Studies	Funding	Construction	Commissioning
			2022-2023

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

WAPP, Côte d'Ivoire

Final version

3.2.2.4. 150 MW SOLAR PROJECT IN THE GAMBIA

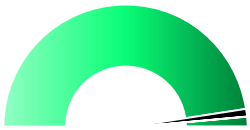
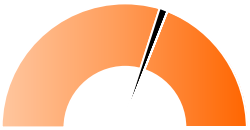
Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in in The Gambia.

Project Justification

This project supported by the World Bank will enable the Gambia to reduce its energy dependence and ensure a better electricity supply while benefiting from less expensive electricity generation than the thermal solutions currently in service in the country.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The Gambia is currently heavily dependent on thermal energy. The development of this flagship project would have a very positive impact on the country's sustainable development	The size of the project in relation to the demand in the Gambia justifies the need to share the resource in a sub-regional electricity market	Excluding the potential storage battery support, the solar project cannot contribute to the security of supply.

Preliminary economic analysis

The Gambia is very dependent on the import for its energy supply (fossil fuels and electricity). The development of a major solar project in the country should help to reduce this energy dependency and reduce the cost of electricity in the country, particularly in view of the reduction of the cost of photovoltaic panels, the projects appear to be highly profitable in the country. The LCOE of the 150MW project put into service in phases from 2023 will be 49 USD/MWh . Considering that solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 600 kUSD.

These results were obtained with the following assumptions for the solar project in the Gambia:

Lifetime	25
Commissioning date of the first phase	2023
Average annual producible [GWh/MW]	1.5
Location	The Gambia

Table 6: Assumptions for economic analysis [Solar PV The Gambia]

As well as the results of the master plan in terms of the country's marginal cost.

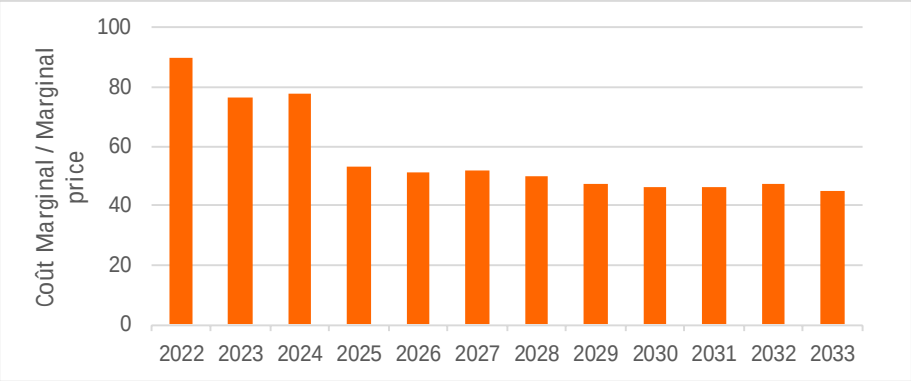


Figure 8: Average marginal cost [The Gambia]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the geographical distribution of the territory around the river, with many flood zones, as well as a relatively high population density (about 200 inhabitants/km²), the choice of suitable sites could be more limited and the environmental impact could be a limiting criterion. Overall, the expected impacts of solar projects at the environmental level are relatively limited. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

The project is supported by the World Bank. The date of commissioning will be after 2020 (First phase of 50MW in 2023).

Studies	Funding	Construction	Commissioning
			2023-2025

Challenges

This project will be the first major renewable project in the country and the development of a project coupled with storage units adds additional complexity.

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

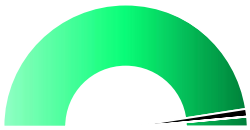
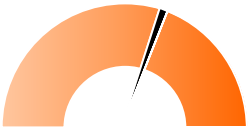
WAPP, The Gambia

3.2.2.5. 150 MW SOLAR PROJECT IN BENIN

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in the extreme North of Benin, close to the connection with the North Core.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This renewable project will allow avoiding thermal generation in the sub-region	Thanks to the North Core, it will be possible to exchange solar-generated electricity with Niger and eastern Burkina Faso in particular.	Given that the peak load is in the evening in most countries of the sub-region, the contribution of this project to improving the reliability of the system is almost zero.

Preliminary economic analysis

The interest in developing solar energy in northern Benin is not only in reducing the average cost of electricity but also in increasing the country's energy independence (reduction of import of fossil fuel and electricity of thermal origin).

In this context, and given the reduction in the cost of photovoltaic panels, solar projects appear to be highly profitable in the country. The LCOE of the 150MW project put into service in phases from 2024 will be 43 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 15 MUSD.

These results were obtained with the following assumptions for the solar project in Benin:

Lifetime	25
Commissioning date of the first phase	2024
Average annual producible [GWh/MW]	1.7
Location	North of Benin

Table 7: Assumptions for economic analysis [Solar PV North Benin]

As well as the results of the master plan in terms of the country's marginal cost.

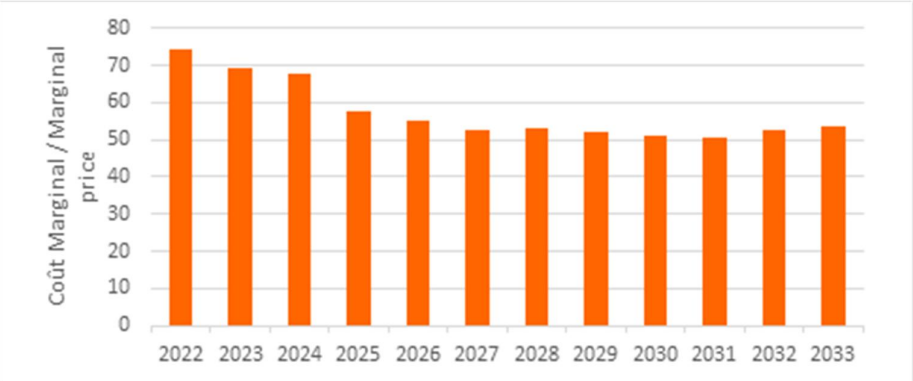


Figure 9: Average marginal cost [North of Benin]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the low density of land use in the North of Benin, the environmental impact does not seem to be a major limiting criterion. Many sites away from protected, forested, flooded (or water) or urban areas could be considered. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

At that stage no specific studies have been launched yet. The date of commissioning will be after 2020 (First phase of 50MW in 2024).

Studies	Funding	Construction	Commissioning
			2024-2026

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

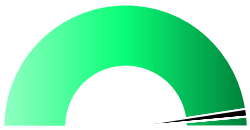
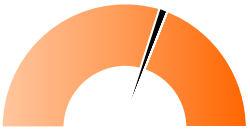
WAPP, Benin

3.2.2.6. 1000 MW SOLAR PROJECT IN NIGERIA

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 1000 MW in the state of Jigawa in Nigeria.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This renewable project will allow avoiding thermal generation in the sub-region	Thanks to the North Core and the new Niger-Nigeria interconnection, it will be possible to exchange solar-generated electricity with Niger, Benin and eastern Burkina Faso, among others.	Given that the peak load is in the evening in most countries of the sub-region, the contribution of this project to improving the reliability of the system is almost zero.

Preliminary economic analysis

The economic interest of the project lies in the supply of a region currently fueled mainly by heavy fuels and characterized by a relatively high marginal cost of electricity.

In this context, and given the reduction in the cost of photovoltaic panels, solar projects appear to be highly profitable in the country. The LCOE of the 10000MW project put into service in phases from 2025 will be 38 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 97 MUSD.

These results were obtained with the following assumptions for the solar project in Nigeria:

Lifetime	25
Commissioning date of the first phase	2025
Average annual producible [GWh/MW]	1.7
Location	State of Jigawa

Table 8: Assumptions for economic analysis [Solar PV North Nigeria]

As well as the results of the master plan in terms of the country's marginal cost.

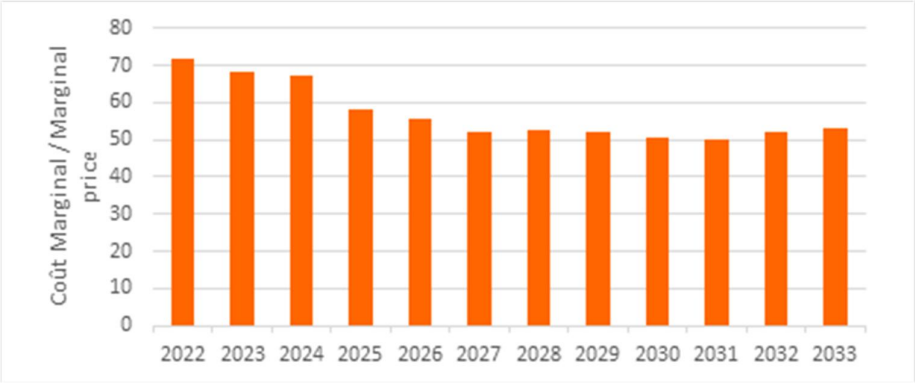


Figure 10: Average marginal cost [North of Nigeria]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the low density of land use in the Jigawa State, the environmental impact does not seem to be a major limiting criterion. Many sites away from protected, forested, flooded (or water) or urban areas could be considered. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

Tenders for feasibility studies for the solar program have been launched. It is assumed that projects will be commissioned gradually between 2025 and 2030.

Studies	Funding	Construction	Commissioning
			2025-2030

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

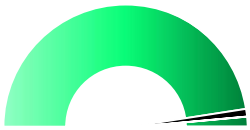
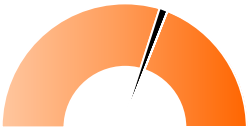
WAPP, Nigeria

3.2.2.7. 150 MW SOLAR PROJECT IN GHANA

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in the extreme North of Ghana, close to the Ghana-Burkina-Mali interconnection.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This renewable project will allow avoiding thermal generation in the sub-region	Thanks to the Ghana-Burkina Mali interconnection as well as the axes to the south of the region, it will be possible to exchange electrical energy of solar origin with Niger and East of Burkina Faso in particular.	Given that the peak load is in the evening in most countries of the sub-region, the contribution of this project to improving the reliability of the system is almost zero.

Preliminary economic analysis

Given the country's limited natural gas reserves, there is considerable interest in diversifying the country's sources of electricity supply in order to reduce the cost of electricity on the one hand and guarantee security of supply on the other hand.

In this context, and given the reduction in the cost of photovoltaic panels, solar projects appear to be highly profitable in the country. The LCOE of the 150MW project put into service in phases from 2026 will be 36 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 16 MUSD.

These results were obtained with the following assumptions for the solar project in Ghana:

Lifetime	25
Commissioning date of the first phase	2026
Average annual producible [GWh/MW]	1.7
Location	North of Ghana

Table 9: Assumptions for economic analysis [Solar PV North Ghana]

As well as the results of the master plan in terms of the country's marginal cost.

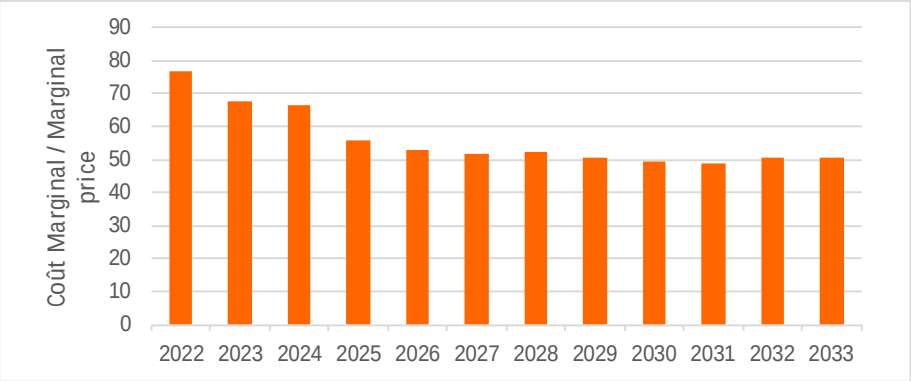


Figure 11: Average marginal cost [North of Benin]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the low density of land use in the extreme North of Ghana, the environmental impact does not seem to be a major limiting criterion. Many sites away from protected, forested, flooded (or water) or urban areas could be considered. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

At that stage no specific studies have been launched yet. The date of commissioning will be after 2025 (First phase of 50MW in 2026).

Studies	Funding	Construction	Commissioning
			2026-2027

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

WAPP, Ghana

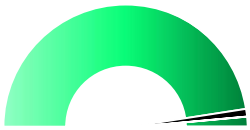
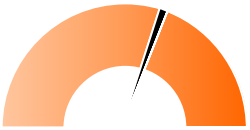
Final version

3.2.2.8. 150 MW SOLAR PROJECT IN TOGO

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in the Northern part of Togo, close to the Median Backbone.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This renewable project will allow avoiding thermal generation in the sub-region	The sharing of the electrical energy produced by this plant will be made possible via the median backbone.	Given that the peak load is in the evening in most countries of the sub-region, the contribution of this project to improving the reliability of the system is almost zero.

Preliminary economic analysis

The interest in developing solar energy in northern Togo is not only in reducing the average cost of electricity but also in increasing the country's energy independence (reduction of import of fossil fuel and electricity of thermal origin).

In this context, and given the reduction in the cost of photovoltaic panels, solar projects appear to be highly profitable in the country. The LCOE of the 150MW project put into service in phases from 2028 will be 35 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 13 MUSD.

These results were obtained with the following assumptions for the solar project in Togo:

Lifetime	25
Commissioning date of the first phase	2028
Average annual producible [GWh/MW]	1.4
Location	North of Togo

Table 10: Assumptions for economic analysis [Solar PV North Togo]

As well as the results of the master plan in terms of the country's marginal cost.

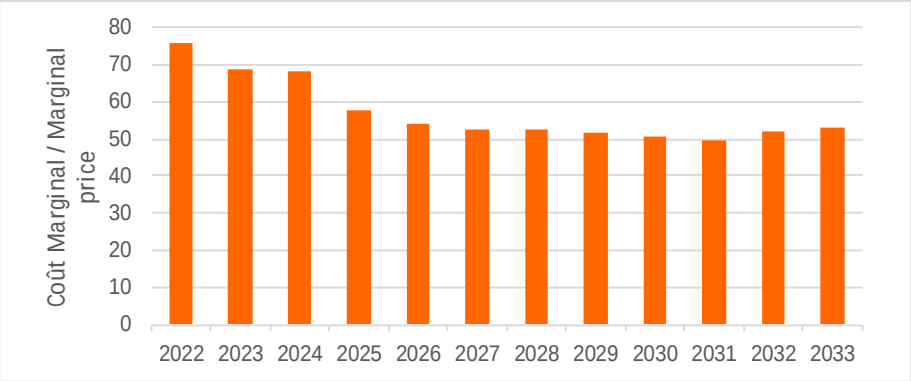


Figure 12: Average marginal cost [North of Togo]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the low density of land use in the extreme North of Togo, the environmental impact does not seem to be a major limiting criterion. Many sites away from protected, forested, flooded (or water) or urban areas could be considered. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

At that stage no specific studies have been launched yet. The date of commissioning will be after 2025 (First phase of 50MW in 2028).

Studies	Funding	Construction	Commissioning
			2028-2030

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

WAPP, Togo

Final version

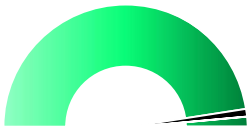
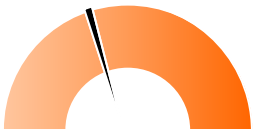
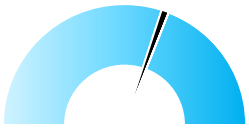
3.2.2.9. GRAND KINKON HYDROPOWER PLANT (GUINEA)

Description of the project

It is a hydroelectric power plant with a capacity of 291 MW (350 MUSD) and a guaranteed producible of 720 GWh per year.

Recent studies recommended however to limit the capacity to 130 MW.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Hydroelectric power produced by Grand Kinkon will contribute to the sustainable development of Guinea and the sub-region as a whole	Due to its location near the OMVG and CLSG interconnection axes, the sharing of energy produced for regional purposes could be envisaged.	The role of this reservoir for the provision of flexibility to the system will have to be taken into account in a scenario of strong development of intermittent renewable energies

Preliminary economic analysis

Guinea has an untapped hydroelectric potential that is very important. Among the projects a priori very interesting from the economic point of view, the project of hydroelectric power station of Grand Kinkon is to be stressed. Indeed, even if the site's producible is relatively limited (use factor of 2500 hours per year), the cost of the infrastructure required for its construction is low compared to other large-scale projects (1000 KUSD/MW). In this context, it appears as economically justified to supply demand in the subregion. The Net Present Value of the project, considering a discount rate of 8% and a remuneration at the country's marginal cost is 71 MUSD.

These results were obtained with the following assumptions for Grand Kinkon:

Lifetime	40
Commissioning date of the first turbine	2023
Average annual hydroelectric producible [GWh]	720
Investment cost [MUSD/MW]	1.1
Location	North Guinea

Table 11: Assumptions for economic analysis [Grand Kinkon]

As well as the results of the master plan in terms of the country's marginal cost.

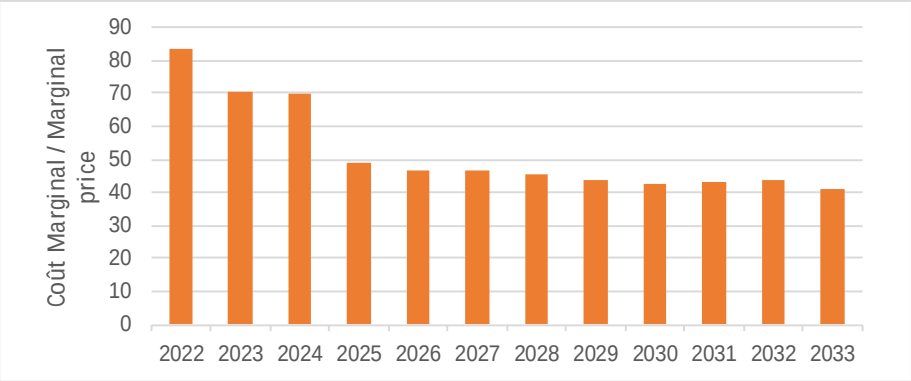


Figure 13: Average marginal cost [North Guinea]

The selling price at the output of the machine should be set at 43 USD/MWh to achieve an internal rate of return of 10%.

Preliminary environmental analysis

The site of Grand Kinkon is not close to any protected natural park. Thus, the impact on fauna and flora should be relatively limited. The hydroelectric power plant will only generate few stakes, since the area is largely dominated by river crops and a very large distribution of small human concentrations. The potential impacts on populations are mainly related to the inconvenience and nuisance of the work phase. Accidents during the work are more than probable, and the impact of the construction is therefore to be considered as negative. Good prevention will be necessary for the workers and the population. The presence of the lake can lead to a change in the prevalence of diseases in relation to water (malaria, onchocerciasis...), which also represents a negative impact in terms of health. With the dam and slowing down of the water, or even its stagnation, the consequences on the water quality will be major, stemming from a consequent modification. These changes can have downstream impacts on vegetation and on the whole of biodiversity. A thorough study of the environmental aspects will have to confirm these elements during the feasibility study of the plant.

Progress of the project

The project is being studied by the company Yellow River Engineering Company for a possible concessional development.

Studies	Funding	Construction	Commissioning
			2023

Implementation Strategy

Concession contract / PPP

Responsible Institution for the development

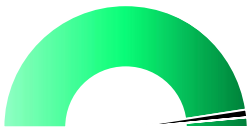
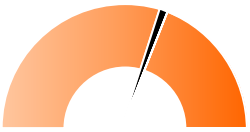
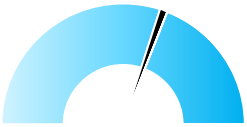
Guinea

3.2.2.10. MORISANAKO HYBRID HYDRO/SOLAR POWER PLANT (GUINEA)

Description of the project

The hydroelectric site of Morisanako is located on the Fomi-Boundiali axis, close to the borders with Côte d'Ivoire and Mali. This is a hybrid project of 100 MW hydroelectric plant with a 523 GWh producible coupled with 100MW solar PV.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Like other renewable projects, the main objective of Morisanako is the substitution of fossil-fuel generation with renewable electricity	The location of this project, which is economically interesting for the sub-region, makes it possible to envisage increased energy exchanges between eastern Guinea and northern Côte d'Ivoire/Mali.	This hybrid project allows to benefit from the synergy between solar energy and hydropower

Preliminary economic analysis

From an economic point of view, Morisanako is another very interesting potential project for Guinea and the sub-region. The site has an exceptional potential (use factor of 5200h per year) for a relatively small cost per MW compared to other sites of the same magnitude (2600 KUSD/MW). From the point of view of solar PV, it is possible to find some zones with high irradiation in the area of Morisanako. Assuming that these areas can be exploited, the hybrid project can reach a net present value of 12 MUSD, when considering a discount rate of 8% and a remuneration at the country's marginal cost.

These results were obtained with the following assumptions for Morisanako:

Lifetime	40 (25 for solar PV)
Commissioning date	2025
Average annual hydroelectric producible [GWh]	523
Average annual solar producible [GWh/MW]	1.6
Investment cost for the hydroelectric power plant [MUSD/MW]	2.6
Location	North Guinea

Table 12: Assumptions for economic analysis [Morisanako]

As well as the results of the master plan in terms of the country's marginal cost.

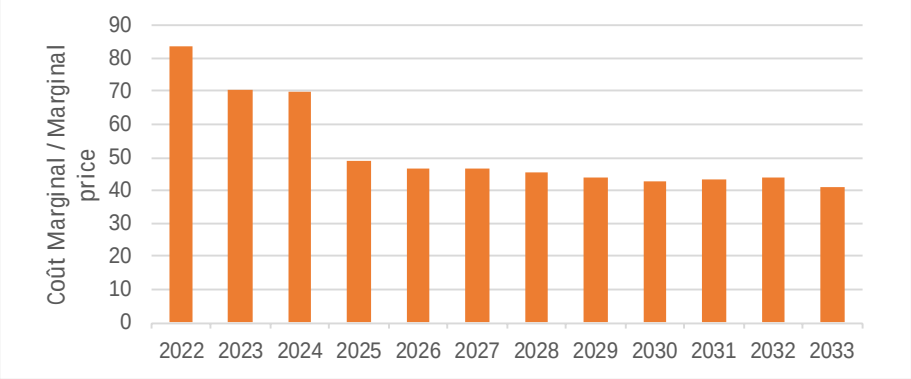


Figure 14: Average marginal cost [eastern Guinea]

The selling price at the output of the machine should be set at 55 USD/MWh to achieve an internal rate of return of 10%.

Preliminary environmental analysis

The site of the hydroelectric project of Morisanako is not close to any protected natural park. Thus, the impact on fauna and flora should be relatively limited. The hydroelectric power plant will only generate few stakes, since the area is largely dominated by river crops and a very large distribution of small human concentrations. The potential impacts on populations are mainly related to the inconvenience and nuisance of the work phase. Accidents during the work are more than probable, and the impact of the construction is therefore to be considered as negative. Good prevention will be necessary for the workers and the population. The presence of the lake can lead to a change in the prevalence of diseases in relation to water (malaria, onchocerciasis...), which also represents a negative impact in terms of health. With the dam and slowing down of the water, or even its stagnation, the consequences on the water quality will be major, stemming from a consequent modification. These changes can have downstream impacts on vegetation and on the whole of biodiversity. A thorough study of the environmental aspects will have to confirm these elements during the feasibility study of the plant.

Progress of the project

Prefeasibility studies for the hydroelectric power plant were carried out a few years ago. Beyond these studies, no significant progress on this project could be identified recently. It is imperative to launch the feasibility studies quickly to keep the proposed schedule.

Studies	Funding	Construction	Commissioning
			2025

Implementation Strategy

The project could be opened to a PPP/BOT approach as part of the Guinean PPP program- **PPP/BOT**

Responsible Institution for the development

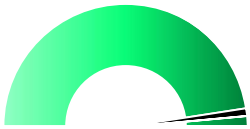
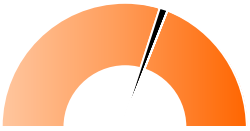
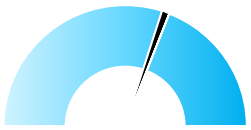
Guinea

3.2.2.11. BONKON DIARA HYDROPOWER PLANT (GUINEA)

Description of the project

The hydroelectric site of Bonkon Diara is located close to Labé, on the route of OMVG loop. This is an hydroelectric plant of 174 MW with an estimated cost of 211 MUSD.

Justification of the project

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
As other hydropower plants, this project will allow avoiding the emission of pollutants associated to thermal generation	The location close to OMVG loop will facilate energy share with neighbouring countries	The role of hydro plants to compensate variability of RES can be highlighted as the main contribution to security of supply

Preliminary economic analysis

As another promising hydroelectric project in Guinea, the plant of Bonkon Diara would gain to be more deeply studied. Indeed, based on the collected information (producible of 451 MW for a cost of 211 MUSD), the Net Present Value of the project, considering a discount rate of 8% and a remuneration at the country's marginal cost is 11 MUSD.

These results were obtained with the following assumptions for Bonkon Diara:

Lifetime	40
Commissioning date of the first turbine	2025
Average annual hydroelectric producible [GWh]	451
Investment cost [MUSD/MW]	1.2
Location	North Guinea

Table 13: Assumptions for economic analysis [Bonkon Diara]

As well as the results of the master plan in terms of the country's marginal cost.

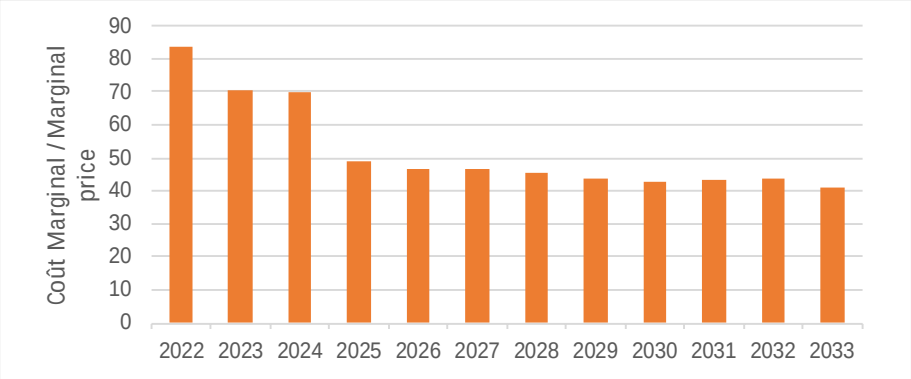


Figure 15: Average marginal cost [North Guinea]

The selling price at the output of the machine should be set at 49 USD/MWh to achieve an internal rate of return of 10%.

Final version

Preliminary environmental analysis

The site of Bonkon Diara is not close to any protected natural park. Thus, the impact on fauna and flora should be relatively limited. The hydroelectric power plant will only generate few stakes, since the area is largely dominated by river crops and a very large distribution of small human concentrations. The potential impacts on populations are mainly related to the inconvenience and nuisance of the work phase. Accidents during the work are more than probable, and the impact of the construction is therefore to be considered as negative. Good prevention will be necessary for the workers and the population. The presence of the lake can lead to a change in the prevalence of diseases in relation to water (malaria, onchocerciasis...), which also represents a negative impact in terms of health. With the dam and slowing down of the water, or even its stagnation, the consequences on the water quality will be major, stemming from a consequent modification. These changes can have downstream impacts on vegetation and on the whole of biodiversity. A thorough study of the environmental aspects will have to confirm these elements during the feasibility study of the plant.

Progress of the project

Prefeasibility studies for the hydroelectric power plant need to be developed

Studies	Funding	Construction	Commissioning
			2025

Implementation Strategy

The project could be opened to a PPP/BOT approach as part of the Guinean PPP program- **PPP/BOT**

Responsible Institution for the development

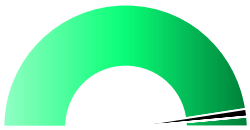
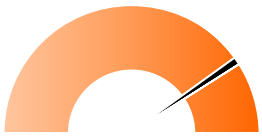
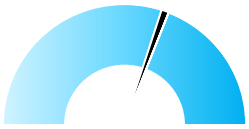
Guinea

3.2.2.12. BOUREYA HYDROPOWER PLANT (OMVS)

Description of the project

It is a hydroelectric power station with a capacity of 160 MW located on the River Bafing, one of the main tributaries of the Senegal River. The Boureya plant is designed as a multi-purpose arrangement with an average annual generation of 733 GWh and a guaranteed producible of 455 GWh per year. The estimated cost of the project is 448 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Although its development is expected to be longer-term, the Boureya project will help reduce the dependence on fossil fuels in the subregion by avoiding investments in thermal power plants	As an OMVS project, this plant has naturally a vocation to be shared between the different Member States	Given the expected long-term issues in the sub-region in terms of integration of renewable energy, it is important to underline the role that hydroelectric reservoirs could play in complementing intermittent resources and participating to the reliability of the power supply

Preliminary economic analysis

The Boureya hydroelectric power plant is one of the flagship projects of the OMVS. From an economic point of view, the project as foreseen in the most recent plans (733 GWh producible at a cost of 353 MUSD) provides a net present value of 4MUSD for a discount rate of 8% and a remuneration at the country's marginal cost.

These results were obtained with the following assumptions for Boureya:

Lifetime	40
Commissioning date of the first turbine	2029
Average annual producible [GWh]	733
Investment cost [MUSD/MW]	2.6
Location	North Guinea

Table 14: Assumptions for economic analysis [Boureya]

As well as the results of the master plan in terms of the country's marginal cost.

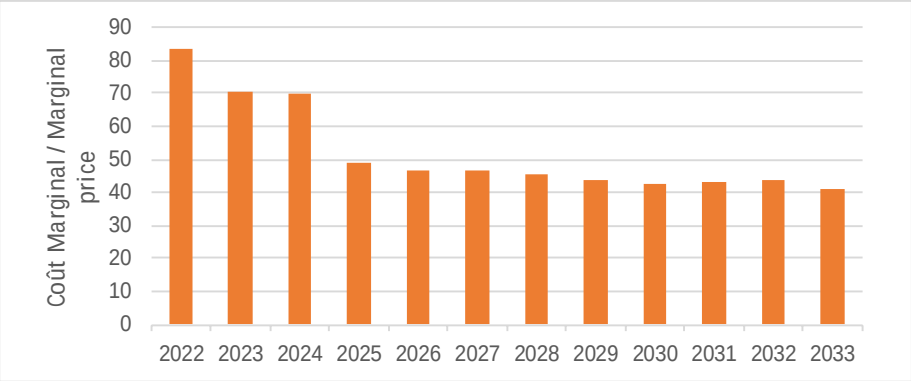


Figure 16: Average marginal cost [North Guinea]

The selling price at the output of the machine should be set at 50.4 USD/MWh to achieve an internal rate of return of 10%.

Preliminary environmental analysis

At the environmental level, the Boureya hydropower plant will not lead a priori to major stakes, since the area is largely dominated by river crops and a very large distribution of small human concentrations. The site is not located near any protected natural park. Thus, the impact on fauna and flora should be relatively limited. The potential impacts on populations are mainly related to the inconvenience and nuisance of the work phase. Accidents during the work are more than probable, and the impact of the construction is therefore to be considered as negative. Good prevention will be necessary for the workers and the population. With the dam and slowing down of the water, or even its stagnation, the consequences on the water quality will be major, stemming from a consequent modification. These changes can have downstream impacts on vegetation and on the whole of biodiversity. A thorough study of the environmental aspects will have to confirm these elements during the feasibility study of the plant.

Progress of the project

Preliminary Project studies were conducted in 2012.

Studies	Funding	Construction	Commissioning
			2029

Implementation Strategy

The project is part of the OMVS development portfolio. The project development could follow the same strategy as Koukoutamba with a procurement for EPC + Financing. An alternative approach could be a concession tendering.

Responsible Institution for the development

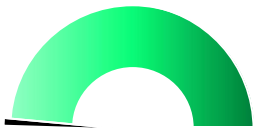
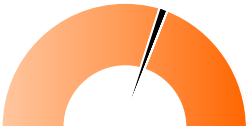
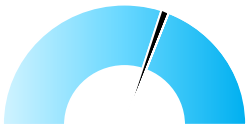
Guinea

3.2.2.13. ABOADZE THERMAL POWER PLANT - GHANA (450 MW)

Description of the project

It is a combined cycle thermal power plant with a capacity of 450 MW and an estimated cost of 585 MUSD. This project should be powered by LNG from a gas terminal to be built in the country

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The thermal project does not contribute to the integration of renewable energy but comes in addition to these renewable projects	Ghana's central position will allow for the sharing of electric power with, at the very least, Benin, Togo and Burkina Faso	The development of thermal energy in addition to renewable energies is required in the long term in order to ensure the reliability of the electricity supply of the subregion. It will provide a security of supply through the diversification of resources.

Preliminary economic analysis

In the interconnected system, gas-fired power plants set the marginal cost of the system. In fact, when heavy fuel-fired power plants will have been replaced by cheaper options, gas will become the most expensive option in operation. That being said, the development of thermal power plants remains required to enable the lower cost and most reliable supply of electricity demand in the sub-region.

Considering the following assumptions for the Aboadze combined cycle plant

Lifetime	30
Commissioning date of the first turbine	2029
Installed Capacity [MW]	450
Investment cost [MUSD/MW]	1.3
Variable operating costs [USD/MWh]	3.2
Specific consumption [KJ/kWh]	6 901
Location	Ghana South

Table 15: Assumptions for economic analysis [Aboadze]

As well as the results of the master plan in terms of the utilization rate of the power plant

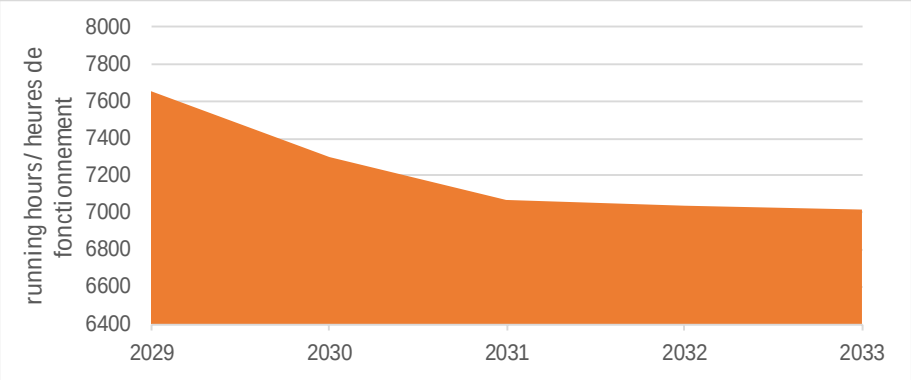


Figure 17: Utilization rate of the plant (Operating hours equivalent at max power) [Aboadze]

The selling price at the output of the machine should be set at 70 USD/MWh to achieve an internal rate of return of 10%. It should be noted that the cost of the gas infrastructure required for the development of LNG in the country is not reflected in the economic analysis of the Aboadze Combined Cycle Power plant project presented here.

Preliminary environmental analysis

The construction of new gas turbines will have a low to medium environmental impact, especially with regard to noise and air quality. The impact is especially important on health, vegetation and animals. In the absence of feasibility study and weather data, it is difficult to make a first estimate of the future dispersion of dust and fumes, but the feasibility study should be able to propose adequate mitigation measures to be put in place. If fuel storage is foreseen (as a substitute fuel), the impact of a possible leakage will also have to be taken into account.

Progress of the project

The design of the plant was studied at the prefeasibility stage. The development of the project is under discussion with the AFC.

Studies	Funding	Construction	Commissioning
			2029

Implementation Strategy

The development of the project is under current discussions with the Africa Finance Corporation (AFC) - **Concession**

Responsible Institution for the development

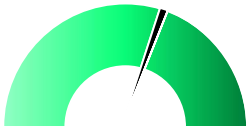
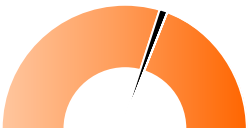
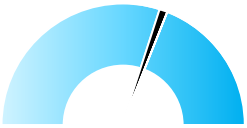
Ghana

3.2.2.14. LINE FOMI (GUINEA) – BOUNDIALI (CÔTE D'IVOIRE)

Description of the project

The project is a 225kV double-circuit line between Fomi (Guinea) and Boundiali (Côte d'Ivoire), with a length of 380km, and an estimated cost of 135 MUSD, related to the hydroelectric production project of Morisanako.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The line will allow the best synergy between the solar energy to be developed in the north of Côte d'Ivoire on the one hand and the hydroelectric energy to be developed in the region of Fomi on the other hand and thus guarantee a better integration of these resources (especially Morisanako)	By supporting trade between northern Côte d'Ivoire and Guinea, this line will participate in the development of a regional electricity market	In addition to its active role in supporting trade, this line will bring redundancy in the exchange capacity between the two countries and will improve the security of supply

Preliminary Economic Analysis

The Fomi-Boundiali line project is intrinsically linked to Morisanako's hybrid project and allows the evacuation of locally produced power in the Ivorian and/or Guinean networks.

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (135MUSD), taking into account the energy flowed annually as simulated under the development plan (approximately 800GWh) and considering a discount rate of 10%. This cost amounts to 5.8 cUSD/MWh/km for the Fomi-Boundiali interconnection.

Preliminary environmental analysis

The route of this line would pass through eight classified forests: Bar, Lefarani, Tieme, Samatiguila, Tinrido, Kimbiria, Tienny and Lapale running along a road: "Sankarani-trusted" and "Niger-Niandan-Milo". In these "Ramsar" areas, Particular attention should be paid in order not to disturb too much the quality of the water during the construction phase, nor the freshwater fauna, abundant and varied, through the setting up of appropriate measures. Similarly, the vegetation in the classified forests will have to be the subject of special measures. Since the line essentially passes (for more than 85%) by savanna zones, crops/fallows, the impact on vegetation will be weak, because if a significant number of trees are to be slaughtered, they will not be high-value trees in terms of biodiversity. It appears that it will be possible to avoid the passage over dwellings almost on the whole route. A risk of having to move certain houses exists very locally, when crossing zones close to villages and towns and when the relief is quite important. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

The project has not yet been investigated.

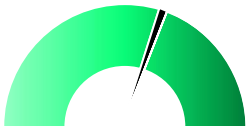
Studies	Funding	Construction	Commissioning
			2025

3.2.2.15. MEDIAN BACKBONE

Description of the project

The project consists of the installation of a 1350km and 330kV double-circuit line Nigeria (Shiroro and Kainji) – Benin (Parakou) – Togo (Kara) – Ghana (Juale and Tamale) – Côte d'Ivoire (Ferkessedougou) (total estimated cost: 813 MUSD)

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Given the hydroelectric potential in Nigeria (Kainji and Zungeru) and the solar projects to be developed in each of the regions traversed by the median backbone, this project will promote the integration of these projects and take advantage of the synergies between hydroelectric reservoirs and solar energy	The median backbone crosses no less than 5 countries and supports the exchange of thermal and renewable energy. In this sense, this is an important project to enable the development of a regional electricity market	The areas crossed by the line are quite weak in terms of availability of electrical infrastructure. The line will allow the electrical supply of these regions to be secured.

Preliminary economic analysis

The median backbone essentially permits the transfer of renewable energy between the five countries concerned.

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (810 MUSD for the 1350 km section between Nigeria and Benin), taking into account the energy flowed annually as simulated under the development plan (approximately 1550GWh) and considering a discount rate of 10%. This cost amounts to 4.5 cUSD/MWh/km for the median backbone.

Preliminary environmental analysis

The route of this line would cross the classified forest of the Ouémé-Superior in eastern Benin. In this forest, particular attention should be paid in order not to disturb the fauna and flora, through the setting up of appropriate measures. In addition, the line would pass in the immediate vicinity, without crossing them, reserves of Kagoro Nindam, from Vobera and Kainji National Park, all located in Nigeria. The impact is therefore likely to be significant in the number of trees to be slaughtered. It should be possible to avoid the passage over dwellings almost on the entire route. However, around important towns and villages, there is a risk of having to move some houses. In addition, the construction and presence of the line will have a certain visual impact. The topography of the crossed regions should not make this impact too important, except in the Kara region where Hills (granitic massifs) are present. If the line goes through these hills, the visual impact can be important. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

The Median Backbone, although discussed for many years, has not been the subject of recent detailed studies. The project is nevertheless regaining interest in the context of the integration of renewable energy and the development of a regional electricity market.

Studies	Funding	Construction	Commissioning
			2025

Implementation strategy

The development of this major interconnection could build upon the lessons learned in previous projects:

- Concession to a SPV (ex. Transco CLSG)
- Coordinated development with a joint project unit (ex. North Core)
- Other (PPP, IPT)

Responsible Institution for the development

WAPP, Nigeria, Togo, Benin, Ghana, Côte d'Ivoire

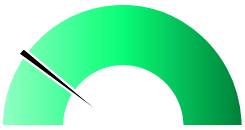
3.2.2.16. STRENGTHENING THE INTERCONNECTION BETWEEN NIGERIA AND GHANA

Description of the project

The project Consists of several sections including:

- The doubling of the 330kV single circuit line between Sakete (Benin) and new Agbara (Nigeria), a total length of about 200km.
- The reinforcement of the axis connecting the Accra (Ghana), Volta (Ghana), Lomé (Togo) and Saket (Benin) through Maria Gleta.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
Although the majority of the flow through this line is of thermal origin, hydroelectric and solar energy could also transit in the medium-term	The main purpose of this line is to strengthen the opportunities for exchanges between the 4 countries concerned, given that the current transfer capacity could become limiting to enable the optimization of these exchanges	By allowing a greater transfer capacity, the axis secures the electrical supply of the entire southern part of the sub-region. It also improves the stability of the system and the trading capacity of Nigeria.

Preliminary economic analysis

Although the entire section needs to be strengthened, the Nigeria-Benin axis is the only one currently under consideration.

From the point of view of this axis, the purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (124 MUSD for the 200 km double-circuit section between Nigeria and Benin), taking into account the energy flowed annually as simulated under the development plan (approximately 2000 to 2100 GWh) and considering a discount rate of 10%. This cost amounts to 4.2 cUSD/MWh/km for the Nigeria-Benin interconnection.

Preliminary environmental analysis

The Nigeria-Benin route would pass through a natural area, the Omo Forest Reserve. Even if this reserve is not classified, special measures will have to be taken to limit the impact on the fauna and flora as much as possible. It appears that it will be possible to avoid the passage over dwellings almost on the whole route. There are only around important towns and villages, particularly in the north of Lagos, and during passages with a high relief that a risk of having to move some houses exists. In addition, the construction and presence of the line will have a visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies that are underway.

Progress of the project

For the Nigeria-Benin section, the study of the environmental and social impacts of the project is underway. The technical feasibility study will start.

The reinforcement of the other sections should be the subject of specific short-term studies.

Studies	Funding	Construction	Commissioning
			2025 for the first phase (Nigeria – Benin) **2028 for the second phase (Benin- Ghana)**

Implementation Strategy

EPC Contract

Responsible Institution for the development

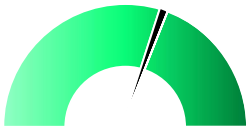
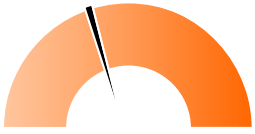
WAPP, Nigeria, Benin, Togo, Ghana

3.2.2.17. CONNECTION LABE-KOUKOUTAMBA

Description of the project

The project aims to establish a link between the loops OMVS and OMVG in order to share the hydroelectric resources and increase security of supply

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The connection of the loops OMVS and OMVG allows a better integration of hydroelectric power in the sub regional network	Although this is a national project, this line will increase trade between the OMVS and OMVG member states	The Labé-Koukoutamba connection will secure the evacuation of locally produced hydroelectric energy to ensure reliability of supply in the subregion.

Final version

Preliminary economic analysis

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (45 MUSD for the 100 km section), taking into account the energy flowed annually as simulated under the development plan (approximately 1000GWh) and considering a discount rate of 10%. This cost amounts to 4.7 cUSD/MWh/km for the Guinean axis.

This cost is to be compared to losses that would represent the non-optimal operation of hydroelectric projects in the region due to network constraints.

Preliminary environmental analysis

The route of this line would not pass through any classified forest. Thus, the impact on fauna and flora should be relatively limited. The area is characterized by a very large distribution of small human concentrations. It appears that it will be possible to avoid the passage over dwellings almost on the entire route. However, around important towns and villages, there is a risk of having to move some houses. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

At this stage no preliminary study was carried out on this section

Studies	Funding	Construction	Commissioning
			2024*

* In the same time as Linsan-Manantali interconnection

Implementation Strategy

EPC Contract

Responsible Institution for the development

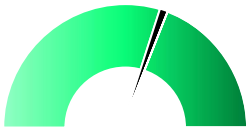
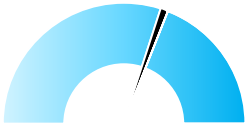
OMVS

3.2.2.18. CONNECTION SEGOU-BAMAKO

Description of the project

The project aims to build an axis to evacuate the power of the regional solar park of 150 MW which will be installed in this region of Mali. This line is 290 km long and 105 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This project will aim to transport solar power to the WAPP interconnected network	Although this is a national project, this line will enable Mali's solar power plant to participate in the regional electricity market	This line is not primarily intended to improve security but will contribute by closing the Malian network

Preliminary economic analysis

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (105 MUSD for the 290 km section), taking into account the energy flowed annually as simulated under the development plan (approximately 1050GWh) and considering a discount rate of 10%. This cost amounts to 4.0 cUSD/MWh/km for the Guinean axis.

This cost is to be compared to losses that would represent the non-optimal operation of hydroelectric projects in the region due to network constraints.

Preliminary environmental analysis

The route of this line will run through a very sparsely populated area and it should be possible to avoid protected area. However, around important towns and villages, there is a risk of having to move some houses. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

At this stage no preliminary study was carried out on this section

Studies	Funding	Construction	Commissioning
			2025*

* In the same time as Mali Solar Power Plant

Implementation Strategy

EPC Contract

Responsible Institution for the development

Mali, WAPP

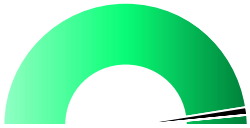
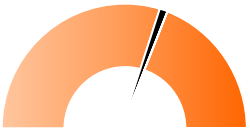
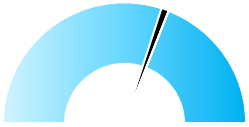
3.3. Long-term priority projects (from 2030)

3.3.1.1. MANO HYDROPOWER PLANT (LIBERIA)

Description of the project

It is a hydroelectric power plant of 180MW for a 795 GWh producible on the border between Sierra Leone and Liberia (Estimated Cost: 487 MUSD).

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
As with other hydroelectric projects, this project is a renewable project that supports the sustainable development of the sub-region	The Mano River defining the border between Sierra Leone and Liberia, any project developed on this river will have a regional vocation that can be supported by the Mano River Union.	In the long run, the project could play a role in securing the energy supply by providing a hydraulic storage solution

Preliminary Economic Analysis

The Mano River hydroelectric power plant project is of paramount importance to the two border countries as it will ensure better security of supply in both countries. From an economic point of view, the selling price at the output of the machine should be set at 64 USD/MWh to achieve an internal rate of return of 10%. Thus, although this project is economically less attractive than other major projects in the sub-region, it is still a viable option, especially given the possible alternatives in the two countries.

Preliminary environmental analysis

The project is located near the classified forest of Gola and Lofa-Mano National Park. The reservoir will partially affect the protected area on the Territory of Liberia. Thus, the fauna and flora of the latter, particularly affected, will have to be the subject of special measures, in order to limit the environmental impact of the project. The impact on vegetation will be all the more important as a significant number of trees will be slaughtered. As the site is currently poorly populated, the human impact should be limited. With the dam and slowing down of the water, or even its stagnation, the consequences on the water quality will be major, stemming from a consequent modification. Accidents during the work are more than probable, and the impact of the construction is so to be considered negative. Good prevention will be necessary for the workers and the population. The presence of the lake can lead to a change in the prevalence of diseases in relation to water (malaria, onchocerciasis...), which also represents a negative impact in terms of health. In conclusion, the implementation of the dam will have a certain impact on the environment of the region, particularly on the fauna and flora of the classified forest of Throat. A thorough and dedicated study of environmental aspects during the feasibility study of the plant is absolutely necessary and will have to propose many mitigation measures.

Progress of the project

No recent progress could be noted on this project

Studies	Funding	Construction	Commissioning
			2030

Implementation Strategy

So far, the schema to enable de development of the project has not been identified. However, it is foreseeable that international donors would intervene to financially support its development. **- EPC Contract / Concession**

Responsible Institution for the development

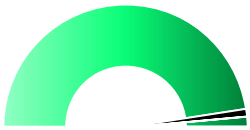
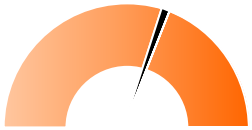
Mano River Union (MRU)

3.3.1.2. 150 MW SOLAR PROJECT IN NIGER

Description of the project

The project concerns a Solar Photovoltaic farm with an installed capacity of 150 MW in Niger.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This project is important for Niger and the subregion to support the transition to renewable energy	Given the size of the project and its location near the North Core, this project is subject to trade	Like other PV projects, and excluding storage options, the contribution to the reserve of this solar PV project in Niger is not significant

Preliminary Economic Analysis

The development of a large-scale solar project in Niger should help reduce the cost of electricity in the country. Particularly in view of the reduction in the cost of photovoltaic panels. Thus, the LCOE of the 150MW project put into service from 2030 is estimated at 31 USD/MWh. Considering that solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a net present value of about 20 MUSD.

These results were obtained with the following assumptions for the solar project in Niger:

Lifetime	25
Commissioning date of the first phase	2030
Average annual producible [GWh/MW]	1.7
Location	Niger

Table 16: Assumptions for economic analysis [Solar PV Niger]

As well as the results of the master plan in terms of the country's marginal cost.

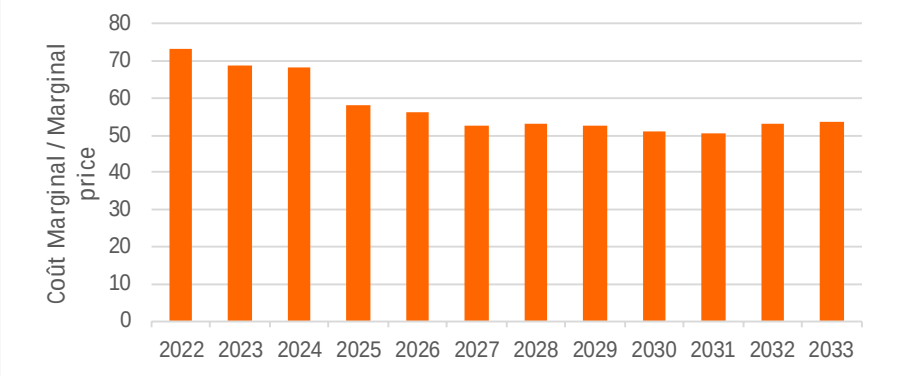


Figure 18: Average marginal cost [Niger]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Given the very large nature and low density of land use in Niger, with many desert (or semi-desert) areas, the environmental impact does not seem to be a major limiting criterion. Many sites away from protected, forested, flooded (or water) or urban areas could be considered. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification). Overall, the expected impacts of solar projects at the environmental level are relatively limited.

Progress of the project

The project has not yet been the subject of dedicated studies. The planned commissioning date is 2030.

Studies	Funding	Construction	Commissioning
			2030

Implementation Strategy

The project could be developed through an IPP procurement backed-up by guarantees to be established with IFIs- **IPP procurement**

Responsible Institution for the development

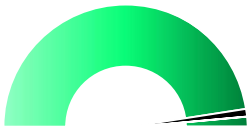
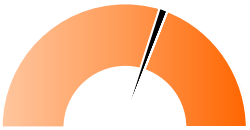
WAPP, Niger

3.3.1.3. 150 MW SOLAR PROJECT IN BURKINA FASO (SECOND PHASE)

Description of the project

The project concerns the second phase of a Solar Photovoltaic farm with an installed capacity of 150 MW in the region of Ouagadougou in Burkina Faso.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This renewable project will allow avoiding thermal generation in the sub-region	Given the interconnections of Burkina Faso with Mali, Côte d'Ivoire, Ghana and Niger, the project can be used to meet the demand of many countries	Given that the peak load is in the evening in most countries of the sub-region, the contribution of this project to improving the reliability of the system is almost zero.

Preliminary economic analysis

The development of a second major solar project in Burkina Faso is expected to reduce the cost of electricity in the country, especially given the reduction in the cost of photovoltaic panels.In this context, the LCOE of the 150MW project put into service in phases from 2031 will be 29 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 21 MUSD.

These results were obtained with the following assumptions for the solar project in Burkina:

Lifetime	25
Commissioning date of the first phase	2031
Average annual producible [GWh/MW]	1.7
Location	Burkina Faso (region Ouaga)

Table 17: Assumptions for economic analysis [Solar PV Burkina]

As well as the results of the master plan in terms of the country's marginal cost.

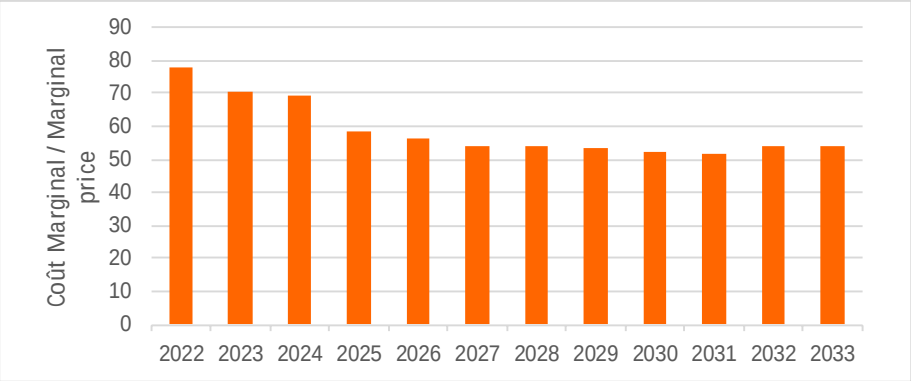


Figure 19: Average marginal cost [Burkina]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Nevertheless, pre-feasibility studies in Phase I have identified several sites that are not located near any protected, forest, flood (or water) or urban area, which severely limits the impact on the environment of such a project. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

At that stage no specific studies have been launched yet. The date of commissioning is foreseen in 2031

Studies	Funding	Construction	Commissioning
			2031

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

WAPP, Burkina Faso

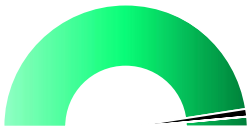
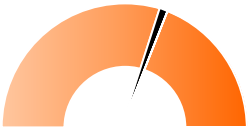
Final version

3.3.1.4. 150 MW SOLAR PROJECT IN MALI (SECOND PHASE)

Description of the project

The project concerns the second phase of a Solar Photovoltaic farm with an installed capacity of 150 MW in Mali.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This renewable project will allow avoiding thermal generation in the sub-region	Given the interconnections of Mali with Burkina Faso, Côte d'Ivoire and Guinea, the project can be used to meet the demand of many countries	Given that the peak load is in the evening in most countries of the sub-region, the contribution of this project to improving the reliability of the system is almost zero.

Preliminary economic analysis

The development of a second major solar project in Mali is expected to reduce the cost of electricity in the country, especially given the reduction in the cost of photovoltaic panels.In this context, the LCOE of the 150MW project put into service in phases from 2032 will be 27 USD/MWh. Whereas solar projects are remunerated at the marginal cost of the country, and considering a discount rate of 8%, the project will have a Net Present Value of about 18 MUSD.

These results were obtained with the following assumptions for the solar project in Mali:

Lifetime	25
Commissioning date of the first phase	2032
Average annual producible [GWh/MW]	1.7
Location	Mali

Table 18: Assumptions for economic analysis [Solar PV Mali]

As well as the results of the master plan in terms of the country's marginal cost.

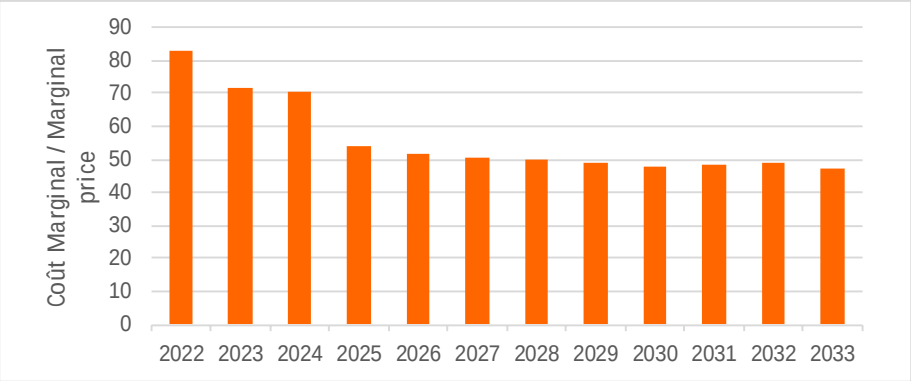


Figure 20: Average marginal cost [Mali]

Preliminary environmental analysis

No environmental analysis has been conducted at this time since no concrete site has been envisaged at this stage. Nevertheless, it is possible to find a lot of sites that are not located near any protected, forest, flood (or water) or urban area, which severely limits the impact on the environment of such a project. The main affected components would be soil and basements (space consumption, partial soil waterproofing, topology modification).

Progress of the project

At that stage no specific studies have been launched yet. The date of commissioning is foreseen in 2032

Studies	Funding	Construction	Commissioning
			2032

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

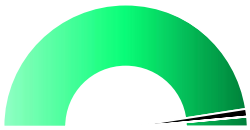
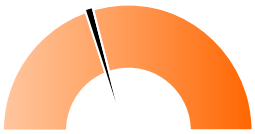
WAPP, Mali

3.3.1.5. 300 MW WIND FARM IN NORTHERN NIGERIA

Description of the project

It is a wind farm with a power of 300 MW to be built by phase and with an estimated cost of 477 MUSD.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This new renewable project in Nigeria will contribute to the sub-region's sustainable development plan and will help to achieve the objectives defined	The north core and median backbone represent two options to share the power generated by this huge wind farm with neighboring countries	Given the intermittency of the resource, the reliability of the system cannot be greatly improved with this project. Let us note however the possible synergy between this project and the reservoirs of the country (Kainji and Zungeru)

Preliminary Economic Analysis

The development of a major wind project in northern Nigeria is expected to reduce the cost of electricity in the region. The neighboring countries, particularly Niger, Benin and Togo, could also benefit from this wind energy. Thus, the LCOE of the 300MW project put into service from 2030 is estimated at 54 USD/MWh, which is similar to the average marginal cost in the subregion.

Preliminary environmental analysis

For the installation of large wind farms, the impact should be studied according to the precise location of these farms. The Jos Plateau, northeast of Abuja, has been proposed as a park development site. The impact will be directly proportional to the surrounding population density is relatively high, mainly in terms of noise, strobe effect and visual constraint. Security issues for access to the site are to be considered. It will be necessary to take into account the migratory corridors of birds and large areas where some large birds spend part of the year. A detailed environmental study will have to be carried out at the feasibility study stage.

Progress of the project

The project has not yet been the subject of specific studies

Studies	Funding	Construction	Commissioning
			2030

Challenges

The project was not incorporated into the national master plan where only 100 MW of wind capacity development is considered.

The location of the 300 MW regional project in northern Nigeria raises security problems for access to the site.

Implementation Strategy

The project could be developed through an **IPP procurement**

Responsible Institution for the development

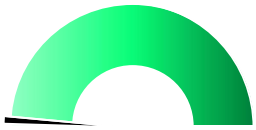
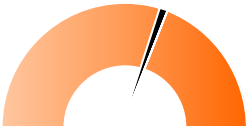
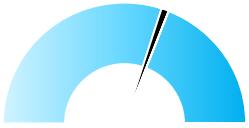
WAPP, Nigeria

3.3.1.6. SONGON THERMAL PLANT – CÔTE D'IVOIRE (450 MW)

Description of the project

It is a combined cycle thermal power plant with a capacity of 369 MW and an estimated cost of 480 MUSD supply by Liquefied Natrual Gas coming from a new installation to be developed in the country.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
The thermal project does not contribute to the integration of renewable energy but comes in addition to these renewable projects	Côte d'Ivoire central position will allow for the sharing of electric power with, at the very least, Burkina Faso, Mali, Sierra Leone and Liberia	The development of thermal energy in addition to renewable energies is required in the long term in order to ensure the reliability of the electricity supply of the subregion. It will provide a security of supply through the diversification of resources.

Final version

Preliminary economic analysis

In the interconnected system, gas-fired power plants set the marginal cost of the system. In fact, when heavy fuel-fired power plants have been replaced by cheaper options, gas will become the most expensive option in operation. That being said, the development of thermal power plants remains indispensable to enable the lower cost and reliable supply of electrical demand in the sub-region.

Considering the following assumptions for the central combined cycle of thought

Lifetime	30
Commissioning date of the first turbine	2031
Installed Capacity [MW]	369
Investment cost [MUSD/MW]	1.3
Variable operating costs [USD/MWh]	3.2
specific consumption [KJ/kWh]	6 901
Location	Côte d'Ivoire South

Table 19: Assumptions for economic analysis [Songon]

As well as the results of the master plan in terms of the Utilization rate of the power plant

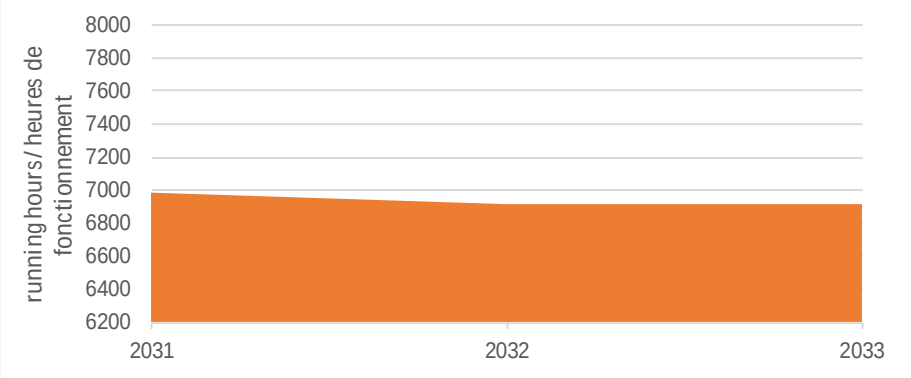


Figure 21: Utilization rate of the plant (Operating hours equivalent at max power) [Songon]

The selling price at the output of the machine should be set at 72 USD/MWh to achieve an internal rate of return of 10%. It should be noted that the cost of the gas infrastructure required for the development of LNG in the country is not reflected in the economic analysis of the combined cycle power plant project presented here.

Preliminary environmental analysis

The construction of new gas turbines at Songon will have a significant environmental impact, especially with regard to noise and air quality. The proximity to the capital Abidjan increases the impact on the populations, in particular on the health, but also, to a lesser extent, the vegetation and the animals. In the absence of a feasibility study and weather data, it is difficult to make a first estimate of the future dispersion of dust and fumes, a detailed feasibility study is essential to allow the implementation of mitigation measures. adequate. If fuel storage is planned (as a substitute fuel), the impact of a possible leak will also have to be taken into account.

Progress of the project

The design of the plant was studied at the prefeasibility stage.

Studies	Funding	Construction	Commissioning
			2031

Implementation Strategy

Endeavor Energy is leading the development of the thermal plant through a joint development agreement with Starenergie 2073. The power purchase agreement (PPA) has already been signed with the Ivorian government. - **IPP procurement**

Responsible Institution for the development

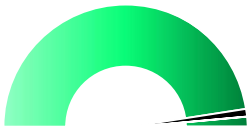
Côte d'Ivoire

3.3.1.7. HYDROPOWER PLAN OF SAINT-PAUL RIVER (LIBERIA)

Description of the project

This involves the building a reservoir on the Via River to regulate Mount Coffee and developing the hydroelectric potential of the Saint Paul River in Liberia through the development of a 360 to 584 MW project.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This major project for the country and the sub-region will reduce the use of fossil fuel	Given its size and location near the CLSG line, the project will have a regional scope	In the long term, the project could play a role in securing energy supply by providing a solution for hydraulic storage

Progress of the project

Feasibility studies should be launched at short-term

Studies	Funding	Construction	Commissioning
			2025 for the first phase phase (Via reservoir at Mount Coffee) 2030 for the second phase (new project on Saint-Paul river)

Implementation Strategy

No development mode has been defined yet. **EPC Contract / Concession**

Responsible Institution for the development

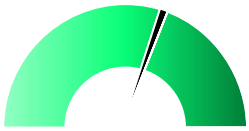
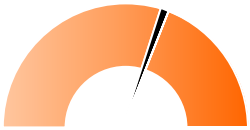
WAPP, Liberia

3.3.1.8. SECOND NORTH-SOUTH AXIS GHANA

Description of the project

The project concerns a second 330kV transport axis in Ghana. Gridco is currently studying this axis and several routes are envisaged, including the route Dawa-Juale-Bolgatanga and a new axis beween Kumasi and New Tamale.

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
By promoting North-South trade, this project contributes to a better Integration of renewable energy into the West African system	Although this is a national project, this line will increase trade between the south of the sub-region and the landlocked countries	The new line will improve Ghana's system stability and by extension will benefit to the whole area

Preliminary economic analysis

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (310 MUSD for the 750 km line between Bolgatanga and Dawa), taking into account the energy flowed annually as simulated under the development plan (approximately 2500GWh) and considering a discount rate of 10%. This cost amounts to 2.0 cUSD/MWh/km for the north-south axis of Ghana.

Preliminary environmental analysis

The route of this line would not pass through any forest nor nature reserve. It would be along Lake Volta on the entire east bank, following the lines already existing between Kadjebi and Dawa, passing through Kpando and Sogakopo. It appears that it will be possible to avoid the passage over dwellings almost on the whole route. It is only around important towns and villages and during passages with a high relief that a risk of having to move certain houses exists. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

The project was studied as part of the Ghana-Burkina Faso Interconnection project, and was designated as the most technically and economically feasible option.

Studies	Funding	Construction	Commissioning
			2030

Implementation Strategy

EPC Contracts

Responsible Institution for the development

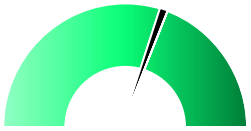
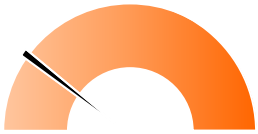
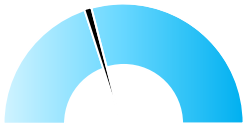
Ghana

3.3.1.9. 330KV EASTERN BACKBONE IN NIGERIA

Description of the project

This project involves the construction of 1856km of 330 kV double-circuit transmission line from Calabar, Ikom, Ogoja, Kashimbilla, Mambilla, Jalingo, Yola, Hong-Bilu - Damaturu-Potiskum, Azare, Dutse, Jogana and Sokoto, Naura, Namoda, Katsina

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
This project will allow sharing hydro power from Eastern Nigeria (Mambilla, Kashimibilla) and later on from CAPP	Although this is a national project, this line will increase with the rest of the region	The new line will improve Nigerian system stability and by extension will benefit to the whole area

Preliminary economic analysis

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (966 MUSD for the 1856 km line), taking into account the energy flowed annually as simulated under the development plan (approximately 4400GWh) and considering a discount rate of 10%. This cost amounts to 1.7 cUSD/MWh/km for the Eastern backbone of Nigeria.

Preliminary environmental analysis

Considering its length, the route of this line could pass through proteced areas. However most of the sections should follow the route of existing infrastructures in order to limit the associated risk. It is only around important towns and villages and during passages with a high relief that a risk of having to move certain houses exists. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

The studies still need to be financed

Studies	Funding	Construction	Commissioning
			2030

Implementation Strategy

EPC Contract

Responsible Institution for the development

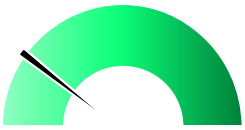
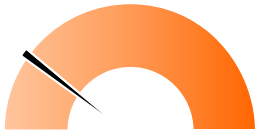
Nigeria

3.3.1.10. DOUBLING OF THE WESTERN SECTION OF THE OMVG LOOP

Description of the project

The OMVG loop is a simple-circuit loop. In order to ensure the security of supply in the Gambia and Guinea Bissau in particular, it is essential to reinforce the Kaolack-Brikama – Bissau – Mansoa – Kaléta section. The route for this new line should take the environmental constraints into account

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
In the long-term, the western part of the OMVG loop will be overloaded, no longer allowing optimum use of the area's hydroelectric projects. Doubling will therefore have a positive effect on the integration of these projects	Since this is the reinforcement of an existing line, it will not contribute to the development of the market but would contribute to its effectiveness	This line is essential to ensure the security of supply in Guinea Bissau and the Gambia. The Kaloack-Bissau section should be traced in such a way as to optimize the security of supply

Preliminary economic analysis

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (230 MUSD for the 850 km reinforcement of OMVG loop), taking into account the energy flowed annually as simulated under the development plan (approximately 900GWh) and considering a discount rate of 10%. This cost amounts to 4.1 cUSD/MWh/km for the reinforcement of the axis

Preliminary environmental analysis

Supposing that the route of this priority project follows that of the current project (simple circuit), it would not pass through any forest nor natural reserve. Impact on fauna and flora should therefore be relatively limited. The overall environmental impact of the construction of this line will be all the more that the area will have already been impacted by other lines. It appears that it will be possible to avoid the passage over dwellings almost on the whole route. Only around important cities and villages, and during passages with a strong relief, there is a risk of having to move some houses. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

No specific analysis related to the strengthening of the western corridor of the OMVG loop has been carried out to date.

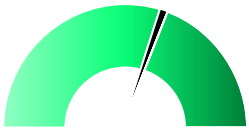
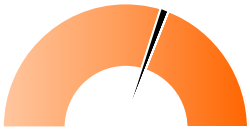
Studies	Funding	Construction	Commissioning
			2030

3.3.1.11. 330 KV TRANSMISSION AXIS SENEGAL-GUINEA-MALI

Description of the project

The project aims at strengthening the links between sources of energy: gas from Senegal, hydro of Guinea and RES in Northern countries. It is a 330kV axis linking Senegal (Tobene)-Guinea (Linsan)-Mali (Sikasso).

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
By promoting East-West trade, this project contributes to a better integration of renewable energy into the West African system	This project will allow important trade from east to west and west to east in order to benefit from the resources available	This line is not intended to improve the reliability of the system but will inevitably contribute to it by strengthening the interconnected electrical network

Preliminary Economic Analysis

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (about 912 MUSD for the 1600 km 330kV line), taking into account the energy flowed annually as simulated under the development plan (approximately 3200GWh) and considering a discount rate of 10%. This cost amounts to 2.1 cUSD/MWh/km for interconnection.

Preliminary environmental analysis

Since the route of this priority axis is not yet clearly defined, no environmental analysis has been carried out at this time. The route of this project is supposed to follow the one of the 225kV lines on the part Tobène-Linsan. It would cross the national Park of the Niokolo-Koba, classified as a UNESCO World Heritage site, along the Tambacounda-Kédougou national road. Impact on fauna and flora should therefore relatively limited, since the area has already experienced a strong human impact. The overall environmental impact of the construction of this section will be all the more that the area will have already been impacted by the 225 kV lines. Similarly, the National Park of Upper Niger, located in Guinea and recently classified, should be crossed on the section Linsan-Fomi, along the national road. Mitigation measures will have to be defined and applied in order to limit to the maximum the impact on the fauna and flora, particularly abundant in these classified parks. It appears that it will be possible to avoid the passage over dwellings almost on the whole route. Only around important cities and villages, and during passages with a strong relief, there is a risk of having to move certain houses. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by the validation of the location of the line on the one hand and then by detailed studies in the framework of feasibility studies on the other hand. The Linsan substation being a major crossroad in Guinea with many interconnection lines, the creation of a second substation close to Linsan with a direct connection between the two should be looked at. This will increase the safety and the security of the network.

Progress of the project

At this stage no preliminary study has been carried out on this section

Studies	Funding	Construction	Commissioning
			2033

Implementation strategy

The development of this major interconnection could build upon the lessons learned in previous projects:

- Concession to a SPV (ex. Transco CLSG)
- Coordinated development with a joint project unit (ex. North Core)
- Other (PPP, IPT)

Responsible Institution for the development

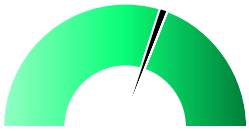
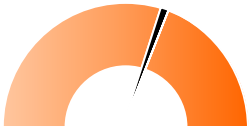
WAPP, Senegal, Guinea, Mali

3.3.1.12. CONNECTION OF THE WESTERN AND MEDIAN BACKBONES

Description of the project

This link aims at closing the East-West 330kV backbone crossing West Africa from Nigeria to Senegal. It links Bobo (Burkina) to Ferkessedougou (Burkina Faso) and makes the junction between the Western and Median backbones

Project Justification

Integration of renewable energy	Development of a regional electricity market	Improving security of supply
		
By promoting East-West trade, this project contributes to a better integration of renewable energy into the West African system	This project will allow important trade from east to west and west to east in order to benefit from the resources available	This line is not intended to improve the reliability of the system but will inevitably contribute to it by strengthening the interconnected electrical network

Progress of the project

At this stage no preliminary study has been carried out on this section

Studies	Funding	Construction	Commissioning
			2033

Implementation strategy

EPC contract could be envisaged for this junction

Responsible Institution for the development

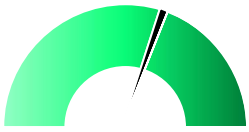
WAPP, Burkina, Côte d'Ivoire

3.3.1.13. INTERCONNECTION 330KV NIGER-NIGERIA

Description of the project

330 kV Salkadamna – Malbaza – Gazoua – Katsina (Nigeria) double-circuit line – 500 km required for the security of supply in Niger and to allow the sharing of solar energy from the Norh of Niger to Nigeria

Project Justification

Integration of Renewable Energy	Development of the regional electricity market	Improving security of supply
		
The axis will allow exchanging solar energy between both countries	As every interconnection project, it will contribute to create a regional electricity market	The priority objective of this project is to ensure security of supply in Niger

Preliminary Economic Analysis

The purpose of the analysis is to establish interconnection transfer fee that should be billed to cover the estimated project investment cost (333 MUSD for the 500 km 330kV section), taking into account the energy flowed annually as simulated under the development plan (approximately 1800GWh) and considering a discount rate of 10%. This cost amounts to 3.7 cUSD/MWh/km for the axis Niger-Nigeria.

Preliminary Environmental Analysis

No specific envrionmental analysis has been done yet for this line but it should not pass through any forest nor natural reserve. Impact on fauna and flora should therefore be relatively limited. The overall environmental impact of the construction of this line will be all the more that the area will have already been impacted by other lines. It appears that it will be possible to avoid the passage over dwellings almost on the whole route. Only around important cities and villages, and during passages with a strong relief, there is a risk of having to move certain houses. In addition, the construction and presence of the line will have a certain visual impact. However, it should be noted that all this information must be confirmed by detailed studies in the context of feasibility studies.

Progress of the project

At this stage no preliminary study has been carried out on this section

Studies	Funding	Construction	Commissioning
			2033

Implementation strategy

EPC contract could be envisaged for this junction

Responsible Institution for the development

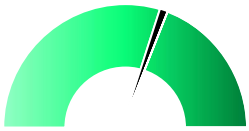
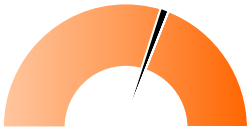
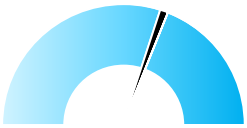
Niger, Nigeria

3.3.1.14. INTERCONNECTION WAPP (SÉNÉGAL/OMVS)-NORTH AFRICA (MAROC)

Description of the project

To link the WAPP system to North African and European systems through Morocco, different interconnection options have been analyzed and compared from a techno-economic point of view. On the basis of preliminary analyses, the option of a HVDC–VSC with line route from Tobene (Senegal) to Dakhla (Morocco) is recommended.

Justification of the project

Integration of Renewable Energy	Development of the regional electricity market	Improving security of supply
		
The axis will allow importing solar and winf energy from North Africa, and probably Europe	The interconnection will allow extending the electricity market beyond the current limits of ECOWAS	The line will allow reducing the needs in long-term reserve in the WAPP system

Progress of the project

Feasibility studies should be launched to confirm the interest of the project

Studies	Funding	Construction	Commissioning
			2033

Implementation strategy

The development of this major interconnection could build upon the lessons learned in previous projects:

- Concession to a SPV (ex. Transco CLSG)
- Coordinated development with a joint project unit (ex. North Core)
- Other (PPP, IPT)

Responsible Institution for the development

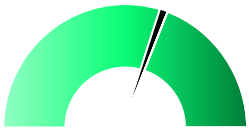
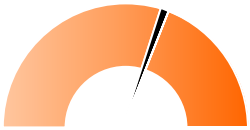
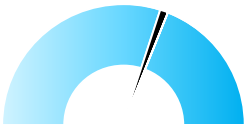
EEEOA, OMVS, ONEE, SOMELEC

3.3.1.15. INTERCONNECTION WAPP (NIGERIA)-CENTRAL AFRICA (INGA)

Description of the project

This project aims at connecting Nigerian system (Calabar substation) to Central Africa (and especially Inga) through Cameroun (Douala)

Justification of the project

Integration of Renewable Energy	Development of the regional electricity market	Improving security of supply
		
The axis will allow importing hydroelectricity from Central Africa	The interconnection will allow extending the electricity market beyond the current limits of ECOWAS	The line will allow reducing the needs in long-term reserve in the WAPP system

Progress of the project

Feasibility studies should be launched to confirm the interest of the project

Studies	Funding	Construction	Commissioning
			2033

Implementation strategy

The development of this major interconnection could build upon the lessons learned in previous projects:

- Concession to a SPV (ex. Transco CLSG)
- Coordinated development with a joint project unit (ex. North Core)
- Other (PPP, IPT)

Responsible Institution for the development

EEEOA, CAAP, Cameroun

Final version

3.4. Synthesis

The proposed list of regional priority projects under the ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure 2019 – 2033 shall be characterized by the following:

- **75 (#) regional projects**, deemed priority, with an estimated total investment cost of US$36.39 billion, of these,
  - **28 (#) Transmission line** projects of approximately 22,932 km of high-voltage transmission lines at an estimated cost of US$10.48 billion;
  - **47 (#) generation projects** with a total capacity of approximately 15.49 GW at an estimated cost of US$25.91 billion;
- Given that the WAPP, in the short term, shall achieve the power system integration of the 14 mainland ECOWAS Member States, the priority list also contains transmission line projects that shall enable WAPP interconnect beyond its current area of coverage in order to among others, further economically diversify its energy mix. These include the northern part of Africa through Morocco and the Central African Power Pool to Inga.
- The generation projects comprise:
  - 31.1% thermal projects operating mainly with natural gas and
  - 68.9% renewable energy projects (10.67 GW) of which 29.5% involve Variable Renewable Energy (VRE) projects (3.15 GW solar, wind);
- VRE projects constitute 20.33 % of the total generation in the priority list.

All of these projects contribute in one way or the other towards the sustainable development of the ECOWAS sub-region, the further development of the regional electricity market and/or the improvement of security of supply in West Africa. There are therefore of paramount importance for the sub-region and their implementation, even though a challenge, shall allow for the optimal development of the WAPP interconnected system.

Finally, it should be noted that the development of storage solutions, particularly battery storage, is a major challenge for optimal use of the sub-regional transmission network, particularly in the presence of renewable energies. As such, a WAPP study is underway to explore opportunities to develop battery storage facilities in the sub-region.

4. IMPLEMENTATION STRATEGY FOR THE REGIONAL MASTERPLAN

The diagnosis of the implementation of the priority projects from the 2012 – 2025 regional masterplan has highlighted recurrent delaying factors for the development of projects and for the compliance to the schedule established in the previous masterplan. The main delaying factors coming out of the diagnosis are:

- Institutional and legal frameworks which are not optimized to facilitate the participation of the private sector or the organization of the multi-country projects.
- The financial weakness of utilities and the small fiscal space which, further to the financing of the projects themselves, slow down the securing of financing for the preparation studies and the implementation of environmental and social mitigation measures.
- Coordination issues between the developments led at national scale and the regional projects, which may induce confusion for financial institutions and potential private partners.
- Coordination issues between national actors and between development financing institutions on the most complex multi-country projects which sometimes multiply the requested administrative steps at the expense of the timely development of projects.

Based on this diagnosis, an implementation strategy has been established for the updated regional masterplan with the objective of reducing the duration of project development. The proposed actions are detailed in this section.

4.1. Generalization and standardization of institutional and organizational frameworks for regional projects

The update of the 2012-2025 Regional Masterplan gave way to the experimentation of various organizational frameworks for the more complex multi-country projects. Reference projects are:

- The implementation of the OMVG Loop through a joint Project unit within the OMVG
- The implementation of the CLSG interconnection through the creation of the Special Purpose Vehicle Transco CLSG in charge of project development and operation
- The development of the Northcore project with the creation of a Joint Project Unit based in Abuja

The institutional and organizational frameworks developed in the occasion of each of these projects may be standardized to be deployed efficiently for the implementation of future priority projects, in particular the large multi-country interconnection. This approach aims at supporting and accelerating the definition of the organizational scheme of future projects and anticipate the challenges associated with the necessary institutional reforms.

4.2. Identification of new sources of financing for the implementation of environmental and social mitigation emasures

The securing of the financing of the environmental and social mitigation measures often lies on the critical path of the development of priority projects. Indeed, this responsibility is usually vested in the States which are not always in a position of making the corresponding budget available in a timely manner with respect to the projects schedule.

In a way of preventing this source of delay, it is proposed to look for new sources of financing for these measure, for example:

- **Specific financing from Development Financing Institutions**. This option must be discussed upstream with DFI partners, in particular regarding the financing of compensations and reinstallation plans as it involves a certain reputational risk and issues of equity between projects. Nevertheless, this approach has been used in the past, for example in the case of the partnership with the World Bank on the Northcore project.
- Financing obtained from private partners through the **implementation of a specific concession fee**. This approach allows for the private partner to integrate this constraint in his financial model thus passing it on his price, while staying free of risks related to the implementation of mitigation measures. Indeed, the management of social and environmental impacts is a critical parameter of the risk analysis conducted by private companies, and can lead to a loss of interest or the inclusion of high risk provisions.

4.3. Identification of new sources of financing for the project preparation activites

A study could be launched to analyse the modalities of using the FODETE (Development and financing fund for ECOWAS transport and energy sectors) for financing preparation activities of the regional priority projects.

4.4. Operationalization of the Division in charge of the monitoring and evaluation of the implementation of regional priority projects within the WAPP General Secretariat

This department already exists within the PIPES (Planning, Investment Programing and Environmental Safeguards) of the WAPP General Secretariat but should be strengthened in a way of improving the follow-up of priority project implementation at a regional level.

It is proposed that this department be entrusted with the **management of a development and implementation schedule of priority projects, updated twice a year**. This schedule should be built on an exhaustive work breakdown structure of preparation and project development activities, including in particular:

- The definition and implementation of legal and institutional framework reforms
- The discussion and contracting of electricity import-export agreements, usually representing a large share of projects' revenues
- The impact assessment studies and the implementation of environmental and social mitigation measures and of land acquisition
- The power evacuation studies and the grid connection studies
- The mobilization of financing for each activity including:
- costs related to the optimal project follow-up by national authorities;
- environmental and social mitigation measures;
- costs for supervision of project construction and commissioning;
- project financing costs.

This department should be able to **analyse bottlenecks in projects' schedules** in a way of alerting stakeholders regarding delays on the critical path. It could also propose measures to unlock progress or accelerate to make up for development delays.

Finally, this department could organization a **yearly workshop to build the capacity of project managers** in view of the main difficulties faced during the year.

4.5. Development of a reference planning software to reinforce the coordination between national planning and the regional masterplan

A reinforcement of the WAPP is required to ensure the coordination between national planning and the ambitions of the regional masterplan. This coordination could be supported by the development of a reference planning software for the region and the implementation of the following actions:

- Free access to the software for national planning units
- Regular updates on the basis of a maintenance contract
- Integration in the requirements of tenders to rely on the reference software
- Sharing of planning databases
- Training sessions for national planning units
- Yearly collective sessions for updating the planning databases (sessions to be moderated by experts)

4.6. Development of "plug and play" tenders for the development of intermitent renewable energy

The development of large renewable energy priority projects (solar and wind) may be carried out through "plug and play" IPP tenders. This tendering procedure requires the preparation of a framework reducing the risks for private investors to the sole construction, operation and technical performance risks. Preliminary steps to launch these tenders are:

- preparation of a specific legal and institutional framework defining among other aspects the concession contracts and the power purchase agreements;
- definition of payment guarantees ad country risk insurances accessible to the projects' preferred bidders;
- anticipation of the grid connection studies;
- anticipation of environmental and social impact assessments;
- land acquisition and defining of simplified licensing for projects' preferred bidders.

4.7. Reinforcement fo the WAPP coordination with influent actos of the electricity sector

Such reinforcement aims at extending the coordination and information sharing activities of the WAPP beyond Utilities and technical and financial partners to include all influent actors of the sector, among which:

- National Regulators,
- Electro-intensive Manufacturing and Industry,
- other high-level government entities involved in the electricity sub-sector,
- other financing institutions (national export-import banks, investment funds, etc.)

This approach be executed through the organization of a yearly workshop gathering all influent actors to present the priority projects and their progress. Thematic workshops may be organized to address the main delaying factors faced during the year.

4.8. Advocating increased coordination among the Development Finance Institutions

The opportunities for improvement of coordination and ultimately project development acceleration are:

- the harmonization of procurement guidelines for regional projects;
- the harmonization of disbursement conditions to be met by public authorities in the framework of large projects involving multiples DFIs;
- the coordination with export-import banks active in the countries of the projects.

5. ACTION PLAN FOR THE WAPP

In addition to the development of the 75 Priority projects, the major actons to be undertaken by the WAPP for an efficient implementation of the Master plan as well as an optimal operation of the interconnected system include:

5.1. Support to the development of renewable energy

In addition to the optimum leveraging of hydropower resources through the development of priority projects, the economic analyses carried out conclude that by 2033, the development of the proposed variable renewable energy projects (solar PV and to a lesser extent wind turbine) shall constitute 18% of energy produced on the basis of renewable resources (excluding hydro) within the sub-region.

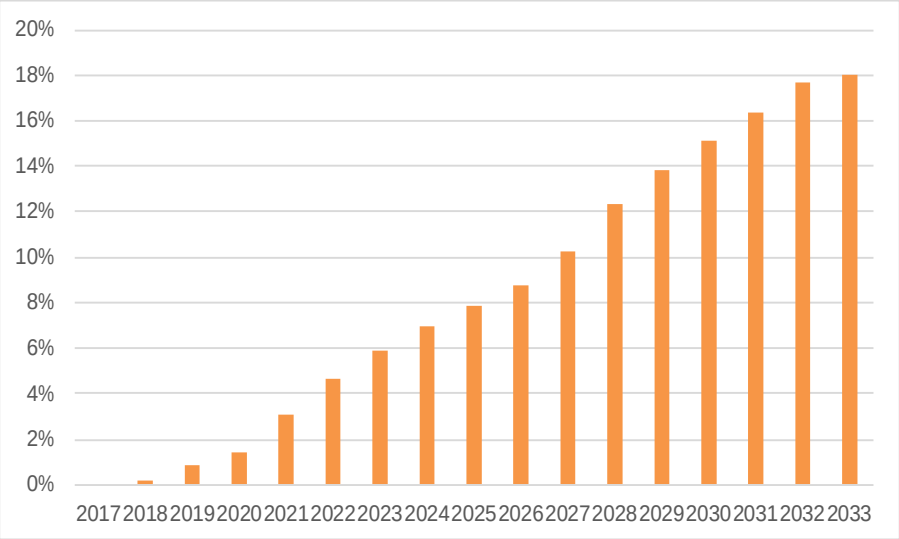


Figure 22: Optimum percentage of renewable energy (excluding hydro) in the energy mix

In particular, the dynamic studies carried out for the years 2022 and 2025 considered an instantaneous integration rate at the solar peak of respectively 17% in 2022 and 28% in 2025. For this rate, the studies demonstrated the technical feasibility of the integration of intermittent renewable energy while optimizing the operation of the system. Thus, the techno-economic feasibility integrating intermittent renewable energy has been demonstrated for a total of 3.3 GW by 2022, 7.0 GW by 2025, 9.6 GW by 2029 and 12.1 GW by 2033.

Of these intermittent renewable projects, 15 solar, wind and hybrid projects were included in the list of priority projects for a total of 3.15 GW

In addition, an economic potential for a total of 37.5 GW by 2033 (ie 24.9 GW in addition to the 12.1 GW previously presented) has been identified. This economic potential, in order to be developed, will nevertheless have to be the subject of in-depth studies, particularly from a technical point of view.

Nevertheless, the integration of such a volume of renewable energy that would cover up to 60% of demand during peak hours of generation requires the establishment of an action plan for:

- Dedicated studies to identify operational measures ensuring a good integration of renewable energies (adapted reserves, voltage support measures, storage facilities, etc.);
- Taking into account the role of interconnections for the management of the reserve and the sharing of renewable generation
- The revision of "Take or Pay" contractual clauses, which may lead to the curtailment of renewable generation or severe financial penalties
- The reinforcement of the telecontrol centers to ensure the operation with an automated dispatching (specific monitoring of Renewable Energy, advanced prediction methods of renewable generation, smart grid, ...)
- The adaptation of energy contracts between countries (wholesale markets, day-ahead, intraday)
- The need for a regional network code with specific requirements for renewable energies
- The implementation of regional programs allowing the development of renewable energy projects on competitive terms for private investors and member countries (such as the Western Africa Clean Energy Corridor (WACEC) and Scaling Solar)

In addition to the role already devolved to it (development of regional projects and operationalization of the electricity market through the ICC especially), the WAPP shall have to play an important role as a driving force by accompanying the countries in their energy transition through among others:

- The shared experience for the contract arrangement of generation agreements;
- The support to the development of in-depth network studies in the different Member States;
- The securing of adequate funding sources for the preparation and implementation of the projects; and
- The harmonization of operational measures ensuring a good integration of renewable energy.

The availability of the necessary skills should also be ensured by supporting a capacity building program in areas that include operations and planning management.

In addition, it is recommended that the WAPP pursue other opportunities related to renewable energy deployment such as the hybridization of hydropower and thermal power plants, the development of floating photovoltaic technologies and the deployment of storage technologies (including battery), and to subsequently implement the related projects for which the economic viability have been demonstrated.

5.2. Monitoring the development of projects carried out by other regional entities

By their mandate, a number of sub-regional entities (such as OMVS, OMVG, CEB, NBA, MRU) have the responsibility to develop generation and interconnection infrastructure that shall benefit their respective Member States. Sometimes it is a multi-purpose infrastructure but for which the generation or transmission of electricity play an important role. Given their regional impact, these generation (especially renewable and hydropower) and transmission projects should be closely monitored by the WAPP independent of their size.

5.3. Support to the optimal operation of the interconnected network

It was observed that at the short term horizon, interzonal oscillations are present on the network between Nigeria and Niger on the one hand against the rest of the WAPP countries of the other hand. To eliminate these oscillations, it is recommended to adjust the power system stabilizers (PSS) of machines at the extremities of the region (hydro units should be a priority).

It is also noted that at this horizon, the loss of some interconnection lines, the network stability is not maintained and defense measures are necessary in order to maintain the network in operation. To address this problem, a series of recommendations are proposed:

- The commissioning of the Bolgatanga - Bobo - Sikasso 330 kV double circuit interconnection must be a priority for the synchronization by 2022.
- The joint commissioning of the two circuit of the line CLSG to ensure synchronization, and avoid a collapse of the network when the loss of the simple circuit.
- In order to satisfy important exchanges between Nigeria and the rest of the WAPP in the short term, the implementation of a special protection scheme (SPS) is recommended in order to maintain the network in its stability limits after the loss of some interconnection lines. The implementation of the SPS, among others, also requires the update of the WAPP operation manual.
- Additional SVCs are necessary at the substations of Ouagadougou (100 MVAr), Salkadamna (200MVAr) and Monrovia (additional 20MVAr) in order to avoid voltage collapses in the region in the case of critical contingencies (loss of a line of the NorthCore, loss of a line of CLSG).

In order to ensure the optimal and coordinated operation of the interconnected network and thus successfully synchronize the electrical networks of the 14 mainland ECOWAS Member States, the WAPP and its Member Utilities shall have to undertake actions that include:

Recommendation	Approximative cost of the measure
Tune PSS of some large units at the extremities of the WAPP system to improve the damping of a critical 0.27 Hz interarea mode between eastern WAPP and the rest of WAPP	500kUSD[1]
Update the WAPP Operations Manual	300 kUSD
Set up a Special Proctection Scheme (SPS) to increase trade between Nigeria and the rest of the WAPP	2 MUSD
Improve dynamic voltage compensation by adding one SVC at Ouagadougou (Burkina), one at Salkadamna (Niger) and by increasing the size of the already planned SVC at Monrovia (Liberia)	32 MUSD
Operationalize the WAPP Information and Coordination Centre (CIC)	

It is also strongly urged that the 330 kV Ghana – Burkina – Mali Interconnection Project (approximately US$234 million) as well as the 2nd Circuit of the CLSG Project (approximately US$131 million) be implemented soonest as they shall both contribute towards the optimal operation of the interconnected system.

5.4. Implementation of action plans to improve the performance of WAPP member utilities

Based on the best practices observed in the WAPP member utilities as well as in other regions of the world facing with similar issues, a list of actions has been proposed that aim at improving the performance, the efficiency and the sustainability of WAPP member utilities.

Depending on the context of each country and each utility, the sequence in which the actions are implemented may vary. Nevertheless, in view of the cross-cutting nature of the critical factors affecting the performance of utilities within the region, the following priority actions can be proposed:

[1] Source : synchronisation study

Theme	Main priority actions to implement at utility level
Governance	Adequate use of plan contracts, performance contracts and management contracts taking advantage of the lessons learned from utilities having experienced them.
Planning	Pursuit of the consistency between national masterplans and the ambitions reflected in the regional masterplan.
	Extension and reinforcement of national networks and interconnections as a key factor for system performance.
Development of large projects	Diversification of development modes and increased involvement of the private sector.
Commercial efficiency	Support to cross-border electricity exchanges by standardizing contractual clauses of electricity import and export, with the support of ERERA.
	Implementation of clientele management systems and of call centers.
	Implementation of pre-paid metering systems and decentralization of invoicing and payment collection activities.
Capacity development	Reinforcement of human resources in technical, legal, financing, commercial and procurement areas in collaboration with Development Finance Institutions, strengthening of WAPP Centers of Excellence and creation of partnerships with universities in the sub-region.

5.5. Action Plan to promote the diligent implementation of projects

A diagnosis of the implementation of the priority projects from the 2012 – 2025 regional masterplan has been conducted through the collection of lessons learned by the actors involved in these projects. This approach highlighted recurrent delaying factors for the development of projects and for the compliance to the schedule established in the previous masterplan.

Based on this diagnosis, an implementation strategy has been established for the updated regional masterplan with the objective of reducing the duration of project development. The proposed actions are the following:

Actions to promote the diligent implementation of projects
Further deployment of institutional frameworks that reflect the common implementation of regional projects such as the creation of Special Purpose Companies (e.g. Transco CLSG) or Joint Project Management Units (e.g. Northcore, OMVG Loop).
Identification of new sources of financing for the implementation of environmental and social mitigation measures from Development Finance Institutions and possibly, pre-financing by the private sector.
Reinforcement of the WAPP to ensure a coordination between national planning and the ambitions of the regional masterplan, in particular through the development of a reference planning software for the region.
Scaling-up of private sector participation in the development of regional variable renewable energy projects. This could include, among others, the development of large renewable energy (solar and wind) priority projects through Auctions involving « plug-and-play » scheme.
Reinforcement of the WAPP to extend its coordination and information sharing activities beyond the Member utilities and the WAPP Technical and Financial Partners to reach other Actors within the sub-sector such as National Regulators, Manufacturing and Industry, other high-level government entities involved in the electricity sub-sector, and other financing institutions (national export-import banks, investment funds, etc).
Advocating increased coordination among the Development Finance Institutions (DFIs) supporting regional projects, in particular regarding the harmonization of procurement guidelines for reginal projects, the harmonization of disbursement conditions where various DFIs are involved in the same project and the coordination with export-import banks active in the projects' countries.
Enhancing funding for project pre-investment studies including the rapid operationalization of the FODETE to fund project preparation activities.
Granting of land with free-zone status at appropriate target locations by countries that have been identified to host the regional solar and/or wind power parks
Diversification of financing resources for the realization of the priority projects that could include Green Climate Fund and enhanced private sector participation
Setting-up of rewarding and strategic partnerships that are fully aligned with the priorities of the Region and shall, among others, facilitate the implementation of the Master Plan

APPENDIX A: SYNTHESIS OF PRIORITY PROJECTS

Priority Generation Projects

	Name of the Project	Installed Capacity MW	Cost Estimated MUSD	Date of commissioning
ShortTerm	*Gouina Hydropower plant (OMVS)	140	462	2020
	*Souapiti Hydropower plant In Guinea	450	1350	2020
	*Gribo-Popoli Hydropower plant in Côte d'Ivoire	112	345	2021
	*Sambangalou Hydropower plant (OMVG)	128	454	2022
	*Zungeru Hydropower plant in Nigeria	700	1200	2022
	*Fomi Hydropower plant in Guinea	90	620	2022
	*Wind Farm in Senegal	150	230	2019-2021
	*Azito IV Thermal Power Plant CC in Côte d'Ivoire	253	302	2020
	*Ciprel V Thermal Power Plant CC in Côte d'Ivoire	412	505	2021
	*Early POWER Thermal Power Plant CC in Ghana	300	390	2019
	*GPGC Thermal Power Plant CC in Ghana	170	221	2019
	*Amandi Thermal Power Plant CC in Ghana	240	312	2019
	*Rotan Thermal Power Plant CC in Ghana	330	429	2022
	*KADUNA Thermal Power Plant in Nigeria	215	280	2019
	*OKPAI Thermal Power Plant in Nigeria	450	585	2020
	*SALKADAMNA Thermal (Coal) Power Plant in Niger	200	573	2021
	Maria Gleta Thermal Power Plant in Benin	450	585	2022 recommended for the first GT
	Boutoubre Hydropower plant in Côte d'Ivoire	150	343	2022 recommended (1st group)
TOTAL SHORT-TERM		4940 MW	9185 MUSD	

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	Name of the Project	Installed Capacity MW	Cost Estimated MUSD	Date of commissioning
Mid-term	*Amaria Hydropower plant in Guinea	300	600	2023
	*Bumbuna II Hydropower plant in Sierra Leone	143	358	2023
	*Louga Hydropower plant in Côte d'Ivoire	246	647	2023
	*Koukoutamba Hydropower plant (OMVS)	294	689	2024
	*Mambilla Hydropower plant in Nigeria	3050	5800	2024
	*Adjaralla Hydropower plant (Togo-Benin)	147	333	2026
	*Tiboto Hydropower plant (Côte d'Ivoire-Liberia)	225	599	2028
	*Alaoji II Thermal Power Plant in Nigeria	285	371	2025
	*San Pedro Thermal (coal) Power Plant in Côte d'Ivoire	700	1900	2026-2029
	Solar Farm PV in Burkina Faso	150	139	2022-2024 Recommended
	Solar Farm PV in Mali	150	139	2022-2024 Recommended
	Solar Farm PV in Côte d'Ivoire	150	143	2022-2024 Recommended
	Solar Farm PV in The Gambia	150	130	2023-2025 Recommended
	Solar Farm PV in Benin	150	120	2024-2026 Recommended
	Solar Farm PV in Nigeria	1000	695	2025-2029 Recommended
	Solar Farm PV in Ghana	150	108	2026-2027 Recommended
	Grand Kinkon Hydropower plant in Guinea	291	350	2023 Recommended
	Morisananko in Guinea (Hybrid PV – Hydro)	200	353	2025 Recommended
	Bonkon Diara Hydropower plant in Guinea	174	211	2025 Recommended
	Boureya Hydropower plant (OMVS)	114	448	2029 Recommended
	Aboadze II Thermal Power Plant in in Ghana	450	585	2029 Recommended
TOTAL MID-TERM		8699 MW	14808 MUSD	

	Name of the Project	Installed Capacity MW	Cost Estimated MUSD	Date of commissioning
Long-term	Solar Farm PV in Niger	150	90	2030 Recommended
	Solar Farm PV in Burkina (Phase II)	150	84	2031 Recommended
	Solar Farm PV in Mali (Phase II)	150	77	2032 Recommended
	Wind Farm in Nigeria	300	190	2030 Recommended
	Mano Hydropower plant (MRU)	180	487	2030 Recommended
	Songon Thermal power plant in Côte d'Ivoire	369	480	2031 Recommended
	Saint Paul Reservoir In Liberia	1st phase: Via Reservoir 2nd phase : New project 360 MW to 585MW	511 (for the first phase)	1st phase: 2025 Recommended 2nd phase : 2030
TOTAL LONG-TERM		1883 MW	1919 MUSD	
GRAND TOTAL		**13592 MW**	**24594 MUSD**	

** Decided Project*

Final version

Priority Transmission Projects

	Line	Level Voltage KV	Length [km]	Estimated cost [MUSD]	Date of commissioning
Short-term	*Coastal backbone project: interconnection Volta (Ghana) - Lomé (Togo) - Sakété (Benin)	330	340	122	2019
	*Laboa-Boundiali-Ferkessedougou (Côte d'Ivoire)	225	310	115	2019
	*Line Kayes (Mali)-Tambacounda (Senegal) (part of the Manantali II project of OMVS)	225	288	94	2020
	*Interconnection CLSG (Interconnection Côte d'ivoire-Liberia-Sierra Leone-Guinea)	225	1303	517	2020
	*OMVG Loop (Senegal-The Gambia-Guinea Bissau-Guinea)	225	1677	722	2020
	*Manantali-Bamako line in Mali (part of the Manantali II project of the OMVS)	225	317	85	2021
	*Inteconnexion Guinea - Mali	225	1074	436	2021
	*Project North Core (interconnection Nigeria- Niger -Benin/Togo-Burkina)	330	832	541	2022
	*Kayes Line (Mali)-Kiffa (Mauritania) (part of the Manantali II project of the OMVS)	225	420	184	2022
	Second circuit of the CLSG interconnection to be commissioned in the same time as the first circuit	225	1303	131	2020
	Line Bolgatanga (Ghana)-Bobo (Burkina Faso)-Sikasso (Mali)	330	555	341	2022 Recommended
TOTAL SHORT-TERM			8419 km	3288 MUSD	
Mid-term	*Line Manantali (Mali)-Boureya (Guinea)-Koukoutamba(Guinea)-Linsan (Guinea) (part of the Manantali II project of the OMVS)	225	462	166	2024
	*Line Buchanan (Liberia)-San Pedro (Côte d'Ivoire)	225	520	129	2028
	*Strengthening interconnection Côte d'ivoire-Ghana	330	387	156	2029
	*Line Boundiali (Côte d'Ivoire)-Tenrgela (Côte d'Ivoire)- Syama (Mali) - Bougouni (Mali)	225	330	96	2029

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	Line	Level Voltage KV	Length [km]	Estimated cost [MUSD]	Date of commissioning
	Line Fomi (Guinea)-Boundiali (Côte d'ivoire)	225	380	96	2025 Recommended
	Median Backbone (Nigeria-Benin-Togo-Ghana-Côte d'Ivoire)	330	1350	813	2025 Recommended
	Strengthening the coastal Backbone First Phase Nigeria-Benin 2nd Phase Benin-Togo-Ghana	330	400	281	First Phase: 2025 recommended Second Phase: 2028 recommended
	Line Labé- Koukoutamba In Guinea	225	115	50	2024 recommended
	Connection Segou Bamako	225	290	105	2025 recommended
TOTAL MID-TERM			4234 km	1892 MUSD	
Long-term	Western Backbone (Senegal-The Gambia-Guinea Bissau-Guinea-Mali) to reach Ghana-Burkina-Mali	330	1600	912	2033 Recommended
	Link Bobo (Burkina Faso)-Ferke (Côte d'Ivoire) to connect the Western Backbone to the Median	330	213	126	2033 Recommended
	Reinforcement of the Western section of the OMVG loop	225	800	301	2030 recommended
	Strengthening Niger-Nigeria Interconnection	330	510	332	2033 Recommended
	Second North-south axis in Ghana	330	750	426	2030 recommended
	Eastern Backbone in Nigeria	330	1856	966	2033
	Interconnection WAPP (Senegal/OMVS) - Northern Africa through Morocco		1250	*615*	2033
	Interconnection WAPP (Nigeria) - CAPP (Inga)		3300	*1622*	2033
TOTAL LONG-TERM			10279 km	5300 MUSD	
GRAND TOTAL			**22932 km**	**10480 MUSD**	

** Decided Project*

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Transversal Actions

Transversal Actions	Support to the development of variable renewable energy projects at national level in ECOWAS Member States
	Monitor the development of projects being developed by other sub-regional entities (OMVG, OMVS, NBA, CEB, MRU)
	Pursue opportunities related to renewable energy deployment eg hybridization of hydropower and thermal power plants, floating photovoltaic technologies, deployment of storage technologies (including battery), and implement related projects should they be proven beneficial
	Deploy supplementary measures aimed at further consolidating the synchronism of the WAPP interconnected system
	Support WAPP Member Utilities prepare and implement Action Plans aimed at improving their efficiency and performance
	Develop a regional approach to address some of the challenges faced by the Distribution Utilities of the WAPP
	Continue the capacity building/reinforcement of WAPP Member Utilities and accelerate the development of the WAPP Centers of Excellence

APPENDIX B : PROJECT DEVELOPMENT MODES AND FINANCING PRECONDITIONS

Project development modes

Public Private Partnership (PPP) concepts

Historically, the states were entirely responsible for the development of capital-intensive and strategic power generation and transmission projects. Nevertheless, the current budgetary constraints of West African States and the high investment requirements for the development of energy projects have given rise to new modes of structuring projects involving the private sector. Depending on the solution chosen, the latter can bear a greater or lesser responsibility for the project. This mode of project development is called "Public Private Partnership (PPP)".

This legal scheme provides governments the access to additional financial resources and technical expertise for the development of energy projects. The PPP considers all the agreements between one or more public entities and one or more private partners under which the private partner(s) commit to carry out the financing, management, operation, construction and / or maintenance of a public service infrastructure. These agreements also enable the transfer of risks from the public entity to its private partner, which can receive a remuneration in proportion of its performance.

Benefits to private sector involvement

The international experience of this type of project shows that private participation generally brings benefits in relation to the public implementation of projects. The private partner brings proven experience in the design, development and construction of major projects in the electricity sector. He will also have more experience and incentives for EPC contracts to be signed and implemented effectively, maximizing project interest. All this leads to obtaining the best price for the projects, as well as their commissioning according to the planned schedules. In addition, private participation, with the experience, organization and financial discipline that goes with it, generally ensures adequate project operation and maintenance and therefore ensures sustainability

This chapter briefly presents different modes of public service management for the electricity sector ranging from a service contract in the context of an Engineering, Procurement, Construction contract (EPC) to a complete privatization contract by going through different schemes of PPPs.

ENGINEERING, PROCUREMENT, CONSTRUCTION CONTRACT (EPC)

The EPC is a construction contract of which the State or a parastatal entity is the contractor in charge of the engineering, procurement and construction of the project. In the case of the electricity market, the EPC is the most common scheme of project development. Under this scheme, the state or public service company takes the overall responsibility for the project from the moment it is delivered by the EPC contractor.

The public authority or utility is then in charge of ensuring the operation and maintenance of the assets at its disposal. The latter may subcontract specific activities related to the operation and maintenance of the infrastructure to a private operate through service contracts.

CONCESSION CONTRACT

In a concession contract, which usually lasts around 30 years, the assets of some or all of the electricity sector are transferred to a private company in charge of the operation, maintenance and development of these assets. There is therefore no asset company and the concession contract is regulated by a sectoral regulatory authority.

CONCESSION SCHEME: BUILD OPERATE AND TRANSFER (BOT)

In a BOT contract, the contracting authority (state or parastatal entity) entrusts the construction, financing, operation and maintenance of an installation to a private company, usually generation but sometimes electricity transmission.

In return, the company receives a payment from the tariff paid by users. At the end of the contract period (between twenty to thirty years) the company transfers the assets to the contracting authority.

CONCESSION SCHEME: BUILD OPERATE AND OWN (BOO)

The BOO contract is established under the same conditions as the BOT with the exception that the asset remains indefinitely a property of the private entity responsible for the public service.

The choice within the different PPP contracts varies according to the needs of the contractor. These types of contracts allow the State to transfer to the private company the risks associated with the preparation, implementation and operation of the project under different commitment levels. It should be noted that the legal and contractual complexity is more important in the case of a BOO than a BOT.

The different project development modes are summarized in the following table:

Comparaison des différents modes de gestions des services publics					
Option contractuelle	**Exploitation et maintenance**	**Risque commercial**	**Investissement en capital**	**Propriété des actifs**	**Durée du contrat**
Régie directe	Public	Public	Public	Public	Pas de contrat
Contrat de service *Out Sourcing or Service Contract*	Public/Privé	Public	Public	Public	1 à 2 ans
Contrat de gérance *Management Contract*	Privé	Public	Public	Public	3 à 5 ans
Affermage *Long Term Lease*	Privé	Privé	Public	Public	8 à 15 ans
Concession	Privé	Privé	Privé	Public	25 à 30 ans
BOT *Build Operate Transfer*	Privé*	Privé*	Privé*	Public/Privé	20 à 30 ans
Privatisation	Privé*	Privé*	Privé*	Privé*	Indéfinie ou limité par le contrat

* ou partagé public/privé dans le cas d'une société d'économie mixte.

Table 20: Comparison of the different modes of public service management[2]

INDEPENDENT POWER PRODUCER (IPP)

IPP's projects are embodied in the contracts between public authorities and energy private producers. These contracts concern BOO or BOT contracts and are intended to define the obligations of the partners as follows:

- build and operate a private energy infrastructure, for the private partner; and
- an obligation to purchase energy, for the public entity. The energy purchase is enabled by Electricity Purchase Contracts (PPAs) also known as Power Purchase Agreements (PPA).

A PPP provides the producer with a regular income that covers the cost of his investment, the operational expenses and reasonable margin of profit. These contracts are long-term (> 20 years) but may be subject to modifications within the contractual period.

Financing preconditions

In the context of "Project Financing" applicable for BOT/BOO/IPPs, the preconditions for "Financial Closing" are:

- Pre-feasibility studies (where applicable),
- Analyzes of the regulatory, fiscal and legal framework,
- Technical feasibility studies and environmental and social impact,
- Risk assessment,
- Financial model of the project to be presented to banks or funders,

[2] René MASSE, Samuel WATCHUENG, Pierre BOUBOU, « Le Partenariat Public-Privé dans les programmes d'électrification rurale en Afrique », Club des agences et structures Africaines en charge de l'Électrification Rurale, décembre 2010.

- Authorizations and permits from the administrative authorities,
- Contracts signed and in particular the power purchase agreement (PPA), and the concession contract, which are usually preceded by "term sheets" which define the main terms of contracts,
- Insurance associated to the project,
- The creation of a Special Purpose Vehicle (SPV) in the case of a development in PPP.

Concerning the risk assessment, it is a question of identifying all the risks to which the financed project can be exposed during the different phases:

- Technical risks
  - Risks related to design and development,
  - Risks related to construction (deadlines, extra costs, etc)
  - Risks related to operation and maintenance
  - Technical risks (e.g geology, hydrology, etc)
  - Risks on the construction company
  - Risks related to the maturity of the technology
  - Social and environmental risks
- Financial risks
  - Country risks
  - Market risks (nonpayment by public entity and / or consumers)
  - Pricing risks
  - Risks on resource mobilization
  - Risks associated with contingent liabilities
  - Risk of devaluation
  - Force majeure

For each of the risks it is necessary to study the capacity of those who assume it and to evaluate their impact on the financial sustainability of the project.

APPENDIX C: ADEQUATION OF THE PLAN WITH PARIS AGREEMENT

Sustainable development is one of the major challenges for the Sub-region. In December 2015, 196 countries whose 14 WAPP countries endorsed the Paris climate agreements, the main objective of which is to contain global warming below 2 °c.

In order to achieve this goal, the signatory States accepted to provide plans to reduce greenhouse gas emissions, better known as Nationally Determined Contributions (NDC).

In order to achieve the sustainable development of the electricity Sector of West Africa in accordance with the objectives of the COP21, IRENA estimated the financial needs for West Africa at 141 billion USD between 2015 and 2030, as illustrated by the Table Below.

USD BILLION

Region	All generation	Large hydro	Other renewables	T&D
North Africa	342	2	218	186
West Africa	89	36	31	52
Central Africa	32	13	17	14
East Africa	72	36	21	49
Southern Africa	145	18	94	74
Total	**681**	**106**	**381**	**375**

Figure 23: IRENA's estimated funding needs for the development of the electricity sector in Africa between 2015 and 2030

The list of priority regional projects and the related Action Plan (see chapters 3 and 5) will undoubtedly contribute to the achievement of these objectives, but other actions must be taken at national and/or local level.

As such, from the point of view of *Renewable*, the estimated investment volume for developing the potential of 37.5 GW of intermittent renewable energy amounts to 26.5 billion USD, or 85% of the amount estimated by IRENA. Decentralized and Off-grid projects (eg. small hydropower, hybrid solar power plants and biomass) at the local level should cover the remaining 15%.

From the point of view *Hydroelectricity*, the 20 priority regional projects represent a total investment of 15.5 billion USD, or about half of the funding needs estimated by IRENA. It should be noted that since 2015, some projects contributing to the NDC have also already been put into service, including Soubré (Côte d'ivoire), Mount Coffee (Liberia) and Kaléta (Guinea). The additional effort will have to focus on smaller projects, including projects carried out by subregional entities (OMVG, OMVS, NBA, CEB, MRU,...) and closely followed by the WAPP. Finally, the importation of hydroelectric power from Central Africa through the Inga-Calabar interconnection will further strengthen the role of hydropower in achieving these objectives.

From the point of view of the *Network*, the interconnections represent only a small part (10 billion USD on 52) of the necessary investments at national and regional level to meet the NDC objectives. Indeed, the strengthening of national transmission and distribution networks and rural electrification by connection to the network represent major issues which are under the responsibility of national authorities and are therefore not included in the list of Regional Projects.

Finally, It should be noted that the development of storage solutions and particularly battery storage is a major challenge for the achievement of NDC. It is worth mentioning that a study conducted by the WAPP is underway to study the opportunities to develop battery-storage infrastructure in the subregion.

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