Regional Integration in the Context of Climate Change

AFRICAN DEVELOPMENT BANK GROUP

NEPAD, Regional Integration and Trade of Department

Table of Contents

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Acronyms and Abbreviations

AfDB	African Development Bank
AFOLU	Agriculture Forestry and Other Land Use
AREP	Adaptation Review and Evaluation Procedures
CBFF	Congo Basin Forest Fund
CBFF	Congo Basin Forest Fund
CLSG	Côte d'Ivoire, Liberia, Sierra Leone and Guinea
COMESA	Common Market for Eastern and Southern Africa
COMIFAC	Central African Forest Commission
COP21	Conference of the Parties 21
CSP	Country Strategy Papers
CSS	Climate Safeguards System
DRC	Democratic Republic of Congo
E&S	Environmental and Social
EAC	East African Community
EAPP	East African Power Pool
ECCAS	Economic Community of Central African States
ECGLC	Economic Community of the Great Lakes Countries
ECOWAS	Economic Community of West African States
EdG	Electricité de Guinée
EDSA	Electricity Distribution and Supply Authority
EGTC	Electricity Generation and Transmission Company
ESAP	Environmental and Social Assessment Procedures
EU	European Union
EWSA	Energy and Water Sanitation Authority of Rwanda
GEF	Global Environment Facility
GHG	Greenhouse gas
HFO	Heavy fuel oil
IESIA	Integrated Environmental and Social Impact Assessment
INDC	Intended Nationally Determined Contributions
ISS	Integrated Safeguards System
LEC	Liberia Electricity Corporation
MDB/DFI	Multilateral Development Bank/Development Financial Institutions
MRU	Mano River Union
MRV	Measurement reporting and verification
NBI	Nile Basin Initiative
NPA	National Power Authority
PDCT-AC	Central African Consensual Transport Master Plan
PES	payment for environmental services
PIDA PAP	Program for Infrastructure Development in Africa Priority Action Plan
PRRC	Kinshasa-Brazzaville railroad bridge Project
RC	Republic of Congo
RECs	Regional Economic Communities
REGIDESO	Régie de Production et Distribution d'Eau et d'Electricité of Burundi
RIPOS	Regional Integration Policy and Strategy
RISPs	Regional Integration Strategy Papers

RMC	Regional Member Country
RMCsHK	Regional Member Countries
ROs	Regional Operations
RPGs	Regional Public Goods
SE4All	Sustainable Energy for All
SEFA	Sustainable Energy Fund for Africa
SNEL	Société Nationale d'Electricité of the Democratic Republic of Congo
TYS	Ten Year Strategy
UA	Unit of Account
UNECA	United Nations Economic Commission for Africa
UNFCCC	United Nations Framework Convention on Climate Change
WAPP	West African Power Pool

Executive Summary

Regional integration is a cornerstone of the African Development Bank's strategy for inclusive growth in Africa. In the Regional Integration Policy and Strategy (RIPOS) released in 2014, the Bank outlines its objective to promote Regional Operations (RO), by supporting regional infrastructure development and by enhancing trade and industrial development. In the context of Africa's increased vulnerability to climate change and non-negligible opportunities to contribute to climate mitigation, there is a strong need to examine the connection between climate change and regional integration. This study, commissioned by the African Development Bank (AfDB), aims to explore this nexus, and create an understanding of how mitigation and adaptation to climate change can be mainstreamed into regional integration operations. The study covers three main perspectives:

- Comparing regional integration approaches to bridging infrastructure gaps with stand-alone national approaches in terms of mitigation and adaptation to climate change.

- Identifying regional infrastructure standards, construction codes, urban and land-use planning policies for enhancing climate resilient infrastructure and finding ways to mainstream climate change resilience in regional projects.

- Examining the extent to which climate resilience considerations inform the preparation, design and implementation of Regional Operations and the RIPOS.A review of AfDB main strategy and operational documents shows that the Bank's guidelines can be further improved to mainstream climate change considerations in Regional Operations:

- Overall, most strategy documents do not tackle the specific issue of climate change in Regional Operations. Main policy frameworks on climate change indicate a stronger emphasis on adaptation, rather than mitigation, strategies. The reason for the greater focus on adaptation is that the development impacts of potential climate risks are of greater concern to AfDB's RMCs, given their greater vulnerability and limited resilience capacity.

- At the operational level, the Climate Screening System (CSS) is used to assess the vulnerability of projects to climate change and to identify appropriate resilience measures. The CSS analyses ROs through the same screening process as other Bank operations. The CSS is not equipped with dedicated tool for the calculation of incremental costs of climate proofing. Available scorecards in the CSS cover only some strategic sectors of AfDB interventions.

- The Integrated Safeguard System (ISS) assesses the impacts of projects on the environment, and has the potential to facilitate the adoption of climate change adaptation activities. With regards to mitigation, the ISS spells out objectives in terms of greenhouse gas emissions tracking. The tracking of greenhouse gas (GHC) emission could indirectly contribute to promoting climate change mitigation,[i] if the Bank and its clients use GHG data to take adequate emissions reduction measures. In addition, the Bank is in the process of developing a GHG emissions tracking tool.To complement the analysis of AfDB's climate change approach, a cursory review was conducted to study which legal frameworks could provide a basis for improving the resilience of ROs.

  Although most African regional economic communities have issued policy papers presenting their strategy on climate change, most of these documents rarely translate into regulatory principles such as norms, protocols, or standards. In this context, some initiatives led by international financial institutions to create common technical guidelines on infrastructure resilience represent an opportunity for the Bank. One such initiative is the creation of an "Africa climate-resilience project preparation facility", under the aegis of the World Bank.

  A central part of the study focuses on a selection of four regional integration projects financially supported by AfDB, The four projects, promoted by regional institutions, were drawn from the energy, transport and forestry sectors. The projects are the "Côte d'Ivoire-Liberia-Sierra Leone-Guinea (CLSG) interconnection project, the Ruzizi III hydropower component project, the Kinshasa-Brazzaville railroad bridge project, and the Congo Basin MRV project. Implementation of these projects started before the CSS was operational. Main objectives of the case studies are to:

- categorize the project on the basis of its climate-sensitivity and likely impact on future climate conditions;

- assess the project's climate change mitigation potential;

- assess the project's climate resilience potential.

The case studies on the four regional projects underline some facets of the nexus between climate changeand regional

i This is shown in the Intended Nationally Determined Contributions (INDCs) prepared by the Bank's regional member countries (RMCs) prior to the 2015 Conference of the Parties 21 (COP21).

A dedicated fund could be created to finance incremental costs associated with the improvement of climate-related outcomes, especially project resilience, contribution to climate change adaptation and mitigation.

Strengthening the adaptation and mitigation dimensions of regional projects could facilitate access to climate co-finance and would also enable better mobilization of co-financing from the private sector.
integration and outline some advantages of regional versus stand-alone national approaches.In the energy sector, the development of regional infrastructure allows collaborating countries to harness the potential benefits of larger scale projects that could not be developed by an individual country alone. Scenarios developed in the case studies show that creation of sub-regional electricity markets and the pooling of renewable sources of energy does yield some climate benefits. In the transport sector, however, the PRRC case highlights the environmental costs of economic development, which is a goal of regional integration. The economic activity induced by the development of this regional infrastructure entails additional greenhouse gases emissions. Shifting the focus from absolute GHG emissions to emission intensity might have important consequences for the assessment of the mitigation potential of a regional project;The Congo Basin MRV case study illustrated the importance of coordinated regional resources management, especially as the project outcomes included the provision of regional public goods.

This report concludes with of the following practical recommendations for a more effective implementation of the RIPOS from a climate perspective:

- Strengthening the resilience of infrastructure projects calls for the development of the CSS scorecards and an accurate estimation of the incremental costs of climate proofing.

- Additional guidance on the ISS could facilitate the identification of climate change adaptation activities.

- The use of data on GHG emissions associated with a project could indirectly facilitate the adoption of climate change mitigation measures.

Introduction

At the COP21 in Paris, many African countries called attention to the continent's high vulnerability to climate change. Stronger and more frequent extreme weather events, shifts in rainfall, droughts, flooding, and rise of sea levels are some of the local consequences of climate evolutions. The low level of development of the African economy exacerbates the impacts of climate change on agricultural production, access to water, food security and human health. Africa contributes very little to global emissions, but endures high exposure to climate change. This provides a strong rationale for ambitious measures to respond to the challenges of climate change in Africa.

Against this backdrop, the African Development Bank (AfDB or the Bank) has gradually mainstreamed climate change into its strategy and interventions. In its strategy for 2013 – 2022, the Bank committed itself to promoting green growth: "Africa must also seize the many opportunities in its gradual transition to green growth, responding to the challenges of climate change and reducing the ecological footprint on its natural capital, as a springboard for development". AfDB identifies the following as priorities: building resilience to climate shocks, providing sustainable infrastructure, creating ecosystem services and making efficient and sustainable use of natural resources. In 2015, the Bank announced the tripling of its annual climate financing from $5 billion by 2020.[3]

Regional integration is one of the five top priorities adopted by AfDB for the acceleration of the development of African countries. In its 2014 Regional Integration Policy and Strategy (RIPOS), the Bank committed to the promotion of Regional Operations (ROs) through the support of regional infrastructure development (Pillar One) and the enhancement of trade and industrial development (Pillar Two). A third crosscutting pillar, strengthening country and regional mechanisms and institutional capacities, will support the implementation of the two first pillars. ROs refer to the Bank's projects that aim to produce goods and services that benefit participating countries. ROs are a key element of the RIPOS since they enable the development of large-scale projects, link landlocked countries and facilitate intra-African trade. ROs cover both infrastructure projects and the promotion of Regional Public Goods (RPGs). Infrastructure projects relate mainly to the energy, transport, water, and agriculture and agro-industry sectors.From a climate change perspective, this Bank's strong emphasis on regional integration presents many challenges and opportunities. The development of larger and better integrated markets and the expansion of investments in regional infrastructure are likely to increase the capacity of African countries to contribute or adapt to climate change. For instance, an electricity interconnection network between neighbouring countries might result in the reduction of per capita GHG emissions, thus contributing to climate change mitigation.

Furthermore, such projects might also reinforce the resilience of electricity networks to climate change, thereby enhancing the countries' adaptive capacities. There is, therefore, a strong rationale for studying the nexus between climate change and regional integration.

Unfortunately, literature on the topic is scarce, for many reasons, among them, unavailability of data, with the problems of comparing scenarios based on solely national approaches with regional approaches, and the complexity of ROs (given that numerous aspects of change that arise from the projects are difficult to estimate). Many methodological options can be used to assess both the physical impacts and the economic values of climate change, with different degrees of precision and accuracy (See Annex 3).

Most studies on the subject acknowledge the significant impact of climate change on infrastructure performance and point to the hazards of taking investment decisions without due consideration to potential climate change impacts. Dams for instance, are likely to operate below their initial objectives lower rainfall and higher average temperatures, which accelerate evaporation. Dams could be damaged by frequent extreme weather events. Existing dams need, therefore, to be assessed for climate resilience, and risk management should be included throughout the project cycle of new ones. Numerous studies focus on the water sector, since the trans-boundary nature of many of Africa's river basins opens opportunities for investing in regional infrastructure (i.e. hydropower, irrigation). Such ROs have the potential to enhance adaptation to climate change, for instance through improved basin-wide environmental management, flood and drought management.

From an economic perspective, a few studies focus on the estimation of additional costs associated with the climate-proofing of investments. Indeed, the cost of investing in resilience of infrastructure is often perceived as detrimental to other investments in broader economic development.

ii In this study, the Bank's definition of Climate change and related concepts was used (AfDB, Climate Finance Tracking Manual, 2013): Climate change: A change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.

iii Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.
Vulnerability: The propensity or predisposition to be adversely affected.
Mitigation: A human intervention to reduce the sources or enhance the sinks of greenhouse gases.
Less than 4% of global CO_2 emissions come from the African continent. ODI, "Climate Finance in Sub Saharan Africa", Climate Finance Policy Brief, 2011.

As far as the cost of promoting adaption to climate change in Africa is concerned, one study estimated the annual cost of adapting to climate change in Sub-Saharan Africa to amount to $14 – 30 billion. In spite of these high costs, most studies acknowledge that the benefits of reduced risk outweigh the increase in cost. Review of literature conducted for this report point to the need for a deeper understanding of climate change in a regional integration context.

This study, therefore, complements existing knowledge by focusing on regional integration in a climate change perspective. The main objective of the study is to provide the Bank with a knowledge document on how ROs can contribute to the mitigation of, and adaptation to, climate change. The study will identify possible ways mainstreaming climate change into the RIPOS and will provide suggestions on the effective implementation of the regional strategy. To fulfil this assignment, the following tasks were conducted:

- Review of AfDB's main strategy documents and operational guidelines in the fields of climate change and regional integration. Climate-compatible implementation of the RIPOS hinges on how these guidelines can be adapted to mainstream climate change considerations in Regional Operations (ROs);
- Cursory review of regional economic communities' climate change policy frameworks;
- Case study analysis on four projects drawn from AfDB's portfolio of Regional Operations in the electricity, transport and forestry sectors- assessing climate change considerations (mitigation, resilience) in their project cycles.

The report is structured as follows: Part 1 outlines the study's rationale, objectives research questions and scope. Part 2 focuses on AfDB's strategy and operational guidelines on climate change. This part also reviews how climate change is mainstreamed into Bank processes and how climate change priorities can be integrated into ROs. With a special emphasis on infrastructure resilience, this part reviews the norms and legal frameworks that could constitute the basis for improving the resilience of ROs. Part 3 presents four selected case studies and discusses the method of analysis.

This part also outlines the main findings of the case studies and elaborates on the nexus between regional integration and climate change. Part 4 features the study's conclusions and recommendations.

1. Context of the Study

1.1 Rationale

The Regional Integration Policy Strategy, approved by the Bank in 2014, sets ambitious goals for Regional Operations (ROs). The RIPOS states that "only regional integration will help create larger markets that are attractive to the investment and trade critical for generating sustained growth, creating jobs and transitioning to inclusive growth." This entails promoting the adoption of Regional Integration Strategy Papers (RISPs) and Country Strategy Papers (CSP), implementing the Priority Action Plan of the Program for Infrastructure Development in Africa (PIDA), supporting trade facilitation measures, attracting private sector investment in infrastructure by adopting modernized frameworks and international principles, etc. Both Regional Economic Communities (RECs) and Regional Member Countries (RMCs) are instrumental to regional integration. However, the RIPOS does not clearly articulate the connection between regional integration and climate change. There are some references to climate change in the RIPOS:

- In the cross-cutting pillar discussion of the strategy, climate change is addressed in the context of the vulnerability of islands to natural disasters and climate change;

- In Annex 5, "How the Bank will support RMCs to address some specific "soft" issues raised in the RIPOS": the document states that, at macro or sector/national levels, "the objective is to take into consideration climate-change issues, both in terms of biodiversity conservation, improved forest and agriculture management and sustainability of natural resources" .Although the Bank has not directly mainstreamed climate change issues in the RIPOS, some elements relate to this topic :

- Clean energy: "the Bank will therefore encourage the regional development and cross-border trade of clean energy by investing in cross-border transmission lines and tackling soft issues such as capacity building and the policy and regulatory frameworks for utilities, regulators and regional power pools";

- Water resources: the Bank will "support trans-boundary water resource management";

- Transport: the Bank will "address sustainable development issues in transport development".This report proposes possible ways that the RIPOS can be implemented from a climate change perspective.

1.2 Objectives

The objective of the study is to examine the nexus between climate change and regional integration in order to improve implementation of the RIPOS. Regional Operations (ROs) have the following unique features:

- Most ROs use, exploit or harness shared natural resources (water resources, forests basins, etc.), which are highly vulnerable to climate change;

- Impacts of ROs spill over many countries, therefore the benefits and adverse impacts of projects must be assessed at the regional level;

- ROs involve states with different levels of economic and institutional development, different priorities with regards to climate change and potentially heterogeneous regulatory frameworks;

- Given that most ROs are large scale infrastructure operations that serve large populations: it is essential to evaluate their resilience to future climate evolutions with the lifespan and scale of projects in mind;

- Regional integration is a top priority for the Bank, and requires significant knowledge of these complex operations.Another objective of the study is to enable the Bank to make its Regional Operations better adapted to climate change. The study aims to address four main research questions:

a) How does a regional integration approach to bridging infrastructure gaps compare to stand-alone national approaches in terms of mitigation (e.g., in reducing GHG emissions) and adaptation to climate change (e.g., in improving water and land use management)?

b) Are climate resilience considerations adequately taken into account in the preparation, design and implementation of Regional Operations and the RIPOS?

c) Are there any regional infrastructure standards, construction codes, urban and land-use planning policies for enhancing climate resilient infrastructure? What coordinated measures can contribute to mainstreaming resilience to climate change in regional operations?

[V]Item c), was not part of the original TOR for this study but was added at the request of the Quality Assurance and Results Department (ORQR) during the review of the Interim Report.

1.3 Scope

Due to time and data constraints, some other research questions had to be left out of the scope of this study. The study is based on four case studies selected from regional integration projects financed by the Bank. It is not a comprehensive review of the climate resilience of all Bank-financed ROs. This report relies mostly on existing data and documentation provided by the Bank or accessed by desk research through publicly available information sources. Additional methodological options could be used in future studies on the subject, for instance: conducting surveys, measuring and verifying the climate resilience of projects through on-the-ground evaluations, etc.

Implementation of the RIPOS relies heavily on AfDB staff members and this knowledge document will provide the basis for a training framework. In addition to that, it would be worth conducting an internal survey to assess the level of knowledge of Bank operational staff on climate change issues and, if necessary, set up complementary training packages. Over the past five years, AfDB has adopted or updated most of its strategic and operational climate change documents, as part of an effort to mainstream climate change considerations into its interventions.

2. Review of AfDB's Climate Policy in Relation to Regional Operations

Review of main strategy frameworks suggests:

- AfDB puts a stronger emphasis on adaptation strategies (i.e. building resilience), than on mitigation strategies (i.e. reducing GHG emissions by promoting low carbon investments).

This reflects the low carbon footprint of the African continent compared to other parts of the world[vii] and its high exposure to climate change;

- Overall, few RO strategy documents address climate change.[viii] Two main sets of procedures are relevant to climate change:

Table 1: Main Climate Change Related Documents in AfDB

Document	Purpose / Objectives	Relevance to climate change
Bank Ten Year Strategy for 2013-2022	Defines AfDB's priorities, actions and expected outcomes	Main objective relevant to climate change is gradual transition to Green Growth.
Green Growth Framework (2014)	Guides the intervention of Bank Staff at the program and project levels to facilitate transition to Green Growth	The Green Growth objective is operationalized along 3 key pillars: • Promoting sustainable infrastructure; • Efficient use of natural assets; • Building resilience. Climate relevant interventions target the policy level (i.e. national development planning processes) and the project level (i.e. integrating green growth into project design).
Climate Change Action Plan 2011-2015 (2011)	Aims to position the Bank as a key operator on climate change in Africa	Three main objectives: • Reducing Africa's vulnerability to climate change • Supporting the transition to low-carbon-growth • Mobilizing finance for climate-related activities Particular emphasis is put on the first objective. AfDB planned to invest about 6 billion UA over the years 2011-2015, mainly in the energy, transport, water, and agriculture and agro-industry sectors.
Climate Risk Management and Adaptation strategy (2009)	Aims to reduce vulnerability to climate change and to build capacity and knowledge on climate change.	The areas of intervention of the CRMA strategy are: • climate proofing (AfDB) investments; • policy, legal and regulatory reforms: • knowledge generation and capacity building.

(See Annex 5 for a description of main strategic documents relevant to climate change).

[vi] AfDB uses a Unit of Account (UA): 1 UA = 1.44881 US dollars (2014)

Table 2: CC Related Procedures in AfDB

Set of Procedures	Objectives and targets	Relevance to Climate change and Regional Operations
Integrated Safeguards System (ISS) (2014)	Aims to reduce the impact of projects on the people and on the environment. • Steps must be taken to prevent, minimize, mitigate or compensate adverse Environmental and Social (E&S) impacts. • Clients of the Bank are required to comply with these safeguards. • ISS provides guidelines for all stages of project cycle.	• The Bank commits to monitor and reduce emissions of Greenhouse Gas (GHG). During project appraisal, GHG emissions as well as GHG emissions reductions achieved by the project (relative to a baseline) must be estimated. AfDB is developing a tracking tool to report ex ante on GHG emissions and emission reductions associated with a project. • Additional scoping, impact assessment and management measures are required to address transboundary effects of ROs. • Revised E&S assessment procedures (ESAP) and detailed guidance materials were issued recently: projects under review in the case studies do not reflect these recent evolutions.
Climate Safeguards System CSS (2014)	Aims to reduce the impact of climate change on projects • Climate screening applies during project preparation.	• Climate screening assesses project vulnerability to climate change. • Adaptation activities at the project level must be undertaken. • Available CSS scorecards cover only a limited number of areas. • The CSS does not provide guidance on how to estimate incremental costs of climate proofing; • ROs are analyzed through the same lens as other operations.

vii Africa represents only a small fraction-just 3.6%- of world global carbon dioxide (CO2) emissions per year, even though it has 14% of the world population", African Union, "Africa Energy Sector", PIDA Energy Report, 2011.

viii For instance, in the Southern Africa Regional Integration Strategy Paper (2011): "in the area of Regional Infrastructure […] the Bank will take leadership in promoting environment- and climate- friendly infrastructure programmes in order to reduce carbon emissions and ensure resilience to climate change".

ix In the ISS, climate change is addressed in the Operational Safeguard 1 (Environmental and social assessment) and in the Operational Safeguard 4(Pollution prevention). Operational Safeguards (OSs) cover numerous topics related to environmental and social matters: Involuntary resettlement, land acquisition, population displacement and compensation, Biodiversity and ecosystem services, Pollution prevention, Labour conditions, etc.

x See fourth Operational Safeguard (OS) of the ISS.

XI A GHG emissions tracking tool was expected to be finalized by end 2015. This tool will provide ex-ante information on GHG emissions produced by the Bank's investments, as well as emission reductions achieved as a result of Bank's investments. (Source: ISS Policy Statement). A consultant is in the process (February 2016) of being recruited for designing the tool.

Analysis of these operational guidelines shows that:

- the CSS can be easily used to assess the climate vulnerability of projects. Yet it lacks functional tools to estimate costs associated with activities that could reinforce the climate resilience of the projects. There is also a gap between sectors covered in the scorecards and AfDB's sectors of intervention.

- in the ISS, successful implementation of the guidelines for the tracking of GHG emission will depend on the ability of the Bank's to take appropriate measures to reduce GHG emissions . These data should enable the Bank and its borrowers to gain a better understanding of the climate-related impact of projects and options for climate change mitigation.

- activities to mitigate adverse effects of projects on the environment may have an adaptive outcome (i.e. improving agricultural water irrigation or promoting sustainable land management). However, these activities will not explicitly be labelled as adaptation measures in the Integrated Safeguards System (ISS). While the CSS explicitly assesses the impacts of climate change on projects and how to strengthen the resilience of the project, the ISS does not provide operational guidance regarding how projects can better contribute to building adaptive capacity and resilience, and may miss out on opportunities to mobilise climate finance to cover the associated incremental costs. The ISS has the potential to facilitate the adoption of climate change adaptation activities, provided adaptation considerations are appropriately operationalized within the ISS.

To complement the analysis of AfDB's climate change approach, a cursory review was conducted to study which legal frameworks could provide a basis for improving the resilience of ROs.

2.2 Climate resilience of Regional Operations: codes, principles and regulatory frameworks

Although they rely on RMCs to propose and implement those operations, ROs may fall under several institutional national and regional frameworks. A cursory review was therefore conducted so as to identify which norms on infrastructure resilience could be enforced at the regional project level. The objective was to examine what general principles, regulatory frameworks or coordinated measures developed either at the sub regional or regional level can contribute to mainstreaming climate change in regional programs and projects. This assessment was limited to the geographical scope of the four case studies presented in section 3 .

The following table shows the regional entities that have jurisdiction over these countries, describes their priorities regarding climate change and identifies regulatory frameworks on infrastructure resilience to climate change, if any.

Table 3: **Summary of case studies**

Case Study	Name of regional Economic community or regional bodies	Main point of entry on the climate change tropic	Regulatory Framewors, principles and norms to improve infrastructure resilience to climatechange
CLSG	Economic Comminity of West Africa States(ECOWAS)	climate smart Agriculture Forest; strategic Program on reduction of Vulnerability and Adaptation to climate change in West Africa Water Ressources Policy and Action Plan Renevwable Energy Policies	Infrastruture resilience to climte change is not specifically addressed in the different policy documents. The ECOWAS parliament has only a consultative and advisory
	west Africa Power Pool (WAPP)	None	none
	Mano River Union (MRU)	None	none
Ruzizi III Hydropower Plant	East Africa Community (EAC)	Protocol on Environment and Natural Resources Management EAC Climate change	Althrough the EAC promotes the Adoption of regional standards in the area of Energy. Building and construction and transport sectors. there is no indication that these Standards integrate a
	Economic Community of the Great Lakes Countries (ECGLC)	none	none
	Nile Basin Initiative (NBI)	nbi climate change Strategy, focusing on transboundary water ressources management	NBI intends to create a Framework prpomoting climate resilince of energy infrastructure but it has not been done yet.
	East Africa Power Pool (EAPP)	NOne	None
Kinshasa- Brazzaville Railroad Bridge	Economic Community of Central Africa States (ECCAS)	Strategie régionele Afrique centrale pour la prévention des risques et la gestion des catastrophes et l'adaptation aux	None

The main findings of this analysis are as follows:

Overall, references to climate change in the strategies of regional economic communities (RECs) are scarce or vague, and most of the smaller, specialized, regional entities such as the West African Water Pool (WAPP), the Mano River Union (MRU), the East African Water Pool (EAPP) and others have not issued any policy framework on climate change.

Some RECs, such as the East African Community (EAC), display higher awareness of risks associated with climate change. For instance, the EAC's Climate Change Policy notes "infrastructure needs to be climate-proofed to secure the high cost of installation. This involves incorporating accepted risk limits in building and construction standards based on the expected return periods of natural hazards, including severe winds, heavy rainfall and storm surges. […] Possible adaptation measures would include revision of structural and building codes and standards, taking into account the expected changes in climate."

Although most RECs (notably, ECOWAS, EAC, ECCAS), have issued policy papers presenting their strategy on climate change, most of those documents rarely translate into regulatory principles such as norms, protocols, or standards. In this context, there is limited normative guidance that could be used in Regional Operations. Besides, protocols are sometimes ratified by only some of the member countries. For instance, the EAC Protocol on Environment and Natural Resources was signed by Kenya, Uganda and Tanzania, but not by Rwanda and Burundi, therefore the protocol is not in force. Possible ways forward: role of AfDB in promoting adoption of climate resilient infrastructure standardsMany studies and statements show that international financial institutions are aware of the needs to create common technical guidelines on infrastructure resilience. For instance, the World Bank Climate Change Strategy Report (2010) insists on updating and using infrastructure norms and standards in new operations. This is further developed in the AFD/World Bank study on "Enhancing the Climate Resilience of Africa's Infrastructure" , where authors plead for the development of technical guidelines on the integration of climate change in the planning and design of infrastructure in climate-sensitive sectors. The study further advocates the promotion of open data knowledge repository, training programs and an Africa climate-resilience project preparation facility. This facility, supported by the World Bank, the African Union Commission and the UN Economic Commission for Africa (UNECA), was officially unveiled during COP21 in Paris. Given the fact that most ROs are designed in regions and countries characterized by low or sometimes absent climate resilience standards, a detailed assessment of environmental and climate eligibility criteria used by other Bilateral and Multilateral Finance Institutions could be conducted. More specifically, it would be worth investigating:

- the sets of eligibility criteria used by these institutions and the minimal standards they use for infrastructure resilience; and
- the technical base on which these international financial institutions build their climate risk and resilience guidelines. For instance, KfW Development Bank takes into account the recommendations of the World Commission on Dams when assessing the climate resilience of its operations in water and dams. Annex 7 presents a more detailed overview of how international financial institutions are addressing climate risk and resilience.

3. Lessons from Case Studies

Regional economic integration is as one the five operational priorities of the AfDB's Strategy for 2013-2022 (At the Center of Africa's Transformation, 2013). A backbone of this integration is the development of regional infrastructures. The AfDB supports regional infrastructure development mainly through its Regional Operations (RO) activities. The Bank's support is guided by continental and regional strategic priorities, especially the Programme for Infrastructure Development in Africa's Priority Action Plan (PIDA PAP). This report focuses on four regional integration projects financially supported by the AfDB. The four projects reflect the Bank's regionally integrated approach to infrastructure development, the continental outreach of its RO activities. The projects, promoted by RECs and other regional institutions, were drawn from the three strategic sectors: energy, transport and forestry. These sectors are crucial to Africa's overall development.

The AfDB's approach to regional infrastructure development encompasses both 'hard' or physical infrastructures (e.g. transmission lines, roads, dams, etc.) and 'soft' infrastructures (e.g. regional institutions and capacity building, etc.). Table 1 below presents a brief description of the projects selected for this study.

Table 4:
Overview of the projects selected for the case study

Project	Sector	REC	Stage	Description
CLSG	Energy	ECOWAS	Approved	Construction of a 1,357-km-long double circuit high voltage (225 kV) interconnection between the electricity networks of Côte d'Ivoire, Liberia, Sierra Leone and Guinea
Ruzizi III hydropower plant	Energy	CEPGL	Structuring/ Financing (S3/S4)	Construction of a hydroelectric plant with a capacity of 147 MW to share power among Rwanda, Burundi and DRC promoted by CEPGL
Kinshasa-Brazzaville Railroad Bridge	Transport	ECCAS	Feasibility study/ Needs assessment (S2)	Construction of a railroad bridge across the Congo River to link the two capitals, and of a 1,015 km railway to connect the cities of Kinshasa and Ilebo (DRC)
Congo Basin MRV Regional Project -Phase I	Forestry	Congo Basin COMIFAC	Executed	Support for the design and implementation of national monitoring and MRV systems in line with international recommendations and requirements, including coordination and capacity building at regional level

The first three projects analyzed in this study focus on physical infrastructures and are all included in the PIDA PAP. The first two projects, namely the CLSG interconnection project and the Ruzizi III hydropower component project, belong to the electricity sector. The third, the Kinshasa-Brazzaville railroad bridge project, was drawn from the transportation sector. Nevertheless, all three also integrate 'soft' components into their original design. These 'soft' components are considered as key to the effective operation and management the 'hard' infrastructures. The fourth project, the Congo Basin MRV Regional Project – Phase I, is simply concerned with the promotion of capacity building for MRV in the Congo Basin's forestry sector. This project can therefore be regarded as a pure 'soft' infrastructure.The four projects were identified as climate-relevant, that is, either climate-sensitive (vulnerable to climate change) or likely to impact on future climate conditions, or both. A project is considered climate-sensitive if its expected development outcomes depend on climate conditions. For example, the expected development outcomes of a hydropower plant include the supply of reliable, low-cost and modern energy to the target population. On the one hand, the potential of hydroelectricity generation depends on hydrological conditions, which in turn depends on climatic conditions. On the other hand, hydropower allows for substitution of fossil fuel energy sources, and by extension, the mitigation of GHG emissions.

Therefore, a hydropower plant is both climate-sensitive and likely to have an impact on future climate conditions.

Each project is examined through an analytical framework developed for assessing whether major climate-related challenges and opportunities have been adequately taken into consideration in the project cycle (design or implementation of the project). The examination of these climate-relevant projects involved:

- the categorization of each project on the basis of its climate-sensitivity and its likely impact on future climate conditions.
- the assessment of the project's climate change mitigation potential project (i.e. the potential GHG abatement attributable to the project implementation).
- the assessment of the project's climate resilience potential (i.e. vulnerability to climate change). This three-step process was used to determine the adequacy of climate considerations given to these projects by the Bank. The conclusion of this assessment forms the basis for the actionable recommendations formulated in this report.

3.1 Methodological approach

This section explains the general methodology used in the assessment of the climate change mitigation and climate resilience potentials of the regional projects under review. The precise methodology and the data and assumptions of the study are described in greater detail in the corresponding annexes. Before presenting the assessment methodology developed in this study, it is useful to present the criteria used to categorize the different projects on the basis of their climate-relevance.

3.1.1 Categorizing the project on the basis of climate-relevant considerations

Like most MDBs/DFIs, the AfDB has developed guidelines and tools for the evaluation of the climate impacts and climate-relevant considerations in its projects. However, the ISS does not provide a synthetic categorization grid for projects financed by the Bank. The climate-relevance of each project was, therefore, assessed according to the categorization grid below:

Relevance	Climate-sensitivity (Resilience)	Likelihood to impact on future climate conditions (Mitigation)
High	Climate conditions have direct effects on the expected outcomes of the project.	The project directly contributes to changes in its sector GHG emissions.
Moderate	Climate conditions have indirect effects on the expected outcomes of the project.	The project indirectly contributes to changes in its sector GHG emissions.
Low	Climate conditions have negligible effects on the expected outcomes of the project.	The project's contribution to changes in its sector GHG emissions is negligible.

3.1.2 Assessing the Cimate change Mitigation Potential of Regional Projects

To assess the climate change mitigation potential of the regional projects, the study estimated the changes in GHG emissions attributable to the implementation of the project over the period 2016-2040 as compared to a baseline scenario (a reference scenario wherein the project is not implemented). A 25-year study period was chosen because the horizon year 2040 provides ample time for realistic forecasts of energy demand and generation capacity. Moreover, the 25-year time frame of this assessment falls short of the average lifetime of most physical infrastructures under consideration in these projects.

For both scenarios, cumulative GHG emissions over the study period were obtained by the means of numerical simulations. The mitigation potential of each project was defined as the difference between the levels of GHG emissions in the baseline scenario and the project scenario, respectively. A project was deemed to have a positive mitigation potential if its implementation resulted in reducing GHG emissions, as compared to the baseline scenario. Conversely, a project was identified as having a negative impact on climate change mitigation if its implementation resulted in an increase in GHG emissions, as compared to the baseline scenario.The determination of a baseline scenario over the study period was therefore a prerequisite for the assessment of the potential impact on climate change mitigation of a project. The baseline scenario was based mainly on the current state of the infrastructure in the sector of the project under consideration. However, most infrastructure development projects in the categories under consideration, and with clear prospects of implementation before 2022 (the last year of the Bank's TYS framework 2013-2022), were also considered in the baseline scenario.

For example, for the CLSG project, the baseline emissions scenario considered GHG emissions from the electricity sector in the four countries involved in this project: Côte d'Ivoire, Liberia, Sierra Leone and Guinea. For each country, baseline emissions were calculated by adding estimates of the emissions from all installed generation capacity or committed capacity likely to come online by 2022 over the study period 2016-2040. These estimates were derived from the state of the current power network infrastructures, under the assumption that the CLSG interconnection project was never implemented.

3.1.3 Assessing the Climate Resilience Potential of a Regional Project

The development outcomes of an infrastructure project might depend on uncertain future climate conditions. It is important that the project be designed with climate resilience features in preparation for the climate of the future. It is important that these safeguards be put in place at the stage of the project design. For the purpose of enhancing the resilience of its infrastructure portfolio, the AfDB has developed guidelines and screening tools to assess the vulnerability to climate related risks. In particular, the Climate Safeguards System (CSS) was developed to ensure that Bank-financed projects are climate resilient. However, as the four regional projects under review in this study began before the implementation of the CSS by the Bank's staff in 2014, it was useful to develop and test a 'climate lens' framework for assessing how climate resilience issues were integrated into the decision-making process for these regional projects.

For these reasons, the main official documents of the project cycle were examined for evidence of climate considerations. For each project, the following questions were asked to assess how the related issues had been handled:

3.2 Study on the CLSG Interconnection Project

Electricity market integration usually aims at achieving three objectives: security of supply, sustainability and economic efficiency. In 2000, the Economic Community of West African States (ECOWAS) established the West African Power Pool (WAPP) with a view to integrating the operations of the national electric power grids into a well-functioning unified regional market. The WAPP has been mandated by its fourteen member states to support reliability, adequacy, integration and mutual support of the regional power grid with the goal of increasing access of Case ECOWAS citizens to stable and affordable electricity. In pursuit of this goal, the WAPP is promoting regional priority projects as identified in the ECOWAS Revised Master Plan for the generation and transmission of electrical energy (WAPP, 2011). The transmission line interconnection between Côte d'Ivoire, Liberia, Sierra Leone, and Guinea, (CLSG) is among these priority projects. The project is expected to raise average electricity access rate in the Mano River Union countries from 28 percent in 2012 to 33 percent by 2017. Box 1 below presents some keys facts on the CLSG interconnection project.

Box 1: Key facts on the CLSG interconnection Project

- Construction of a 1,357-km-long double circuit high voltage (225 kV) with a capacity of 290 MW interconnecting the electricity networks of Mano River Union countries: Côte d'Ivoire, Liberia, Sierra Leone and Guinea (CLSG).
- Two phases of implementation. Phase 1: a single circuit with a capacity of 145 MW will mainly enable Liberia, Sierra Leone and Guinea to import electricity from Côte d'Ivoire. Phase 2 (from 2020 onwards) a second circuit with a capacity of 145 MW for export from other countries as well.
- Among the priority projects of the West African Power Pool (WAPP) Master Plan and PIDA Priority Action Plan to foster development of the sub-region huge hydroelectric potential.
- Overall goal to facilitate sustainable energy trade between the four countries, thereby reducing the reliance of on fossil fuel-fired power electricity generation.
- Secured availability of 83 MW for export from Côte d'Ivoire along the transmission line at the start of operation.
- Total cost estimated at UA 331.51 million with contribution of the Bank Group amounting to UA 128.15 million (or 38.66 percent of the total cost).

3.2.1 The CLSG Project in the Context of Regional Integration and Climate change

The objective of this proposed regional transmission line of 220 kilovolts (kV) double circuit with a power capacity of 290 MW is to provide access to least-cost (hydro) power options for the sub-region and to enable the pooling of power resources across these four countries. However, current electricity demand/supply balances in the four countries indicate that, in the short term, the CLSG interconnection line (expected to begin operation in 2017) will mainly allow Liberia, Sierra Leone and Guinea to import electricity from Côte d'Ivoire, thereby reducing their reliance on carbon intensive fossil fuel-fired electricity generation. In the longer term, the CLSG project is expected to foster development of the huge hydroelectric potential of the sub-region by offering the possibility of electric power trade between the countries within the WAPP larger market. For example, it is expected that by 2020, Guinea will be exporting hydropower to the other interconnected countries. These countries will therefore be provided with additional opportunities to reduce their domestic GHG emissions by importing cheaper and cleaner electricity. The benefit of the CLSG project to the region is, therefore, twofold: economic growth and climate change mitigation potential.

3.2.2 Scope of the Case study on the CLSG Interconnection Project

This case study focuses on the four national power systems of the Mono River Union countries involved in the CLSG interconnection project, namely, Côte d'Ivoire, Liberia, Sierra Leone and Guinea. Since, the CLSG power line is expected to begin operation in 2017, the study period is 2017-2040.
Overview of the national electricity systems of Mano River Union countries Of all the Mano River Union countries , Côte d'Ivoire has the most developed power system, depending on a combination of thermal and hydro generation, with a total installed capacity of 1,624 MW. Hydropower generation represents a potential capacity of 604 MW distributed among five hydropower plants. The remaining installed capacity of 1,020 MW is distributed among 5 thermal plants. The sharp contrast between the national electricity access rate of 74 percent and the country's low electricity coverage rate of 34 percent is attributable to the low level of rural electrification. Côte d'Ivoire's transmission and distribution network is interconnected with Ghana, Togo, Benin, Burkina Faso and Mali, allowing Côte d'Ivoire to export up to 16 percent of its sales. As regard pricing, like in the three other countries of the Mano River Union, national electricity selling prices are set by the State below cost recovery levels, thus preventing the electricity sector to be profitable.Civil wars destroyed the public power systems of Liberia and Sierra Leone. The cost of generating power in the countries remains high, primarily due to the small size of their power systems and the reliance on fossil fuel-based generation. With an electricity connection rate of 2 percent, among the lowest in the world, Liberia and Sierra Leone require heavy investment in this sector. However, the efforts that are underway in both countries should improve the current performance of the energy sectors and broaden the electricity access rates.

In Liberia, a management contractor, Manitoba Hydro International, in place since 2011 has significantly improved the technical and financial performance of the national power utility Liberia Electricity Corporation (LEC) that had ceased operating during the civil war. The existing generation system is composed of high-speed diesel generation units with an installed capacity of 10 MW. The cost of producing electricity with these diesel units is high due to high fuel costs and the small size and decentralized structure of the system. However, several hydroelectric projects such as the refurbishment of Mount Coffee hydropower plant should change significantly the country's power generation profile.

In Sierra Leone, public electricity services are available only in selected parts of the country for about 25 percent of the time. To improve service and management quality, the Sierra Leonean government recently split the integrated public utility, the National Power Authority (NPA), into two entities: the Electricity Generation and Transmission Company (EGTC) and the Electricity Distribution and Supply Authority (EDSA). In October 2015, the country unveiled a roadmap for the increase of the country's power generation capacity from the current level of about 100MW to 1,000MW by 2017.

Guinea has a huge hydroelectric potential, but is currently exploiting only a tiny fraction of it. However, with 360 MW of installed capacity as compared to about 180 MW of thermal capacity, hydropower generates the bulk of the electricity sold by the national utility, Electricité de Guinée (EdG), mainly to urban consumers. Poor service quality and frequent load shedding have led mining companies and many businesses to rely on diesel-fired self-generation representing as much as 180 MW. The Government has recently signed a contract with the multinational environmental services company, Veolia, for the update of the management of facilities, improvement of the efficiency of the energy distribution network and the expansion of the network.

xvii Mano River Union member states include Cote d'Ivoire, Liberia, Guinea Sierra Leone
xviii The national coverage rate indicates the number of localities with access to electricity as a proportion of total localities, while the access rate indicates the population living in localities with access to electricity as a proportion of the total population

Mitigation Potential

The methodology was designed to answer the following two questions:

1) Were the CLSG project never to be implemented, what would be each country's cumulative CO2 emissions from electricity generation over the study period? (Baseline scenario)

2) What will be each country's cumulative CO2 emissions from electricity generation over the study period if the project begins operation in 2017as expected? (Project scenario)Two sets of simulation exercises were performed to estimates CO2 emissions in the two following scenarios: a baseline scenario in which the CLSG project is never implemented and a project scenario in which the project begin operation in 2017, as expected.

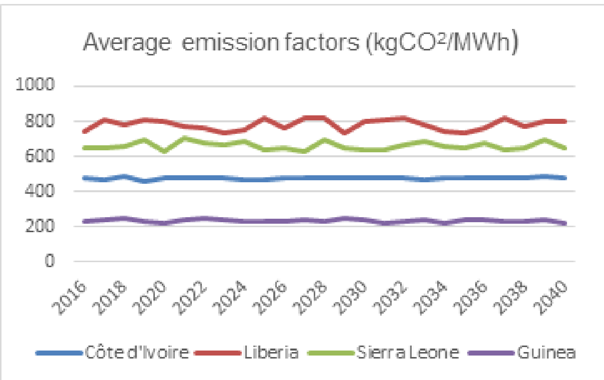
Baseline Scenario (without CLSG)

Given the installed and committed capacity assumed to begin operation by 2022, what would be the cumulative direct emissions of CO2 generated by the national power system of the four countries involved in this project, without the opportunities for electricity trading brought about by the CLSG power line? In this baseline scenario, forecasts of emissions of CO2 over the period 2017 - 2040 were obtained by the means of numerical simulation. It was assumed that without the CLSG interconnection line, no other opportunities for electricity trading among the four countries could materialize. Therefore, for each year of the study period, CO2 emissions in each country correspond to the emissions generated by the national power system. The higher the share of hydropower in the electricity mix in a given year, the lower the CO2 emission factor of the system.

For example, in 2010 Côte d'Ivoire produced 5,884,609 MWh in total. Hydropower represented 27.5 percent of this production with the remaining 72.5 percent coming from natural gas-fired plants. The average CO2 emission factor for that year was 488 kgCO2/MWh and total emissions amounted to 2.87 million tons of CO2. However, within a national electrical system, the share of hydropower in the generation mix varies each year depending on the hydrologic conditions.For each year of the study period a national average CO2 emission factor was derived for each country based on its historical generation profile assuming normal climate variability. As shown in Figure 1 below, of all the Mano River Union countries, Guinea has the less emission-intensive electric system due to the large contribution of hydropower in its electricity mix.

Liberia has the highest average emission factor followed by Sierra Leone indicating that their respective electric systems are relatively more emission-intensive that those of Guinea and Côte d'Ivoire.

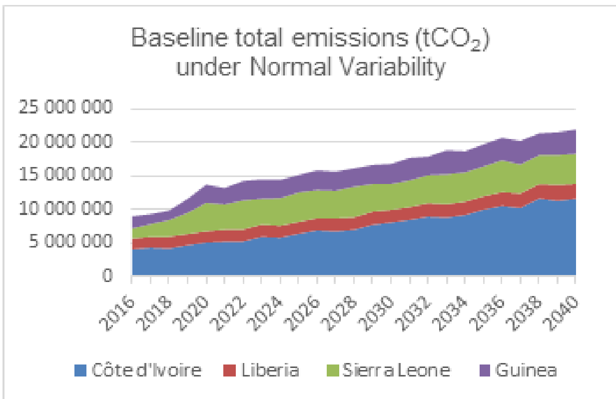
Figure 1:
Average Emission Factors (kgCO2/MWh) Under Normal Variability



This, however, does not mean that Liberia and Sierra Leone are the biggest absolute emitters. The next figure shows that over the study period Côte d'Ivoire stands out as the largest emitter with Sierra Leone coming second and Liberia emitting the less, as shown in the next figure.

In this baseline scenario under normal climate variability, the total emissions from the four countries' electricity sectors is expected to grow from about 9 million tons of CO2 to over 21 million of tons of CO2, yielding a cumulative emissions level of 384 million tons of CO2 over the study period. But this is only one possible figure among many others as climate change might foster climate conditions different from those obtained in the normal climate variability scenario.

Figure 2:
Baseline CO2 Emissions Under Normal limate Variability

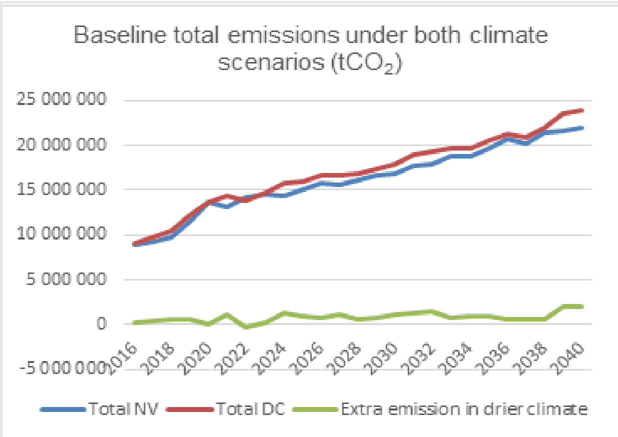


xix Export of electricity from Côte d'Ivoire to Liberia did take place but was very limited and was therefore ignored for the baseline scenario. (ANARE, 2014).

For the purpose of illustrating the potential impact of climate on generation profiles, another baseline scenario featuring a drier climate was simulated. Under this mildly drier climate baseline scenario, the average share of hydropower of each country's generation profile was reduced by a fixed percentage (from 5 percent to 20 percent) to reflect the negative impact of higher evaporation rates on the productivity of hydropower plants.

The following figure shows the difference between the total CO2 emissions under both scenarios (grey line).

Figure 3:
Total CO2 Emissions Under both the Normal climate Variability (NV) and the Drier climate (DC) Scenarios

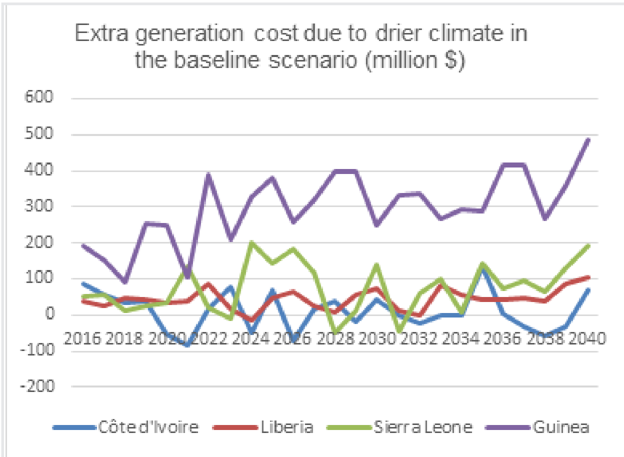


Even a mildly drier climate might lead to an increase in the cumulative emissions of the Mano River Union countries of about 20 million tons of CO2 over the period 2017-2040 or an equivalent of 873 000 ton of CO2 each year. Interestingly, this suggests that climate change might have the perverse consequence of reinforcing the carbon intensity of the four national electrical systems.

From an economic perspective, climate change might also have a significant impact on a country's cost of electricity generation. Under a drier scenario for example, downward pressure on hydrological resources might reduce the productivity of relatively low-cost hydropower plants and increase the country dependence on more expansive fossil fuel-fired generation. If a 5 percent reduction of the share of hydropower in the generation mix was replaced by a 5 percent increase of the share of HFO for example, the corresponding increase in generation cost would be given difference in LCOE between these two production technologies.

The economic impacts of a drier climate in the baseline scenario (in terms of generation cost), are unequally distributed across the four national power systems (see Figure 5 below. Given the generation profiles considered in the simulation exercises, Guinea was the most affected by the drier climate causing annual generation costs increases ranging from $154 million to $485 million.

Figure 4:
Extra Generation Cost due to Drier climate in the Baseline Scenario



Overall, in the baseline scenario, the present value of the extra generation costs attributable to the drier climate, amounts to $3,074 million (discounted at a 10 percent rate) over the study period. The following table presents the breakdown of this amount by country.

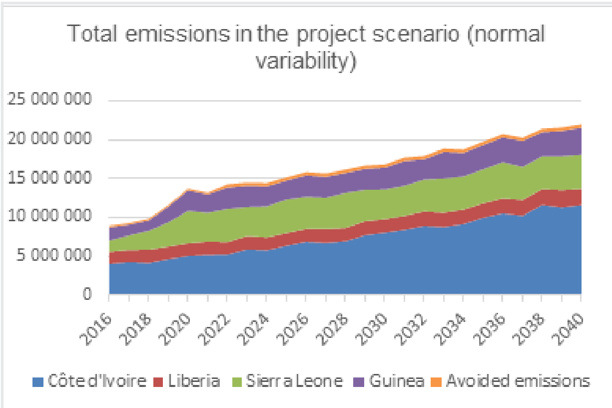
Present value of Extra Generation Costs due to Drier Climate in $ million (Discounted at 10%)			
Côte d'Ivoire	Liberia	Sierra Leone	Guinea
76	324	541	2133

Project Scenario (with CLSG)

Based on the merit-order of thermal technologies (ranking of available sources of energy based on ascending order of price), priority would be given to HFO-fired generation over imports of gas-fired generated electricity, which would be given priority over diesel-fired generation. Each MWh of imported electricity avoided a level of CO2 emissions corresponding to the difference between the respective average emission factors of the sources of the imported energy and the sources of energy replaced by this import. The simulations for the project scenario were based on the conservative assumption that all electricity exported by Côte d'Ivoire was generated by natural gas-fired plants[xx].

Under the under normal climate variability the CLSG interconnection line might save more than 9.1 million tons of CO2 over the period 2017-2040 or an equivalent of about 377,000 tons of CO2 avoided each year as compared to the baseline scenario in which the project is not implemented.

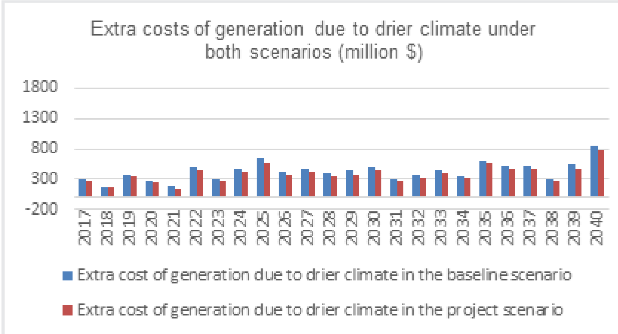
Figure 5: **Total Emissions in the Project Scenario (Normal Climate Variability)**



If the ton of CO2 was valued at a price of $5 for example, this would be worth annually $1,885,000. The figure of 9.1 million tons of CO2 avoided might simply be a lower bound for gains from trade in terms of environmental benefits under a drier scenario, since pressure on hydrological resources could increase the dependence on fossil fuel-fired generation and leave more room for gains from trade in terms of environmental benefits. From an economic perspective, even in this mildly drier scenario, the CLSG project might have significant effects on the capacity of the interconnected countries to manage the generation costs increases due to a drier climate.

The next figure represents the difference between the extra costs of generation due to the drier climate under the baseline and project scenarios.

Figure 6:
Comparison of Extra Generation Costs due to a Drier Climate Under Both Scenarios



The extra costs of generation due to the drier climate are always lower than the extra costs of generation due to the same drier climate under the baseline scenario. The CLSG project reduces these extra costs by $11 million to $67 million annually. The present value of savings in generation costs amounts to $303 million over the study period.

Once the four Mano River Union countries' powers system are interconnected, they become less vulnerable to the increases in costs of generation induced by climate change. The CLSG project increases the economic resilience of the national power systems of importing countries by raising their generation profile and lowering generation costs, and thereby producing enough cheap and climate-friendly energy for export over the transmission line.

Climate resilience

The CLSG project was initiated before the Bank adopted the ISS and the CSS. At its inception, the CLSG could therefore not be screened with the Climate Screening tool developed within the CSS framework. However, the Bank's internal documents on the CLSG project and related technical and economic studies revealed that climate-related risks and vulnerabilities identified in the project area were taken into account and addressed. These risks included increased frequency and intensity of floods and storms; rising sea levels, which could lead to coastal erosion; prolonged flooding and high exposure to corrosion, specifically for Liberia where a segment of

xx Since Côte d'Ivoire's hydropower plants are mostly used for baseload generation, it is assumed that the energy they produced is entirely consumed domestically, while the country's energy surplus available for export comes from its thermal plants.

the power grid runs close to the coast between the Monrovia and Mano sub-stations. Technical reports indicated that the transmission line will be designed and constructed according to the best international engineering standards to ensure physical resistance to the major climate risks identified. This will entail the incorporation of safeguards against such climatic factors as the speed of high winds and storms, water levels, geotechnical conditions and corrosion.

Conclusion

The primary objective of the CLSG project is to facilitate sustainable energy trade between Côte d'Ivoire, Liberia, Sierra Leone and Guinea. In the short term (from the beginning of the line operation up to 2020), the CLSG line will allow Liberia, Sierra Leone and Guinea to import electricity from Côte d'Ivoire. Gas-fired plants produce the bulk of Côte d'Ivoire's energy surplus. Although they do emit GHG, these gas-fired power plants are nonetheless less CO2-intensive than diesel generators and HFO-fired plants in use in the three other countries of the Mano River Union. In the medium to long term (i.e. from 2020 onward), further expanded hydropower capacity in Guinea should generate surplus energy for import.

The climate change mitigation potential of electric power transmission and distribution projects is often overlooked by international development institutions. However, by itself, "the power transmission and distribution sector does not typically give rise to significant air emissions or effluents". Likewise, national infrastructure projects that do not drastically modify the structure of their domestic electricity generation are likely to have insignificant impact of the GHG emissions from their insulated electricity sector. At the regional level, however, the picture might look quite different since a regional interconnection line might then permit the allocation of the power produced by cleaner energy sources, such as renewable sources, that were not available to some individual countries.

In the Bank's internal document used to extract main figures, there were no analytical or methodological explanations to support those figures. However, the simulation therein indicated that "the project will contribute to the mitigation of climate change by avoiding the emission of approximately 5.6 million tons of CO2 when the countries resort to hydroelectric energy imports[xxi]. The simulation exercises were based only on imports of electricity from natural gas-fired plants rather suggest an amount of 9.1 million tons of CO2 avoided over the study period 2017 - 2040 as compared to the baseline scenario where the project is not implemented.

For a price of 5$ per ton of CO2, taking these avoided emissions into account would increase the present value (at a 10 percent discount rate) of the project by about $13 million. The climate change mitigation benefits in terms of avoided CO2 emissions of Guinea's eventual export of its hydroelectricity might surpass the benefits derived in this case study.

In addition, the CLSG project increases the economic resilience of interconnected national power systems by reducing their vulnerability to generation cost increases due to climate conditions.

3.3 Case Study on the Ruzizi III Hydropower Project

First established in 2005 by seven Eastern Africa countries (Burundi, DRC, Egypt, Ethiopia, Kenya, Rwanda and Sudan), the Eastern Africa Power Pool (EAPP) was further developed as a specialized institution aiming at fostering power system interconnectivity within the Common Market for Eastern and Southern Africa (COMESA) region. The EAPP's principal mandate is to facilitate the development of regional electricity markets through coordinated development and operation of generation and transmission systems that would foster the development of a fully integrated regional electricity market.

The EAPP aims to provide sustainable power to meet the demands of the member states efficiently and cost-effectively. To this end, the Ruzizi III project is committed to capacity expansions in all member countries. The Ruzizi III hydropower station is expected to be in operation by 2021.

3.3.1 The Ruzizi III Hydropower Project in the Regional Integration and Climate change Context

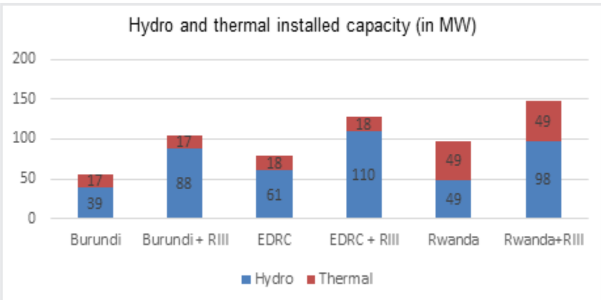
The Ruzizi III hydropower project ("Ruzizi III") is one of the EAPP Master Plan's priority projects. It will be located downstream of the existing Ruzizi II hydropower plant on the Ruzizi River, which forms the border between the Democratic Republic of Congo and Rwanda. Ruzizi III will add 147MW to Ruzizi II's existing capacity of 41MW (see Figure 7), currently of shared by the three countries forming the Economic Community of the Great Lakes Countries (CEPGL): Burundi, DRC and Rwanda. The new plant will be operated by SINELAC, the same joint public utility already operating the Ruzizi II power station.

[xxi] See the Climate change section in the Project Appraisal Report

Box 2: **Key Facts on the Ruzizi III Hydropower Project**

- The Ruzizi III hydropower project is a 147 MW run-of-the-river hydro-electric plant with three power units spanning Burundi, DRC, and Rwanda. This project is part of the PIDA Priority Action Plan.
- The project goal is to increase the production of green energy to ensure sustainable development, with a strong focus on building the capacity of two States in transition: Burundi and DRC.
- The project, estimated at an overall cost of UA 350.7 million is expected to be operational by 2021. The Bank Group's contribution to the project is UA 133.5 million (or 38 percent of the total cost).
- The project will include a capacity building component to ensure the transfer of knowledge to national structures to improve the management of future interconnections in East Africa.
- Power exchanges among DRC, Burundi and Rwanda are currently limited to the 45 MW capacity of the jointly developed hydropower plant Ruzizi II operated by the joint utility, SINELAC.

Figure 7:
Hydro and thermal installed capacity (in MW) in both scenarios



Source: IRENA EAPP model (2014) and author calculation

3.3.2 Scope of the Case Study on the Ruzizi III Hydropower Project

The EEAP is still at an early stage of development. Power exchanges will remain dominated by bilateral trade agreements. In fact, the energy generated by Ruzizi III will be purchased by Burundi's Régie de Production et Distribution d'Eau et d'Electricité (REGIDESO), DRC's Société Nationale d'Electricité (SNEL), and Rwanda's Energy and Water Sanitation Authority (EWSA) under a long-term Power Purchase Agreement. The geographical scope of this case study was, therefore, limited to the CEPGL's three member countries. .It should be noted, however, that since the project's only area of influence in the DRC was East DRC (EDRC), which is isolated from the rest of the country, the analysis was limited to the electric systems of Burundi, EDRC and Rwanda[xxii].

The case study analysis was based on an in-depth document analysis, as well as qualitative content analysis of interviews with AfDB staff. Relevant documents include primary literature, such as policy and project documents. In particular, the ESIAs and technical reports were scrutinised.

Mitigation Potential

As in the CLSG case study, the assessment of the mitigation potential of Ruzizi III was based mainly on CO2 emissions. The methodology was designed to answer the following two questions:

1. Were the Ruzizi III project never implemented, what would have been each country's cumulative CO2 emissions from electricity generation over the study period? (Baseline scenario)
2. What will be each country's cumulative CO2 emissions from electricity generation over the study period if as expected the project begins operation in 2021? (Project scenario)

Two sets of simulation exercises were performed to estimates CO2 emissions in the two following scenarios: a baseline scenario in which the Ruzizi III project is never implemented, and a project scenario in which the project will begin operation in 2021, as expected.

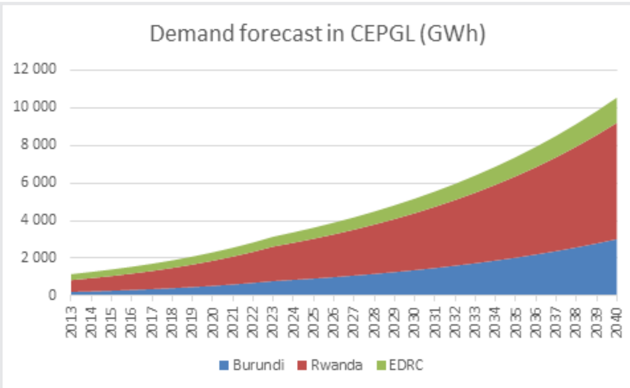
XXII East DRC is only connected to EAPP. The rest of the country is connected to SAPP.

Baseline Scenario (Without Ruzizi III)

Given the installed and committed capacity assumed to begin operation no later than 2021, what would be the cumu lative direct emissions of CO2 generated by the national power system of each of the three countries involved in the development of Ruzizi III?

In this baseline scenario, forecasts of emissions of CO2 over the period 2021-2040 were obtained through numerical simulation, and were based on the assumption that renewable energy sources generate zero CO2 emission. Hence, the higher the share of hydropower in the electricity mix in a given year, the lower the CO2 emission factor of the system is expected to be that year.

The simulations were based on the assumption that the 147MW capacity of Ruzizi III will be equally shared among the three countries, representing a maximal additional 365GWh of clean energy. Results indicated that over the study period 2021-2040, the Ruzizi III hydropower will have saved up to 3 million tCO2 or an equivalent of 120,000 tCO2 avoided each year.



Climate resilience

According to the AfDB rating, the Ruzizi III is in Category I of the CSS, which means that is recognized as highly-sensitive to climate risks. The Bank's internal documents on the Ruzizi III project and related technical reports revealed that climate-related risks and vulnerabilities identified in the project area were adequately taken into account and received an appropriate treatment. However, the impacts of climate change upstream and downstream of the project have not been covered by the feasibility studies done. Also, the Ruzizi III project was initiated before the Bank adopted the ISS and the CSS. There is a strong rationale for ensuring feasibility studies adequately address the regional dimension of ROs and that resilience is not limited to the strict boundaries of the project.

Conclusion

In addition to the economic benefits of low-cost electricity generation, the Ruzizi III hydropower will contribute to reducing GHG emissions in the region. Furthermore, the optimization of power generation along the CEPGL interconnected networks will reduce the use of the most polluting supply options. This significant mitigation potential could not have been realized at individual country level. Economies of scale will make the project Ruzizi III economically viable. As the recent AfDB Project Appraisal Report points out, the alternative, building smaller hydro plants nationally, with a total capacity equating that of Ruzizi III, would be significantly costlier and harder to finance. Without the cooperation under the umbrella of the CEPGL, the three countries would have resorted to more polluting generation options to meet their individual power needs.

3.4 Case Study on the Kinshasa Brazzaville Railroad Bridge (PRRC) Project

Poor integration of infrastructure networks and high transport costs in the sub-region represent major impediments to a viable and competitive Central African market. To tackle these problems, the Heads of State and Governments of the Economic Community of Central African States (ECCAS) adopted the Central African Consensual Transport Master Plan (PDCT-AC) in January 2004. Taking into account NEPAD's priority infrastructure projects, ECCAS conceived this Master Plan to strengthen the process of regional economic integration, as well as trade between member states. It is in this spirit that the governments of the Democratic Republic of Congo (DRC) and the Republic of Congo (RC) decided on the construction of a bridge across the Congo River to link the capitals of the two countries, and a 1,015 km railway line connecting the cities of Kinshasa (RC) and Ilebo (DRC).

3.4.1 The PRRC Project in the Context of Regional integration Climate change

The construction of the rail-road bridge project between Kinshasa and Brazzaville (the PRRC project) and the extension of the Kinshasa-Ilebo railway line are intended to increase the volume of trade between the two countries.

The project would additionally ensure continuity in the transportation system along the Tripoli-Windhoek Corridor, adopted under the NEPAD Short-Term Action Plan. The Central African section of the corridor, comprising the Cameroon-Chad-Congo-DRC link, will link Yaounde, The project also has the potential of increasing freight and passenger traffic (resulting largely from the shift from air and waterways to road and rail transportation. This increase in traffic will, therefore, contribute to higher GHG emission intensity by the region's transportation sector.

Box 3: Key facts on the Kinshasa-Brazzaville Rail-road Bridge Project

- The Kinshasa and Brazzaville rail-road bridge project involves the construction of a 1650-meter bridge across the Congo River to link the two capitals, and of a 1,015- kilometer railway to connect the cities of Kinshasa (RC) and Ilebo (DRC).
- This project is part of the PIDA PAP and is intended to accelerate trade between the two countries, ensure continuity of the transportation system along the Tripoli-Windhoek Corridor and strengthen the process of regional economic integration and trade within ECCAS.
- The project comprises a soft component dealing with customs modernisation
- The project's feasibility study put the overall cost the construction of the Malakou-Tréchot railroad bridge at UA 700-900 million.
- The project is still in an early stage of development. AfDB contributed UA 5.44 million to the feasibility study, but its total contribution to the project is yet to be determined.
- Latent demand and freight and passenger traffic induced by the bridge is likely to generate significant additional GHG emissions from road transportation

3.4.2 Scope of the PRRC Case Study

The objective of this case study was to assess all the climate-relevant issues related to the PRRC project. This case study was based on the feasibility study executed by the Consultant EGIS International on the PPRC project. Several alternative routes for the construction of the railroad-bridge linking Kinshasa and Brazzaville were examined in the feasibility study. The Malakou-Tréchot alternative was presented as the one to be implemented.

Figure 8: Shows the Exact Location of the PRRC Project.

Figure 8 shows the exact location of the PRRC project.

As mentioned above, the implementation of the PRRC project is expected to have important regional impacts, boosting trade within the ECCAS region. However, the geographical scope of this case study was restricted to the project's area of influence as described in the feasibility study considering the Malakou-Tréchot alternative. The feasibility study considered that the populations directly impacted by the project are those of the departments of Brazzaville (population: 1.7 million) and Pool (0.26 million) for RC and the provinces of Kinshasa (11.6 million) and Bas-Congo (4.9 million) for DRC. Because the PRRC project is expected to be implemented in 2019, therefore, the period 2019-2040 was chosen as the study period.

3.4.3 Key results of the Case study on the PRRC Project

Climate-relevance

The PRRC project is in the moderate-moderate category. One of the major benefits of the project will be bigger and better cross-border freight and passenger traffic. Climate conditions might have an effect on both the volume of traffic on the bridge and the quality of service offered by the bridge. The project's feasibility study, however, identified a significant latent demand for travel between the two capitals. Increased cross-border trade and travel between RC and DRC as a result of the PRRC project will lead to a surge in freight and passenger traffic and, therefore, higher GHG emissions.

Mitigation Potential

The methodology was designed to estimate the changes in emission intensity of freight and passenger traffic in the region covered by the PRRC project over the study period as compared to a baseline scenario where the PRRC project would not be implemented. Emission intensity of freight traffic is the ratio of total emissions from freight traffic (tCO_2) over total freight (in ton-km). The emission intensity of passenger traffic is the ratio of total emissions from passenger traffic (tCO_2) over total passenger traffic (in passenger-km).

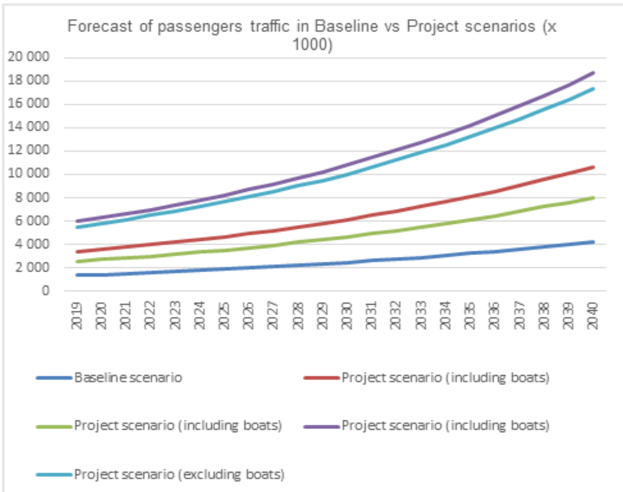
While for the baseline scenario was an extrapolation of freight and passenger traffic trends, for the project scenario, the passenger traffic on the bridge depends on the available transport alternatives for cross-border trips on the river. In this regard, the feasibility study considered two alternative scenarios—based on the availability and absence of boat transportation. Freight traffic forecasts were based on the assumption that the Port of Banana will be operational in 2020.

The baseline scenario

Currently, boats and airplanes are the main transport modes for passenger travels between Kinshasa to Brazzaville. The baseline scenario focused on boat travel because more passengers travel by sea than by air between the two cities.

Figure 9 shows that when the PPRC project is implemented, the suppression of the boat transportation (dark blue line) would significantly increase the traffic on the bridge, as compared to a scenario where both modes of transportation are available (orange line). Interestingly, the number of people who travel by boat (and therefore do not use the bridge) increases in the project scenario, as compared to the baseline scenario. This is due to the 'soft' component of the PRRC project, which is the modernization of customs services in both countries.

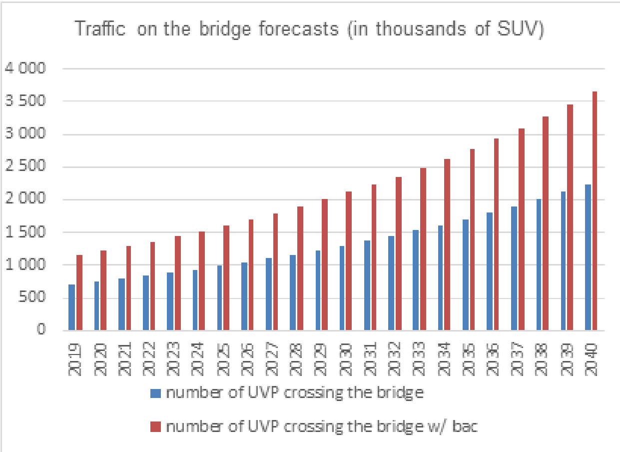
Figure 9: **Forecasted Passenger Traffic in both Scenarios**



The GHG emissions associated with these traffic forecasts are difficult to estimate because of the multiplicity of the types of boats used for passenger transportation. In the baseline scenario, all the passenger travels generate emissions associated with maritime transportation, whereas in the project scenario passengers on the traffic bridge is split between road 92 percent and rail 8 percent.

Passenger traffic forecasts were then translated into forecast of road traffic on the bridge, as represented in Figure 10.

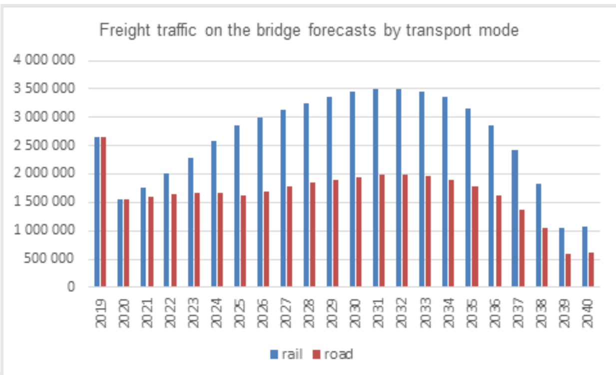
Figure 10: Freight Traffic on the Bridge (forecasts)



Using the conservative estimates of 38 gCO2/ton-km for rail, 55 gCO2/ton-km for road (for single unit vehicles) would yield the average estimates of 54 gCO2/ton-km for the traffic on the bridge. This emission intensity of passenger traffic is to be compared to an average of 45 gCO2/ton-km for barge transportation (see Annex 10).

These estimates indicate that the PRRC project will increase, not only the absolute emissions generated by passenger traffic in in the given area, but also the emission intensity. This somewhat negative results for passenger traffic are to be balanced against the much better results of the PRRC project for freight traffic represented in Figure 11.

Figure 11: Freight traffic on the Bridge by Transport Mode



As Figure 11 (above) shows, there will be more traffic by rail than by road. The transportation of the same tonnage by road or boat would result in the increase of the emission intensity from 38 gCO2/ton-km, or 45 gCO2/ton-km, to 71 gCO2/ton-km. Therefore, the use of the bridge can reduce the emission intensity of freight traffic from 26 to 33 gCO2/ton-km.

Resilience

The PRRC project is still at an early stage of development. The technical documentation reviewed indicated no evidence of considerations of climate risks. The technical feasibility report by EGIS International does mention soil erosion and the possibility of floods, but not in the context climate change. The project needs a proper assessment of its resilience to climate change.

Conclusions

The PRRC project has the potential to clear the Kinshasa-Brazzaville bottleneck and foster economic integration by facilitating freight and passenger traffic. From a climate perspective, the additional traffic induced by the project could generate additional GHG emissions, compared to a baseline scenario. However, it is important to determine whether the emission intensity of the freight and passenger traffic will be reduced by the project. The assessment presented in this case study should be complemented by further studies.

3.5 Case study on the Congo Basin Monitoring Reporting and Verification, MRV, Regional Project (Phase I)

Climate change negotiations have resulted in significant discourse on mitigation and adaptation with varying levels of international commitment towards these objectives. Mitigation and adaptation are usually addressed separately in United Nations Framework Convention on Climate Change (UNFCCC) negotiations. The Reducing Emissions from Deforestation and Forest Degradation (REDD+) program is one the several initiatives that acknowledge the cross-cutting linkage between deforestation and GHC emission and simultaneously address mitigation and adaptation. Forest degradation is one of the biggest contributors to GHG emissions in Africa. REDD+ seeks to reduce carbon emission by reducing deforestation and land degradation while simultaneously triggering poverty alleviation in vulnerable communities.

3.5.1 The Congo Basin forest MRV project in the regional integration climate change context

With an area of almost 180 million hectares, the Congo Basin forests are the world's second largest contiguous tropical rainforest after Amazonia. These forest ecosystems provide significant environmental benefits, as well as providing livelihoods for a large proportion of the local population. Overall, the region accounts for 89 percent of Africa's tropical rainforests and stores 39 billion tons of carbon, accounting for 79 percent of the continent's terrestrial carbon. However, the opportunity for Central African countries to participate actively in international climate negotiations and benefits from incentive mechanisms to mitigate environmental degradation largely depends on their ability to use reliable measurement methods and techniques in generating data needed to formulate national policies, measures and actions for reducing greenhouse gas emissions due to deforestation and forest degradation. The Congo Basin countries were, therefore, called upon to speedily design and implement national forest monitoring and measurement, reporting and verification (MRV) systems.

It is against this backdrop that the Congo MRV regional project was conceived to support the design and implementation of national monitoring and MRV systems in line with international recommendations and requirements. This includes coordination and capacity building at regional level. The project was financed by the Congo Basin Forest Fund (CBFF).

The CBFF, funded by Norway and the United Kingdom and hosted by the AfDB, was launched in June 2008 with the aim to "slow down the deforestation rate by developing the capacities of the people and institutions in the Congo Basin countries to manage their forests, and help local communities to obtain living conditions that are consistent with forest conservation" (CBFF, 2008).

Box 4: Key facts Congo Basin MRV Regional Project –Phase I

- The 178-million-hectares Congo Basin is depleting at an annual rate of 0.19 percent.
- The main objective of the regional capacity building project is to reduce the deforestation rate from 0.19 percent to 0.10 percent in 2015.
- The project other aims include the improvement of the knowledge on climate change by national experts in COMIFAC partner countries and support for the establishment and management of national monitoring and MRV systems.
- The design and implementation of national monitoring and MRV systems in line with international recommendations and requirements.
- The outcomes expected from the MRV project included the development of the legal and institutional framework for REDD+ and the improvement of the technical and institutional MRV system.
- The project is directly implemented in ten countries of the Central African Forest Commission (COMIFAC) zone.
- The project is solely funded by AfDB through a EUR 6 157 127 allocation of the Congo Basin Forest Fund.

3.5.2 Scope of the case study on the Congo Basin regional MRV project

The Congo MRV regional project has been implemented directly in ten countries of the Central African Forest Commission (COMIFAC) zone, namely Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, Rwanda, and São Tomé and Principe. This case study focused on deforestation in the COMIFAC zone during the period 2010 - 2040.

3.5.3 Key Results of the Case study on the Congo Basin Regional MRV Project

Climate-relevance

The Congo Basin MRV project falls in the intermediate-high category. Indeed, the project was conceived with a view to build capacity for forest management in the Congo Basin forest. One key measurable indicator of the success of the project was the reduction of the deforestation rate of the Congo Basin rainforest. Since deforestation entails GHG emissions, the expected outcomes of the project directly impact on climate conditions. Conversely, climate conditions might indirectly have great influence on the deforestation rate by affecting other land-use opportunities (droughts, floods, etc.)

Mitigation potential

The mitigation potential of the MRV project was determined by addressing two important questions:

1. What would have been the total GHG emissions from deforestation in the ten COMIFAC partner countries over the 2010 – 2040 period, had the project not been implemented? (Baseline scenario)

2. What will be the total GHG emissions from deforestation in the ten COMIFAC partner countries over the 2010 – 2040 period, given that the MRV project has been successfully implemented? (Project scenario)

The Baseline Scenario (without the MRV Project)

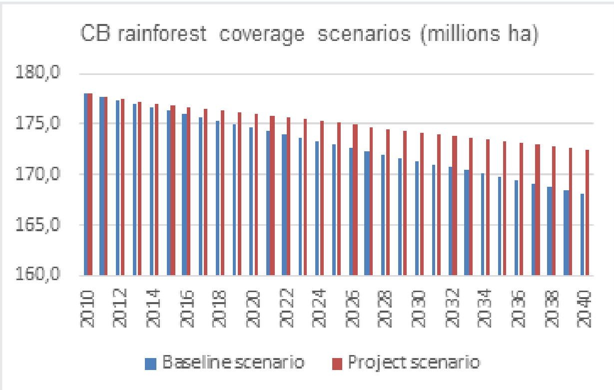
The expected outcome of the project was the reduction of the average annual rate of deforestation in the ten countries from its 2010 level of 0.19 percent to 0.10 percent in 2015.

Therefore, in the baseline scenario where the project is not implemented, a steady deforestation rate of 0.19 percent over the study period was considered. To illustrate, starting from the 2010 situation with 178 million hectares of rainforest in the Congo Basin, this rate of deforestation would roughly correspond to a loss of 330,000 hectares of forest each year.

The project scenario (with the MRV project)

For the project scenario, where the project is successfully implemented, a steady annual rate of 0.10 percent from 2015 onwards was considered. For a comparison, this rate of deforestation would roughly correspond to a yearly loss of 180 000 hectares of forest. Figure 12 illustrates the difference between the baseline scenario and the project scenario.

Figure 12: Difference Between Deforestation in the Baseline and Project Scenarios



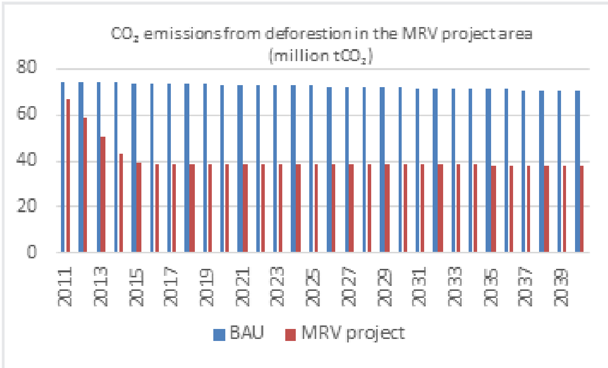
In the baseline scenario, the total deforestation represents a loss of 10 million hectares over the 2010 - 2040 period.

In the MRV project scenario, improved forest management would limit deforestation to only 5.5 million hectares over the study period. Therefore, the successful implementation of MRV project would preserve 4.5 million hectares from deforestation in 30 years.

The next step consisted in converting this avoided deforestation into avoided GHG emissions.
This conversion was made by estimating carbon stock changes associated with deforestation of the Congo Basin rainforest. Non-CO2 GHG emissions were converted into their CO2 equivalent (see Appendix).

Simulations, based on a conservative estimate of 220 tons of CO2 released in the atmosphere per hectare deforested, indicated that the preservation 4.5 million hectares of rainforest in the Congo Basin could be expected to avoid the equivalent of 952 million tons of CO2 over the 2010-2040 period or an equivalent of 32 million tons of CO2 per year.

Figure 13: difference between CO2 Emissions from Deforestation in the Baseline and Project Scenarios



Climate resilience

Since forestry and agriculture are not yet included in the scope of the Climate Safeguards System, the Congo Basin MRV project could not be screened through the Climate Screening Tool. However, by enhancing awareness and sustainable management of the Congo Basin forest resources, the project helped improve the knowledge of climate change by national experts in COMIFAC partner countries, thereby enhancing the adaptation capabilities of the countries. Moreover, the project helped improve the management of a monitoring and MRV system at national level. It also provided new knowledge about IPCC/UNFCCC guidelines on the development of monitoring and MRV systems and payment for environmental services (PES).

Conclusion

The Congo Basin MRV project contributed towards the achievement of the CBFF's primary objective of alleviating poverty and meeting the challenge of climate change by reducing deforestation. By promoting closer cooperation between Central African governments, regional institutions, COMIFAC and the technical partners in the Congo Basin, the project also contributed to the Bank's objective of regional integration. COMIFAC is the only policy and technical body that guides, coordinates and harmonizes the conservation and sustainable management of forest and savannah ecosystems in Central Africa.

The Convergence Plan is a strategic document outlining sub-regional actions and specific programs comprising the national actions of each signatory State. The Congo Basin MRV project addressed countries' concerns reflected in their sector policies implemented in forest and environment sector programs. The activities developed by the Congo MRV regional project covered several strategic aspects of the COMIFAC Convergence Plan, notably, a regional management of Congo Basin forests, harmonization of forest and tax policies, development of financing mechanisms and ongoing regional cooperation and partnerships.

Although its main beneficiaries were the populations of the countries concerned, the Congo MRV regional project potentially benefits the entire world in view of the environmental safeguards provided by the Congo Basin forests.

4. Conclusions and Recommendations: Improving the Implementation of the RIPOS in a Climate change Context

4.1 General Conclusions

4.1.1 Overall, this study recognizes the Bank's significant efforts to mainstream climate change considerations in its strategy and operational processes. However, the relatively recent adoption of climate-related operational guidelines at the Bank did contain no comprehensive assessment of the effectiveness of their implementation. Moreover, the Bank's Regional Operations (ROs) are excluded from the dedicated climate related operational guidelines, and are processed with the same tools as other Bank operations.

4.1.2 The CSS has the capacity to screen projects and ensure infrastructure resilience. A review of the CSS shows that two main components that it includes could be improved:

- A tool to enable Task Managers to estimate incremental costs of climate proofing (resilience activities resulting from the CSS) could be added into or in parallel to the system;

- The set of CSS scorecards used to screen vulnerability of projects to climate change could be expanded to all main sectors of AfDB interventions (e.g. forestry, non-road transport, etc.).

4.1.3 Regarding climate change mitigation, reduction of GHG emissions will depend on the effective implementation of ISS guidelines by the Bank's RMCs and private sector clients. Data collected through the planned GHG emissions tracking tool should give the Bank and its borrowers a better understanding of the climate-related impacts of ROs.

4.1.4 Even though activities designed to mitigate the adverse environmental effects of regional operations contribute to project adaptation to climate change, the CSS does not label them in the ISS as adaptation measures. Also, while the CSS does not provide operational guidance on adaptive capacity and resilience, for instance, the impacts of climate change on projects and how to strengthen the resilience of a project. As a consequence, the ISS may encounter difficulties in mobilizing climate finance. Better operationalized adaptation considerations, would increase the capacity of the ISS to facilitate the adoption of climate change adaptation activities.

4.1.4 Most institutions agree on the strong need for improved standards on infrastructure resilience. A cursory review shows that few RECs have issued norms and regulatory frameworks on infrastructure resilience to climate change. In this context, current initiatives fostered by international financial institutions represent an opportunity for AfDB. The Africa climate-resilience project preparation facility is a good illustration of such initiatives.

4.2 Key findings on the Nexus between Regional Integration and Climate Change (Results of the case studies)

The four case studies on regional projects shed some light on the nexus between climate change and regional integration at the heart of the AfDB strategy. From a climate change perspective, adopting a regional approach to infrastructure development rather than a national one is poised to yield superior economic and resilience outcomes under the following considerations:

- Economies of scale matters: When reduced costs due to economies of scale encourage partner countries to jointly develop a regional renewable energy infrastructure they would not be able to develop on the national level. This was exemplified by the Ruzizi III hydropower project. CEPGL countries' national power systems will reduce, not only the cost price of electricity (due to lower operating costs resulting from economies of scale), but also GHC emissions from these countries' electricity sector. In this case, a RO facilitates the feasibility and bolsters the economic potentials of a GHG mitigation project.

- Climate resilience is a decisive factor: When climate change mitigation and resilience aspects of the projects are given adequate consideration. From a climate change perspective, regional infrastructures present no systematic advantage over stand-alone national approaches. For example, due to its larger scale, a regional coal-fired generation complex could have more adverse impact on the climate than smaller stand-alone national ones. However, as the case study on the CLSG interconnection project revealed, an adequate assessment of the mitigation potential of the project might reveal unexpected climate benefits. Moreover, CLSG case study also suggests that the key concept of resilience might take another meaningful sense in the context of regional infrastructure development. Beyond the resilience of the regional physical infrastructure itself, there is the question of the resilience of regional partner countries. For example, the CLSG power line to be resilient, its construction and design need to be climate-proofed. But more importantly, by reducing the vulnerability of the interconnected national power systems to increases in generation costs due to climate conditions (e.g., a drier climate reducing the productivity of low-cost hydropower plants) the CLSG project might increase their "economic" resilience.

- When the focus is emission efficiency, and not just absolute emissions. The case study on the Kinshasa-Brazzaville railroad bridge highlighted the fact that a shift of focus from absolute GHG emissions to emission intensity might have important consequences for the assessment of the mitigation potential of a regional project. While the development of a regional infrastructure might increase the absolute carbon footprint of the sector under consideration in the regional economic partner countries, (e.g. more GHG emissions from the transport sector due to the increased freight and passenger traffic induced by the bridge) that infrastructure might be designed to reduce its carbon intensity (e.g., modal shift from road to rail could reduce the emission per unit of transportation measurement).

- When the desired outcomes of the development of the project include the provision of regional public goods. The importance of coordinated regional approach to resources management was well illustrated by the Congo Basin MRV. National territorial efforts to reduce deforestation would have been undermined by the possibility of leakage to neighboring countries, with less constraining regulations. Leakage of deforestation would have nullified the climate change mitigation potential of the MRV project. A regional approach to resources management would factor in the national constraints of different countries with a view to generate a collectively profitable (Pareto optimal) management scheme.

4.3 Improving implementation of the RIPOS from a climate perspective

The following recommendations are proposed:

4.3.1 Resilience of projects and adaptation to climate change: three additional suggestions could be made:

1. Develop guidance material for the costing of additional resilience activities resulting from the CSS. A web based tool or a practical methodology could help AfDB staff to estimate incremental cost of climate proofing, thereby facilitating adoption of resilience measures.

2. Develop the CSS scorecards to match all sectors of AfDB interventions so that vulnerability of ROs can be systematically assessed through the web-based tool of the CSS.

3. Develop additional guidance to explain how adaptation activities can be derived from the assessment conducted in the ISS: This guidance could use existing lists of adaptation activities [xxiv].

By facilitating the identification of explicit adaptation activities, these measures would make the project more eligible for climate co-finance. One of the many benefits of a more ambitious approach on climate change in Regional Operations is access to climate finance[xxv]. Climate finance is still insufficiently mobilized in Africa and ROs could benefit from this resource[xxvii]. As the AfDB funding envelope for Regional Operations is limited[xxviii], it is worth considering this complementary source of funding.

4.3.2 Climate change mitigation: To successfully implement ISS guidelines on GHG emissions, AfDB could:

- **Use data collected through the GHG tracking tool:** This tool cab be used to calculate the CO2 emissions "embedded in" each given infrastructure

[xxvi]See for instance : OECD, Handbook on the OECD-DAC Climate Markers, 2011.
[xxv]The main sources of climate finance are GCF, GEF, SE4All, and Africa Climate Change Fund.
[xxvi]A total of $1.16 billion has been approved for SSA, of which only $379 million has been disbursed" (2011), ODI, ibid.
[xxvii]Africa still gets a small share of climate finance as compared to other continents. This is mainly due to the region's lack of readiness and capacity to access international climate finance, the cumbersome procedures of some funds, as well as the limited capacity of African countries to negotiate international climate deals that could benefit the continent." AfDB, 2014.
[xxviii]The RO envelope is characterized by an "intense competition for resources" and the "demand for ROs has greatly outstripped available resources", in AfDB, "Proposed Adjustments to the Regional Operations Framework, Discussion Paper", 2010.

project, that is, the CO2 emissions to be caused by the construction, maintenance and operation of the project. However, the GHC tracking tool is not intended to provide a basis for the quantification of the mitigation potential of a given project over its life cycle. Yet, as the case studies on the CLSG and Ruzizi III projects revealed, this potential might be significant. The tool could therefore help build capacity in RMCs to foster better assessment of the climate impacts of regional infrastructures. Data provided through the tracking tool could also help the Bank define more ambitious objectives on climate change mitigation (i.e. internal standards on GHG emissions).

- **Issue guidance materials to help clients of the Bank take appropriate measures to reduce GHG emissions:** AfDB could use the typology of climate mitigation activities, as developed by the IDFC and MDBs (including AfDB)[xxix]. This list of activities is particularly useful because it provides a comprehensive and internationally recognized typology of mitigation activities. For instance, when developing an energy generation operation, project proponents could be invited—or compelled—to consider the use of low carbon technologies, e.g. replacing coal-based power generation by geothermal, solar or wind electricity generation, unless they can demonstrate the inadequacy of these low carbon options in the project context.

  Climate finance mobilization will be facilitated by stronger and explicit mitigation (and adaptation) components embedded within ROs. In addition to access to climate funds and facilities, including private sources of financing[xxx], RMCs developing Regional Operations could also benefit from the future crediting mechanisms (Financial Mechanism) that could be implemented under the COP21 agreement.

4.3.3 Improving Financing of Climate-related Activities in Regional Operations:

AfDB should provide RMCs incentives to engage in climate-friendly and climate resilient regional projects. The case study on the CLSG interconnection project revealed that certain regional infrastructure projects might yield unexpected climate benefits. Once their electric power networks are interconnected, the Mano River Union countries will have further opportunities to mitigate climate change by importing cleaner electricity.

In order to make the integration of climate perspectives into operations more attractive to projects proponents, particularly RMCs, two options are possible: a) creating a climate-related premium within the RO incentive mechanism; or b) creating a dedicated climate trust fund. Either mechanism would enable:

- the financing of incremental costs associated with building resilience of projects;
- the financing adaptation activities identified through the ISS aiming to reinforcing adaptive capacities of regions; and
- the promotion of low-carbon investments, which would contribute to GHG emissions reductions.

The dedicated climate fund has two main advantages over the RO incentive mechanism, namely: a) tweaking the RO incentive mechanism would be complicated; and b) a climate 'top-up' fund would benefit both ROs and other Bank operations based on each project's climate benefits. It implies the adoption of more ambitious climate related initiatives/components within ROs. The Bank could use a dedicated climate fund to mobilize funding from international sources (GCF, for instance). The European Union is implementing a similar scheme for its member states through investments in transport infrastructure, co-financed under the Connecting Europe Facility. The EU may increase co-financing rates of these projects by up to 10 percentage points for "actions enhancing climate resilience".

4.3.4 Fostering the Development of Regional ElectriCity markets

The development of regional interconnection of national power systems is a key priority of the Programme for Infrastructural Development in Africa (PIDA). The case study on CLSG revealed that the interconnection of national power systems might offer significant climate dividends, and that an accelerated implementation of the PIDA would yield significant climate benefits and foster regional integration. But more than the construction of physical transmission lines is needed for regional trade in electricity.

[xxix] The Group of Multinational Development Banks and the International Development Finance Club (IDFC) have agreed on a common set of principles to track financial commitments on climate-related activities. Their List of activities eligible for classification as climate mitigation finance and the Common Principles can be found at: http://www.worldbank.org/content/dam/Worldbank/document/Climate/MDB%20IDFC%20Mitigation%20Finance%20Tracking%20Common%20Principles%20-%20V2%2015062015.pdf.

[xxx] In the RIPOS, one of the measures identified by the Bank to improve ROs is to facilitate private sector participation. European Commission, Adapting infrastructure to climate change, Commission Staff Working Document, 2013

The key the full climate benefits of regional interconnection infrastructures is capacity building to help regional power pools transit from bilateral trading agreements to an integrated regional electricity market..

4.3.5 Fostering the development of regional railways and multimodal corridors

Regional transport infrastructure development is often conceived as a means of fostering regional integration and increasing economic activity. In turn, increased economic activity translates into increased freight and passenger traffic, which is likely to increase the carbon footprint of the regional transport sector. However, promoting the development of regional railways and multimodal corridors can reduce the carbon intensity of the regional transport sector—accommodating more freight and passenger traffic while emitting relatively less GHG (i.e. reducing the emission per unit of transportation measurement). In addition, the AfDB should encourage the adoption of regional emission standards for the RMCs' fleet to 'green' the transport sector.

5. Annexes

Annex 1

Methods for Economic Assessment of Climate change and Adaptation

Approach	Description	Examples	Advantages	Issues
Economic Integrated Assessment Models (IAM)	Aggregated economic models. Values in future periods, expressed in £ and %GDP and values over time (PVs)	Global studies (e.g. Hope et al, 2009). Regional/National studies (e.g. ADB SE Asia RECCS; SEI for East Africa RECCs)	Provide headline values for raising awareness. Very flexible – wide range of potential outputs (future years, PV, CBA).	Aggregated and low representation of impacts, generally exclude extreme events and do not capture adaptation in any realistic form. Not suitable for detailed national planning.
Investment and Financial Flows (I&FF)	Financial analysis. Costs of adaptation (increase against future baseline)	Global studies (e.g. UNFCCC, 2007) National Studies (e.g. UNDP I&FF) – will emerge later this year.	Costs of adaptation in short-term policy timescale. More rigorous than NAPAs. Easier to apply even without detailed analysis of climate change.	No specific linkage with climate change or adaptation (though can be included). No analysis of adaptation benefits or residual impacts.
Computable General Equilibrium models (GCE)	Multi-sectoral economic analysis / trade considerations for sector (agriculture). £ values and GDP in future year.	National level - Brazil RECCS (2009) Sector e.g. Namibia natural resources (IIED, 2007), Tanzania agriculture (IIED, 2009), Malawi agriculture (2009), Zambia agriculture (2009)	Capture cross-sectoral linkages in economy-wide models (not in other approaches). Can represent global and trade effects.	Aggregated representation of impacts and can only capture adaptation in market form. Omits non-market effects. Not suitable for detailed national planning.
Impact assessment (functions and scenario based assessment)	Impacts of climate in physical effects and economic values with sectoral models in units and £ in future year, and costs and benefits of adaptation	Sectoral assessments in East Africa RECCS (SEI, 2009)	More sector specific analysis. Provides physical impacts as well as economic values – therefore can capture gaps and non-market sectors.	Not able to represent cross-sectoral, economy- wide effects.
Impact assessment - shocks	Use of damage loss relationships from historic events (statistics and econometrics) applied to future projections of shocks	Aggregate level, e.g. EACC (2009) Sector level, e.g. EAC study (2009)	Allow consideration of future climate variability and future trends)	Issues of applying historical relationships to the future. Issues with high uncertainty in predicting future extremes.
Impact assessment - econometric based	Relationships between economic production and climate parameters are derived with econometric analysis and then applied to future scenarios.	National level, e.g. GTZ, 2009 Household level or sector (agriculture).	Can provide information on overall economic growth and allow analysis of longer-term effects. Provide greater sophistication with level of detail.	Very simplistic relationships to represent complex parameters. No information on casual attributes that affect growth. Issues with the confident application of relationships in future cases.

Approach	Description	Examples	Advantages	Issues
Vulnerability assessment	Focuses on existing socio- and economic vulnerabilities, inequalities and adaptive capacity, then considers climate change	Numerous studies – though not the focus here	Centers on analysis within existing socio-economic conditions and decision-making structures, consideration distributional and equity issues and adaptive capacity.	Lack of common metrics makes prioritization challenging. Very difficult to frame in economic terms. Very low coverage against economic valuation aspects.
Risk management	Current and future risks to climate variability. Probabilistic approach.	Climate Proofing: A Risk-based Approach to Adaptation (ADB) Pacific developing member countries.	Well suited for current and future risks and uncertainty. Often used with Cost-effectiveness	Extra dimension of complexity associated with probabilistic approach. Limited applicability: focused on thresholds (e.g. risk of flooding).
Adaptation assessments	Risks over a range of policy/planning horizons. Often linked risk management and adaptive capacity.	No real economic examples. Emerging number of adaptation assessments.	Stronger focus on immediate adaptation policy needs and decision making under uncertainty and greater consideration of diversity of adaptation options (including soft options) and adaptive capacity.	Less explored in relation to economic assessment

Annex 2

Main findings from data and literature

Neumann, "Enhancing the Climate resilience of African Infrastructure, The water and Power sectors", February 2015	• This regional report aims to estimate the impact of climate change on infrastructure and to propose ways of improving design and planning of investments, and the readiness of African countries to increase climate resilience of infrastructure. Main findings are: • Climate change has large effects on infrastructure performance; ignoring it may lead to significant regrets. Despite uncertainty, it is possible to plan climate-resilient infrastructure development; • Strengthening resilience to climate change entails cost increases and cost savings. The study finds that "benefits in terms of reduced risk outweigh the cost increase".
Economic Commission for Africa, "Cost-Benefit Analysis for Regional Infrastructure in Water and Power Sectors in Southern Africa", 2010	• This study focuses on key issues and challenges of regional infrastructure development, especially in the water and power infrastructure sector, in the Southern African subregion. It assesses the use of cost-benefit analysis (CBA) to appraise feasibility or assess cooperation project. • The study notes the scarcity of "empirical studies that have focused on regional integration of infrastructure in Africa", and identifies the following levers for enhanced integration: strengthening political commitment, enhancing project preparation, establishing appropriate governance structures, improving evaluation procedures, etc. Countries that share common resources (e.g. trans-boundary waters or hydroelectric power), are likely to benefit from cooperation. On the contrary, relying only on market solutions to mitigate trans-boundary externalities is deemed sub-optimal, and "failure to cooperate can be very costly," the study notes.
World Bank, "Economics of Adaptation to Climate Change", 2009	• The annual cost of adapting to climate change in Sub-Saharan Africa is estimated to amount $14-17 billion. • Investment in adaptation measures is often wrongly perceived as detrimental to other investments in broader economic development. Cost-benefit analysis of many projects in the study suggests that these are good for development and adaptation. • The example of Ghana demonstrates that regional cooperation is key to enable adaptation measures, especially in the water sector.

• **OECD, "Climate-compatible growth: Seizing the opportunity for Africa", 2011**	• Climate-compatible growth combines two components: low carbon growth and climate resilient growth. • There is significant potential for no-regret low-carbon mitigation measures (for instance: improving energy efficiency, use of landfill gas and recycling).
Stockholm Environment Institute, "The Economies of Low Carbon, Climate Resilient Patterns of Growth in Developing Countries: A Review of the Evidence", 2010	• This study details the different methodological approaches that can be used to estimate the costs and benefits of adaptation. • Regional investments in the electricity network have the potential to reduce per capita emissions, as illustrated by the project of the interconnection between Kenya and Ethiopia. • This study stresses the need for adopting regional energy models, such as the Pan European TIMES and PRIMES models. Such models offer opportunities for regional energy systems integration.
Fankhauser S and G Schmidt-Traub, "From Adaptation to Climate-resilient Development – The Costs of Climate-proofing the Millennium Development Goals in Africa.", 2010	• This study calculates the combined cost of meeting and the "climate-proofing" of the Millennium Development Goals for Africa. • One of the key success indices of the MDGs is adequate investment at the regional level (e.g. transboundary ecosystem management, water management, regional agricultural research). • The external financing needed for "climate resilient" MDGs in Africa is about 40 percent higher than the external financing for the MDGs alone. Financing MDGs is estimated around $72 billion a year, while financing climate resilient MDGs is estimated to cost around $100 billion a year.
AfDB, The Cost of Adaptation to Climate Change in Africa, 2011	• This document notes that, although African countries contribute very little to global emissions, they are highly exposed to climate change. • Adaptation costs are estimated to amount US$ 20-30 billion per annum over the next 10 to 20 years. - There is a strong economic case for integrating climate risks when building infrastructure in Africa.
Goulden, "Adaptation to climate change in international river basins in Africa: a review", Tyndall Working Paper 127, 2008	• The trans-boundary nature of many of Africa's river basins calls for cooperation between neighbouring countries. High variability and regional scarcity are likely to be exacerbated by climate change. Without appropriate cooperation, adaptation may be limited and uneven. • The benefits of cooperation in international river basins include basin-wide environmental management, it opens new opportunities (e.g. hydropower, irrigation, flood and drought management…), secure relations between states and the integration of regional infrastructure, markets and trade.

International Task Force on Global Public Goods, "Meeting global challenges, international cooperation in the national interest- towards an action plan for increasing the provision and impact of global Public goods", 2004	• On the contrary, where water resource management decisions are taken without due consideration to possible future climate change impacts, maladaptation may result, as vulnerabilities to future climate change increase. This study tackles the issues of undersupply of Global Public Goods: • Failure to exploit opportunities to improve international welfare through enhanced cooperation; • Lack of international coercive power, which would force countries to cooperate in order to promote regional public goods the study identifies three factors that are instrumental to the promotion of voluntary approaches in favour of public goods: • the nature of the public good itself; • the profile of the countries with an interest in the public good and the underlying political economy; and • the scope for monitoring and enforcing compliance with agreements to increase the supply of global public goods.
World Energy Council, The road to resilience – managing and financing extreme weather risks, World Energy Perspective, 2015	• Globally, the number of extreme weather events increased more than four-fold, from 38 in 1980 to 174 events in 2014. • While in the past, impact-resistant ('fail-safe') structures were built, today's system complexity and increased incidence of extreme weather require energy infrastructures operating under a 'safe-fail' approach. The solution appears to be 'smarter, not stronger'.
International Rivers, "Civil Society Guide to Healthy Rivers and Climate Resilience", 2013 Helmore, "Laying the Foundations for Climate Resilient Development", 2013	• This study critically analyses the impact of dams on rivers, ecosystems and local populations, and assesses the risks of maladaptation; Dams are highly vulnerable to climate change, and could be highly impacted by frequent extreme weather. Existing dams must be assessed against this backdrop, and climate risk management must be included throughout the project cycle of new ones.
Helmore, "Laying the Foundations for Climate Resilient Development", 2013	• This study identifies the challenge facing climate resilient development in Africa and stresses the need for a regional approach, especially in the following priority areas: • support for knowledge management • support for data information management • support to climate adaptation finance
Qaddumi, "Practical approaches to transboundary water benefit sharing" Working paper 292, Overseas Development Institute, 2008	- This study examines the case of river basins, where many countries share a common pool resource. The use of this resource by one riparian state necessarily diminishes the benefits available to others. Hydrologists and economics agree on the importance of treating a river basin in holistic manner, and therefore regional cooperation between neighbouring riverine African countries is needed.

Annex 3

Summary of AfDB main strategic documents relevant to climate change

- AfDB's Ten Year Strategy (TYS), "At the Center of Africa's Transformation: Strategy for 2013-2022" (2013) This document is the cornerstone of the Bank's intervention and defines the Bank's priorities, actions and expected outcomes (see Figure 14 below). The TYS is a general document, which covers the whole spectrum of Bank's interventions, without a special focus on climate change. From a climate change perspective, the Strategy's objective to promote green growth in the following excerpt is one of the strongest signals of the Bank's commitment to climate change: "Priorities in reaching green growth include building resilience to climate shocks, providing sustainable infrastructure, creating ecosystem services and making efficient and sustainable use of natural resources (particularly water, which is central to growth but most affected by climate change)".

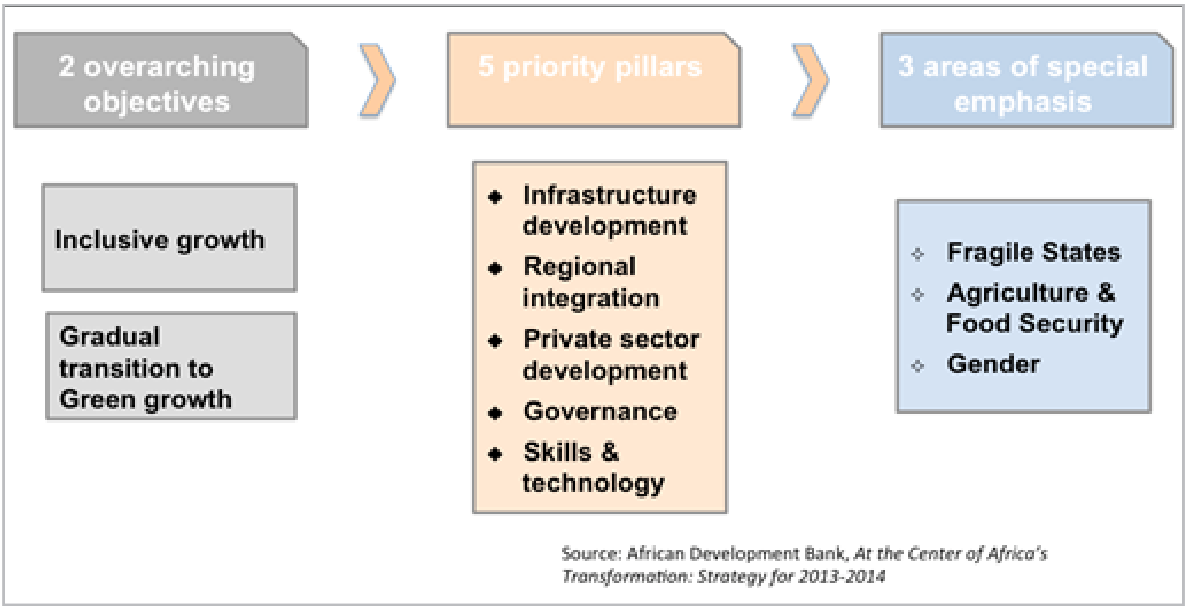


Figure 14: Overview of AfDB's strategy for 2013-2022

- AfDB's Green Growth Framework (GGF) (2014) elaborates on the second objective of the AfDB's Ten Year Strategy: gradual transition to green growth. Green Growth is defined by AfDB as "the promotion of economic growth through building resilience, managing natural assets efficiently and sustainably, including enhanced agricultural productivity, and promoting sustainable infrastructure and urbanization, while minimizing pollution and waste". This objective is operationalized along 3 key pillars (see Figure 15):

- Promoting sustainable infrastructure;
- Managing natural resources;
- Building climate resilience.

Sustainable	Efficient/Sustainable Use of Natural Assets	Resilient Livehoods and Econo-mic Sectrs
• Maximizing efficiency, minimizing pollution and waste, e.g: • Energy efficiency Mass transport • Sustainable urban development water security • Multi-purpose solutions	• Sustaining rentable ressources: • Land (agriculture, forests and other land use) water (freshwater and marine) • Maximizing ecological footprint when utilizing non-renewable ressources: • Mineralos	• Strengthening Disaster Risk Management and adaptive Capacities to: • Physiucal/ Environnemental Shoks (naturel hazards weather and Climate Extremes, Climatic change) • Improving Social and Economic safety nets to buffer againts: Socio Economic shocks (e.g. commodity risks)

Figure 15: Focal areas for inclusive Green Growth

Against the backdrop of the TYS, AfDB intervenes first at the policy level, by mainstreaming green growth into national development planning processes. This objective seems to depend highly on the awareness of each country's political leadership on climate-related matters. Second, the Bank intervenes at the project level, by integrating green growth into project design.

This translates into the introduction into the Bank's operations such new tools as spatial risk mapping or the Climate Screening System (CSS), as well as the adoption of sector guidance notes on green growth activities in sectors such as water, transport and energy. The Green Growth Framework also identifies financial instruments that can be mobilized to fund green projects.

- **Climate Change Action Plan 2011-2015 (2012)** The Climate Change Action Plan (CCAP) was designed with two overarching objectives, namely, reducing Africa's vulnerability to climate change and supporting the transition to low-carbon-growth and sustainable-development paths. The main priorities of the Bank's climate change approach are outlined in Figure 16. Particular emphasis is placed on adaptation to climate change and climate resilience. As a consequence, the development of a climate screening tool will help ensure that "all Bank-funded projects are climate-proofed or that climate resilience is built into its projects." AfDB planned investment is about UA 6 billion, t to be spread over the period of 2011-2015, for projects in the energy, transport, water, and agriculture and agro-industry sectors.

Figure 16:

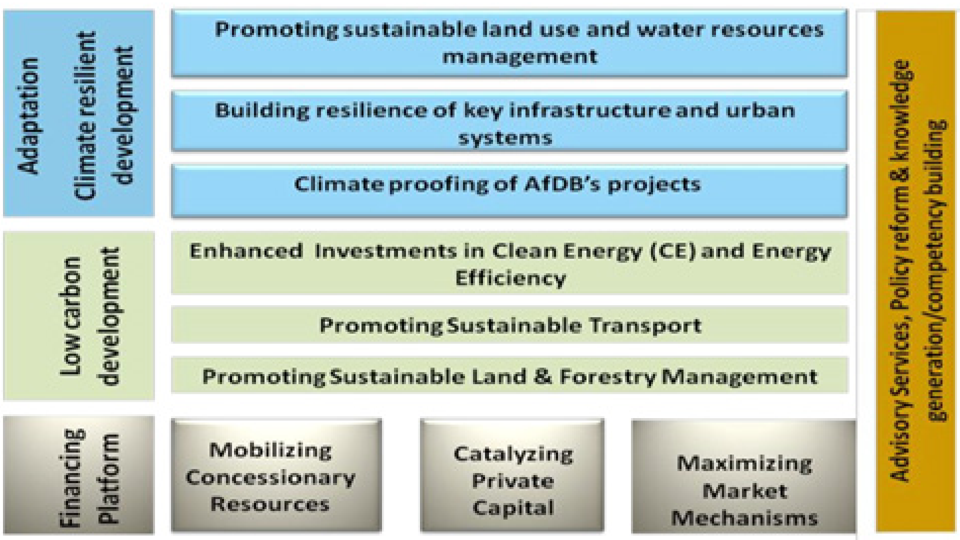
AfDB Climate change Program

Figure 16: AfDB climate change program

- **Climate**

climate

Risk



Management and Adaptation (CRMA) Strategy (2009):

The first objective of the CRMA is to "reduce vulnerability within the RMCs to climate variability" and to promote climate resilience of AfDB-financed investments. The second objective of the CRMA is to "build capacity and knowledge within the RMCs to address the challenges of climate change", by promoting policy and regulatory reforms. The areas of intervention of the CRMA strategy are:

- climate proofing investments;
- policy, legal and regulatory reforms; and
- knowledge generation and capacity building.

Other AfDB Documents Related to Climate Change Include:

- "Green Growth: Sector Guidance Notes" (2014) This document, a helpful complement of the Green Growth Framework, presents, possible ways of operationalizing the principles outlined in the Framework in the different sectors. The key sectors identified in the document are water, agriculture, fisheries, forestry, human development, energy infrastructure and services, and transport. Sector guidance notes highlight the main challenges in terms of development and sustainability, opportunities for green growth, entry points for action and good practice examples for greening project level investments.

- "Towards Green Growth in Africa", African Development Report (2012): This report provides a comprehensive description of the meaning of green growth in Africa. Its objective is to guide Bank staff through the implementation of green growth policies. It highlights the economic rationale for promoting green growth, and puts in perspective climate change and other drivers of economic growth (demographic growth, global energy system transformation, agricultural markets, etc.). The document emphasizes the need for proper management of Africa's natural assets, notably water and forests.

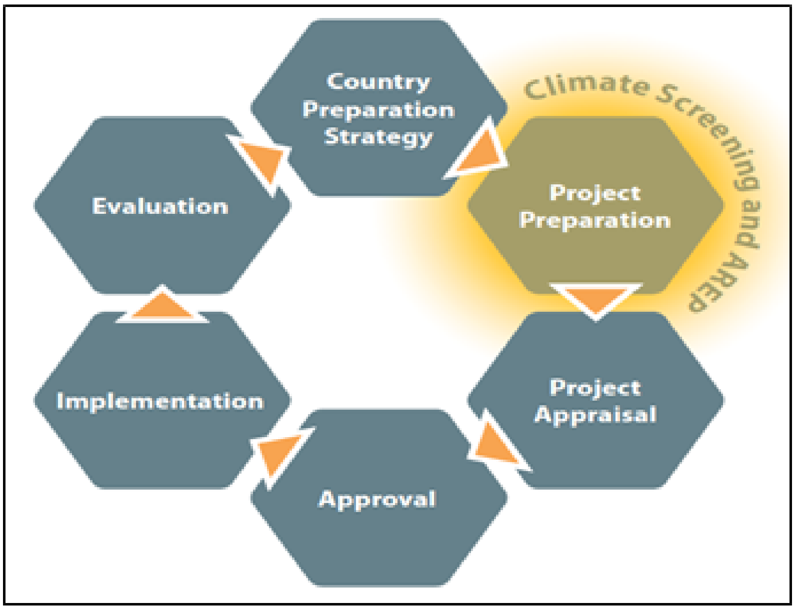
- "Facilitating Green Growth in Africa" (2012): This discussion paper articulates the rationale for the promotion of green growth in Africa and identifies AfDB's possible contributions to environmental issues.

Annex 4

Summary of Main AfDB Operational Procedures Relevant to Climate Change

- Climate Safeguard System (CSS). CSS is a set of web-based processes for project preparation. The objective of the CSS is to assess the vulnerability of the project to climate change and to identify adaptation activities. As such, it delivers on one of the CRMA key objectives, which is mainstreaming climate screening and adaptation in investments.

Figure 17: Applying the Cycle CSS to AfDB Project



The Climate Screening System consists of different modules:

1. Climate Screening: This first step assesses project vulnerability, based on need for additional measures to manage climate risks. This tool is used by Task Managers in each operations division and involves a limited set of questions that will determine the category of the project under review (ranging from category 1— most vulnerable, to Category 3—least vulnerable to climate change). The Climate Screening is produced early in the project cycle, with the aid of pre-designed scorecards, at the time of the production of the Project Concept Note. The use of the screening tool is limited to the climate proofing of investments; mitigation issues are treated in a separate process.

2. Adaptation Review and Evaluation Procedures (AREP): The aim of this second phase of the CSS is to climate proof investments by incorporating adaptation measures into project proposals. Building on the project scorecards produced during the climate screening, the AREP integrates predefined adaptation components and activities into projects

3. Country Adaptation Factsheets (CAFSs): These factsheets are support material, which provide overviews of climate scenarios, for a set of climate variables. These scenarios are based on data of climate projections drawn from the University of Cape Town database. They are a prime source of information on the conduct of the AREP.

4. CSS information and knowledge base: This is a platform for information and guidance on the implementation of climate screening and AREP. It is designed to provide climate data and information (future climate projections, factsheets on adaptation, possible adaptation activities, etc.).

5. Integrated Safeguards System (ISS): The main objectives of ISS are to protect people and the environment from potentially adverse impacts of projects and to promote mitigation or compensation of adverse impact on the environment. The Bank's clients are required to comply with these safeguards. Four categories groups are used, depending on environmental and social impacts. The ISS is not climate specific but covers the whole spectrum of impacts. The system's five operational guidelines are as follows:

- Environmental and social assessment
- Involuntary resettlement land acquisition, population displacement and compensation
- Biodiversity and ecosystem services
- Pollution prevention and control, hazardous materials and resource efficiency
- Labour conditions, health and safety

6. Environmental and Social Assessment Procedures (ESAP): The main aim of this set of procedures is to asses a project's environmental and social impacts and define the environmental categories

to which the projects may be assigned. The ESAP also sets out the assessments and procedures for each stage of the project cycle. As such, these processes are used in parallel with AREP.

7. Integrated Environmental and Social Impact Assessment (IESIA): The objective of the IESIA, a component of the ESAP, is to identify the extent of a project's environmental and social impacts. After these impacts are identified, appropriate steps must be undertaken to prevent, minimize, mitigate or compensate adverse impacts.

Annex 5

Financial Institutions Approach on Climate Risk and Resilience

Agence française de développement (AFD) has adopted a case-by-case approach on adaptation projects, assessing climate risks and resilience, using multiple metrics. Criteria and specifications are used to determine whether a project will reduce proven risks or increase the resilience of a community. The criteria include existing vulnerability based on geography and the type of action that can help reduce vulnerability or increase resilience among the populations.

Asian Development Bank (ADB) is preparing and testing technical guidance and tools to help assess the vulnerability of projects to climate change and to climate-proof vulnerable investments. These include the 'Guidelines for Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects', which provides a step-by-step approach to help project teams to incorporate adaptation in transport projects. Before producing the Guidelines, the ADB had completed high level studies on project level climate proofing.

These covered the economics of adaptation, using two road development projects as case studies and identifying climate risks and adaptation options for the power sector.

European Bank for Reconstruction and Development (EBRD) undertook a project to develop a methodology for the assessment of the risks posed by climate change and the impacts of those risks on the bank's operations. The project developed guidance and practical tools to integrate climate risk assessment and adaptation into the EBRD's project cycle. The EBRD is also participating in the Pilot Programme for Climate Resilience (PPCR), implemented under the Climate Investment Fund. PPCR is pioneering pro-adaptation technical assistance and investment projects.

The European Investment Bank (EIB) has recently developed sector strategies, which include addressing climate change adaptation. The EIB will only finance projects that fulfil the requirements described in their Environmental and Social Statement and Handbook. This includes projects applying cost effective, appropriate adaptation measures where there is a risk of significant adverse impacts from climate change and increased frequency of extreme weather events. The EIB actively promote adaptation projects such as water resource management.

KfW Entwicklungsbank's projects undergo a systematic two step climate change assessment to ensure potential impacts are managed and opportunities are capitalised. The first step is an initial assessment of the risks of anticipated climate change and opportunities for additional mitigation measures. If significant climate change risks or mitigation potentials are identified, a more detailed second stage is undertaken. The result of this in-depth analysis might include the modification of the project design, the implementation of risk mitigation measures or an additional project phase.

The Inter-American Bank (IDB) declares in its third "strategic line for intervention", a plan to "ensure that investments in infrastructure (such as transport, water and energy) and other areas that may be sensitive to the impacts of climate change are designed to withstand those impacts." To this end, it will develop the capacity to assess the vulnerability of the projects it finances to climate variability and change.

The International Finance Corporation (IFC) created a Climate Risk Working Group to identify risks of climate change at the investment and post-investment stage. Their Performance Standards state the importance of identifying risks and impacts of climate change. The IFC is currently supporting three Pilot Program for Climate Resilience (PPCR) projects. In 2008, the IFC initiated the Climate Risk Program, a series of pilot studies analysing climate risks and adaptation options for a range of projects in different sectors and regions. The objective was to develop and test methods for evaluating climate risks to the private sector and to identify appropriate adaptation responses.

At the World Bank (WB), is developing tools for more systematic treatment of climate impacts. These tools will also be relevant for International Bank for Reconstruction and Development (IBRD) countries. Key products include a methodology for mainstreaming climate impacts at the strategic level and sector guidance for select climate sensitive sectors (agriculture, water, roads) at the project level. Tools that are already available include:

- Rapid assessment of climate change vulnerability, risk and adaptation in the energy sector,
- Urban Risk Assessment (URA) tool for assessing disaster and climate risk in cities,
- Mainstreaming adaptation to climate change in agriculture and natural resources management projects.

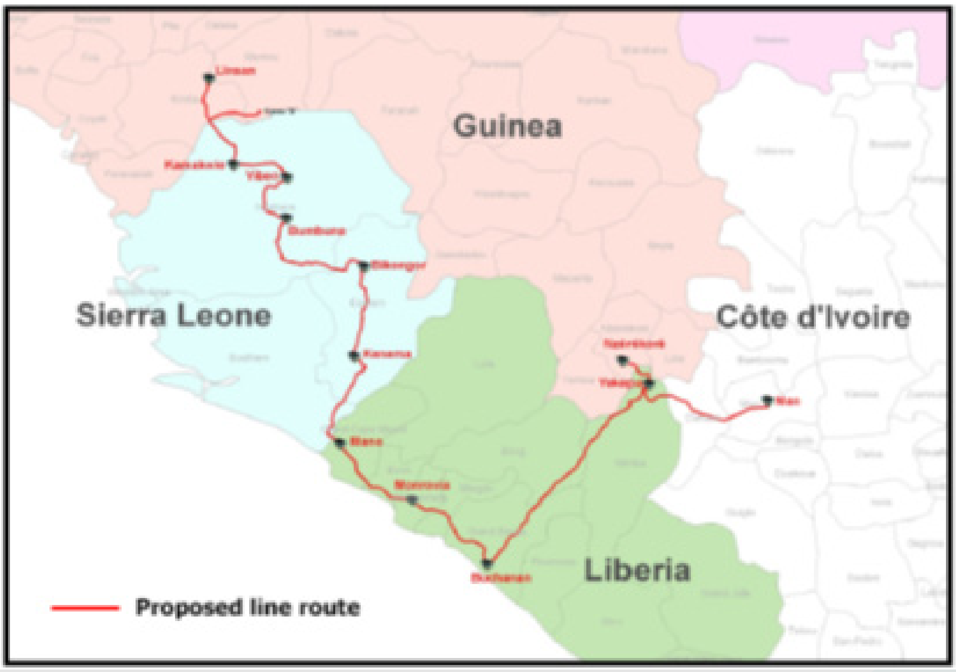
Annex 6

Case Study on the CLSG interconnection Project

This section presents the main data and assumptions on which the simulation exercises were based. Figure 18 (below) shows the route selected for the construction of the transmission line.

Figure 18

Route selected for the construction of the CLSG interconnection line



Source: KEPCO 2011

Detailed Methodology

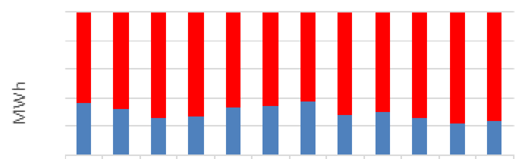
According to IPCC 2006 Guidelines, "CO2 accounts typically for 95 percent of energy sector emissions with methane (CH4) and nitrous oxide (N2O) responsible for the balance." The assessment of the mitigation potential of the CLSG project was therefore based on the potential reduction of CO2 emissions allowed by the project over the period, 2017 - 2040.

Variations of the share of hydropower in the power generation mix observed during the historical period served as the basis for the forecast of the share of hydropower in the generation mix during the study period. For each year from 2017 to 2040 the generation profile indicating the share of hydropower in the generation mix was obtained as a random combination of the shares of hydropower in the generation mix observed during the historical period (Monte Carlo simulation). This simulation strategy was intended to reflect normal climate variability.

The historical power generation data used for Côte d'Ivoire and Guinea were the following ones:

Figure 19:

Historical Generation Mix in Cote d'Ivoire (2003-2014)



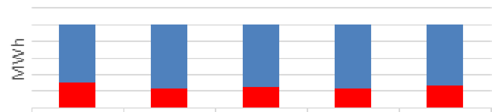
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Thermal	64%	68%	74%	73%	67%	66%	63%	72%	71%	74%	79%	77%
Hydro	36%	32%	26%	27%	33%	33%	37%	28%	29%	26%	21%	23%

Hydro Thermal

Source ANARE (2014)

Figure 20:

Historical Generation Mix in Guinea



	2009	2010	2011	2012	2013
Hydro	69%	76%	75%	77%	74%
Thermal	31%	24%	25%	23%	26%

Thermal Hydro

Source EDG/SIE (2015)

Unfortunately, no reliable data on the historical generation mix of Sierra Leone and Liberia. This is partly due to the fact that civil war destroyed public electric power infrastructures in the two countries. Moreover, the obsolescence of the surviving power infrastructure and the extremely poor quality of service led to the use of diesel generators as of the primary source of power in both countries.

Official sources indicated that the share of hydropower in the grid-generated electricity mix in Sierra Leone might fluctuate around 60 percent, a figure which includes power from oil-fired plants. However, the same sources indicated that individual diesel generators represent at least as much as the total capacity connected to the national grid). Therefore, the share of hydropower was estimated to fluctuate around 30 percent with 15 percent of oil-fired generation and the remainder produced by diesel generators.

The simulation of the baseline scenario generation profile in Liberia was based on the current power generation mix comprised of 15 percent of hydropower, 40 percent of oil-fired generation, with the remaining 45 percent coming from diesel generators.

Main Data Sources

Data assembled from different sources including but not limited to the following sources:

- The WAPP revised master plan 2011
- Bilan Energétique National 2013 (Guinée)
- Rapport Annuel de la Compagnie Ivoirienne d'Electricité (CIE)
- Rapport Annuel de l'ANARE
- The IEA Africa Energy Outlook 2014
- The IRENA Report on the Africa Power Sector 2014
- National UNFCC communication
- INDC of the countries

Assumptions

It was assumed that renewable energy sources generate zero CO_2 emissions. The total demand for energy of the Mano River Union countries can be expected to grow from 17,000 GWh to about 45,000 GWh over the study period (2017-2040). As such, the installed capacity of the four countries would not be sufficient to meet the projected demand over the entire study period. Many generation projects are under development in the sub-region and will modify the countries generation profiles. Many development paths could be envisioned factoring in more or less renewables, biomass, peat or even coal-fired generation. The purpose of these simulation exercises was not to evaluate any particular development path for electricity generation in the Mano River Union countries. For the purpose of simplicity, the conservative assumption that generation capacity evolved proportionally to match demand in these simulation exercises. However, since many hydropower projects are under consideration in the four countries, the outcomes of the simulations can confidently be taken as lower bounds for the mitigation potential of the CLSG interconnection line.

The simulations of the project scenario were based on the assumption that a capacity of 145 MW could be traded during the first phase of the project implementation (2017-2021) and 290 MW could be traded during the second phase of the project (2022 - 2040) with a load factor of 75 percent or the equivalent of 953 GWh and 1905 GWh to be shared by the importing countries during the first and second phases, respectively.

Emissions Factors (kgCO2/MWh)

The estimates of the emissions of national electric systems estimated based on each country's generation mix, using the following parameter values for thermal plants:

Fuel	Default CO2 emission factors (kgCO2/TJ) on a NCV basis	Average Thermal efficiency Coefficient (%)	Average emissions factors (kgCO2/MWh
Gas/Diesel oil	74 100	30	889
Residual Fuel (HFO)	77 400	30	929
Natural Gas	56 100	30	673
Peat	106 000	20	1908
Coal	94 600	20	1703

Source : IPCC 2006 Guidelines, Eurelectric WBG

Existing Generating Capacity (MW)

Future patterns of electricity generation were extrapolated from historical generation activity in the four countries as retrieved from available sources based on the following representation of existing thermal and hydro generation capacities identified through desk research.

Country	Installed Capacity by Type of Fuel (MW) as of 31.12.2015				
	Oil (HFO)	Diesel	Gas	Hydro (MW)	
Côte d'Ivoire	0	0	1200	604	104
Liberia	13	10	0	4	27
Sierra Leone	44	10	0	50	104
Guinea	77	22	0	368	1935
Total	134	42	1200	1026	2402

Electricity Demand Projections (GWh)

The main source used for electricity demand projections is the WAPP Master Plan (WAPP, 2011), which projects secondary electricity demand (i.e., at the utility level, before transmission) up to 2025. Mining projects were excluded in the case of Côte d'Ivoire because in that country they represent a negligible share of secondary electricity demand. Post-2025 demand considered in all the simulation exercises was extrapolated from the growth projected in the WAPP Master Plan for the period 2020-2040. Projections for Guinea, Liberia and Sierra Leone included the demand for mining projects, which is projected to be several times larger than all other electricity demand.

Projected Demand Extrapolated from WAPP Master Plan (MWh)

	Côte d'Ivoire	Liberia	Sierra Leone	Guinea	Total
2017	8 680	2 136	3 102	4 448	18 366
2018	9 182	2 154	3 841	4 542	19 719
2019	9 703	2 174	5 003	6 739	23 619
2020	10 244	2 195	6 163	6 873	25 475
2021	10 807	2 218	6 213	7 043	26 281
2022	11 391	2 242	6 263	7 187	27 083
2023	11 998	2 268	6 313	7 332	27 911
2024	12 628	2 295	6 363	7 477	28 763
2025	13 284	2 324	6 413	7 626	29 647
2026	13 963	2 354	6 462	7 769	30 548
2027	14 665	2 387	6 511	7 915	31 478
2028	15 392	2 420	6 559	8 061	32 432
2029	16 144	2 456	6 605	8 206	33 411
2030	16 798	2 491	6 619	8 323	34 231
2031	17 606	2 531	6 664	8 470	35 271
2032	18 363	2 577	6 711	8 597	36 247
2033	19 153	2 623	6 758	8 726	37 259
2034	19 976	2 670	6 805	8 857	38 308
2035	20 835	2 718	6 853	8 990	39 396
2036	21 731	2 767	6 901	9 125	40 523
2037	22 666	2 817	6 949	9 261	41 693
2038	23 640	2 868	6 997	9 400	42 906
2039	24 657	2 919	7 046	9 541	44 164
2040	25 717	2 972	7 096	9 685	**45 469**

Generation Profiles (%)

Technical studies and donors document (SOGREAH, 2010, World Bank), indicated that the volume of the primary reserves corresponding to a total exchange of 83 MW could be split as follows:

- 27 MW for Liberia representing 33 percent of the total
- 21 MW for Sierra Leone representing 24 percent of the total
- 35 MW for Guinea representing 43 percent of the total

The same percentages of import allocations were retained for the simulation exercises. The generation profile used in the simulation exercises, which took into account Côte d'Ivoire's exportation of its gas-fired generated electricity, was computed as follows:

HFO	Diesel	Hydro	Share of available Export capacity	
Liberia	45±3	40±3	100-HFO -Diesel	33%
Sierra Leone	15±3	55±3	100-HFO -Diesel	24%
Guinea	30±3	10±3	100-HFO -Diesel	43%

Cost Assumptions (Levelized Cost of Electricity Generation and import)

The LCOE for the different sources of generation were the following:

LCOE $/MWh	HFO	Diesel	Natural gas	Domestic Hydro	Imported Natural Gas
Côte d'Ivoire	-	-	130	2	-
Liberia	160	300	-	2	170
Sierra Leone	160	300	-	2	170
Guinea	160	300	-	2	170

Source: AFTEG, 2011, IRENA WAPP 2013

Extra Generation Costs due to Drier Climate in the Baseline Scenario in Million $

	Côte d'Ivoire	Liberia	Sierra Leone	Guinea	Total
2016	85	38	52	192	367
2017	57	26	56	154	294
2018	36	45	10	89	180
2019	37	45	27	255	364
2020	-52	35	35	250	268
2021	-85	39	134	103	192
2022	15	85	21	389	510
2023	79	17	-10	210	297
2024	-48	-15	201	330	468
2025	70	45	145	379	640
2026	-72	64	183	257	432
2027	18	26	115	319	478
2028	39	6	-51	400	393
2029	-19	56	10	397	443

2027	18	26	115	319	**478**
2028	39	6	-51	400	**393**
2029	-19	56	10	397	**443**
2030	45	72	138	250	**504**
2031	-2	11	-44	333	**298**
2032	-24	-1	61	338	**374**
2033	0	84	101	265	**449**
2034	1	56	8	293	**357**
2035	135	41	143	287	**607**
2036	1	43	73	414	**531**
2037	-30	46	94	417	**527**
2038	-60	38	63	268	**310**
2039	-32	89	131	359	**547**
2040	69	103	190	485	**846**

Annex 7
Case Study on the Congo Ruzizi III Hydropower Plant

This section presents the main data and assumptions used in the Ruzizi III case study.

Main data sources

Data were assembled from different sources, including the following:

- The EAPP revised master plan and grid code, 2011
- Rwanda Energy Sector Review and Action Plan, 2011
- The IEA Africa Energy Outlook, 2014
- AfDB internal project documentation
- The IRENA Report on the Africa Power Sector, 2014

Emissions factors (kgCO2/MWh)

The estimates of the emissions of each national electric system were based on its generation mix, using the following parameter values for thermal plants:

Fuel	Default CO2 emission Factors (kgCO2/TJ) on a NCV Basis	Average Thermal Efficiency Coefficient (%)	Average Emissions Factors (kgCO2/MWh)
Gas/Diesel oil	74 100	30	889
Residual Fuel (HFO)	77 400	30	929
Natural Gas	56 100	30	673
Peat	106 000	20	1 908
Coal	94 600	20	1 703

Methodological Note

The following equation was used to determine the mitigation potential of the Ruzizi III project:

CO_2 emissions avoided = Baseline Scenario CO_2 emissions minus Project Scenario CO_2 emissions

Electricity demand projections (GWh)

The main source used for electricity demand projections is the EAPP Master Plan (EAPP, 2011), which forecasts secondary electricity demand (i.e., at the utility level, before transmission) to 2038, Post-2038 demand considered in all the simulation exercises was extrapolated from the growth projected in the EAPP Master Plan for the period, 2021-2040

Projected Demand Extrapolated from EAPP Master Plan (MWh)			
	Burundi	**Rwanda**	**EDRC**
2021	612	1483	473
2022	696	1651	498
2023	792	1837	524
2024	857	1973	554
2025	927	2119	586
2026	1003	2276	619
2027	1085	2445	655
2028	1174	2626	692
2029	1271	2820	731
2030	1375	3029	773
2031	1488	3253	817
2032	1610	3493	864
2033	1742	3752	913
2034	1885	4030	965
2035	2039	4328	1020
2036	2206	4648	1078
2037	2387	4992	1140
2038	2583	5361	1205
2039	2795	5758	1273
2040	3024	6184	1346

Generation profiles (%)

The same percentages of import allocations were retained for the simulation exercises. The generation profile used in the simulation exercises, based on an equal sharing of Ruzizi III generated electricity, was computed as follows:

	HFO	Diesel	Hydro	Share of Available Export Capacity
Burundi	15±3	15±3	100-HFO -Diesel	33%
EDRC	15±3	10±3	100-HFO -Diesel	33%
Rwanda	10±3	20±3	100-HFO -Diesel	33%

Annex 8

Case Study on the Kinshasa-Brazzaville Railroad Bridge

This section presents the main data and assumptions used in the PRRC case study.

Main data sources

Data for this case study were assembled from different sources, including the following sources:

- feasibility studies by the consulting consortium led by Egis International 2011
- guidelines for measuring and managing CO2 emissions from freight transport operations
- IPCC 2006 Guidelines

	Baseline Scenario Project Scenario (Boat maintained)				
	Boat	Bridge	Boat	TOTAL	Bridge (Boat suppressed)
2019	1 364	3 396	2 572	5 968	5 534
2020	1 439	3 583	2 713	6 296	5 840
2021	1 518	3 780	2 863	6 643	6 163
2022	1 602	3 988	3 020	7 008	6 504
2023	1 690	4 207	3 186	7 393	6 864
2024	1 783	4 440	3 362	7 802	7 243
2025	1 882	4 685	3 548	8 234	7 644
2026	1 987	4 948	3 748	8 696	8 073
2027	2 099	5 226	3 958	9 184	8 526
2028	2 217	5 520	4 180	9 700	9 005
2029	2 341	5 829	4 415	10 244	9 510
2030	2 473	6 157	4 663	10 820	10 044

Pay-load tons	% of Truck-kms Run Empty										
	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
10	81.0	84.7	88.8	93.4	98.5	104.4	111.1	118.8	127.8	138.4	151.1
11	74.8	78.2	81.9	86.1	90.8	96.1	102.1	109.1	117.3	127.0	138.6
12	69.7	72.8	76.2	80.0	84.3	89.2	94.7	101.1	108.6	117.5	128.1
13	65.4	68.2	71.4	74.9	78.9	83.4	88.5	94.4	101.3	109.5	119.3
14	61.7	64.4	67.3	70.6	74.2	78.4	83.2	88.7	95.1	102.7	111.8
15	58.6	61.0	63.8	66.8	70.3	74.2	78.6	83.7	89.7	96.8	105.3
16	55.9	58.2	60.7	63.6	66.8	70.5	74.6	79.5	85.1	91.7	99.7
17	53.5	55.7	58.1	60.8	63.8	67.2	71.2	75.7	81.0	87.2	94.7
18	51.4	53.5	55.8	58.3	61.2	64.4	68.1	72.4	77.4	83.3	90.4
19	49.6	51.5	53.7	56.1	58.8	61.9	65.4	69.5	74.2	79.8	86.5
20	48.0	49.8	51.9	54.2	56.8	59.7	63.0	66.9	71.4	76.7	83.0

21	46.6	48.3	50.3	52.5	54.9	57.7	60.9	64.5	68.8	73.9	80.0
22	45.3	47.0	48.8	50.9	53.3	55.9	59.0	62.5	66.5	71.4	77.2
23	44.2	45.8	47.6	49.6	51.8	54.3	57.2	60.6	64.5	69.1	74.7
24	43.2	44.7	46.4	48.3	50.5	52.9	55.7	58.9	62.7	67.1	72.4
25	42.3	43.8	45.4	47.3	49.3	51.7	54.3	57.4	61.0	65.2	70.3
26	41.5	42.9	44.5	46.3	48.3	50.5	53.1	56.0	59.5	63.6	68.5
27	40.8	42.2	43.7	45.4	47.3	49.5	52.0	54.8	58.1	62.1	66.8
28	40.2	41.5	43.0	44.6	46.5	48.6	51.0	53.7	56.9	60.7	65.3
29	39.7	41.0	42.4	44.0	45.7	47.8	50.1	52.7	55.8	59.5	63.9

Carbon Emission Factors (gCO2/ton-km) for 40-44 ton Trucks with Varying Payloads and levels of empty Running
Source: Alan McKinnon, based on data from Coyle, 2007

Published Emission Factors for Rail Freight Movement (gCO2/ton-km)

Organization	All Rail Freight	Diesel-hauled	Electric-hauled	
ADEME	7.3	55		1.8
NTM	15	21		14
AEA Technology	20			
DEFRA	21			
INFRAS	22.7	38		19
TRENDS	23			
T Remove	26.3			
IFEU	35		18	

Barge CO2-emission factors (gCO2 / ton-km)

Ship type	Upstream	Downstream	Canal
Container Barges	gCO2/ton-km		
Small (90TEU)	63.4	31.3	44.5
Medium (208 TEU)	28.3	14.7	17.4
Large (500 TEU)	19.6	10.2	
Tank / Solid Bulk Barges	gCO2/ton-km		
50% load factor			
800 t	70.8	27.3	39.3
1250 t	62.6	24.1	34.3
1750 t	57.7	22.3	31.1
2500 t	46.0	18.1	25.8

Published Emission Factors for Maritime Transpor

Bulk ships	gCO2/ton-km Source
Small tanker (844 tons)	20 DEFRA
Large tanker (18,371 tons)	5 DEFRA
Deep-sea tanker (120,000 tons)	5 NTM
Small (solid) bulk vessel (1,720 tons)	11 DEFRA
Large (solid) bulk vessel (14,201 tons)	7 DEFRA
Container vessels	
Small container vessel (2,500 tons)	13,5 DEFRA
Larger container vessel (20,000 tons)	11,5 DEFRA
Average deep-sea container vessel	8,5 BSR/Clean Cargo
(assuming mean 11-tone load per TEU)	
All maritime	**14 TRENDS**

Source: Alan McKinnon

Assumption on distances:

Bridge: 1650 meters.

Annex 9

Case Study on the Congo Basin MRV Regional Project (Phase I)

This section presents the methodology and the main data and assumptions used in the case study on the Congo Basin MRV project.

Main data sources

The main sources of the data in this case study were:

- UN-REDD Programme Evaluation report, 2014
- Plan de Convergence COMIFAC, 2004
- OFAC report on the state of forests, 2015
- CIFOR state of the Congo Basin forest, 2015
- IPCC 2006 Guidelines
- AfDB's project documentation

Methodological notes and Main Assumptions

The following equation was used to determine the mitigation potential mitigation potential of the MRV project:

GHG emissions avoided = Baseline GHG emissions minus Project GHG emissions

The amount of CO2 sequestrated on the forest land corresponds to the difference between CO2 emissions and removals by the forest under consideration. The CO2 emissions and removals on land converted to a new land-use category include annual changes in carbon stocks in above-ground and below-ground biomass. Possible conversions include conversion from non-forest to Forest Land, Cropland and Forest Land to Grassland, and Grassland and Forest Land to Cropland. However, at the Tier 1 level of the IPCC 2006 methodology that was applied to this case, the assumed level of change in below-ground biomass carbon stocks, is assumed to be zero. Dead wood and litter pools are lumped together as 'dead organic matter', because they belong to non-forest land-use categories, whose carbon stocks are assumed to be zero.

Avoided Deforestation

Starting from an initial forest area of 178 million hectares in 2010, the annual rate of deforestation was assumed to decrease linearly from 0.19 percent to the target of 0.10 in 2015 and to remain at this level afterwards over the study period.

Projected Deforestation and Avoided Deforestation (in millions of Hectares)

	Baseline scenario	Project scenario	Avoided deforestation
2010	178.00	178.00	0.00
2011	177.66	177.70	0.04
2012	177.32	177.43	0.11
2013	176.99	177.20	0.21
2014	176.65	177.01	0.35
2015	176.32	176.83	0.51
2016	175.98	176.65	0.67
2017	175.65	176.47	0.83
2018	175.31	176.30	0.99
2019	174.98	176.12	1.14
2020	174.65	175.95	1.30
2021	174.31	175.77	1.46
2022	173.98	175.59	1.61
2023	173.65	175.42	1.77
2024	173.32	175.24	1.92
2025	172.99	175.07	2.07
2026	172.67	174.89	2.23
2027	172.34	174.72	2.38
2028	172.01	174.54	2.53
2029	171.68	174.37	2.69
2030	171.36	174.19	2.84
2031	171.03	174.02	2.99
2032	170.71	173.85	3.14
2033	170.38	173.67	3.29
2034	170.06	173.50	3.44
2035	169.73	173.33	3.59
2036	169.41	173.15	3.74

2037	169.09	172.98	3.89
2038	168.77	172.81	4.04
2039	168.45	172.63	4.18
2040	168.13	172.46	4.33
Total	**2172**	**1219**	**953**

Avoided CO2 emissions

The calculation was based on the IPCC default carbon fraction of 0.47 per ton of biomass and a density of 468 tons of biomass per hectare, yielding 220 tons of CO2 released in the atmosphere per hectare deforested.

Emission of CO2 due to deforestation (in millions of tCO2)			
	Baseline scenario	**Project scenario**	**Avoided emissions**
2011	74.40	66.57	7.83
2012	74.26	58.64	15.62
2013	74.12	50.75	23.38
2014	73.98	42.88	31.10
2015	73.84	38.94	34.90
2016	73.70	38.90	34.80
2017	73.56	38.86	34.70
2018	73.42	38.82	34.60
2019	73.28	38.79	34.49
2020	73.14	38.75	34.39
2021	73.00	38.71	34.29
2022	72.86	38.67	34.19
2023	72.73	38.63	34.09
2024	72.59	38.59	33.99
2025	72.45	38.55	33.90
2026	72.31	38.51	33.80
2027	72.17	38.48	33.70
2028	72.04	38.44	33.60
2029	71.90	38.40	33.50
2030	71.76	38.36	33.40
2031	71.63	38.32	33.30
2032	71.49	38.28	33.21
2033	71.36	38.25	33.11
2034	71.22	38.21	33.01
2035	71.08	38.17	32.91
2036	70.95	38.13	32.82
2037	70.81	38.09	32.72
2038	70.68	38.06	32.62
2039	70.55	38.02	32.53
2040	70.41	37.98	32.43
Total	**2 171.70**	**1 218.75**	**952.95**

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