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INTERNATIONAL MASTER'S PROGRAM IN ENERGY AND GREEN HYDROGEN (IMP-EGH)

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MASTER THESIS

Speciality: Economics/Policies/Infrastructures and Green Hydrogen Technology

Topic:

The Effect of Institutions on the Production of Renewable Energy in West African Countries: A Quantitative Assessment

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Dedication

I dedicate this work with all my love and thankfulness to my lovely parents for their constant support and encouragement. I also dedicate this work with respect and gratitude to my supervisors, Dr Lansana Cissokho, MSc Marcel Kottrup, and MSc Richa Adhikari, who have served as my mentors and advisors.

Declaration of Authorship

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Acronyms And Abbreviations

AFDB	African Development Bank
AU	African Union
CO2	Carbon Dioxide
COP	Conference of the Parties
ECO	Economic Cooperation Organisation
ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EE	Energy Efficiency
EEEP	ECOWAS Renewable Energy Efficiency Policy
EREP	ECOWAS Renewable Energy Policy
ERERA	ECOWAS Regional Electricity Regulatory Authority
EU	European Union
FD	Financial Development
FDI	Foreign Direct Investment
FE	Fixed Effect
GDP	Gross Domestic Product
GWh	Gigawatt hour
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
MENA	Middle East and North Africa
MW	Megawatt
NEEAP	National Energy Efficiency Action Plan
NREAP	National Renewable Energy Action Plans
OMVG	The Senegal River Basin Development Organisation
OMVS	The Gambia River Basin Development Organisation
RE	Random Effect
RE	Renewable Energy
RPS	Renewable Portfolio Standards
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
UN	United Nations
US	United States
WACEC	West Africa Clean Energy Corridor
WAPP	West African Power Pool
WDI	World Development Indicators

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Abstract

In response to pressing challenges of climate change and growing global energy demand, governments and policymakers worldwide have recognised renewable energy as the key solution for mitigating climate change and meeting global energy needs through clean, sustainable energy production. However, several factors may influence the development of renewable energy production, among which institutional quality is important. While the relationship between institutional quality and renewable energy production has been widely studied in various regions, limited research exists on this topic within the context of West Africa. To fill this gap, the present study investigates the effect of institutional quality on renewable energy production in the 15 West African countries from 2000 to 2020. A distinctive feature of this study is the use of two dependent variables: renewable energy production and renewable electricity output as a percentage of total energy production. These variables provide a comprehensive quantitative assessment of renewable energy production and its structure. Using a panel data regression model, this research reveals key findings with important policy implications. The results provide empirical evidence that the quality of institutions has a significant effect on renewable energy production. Moreover, foreign direct investment shows no significant influence on renewable energy production. In contrast, natural resources have a negative effect on renewable energy production, indicating a type of natural resource curse effect. Additionally, economic growth measured by gross domestic product and financial development has a positive effect on renewable energy production. These findings highlight the importance of strengthening institutional frameworks and promoting economic and financial development to scale up renewable energy production in West Africa. Recommendations are also made to policymakers to prioritise anti-corruption efforts, uphold the rule of law, and support mechanisms that improve accountability to create a favourable environment for clean energy investment.

Keywords: Institutional Quality, Climate Change, Renewable Energy, West Africa, Panel data.

Résumé

Face aux défis pressants du changement climatique et à la demande énergétique mondiale croissante, les gouvernements et les décideurs politiques du monde entier ont reconnu les énergies renouvelables comme la solution clé pour atténuer le changement climatique et répondre aux besoins énergétiques mondiaux grâce à une production d'énergie propre et durable. Cependant, plusieurs facteurs peuvent influencer le développement de la production d'énergie renouvelable, parmi lesquels la qualité des institutions est importante. Bien que la relation entre la qualité des institutions et la production d'énergie renouvelable ait été largement étudiée dans diverses régions, peu de recherches existent sur ce sujet dans le contexte de l'Afrique de l'Ouest. Pour combler cette lacune, la présente étude examine l'effet de la qualité des institutions sur la production d'énergie renouvelable dans les 15 pays d'Afrique de l'Ouest de 2000 à 2020. Une caractéristique distinctive de cette étude est l'utilisation de deux variables dépendantes : la production d'énergie renouvelable et la production d'électricité renouvelable en pourcentage de la production totale d'énergie. Ces variables fournissent une évaluation quantitative complète de la production d'énergie renouvelable et de sa structure. À l'aide d'un modèle de régression sur données de panel, cette recherche révèle des conclusions clés ayant d'importantes implications politiques. Les résultats fournissent des preuves empiriques que la qualité des institutions a un effet significatif sur la production d'énergie renouvelable. De plus, l'investissement direct étranger ne montre aucune influence significative sur la production d'énergies renouvelables. En revanche, les ressources naturelles ont un effet négatif sur la production d'énergie renouvelable, ce qui indique une malédiction des ressources naturelles. De plus, la croissance économique mesurée par le produit intérieur brut et le développement financier a un effet positif sur la production d'énergie renouvelable. Ces résultats soulignent l'importance de renforcer les cadres institutionnels et de promouvoir le développement économique et financier pour accroître la production d'énergie renouvelable en Afrique de l'Ouest. Des recommandations sont également formulées aux décideurs politiques pour qu'ils donnent la priorité à la lutte contre la corruption, au respect de l'État de droit et au soutien des mécanismes qui améliorent la responsabilisation afin de créer un environnement favorable aux investissements dans les énergies propres.

Mots-clés : Qualité des Institutions, Changement Climatique, Energie Renouvelable, West Africa, Données de Panel.

Introduction

1. Background and Context

Climate change is one of the most urgent challenges faced by humanity. Human-caused global warming had already surpassed 1°C above pre-industrial levels by 2017, according to the recent study by the Intergovernmental Panel on Climate Change (IPCC) (Roy et al., 2018). The threat that global warming poses to human existence is real and imminent, causing an increase in temperature, glaciers melting, rising sea levels, drought, and devastation of ecosystems (Uzar, 2020a). In response to the pressing challenges of global warming and climate change driven by the use of fossil fuels, the transition to clean and sustainable energy has become imperative. Renewable energy sources have been pointed out as an important alternative to produce clean, reliable and sustainable energy while helping to meet global energy demand, mitigate climate change, reduce greenhouse gas emissions, and achieve sustainable development goals (SDGs) (Chapel, 2022; Lee et al., 2023). Renewable energies are more than just an alternative to fossil fuels. They are the only pathway to guarantee both climate preservation and sustainable economic development (E. Joseph & C. Charles, 2021). Furthermore, developed countries have urged developing countries to take an active role in the global environmental agenda by expanding the scope of adoption of solutions to mitigate the impacts of climate change (Stern, 2017). This demand is emphasised during major international conferences, which include the United Nations Climate Change Conferences, COP 15 in Copenhagen, Denmark, between 7-18 December 2009, COP 16 in Cancun, Mexico, between 29 November- 10 December 2010 and COP 17 in Durban, South Africa 28 November- 9 December 2011. These Conferences are some of the most important venues for negotiations, cooperation, and the global distribution of climate change adaptation and mitigation strategies (Abanda et al., 2012).

Institutions such as governments, regulatory bodies, legal systems, and financial organisations are important because they provide the rules, norms, and frameworks that structure how societies function (North, 1990). In this context, neglecting the influence of institutions will result in an incomplete understanding of the energy transition because it is, without question, a political decision. Therefore, policymakers increasingly recognise the importance of developing this sector, due to its potential to foster economic growth and promote environmental sustainability (Bellakhal et al., 2019). This recognition reflects an understanding of the sector's role in supporting sustainable development goals, improving resource efficiency and contributing to the transition to a low-carbon economy. These advantages have to be supported by political and economic institutional frameworks, which serve an essential role in the effective implementation of policies. Moreover, the effectiveness of these institutions largely depends on their quality.

2. Problem Statement

In Africa, the energy transition is intensified by urgent domestic needs. The continent is still the most energy-poor in the world, with millions of people lacking a reliable electricity supply. According to the 2024 Renewables Energy Global Status Report (REN21, 2024), in 2023, the number of people without access to electricity was around 745 million. Approximately 570 million people live in sub-Saharan Africa. Africa's energy mix is still dominated by fossil fuels, and the continent is moving slowly towards clean energy sources compared to other regions (Schwerhoff & Sy, 2019). However, West Africa has great renewable energy potential, which could be tapped to transform its energy future. Therefore, one of the major objectives set in the continent's economic development agenda is for all Africans to have access to modern, clean energy. The achievement of this goal requires the institution's implication by providing good rules and support to public and private initiatives.

The consequences of climate change have ramifications for energy security as well (Avila et al., 2017). With 171 million out of the 350 million people living without power, when most of the ECOWAS countries still have access to electricity below 50%. Eight[1] of the fourteen countries in the region primarily depend on fossil fuels to meet their electricity needs.

In acknowledgement of this, the majority of African and West African nations have ratified several international accords and protocols in recognition of the Sustainable Development Goals (SDGs), the Paris Agreement (PA), Agenda 2063 of the African Union (AU), the Africa Clean Energy Corridor, and the Renewable Energy Policies of the ECOWAS are prominent examples of these.

As shown in Fig. 1, the scatter plots of renewable energy production against six Governance Indicators: Control of Corruption, Governance Effectiveness, Political Stability, Rule of Law, Regulatory Quality, and Voice and Accountability for West African countries. In most cases, the data points are clustered in the lower-left quadrants, indicating that both governance scores and renewable energy production levels are generally low across the region. Only a few countries show relatively higher governance scores and renewable energy production. The

[1] Benin, Burkina Faso, Guinea-Bissau, Liberia, Niger, Nigeria, Sierra Leone, and Togo.

overall pattern highlights the dual challenge facing West Africa: weak governance performance and limited renewable energy generation. These findings underline that every country must build strong institutions with comprehensive policies to facilitate a successful energy transition. However, it also underscores significant room for improvement, particularly by emphasising the critical role of institutions in making the energy transition.

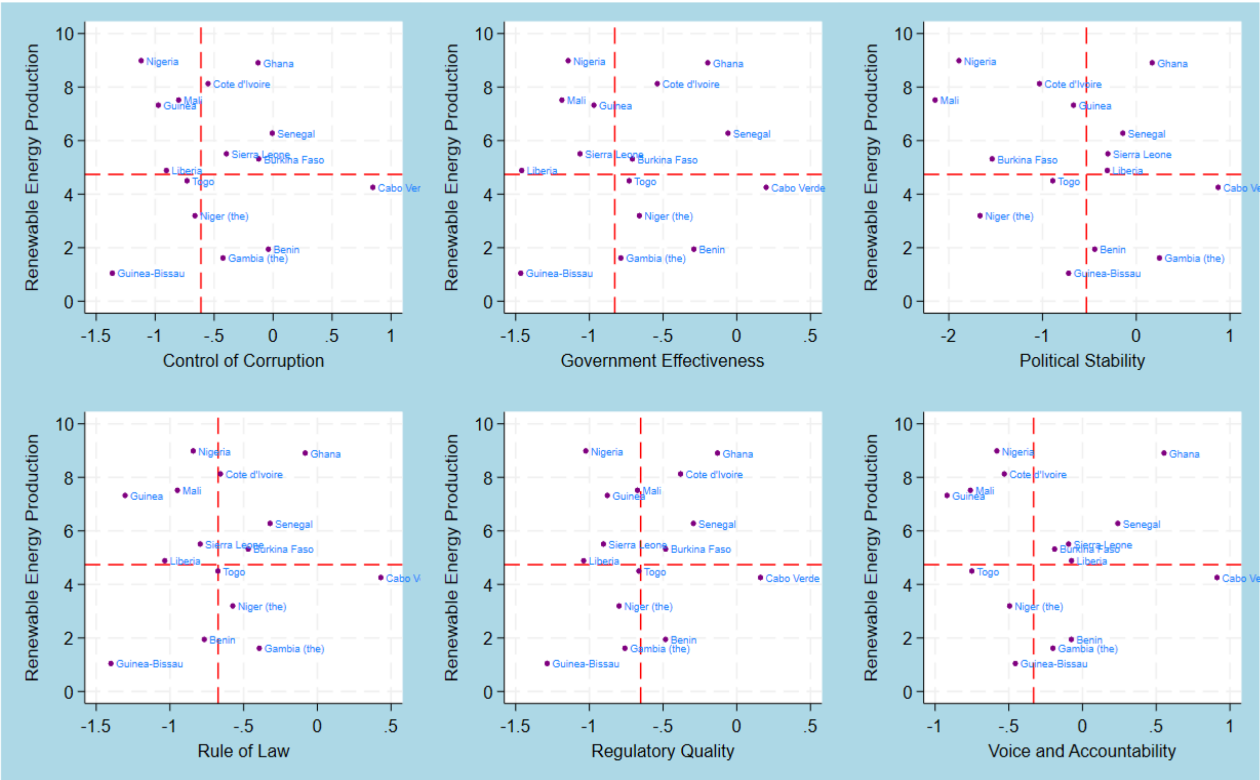

Figure 1: Renewable Energy Production and Governance Quality in West Africa, 2000-2020

Source: Authors' calculation

Although there are few studies on the effect of institutional quality on renewable energy production, the research concerning West Africa remains very limited, to our knowledge. In the meantime, it has been argued that the advancement of renewable energy sector depends on the quality of institutions or governance within a region or country.

Despite the growing body of research on this interesting topic, there is a lack of comprehensive studies concerning West Africa. Therefore, this study seeks to explore the relationship between institutions and renewable energy production in 15 West African countries over the period 2000-2020, with the aim of encouraging policymakers to reconsider issues of energy security within the region. Developing countries, especially in West Africa, face many challenges, including persistent financial constraints that limit investment in renewable energy. Many governments operate on tight budgets, with the high upfront costs of renewable technologies and currency volatility. These financial issues are compounded by limited access to electricity, reliance on fossil fuels, and environmental problems. One of the strategic ways to overcome these challenges is to promote renewable energy, which is very important for achieving the SDGs.

3. Research Question, Objective and Structure of the Thesis

This study seeks to answer the following question: ***How does institutional quality affect renewable energy production in West Africa?***

The main objective of this study is to estimate the effect of institutional quality on renewable energy production in West Africa. By exploring this relationship, the research seeks to inform regional sustainable energy policies and contribute to academic debates.

The following section of this research is designed to provide a deeper understanding of the topic and is organised into four main chapters. Chapter 1 presents a literature review, given the background information and followed by key findings from previous studies. Chapter 2 outlines the methodology used, including the processes of data collection and analysis. Chapter 3 focuses on the results and discussion, interpreting and explaining the various findings of the study. Finally, the conclusion and recommendations present a summary of the main findings and insights drawn from the research.

Chapter I: Literature Review

1. Overview of Institutions and Renewable Energy in West African Countries

1.1. Energy Institutions

The energy sector in the West Africa region is characterised by recurring challenges such as fossil fuels dependence, reliability and quality of energy supply that need to be addressed to achieve Sustainable Development Goal (SDG) 7, which goal is to ensure universal access to affordable, reliable and modern energy services. The region has a low access rate to electricity, 57.4% (ECREEE, 2022), with insufficient capacity for electricity generation and distribution, low reliability of energy supply, relatively high costs, low penetration of renewable energy, and very high unmet demand (Ishaku et al., 2022).

The ECOWAS region has one of the highest potentials for energy production in Africa. This applies to both non-renewable and renewable sources. However, the transition to renewable energy has been slow, due to some factors such as dependence on fossil fuels, infrastructure limitations, socio-economic and political reasons (Mewenemesse & Yan, 2023; Soremi, 2023). The region has made significant strides in promoting renewable energy through various policy instruments and international cooperation (Gatete & Dikko, 2024). These issues are affecting the region's economic growth. To be able to tackle these challenges, some institutions have been founded, including:

1.1.1. West African Power Pool (WAPP)

The West African Power Pool (WAPP), established in January 2006, through Decisions A/DEC.18/01/06 and A/DEC.20/01/06, was adopted by the 29th summit of the authority of ECOWAS Heads of State and Government held in Niamey. The summit approved the articles of agreement for the establishment and operation of WAPP, and granted it the status of a specialised institution of ECOWAS to promote and develop power generation and transmission infrastructure, as well as to coordinate power exchange among the ECOWAS member states. Established with the primary objective of integrating the national power systems of West African countries into a unified regional electricity market. Since its creation, the WAPP has achieved notable progress, including the development of major interconnection projects such as the Côte d'Ivoire–Liberia–Sierra Leone–Guinea line and the Ghana–Burkina Faso line, which help link national grids. In 2018, it successfully launched the ECOWAS Regional Electricity Market, enabling initial cross-border electricity trading (WAPP, 2025).

1.1.2. ECOWAS Centre for Renewable Energy and Energy Efficiency

ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) was officially instituted by regulation C/REG.23/11/08 during the 61st session of the ECOWAS Council of Ministers held in Ouagadougou on November 29th 2008, with the mission to develop and promote Renewable Energy (RE) and Energy Efficiency (EE) (ECREEE, 2024).

1.1.3. ECOWAS Regional Electricity Regulatory Authority (ERERA)

Within the framework of the Energy Protocol and the West African Power Pool Program (WAPP), the Member States of ECOWAS established the ECOWAS Regional Electricity Regulatory Authority (ERERA) in January 2008 by supplementary Act A/SA.2/1/08 as a specialised institution of ECOWAS. ERERA's main objective is to ensure the regulation of interstate electricity exchanges and to give appropriate support to national regulatory bodies or entities of the member states (ERERA, 2025).

1.2. Renewable Energy Policies

The development of renewable energy policies in West Africa has been led by the region's abundant natural resources, socio-economic challenges, and evolution of policy frameworks. In the early 2000s, West African countries began to recognise the importance of renewable energy to address energy poverty and climate change. This period saw the establishment of regional initiatives, such as the ECOWAS Renewable Energy Policy (EREP), which aimed to promote the development of renewable energy sources in the region's overall electricity mix, including large and medium hydropower plants. The policy set a target of 35% by 2020 and 48% by 2030 for the overall energy mix, excluding large and medium hydropower plants, to 10% by 2020 and 19% by 2030 to improve energy access (Mewenemesse & Yan, 2022a; Gatete & Dikko, 2024). Under the framework of EREP, ECOWAS member states have set a focus on sustainable energy for all goals by developing National Renewable Energy Action Plans (NREAP) and the National Energy Efficiency Action Plan (NEEAP) (table 1). The West Africa Clean Energy Corridor (WACEC), which was initiated in 2016 through the collaboration of IRENA, ECREEE, WAPP, and ERERA, aims to promote the development and integration of renewable energy into West Africa's electricity system. It builds on efforts already made in the region to facilitate electricity trade and optimise the use of renewable energy sources in ECOWAS member states (IRENA, 2019). In 2023, ECOWAS introduced the Green Hydrogen Policy and Strategy to promote hydrogen production, to achieve 0.5 million tons of green hydrogen per year by 2030 and at least 10 million tons by 2050 (ECOWAS, 2023).

Table 1: Renewable Energy target of ECOWAS member states

Country	Renewable Energy Targets	Policy Option	Source
Benin	64.7% of RE in the electricity mix by 2020 35.14% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan (NREAP) (2015)*	*(Ministère de l'Energie, des Recherches Pétrolières et Minières et du Developpement des Energies Renouvelables du Benin, 2015)*
Burkina Faso	9% of RE in the electricity mix by 2020 9% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan (NREAP) (2015)*	*(Ministère des Mines et de l'Energie, 2015)*
Cape Verde	The ultimate goal is to generate 50% of the country's energy from renewable sources by 2030.	*National Renewable Energy Action Plan (NREAP) (2015)*	*(General Directorate for Energy, 2015)*
Côte d'Ivoire	34% of RE in the electricity mix by 2020 42% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan (NREAP) (2015)*	*(Ministère du Pétrole et de l'Energie, 2016)*
The Gambia	28% of RE in the electricity mix by 2020 26% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan (NREAP) (2015)*	*(The Republic of The Gambia, 2014)*
Ghana	Ghana aims to produce 1,700 MW of electricity from renewable sources by 2020.	*National Renewable Energy Action Plan (NREAP) (2015)*	*(Ministry of Energy of Ghana, 2015)*
Guinea	60.98% of RE in the electricity mix by 2020 90% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan (NREAP) (2015)*	*(Sustainable Energy for All, 2015)*
Guinea Bissau	3.6% of RE in the electricity mix by 2020 58% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan (NREAP) (2015)*	*Ministerio da Energia e Industria, 2017)*
Liberia	62.7% of RE in the electricity mix by 2020 75% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan (NREAP) (2015)*	*(Sandikie, 2015)*
Mali	49.3% of RE in the electricity mix by 2020 37.1% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan NREAP (2015)*	*(Bagui DIARRA & Edgar BLAUSTEIN, 2015)*
Niger	40% of RE in the electricity mix by 2020 57% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan NREAP (2015)*	*(Ministère de l'Energie et du Développement des Energies Renouvelables, 2015)*
Nigeria	38% of RE in the electricity mix by 2020 29% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan NREAP (2015)*	*(Ministry of Power, Works and Housing of Nigeria, 2016)*
Senegal	20% of RE in the electricity mix by 2020 23% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan NREAP (2015)*	*(Ministère de l'Energie et du Développement des Energies Renouvelables Sénégal, 2015)*
Sierra Leone	52.3% of RE in the electricity mix by 2020 65.3% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan NREAP (2015)*	*(Ministry of Energy Sierra Leone, 2015)*
Togo	17% of RE in the electricity mix by 2020 20% of RE in the electricity mix by 2030	*National Renewable Energy Action Plan NREAP (2015)*	*(Ministère des Mines et de l'Energie Togo, 2015)*

Table 2: Current Status of Renewable Energy in ECOWAS countries

Country	NREAPs indicators	Results in 2022	2030 Targets
Benin	Access rate to electricity	38,0%	100,0%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	3.4%	35.1%
Burkina Faso	Access rate to electricity	27%	65%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	14.6%	9%
Cabo Verde	Access rate to electricity	92%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	17.8%	-
Cote d'Ivoire	Access rate to electricity	85%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	23.6%	42%
The Gambia	Access rate to electricity	63.0%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	0.7%	26%
Ghana	Access rate to electricity	89%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	3.6%	-
Guinea	Access rate to electricity	55.0%	57.4%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	90.6%	-
Guinea Bissau	Access rate to electricity	24%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	8.7%	75%
Liberia	Access rate to electricity	29%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	10.6%	95%
Mali	Access rate to electricity	53.4%	87.0%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	25.1%	37%
Niger	Access rate to electricity	20%	60%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	1.0%	57%
Nigeria	Access rate to electricity	59%	90%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	24.3%	29%
Senegal	Access rate to electricity	76%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	14.7%	23%
Sierra Leone	Access rate to electricity	25%	92%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	50.9%	65%
Togo	Access rate to electricity	58%	100%
	Renewable energy generation in the electricity mix in % (including medium and large hydro)	20.2%	20%

Source: (ECREEE, 2022)

West African countries have made notable strides in advancing renewable energy through regional policies, cross-border initiatives, and growing investment in solar, hydro, and wind resources. However, the implementation of these policies was often hindered by inadequate funding, political instability, and a lack of institutional capacity (Ackah & Graham, 2021; Mewenemesse & Yan, 2022). Following this perspective, Mewenemesse & Yan (2023b) investigated the renewable energy transition in ECOWAS countries, which encounter several policy formulation and implementation challenges. They evaluated 75 policies from all ECOWAS member states across four categories: energy access, energy efficiency, renewable energy, and climate change. Using multicriteria decision analysis, they also compared the progress of two key regional policies, the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP). The results show that only a few policies are truly effective, indicating that much more effort has to be made across the region. However, some countries, such as Senegal, are demonstrating notable progress. This is reflected in Senegal's top scores of 76.88 for its NREAP and 73.25 for its NEEAP. The current trends in renewable energy policies in West Africa reflect a growing commitment to address energy poverty.

1.3. Renewable Energy Potential

There is significant renewable energy potential, especially hydro, solar, biomass and wind available in West Africa that is technically viable and offers opportunities for economic development. These energy resources are abundant and relatively evenly distributed across the regions. According to the International Renewable Energy Agency (IRENA) and the African Development Bank (AFDB), the potential in the region is estimated at 1,956 GW for solar energy, 106 GW for wind and 162 GW for hydro (WREI, 2022). This highlights the richness of resources in West Africa, as well as the diversity of potential for renewable energy among the member countries.

The result is a portrait of great, but largely unreleased, potential. Most of the renewable potential in the region is in solar energy. Among West African countries, Nigeria, with 500,000 MW of PV potential, along with Niger and Mali, holds the most significant potential for solar PV. This reflects the area's high solar irradiation and vast land endowment, especially in the Sahel. Although the potential for solar CSP (Concentrated Solar Power) is not vast, it is particularly concentrated in Niger and Mali (171,136MW and 103,658 MW) and, as such, they could support large-scale solar thermal generation. This dominance means that solar can establish itself as the foundation of the region's clean energy transition, for both grid-connected systems and decentralised solutions.

Wind energy, known for being underrated in Africa, shows impressive results as well. Niger and Nigeria have wind energy potential, respectively 54,156 MW and 44,024 MW. Senegal and Mali, for example, have large wind resources. This points towards wind constituting a substantial portion of the overall energy mix of West Africa, especially when coupled with solar in seasonal balancing hybrid systems.

Small hydropower is not yet over in terms of being relevant in Ghana, Nigeria, and Sierra Leone, all have large untapped potential when it comes to this area. In addition, regional hydropower initiatives such as the Senegal River Basin Development Organisation (OMVS) and the Gambia Basin Development Organisation (OMVG), along with other projects like the Bui Dam in Ghana and the Kainji and Jebba dams in Nigeria, illustrate the significant role already played. However, small hydro has the potential to aid in rural electrification and provides a reliable complement to variable renewables (where it's viable, which is limited or zero potential for many countries). A second major but frequently overlooked resource is biomass. A number of countries, such as Nigeria and Ghana, have high biomass potentials estimated at above 3,000 and 7,000 MW, respectively. These resources are especially beneficial in agricultural economies that can conduct waste-to-energy projects and industrial cogeneration. However, to realise this potential would still mean tackling issues such as the supply of feedstock, logistics and sustainable harvesting.

Table 3: Estimates of technical potential for renewable energy in ECOWAS countries

	Small hydro (MW)	Solar CSP (MW)	Solar PV (MW)	Biomass (MW)	Wind (MW)
Benin	187	0	3,532	761	322
Burkina	38	0	82,556	1,075	9,881
Côte d'Ivoire	41	213	28,919	3,260	2,548
Gambia	12	953	428	60	44
Ghana	1,245	229	20,295	4,449	2,014
Guinea	198	2,774	37,569	1,732	2,114
Guinea-Bissau	0	2,583	1,043	205	101
Liberia	66	41	2,871	1,375	192
Mali	117	103,658	298,812	447	7,962
Niger	0	171,136	442,931	266	54,156
Nigeria	735	36,683	492,471	7,291	44,024
Senegal	0	5,424	37,233	466	4,531
Sierra Leone	330	111	1,885	587	131
Togo	144	0	2,686	378	73
Total	3,113	323,805	1,453,231	22,352	130,151

Source: (IRENA, 2018)

1.4. Renewable Energy Production

For decades, the fossil-fuel based electricity production in West Africa involved an important dependence on oil and natural gas. According to historical data, West Africa had 58% of oil, 38% of natural gas and 4% of renewables in energy consumption in 2004 (Nwokocha et al., 2013). In 2025, electricity generation from fossil fuels reached 53.37 billion kWh (Statistica, 2025). Thus, renewable energy generation in West Africa has an important role in the need to tackle power deficits, decrease carbon emissions, and foster sustainable growth for the region.

From the ECREEE status report 2014, the installed capacity of grid-connected non-hydro renewable energy provided 39 MW of grid-connected electricity in the region. At the same time, the total installed capacity, including hydro-generated electricity, was 4.8 GW. Guinea-Bissau, Ghana, and Sierra Leone stand out as regional leaders in terms of the renewable contribution to their final consumption of 30.3%, 22.4% and 19% as a result of their use of modern biomass. The total installed capacity from hydropower accounted for 57% in Ghana, 34.2% in Guinea, 28.8% in Togo, 28.2% in Côte d'Ivoire and 16.2% in Nigeria. The installed grid-connected solar PV was 6.4 MW in Cabo Verde. The installed capacity of solar PV technology was 21MW in Senegal, 20 MW in Nigeria and 4 MW in Niger (ECREEE, 2015). These statistics have been improved over the years as countries have made a clear commitment to meet the needs of their population in terms of access to electricity.

According to the Regional Progress Report (ECREEE, 2022), the region's overall grid-connected electricity generation capacity increased from 27,424 MW to 28,032 MW between 2021 and 2022, making a 2.2% rise. This growth includes a 4% increase in renewable energy generation capacity, which rose from 6,784 MW to 7,059 MW (see Fig. 2).

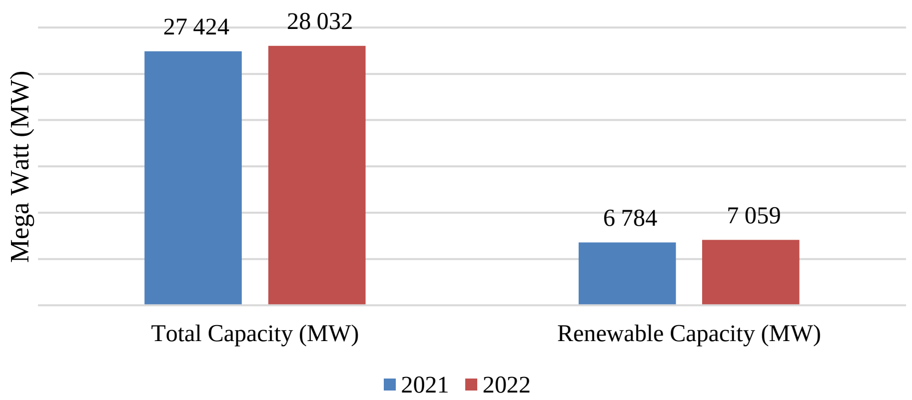

Figure 2: Total on-grid installed renewable energy generation capacity

Source: (ECREEE, 2022)

In 2022, the region's installed renewable energy capacity represented 25.2% of the total electricity mix, with the EREP target of 48% by 2030. Renewable energy sources, including small hydropower, solar photovoltaic energy, wind energy, and biofuels, accounted for 3.3% of the overall electricity mix in 2022, compared to the EREP's aim of 19% (see Fig. 3).

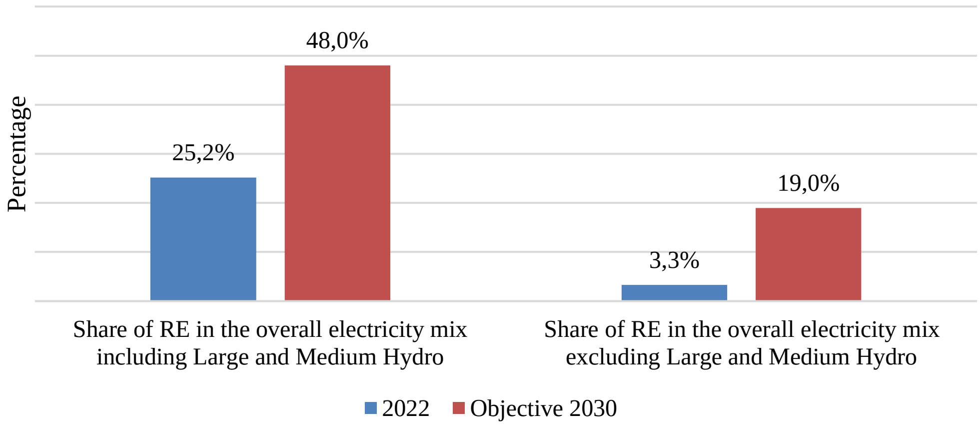

Figure 3: Share of on-grid RE installed capacity in the overall Electricity Mix
Source: (ECREEE, 2022)

The overall electricity output reached 88,966 GWh in 2022, compared to 85,431 GWh in 2021, showing an increase of 4.1%. Total electricity generation from renewable energy sources amounted to 18,074 GWh, 20.3% of the total electricity produced in 2022 (see Fig. 4). The contribution of small hydropower, solar energy, wind energy, and bioenergy to renewable electricity generation was 1,189 GWh (1.4%). At the Member State level, Nigeria, Guinea, and Côte d'Ivoire produced the most renewable energy-based power in 2022, with 7,613 GWh, 2,957 GWh, and 2,864 GWh, respectively. Together, these three countries produced 75% of the region's total renewable electricity, with large and medium-scale hydropower accounting for 98.6%.

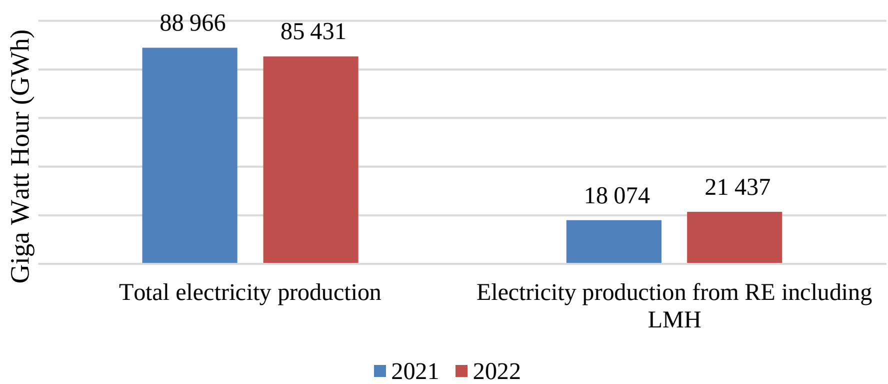

Figure 4: On-grid Renewable Energy Power Generation
Source: (ECREEE, 2022)

Despite the important progress in improving access to sustainable energy, ECOWAS member states continue to face significant challenges in meeting the targets set in the EREP and EEEP. The present access rate to electricity within the region in 2022 is 57.4% (ECREEE, 2022), demonstrating the need for considerable efforts to achieve universal access by 2030.

According to the International Renewable Energy Agency in 2015, the renewable energy share of electricity generation in West African countries was 1.22% in Benin, 9.79% in Burkina Faso, 20.27% in Cabo Verde, 15.70% in Côte d'Ivoire, 1.02% in Gambia, 51.02% in Ghana, 78.87% in Guinea, 1.16% in Guinea-Bissau, 7.63% in Liberia, 67.72% in Mali, 2.48% in Niger, 20.10% in Nigeria, 1.96% in Senegal, 74.70% in Sierra Leone and 14.76% in Togo. In 2022, the respective statistics were as follows: 3.28% in Benin, 23.79% in Burkina Faso, 16.82% in Cabo Verde, 23.65% in Côte d'Ivoire, 1.09% in Gambia, 35.88% in Ghana, 90.64% in Guinea, 10.52% in Guinea-Bissau, 52.21% in Liberia, 34.07% in Mali, 10.51% in Niger, 27.28% in Nigeria, 16.38% in Senegal, 75.06% in Sierra Leone and 14.51% in Togo (IRENA, 2025).

Though there was an increase in renewable energy capacity, its share of the total electricity mix remained low at 25.2% compared to the 48% objective set for 2030 (ECREEE, 2022). According to the EREP, the share of renewable energy in the overall electricity mix, excluding medium and large hydro, was 3.3%, significantly below the 19% target (ECREEE, 2022). Moustapha et al. (2022) assessed how renewable energy policy in ECOWAS member states affects energy intensity. The results show that renewable energy policies positively improve electricity access in the region, even if more effort is needed regarding these policies.

2. Theoretical Foundation

The international transition to sustainable energy highlights the need for institutional structures that will stimulate renewable energy development. Especially in the context of limited energy access and developing governance structures in places such as West Africa, insight into how institutions shape the Renewable Energy sector is far more relevant. Drawing from different theories (Institutional Theory, Resource Curse Theory, Development Economics theory, and Sustainability Theory), this section investigates the political, economic, and financial determinants of renewable energy in West African countries.

2.1. Institutional Theory

Institutional Theory is a key foundational framework in economics, political and social sciences, that analyses how institutions shape economic, social and political behaviours. It refers to the structured set of rules, norms, and organisations that guide the interactions and behaviours within a society or a specific domain from North (1990) perspective. This theory can be explored in the context of renewable energy production, as various studies have drawn on institutional theory to analyse the link between institutions and renewable energy production.

Institutional quality is important in facilitating the investment and implementation of policies in favour of renewable energy (Diallo & Ouoba, 2024a). To emphasise, Villar-Roldán et al. (2025) in their study on Sub-Saharan Africa underscores the important role of institutions in improving electricity access through renewable energy production by attracting more investment in the field. In West Africa, weak institutions contribute to increased carbon dioxide emissions through fossil fuel dependence, whereas strong institutions are essential to promote green technologies and improve environmental outcomes (Fagbemi & Oke, 2025). Institutional Theory helps explain renewable energy development in West Africa by showing the role of governance, regulations, and social norms.

2.2. The Resource Curse Theory

Although the idea that resource wealth can hinder economic growth was hinted at earlier, Auty (1993) was the first to explicitly frame it as the **"resource curse".** The resource curse theory posits that countries rich in natural resources, such as fossil fuels or minerals, often experience slower economic growth, weaker governance, and higher corruption than resource-poor nations. This paradox arises when natural resources are exploited, leading to undesirable political and socioeconomic outcomes (Narh, 2023a). Rentier State Dynamics (Hazem Beblawi, 1987) posits that governments dependent on resource rents may neglect institutional accountability, leading to corruption and weak governance.

In ECOWAS, fossil fuel-dependent economies such as Nigeria exemplify the resource curse, where weak institutions perpetuate reliance on oil and gas, hindering renewable energy transitions (Ologunla et al., 2014). On the other hand, strong institutions can help minimise the curse by channelling resource revenue into renewable infrastructure and ensuring transparency. For example, Saudi Arabia's diversification initiatives show how institutional reforms can help reduce dependency. Therefore, effective institutions are crucial to breaking the curse. Centralised planning, long-term development strategies, and environmental regulations are important to ensure equitable resource distribution and foster renewable energy investments (Narh, 2023b).

2.3. Economic Growth Theory

Economic Growth theory focuses on structural transformation to attain sustainable growth, emphasising the accumulation of capital, institutional capacity, human capital and technology. Accumulation of capital involves the addition of more physical capital, such as infrastructure, buildings, and equipment, which boosts economic growth and productive capacity (Garzarelli & Limam, 2019). Policies that promote more rapid accumulation of capital have a direct, immediate, and long-term impact on the rate of economic growth (HOLTZ-EAKIN, 1993).Highlighting the importance of capital accumulation, Solow (1956) model shows that capital investment contributes to increases in output over time.

Human capital and technology adoption also drive productivity, particularly in renewable energy sectors. In addition, institutional capacity, such as effective governance, ensures equitable resource allocation and minimises rent-seeking. ECOWAS energy poverty reflects underinvestment in infrastructure and human capital. Therefore, development economics highlights the necessity for institutions to prioritise renewable energy as a catalyst for development.

2.4. Sustainability Transition Theory

Sustainability transition is an institutional catalyst for systemic transformation that explains how society moves towards more sustainable systems by understanding the complex interaction of various actors, technologies, and societal structures (Geels, 2002). This theory applies to how institutions influence the production of renewable energy in ECOWAS countries. This theory emphasises the systemic shift from fossil fuels to renewables through interaction between innovative technologies, existing energy systems, and socio-political terrain (Maman Ali & Yu, 2021). For example, strategic niche development, such as Pilot projects in Burkina Faso's decentralised solar grids, thrives under supportive policies, such as tax breaks and private and public partnerships (Mewenemesse & Yan, 2023b).

3. Empirical Literature Review

The transition to renewable energy is an important aspect of the global response to climate change. A growing body of literature emphasises the importance of institutional frameworks, financial development (FD), foreign direct investment (FDI) and resource availability in driving this transition, particularly in developing regions such as West Africa (Fang et al., 2024; Osman et al., 2025; Samour et al., 2022; Shahbaz et al., 2022; Sun et al., 2023). However, empirical findings remain mixed, reflecting the diversity of economic, political, and governance contexts across regions or countries.

3.1. Institutional Quality and Renewable Energy Production

Institutions are key components in shaping the environment for renewable energy investment and production, and policy implementation. Various studies underline that strong governance, regulatory quality, and political stability promote renewable energy production and usage. Satrianto et al. (2024) provide evidence in their study that the quality of institutions has a considerable impact on renewable energy production in developing countries. The study analyses the quality of institutions in terms of governance effectiveness, voice and accountability, regulatory quality, rule of law, and foreign direct investment. The results of the study suggest that every country must have strong, quality institutions.

According to the United Nations (UN), the promotion of renewable energy development is dependent on adequate financial and other resources, such as good policies from the government (Bellakhal et al., 2019). Therefore, institutional quality remains an important component in advancing renewable energy. Mehrara et al. (2015), analysing Economic Cooperation Organisation (ECO) countries between 1992 and 2011, identified governance indicators such as rule of law, political stability, governance effectiveness, regulatory quality and control of corruption as significant determinants of renewable energy production and consumption.

Similarly, Carley (2009) found that in the United States (U.S.) between 1998 to 2006, the development of renewable energy production was significantly influenced by the presence of political institutions, which encompassed regulatory and technical aspects. In the same spirit, Omri & Ben Jabeur (2024), using data from the top 10 polluting economies, argued that climate laws alone are ineffective without strong political institutions and robust financial systems. Cadoret & Padovano (2016) supported this by demonstrating that government quality significantly impacts renewable energy deployment in the European Union (EU). The Middle East and North African (MENA) region-focused study by Saadaoui (2022) also emphasised institutional quality as essential for carbon emission reduction through renewable energy. These findings align with the institutional theory by showing that well-functioning institutions promote renewable energy investment and implementation.

The legal and institutional framework, including laws and governance structures are key mechanism for enabling the full maximisation of renewable energy potentials. It has been argued that lower corruption could encourage renewable energy investment (Zhang & Zhang, 2022). In the same line, political stability has been pointed out as one of the key drivers to promote renewable energy technologies (BELAÏD et al., 2021). In support of this assertion, Pan et al. (2023) argued that institutional development appears to encourage the growth of renewable energy.

In developing countries, Shang et al. (2023) found a strong positive correlation between governance quality and clean energy supply across 103 countries. They indicated that countries with higher national governance quality are more likely to produce and consume more clean energy. African studies reinforce these findings. For instance, Akintande et al. (2020) analysed the five most populous African countries, which are Ethiopia, South Africa, Nigeria, the Democratic Republic of Congo and Egypt, and Asongu & Odhiambo (2021), Maji et al. (2022) investigated Sub-Saharan African (SSA) countries highlighted the positive role of institutions in renewable energy production using variables such as rule of law, control of corruption, regulatory quality, political stability, governance effectiveness, voice and accountability, FDI, GDP, domestic credit provided by financial bank sector, pollution growth and trade openness.

Also, Dube & Horvey (2023) in their investigation covering 20 African countries, found that institutional quality has a significant and positive impact on renewable energy production, indicating that strong institutions boost investment in the renewable energy sector across Africa. In addition, Dossou et al. (2023) reinforce that governance quality is indeed linked to renewable energy in Sub-Saharan Africa. According to Uzar (2020b), the investigation conducted using 38 countries from 1990 to 2015 revealed that institutional quality is a key strategic choice, given its substantial impact on renewable energy production.

In their study, S. Asongu & Odhiambo (2022) assessed the nexus between governance and renewable energy in SSA. They utilised data from 1996 to 2016 to support their analysis. The findings indicate that institutional governance plays a significant role in renewable energy consumption. Subsequently, Dossou et al. (2023) examined the relationship between governance quality and renewable energy development in 37 SSA over the period 1996-2020. The findings indicate that renewable energy development is significantly associated with governance quality.

However, not all evidence is consistent. Saba & Biyase (2022), Ergun et al. (2019), Amoah et al. (2020), and Opeyemi et al. (2019) found weak or no significant institutional influence on renewable energy transitions. Notably, Pan et al. (2023) conducted a study that extensively assessed governance quality on renewable energy production in 42 African countries from 1996 to 2020. The results reveal that governance quality has a negative impact on renewable energy deployment in Africa. This shows that as governance quality increases, renewable energy development decreases. The rationale is that, in several African countries, continued reliance on non-renewable and energy-intensive production systems may be influenced by the availability of natural resources, such as oil and gas. These outcomes support the Resource Curse Theory.

3.2. Financial Development and Renewable Energy

Financial development is the process by which a country's financial system, comprising institutions, markets, instruments, and regulatory frameworks, becomes more efficient, inclusive, and robust over time (World Bank Group, 2025a). Financial development enhances access to capital and reduces risk, such as credit risk and investment uncertainty, by improving the efficiency of financial markets and providing diversified financing instruments, making ease of long-term investments in renewable energy.

Several global and regional studies support this perspective. Shahbaz et al. (2021) found that financial development significantly boosts renewable energy demand across 34 developing countries. Going in the same line, Khan et al. (2020), using data from 192 nations, and Qamruzzaman & Jianguo (2020) for 113 countries, reported similar results. Amuakwa-Mensah & Nässtrröm (2022), with a dataset covering 124 countries, confirmed these findings. Regionally, Alsaleh & Abdul-Rahim (2019) noted that financial development positively impacts bioenergy consumption in the EU. In the U.S., Pata et al. (2022) showed that it facilitates the transition away from fossil fuels. Chang et al. (2022) reported that in China, an increase in financial development has been shown to result in an increase in renewable energy consumption. The findings demonstrate that sustainability targets must be incorporated into institutional and economic systems, rather than being achieved only through policy or technological means. This assertion aligns with the economic growth theory.

In Sub-Saharan Africa, Opeyemi et al. (2019), in their research based on 42 countries, showed that while renewable energy may hinder trade under weak institutions, improvements in regulation and finance can reverse this effect. Appiah et al. (2022) found that while renewable energy impacts economic growth in SSA, institutional quality moderates this relationship negatively. Diallo & Ouoba (2024b) identified a governance threshold beyond which the effect of renewable energy on economic growth becomes positive, highlighting the need for a minimum level of institutional effectiveness. Muoneke et al. (2023) confirmed that financial development supports renewable energy in Africa, but political conflict remains a significant barrier.

In contrast, some findings deviate. For instance, Wang et al. (2021) in China, Irfan et al. (2023) in G7-E7 countries and Saba & Biyase (2022) in the EU, it was found that financial development had negative or insignificant effects on renewable energy. Similarly, Ankrah & Lin (2020) observed that in Ghana, financial development hindered renewable energy growth, while trade and foreign direct investment were more effective. Lei et al. (2022), Assi et al. (2021) and Burakov & Freidin (2017) reinforce that financial expansion does not matter in renewable energy deployment, while innovation and Gross Domestic Product (GDP) have a positive influence.

FDI has been seen as one of the financial factors which could introduce capital and technology needed for renewable energy production, especially in capital-constrained economies. Kutan et al. (2018) found that FDI promotes renewable energy production and reduces CO_2 emissions through the energy sector in countries like Brazil, China, India, and South Africa. Ahmad et al. (2011) argued that institutional improvements, particularly corruption control, can boost FDI inflows and consequently renewable energy investments. Akpanke et al. (2023), focusing on ECOWAS countries from 1990 to 2021, concluded that FDI has a long-run effect on renewable energy consumption. Awijen et al. (2022) similarly emphasised that FDI and government effectiveness are highlighted as key to renewable energy progress in MENA countries.

The literature shows a general consensus that institutional quality and financial development are essential for renewable energy transitions. However, findings remain mixed, most especially in Africa due to varied governance contexts, political priorities, and development levels, even though the region is rich in terms of renewable energy potential. Few studies focus on the West African case, and even fewer examine the effect of institutions on renewable energy production. This gap highlights the need to analyse how institutions function in West African countries.

Chapter II: Methodology

This section introduces the methodology and data used in the empirical research. The primary method employed is the panel data regression model. To assess the suitability of the selected data, a correlation test was performed, and the chosen estimation model is a random-effects model, following a Hausman test.

1. Model Specification

To quantitatively assess the effect of institutions on the production of renewable energy in West African countries, the empirical model is built following the study of Dube & Horvey (2023), Dossou et al. (2023), Alinsato et al. (2024), Kolawole et al. (2024), and Satrianto et al. (2024) to which some readjustments have been made regarding the choice of variables to achieve the objective of this study. These studies provided a strong starting point, but adjustments have been made to ensure the model aligns with the focus of my research. First, the definition of the dependent variable is renewable production, which shows progress toward a clean energy transition. For institutional quality, six world governance indicators: control of corruption, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability, capture different sides of governance. Also, Gross Domestic Product, financial development, foreign direct investment, and natural resource rents are control variables because they're important drivers of renewable energy. The final set of variables was also influenced by data availability for ECOWAS countries. The model is specified as follows:

$$\boldsymbol{logREP_{it}} = \boldsymbol{\alpha_1 Gov_{it}} + \boldsymbol{\alpha_2 logGDP_{it}} + \boldsymbol{\alpha_3 FD_{it}} + \boldsymbol{\alpha_4 FDI_{it}} + +\boldsymbol{\alpha_5 NR_{it}} + \boldsymbol{\varepsilon_{it}} \quad \textit{(Eq 1)}$$

Where: $\boldsymbol{logREP_{it}}$= renewable energy production (proxied by total renewable energy production in GWh and renewable electricity output in percentage of total electricity generation); $\boldsymbol{Gov_{it}}$= represent indicators of the quality of government measured in scale from -2.5 to +2.5 (control of corruption, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability); $\boldsymbol{logGDP_{it}}$= gross domestic product per capita (constant 2015 US$); $\boldsymbol{FD_{it}}$= financial development represents domestic credit to the private sector as a percentage of GDP; $\boldsymbol{FDI_{it}}$= foreign direct investment net inflows as a percentage of GDP; $\boldsymbol{NR_{it}}$= natural resources represent the total natural resources rents as a percentage of GDP; $\boldsymbol{i}$**:** Country (1…….15); $\boldsymbol{t}$: Time (2000……2020) and $\boldsymbol{\varepsilon_{it}}$**:** Error term.

1.1. Dependent variables

The expectation from governance indicators is to have a positive effect on total renewable energy production and renewable electricity output in West Africa. Strong control of corruption helps investment reach projects and builds investor trust (Zhang & Zhang, 2022). Government effectiveness ensures policies are carried out and infrastructure is maintained (Morell-Dameto et al., 2024). Political stability lowers risk and attracts long-term investment (Liu et al., 2021). Regulatory quality creates clear rules that encourage private sector participation (Balta-Ozkan et al., 2021). Rule of law protects contracts and property rights, giving investors' confidence (García Medina et al., 2023). And voice and accountability increase public support and keep leaders focused on clean energy goals (Dossou et al., 2023). Together, these factors make it easier to build and operate renewable energy projects.

1.1.1. Total Renewable Energy Production

Total Renewable energy production is the generation of usable energy from renewable resources such as solar, wind, hydro, and biomass. Renewable Energy Production remains important in addressing climate change, a pressing issue that negatively impacts public health and economic stability. Given priority to sustainable energy sources, societies can work towards reducing CO_2 emissions. The data on renewable energy production has been extracted from The Quality of Government Institute (QoG) dataset.

1.1.2. Renewable Electricity Output

Renewable electricity output is the gross generation of electrical energy from renewable resources measured at the output terminals of generating plants before deducting transmission and distribution losses, over a specified reporting period. Renewable Electricity Output is an important indicator when assessing the impact of institutions on renewable energy production. It demonstrates how effectively policies, regulations and investments translate into actual energy production. The data on renewable electricity output have been extracted from the World Development Indicators (WDIs) of the World Bank.

1.2. Explanatory variables

1.2.1. Governance Quality

According to institutional economists, governance is important for promoting green economic growth while avoiding human costs. Building on the work done by Dossou et al. (2023) and Alinsato et al. (2024), the institutional quality variable is measured by six indicators of institutional quality as contained in the World Governance Indicators. These include estimates of control of corruption, government effectiveness, political stability, rule of law, and voice and accountability. The estimates provide a clear score for the nation on the total measurement scale, using units from a standard normal distribution. This range is from -2.5 to 2.5. The control of corruption focuses on the degree to which public power is used for private gain. Government effectiveness measures the efficiency of government services in policy formulation and implementation. The concept of political stability encompasses the perception of the tendency towards instability within the political system. Regulatory quality is defined as the capacity of the government to formulate and implement policies and regulations that allow and promote private sector development. The rule of law is a critical component of societal stability, as it impacts perceptions regarding the extent of public confidence in and adherence to the established legal framework. Voice and accountability are key measures of a nation's citizens' participation in electing their leaders, as well as their freedom to associate and express their views. The data on governance indicators emanated from the World Governance Indicators (WGIs) of the World Bank.

1.3. Control Variables

1.3.1. Gross Domestic Product

Gross Domestic Product (GDP) is the total monetary value of all final goods and services produced within a country’s borders over a specific period. The choice of Gross Domestic Product is motivated by extensive research that has shown its relevance in supporting the transition to green energy (Hoa et al., 2023; Padhan et al., 2020). T. H. Chang et al. (2009) in their research found that higher-income countries are more likely to produce energy from renewable sources than low-income per capita countries. The data on Gross Domestic Product have been collected from the World Development Indicators (WDIs) of the World Bank.

1.3.2. Financial Development

Financial development is the process by which a country’s financial system becomes more effective, efficient, and inclusive in mobilising savings, allocating capital, managing risks, facilitating transactions, and supporting economic growth. In this study, financial development represents domestic credit to the private sector in line with the literature (Kolawole et al., 2024). The financial development of a nation has been identified as a key factor in the acceleration of economic growth and development, both in developed and developing countries (Samour et al., 2022). Recent studies have indicated a significant correlation between financial development and the promotion of renewable energy development (Hanni et al., 2011;

Mukhtarov et al., 2020). Improving financial development could therefore encourage the development of renewable energy. The data on financial development have been collected from the World Development Indicators (WDIs) of the World Bank.

1.3.3. Foreign Direct Investment

Foreign direct investment (FDI) is defined as an investment made by an entity from one country into a business or productive asset located in another country. The positive correlation between foreign direct investment and economic growth may be reflected in the expansion of the renewable energy sector (Sarkodie et al., 2020). In line with extant literature on FDI and clean energy, the present study utilises foreign direct investment flows as a percentage of GDP (Kaffo Fotio et al., 2022). Then, an improvement in foreign direct investment could facilitate the advancement of the renewable energy sector. The data on foreign direct investment have been collected from the World Development Indicators (WDIs) of the World Bank.

1.3.4. Natural Resources

Natural resources are defined as materials, substances, and environmental features that occur naturally in the environment and provide raw materials that can be used by humans to meet their needs. The link between Natural Resources (such as oil, gas, etc) and Renewable Energy is receiving great attention as prospects for sustainable development and a green economy grow (Li et al., 2023). Furthermore, understanding the relationship between natural resources and renewable energy will help to evaluate the potential risks and opportunities of sustainable energy sources. The data on natural resources have been collected from the World Development Indicators (WDIs) of the World Bank.

2. Data Analysis

2.1 Data

This study utilised secondary data obtained from the World Development Indicators and the QoG Standard Dataset to achieve the study's stated objective. It considers 15 West African countries—namely, Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo during the period from 2000 to 2020. Data on Financial Development, Foreign Direct Investment, Natural Resources, Gross Domestic Product, and Governance Quality (control of corruption, government effectiveness, political stability, rule of law, regulatory quality, and voice accountability) were collected from the World Development Indicators (WDIs) database of the World Bank (World Bank Group, 2025b). In contrast, data on total renewable electricity generation were obtained from the Quality of Government Institute (QoG) dataset (The Quality of Government Institute, 2025).

2.2 Panel Data Selection Method

Researchers prefer panel data over other methods because it allows them to see both the bigger picture and the finer details simultaneously (Hsiao, 2007). By tracking the same units, such as countries or companies, over multiple years, it also provides more data points, which leads to more reliable estimates. Additionally, panel data makes it easier to identify patterns of change and determine whether one event tends to precede another, which is critical for making stronger claims about cause and effect. As Hsiao explains, it's this combination of depth and breadth that makes panel data such a versatile and powerful tool in econometrics.

The Hausman test is used in panel data analysis to decide whether a fixed effects (FE) or random effects (RE) estimator is more appropriate. It checks whether unobserved, unit-specific effects, in this case, country-level effects, are correlated with the explanatory variables. Under the null hypothesis, these unobserved effects are uncorrelated with the dependent variables, meaning that RE is both consistent and efficient. Under the alternative hypothesis, there is a correlation, making RE inconsistent and FE the safer choice.

In the case of this study, the Hausman test failed to reject the null, indicating no significant correlation between the country effects and the regressors. As shown in Table 4, the Chi-squared statistic = 2.04 with an associated p-value of 0.8436 (well above 0.05). Which means there is no statistical evidence that the unobserved, time-invariant country effects are correlated with explanatory variables. The RE model here is estimated using generalised least squares (GLS). In this situation, RE accounts for observable and unobservable omitted variables, specifically, those that differ across countries but do not change over time and are uncorrelated with the dependent variables. These unobserved factors are captured in the model's random individual effects and do not bias the coefficient estimates or the variance of the estimated parameters.

In the context of this research, the random effects (RE) approach offers several advantages. Because the study includes governance indicators that change slowly over time, RE allows these time-invariant or near time-invariant characteristics to remain in the model, whereas fixed effects (FE) would drop them entirely. This is important for West Africa, where structural governance conditions and long-term resource endowments are critical to understanding renewable energy trends. RE leverages both within-country changes (how governance and other drivers evolve within each country) and between-country differences (how countries with stronger institutions differ from those with weaker ones), providing a more comprehensive picture of the institutional energy relationship. This dual use of variation is particularly valuable in ECOWAS, where there are differences in institutional quality, resource availability, and renewable energy potential. Reverse causality is not considered, as this study looks at how institutions affect the production of renewable energy, not whether institutions cause it.

Table 4: Hausman (1978) specification test

	Coef.
Chi-square test value	2.04
P-value	.844

Chapter III: Results and Discussion

1. Descriptive Statistics

Tables 5 display the descriptive statistics. As shown in Table 5, the mean value of Renewable Energy Production is 4.738, suggesting that some countries have very low levels of renewable energy production. The mean value of Renewable Electricity Output is 2.462. The wide range indicates variation among countries in their contributions to renewable electricity (see Fig. 6). This implies that renewable energy deployment in West Africa remains limited. The mean value of governance quality indicators reflects generally weak institutional performance in the region (see Fig. 5).

Control of Corruption has a mean of -0.612, indicating moderate to low levels of corruption control. Governance Effectiveness (-0.828) suggests that public services and policy implementation are generally perceived as less effective. Political Stability (-0.531) reflects a moderate degree of political instability across countries. The Rule of Law (-0.673) indicates weak enforcement of laws and property rights in many countries. Regulatory Quality (-0.652) indicates limited capacity to formulate and implement good regulations. Voice and Accountability (-0.332) suggests that political participation and freedom of expression are constrained in many countries. Overall, these figures indicate that institutional quality in West Africa is quite low.

The average value of Gross Domestic Product is 6.83, which likely reflects a log-transformed GDP, indicating large economies with some variations. Meaning that even though the average is 6.83, there are differences between countries; some economies are bigger, others smaller, but the average still corresponds to relatively large economies. Table 5 also shows that the mean value of foreign direct investment is 0.045% of GDP. This is relatively low compared to regions like Asia and Latin America (Asiedu, 2006). Financial development, with a mean value of 0.148% of GDP, indicates relatively low to moderate levels of financial system development. The mean value of Total Natural Resources is 0.104% of GDP, which may influence countries' energy choices.

Table 5: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent variables					
Total Renewable Energy Production (TREP)	288	4.738	2.783	2.564	9.479
Renewable Electricity Output (REO)	287	2.462	1.724	1.808	4.525
Explanatory variables					
Control of Corruption (CC)	315	-.612	.536	-1.596	1.127
Governance Effectiveness (GE)	315	-.828	.441	-1.806	.341
Political Stability (PS)	315	-.531	.828	-2.403	1.224
Rule of Law (RL)	315	-.673	.543	-1.881	.662
Regulatory Quality (RQ)	315	-.652	.386	-1.856	.161
Voice and Accountability (VA)	315	-.332	.595	-1.46	.975
Control variables					
Log Gross Domestic Product (GDP)	315	6.83	.539	5.974	8.323
Financial Development (FD)	313	.148	.118	0	.685
Foreign Direct Investment (FDI)	314	.045	.102	-.026	1.033
Total Natural Resources (TNR)	315	.104	.07	.02	.492

2. Correlation Matrix

The correlation matrix has been presented in Table 6. As shown in Table 6, there is a positive correlation between gross domestic product and renewable energy. This means that gross domestic product might promote green energy. Moreover, negative correlations are also seen between governance quality, financial development, foreign direct investment and renewable energy development. In other words, as governance quality, financial development, and FDI increase, renewable energy development tends to decrease. This is about the statistical association (correlation), not about proving one causes the other.

As presented in Table 6, there is a strong positive correlation (0.773) between Total Renewable Energy Production and Renewable Energy Output. This indicates that countries with higher levels of renewable energy production tend to have greater renewable output. In other words, scaling production appears to scale output. Furthermore, the correlation among governance indicators reveals significant consistency. For instance, Rule of Law and Governance Effectiveness are strongly correlated (0.878), as are Regulatory Quality and Governance

Effectiveness (0.866), and Voice and Accountability and Control of Corruption (0.771). These findings support a holistic understanding of governance, suggesting that progress in one institutional dimension could reinforce improvements in others.

Gross Domestic Product is also positively correlated with governance quality, showing moderate correlations with Governance Effectiveness (0.443), Voice and Accountability (0.411) and Regulatory Quality (0.354). This implies that countries with strong economies tend to have better institutions. The correlation between Gross Domestic Product and Total Renewable Energy Production (0.371) suggests that higher national income may not guarantee sustainability.

Total Natural Resources exhibits a near-zero correlation with Total Renewable Energy Production (0.013) and a weak, positive correlation with Renewable Electricity Output (0.236). This suggests that resource-rich countries could not prioritise renewable energy, potentially due to a reliance on fossil fuels. Moreover, Total Natural Resources shows a weak correlation with GDP (0.158), FD (0.380), as well as weak and negative correlations with Rule of Law (-0.014), Regulatory Quality (-0.236), and Political Stability (-0.007). These patterns support the resource curse theory, which posits that natural resource abundance may hinder institutional development, reduce transparency, and less accountability. Foreign Direct Investment presents negligible and slightly negative correlations with both Total Renewable Energy Production (-0.036) and Renewable Electricity Output (0.016), indicating that Foreign Direct Investment could not currently be a significant driver of renewable energy development in West Africa

Table 6: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Total Renewable Energy Production	1.000											
Renewable Energy Output	0.773	1.000										
Control of Corruption	-0.140	-0.213	1.000									
Governance Effectiveness	-0.020	-0.307	0.821	1.000								
Political Stability	-0.433	-0.322	0.654	0.584	1.000							
Rule of Law	-0.149	-0.303	0.877	0.876	0.747	1.000						
Regulatory Quality	0.035	-0.251	0.749	0.866	0.589	0.844	1.000					
Voice and Accountability	-0.085	-0.217	0.771	0.734	0.691	0.838	0.669	1.000				
Log Gross Domestic Product	0.371	0.100	0.417	0.443	0.110	0.354	0.325	0.411	1.000			
Financial Direct Investment	-0.088	0.074	0.036	-0.102	0.036	-0.029	-0.149	0.040	-0.077	1.000		
Financial Development	-0.001	-0.093	0.747	0.595	0.410	0.664	0.553	0.611	0.575	-0.021	1.000	
Total Natural Resources	0.013	0.234	0.131	-0.086	0.007	-0.014	-0.236	0.100	0.158	0.380	0.220	1.000

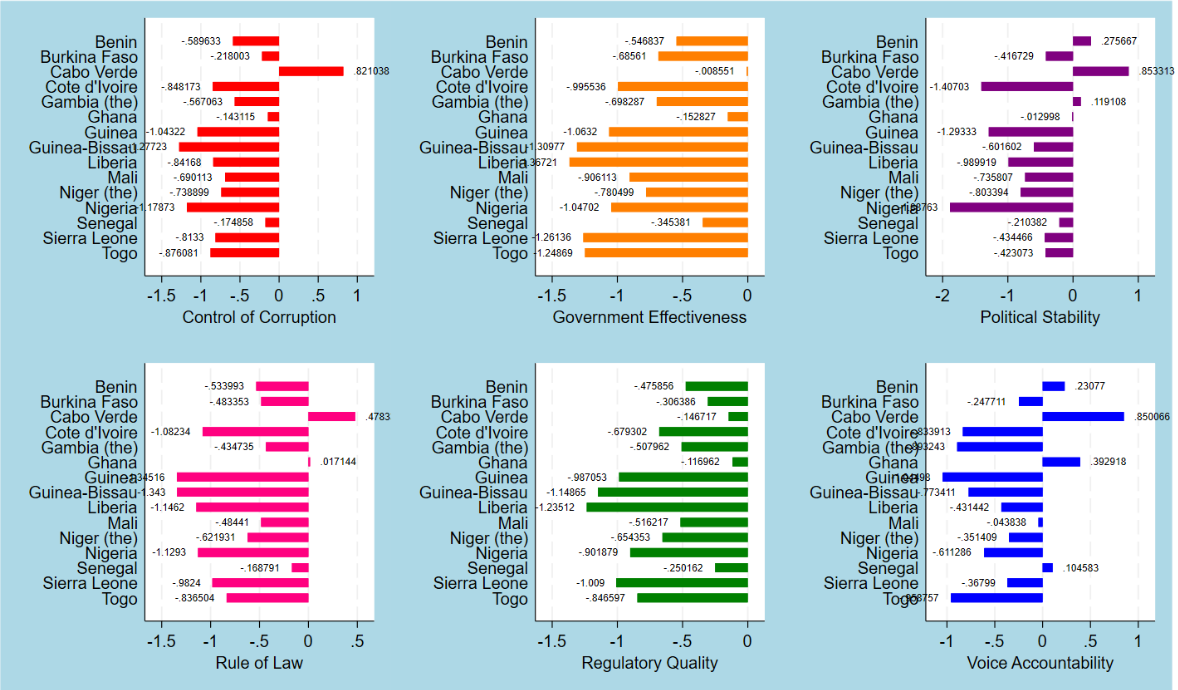

Figure 5: Average of Governance Indicators in West Africa, 2000-2020
Source: Authors' calculation

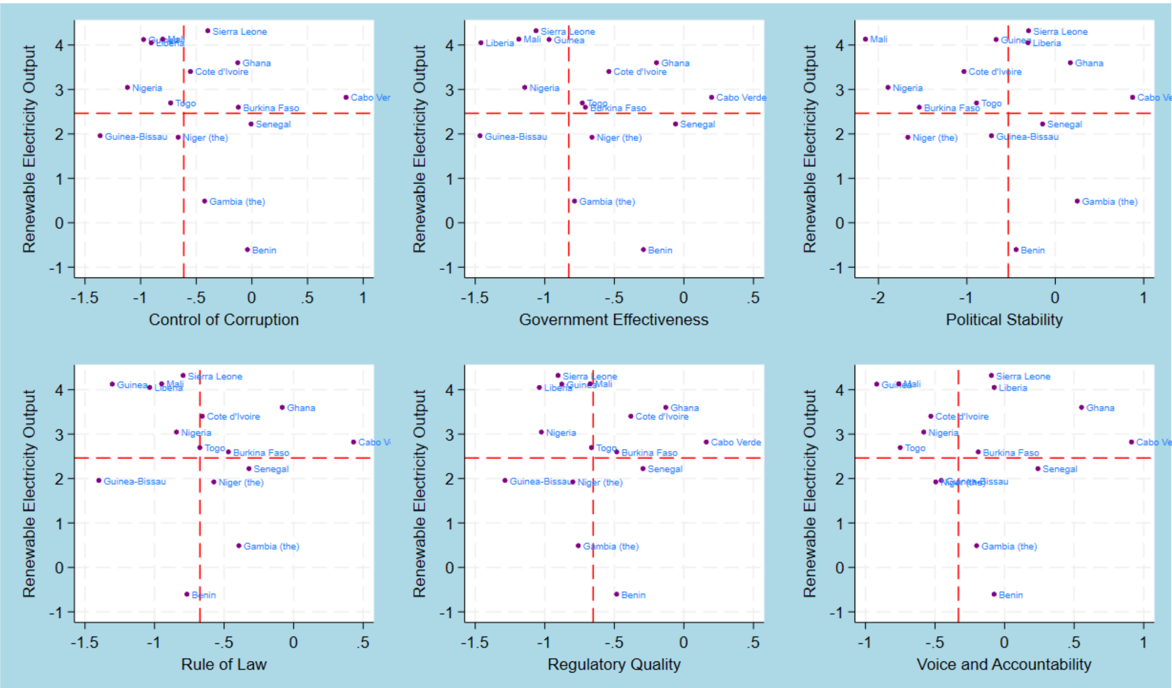

Figure 6: Renewable Electricity Output (% of Total Electricity Produced) and Governance Quality in West Africa, 2000-2020.
Source: Authors' calculation

3. Empirical Results and Discussion

The results on the effect of institutional quality and financial development on renewable energy production are displayed in Table 7.

Regarding the variable of interest, governance quality, only the Control of Corruption is positive and significant ($p = 0.046$). Other governance variables, such as Governance Effectiveness, Political Stability, Rule of Law, Regulatory Quality, and Voice and Accountability, are not statistically significant in their respective models. The positive coefficient suggests that improvements in corruption control are linked to higher levels of renewable energy development. In practical terms, if the Control of Corruption score increases by one unit, the model predicts an increase in renewable energy production equivalent to the magnitude of the estimated coefficient. This suggests that corruption is an important barrier to renewable energy production in West Africa. In contexts where corruption is considerable, resources allocated for renewable infrastructure may be misused, regulatory enforcement may be inconsistent, and trust in government decisions may be compromised.

Corruption creates uncertainty for investors and undermines fair market competition, making it difficult for clean energy projects to thrive. The result supports the notion that fighting corruption can yield environmental co-benefits, especially by facilitating green investments. West African countries seeking to transition to renewable energy must address corruption at all levels. The implementation of strong anti-corruption measures helps safeguard environmental policies from potential subversion. It also reduces the diversion of funds away from renewable projects, and improves the efficiency of public spending factors that the literature identifies as critical for attracting investment in the renewable energy sector (Zhang & Zhang, 2022). Effective control of corruption reduces the influence of lobbying activities by companies that are not committed to allocate capital towards investments in renewable energy. According to Bellakhal et al. (2019), the reduction of corruption could contribute to an increase in renewable energy investment. Fighting corruption is not just a matter of institutional integrity but a key strategy to unlock renewable energy potential in West Africa. Furthermore, effective control of corruption allows for good responsiveness to public demands to improve environmental quality, including the adoption of renewable energy.

Governance Effectiveness also presents a positive effect on renewable energy production. In West Africa, public service delivery is often hampered by bureaucratic inefficiencies and limited institutional capacity. These limitations may potentially affect governance effectiveness on renewable energy outcomes. Even where technically competent agencies exist, lack of coordination and weak oversight can dampen policy effectiveness (Ackah & Graham, 2021; Eke et al., 2020). Moreover, improving administrative institutions with a focus on energy planning is needed in West Africa.

In addition, Regulatory Quality has a positive effect on renewable energy production. Good regulation is important, but it may not by itself drive renewable energy growth. Regulations exist in West Africa, but lack enforcement mechanisms, clarity, or sectoral targeting. Also, general regulatory competence does not automatically imply environmental concern. West African countries might score high on business, but still subsidise fossil fuels or lack specific incentives for renewable energy (Bissiri et al., 2024a; Dube & Horvey, 2023). Moreover, the regulatory landscape may be evolving, with recent reforms not yet reflected in renewable energy data. Then, regulatory quality must be coupled with clear green policy objectives and stakeholder engagement to be truly effective in fostering environmental awareness and supporting the development of incentives to promote the use of renewable energy.

Conversely, Political Stability has a negative effect on renewable energy production in Table 7. West Africa has experienced political instability, with military coups, civil unrest, and contested elections. The instability does not have a significant effect on renewable energy production. Contrary to common assumptions, political stability does not always mean clean energy production. Stable governments may prioritise maintaining economic growth through traditional energy sources, especially fossil fuels (Nassar, 2024). Countries that are politically unstable may get help from other countries to use clean energy. This help is part of international aid to help these countries grow. Therefore, the link between political stability and clean energy may not be evident in West Africa.

Also, Rule of Law shows a negative impact in Table 7 on renewable energy production in West Africa. The result may appear counterintuitive, as a stronger rule of law is expected to enforce contracts and protect property rights. But the legal systems in many West African countries are underdeveloped and often lack the capacity for enforcement. In weak legal environments, governments may expedite renewable projects by bypassing legal procedures. This may temporarily boost renewable energy production but raises concerns about procedural justice and long-term sustainability. In this context, strengthening property rights and providing protection for investors against uncertainty can encourage investment in the renewable energy sector. This is in line with the findings of Yang & Park (2020), who argued that the promotion of security could stimulate investment in renewable energy. Thus, the establishment of strong institutions is important for more attention to environmental problems. Especially knowing the upfront cost associated with renewable energy projects, institutional quality can play an essential role to facilitate and motivate such investments (Uzar, 2020a). This corroborates the study of Ofori et al. (2023), who supported that good governance matters for the achievement of the SDGs. Further strengthening legal institutions remains vital, but should be balanced with efficiency in project implementation.

Additionally, Voice and Accountability present a negative effect on renewable energy production. This reflects the complex dynamics of governance in West Africa. Democratic participation and freedom of the press are basic elements of good governance, their direct impact on renewable energy production may be minimal. In some countries, civic activism has helped push environmental agendas, but in others, public dissent is met with suppression (Späth et al., 2022). However, long-term sustainability and accountability are more likely to be achieved in participatory governance systems, where civil society can advocate for environmental goals. But their short-term impact on renewable energy is less direct in West African context.

The results indicate a significant and positive effect of Gross Domestic Product (GDP) on renewable energy production across all regressions. The result remains stable even when multiple governance indicators are included, highlighting the reliability of this finding. This means that as GDP increases, renewable energy development increases. Gross domestic product significantly supports renewable energy growth. In other words, the magnitude effects show that a unit increase of GDP in West Africa could lead to a 1.500 increase in renewable energy production. This finding aligns with Sichigea et al. (2024), who argued that reinforcing the economic capacity tends to increase in proportion to renewable energy. This finding is consistent with the argument of Marques & Fuinhas (2012) and Murshed, (2021), who documented that improving income growth could contribute to developing infrastructure, which, by extension, could contribute to enhancing renewable energy development. This finding supports the argument of Xu et al. (2023) and Ehigiamusoe (2020), who argued that the improvement of economic growth could contribute to promoting education, which will play a significant role in the attainment of SGDs by 20230. Going in the same line, Ntanos et al. (2018) showed in their study that every 1% increase in renewable energy consumption increases GDP by 0.105%, confirming the mutual relationship between GDP and renewable energy. Musah et al. (2020) emphasise that as GDP increases in West African countries, it catalyses institutional and financial reforms, which enable higher renewable energy consumption. The development of renewable energy is closely linked to favourable economic conditions. This is consistent with the finding of Sadorsky (2009), who identified real GDP growth as a key driver of renewable energy consumption. Additionally, consistent with the results of Omri & Nguyen, (2014), the influence of economic growth on renewable energy advancement appears to depend significantly on a country's GDP level.

Meanwhile, this result contradicts the findings of Uzar (2020), Ergun & Rivas (2023), Shahbaz et al. (2021), and Ergun et al. (2019), who argued that the demand for renewable energy consumption declines as income rises. Economic growth can stimulate renewable energy production through multiple channels, including greater fiscal capacity for investment, enhanced infrastructure, and stronger regulatory and policy frameworks (Grossman & Krueger, 1995; Sadorsky, 2009a). As GDP rises, governments and private investors can be better positioned to finance capital-intensive renewable projects, integrate them into upgraded grids, and implement supportive measures such as feed-in tariffs and subsidies. However, the reverse effect of renewable energy production significantly boosting GDP appears weaker in many West African contexts. This could be due to the small share of renewables in the total energy mix, their primary focus on rural and household electrification rather than industrial demand, reliance on imported technology and expertise (Apergis & Payne, 2011; Payne, 2010). Empirical evidence in developing countries often supports a unidirectional causality from GDP growth to energy consumption, including renewables, rather than the reverse (Esso, 2010).

The positive and significant effect of financial development, which is used as a proxy for domestic credit to the private sector, implies that an increase in financial development increases renewable energy production in West Africa. It can also be interpreted that the enhancement of the finance sector could contribute to the advancement of renewable energy projects. This consolidates that the creation of financial mechanisms is one of the most significant aspects for the expansion of renewable energy production. Financial development is a necessary foundation to stem sustainable solutions and sustainable green investment efforts. This is consistent with the empirical research of Doytch & Narayan (2016) that provides new evidence for the importance of finance in energy transition.

In principle, the establishment of a strong financial system allows firms and households to access services and acquire durable products, which, in effect, may help to lift the demand for renewable energy. This is in line with the findings of Ehigiamusoe et al. (2019) also reported that the financial sector can play a major role in the growth of renewable energy by providing financial assistance to investors. Y. Wang et al. (2020) reported similar findings, showing that the Chinese government has used green credit as part of its effort to promote renewable energy development and address climate change challenges. This agrees with the work of Sun et al. (2023) and Ma & Fu (2020), which demonstrated that funds from financial sector to the energy sector have helped to improve the accessibility of energy, with more investment in energy generation and distribution.

As such, the development of the financial sector will result in higher financing for renewable energy provision. Financial development can influence renewable energy production by increasing access to long-term investment capital for public and private sector actors, enhancing risk management and credit assessment (Zhang & Zhang, 2022). In the context of West Africa, where renewable penetration is low and financing constraints are important, an efficient and developed financial sector can play a role in bridging the investment gap, particularly when supported by strong governance and stable regulatory frameworks (Apergis & Payne, 2014).

Foreign Direct Investment has a statistically insignificant effect on renewable energy production in all models, with a p-value greater than 0.7. This indicates no statistically significant relationship between FDI and renewable energy production. The lack of significance of FDI is notable; this could reflect that FDI is not yet targeted toward the renewable energy sector, or that regulatory or institutional barriers are discouraging such flows. This may be due to the presence of weak regulations, which potentially attract foreign investments that favour fossil fuel-based energy production because of the availability of natural resources. This contradicts the theory, which views FDI as a key mechanism to facilitate technology transfer and enhance renewable energy capacity in developing countries. This outcome is in agreement with the study of Anton & Afloarei Nucu (2020), Emre Caglar (2020), and Mukhtarov et al. (2022). Similarly, Saygın & İskenderoğlu (2022) in their study, based on a panel of 23 developed economies. They found an insignificant influence of FDI on renewable energy. However, this finding disagreed with the results of Ali et al. (2022), Doytch & Narayan (2016b), and Ergun et al. (2019). These studies assert that FDI has a significant impact on renewable energy in developing countries through the promotion of technology transfer, creation of green employment and sustainable economic growth.

Furthermore, the results of Total Natural Resources (percentage of GDP) indicate that the effect is negative and significant across all the regressions. This negative effect indicates that the availability of natural resources in West Africa does not support renewable energy development. This highlights the resource curse theory, where countries rich in natural resources tend to underinvest in renewable energy (Nurohman Dede, Abd Aziz, 2021). Resource endowments result in inefficient and unsustainable policy choices. This result is concerning in the context of renewable. With the world currently faced with the challenge of climate change and reliance on fossil fuels, more and more nations are increasing the pace of transition to cleaner and more sustainable energy systems. But in West Africa, this high dependence on resource rents can slow these transitions. High income from oil, gas and minerals could reduce the sense of urgency or need for investment in alternative sources of energy. It is accentuated by the challenge of governance. The abundance of resources can also cause rent-seeking, corruption, and misallocation of public funds (Mumuni & Mwimba, 2023). Even if there is some political will to diversify the energy mix, the capacity to implement effective policies or provide sufficient resources to those initiatives may be lacking. These take into account poor regulatory frameworks, weak infrastructure, and limited access to finance for renewable projects. West Africa demonstrates that the region's resources might not lead to progress, but could instead make it harder to make a change in the energy industry. Therefore, West African countries must take a more holistic, anticipatory approach to energy and economic planning to address these challenges.

Table 7: Results of the Effects of Governance Quality on Renewable Energy Production (dependent variable: Total Renewable Energy Production)

	(1)	(2)	(3)	(4)	(5)	(6)
Log Gross Domestic Product	1.500***	1.540***	1.616***	1.699***	1.533***	1.615***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Foreign Direct Investment	-0.168	-0.110	-0.0155	-0.0968	-0.101	-0.0156
	(0.732)	(0.823)	(0.975)	(0.845)	(0.840)	(0.975)
Financial Development	4.149***	4.213***	4.297***	4.377***	4.293***	4.436***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Total Natural Resources	-2.608**	-2.744**	-2.920***	-3.073***	-2.831***	-2.955***
	(0.016)	(0.012)	(0.008)	(0.004)	(0.009)	(0.007)
Control of Corruption	0.503**					
	(0.046)					
Governance Effectiveness		0.395				
		(0.166)				
Political Stability			-0.00971			
			(0.914)			
Rule of Law				-0.350		
				(0.117)		
Regulatory Quality					0.262	
					(0.328)	
Voice and Accountability						-0.0443
						(0.802)
Constant	-5.923**	-6.180**	-7.038***	-7.835***	-6.295**	-7.055***
	(0.026)	(0.021)	(0.006)	(0.003)	(0.019)	(0.009)
N	285	285	285	285	285	285
R^2	0.038	0.054	0.069	0.094	0.061	0.069
p	0.000	0.000	0.000	0.000	0.000	0.000

p-values in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4. Robustness Check

To verify the results of this study, another renewable energy variable is adopted, namely Renewable Electricity Output. The results in Table 8 (dependent variable: Renewable Electricity Output) are somewhat different from those in Table 7 (dependent variable: Total Renewable Energy Production). These variables are related to each other, but have different scopes. The one covers renewable energy sources (biomass, wind, solar, etc.) and the other only on the generation of electricity. This distinction is significant in West Africa, where energy systems are diversified with low levels of development and are dominated by traditional biomass. Modern renewables for power generation are still in the early stages.

Regarding the governance indicators, the models present mixed results. Control of Corruption is the only statistically significant governance variable in Table 7, with a positive value, and in Table 8, with a negative value but statistically insignificant. This means that corruption, while detrimental in general, may not directly constrain the production of renewable electricity, especially. This could be because electricity production often happens through public monopolies or large projects that are funded by donors and have more oversight from the public. Alternatively, corruption in West Africa might have more impact on the planning and production of electricity than on its transmission and distribution. However, the lack on significance does not mean corruption is irrelevant, it may not have an immediate or linear effect on electricity output. Dube & Horvey (2023) demonstrated that corruption has adverse effects on electricity access rates, sector efficiency, and reform outcomes. Improving the implementation of anti-corruption measures could directly stimulate activity in the renewable sector.

In Table 8, Rule of Law stands out with a negative and statistically significant. This result seems surprising. But it may be explained by the fact that rigid legal frameworks may slow down project implementation through bureaucratic delays or complex compliance requirements. It may also reflect that in countries with weak legal systems, projects could move quickly due to few regulatory obstacles. Sometimes this may come at a cost to social or environmental justice. Weaker oversight may mean bypassing essential safeguards such as deep environmental impact assessments, public consultations, and the protection of land rights. Without these processes, affected communities may be excluded from decision-making, ecosystems can be harmed, and the benefits of renewable projects may be unevenly distributed, undermining both social equity and environmental sustainability

For instance, countries with relatively stronger rule of law (e.g., Cape Verde, Ghana) may also have civil resistance to large infrastructure development, delaying renewable electricity rollouts (S. Asongu & Odhiambo, 2022). This result should be interpreted with attention. It does not mean that a weak rule of law is desirable, but rather that legal systems need reform to balance due process with efficiency and project facilitation.

Voice and Accountability is negative and significant. Meaning that great democratic participation and civil liberties are associated with lower renewable electricity output. This result is counterintuitive, but it could be a sign of the challenges of democratic governance in countries that don't have many resources. In contexts with an active civil society, energy projects may face opposition. This opposition can come from concerns about land use, displacement fears, or environmental concerns. Democratic procedures may also slow down implementation through extensive consultation and debate. The finding of Ndi (2024) show that higher voice and accountability might lead to community opposition (e.g., land use conflicts), which can stall large-scale projects. Meaning that democratisation does not automatically translate into energy transition success. This result should not be misinterpreted as an argument against democracy. Instead, it should be seen as a call to create governance mechanisms that include the public and are effective. These mechanisms should align with development goals.

Governance Effectiveness again show no statistical significance. This suggests that the general ability of governments to deliver public services and implement policies effectively does not show a direct impact on renewable electricity production. In West Africa, governance effectiveness may be reduced by overlapping responsibilities, a lack of technical skills and decentralisation of power without enough resources (Kolawole et al., 2024). Furthermore, energy policies exist in principle but fail in implementation due to political interference or administrative problems. Institutional effectiveness needs sector-specific focus and alignment with energy planning to influence real outcomes.

Political Stability is also insignificant. This result shows that political stability alone is not a strong determinant of renewable electricity output. West African countries experience different levels of political tension, but this does not appear to directly impact electricity production. Alternatively, stability is more important for long-term investments in renewable energy than for short-term investments (Yusuf, 2023). Therefore, political stability is important, especially when external actors continue to fund and manage key energy projects.

Regulatory Quality is not statistically significant in either set of models. This may indicate institutional weakness of these dimensions in the context of West Africa. Regulations exist, but may be outdated, poorly implemented, or undermined by political capture (Bissiri et al., 2024b). It may reflect the inadequacy of indicators to capture administrative capacities on the ground. In practice, local politics and informal networks tend to play a more significant role in energy decision-making than national governance indicators. This result calls for attention not just to regulatory design but to enforcement mechanisms, monitoring capacity, and feedback from energy producers and consumers.

Table 8 shows a weak positive correlation in GDP. This result likely reflects the region's energy use patterns. West African countries tend to invest in clean cooking fuels or biofuels for transport to combat energy poverty (Compaore et al., 2024). However, the electricity infrastructure is still centralised and underfunded. Furthermore, electricity grids are frequently unreliable and limited in scope, making off-grid solutions more relevant. Hafner et al. (2018) highlight the economic dominance of off-grid systems in rural areas, noting how these solutions are essential due to centralised electricity infrastructure. Emphasising that the growth of GDP does not translate into conventional electricity infrastructure. The prevalence of mini-grids in West Africa, with low electrification rates, high grid losses, and heavy reliance on diesel, shows a weak link between GDP and electricity access, illustrating how GDP correlates with clean cooking and transport biofuels more than grid capacity, which, for expansion, is economically unrealistic (Babayomi et al., 2023; Gafa & Egbendewe, 2021; Nelson et al., 2021). These solutions are not always fully reflected in conventional data on electricity generation.

The effect of FDI is statistically insignificant in both models. Historically, FDI in West Africa has concentrated on mining, oil, and agribusiness rather than green infrastructure. Rashed et al. (2022) using panel data in their study found that the past inflows of FDI did not help to predict renewable electricity production in Sub-Saharan Africa. This highlights the need for policy innovations, such as tax incentives for renewable energy, to stimulate investors towards sustainable energy projects.

Financial development has a positive and significant effect across both models. This is crucial information for the region, where financial markets are a significant barrier to investment in clean energy. Renewable energy projects require initial capital that small financial systems cannot provide. The results indicate that targeted financial sector reforms, including the promotion of financial instruments and microfinance for decentralised renewable energy, will be required to expand renewable energy in West Africa.

In both models, the Total Natural Resources have a negative and statistically significant impact on the development of renewable energy. This supports the resource curse theory, which is particularly pertinent in the context of West Africa. Many countries in the region have abundant oil, gas and mineral reserves, leading to a reliance on extractive industries. This diverts attention away from renewable energy policies and investments. This corroborates the study of Gorji & Martek (2023), they found that while renewable energy policies boost deployment in oil-developed countries, in oil-developing countries, the resource curse significantly impedes renewable energy capacity. The results imply that, without structural reforms to reduce dependence on extractive industries, the region may find it difficult to shift towards renewable energy, despite international climate commitments.

Table 8: Results on the Effects of Governance Quality on Renewable Energy Production (dependent variable: Renewable Electricity Output)

	(1)	(2)	(3)	(4)	(5)	(6)
Log Gross Domestic Product	0.0299	0.0202	0.0329	0.180	0.00956	0.152
	(0.930)	(0.952)	(0.922)	(0.593)	(0.978)	(0.655)
Foreign Direct Investment	0.0247	0.00587	0.0651	0.196	0.0297	0.0585
	(0.957)	(0.990)	(0.888)	(0.666)	(0.949)	(0.897)
Financial Development	2.506**	2.461**	2.289**	2.418**	2.417**	2.768***
	(0.010)	(0.011)	(0.018)	(0.011)	(0.013)	(0.004)
Total Natural Resources	-2.459**	-2.416**	-2.489**	-2.667***	-2.381**	-2.671***
	(0.016)	(0.017)	(0.014)	(0.008)	(0.019)	(0.008)
Control of Corruption	-0.0770					
	(0.736)					
Governance Effectiveness		-0.0158				
		(0.952)				
Political Stability			-0.0835			
			(0.312)			
Rule of Law				-0.555***		
				(0.005)		
Regulatory Quality					0.107	
					(0.665)	
Voice and Accountability						-0.331**
						(0.040)
Constant	2.003	2.107	2.020	0.677	2.399	1.089
	(0.390)	(0.368)	(0.372)	(0.770)	(0.309)	(0.640)
N	284	284	284	284	284	284
R^2	0.034	0.039	0.017	0.020	0.051	0.075
p	0.003	0.004	0.003	0.000	0.003	0.001

p-values in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Conclusion and Policy Implications

In the last decades, developed and developing nations have experienced and continue to face severe consequences of climate change, largely due to the dependence on fossil fuels and environmental degradation. As per the data of the World Health Organisation, deaths due to climate change were around 7 million in 2021. Worldwide, governments and policymakers have prioritised transitioning to renewable energy to combat climate change and dependency on fossil fuels.

Over the last few years, several studies have examined the drivers of renewable energy development. Findings show that renewable energy development is the pathway to tackle climate change and achieve the Sustainable Development Goals. Yet such studies have mostly overlooked the institutional quality context in West Africa. Therefore, this study seeks to explore the relationship between institutional quality and renewable energy production in 15 West African countries from 2000 to 2020 using variables such as renewable energy production, governance quality, gross domestic product, financial development, foreign direct investment, and natural resources.

Using a panel data regression model, this research reveals key findings with important policy implications. The results are mixed, with only a few governance variables having a significant effect on renewable energy production, which are control of corruption, rule of law and voice and accountability. This is an indication that there is a need for improvement in institutional frameworks in many West African countries, as they tend to rely on non-renewable energy sources. Moreover, foreign direct investment shows no significant influence on renewable energy. In contrast, natural resources have a negative effect on renewable energy production, indicating a type of natural resource curse effect. Additionally, economic growth measured by gross domestic product and financial development has a positive effect on renewable energy production.

These results show that while institutional quality matters for renewable energy development in West Africa, most countries in the region still lack the strong, supportive institutions needed to really drive the transition away from fossil fuels. This underscores the need for institutional reforms that strengthen regulatory frameworks, enhance policy consistency, and improve transparency to create an enabling environment for renewable energy investment. The absence of a significant effect from foreign direct investment suggests that existing capital inflows are not being channelled effectively toward clean energy projects, highlighting the need for targeted incentives and investment facilitation. The negative relationship between natural resources and renewable energy production reflects a natural resource curse dynamic, where dependence on fossil fuel wealth delays the energy transition.

Conversely, the positive effects of GDP growth and financial development indicate that stronger economies and deeper financial systems can accelerate renewable energy deployment by improving access to capital and reducing investment risks. In the context of West Africa's transition to clean energy, there is an opportunity to address existing gaps in governance, coordinate policies that integrate institutional strengthening, economic diversification, and financial sector development with targeted support for renewable energy. This approach could help reduce dependence on fossil fuels and utilise economic growth and financial strength to facilitate the transition.

Following the findings of our study, some policy recommendations are presented:

- Institutions in the region must combat corruption and strengthen the rule of law by ensuring transparent procurement, public budget tracking, independent audits, citizen oversight, and strict enforcement of anti-corruption laws.
- Restructuring the financial sector to make it more inclusive is essential, as it plays a key role in promoting investment in renewable energy. This involves improving access to capital, reducing investment risks, and supporting small-scale energy developers through blended finance models, clearer regulatory frameworks, and streamlined project approvals. Expanding financial inclusion, especially loan guarantees and green bonds.
- Developing strong financial markets is also important, particularly through the creation of dedicated funds to support renewable energy investment projects and long-term energy transitions in the region.
- Promote financial access for renewable projects by expanding credit lines and support microfinance for off-grid and decentralised solutions.
- Reform natural resource governance through incentives for fossil-rich countries to invest part of their resource revenue into renewable energy.
- Strengthening regulatory quality by coupling with clear renewable energy targets, strong enforcement mechanisms, and sector-specific incentives, while engaging stakeholders to ensure regulations translate into real renewable energy growth.

Limitations and Future Work

This study presents certain limitations that should be recognised and considered in future research. These include:

- Future studies can also improve this study by investigating the institutional quality on renewable energy production in individual countries using time series data for effective policy recommendations.
- This study uses a simple panel data analysis method, which is random effects. Future research could employ Dynamic panel methods.
- The effect of corruption on renewable electricity output may be indirect, nonlinear, or delayed. Anti-corruption measures can influence planning, investment, and approvals, but these changes may take years to translate into measurable output, meaning short-term models may underestimate the true impact.

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