INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

ISSN(print): 2643-9840, ISSN(online): 2643-9875

Volume 08 Issue 10 October 2025

DOI: 10.47191/ijmra/v8-i10-30, Impact Factor: 8.266

Page No. 5809-5822

Assessing National Energy Policies Promoting Renewables in West African Cities: Progress, Challenges, and Recommendations

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ABSTRACT: The accelerating urbanization of West Africa presents both a challenge and an opportunity for sustainable energy development. With cities accounting for the bulk of energy consumption in the region, the transition from fossil fuel dependency to renewable energy is essential for achieving energy security, climate resilience, and sustainable growth. This paper critically assesses national energy policies that promote renewable energy in selected West African countries namely Nigeria, Ghana, Senegal, and Côte d'Ivoire with a particular focus on their impact and implementation in urban areas. The study adopts a comparative policy analysis approach, examining legal frameworks, national energy strategies, implementation mechanisms, and city-level applications. While all countries under review have established renewable energy policies or legal frameworks, findings reveal a significant disconnect between national ambitions and urban execution. Common challenges include limited financing for urban renewable projects, weak institutional coordination between national and local governments, inadequate technical capacity, and a lack of city-specific renewable energy targets. However, the research also highlights emerging progress, such as mini-grid deployment in Nigerian cities, solar rooftop programs in Accra, and Dakar's steps toward electrifying public transport using green energy sources. The paper argues that strengthening the role of city governments, improving policy coherence, and enhancing public-private partnerships are critical to scaling renewable energy solutions in West African cities. It recommends greater decentralization of energy governance, increased investment in urban renewable infrastructure, and harmonization of regional policies through ECOWAS frameworks. Ultimately, aligning national energy goals with urban development strategies will be vital for an inclusive and sustainable energy transition across the region. This research contributes to the broader discourse on energy policy in sub-Saharan Africa by highlighting the urban dimension of renewable energy planning, offering practical insights for policymakers, development partners, and stakeholders committed to a green and equitable energy future.

KEYWORDS: sustainable energy, urbanization, renewable energy, fossil fuel

1. INTRODUCTION

West African cities are at the forefront of a profound energy paradox: rapid urban growth and accelerating socio-economic activity are driving sharply rising demand for electricity, even as chronic supply shortfalls, aging transmission infrastructure and high dependence on fossil-fuel backup generation render urban power systems unreliable, expensive and environmentally damaging. Urban households and businesses routinely rely on diesel generators to fill gaps in public supply, creating localized air pollution, noise and greenhouse-gas emissions while imposing large hidden costs on firms and consumers (Adelaja, 2020). At the same time, urbanization and industrialization amplify energy intensity and pollution concentrations in metropolitan areas, intensifying public-health risks and undermining the sustainability of urban development trajectories across the region. Scholars analyzing West Africa's urban-environment nexus argue that renewable energy consumption can improve environmental quality and mitigate the adverse effects of urbanization but only if policy design and implementation are effective and attuned to local urban realities. (Adelaja, 2020).

The case for accelerating a shift from fossil fuels to renewables in West African cities is compelling on both climate and development grounds. Although the region's aggregate contribution to global greenhouse-gas emissions remains modest, West African countries are highly vulnerable to climate impacts from coastal erosion and flood risk in coastal metropolises to heat stress and water scarcity in rapidly expanding inland cities. Deploying renewable energy at scale would reduce local combustion-related

air pollution with immediate public-health benefits, lower greenhouse-gas emissions, and provide a resilient means of meeting growing urban demand through a combination of grid-tied and decentralized solutions (mini-grids, rooftop photovoltaics, and productive-use solar services). Empirical evidence from the region suggests that increased renewables consumption contributes to improved environmental quality when accompanied by coherent policy and institutional frameworks; conversely, weak policy signals and governance gaps have limited the environmental gains of renewable initiatives in several countries (Adelaja, 2020)

Despite abundant renewable potential particularly solar and, in some coastal locations, wind national policy frameworks across West Africa have produced uneven outcomes. In Nigeria, for example, a substantial body of literature highlights the persistent gulf between an ambitious policy landscape (master plans, targets and incentives) and the practical realities of grid instability, financing constraints and institutional fragmentation that impede large-scale renewable deployment in urban settings. Solar resources are wide spread in the country at considerably good potential, nevertheless, Nigeria's solar photovoltaic (PV) installation capacity could be better, (Diyoke, Ngwaka& Ugwu, 2023) In Ghana, legal and legislative weaknesses described by practitioners and commentators as symptoms of "policy paralysis" have constrained the impact of the Renewable Energy Act and related instruments, producing slow implementation despite favorable rhetoric and target-setting. (Atuguba & Tuokuu, 2020). By contrast, Senegal's recent policy trajectory demonstrates how targeted reform, international partnerships and large-scale projects (notably wind and solar parks) can accelerate urban and national renewable capacity, although the politics of transition and the interplay with new fossil-fuel discoveries complicate the pathway to a fully sustainable urban energy future. (Aptel, 2021; Atuguba & Tuokun, 2020)

These contrasts point to the central analytical question of this study: how effective are national policies aimed at promoting renewable energy in producing tangible benefits for urban areas in West Africa, and what explains variation in outcomes between countries? The present research adopts an evaluative and comparative orientation. Its general purpose is to examine the design, instruments and implementation of renewable energy policies in selected West African countries and to assess their impact on urban energy access, reliability, economic burden and environmental quality. Specifically, the study focuses on three countries that are illustrative of distinct policy pathways and urban energy challenges: Nigeria (a large, oil-dependent economy with chronic grid unreliability and a flourishing off-grid market), Ghana (a country with detailed renewable legislation whose implementation record reveals governance and legislative frictions), and Senegal (a country that has pursued an active program of large renewable projects and international financing instruments). This selection permits a comparative interrogation of policy instruments (tariffs and feed-in arrangements, procurement frameworks, mini-grid regulation, fiscal incentives and institutional coordination) and their proximate effects on urban consumers, firms and municipal environmental outcomes. (Ozoegwu, Mgbemene, & Ozor, 2017)

A growing scholarly literature provides both conceptual and empirical anchors for this evaluation. Policy-oriented analyses identify recurrent barriers institutional fragmentation, fiscal and currency risk, high upfront capital costs, and limited domestic financing and skills that undermine policy effectiveness in many West African states (Adelaja, 2020; Ozoegwu, Mgbemene & Ozor, 2017). Meanwhile, region-level empirical studies show that renewable energy consumption can be associated with reductions in CO_2 and improved environmental quality, but these aggregate gains often mask urban-level distributional and implementation challenges that determine whether urban populations actually benefit. The literature therefore points to the importance of assessing not only policy texts and targets but also the modalities of policy delivery in urban settings: procurement practices, regulatory capacity, municipal engagement, and mechanisms to integrate decentralized renewable options with the existing grid (Ozoegwu, Mgbemene & Ozor, 2017)

II. METHODOLOGY

This study employs a qualitative comparative policy analysis framework to evaluate national renewable energy policies across selected West African countries and their specific impacts on urban areas. The research design is informed by the Multiple Streams Framework (MSF) developed by Kingdon (2010), which provides a structured approach for analyzing how policy problems, solutions, and political conditions converge to create opportunities for policy change. This framework is particularly appropriate for understanding the complex dynamics of renewable energy policy adoption in West Africa, where rapid urbanization, energy poverty, and climate imperatives intersect amidst evolving political landscapes.

The comparative approach enables systematic examination of both similarities and differences in policy frameworks across cases, facilitating the identification of effective policy mechanisms and implementation challenges specific to urban contexts. Following the approach of comparative policy analysis scholars (Brans, Geva-May, & Howlett, 2017), this research examines not only policy content but also the institutional arrangements, implementation mechanisms, and contextual factors that influence policy

outcomes. The design incorporates both vertical and horizontal comparison: vertically by examining national policies in relation to urban implementation, and horizontally by comparing approaches across different national contexts.

The research utilizes a multiple case study design with embedded units of analysis (Yin, 2018), examining each country's policy framework while also investigating specific urban renewable energy projects and outcomes within each national context. This approach allows for comprehensive understanding of how national policies translate to urban settings while accounting for local contextual factors. The timeframe for policy analysis spans from 2010 to 2025, capturing the period during which most West African countries developed significant renewable energy policies in response to both the Paris Agreement and regional initiatives like the ECOWAS Renewable Energy Policy (EREP).

The study employs a purposive sampling strategy to select four West African countries: Nigeria, Ghana, Senegal, and Côte d'Ivoire. This selection represents significant variation in policy approaches, implementation capacity, renewable energy resources, and urban contexts, while sharing common regional characteristics and challenges. The selection criteria were designed to capture both larger and smaller economies, different colonial histories, varying levels of renewable energy deployment, and diverse urban governance structures.

Nigeria is included as Africa's most populous country and largest economy, with significant renewable energy potential but substantial implementation challenges, particularly in its rapidly growing cities like Lagos and Abuja. Ghana represents a country with relatively stronger institutional capacity and earlier power sector reforms, providing insights into more established policy frameworks. Senegal is selected for its notable progress in utility-scale renewable projects, including the Taiba N'Diaye wind power station (158 MW) and Diass Solar Park (15 MW). Côte d'Ivoire offers a contrasting case as a country that has traditionally relied heavily on hydropower and thermal generation but is increasingly exploring solar and other renewables to meet growing urban demand.

The selection follows a most-different systems design (Anckar, 2020), which allows for identifying common policy elements that lead to similar outcomes despite different contextual factors. This approach is particularly valuable for understanding which policy mechanisms transcend national contexts to effectively promote renewable energy in urban areas across the region. The cases also share important similarities, including membership in ECOWAS, exposure to similar regional initiatives like the West African Power Pool (WAPP), and facing common challenges of rapid urbanization and energy access deficits.

Data collection employed a triangulation approach utilizing multiple sources to ensure validity and comprehensiveness. The methodology incorporated both documentary analysis and primary data collection through stakeholder interviews, allowing for cross-verification of findings across different data sources. The research analyzed an extensive range of policy documents and government reports, including:

- National Renewable Energy Action Plans (NREAPs) and renewable energy policies
- Energy sector master plans and strategic documents
- Legislative and regulatory frameworks governing renewable energy
- Government reports on energy access, generation, and urban development
- ECOWAS and West African Power Pool (WAPP) policy documents and implementation reports
- National and urban development plans incorporating energy dimensions

Additional documentary sources included performance data from energy ministries and regulatory agencies, project reports from development partners (e.g., World Bank, African Development Bank), and monitoring reports related to renewable energy targets and climate commitments (Nationally Determined Contributions under the Paris Agreement). The documentary analysis also incorporated relevant academic literature and technical reports on renewable energy deployment in urban West Africa. Semi-structured interviews were conducted with 42 key stakeholders across the four countries to complement documentary sources and provide insights into policy implementation challenges and outcomes. Interview participants were selected through purposive sampling to represent key institutions and perspectives, including:

Table 1: Stakeholders Interview Categories and Sample Size

Stakeholder Category	Number Interviewed	Selection Criteria
National Policy Makers	10	Senior officials from energy ministries and regulatory agencies
Urban Government Officials	8	Energy and planning departments in major cities
Utility Representatives	6	National power companies and distribution firms

Renewable Energy Developers	9	Companies involved in urban renewable projects
Civil Society Organizations	5	NGOs focused on energy access and sustainability
International Development Partners	4	World Bank, AfDB, and regional initiatives

Interview protocols were tailored to each stakeholder category but covered common themes including: policy formulation processes, implementation challenges, coordination mechanisms between national and urban authorities, financing mechanisms, technical capacity, and perceived outcomes of renewable energy policies. Interviews were conducted between January and June 2025, with approximately 60% conducted in person during field visits and 40% conducted virtually to access a broader range of stakeholders.

Data analysis followed a qualitative content analysis approach (Mayring, 2014) combined with cross-case synthesis (Yin, 2018) to identify patterns, themes, and relationships across the cases. The analysis proceeded in several stages:

First, documentary analysis employed a structured coding framework based on key policy dimensions derived from the theoretical framework and research questions. These dimensions included: policy instruments (regulatory, fiscal, informational), governance arrangements, financing mechanisms, implementation capacity, and monitoring systems. The coding framework was iteratively refined through initial application to a subset of documents.

Second, interview transcripts were analyzed using thematic analysis (Braun & Clarke, 2006), with codes both derived from the theoretical framework (deductive coding) and emerging from the data itself (inductive coding). NVivo software facilitated the organization and analysis of qualitative data, allowing for identification of patterns across different stakeholder groups and country contexts.

Third, cross-case analysis was conducted to identify similarities and differences in policy approaches and outcomes. This involved creating systematic case summaries for each country organized around key analytical categories, then comparing these summaries to identify recurring patterns, divergent outcomes, and potential causal mechanisms linking policy designs to implementation outcomes. The analysis paid particular attention to urban-specific dimensions of policy implementation, including: the adaptation of national policies to urban contexts, coordination between national and urban authorities, the role of municipal governments in implementation, and the distinctive challenges and opportunities presented by urban settings (e.g., density, existing infrastructure, governance capacity).

The research adhered to standard ethical protocols for social science research. Informed consent was obtained from all interview participants, with clear explanation of the research purpose, use of data, and confidentiality protections. Participants were informed of their right to withdraw consent at any time without penalty. Confidentiality was maintained through anonymization of responses in reporting, with particularly sensitive information excluded from publication. The research received ethical approval from the appropriate institutional review board. Given the focus on policy analysis rather than human subjects, the documentary analysis component posed minimal ethical risks beyond standard academic integrity requirements for proper attribution and representation of sources. Positionality was considered throughout the research process, particularly given that the principal researcher is external to the region. To mitigate potential biases, the research incorporated member checking by sharing preliminary findings with selected participants for verification, and sought to include diverse perspectives across different stakeholder groups. The analysis explicitly acknowledges the limitations of external perspective while leveraging the potential advantages of comparative distance.

Several limitations should be acknowledged. First, the availability and reliability of documentary data varied across countries, with some having more comprehensive and accessible records than others. This was mitigated through triangulation with interview data and secondary sources from international organizations. The selection of cases necessarily omits some West African countries with interesting renewable energy initiatives, such as Cabo Verde with its high renewable penetration or Niger with ambitious solar plans. The findings are therefore not necessarily representative of all West African contexts but provide insights into patterns across diverse cases. However, the focus on national policies and urban implementation may underemphasize sub-national variations and rural-urban linkages in energy systems. Future research could more systematically examine intra-urban differences and connections between urban and rural energy access.

Finally, the timeframe of the study captures policies and implementations through mid-2025, but the renewable energy landscape in West Africa is evolving rapidly. Some policies may have been updated or new initiatives launched since data collection was completed. Despite these limitations, the methodological approach provides a robust foundation for understanding the complex

dynamics of renewable energy policy implementation in West African urban contexts and generating insights that can inform both scholarship and policy practice.

III. OVERVIEW OF RENEWABLE ENERGY LANDSCAPE IN WEST AFRICA

The energy landscape in West Africa presents a complex paradox of abundant renewable resources alongside persistent energy access challenges and growing urban demand. As a region characterized by rapid urbanization, economic development, and population growth, West African countries face increasing pressure to transform their energy systems to support sustainable development while addressing climate imperatives. The current energy mix remains dominated by traditional biomass and fossil fuels, despite the region's substantial solar, wind, hydro, and biomass potential that remains largely untapped. This overview examines the current energy profile, renewable energy potential, urban consumption patterns, and the critical role of cities in driving the energy transition in West Africa. Understanding these dynamics is essential for formulating effective policies and investments that can harness the region's renewable resources to meet its growing energy needs while contributing to global climate goals.

The energy composition in West Africa is characterized by a heavy reliance on traditional biomass and increasing dependence on fossil fuels, alongside a growing but insufficient renewable energy component. According to statistical data, approximately 60% of the region's energy supply comes from traditional biomass, primarily used for cooking and heating in rural and peri-urban households. Fossil fuels account for about 30% of the energy mix, with oil products dominating the transportation sector and increasingly used for power generation in urban areas. The remaining 10% comprises electricity, predominantly generated from hydropower and thermal sources, with renewable sources like solar and wind representing less than 2% of the total energy mix.

Urban consumption patterns in West African cities reveal distinctive characteristics shaped by urbanization trends, economic activities, and infrastructure development. Cities across the region exhibit rising electricity demand driven by population growth, economic expansion, and increasing appliance ownership. The commercial and industrial sectors in urban areas account for a significant portion of electricity consumption, with peak demand patterns typically occurring during evening hours due to residential lighting needs and commercial activities. Unlike rural areas where energy access remains limited, urban centers generally benefit from higher electrification rates, though reliability remains a significant challenge necessitating widespread use of backup generators that increase costs and pollution. The residential energy profile in West African cities demonstrates a dualistic pattern where households often combine grid electricity with other sources for different end-uses. While electricity is primarily used for lighting, entertainment, and cooling, many urban households continue to use charcoal, liquefied petroleum gas (LPG), or electricity for cooking, depending on income levels and fuel availability. This energy stacking behavior reflects both cultural preferences and the unreliable nature of grid supply, which continues to impede complete transition to modern energy services even in urban areas with grid infrastructure.

Table 2: Current Energy Mix in West Africa

Energy Source	Percentage of Total Energy Mix	Primary Applications
Traditional Biomass	60%	Residential cooking and heating
Hydropower	30%	Transportation, power generation, industry
Hydropower	5%	Grid electricity generation
Other Renewables (solar, wind)	2%	Grid injection, off-grid applications
Imported Electricity	3%	Cross-border power trade

Source: Adapted from Regional Energy Statistics (2025)

Renewable Energy Potential in West Africa

West Africa possesses substantial renewable energy resources that remain significantly underutilized despite their potential to address the region's energy challenges. The region's solar energy potential is particularly remarkable, with most areas receiving between 3-7 kWh/m²/day of solar irradiation, among the highest levels globally. This solar abundance translates into technical potential far exceeding current and projected energy demand, with projections suggesting that solar PV alone could generate between 8-20 GW by 2030 under appropriate policy conditions. Countries like Nigeria, Ghana, and Senegal have begun tapping

into this potential through utility-scale solar projects and distributed generation systems, though deployment remains well below technical capacity.

The region's wind energy resources are also considerable, especially along coastal areas and in certain inland regions where wind speeds exceed 5-7 m/s at hub height. Countries like Cabo Verde and Senegal have demonstrated the viability of wind power through projects like the 158.7 MW Taiba N'Diaye wind farm the largest in West Africa. Hydropower potential remains significant though unevenly distributed, with countries like Guinea, Nigeria, and Ghana possessing substantial untapped capacity beyond existing installations such as the Akosombo and Bui dams. Additionally, biomass resources from agricultural residues, municipal waste, and dedicated energy crops offer considerable potential for bioenergy generation, particularly in countries with significant agricultural sectors like Nigeria, Côte d'Ivoire, and Ghana.

The geothermal energy potential in West Africa is less pronounced than in Eastern Africa but remains unexplored in several geological formations, particularly along the Man Shield region stretching from Guinea to Nigeria. Despite this diverse renewable resource base, development has been hampered by technical constraints, financing challenges, and policy implementation gaps that have limited the region to utilizing only a fraction of its clean energy potential. As Eyime and Ushie (2025) note, "Africa holds 60 per cent of the world's solar potential, yet attracts less than 3 per cent of global energy financing", highlighting the significant investment gap that must be addressed to harness these resources fully.

Urban Energy Demand Trends

West African cities are experiencing rapidly increasing energy demand driven by multiple interrelated factors including urbanization, population growth, economic development, and changing consumption patterns. The region's urban population is growing at approximately 3-4% annually, among the highest rates globally, with cities expected to house over 50% of the population by 2040. This demographic transition is accompanied by rising incomes and expanding middle classes with greater purchasing power for electrical appliances, cooling systems, and mobility services, further accelerating energy consumption. The compound annual growth rate for electricity demand in West African urban centers is estimated at 5-7%, significantly higher than the global average of 2-3%.

The sectoral distribution of urban energy demand reveals important patterns that inform energy planning priorities. The residential sector accounts for approximately 40-50% of urban electricity consumption, followed by the commercial sector (25-35%), industrial activities (15-25%), and public services (5-10%). This distribution varies significantly across cities depending on their economic structure, with industrial hubs showing higher proportional demand from manufacturing activities. The temporal pattern of electricity demand in West African cities typically exhibits morning and evening peaks corresponding to commercial opening hours and residential lighting needs, creating challenges for grid management especially given the limited flexibility of existing generation assets.

A critical trend in urban energy demand is the increasing transportation energy consumption resulting from growing vehicle ownership and urban sprawl. Most West African cities are characterized by low-density development and inadequate public transportation systems, leading to heavy reliance on private vehicles and informal transport services that predominantly use petroleum products. This pattern not only increases energy demand but also contributes significantly to urban air pollution and congestion. As noted in the IISD's "Cities in Transition" report, "Reducing emissions will take more than building out renewables it will require an overall reduction in energy demand through thoughtful redesign of neighborhoods", highlighting the importance of integrated urban planning alongside energy sector interventions. West African cities play a pivotal role in driving the energy transition due to their concentration of energy demand, economic activity, innovation capacity, and policy implementation capabilities.

As centers of consumption and emissions, cities represent the frontline where energy transitions must manifest to achieve meaningful impact. Municipal governments increasingly exercise influence over energy outcomes through urban planning decisions, building codes, transportation systems, and municipal energy procurement. The compact nature of urban areas also provides opportunities for implementing efficient district energy systems, integrated renewable energy projects, and demand-side management programs that may be less feasible in rural settings. Cities across West Africa are demonstrating innovative approaches to advancing renewable energy adoption and sustainable energy planning. For example, Accra, Ghana, has incorporated solar PV requirements for certain new buildings and is exploring waste-to-energy projects to address both energy and sanitation challenges. Dakar, Senegal, is implementing energy efficiency measures in public lighting and municipal buildings while developing utility-scale renewable projects to diversify its generation mix. Lagos, Nigeria, despite its massive size and complex energy challenges, is pioneering integrated energy planning that considers both formal and informal settlements. These

municipal initiatives complement national energy policies and often serve as testing grounds for innovative approaches that can be scaled regionally.

The multilevel governance of energy transitions requires effective coordination between national and urban authorities to align policies, regulations, and investments. While national governments typically control overarching energy policy, utility regulation, and large-scale infrastructure projects, municipal governments influence energy outcomes through land-use planning, building standards, transportation systems, and local economic development policies. As noted in the assessment of utility reforms, "structural barriers in urban planning including NIMBY opposition, outdated governance models, and the high cost of sprawl are holding cities back from building more sustainable, climate-aligned communities", highlighting the need for coordinated governance approaches. The financing of urban energy transitions remains a significant challenge, with municipalities often lacking the fiscal capacity and technical expertise to develop and implement comprehensive energy strategies. International partnerships and climate finance mechanisms increasingly target cities as implementing partners for low-carbon projects, though access remains constrained by capacity limitations and bureaucratic hurdles. As the Economic Commission for Africa notes, "Africa isn't just asking for help, it's offering answers. Energy isn't just a public good. It's a driver of jobs, industry, and transformation", emphasizing the developmental co-benefits that urban energy transitions can deliver beyond climate mitigation.

IV. ANALYSIS OF NATIONAL ENERGY POLICIES

National policies across West Africa exhibit a mixture of ambition and uneven implementation when it comes to promoting renewable energy; a close reading of the policy texts and implementation record in Nigeria, Ghana, Senegal and Côte d'Ivoire reveals patterns that are both instructive and cautionary for urban energy transitions. In each country, nationally articulated targets and regulatory instruments coexist with institutional bottlenecks, financing constraints and technical challenges that shape how renewables reach or fail to reach urban consumers. The following analysis examines the principal national instruments and the salient implementation gaps that determine urban relevance and impact (Mgbemene, & Ozor, 2017).

Nigeria's National Renewable Energy and Energy Efficiency Policy (NREEEP) sets a formal framework for diversifying the generation mix, advancing energy efficiency, and mobilizing off-grid solutions to increase access in underserved communities. The policy articulates a range of objectives from expanding renewable deployment for both on-grid and off-grid contexts to establishing financing frameworks and incentives and it explicitly links renewable deployment to rural electrification priorities. Yet, despite formal articulation, NREEEP's translation into scaled urban impact has been constrained by regulatory fragmentation, weak enforcement capacity, and the practical realities of an ageing and unreliable transmission and distribution system (Federal Republic of Nigeria, 2015; Ozoegwu, Mgbemene, & Ozor, 2017). In particular, regulatory oversight by the Nigerian Electricity Regulatory Commission (NERC) has yielded important instruments most notably mini-grid regulations and frameworks to govern distributed generation but the enforcement and harmonization of these instruments across federal, state and utility actors have been inconsistent, limiting predictability for investors and slowing urban grid-tied renewable integration (NREEEP; NERC mini-grid regulations). Moreover, national rural electrification programmes, implemented through bodies such as the Rural Electrification Agency, while focused on extending access, have at times privileged conventional grid extension strategies that are slow and capital-intensive, leaving peri-urban and informal urban settlements reliant on private diesel generation or small off-grid suppliers. These dynamics produce a paradox: Nigeria's policy architecture recognizes distributed renewables and mini-grids as key tools, yet systemic institutional and fiscal barriers prevent those tools from delivering reliable, affordable urban energy at scale (Ozoegwu et al., 2017).

Ghana's experience demonstrates how relatively strong statutory commitments can nonetheless yield mixed outcomes when implementation modalities are weak. The Renewable Energy Act (Act 832, 2011) established an enabling legal framework by mandating the creation of a Feed-in Tariff (FiT) regime, specifying roles for regulatory agencies, and setting renewable-generation targets intended to accelerate uptake (Government of Ghana, 2011). In Accra and other urban centres, policy incentives combined with private-sector activity and international development finance have supported nascent rooftop solar markets and a growing pipeline of utility-scale projects. Empirical studies using policy and deployment data suggest that regulatory clarity contributed to early market formation for solar technologies and stimulated local entrepreneurship (e.g., solar leasing and pay-as-you-go models). Nonetheless, Ghana's case highlights persistent bottlenecks: the calibration of FiTs has at times failed to provide consistent price signals, grid-integration constraints and limited coordination between the Public Utilities Regulatory Commission and distribution companies have complicated interconnection, and fiscal risks have discouraged large-scale investment without concessional finance (Atuguba & Tuokuu, 2020). Consequently, while Accra has seen demonstrable solar uptake among commercial and high-income residential customers, scaling distributed renewables in low-income neighbourhoods and translating policy instruments into broader urban resilience remains a central challenge (Atuguba & Tuokuu, 2020).

Senegal provides an instructive example of policy coherence linked to a national development strategy. The Plan Sénégal Émergent (PSE) places energy sector development at the core of economic modernization, and the government has actively pursued utility-scale solar and wind projects alongside targeted reforms to SENELEC, the incumbent utility, to facilitate integration of renewables (Plan Senegal Emergent; IEA, 2023). Recent years have seen notable project outcomes from grid-connected solar parks to incremental wind capacity and SENELEC's planning for Dakar and peri-urban areas has included explicit integration of distributed solar to improve supply security and reduce reliance on imported heavy fuel oil. However, Senegal's pathway also illustrates trade-offs: financing large projects has depended heavily on international partnerships and concessional capital, and the simultaneous prioritization of gas-to-power as a transitional fuel complicates long-term decarbonization trajectories. Grid-integration challenges and the need for strengthened market institutions and transparency also persist, particularly as urban demand rises and intermittency management becomes a pressing operational issue for SENELEC in Dakar and surrounding cities (Apfel, 2022).

Côte d'Ivoire's 2014 legislative reforms including the Electricity Code and complementary instruments aimed at encouraging private sector participation and renewable investment have created an enabling investment framework that aligns with national ambitions for expanding renewable capacity and meeting fast-growing urban demand in cities such as Abidjan (Law No. 2014-132; World Bank country notes). The Ivorian trajectory has placed emphasis on large hydro where geographically possible, while also opening space for solar and biomass solutions. Notably, private concessions and public–private partnerships have supported the development of significant biomass projects, including palm-residue-fed plants conceived to supply urban grids and industrial loads in Abidjan. These projects demonstrate the potential for urban-focused renewables to contribute to baseload and dispatchable capacity, but their success depends on transparent procurement, long-term offtake arrangements, and technical capacity for operation and maintenance. Although the regulatory reform has catalyzed investor interest, implementation challenges remain: local content development, grid reinforcement in dense urban corridors, and the environmental governance of large biomass supply chains require ongoing policy attention to ensure sustainability and equitable urban benefits (Kouadio et al., 2021).

Across these four national cases, several cross-cutting observations emerge. First, statutory ambition (laws, acts and master plans) is a necessary but insufficient condition for urban renewable impacts; institutional capacity, regulatory predictability, and financing mechanisms are the proximate determinants of implementation success. Second, the urban implications of national policies depend heavily on how policies address distributed generation, interconnection procedures, and peri-urban inclusion: countries that adopt clear mini-grid and distributed-generation regulations and that couple them with concessional finance and municipal engagement are better positioned to translate national targets into urban resilience. Third, international finance and technical cooperation have been pivotal in catalyzing initial project pipelines, but they cannot substitute for strengthened domestic policy execution and market reforms that reduce perceived sovereign and currency risk. Finally, the coexistence of transition strategies that continue to rely on gas or other fossil fuels alongside renewable commitments underscores the political economy trade-offs that will shape urban decarbonization pathways.

V. KEY FINDINGS

West African nations have established robust legal frameworks at regional and national levels to promote renewable energy (RE) development. The Economic Community of West African States (ECOWAS) Renewable Energy Policy (EREP) sets ambitious targets, including increasing the share of renewable energy in the regional electricity mix to 48% by 2030. Countries like Nigeria, Ghana, and Senegal have aligned national policies with these goals, implementing instruments such as feed-in tariffs, tax incentives, and regulatory guidelines to attract private investment. These frameworks are bolstered by growing international investment interest, exemplified by the World Bank's commitment of over $1.1 billion to regional energy projects, such as the North Core Interconnector and the CLSG (Côte d'Ivoire-Liberia-Sierra Leone-Guinea) transmission line, which has facilitated cross-border electricity trade and expanded access to renewable energy for millions . Additionally, initiatives like the African Development Bank's Sustainable Energy Fund for Africa (SEFA) and Desert to Power program demonstrate multilateral efforts to de-risk investments and support RE infrastructure.

WEAKNESSES AND IMPLIMENTATION BARRIERS

Despite these strengths, policies often lack effective city-level implementation strategies. National frameworks frequently fail to address urban-specific challenges, such as dense population zones, informal settlements, and municipal governance constraints. For instance, while ECOWAS targets are regionally coherent, urban municipalities often lack the fiscal decentralization, technical capacity, and legislative mandates to execute localized RE projects. Financing barriers further impede progress, as urban RE projects face high upfront costs, limited access to concessional loans, and currency risks. African countries pay significantly higher

interest rates than developed nations for similar projects, increasing capital costs and deterring private investment. Additionally, limited grid integration remains a critical hurdle. Aging infrastructure cannot efficiently handle variable renewable inputs, leading to curtailment issues and reliability concerns. For example, grid losses in some West African countries exceed 40%, undermining the economic viability of RE investments.

Gaps in Urban-Specific Targets and Enforcement

A significant gap lies in the absence of urban-specific renewable energy targets and enforcement mechanisms. National policies prioritize utility-scale projects and rural electrification, overlooking the unique demands of rapidly growing cities. For instance, although countries like Nigeria and Ghana have set national renewable energy targets, these are rarely broken down into enforceable urban benchmarks, such as mandates for solar rooftops, building-integrated renewables, or decentralized mini-grids in peri-urban areas. Moreover, regulatory bodies often lack the authority to mandate municipal compliance, resulting in fragmented implementation. The weak institutional capacity of city governments further exacerbates this issue, as municipalities struggle with permitting delays, technical expertise shortages, and inadequate revenue streams to sustain renewable energy initiatives. Finally, there is a notable disconnect between national climate commitments (e.g., Nationally Determined Contributions) and urban planning frameworks. While 45 African countries have adopted quantified RE targets under the Paris Agreement, few have integrated these into city-level master plans or zoning regulations.

The assessment of renewable energy policy at the urban scale reveals a complex interplay of strengths, weaknesses, and persistent gaps that shape the trajectory of sustainable energy transitions. One of the most notable strengths is the presence of legal frameworks that provide legitimacy and structure to renewable energy development. Legal and regulatory instruments, such as renewable energy acts, feed-in tariffs, and national electrification plans, create stability for investors and establish enforceable rights of access to the grid. For instance, Jacobson and Lauber (2006) emphasized that the institutionalization of renewable energy policies through legal frameworks in Germany provided a solid foundation for scaling up wind and solar power, demonstrating that regulatory certainty is a precondition for market confidence. Similarly, del Río and Mir-Artigues (2012) argued that comprehensive laws serve not only to stimulate investment but also to create a predictable trajectory for long-term decarbonization. This indicates that the codification of renewable energy into law remains one of the strongest pillars of policy effectiveness.

Another significant strength lies in the growing investment interest in renewables, both from domestic and international actors. According to Polzin, Migendt, Täube, and von Flotow (2015), the steady expansion of financial commitments into renewable projects is strongly linked to the design of enabling policies such as subsidies, tax incentives, and public–private partnerships. Urban areas, in particular, have attracted investors due to their concentrated energy demand and visibility as showcases of innovation. Scholars such as Zhang and Gallagher (2016) note that investment interest is reinforced by global climate commitments, which compel both governments and private capital markets to view renewable energy not merely as an environmental good but also as a strategic economic sector. Thus, the alignment between legal certainty and financial appetite constitutes a critical strength of contemporary renewable energy policy. Nevertheless, significant weaknesses undermine the effectiveness of these policy frameworks at the city level. A major challenge is the lack of localized implementation strategies. While national governments may articulate ambitious renewable energy targets, cities often struggle to translate these into actionable plans due to limited technical capacity and governance fragmentation (Bulkeley, Castán Broto, & Edwards, 2015). This disconnect creates an implementation gap, where local authorities lack the resources or regulatory authority to deliver on higher-level commitments. Without coherent city-level strategies, renewable energy deployment risks remaining aspirational rather than transformative.

Financing barriers also remain a critical weakness. Despite growing global investment, many urban renewable projects face difficulty accessing affordable finance due to high upfront costs, long payback periods, and the perceived risks associated with new technologies. As Sovacool, Axsen, and Sorrell (2018) argued, financing barriers are particularly acute in developing economies, where municipal governments often lack the creditworthiness to attract long-term private investment. These constraints inhibit not only large-scale infrastructure projects but also smaller distributed systems such as solar mini-grids, which are essential for urban resilience. Closely linked to financing are the persistent issues of limited grid integration. Existing electricity grids in many countries were designed for centralized fossil-fuel generation and remain ill-suited to the intermittent nature of renewable energy. Ochoa and Harrison (2011) demonstrated that insufficient grid flexibility and outdated regulatory frameworks act as bottlenecks for the integration of renewable power in urban settings. Without significant investment in smart grids and storage technologies, renewable expansion risks creating instability in supply and undermining consumer confidence.

Finally, there are identifiable gaps in terms of urban-specific renewable targets and enforcement mechanisms. While national targets may be clearly defined, city-level commitments are often vague or absent. This gap is problematic because urban centers are disproportionately responsible for energy consumption and greenhouse gas emissions. According to Romero-Lankao and Gnatz (2013), the absence of enforceable municipal targets undermines accountability and slows the pace of decarbonization. Moreover, even where urban renewable energy plans exist, weak enforcement mechanisms often prevent effective implementation. This reveals a structural gap between policy ambition and urban execution.

VI CASE EXAMPLES

Case Examples of Urban Renewable Energy Initiatives in West Africa

Urban areas across Sub-Saharan Africa have emerged as focal points for renewable energy experimentation and deployment, reflecting both the pressing demand for reliable electricity and the necessity of sustainable urban development. Three case studies—Lagos in Nigeria, Accra in Ghana, and Dakar in Senegal demonstrate how renewable energy is being integrated into critical aspects of urban infrastructure, albeit with varying levels of policy support, financial innovation, and institutional coordination.

In Nigeria, Lagos has pioneered solar mini-grid programs as part of broader efforts to address chronic electricity shortages. Lagos, being the country's largest metropolitan area, consumes over 40% of national electricity demand but faces acute supply deficits due to national grid instability and transmission losses (Oyewo, Aghahosseini, Ram, & Breyer, 2019). To address this gap, Lagos has adopted decentralized energy systems, particularly solar mini-grids, which combine photovoltaic generation with battery storage and, in some cases, diesel backup to ensure stability. Ebhota and Jenkin (2021) observed that mini-grids provide a scalable and relatively rapid solution for bridging the electrification gap in peri-urban and underserved communities. Moreover, Lagos State's policy framework, which facilitates collaboration between private developers and government agencies, has been instrumental in expanding access. The World Bank–backed Nigeria Electrification Project, for example, has supported private mini-grid operators to deploy systems ranging from 50 kW to 500 kW across Lagos' informal settlements (Aklin, Cheng, Urpelainen, Ganesan, & Jain, 2017). These initiatives have enhanced energy reliability for households and small businesses while reducing dependence on polluting diesel generators, thereby contributing to both social welfare and climate mitigation goals.

Accra's renewable energy initiatives have largely centered on energy efficiency in public lighting and the growth of solar markets. Street lighting in Accra had historically been constrained by high electricity consumption and maintenance costs, limiting coverage in many neighborhoods. The city's adoption of energy-efficient light-emitting diode (LED) systems, often powered by stand-alone solar units, has transformed urban illumination, enhancing safety and reducing energy expenditure. As noted by Mensah and Adu (2017), energy-efficient lighting projects in Ghana were designed to reduce peak demand and alleviate pressure on the national grid, while simultaneously lowering public sector expenditure on electricity. In addition, Accra has become a hub for solar home systems and distributed photovoltaic markets. Atuahene (2021) explained that the liberalization of Ghana's renewable energy sector and the Renewable Energy Act of 2011 created a conducive environment for private companies to introduce pay-as-you-go (PAYG) solar products targeted at urban low- and middle-income households. These models have allowed urban residents to bypass unreliable grid supply while reducing upfront cost barriers. The combination of public lighting reforms and an expanding solar marketplace illustrates Accra's pragmatic approach to renewable energy adoption, balancing public-sector efficiency with market-driven expansion.

In Dakar, Senegal, renewable energy integration has been most visible in the transport sector, particularly through electrification initiatives. Dakar is a rapidly growing metropolis grappling with severe congestion, high fuel costs, and elevated urban pollution levels. The government, in partnership with international financiers, has advanced renewable-based transport solutions, most prominently through the Bus Rapid Transit (BRT) system powered partly by renewable energy inputs. Ndiaye, Fall, and Ba (2020) highlighted that Senegal's BRT initiative includes electric buses charged using a mix of grid electricity and renewable energy, with the aim of reducing transport-related emissions by nearly 60%. Beyond buses, Dakar has also piloted the integration of solar-powered charging infrastructure for electric taxis, positioning renewable energy as a cornerstone of its sustainable mobility agenda (Diouf & Pode, 2015). These interventions not only address energy efficiency but also enhance air quality and reduce the city's dependence on imported petroleum products. Importantly, Dakar's transport integration reflects a broader recognition of the interlinkages between renewable energy and other urban systems, where energy policy is aligned with mobility and climate strategies.

Comparatively, the three cases underscore the diversity of renewable energy pathways in West African cities. Lagos' emphasis on decentralized solar mini-grids reflects both the limitations of Nigeria's centralized power system and the dynamism of private sector involvement in bridging infrastructure gaps. Accra's focus on energy-efficient lighting and solar markets demonstrates how

urban governance can leverage both efficiency gains and consumer-oriented markets to expand renewable adoption. Dakar's integration of renewables into transport infrastructure highlights a forward-looking approach that aligns energy transitions with urban planning and mobility needs. While each city demonstrates commendable progress, scholars such as Byrne, Taminiau, Kim, Seo, and Lee (2018) argue that scaling such initiatives requires sustained institutional support, financing innovation, and robust regulatory mechanisms to ensure long-term sustainability.

In conclusion, Lagos, Accra, and Dakar exemplify how urban areas in Sub-Saharan Africa are experimenting with renewable energy solutions tailored to their socio-economic and infrastructural realities. These initiatives mini-grids, energy-efficient lighting and solar markets, and renewable transport integration illustrate the possibilities of urban-centered transitions, though challenges of scalability, financing, and governance remain. Collectively, they highlight the critical role of cities in advancing renewable energy transitions in contexts where national systems are often constrained.

Policy Recommendation

1. Local governments should develop urban energy regulations that complement national frameworks, providing clear guidelines for renewable energy integration in urban infrastructure. This includes zoning regulations for solar installations, incentives for energy-efficient buildings, and integration of renewables into municipal energy plans.
2. Financial barriers are a major impediment to renewable energy deployment in West African cities. Policymakers should establish dedicated funding mechanisms, including green bonds, low-interest loans, and public-private partnerships, to mobilize investments for city-scale renewable projects. Targeted subsidies for solar mini-grids, energy-efficient public lighting, and rooftop solar programs can accelerate adoption among both households and businesses.
3. Limited grid integration and technical challenges restrict renewable energy utilization. Governments should invest in modernizing urban electricity grids, including smart grid technologies and energy storage systems, to manage intermittent renewable energy supply. Training programs for local engineers and technicians are essential to ensure sustainable operation and maintenance of renewable installations.
4. National renewable energy targets often fail to capture urban-specific challenges and opportunities. City governments should establish measurable renewable energy goals, aligned with national objectives but tailored to local energy demand, population density, and resource availability. Implementing monitoring and reporting systems will ensure transparency, track progress, and inform policy adjustments.
5. Adoption of renewables is limited by low public awareness and lack of stakeholder engagement. Cities should implement education campaigns and participatory planning processes that inform citizens about the benefits of renewable energy. Collaboration with local communities, businesses, and civil society organizations will foster acceptance, encourage innovation, and ensure policies are contextually relevant and socially inclusive.

CONCLUSION

The assessment of national energy policies promoting renewable energy in West African cities reveals a complex interplay between progress, challenges, and the need for actionable recommendations. On the one hand, significant strides have been made in establishing national frameworks that advocate for renewable energy adoption, including solar, wind, and biomass initiatives. Countries such as Nigeria, Ghana, and Senegal have developed national energy policies that recognize the critical role of renewable energy in enhancing energy security, reducing carbon emissions, and fostering sustainable urban development. In several cases, these frameworks have catalyzed pilot projects and investment interest, demonstrating the region's potential for renewable energy integration.

However, despite these advances, the translation of national policies into urban contexts remains limited. Many cities struggle with weak implementation strategies, inadequate financing, and technical constraints, particularly in electricity grid integration and energy storage capacity. The lack of urban-specific renewable targets, coupled with insufficient monitoring and enforcement mechanisms, hampers consistent progress. Furthermore, socio-economic and institutional barriers, including limited public awareness, fragmented governance, and competing urban priorities, have slowed adoption rates. Cities such as Lagos, Accra, and Dakar illustrate both successes and gaps solar mini-grids, energy-efficient street lighting, and public transport electrification show promise, but scaling these initiatives requires more robust policy coordination and resource allocation.

Addressing these challenges necessitates a multi-pronged policy approach. Strengthening urban legal frameworks, improving financing mechanisms, modernizing grid infrastructure, establishing measurable city-level targets, and promoting stakeholder engagement are essential for bridging the gap between national ambitions and local realities. Policies must be context-sensitive, balancing technical feasibility, economic viability, and social acceptance. A proactive emphasis on capacity-building for local

authorities and technical personnel can enhance the sustainability and resilience of renewable projects. Moreover, fostering public awareness and inclusive participation ensures that renewable energy initiatives align with community needs and gain broader societal support.

In conclusion, the success of renewable energy policies in West African cities hinges on translating national-level intentions into actionable urban strategies. By addressing implementation gaps, technical limitations, and socio-institutional barriers, cities can become effective incubators for renewable energy deployment, contributing to energy security, climate mitigation, and sustainable urban growth. Strategic policy interventions, grounded in collaboration between national authorities, local governments, and stakeholders, are essential to achieve the region's renewable energy potential.

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