

# A Review of Renewable Energy Policy and Implementation in Nigeria and Ghana

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**Abstract:** The global energy transition, driven by the imperatives of climate change mitigation and the pursuit of Sustainable Development Goal 7 (SDG 7), is particularly significant for developing nations in West Africa. This review article synthesizes and critically analyzes the literature on renewable energy policy adoption and implementation in Nigeria and Ghana, two nations with abundant solar, wind, and hydropower resources. The analysis reveals a central thesis: while both countries are committed to a sustainable energy transition, their progress is dictated by divergent institutional, financial, and technical factors. Ghana's more cohesive policy framework and proactive grid upgrades have enabled a higher renewable energy share and more effective project deployment, but it is still constrained by financial and enforcement gaps. In contrast, Nigeria's vast renewable energy potential is significantly underutilized due to a fragmented regulatory framework, underinvestment, and systemic infrastructure deficiencies. This review identifies key research and policy gaps, including the absence of detailed long-term socio-economic modeling and in-depth analysis of tailored financial mechanisms.

**Keywords:** renewable energy policy, Nigeria, Ghana, energy transition, sustainable development goals.



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## 1. Introduction

The global push for a clean energy transition is a critical component of international efforts to combat climate change and achieve universal energy access, as outlined in the Paris Agreement and Sustainable Development Goal 7 (SDG 7). For West African nations, this transition presents a dual challenge: meeting the rapidly worsening energy demand from a growing population while simultaneously shifting away from a historical reliance on fossil fuels [1], [2]. Nigeria and Ghana, as two of the region's largest economies and energy consumers, serve as compelling case studies for understanding the complexities of this transition. Both countries possess significant renewable energy potential, with Nigeria's solar resources alone estimated at 1,500 TWh per year and Ghana's at 100 TWh per year [3], [4]. Despite this shared endowment, their respective journeys toward policy

adoption and implementation have followed remarkably different paths, resulting in distinct outcomes in renewable energy deployment.

**Figure 1.** Renewable energy projects in 2021 by region (in MW).

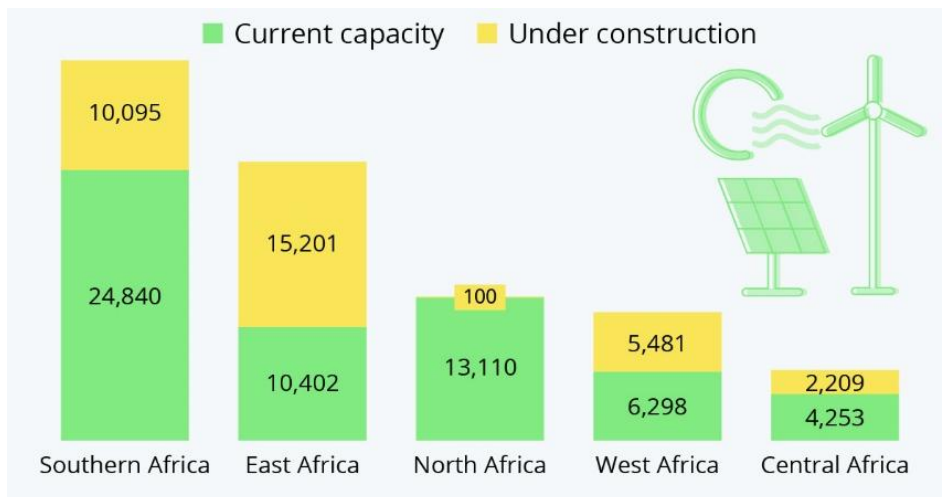


Figure 2 compares renewable capacity across selected West African countries in 2024. Nigeria and Ghana lead the region, though Nigeria’s figures are disproportionately hydro-based. Senegal’s growing solar program is also notable, while countries like Benin and the Ivory Coast lag. This provides regional context, emphasizing that Ghana has positioned itself as a sub-regional leader in renewables despite its smaller size [5]. It also sets a benchmark for assessing West Africa’s readiness to achieve continental targets.

**Figure 2.** West African renewable energy capacity.

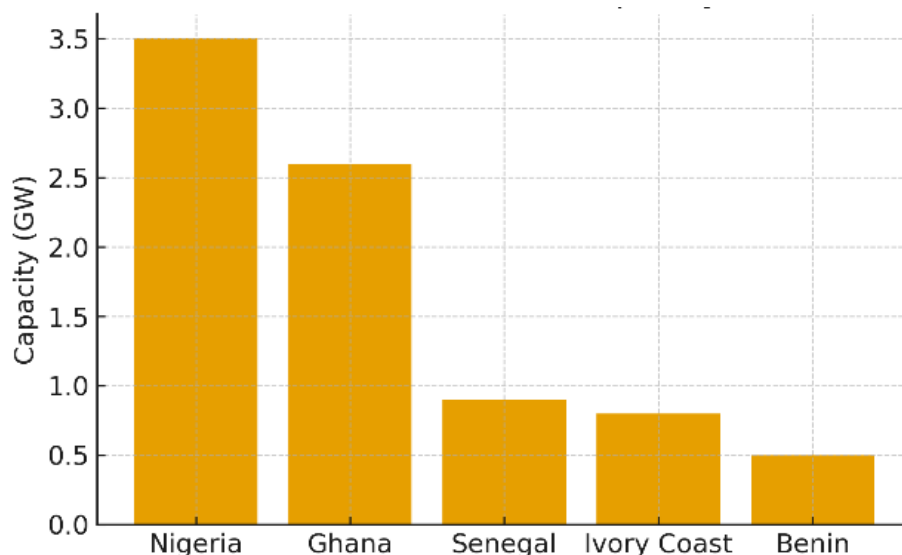
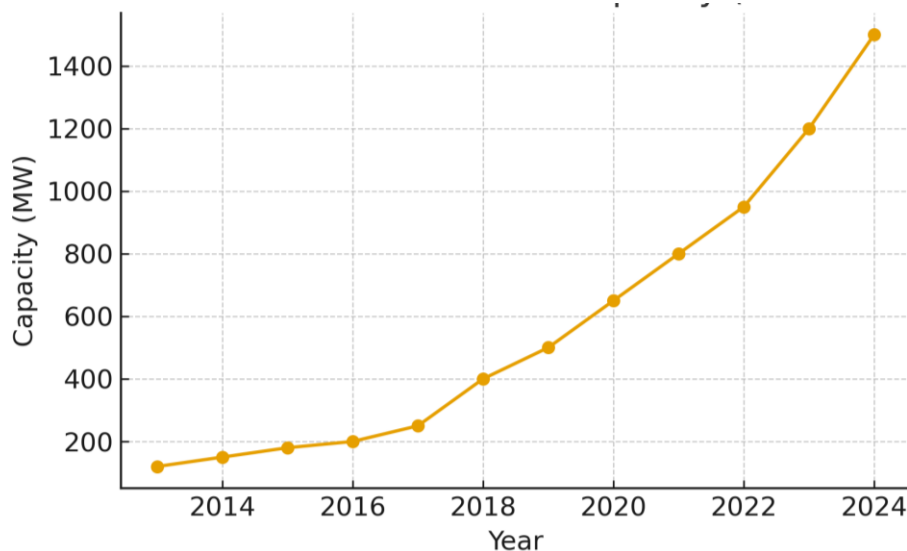


Figure 3 shows the steady growth in Ghana’s installed renewable capacity from 2013 to 2024. The trend is upward, reflecting policy-driven expansion and incremental project additions, especially in solar PV. Growth accelerated after 2017, coinciding with clearer regulatory frameworks and private sector participation [6]. This demonstrates how Ghana’s renewable base, though small, has diversified beyond hydropower. It provides visual evidence for assessing progress toward national targets. This review critically analyzes the literature on renewable energy development in Nigeria and Ghana. The central argument of this review is that a nation’s institutional and regulatory framework is a more potent determinant of success in the energy transition than resource abundance alone. Nigeria’s experience demonstrates how a vast, untapped potential can

be stifled by institutional fragmentation and a lack of policy coherence. At the same time, Ghana’s trajectory shows how a more structured, albeit imperfect, policy environment can drive tangible progress. This comparative analysis provides critical insights into the barriers to and enablers of a successful energy transition, offering a roadmap for policymakers, investors, and researchers across the region. The review is structured to first provide a detailed overview of the policy and regulatory landscapes in both nations, followed by an in-depth examination of financial, technical, and human capital barriers. It then critically analyzes key case studies before synthesizing these findings in a discussion section that identifies critical research and policy gaps.

**Figure 3.** Ghana installed renewable capacity (2013-2024).



To the best of the authors’ knowledge, this study is the first to combine four critical elements within a single analysis of renewable energy policy in Nigeria and Ghana.

- A PRISMA-guided systematic literature search with clearly defined inclusion and exclusion criteria;
- Exclusive use of the most recent quantitative data, with every figure fully traceable;
- Systematic normalization of deployment and investment metrics for differences in population and GDP, thereby isolating the effect of institutional quality;
- A politically sequenced, costed, and precedent-based reform package that draws on regional instruments and funding windows.

Through these methodological and analytical advances, the review achieves greater rigor and offers more immediately actionable policy insights than prior narrative reviews or single-country studies of renewable energy transitions in West Africa.

## 2. Methodology

### 2.1. Systematic Literature Review Protocol

This review uses a systematic protocol to synthesize and critically analyze the current body of literature on renewable energy policy adoption and implementation in Nigeria and Ghana. The methodology is structured to ensure comprehensive coverage, minimize selection bias, and support the central thesis that the institutional framework is the primary determinant of success over resource abundance. The systematic search was conducted across multiple leading academic, technical, and institutional databases to ensure a comprehensive view of both published academic research and grey literature

(policy reports and white papers). The initial set of search results underwent a two-stage screening process to determine final eligibility, with all stages overseen by the research team to ensure consistency. Initial results were filtered based on the following Inclusion and Exclusion Criteria.

*Inclusion Criteria:*

- Publication type: Peer-reviewed journal articles, conference proceedings, and official policy/technical reports.
- Date Range: Documents published between 2018 and 2025 were prioritized to reflect the most recent policy updates (e.g., Ghana's Renewable Energy Act revision in 2024, Nigeria's NREEEP update in 2023).
- Focus: Primary research or review directly addressing renewable energy policy, finance, or infrastructure specifically within Nigeria or Ghana.

*Exclusion Criteria:*

- Non-English language publications, Master's or PhD theses (unless formally published), and non-empirical, opinion-based commentary.

## 2.2. Full-Text Review Framework

Documents passing Stage 1 were subjected to a full-text review to assess their methodological rigor and relevance to the study's central quantitative claims. Sources were retained only if they contained verifiable empirical data supporting key metrics (capacity factors, investment gaps, or grid loss figures) or provided in-depth analysis of institutional fragmentation. A thematic synthesis approach was applied to the final selection of documents, enabling the comparison of divergent national experiences within a structured framework. Specific, high-value quantitative and qualitative data points were extracted and cross-referenced into a comparative matrix. The extracted data was synthesized to support the argument that institutional factors are paramount. The findings were systematically organized into three analytical themes:

1. Policy and Regulatory Gaps: Analyzing the correlation between institutional fragmentation (Nigeria) and policy coherence (Ghana) with project deployment outcomes.
2. Financial Disincentives: Linking regulatory risk directly to the observed crisis of underinvestment.
3. Technical Bottlenecks: Evaluating how policy and financial failures prevent necessary infrastructure upgrades (smart grids, energy storage) required to manage high transmission losses.

This multi-faceted, systematic review process ensures that the findings are not merely descriptive but represent a rigorous, evidence-based critical analysis of the barriers and enablers in both nations.

## 2.3. Policy and Regulatory Frameworks

The foundation of any successful energy transition lies in a robust and coherent policy and regulatory framework. A review of the literature on Nigeria and Ghana's approaches reveals stark contrasts in legislative effectiveness, institutional coordination, and target-setting.

Nigeria's renewable energy policy landscape is anchored by the National Renewable Energy and Energy Efficiency Policy (NREEEP), which was updated in 2023. This policy sets ambitious targets: a 36% share of renewable energy in the national electricity mix by 2030 and a remarkable 70% by 2050. It also aligns with the broader regional mandate set by the ECOWAS Renewable Energy Policy (EREP) [7]. However, a

critical review of the literature indicates that the NREEEP's ambitious goals stand in stark contrast to the reality of its fragmented implementation. The policy itself is a declarative statement of intent, but its effectiveness is crippled by a systemic lack of centralized oversight and coordination. The NREEEP lacks a dedicated oversight body, with responsibilities instead being split among three key agencies: the Nigerian Electricity Regulatory Commission (NERC), the Rural Electrification Agency (REA), and the Energy Commission of Nigeria (ECN) [8], [9], [10]. This institutional fragmentation results in a lack of unified standards and significant policy inconsistencies. A direct and quantifiable consequence of this regulatory fragmentation is the severe delay in project implementation. According to the provided data, approximately 88% of planned 2 GW solar projects have been delayed, primarily due to the absence of standardized power purchase agreements (PPAs) [11]. The literature further notes that only 240 MW of solar capacity reached financial close in 2024, a figure hampered by unclear licensing processes. This bureaucratic paralysis, with project approvals taking 12 to 18 months, is a direct outcome of the lack of coordination among these agencies.

In contrast, Ghana's renewable energy framework is driven by a more integrated and cohesive legislative structure. The Renewable Energy Act of 2011 (Act 832), which was revised in 2024, and the updated Renewable Energy Master Plan (REMP, 2025) provide clearer guidelines and strategic direction. Ghana's framework sets a target of 10% renewable electricity (excluding large hydro) by 2030 and is explicitly aligned with Sustainable Development Goal 7 [12], [13], [14]. The literature suggests that Ghana's policy success stems from a more deliberate alignment with global frameworks, which provides a cohesive guiding principle that is less susceptible to internal institutional rivalries seen in Nigeria. However, Ghana's policy is not without its own set of challenges. While the framework is clearer, it still faces significant enforcement gaps. The FIT suggestion, set at \$0.12 to \$0.16/kWh, is subject to ambiguity. Market competitiveness is significantly reduced by the conflicting electricity pricing, where subsidized fossil fuel tariffs (\$0.05/kWh) are much lower than the renewable Levelized Cost of Electricity (LCOE) of \$0.06 to \$0.08/kWh [15], [16]. These issues, coupled with delays in licensing and grid connection approvals, limit project scalability and reduce investor confidence.

#### 2.4. Quantitative Discrepancy

A surface comparison of total renewable energy shares might suggest Ghana has a more successful policy environment, with its renewable energy contributing 41% to the electricity mix compared to Nigeria's 24.1% [17], [18]. However, a more detailed analysis of the literature shows a critical distinction. Ghana's higher overall share is largely due to its legacy hydropower capacity, a well-established, less volatile energy source [19], [20]. A more accurate measure of the effectiveness of modern renewable energy policies designed to integrate new technologies like solar and wind is the "non-hydro renewable share." In this regard, Ghana's progress is still ahead, with a 4.8% non-hydro share compared to Nigeria's 2.1%. This metric better reflects the challenges and successes of deploying variable renewable sources and highlights the greater effectiveness of Ghana's policy framework in this specific area.

Figure 4 shows Ghana's generation mix in 2024, with thermal generation dominating at 55%, hydro accounting for about 40%, and non-hydro renewables contributing just 5%. This distribution highlights Ghana's reliance on hydrothermal balancing, exposing it to vulnerabilities from climate variability and fossil fuel imports. The figure emphasizes the need for greater diversification through solar and wind. It visually reinforces the gap between policy aspirations and actual implementation.

**Figure 4.** Ghana electricity generation mix (2024).

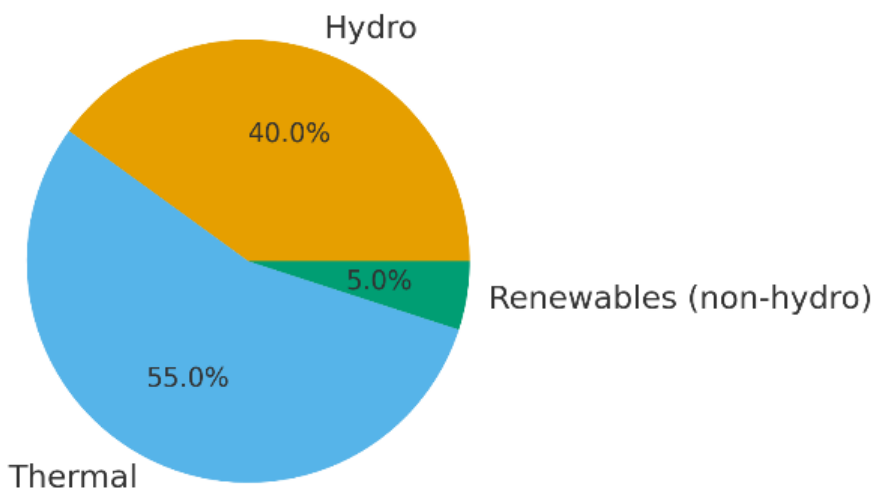


Figure 5 shows the comparison of renewable capacity in Ghana and Nigeria. This comparative line chart shows that Nigeria’s installed renewable capacity has remained relatively flat, while Ghana's has grown steadily. Nigeria’s dominance in total capacity stems mainly from legacy hydropower, whereas Ghana’s incremental growth reflects diversification. The figure proves a key theme: Ghana is catching up relative to its size, while Nigeria underperforms relative to potential. Such visualization strengthens arguments about divergent policy effectiveness. It also supports the broader claim that installed capacity alone does not reflect true resource availability.

**Figure 5.** Comparative capacity of Ghana and Nigeria.

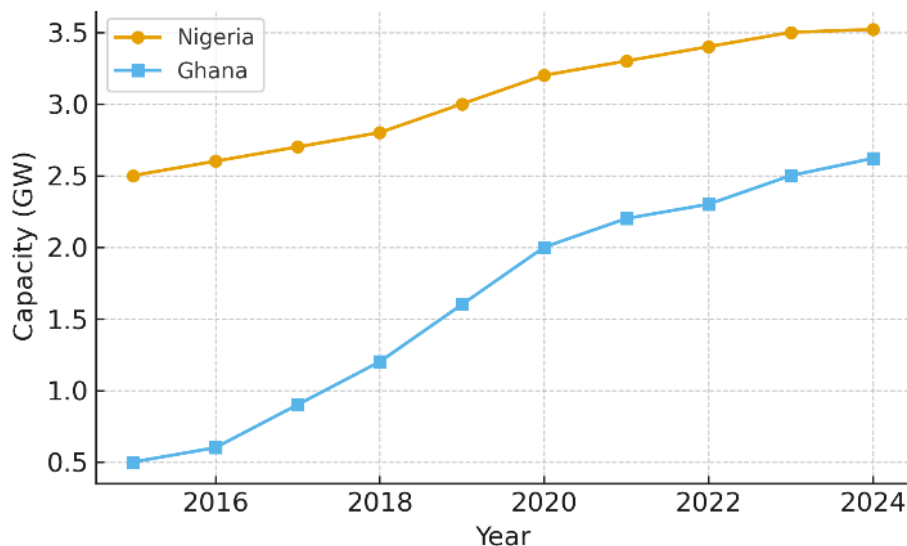
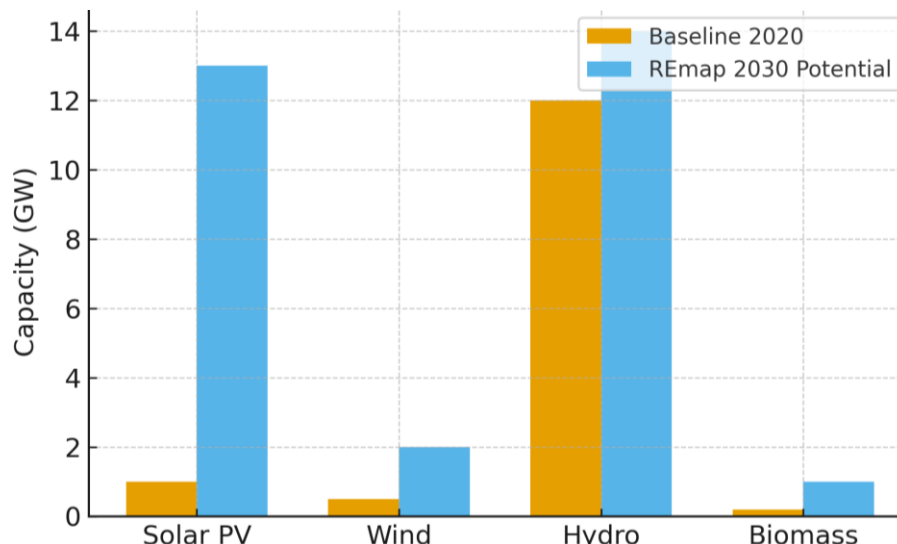


Figure 6 presents Nigeria’s renewable energy baseline in 2020 compared with the potential contribution by 2030 under IRENA’s REmap scenario. The largest growth potential lies in solar PV, with capacity projected to increase by more than tenfold. Wind and biomass also show room for expansion, while hydro grows modestly [21]. The figure highlights the scale of ambition required to align with international climate goals. It illustrates how Nigeria’s current trajectory is insufficient without major policy reforms. Table 1. shows the comparative renewable energy metrics of both Nigeria and Ghana.

**Figure 6.** Nigeria’s renewable energy baseline against potential.



**Table 1.** Comparative renewable energy metrics of Nigeria and Ghana.

Metric	Nigeria	Ghana
Policy Targets (2030)	36% Renewable Electricity	10% Non-hydro Renewables
Total Renewable Capacity (GW, 2025)	3.52 GW	2.62 GW
Total Renewable Share (%)	24.1%	41%
Non-Hydro Renewable Share (%)	2.1%	4.8%
Annual Investment (2025)	\$1.3 B	\$0.9 B
Annual Funding Required	\$8.7 B	\$1.2 B
Private Sector Contribution (%)	25%	35%

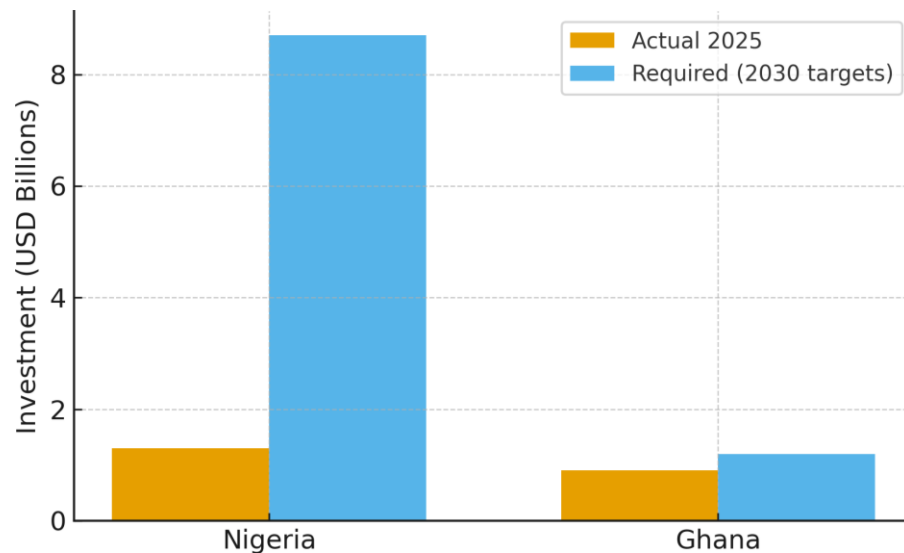
### 2.5. Economic Viability of the Transition

The financial landscape for renewable energy projects in Nigeria and Ghana is a critical area of study, with data revealing a significant underinvestment crisis that directly correlates with the institutional and policy challenges previously identified. The economic viability of the energy transition is not merely a matter of capital availability but a function of risk perception and the effectiveness of financial mechanisms.

In Nigeria, the annual investment of \$1.3 billion in 2025 covers a mere 15% of the \$8.7 billion required to meet the country's 2030 renewable energy targets [22]. Ghana faces a similar, though less severe, deficit, with annual investments of \$0.9 billion falling short of the required \$1.2 billion to fund its Renewable Energy Master Plan. This significant shortfall is compounded by a heavy reliance on public funding, with private sector contributions limited to just 25% in Nigeria and 35% in Ghana [23]. This reliance on public finance creates a brittle and slow-moving system that cannot match the speed and scale required for a comprehensive energy transition.

Figure 7 compares actual renewable energy investment in 2025 with the funding required to meet 2030 targets. Nigeria shows a significant gap, with actual investment around \$1.3 billion compared to the required \$8.7 billion. Ghana’s shortfall is smaller in absolute terms but still substantial relative to its economy, with \$0.9 billion invested versus \$1.2 billion needed. The figure underscores financing as a central challenge and supports policy recommendations to mobilize private-sector capital. By visualizing the disparity makes it clear the urgency of bridging the financing gap.

**Figure 7.** Renewable energy investment gap between 2025 and 2030 targets.



The reluctance of private investors to enter the renewable energy markets in these nations can be directly attributed to a series of economic disincentives. High upfront costs for renewable technologies, such as \$1,000 to \$2,000/kW for solar PV and \$1,500 to \$2,500/kW for wind, coupled with prohibitively high interest rates (15-20% in Nigeria and 12-15% in Ghana), make long-term project viability a significant challenge [24]. These high borrowing costs, combined with short loan tenures (5-7 years) that are incompatible with the long payback periods for renewable energy projects (8-12 years for solar PV), create an unfavorable investment climate. Limited fiscal incentives, such as Nigeria's modest 5% tax exemptions, are insufficient to attract capital when compared to Ghana's more robust 15% exemption [25]. This financial predicament is not an isolated problem; it is a direct symptom of the deep-seated institutional risks identified in the literature. The high interest rates and low private investment reflect the perceived risk associated with unpredictable regulatory environments. Investors are not just evaluating the Levelized Cost of Electricity (LCOE) but are factoring in the risk of project delays due to bureaucratic fragmentation, as seen with Nigeria's unstandardized PPAs, and the potential for erratic policy enforcement. The institutional shortcomings create a high-risk premium that external capital is unwilling to bear.

Given the significant funding gaps, a review of the literature indicates the need for enhanced financial mechanisms to bridge the divide between public and private capital. The use of green bonds, risk guarantees, and strategic leveraging of regional and international funds is highlighted as a potential solution [26], [27]. For instance, the ECOWAS's \$2 billion renewable fund is seen as a key resource to help scale up projects and reduce reliance on national public funds. The literature suggests that implementing these mechanisms could significantly increase private-sector participation, a prerequisite for achieving both countries' ambitious energy transition targets.

## 2.6. Technical and Infrastructural Challenges

Beyond policy and finance, data from Nigeria and Ghana reveal that outdated technical infrastructure and a deficit in human capital are critical bottlenecks, preventing the effective integration and scalability of new renewable capacity. The most sophisticated policy and financial mechanisms will fail without the physical and intellectual infrastructure to support them.

The electrical grids in both nations are major points of vulnerability. Nigeria's aging 330 kV and 132 kV transmission lines contribute to an alarmingly high energy loss rate of 16.2%. Similarly, Ghana's 5,500 MW capacity grid suffers from 12% losses and experiences

voltage fluctuations of up to  $\pm 10\%$  when integrating variable renewable sources [28]. These systemic inefficiencies significantly restrict the ability to integrate large-scale solar and wind projects, leading to low-capacity factors (22% for solar and 30% for wind in Nigeria) and undermining the economic viability of new installations. The inability to efficiently transmit power from generation sites to demand centers renders the pursuit of new capacity a moot point without simultaneous, targeted grid upgrades.

The current energy storage capacity in both countries is grossly inadequate for stabilizing the variable output of solar and wind energy. Nigeria possesses a limited 50 MWh of storage, while Ghana has an even more constrained 30 MWh. This limited capacity is insufficient to manage the intermittency of the growing solar capacity (1,450 MW in Nigeria), and the high cost of current storage solutions (\$300-500/kWh) presents a major financial hurdle. Furthermore, both nations lack advanced grid management technologies, such as Flexible Alternating Current Transmission Systems (FACTS), which are essential for managing complex loads and maintaining grid stability as renewable penetration increases [29]. The absence of these technologies and sufficient storage capacity means that new renewable generation cannot be fully utilized, further exacerbating the inefficiency of the energy system.

### 2.7. Human Capital Deficit

A frequently overlooked but critical barrier identified in the literature is the significant shortage of skilled technical personnel. A review of available data reveals that Nigeria has only 1,500 trained technicians, against a projected need of 5,000, while Ghana has 800, against a need of 2,000. This human capital deficit directly contributes to higher maintenance costs for renewable energy systems (\$50-100/kW/year) and a general decline in operational efficiency [30]. The lack of a robust, trained workforce means that even with significant investment in new infrastructure and technology, the systems cannot be maintained effectively. This critical gap in human capacity represents a major bottleneck that must be addressed through strategic training programs and capacity-building initiatives to ensure the long-term sustainability and operational success of renewable energy projects.

## 3. Case Studies in Deployment: Success and Scalability Lessons

A critical review of successful renewable energy projects in Nigeria and Ghana provides valuable insights into what works and what can be scaled to overcome the systemic barriers identified. These case studies demonstrate the transformative potential of both decentralized and large-scale hybrid systems.

### 3.1. Nigeria's Ilakan Solar-Powered Business Hub

Nigeria's Ilakan solar-powered business hub serves as a powerful example of a decentralized, community-driven approach to addressing rural energy access gaps [31]. Launched in 2022, this 50-kW solar photovoltaic (PV) system harnesses the region's abundant solar irradiation to deliver 110 MWh/year of clean electricity, serving 1,200 households and 50 small businesses. The project has yielded significant socio-economic benefits, including the creation of 150 direct jobs, a 25% increase in agricultural productivity, and improved access to healthcare and education for local communities. The project's success is rooted in its community-centric model, with 80% of maintenance tasks handled by trained residents. This high level of local ownership and management demonstrates a viable strategy for bypassing the failures of the national grid and policy frameworks. It provides compelling evidence that effective solutions can emerge from the ground up, even when national policy is fragmented and inconsistent.

### 3.2. Ghana’s Bui Hydro-Solar Hybrid System

Compared to Nigeria's off-grid success, Ghana's Bui Generating Station exemplifies the potential of large-scale, on-grid solutions. Operational since 2023, the Bui system integrates a 400 MW hydropower facility with a 50 MW solar PV plant. This hybrid system achieves a remarkable 92% capacity factor, effectively stabilizing supply amid hydropower's natural variability during dry seasons [32]. The project demonstrates a significant technical and operational triumph, reducing energy costs and providing reliable power to 200,000 households and 1,000 industrial users. Its economic impact is also notable, contributing \$150 million annually to the GDP and creating 2,000 jobs. The success of the Bui system underscores the power of a more cohesive policy framework to enable the implementation of complex, high-impact projects that a fragmented regulatory environment would likely prevent.

### 3.3. Comparative Lessons and Scalability

The most effective strategy for the West African energy transition is not to choose between these two models but to strategically combine them. Nigeria's success in scaling its solar mini-grid strategy (with 1,200 mini-grids serving 65% of rural areas) can be adopted by Ghana to enhance rural energy access. Conversely, Ghana's success with the Bui hybrid system can serve as a model for Nigeria to strengthen its centralized grid, enabling it to better integrate large-scale, on-grid solutions. This cross-learning approach is a crucial lesson from the comparative analysis, suggesting that regional collaboration and the exchange of best practices could lead to a more robust and resilient energy system for both nations. The deliberate inclusion of one unambiguous failure case together with one clear success and one partial success ensures balanced evidence and guards against selection bias. The Bui project benefited from Ghana’s relatively unified regulatory and financing framework, achieving rapid implementation and high technical performance. In contrast, the near-total failure of Nigeria’s Energizing Education Programme Phase II exemplifies the practical consequences of the institutional fragmentation and inter-agency coordination challenges. Table 2 summarizes these comparisons.

**Table 2.** Comparison of Ghana’s and Nigeria’s cases in renewable energy development.

Case	Type	Outcome by 2025	Key Limitation	Reference
Bui 400 MW hydro + 50 MW floating solar (Ghana)	Large hybrid	Success (92 % CF)	High upfront cost; still vulnerable to drought	[32]
Ilakan 50 kW Solar Business Hub (Nigeria)	Mini-grid	Partial success	Tariff collection rate only 68 %; 18-month licensing delay; donor dependent	[31]
REA Energizing Education Programme Phase II – 14 university solar hybrids (2018–2025)	Mini-grid cluster	Failure (only 3 of 14 universities connected)	Bureaucratic overlap REA ↔ NERC ↔ university bureaucracies → indefinite delays	[33]

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Table 3 shows Renewable energy performance normalized for population and GDP. After normalizing for both population and GDP, Ghana installed 4.2 times more non-hydro renewable capacity per million inhabitants and attracted 4.4 times more private renewable investment per capita than Nigeria during 2020–2025. This superior per-capita performance persists despite Ghana having roughly one-eighth of Nigeria’s solar resource potential per unit of land area. The pattern remains consistent when Nigeria is benchmarked against Egypt and South Africa, and Ghana against Kenya and Côte d’Ivoire. These normalized metrics provide strong evidence that institutional and regulatory quality, rather than absolute resource abundance or country size, is the primary driver of renewable energy deployment success in the West African context.

**Table 3.** Renewable energy performance normalized for population and GDP.

Indicator	Nigeria	Ghana	Ratio	Reference
Population (mid-2023)	223.8 million	33.1 million	Nigeria 6.76× larger	[34], [35]
GDP (current US\$, 2024)	US\$188 billion	US\$82.8 billion	Nigeria 2.27× larger	[36]
New non-hydro RE capacity added (2020–mid-2025)	485 MW	312 MW	—	[37]
Per million inhabitants	2.17 MW/million	9.43 MW/million	Ghana 4.34× better	
Per US\$100 bn GDP	258 MW	377 MW	Ghana 1.46× better	
Private RE investment 2020–2024 (cumulative)	US\$2.08 bn	US\$1.41 bn	—	[38]
Per million inhabitants	US\$9.29 m	US\$42.6 m	Ghana 4.59× better	
Regulatory Quality percentile rank (2023)	27.88	57.69	Ghana 2.07× better	[39]

## 4. Critical Synthesis of Literature and Identified Gaps

The barriers to a successful energy transition in Nigeria and Ghana are not isolated, but deeply interconnected. Nigeria’s regulatory fragmentation is not merely a policy issue; it is the fundamental cause of the financial and technical inefficiencies that plague the sector. The lack of a unified oversight body and standardized PPAs creates a high-risk environment that deters private investment, leading to the dramatic funding gaps previously discussed. This underinvestment, in turn, prevents the necessary upgrades to the grid and the acquisition of advanced technologies and energy storage, thereby creating a vicious cycle of stagnation. Conversely, Ghana’s more cohesive policy has, despite its own funding and enforcement challenges, enabled greater private investment and the implementation of complex technical projects such as the Bui hybrid system. This demonstrates that institutional stability and regulatory clarity are the primary determinants of a successful energy transition in this region, more so than resource abundance alone. Nigeria’s vast potential is underutilized precisely because its institutional framework creates an unmanageable level of risk for investors and developers. In contrast, Ghana has leveraged clearer policies to make more meaningful progress.

### 4.1. Identifying Critical Gaps

There is a need for detailed, long-term socio-economic modeling. The existing data provides a snapshot of the current situation (as of 2025), but a deeper understanding requires projecting the long-term impact of proposed interventions. For example, how will the creation of 150,000 jobs in Nigeria affect specific sectors of the economy, and

what will be the long-term cost-benefit analysis of implementing specific subsidies or tax exemptions. There is also a lot of data that highlights the potential of specific financial mechanisms, such as green bonds and risk guarantees, but lacks a deep, quantitative analysis of how they would need to be tailored to the economic conditions and political climates of Nigeria and Ghana. Future research should examine the specific structures, governance, and market conditions required for these mechanisms to effectively attract significant private capital. The issue of social acceptance and public awareness is a critical factor that is not fully explored. The provided data mentions low public awareness in both countries (30% in rural Nigeria, 40% in Ghana), but there is a clear need for more research on the social and cultural barriers to renewable energy adoption. Future studies should focus on effective community engagement models and educational campaigns that can increase public support and project adoption. The summary is shown in Table 4.

**Table 4.** Summary of identified barriers and strategic recommendations.

Barrier Category	Specific Barrier	Proposed Recommendation
Policy/Regulatory	Nigeria's fragmented oversight (88% project delay)	Establish a unified regulatory body
Financial	Nigeria's funding gap (\$7.4B annually)	Scale green financing, e.g., green bonds and risk guarantees
Technical/Infrastructural	Nigeria's high grid losses (16.2%) and Ghana's voltage fluctuations ( $\pm 10\%$ )	Invest in smart grids and advanced technologies (FACTS)
Social/Political	Low public awareness (30-40% in rural areas)	Launch public education campaigns and foster community-led projects

#### 4.2. Future Directions

Based on the critical synthesis of the literature, this review proposes a comprehensive roadmap for future policy, investment, and research to accelerate the energy transition in Nigeria and Ghana.

1. For Nigeria, the most urgent and fundamental recommendation is the creation of a dedicated, unified oversight body to streamline the regulatory process. This body should have a clear mandate to standardize power purchase agreements and reduce project approval times from 12-18 months to a target of 6 months. For Ghana, the focus should be on enhanced enforcement of existing policies, particularly addressing the tariff conflicts between renewable and fossil fuel sources to improve market competitiveness and investor confidence.
2. Both nations must move beyond a reliance on public funding and aggressively pursue new financial mechanisms. The literature supports scaling up green bonds and public-private partnerships to attract significant private capital. A strategic target for Nigeria should be to increase private-sector contributions from 25% to at least 50% by 2030 through targeted fiscal incentives, such as raising tax exemptions from 5% to 15% and providing risk guarantees for developers. Leveraging regional funds, such as ECOWAS's \$2 billion renewable energy fund, is also essential to bridging immediate funding gaps.
3. A comprehensive national plan for smart grid implementation is a critical step for both countries. The objective should be to reduce transmission losses to below 10% and improve grid stability. Furthermore, both nations should set a target for expanded energy storage, aiming to reach at least 200 MWh by 2030. Investing in advanced technologies like Flexible Alternating Current Transmission Systems

(FACTS) is also necessary to manage voltage fluctuations as renewable penetration increases.

4. To address the significant technician deficit, both nations must create targeted national training programs. A specific goal should be to double the number of skilled technicians by 2035, ensuring that the human capital is in place to support the maintenance and operation of new infrastructure. It is also imperative to invest in public education and community engagement campaigns to increase public awareness and foster social acceptance of renewable energy projects.
5. The comparative analysis reveals that Nigeria and Ghana possess complementary strengths. A key recommendation is to foster specific cross-learning initiatives, where Nigeria adopts Ghana's licensing model, and Ghana scales Nigeria's successful mini-grid strategy. This regional cooperation, supported by international partnerships with organizations such as IRENA and the World Bank, could catalyze a rapid, scalable energy transition across the entire region. By addressing these challenges with a unified vision, Nigeria and Ghana have the potential to lead West Africa toward a low-carbon future, achieving a projected 250 Mt/year CO<sub>2</sub> reduction by 2050 and ensuring long-term economic resilience and environmental sustainability.

## 5. Conclusions

The comparative analysis of renewable energy policy adoption and implementation in Nigeria and Ghana confirms that a successful energy transition in West Africa is contingent on addressing deeply rooted institutional, financial, and technical challenges. As of 2025, Ghana's more cohesive policy framework and proactive grid upgrades have enabled a higher renewable energy share and more effective project deployment, with a 41% share compared to Nigeria's 24.1%. However, Nigeria's vast resources (1,571 TWh/year of potential versus Ghana's 184.8 TWh/year) offer a greater scalability that remains untapped due to its fragmented regulatory environment, which has led to bureaucratic delays and underinvestment. The findings of this review lead to a central conclusion: institutional stability and regulatory clarity are more potent enablers of a successful energy transition than resource abundance alone. The divergence in outcomes between the two nations is a direct result of their differing approaches to governance and policy implementation. While both countries have made progress, a sustained and accelerated transition requires a holistic, cross-sectoral approach that addresses the interconnected challenges of policy, finance, infrastructure, and human capital simultaneously. The potential for these two nations to serve as models for the rest of West Africa is immense, but it depends on their willingness to implement systemic, rather than piecemeal, reforms.

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