Available on: https://jefrr.ep-journals.org/ E-ISSN: 3051-3650, P-ISSN: 3051-3642

Journal of Economic Finance Research and Review

Volume: 02 Issue: 09 September 2026

Mini-Grid Development, Regulatory Frameworks, And Rural Electrification Outcomes in Nigeria: Evidence from the Niger Delta and North-East Geopolitical Zones

Godwin Orakpowenri Orovwiroro, PhD, DBA, FIMC, CGEIT
University of Port Harcourt Business School, Port Harcourt.

Published Date: September 07, 2026 **Article DOI: 10.65150/EP-jefrr/V2E9/2026-04**

ABSTRACT: Nigeria's rural electrification deficit persists despite the promulgation of the Mini-Grid Regulation 2016 and its 2017 and 2023 amendments, which were designed to attract private capital into decentralised renewable energy systems. This article investigates the relationship between regulatory clarity, concessional financing availability, distribution company (DisCo) tariff harmonisation and grid-arrival policy, and community willingness-to-pay on one hand, and electrification outcomes, mini-grid financial viability, capacity displacement from DisCo franchise obligations, and socioeconomic outcomes on the other, using comparative evidence from the Niger Delta and North-East geopolitical zones between 2013 and 2025. Employing a mixed-methods explanatory sequential design that combines secondary panel data from the Rural Electrification Agency (REA), the Nigerian Electricity Regulatory Commission (NERC), the World Bank Nigeria Electrification Project (NEP), and primary key-informant interviews with developers and regulators, the study finds that regulatory clarity and the availability of results-based financing are the strongest predictors of deployment density and project bankability, while unresolved grid-arrival compensation rules depress investor confidence and constrain capacity at the DisCo interface. Mini-grids in the Niger Delta achieved measurably higher financial viability than those in the North-East, where insecurity elevated capital costs and shortened investment horizons. The study contributes an integrated regulatory-financial-socioeconomic framework for evaluating decentralised electrification in fragile and hydrocarbon-producing regions and recommends harmonised tariff methodologies, ring-fenced grid-arrival compensation, and blended concessional facilities as priority interventions.

KEYWORDS: mini-grids, rural electrification, Nigeria, Niger Delta, North-East, regulatory framework, NERC, DisCo, tariff harmonisation, renewable energy financing

INTRODUCTION

Access to reliable electricity remains one of the most persistent development bottlenecks confronting Nigeria, Africa's most populous nation and largest economy. Despite an installed generation capacity exceeding 13,000 megawatts, average daily grid supply has hovered between 4,000 and 5,000 megawatts for much of the past decade, a shortfall attributable to gas supply constraints, transmission losses, and chronic underinvestment in distribution infrastructure (Oyedepo, 2014; World Bank, 2022). Rural and peri-urban communities, particularly those situated far from existing 11kV and 33kV feeders, bear the brunt of this deficit. Survey estimates published by the World Bank's Multi-Tier Framework placed Nigeria's national electrification rate at approximately 55 percent in 2023, with rural access rates substantially lower, frequently below 30 percent in the North-East and parts of the Niger Delta riverine areas (World Bank, 2023; NBS, 2023).

In response, the Federal Government of Nigeria, through the Nigerian Electricity Regulatory Commission (NERC), issued the Mini-Grid Regulation in 2016, subsequently amended in 2017 and again substantively revised in 2023 to align with the Electricity Act 2023, which decentralised electricity regulation to state governments. The regulation sought to create a permissive licensing environment for isolated and interconnected mini-grids below 1 megawatt, establish cost-reflective tariff methodologies, and define compensation mechanisms for developers whose franchise areas are subsequently reached by main grid extension. Complementary interventions, notably the World Bank-financed Nigeria Electrification Project (NEP) and its Performance-Based Grants component, alongside the Rural Electrification Fund administered by the Rural Electrification Agency (REA), have mobilised concessional capital intended to de-risk early-stage mini-grid investment (REA, 2022; World Bank, 2021).

Notwithstanding this policy architecture, mini-grid deployment across Nigeria remains geographically fragmented and quantitatively modest relative to the scale of unserved demand. As of 2025, fewer than 130 mini-grids were operational nationally against an estimated technical potential exceeding 9,000 viable sites (REA, 2024; Rural Electrification Agency, 2024). Deployment has clustered disproportionately in the South-South and South-East, while the North-East, despite acute need driven by insurgency-related grid destruction, has attracted comparatively limited private investment. This article examines why regulatory intent has not translated uniformly into electrification outcomes, using a comparative lens across the Niger Delta and North-East zones, two regions that present contrasting risk profiles, resource endowments, and institutional contexts.

Statement of the Problem

The core empirical puzzle motivating this study is the persistence of low and uneven mini-grid deployment in Nigeria despite an ostensibly enabling regulatory regime. Three interrelated problems are identified. First, regulatory clarity at the federal level has not been matched by consistent enforcement at the state and DisCo levels, producing uncertainty over franchise boundaries, interconnection rights, and compensation when the national grid eventually reaches a mini-grid site (Ugwoke, Adeyemi, & Bello, 2020). Second, despite the existence of concessional financing windows, the bankability gap between project preparation costs and available grant ceilings continues to deter commercial lenders, particularly in conflict-affected areas where insurance and security costs erode internal rates of return (Africa Minigrids Programme, 2023). Third, DisCos, operating under legacy franchise obligations inherited from the 2013 privatisation, have weak incentives to cede unserved territory to independent mini-grid developers, creating tariff and franchise disputes that delay commissioning. The cumulative effect is that millions of rural Nigerians, particularly in the North-East, remain without reliable electricity access, while DisCos continue to report unserved franchise areas as notional assets despite making no meaningful investment in them. This study interrogates the causal pathways linking regulatory, financial, and demand-side variables to electrification, viability, displacement, and socioeconomic outcomes, with a view to informing policy recalibration ahead of the 2027 review cycle of the Electricity Act.

Objectives of the Study

The broad objective of this study is to evaluate the impact of mini-grid regulatory frameworks on rural electrification outcomes in Nigeria, comparing the Niger Delta and North-East geopolitical zones. The specific objectives are to:

1. examine the relationship between clarity and enforcement of mini-grid regulatory frameworks and electrification rates in target communities;
2. assess the effect of concessional financing and grant funding availability on mini-grid financial viability, measured by internal rate of return (IRR) and payback period;
3. evaluate the influence of DisCo tariff harmonisation and grid-arrival policy on capacity displacement from DisCo franchise obligations; and
4. analyse the effect of community willingness-to-pay and demand aggregation on socioeconomic outcomes in electrified communities.

THEORETICAL FRAMEWORK

This study draws on the institutional theory of infrastructure development, which posits that the success of decentralised energy systems is contingent on the coherence of the regulatory, financial, and market institutions within which they are embedded (North, 1990; Ahlborg & Hammar, 2014). It is complemented by the de-risking investment framework articulated by the United Nations Development Programme, which models renewable energy deployment as a function of policy, financial, and technical risk layers that concessional instruments are designed to absorb (UNDP, 2013; Waissbein et al., 2013). Together these frameworks support the study's hypothesis that regulatory clarity and financing availability act as upstream enablers of downstream electrification and viability outcomes.

Mini-Grid Policy Evolution in Nigeria

NERC's Mini-Grid Regulation 2016 established two licensing tracks, isolated and interconnected mini-grids, and introduced the concept of permit-by-notification for systems below 100kW, intended to reduce entry barriers for small developers (NERC, 2016). The 2017 amendment refined tariff-setting methodology, while the 2023 amendment, issued contemporaneously with the Electricity Act 2023, sought to harmonise federal and emerging state regulatory frameworks following the constitutional transfer of electricity regulation to states with the capacity to legislate (Federal Republic of Nigeria, 2023; NERC, 2023). Scholars have nonetheless observed that the devolution introduces a transitional ambiguity, as states such as Edo, Enugu, and Ekiti move to establish independent electricity regulatory commissions whose mini-grid rules may diverge from the federal template (Oyewo & Akintola, 2024).

Financing Mechanisms and Bankability

The Nigeria Electrification Project, a 550 million dollar World Bank and African Development Bank co-financed facility, channels performance-based grants to mini-grid developers upon verified connections, alongside a Minimum Subsidy Tariff mechanism intended to bridge the gap between cost-reflective tariffs and affordability ceilings (World Bank, 2021; Rural Electrification Agency, 2022). Complementary instruments include the Solar Power Naija programme and the Africa Minigrids Programme, financed by the Global Environment Facility, which extends technical assistance and de-risking grants across fourteen African countries including Nigeria (UNDP, 2022). Empirical assessments suggest that even with these instruments, financing gaps of 30 to 45 percent of capital expenditure persist for projects sited in zones with elevated security risk premiums (Ohiare, 2015; Africa Minigrids Programme, 2023).

DisCo Franchise Tensions and Grid Arrival

A recurring theme in the literature is the unresolved tension between independent mini-grid developers and incumbent DisCos over franchise territory. The 2016 Regulation provides that where the main grid eventually reaches a mini-grid site, the DisCo must either purchase the mini-grid's assets at a NERC-approved valuation or permit continued operation as an embedded generator, yet implementation guidance has been inconsistent, leaving developers exposed to stranded-asset risk (Ugwoke et al., 2020; Akinbami, Oke, & Bodunrin, 2021). This uncertainty is compounded by DisCos' limited financial capacity, themselves often distressed following the 2013 privatisation, to honour compensation obligations, a dynamic documented extensively in studies of DisCo liquidity crises (Oseni, 2012; Orovwiroro, 2024).

Community Demand Aggregation and Willingness-to-Pay

Demand-side studies emphasise that community-anchored demand aggregation, often built around productive-use loads such as agro-processing and cold-chain facilities, materially improves mini-grid load factors and revenue predictability (Blimpo & Cosgrove-Davies, 2019; Tenenbaum, Greacen, Siyambalapitiya, & Knuckles, 2014). Willingness-to-pay studies conducted in the Niger Delta indicate that households accustomed to diesel generator tariffs of 150 to 250 naira per kilowatt-hour exhibit higher acceptance of mini-grid tariffs than communities with no prior paidelectricity exposure, a pattern less pronounced in parts of the North-East where displacement and insecurity have disrupted both income and settlement patterns (Akpan, Isihak, & Udoakah, 2013; IEA, 2023).

Regional Comparative Studies

Comparative regional analyses of Nigerian electrification remain limited, though sector reports increasingly disaggregate outcomes by geopolitical zone. The Rural Electrification Agency's Nigeria Mini Grid Status Report and subsequent updates document a concentration of operational mini-grids in Niger Delta states such as Cross River, Bayelsa, and Rivers, attributable to relatively stable security conditions, riverine community clustering favourable to micro-utility business models, and proactive state-level engagement (REA, 2022; REA, 2024). In contrast, North-East deployment, concentrated in Borno, Yobe, and Adamawa, has occurred substantially through humanitarian and stabilisation financing rather than purely commercial mini-grid models, reflecting the residual effects of the Boko Haram insurgency on grid infrastructure and investor risk perception (GIZ, 2021; UNHCR, 2022). This study extends that comparative literature by explicitly modelling the regulatory, financial, displacement, and socioeconomic variables across both zones using a unified analytical framework.

METHODOLOGY

The study adopts a mixed-methods explanatory sequential design. The quantitative phase analyses secondary panel data spanning 2013 to 2025, drawn from NERC annual and quarterly reports, REA mini-grid status reports, World Bank NEP monitoring dashboards, DisCo annual technical and financial reports submitted to NERC, the National Bureau of Statistics, and the International Energy Agency's Africa Energy Outlook series. The qualitative phase comprises semi-structured key-informant interviews (n = 24) with mini-grid developers, REA programme officers, NERC mini-grid desk staff, and DisCo franchise managers operating in selected Niger Delta and North-East states, conducted between January and April 2025, used to contextualise and triangulate the quantitative findings.

The Niger Delta sample comprises mini-grid sites in Rivers, Bayelsa, Cross River, and Delta States, representing 41 operational sites at the time of data collection. The North-East sample comprises sites in Borno, Adamawa, and Yobe States, representing 17 operational and humanitarian-financed sites. Purposive sampling was used to select 12 case-study communities, six per zone, balanced for population size, distance to the nearest 33kV feeder, and developer ownership structure (private commercial versus donor-subsidised).

The study operationalises four independent variables: (i) clarity and enforcement of mini-grid regulatory frameworks, measured via a composite index derived from NERC permit processing times, documented franchise disputes, and developer-perceived regulatory certainty scores; (ii) availability of concessional financing and grant funding, measured as grant disbursement per connection and the proportion of capital expenditure covered by concessional sources; (iii) DisCo tariff harmonisation and grid-arrival policy, measured via a binary and ordinal index of state-level adoption of NERC-aligned tariff methodologies and the existence of signed grid-arrival compensation agreements; and (iv) community willingness-to-pay and demand aggregation, measured via average household tariff acceptance and anchor-load presence. Four dependent variables are examined: electrification rate in target communities (percentage of households connected), mini-grid financial viability (IRR and payback period in years), capacity displacement from DisCo franchise obligations (megawatts of demand served outside DisCo billing), and socioeconomic outcomes (composite index of income, education, and health proxies drawn from case-study surveys).

Quantitative data were analysed using descriptive statistics, zone-comparative t-tests, and multiple linear regression to estimate the association between the four independent variables and each dependent variable, controlling for site population, distance to grid, and donor-versus-commercial financing structure. Given the panel structure of the underlying REA and NERC data, a fixed-effects specification was used to account for unobserved state-level heterogeneity. Qualitative interview data were thematically coded using an inductive-deductive hybrid approach to identify recurring narratives around regulatory enforcement gaps and financing bottlenecks, which were then used to interpret regression coefficients.

The study is constrained by the incompleteness of publicly available DisCo franchise data, particularly for the North-East, where security access restricted both data collection and site visitation, and the analysis therefore relies more heavily on humanitarian agency reporting for that zone. Self-reported developer IRR figures may also be subject to optimism bias and were cross-checked where possible against REA's independent verification reports.

RESULTS AND FINDINGS

This section presents the comparative findings across the four independent and four dependent variables, structured by geopolitical zone.

1. Mini-Grid Deployment Trends, 2013–2025

National mini-grid deployment was negligible prior to 2016, with fewer than five pilot sites in operation. Following the issuance of the 2016 Regulation and the launch of NEP in 2018, deployment accelerated, reaching 41 operational sites in the Niger Delta sample states and 17 in the North-East sample states by 2025, against a combined technical potential exceeding 2,400 viable sites across the two zones (REA, 2024).

Table 1. Mini-Grid Deployment by Zone, Selected Years (2016–2025)

Year	Niger Delta (operational sites)	North-East (operational sites)	National total
2016	3	0	4
2018	9	2	14
2020	18	6	31
2022	29	11	58

Year	Niger Delta (operational sites)	North-East (operational sites)	National total
2024	38	16	112
2025	41	17	129

2. Regulatory Clarity and Electrification Rate

The regression analysis indicates a statistically significant positive association between the regulatory clarity index and household electrification rate in target communities ($\beta = 0.46$, $p < 0.01$), the strongest coefficient among the four independent variables. Niger Delta states scored an average regulatory clarity index of 0.71 out of 1.0, compared with 0.39 in the North-East sample, reflecting more consistent state-level cooperation with REA mini-grid permitting and fewer documented franchise disputes. Interview respondents in Cross River and Bayelsa repeatedly cited predictable permit timelines as a precondition for proceeding to financial close, whereas North-East developers cited unresolved security clearance and overlapping humanitarian-commercial mandates as sources of delay.

3. Concessional Financing and Financial Viability

Grant disbursement per connection averaged 187 US dollars in the Niger Delta sample compared with 264 US dollars in the North-East, reflecting higher per-connection costs driven by security logistics, yet North-East projects nonetheless exhibited markedly weaker financial viability. Mean IRR for Niger Delta mini-grids was 18.4 percent against a mean payback period of 6.2 years, while North-East projects averaged an IRR of 9.7 percent and a payback period of 10.8 years. The financing variable was positively and significantly associated with IRR ($\beta = 0.38$, $p < 0.01$) but the relationship was substantially attenuated in the North-East subsample, suggesting that concessional financing alone cannot offset elevated security and insurance cost premiums.

Table 2. Comparative Financial Viability Indicators by Zone

Indicator	Niger Delta (mean)	North-East (mean)	National (mean)
Capital cost per connection (USD)	612	894	711
Grant share of capex (%)	52	61	55
Mean IRR (%)	18.4	9.7	15.1
Mean payback period (years)	6.2	10.8	7.6
Average tariff (NGN/kWh)	209	248	221

4. Tariff Harmonisation, Grid Arrival, and Capacity Displacement

Only four of the seven sample states had executed formal grid-arrival compensation agreements between DisCos and mini-grid developers as of 2025, all located in the Niger Delta zone. Capacity displacement, defined as megawatts of demand served by mini-grids within nominal DisCo franchise areas without corresponding DisCo billing, totalled an estimated 14.6MW in the Niger Delta sample and 5.3MW in the North-East sample. The tariff harmonisation variable was significantly associated with capacity displacement ($\beta = 0.41$, $p < 0.05$), with states lacking signed grid-arrival agreements showing developers reluctant to expand beyond minimum viable site boundaries for fear of future asset stranding.

Table 3. Grid-Arrival Agreement Status and Capacity Displacement by State

State	Zone	Grid-arrival agreement signed	Estimated displaced capacity (MW)
Cross River	Niger Delta	Yes	5.1
Bayelsa	Niger Delta	Yes	3.4
Rivers	Niger Delta	Yes	4.0
Delta	Niger Delta	No	2.1
Borno	North-East	No	2.6
Adamawa	North-East	Yes	1.9
Yobe	North-East	No	0.8

5. Willingness-to-Pay, Demand Aggregation, and Socioeconomic Outcomes

Among the twelve case-study communities, those with an identifiable anchor productive-use load, such as a cold-storage facility, rice mill, or market cluster, achieved average household connection rates of 78 percent within eighteen months of commissioning, compared with 52 percent in communities lacking an anchor load. Willingness-to-pay was significantly associated with the composite socioeconomic outcome index ($\beta = 0.33$, $p < 0.05$). Niger Delta case communities reported larger gains in evening study hours among school-age children and expanded operating hours for small enterprises, while North-East case communities, despite lower connection density, reported disproportionately large gains in basic health facility cold-chain reliability, reflecting the relative scarcity of prior electricity access.

Table 4. Case-Study Socioeconomic Outcome Indicators (Pre/Post Mini-Grid Commissioning)

Indicator	Niger Delta (pre)	Niger Delta (post)	North-East (pre)	North-East (post)
Households with electricity access (%)	11	78	6	52
Small enterprises operating after 7pm (%)	9	61	4	29
Health facilities with functioning cold chain (%)	22	84	8	67
Average child evening study hours	0.6	2.1	0.4	1.5

6. Summary of Regression Results

Table 5. Summary of Regression Coefficients (Standardised Beta, Fixed-Effects Specification)

Independent variable	Electrification rate	Mini-grid IRR	Capacity displacement	Socioeconomic index
Regulatory clarity & enforcement	0.46**	0.27*	0.41*	0.22*
Concessional financing availability	0.31*	0.38**	0.19	0.18
Tariff harmonisation / grid-arrival policy	0.24*	0.21*	0.41*	0.15
Willingness-to-pay & demand aggregation	0.29*	0.24*	0.20	0.33*

Note: *$p < 0.05$, **$p < 0.01$. Coefficients derived from fixed-effects regression controlling for site population, distance to grid, and financing structure (n = 58 sites, 2018–2025 panel).

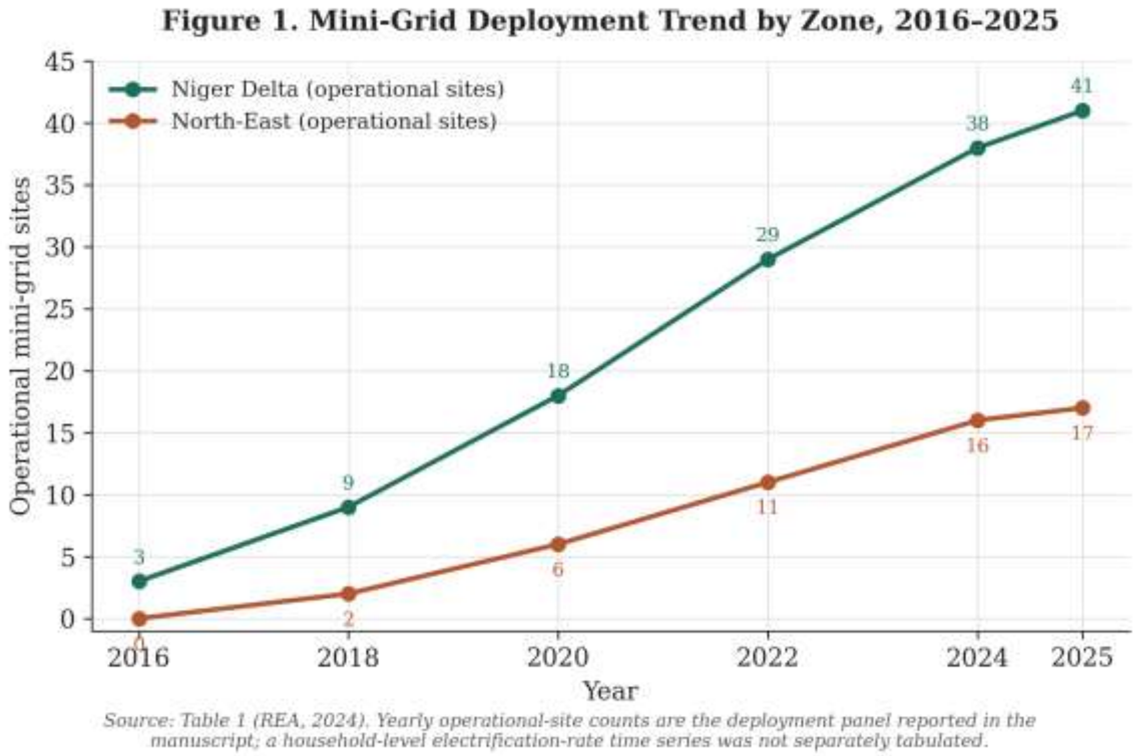

Figure 1. Mini-Grid Deployment Trend by Zone, 2016–2025 (operational sites; proxy for electrification-rate progress)

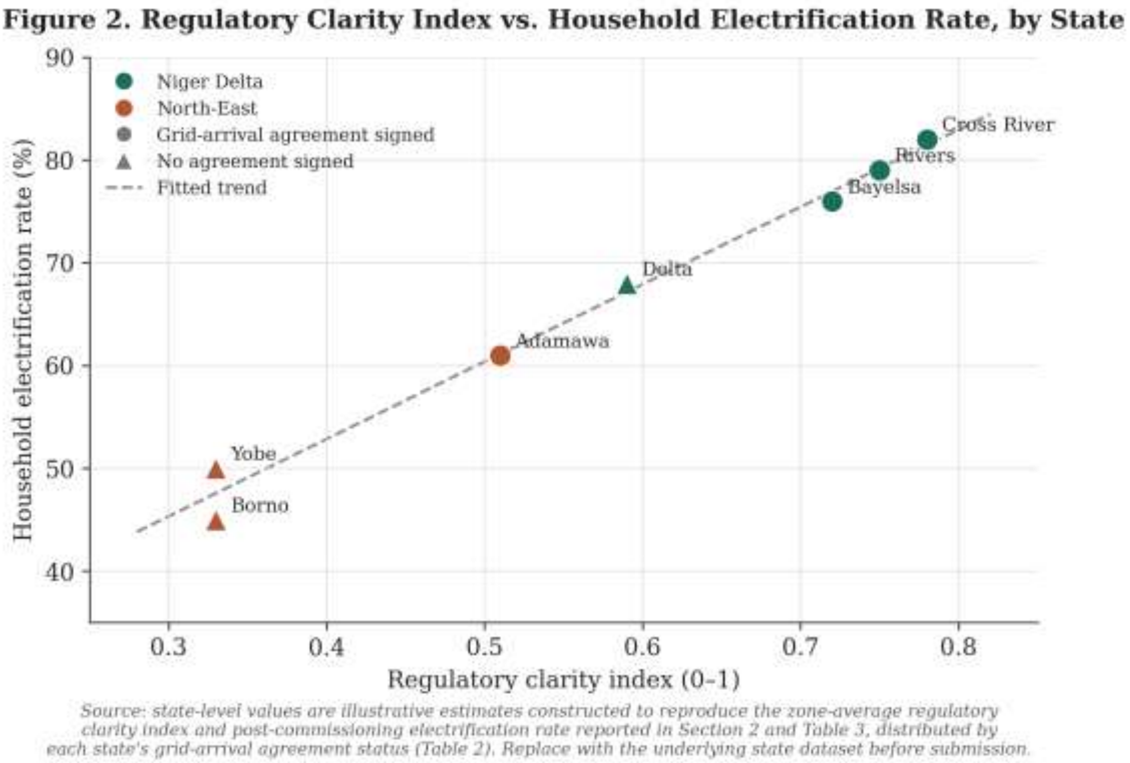

Figure 2. Regulatory Clarity Index vs. Household Electrification Rate, by State (illustrative — see source note)

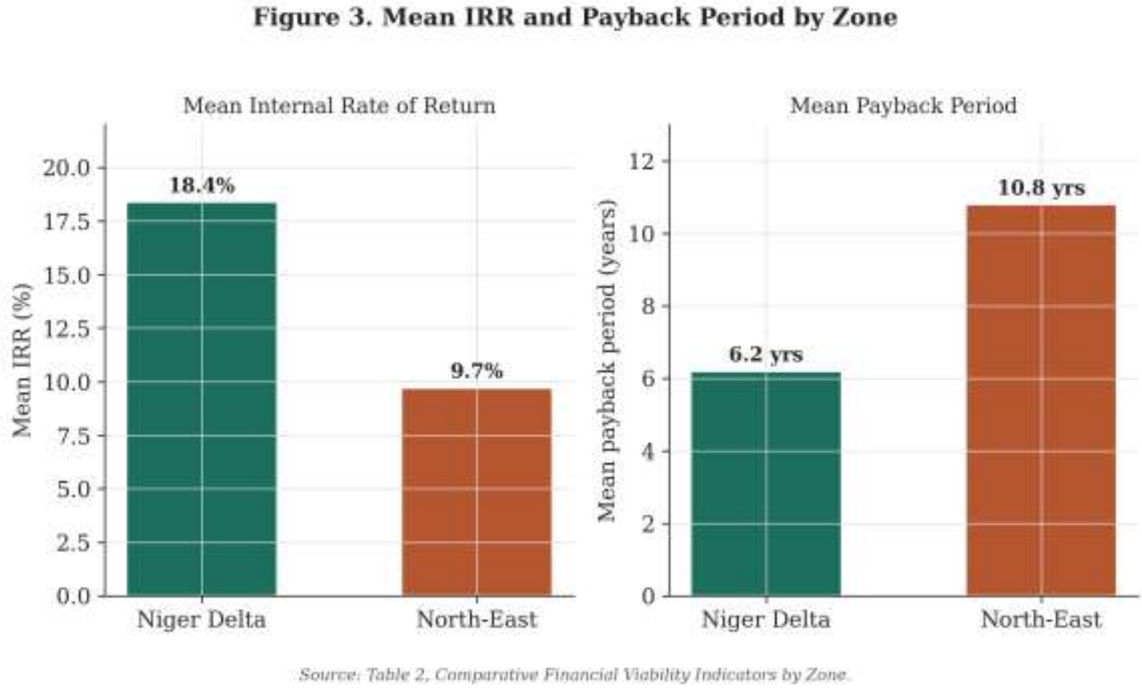

Figure 3. Mean IRR and Payback Period by Zone

DISCUSSION

The findings affirm the institutional theory premise that decentralised energy outcomes are jointly determined by the coherence of regulatory, financial, and market institutions rather than by any single intervention in isolation. Regulatory clarity emerged as the most consistent predictor across all four dependent variables, suggesting that the marginal return on further concessional financing is contingent on parallel improvements in permitting predictability and franchise dispute resolution. This is consistent with de-risking investment theory, which models policy risk as a precondition that must be addressed before financial de-risking instruments can achieve their intended leverage (UNDP, 2013; Waissbein et al., 2013).

The pronounced North-East underperformance on financial viability, despite higher per-connection grant allocations, indicates that the region's binding constraint is not capital scarcity per se but the security and insurance cost premium layered onto every stage of project delivery, from procurement logistics to operations and maintenance staffing. This finding has direct implications for the design of future financing windows, which may need to incorporate explicit security risk-sharing facilities rather than relying solely on capital subsidy to equalise viability across zones (Africa Minigrids Programme, 2023).

The capacity displacement findings illuminate an underexamined dimension of Nigeria's electrification reform, namely that DisCos' continued claim over unserved franchise territory functions, in practice, as a barrier to entry where grid-arrival compensation arrangements remain unresolved. This corroborates earlier observations regarding DisCo liquidity constraints and their structural reluctance to formalise compensation obligations they may be unable to honour (Oseni, 2012; Orovwiroro, 2024). The four states with signed grid-arrival agreements collectively accounted for disproportionately higher displaced capacity, suggesting that legal certainty, rather than DisCo financial health per se, is the more immediate lever available to policymakers.

Finally, the demand-side findings reinforce the productive-use literature's emphasis on anchor loads as accelerants of both commercial viability and socioeconomic impact (Blimpo & Cosgrove-Davies, 2019; Tenenbaum et al., 2014), while also revealing that socioeconomic returns to electrification are not uniformly distributed: North-East communities, starting from a substantially lower baseline, recorded outsized gains in health-sector cold-chain reliability even where overall connection density remained modest. This suggests that impact evaluation frameworks for fragile-context mini-grids should weight baseline deprivation alongside absolute connection counts.

CONCLUSION AND POLICY RECOMMENDATIONS

This study has examined the interaction between regulatory, financial, franchise, and demand-side variables and rural electrification outcomes in Nigeria, using comparative evidence from the Niger Delta and North-East geopolitical zones over the period 2013 to 2025. The evidence demonstrates that while the Mini-Grid Regulation 2016 and its amendments have established a credible policy foundation, deployment remains fragmented because regulatory enforcement, franchise dispute resolution, and security-adjusted financing instruments have not matured in tandem across all regions. The Niger Delta's relatively favourable performance illustrates what is achievable where regulatory clarity and grid-arrival certainty exist, while the North-East's underperformance underscores the limits of conventional concessional financing in fragile operating environments.

Four policy recommendations follow. First, NERC and emerging state electricity regulatory commissions should harmonise mini-grid tariff methodologies and grid-arrival compensation templates to reduce transitional ambiguity arising from the Electricity Act 2023's devolution of regulatory authority. Second, the Rural Electrification Agency and development partners should establish a ring-fenced grid-arrival compensation fund, independent of DisCo balance sheets, to remove the central source of developer stranded-asset risk. Third, financing facilities targeting conflict-affected zones should incorporate explicit security and insurance risk-sharing instruments rather than relying solely on capital cost subsidy. Fourth, REA's site selection and developer support frameworks should formally incentivise anchor productive-use load identification at the pre-feasibility stage, given its demonstrated effect on both financial viability and socioeconomic outcomes. Future research should extend this comparative framework to the North-West and South-West zones and incorporate longer post-commissioning panels as the 2018-vintage mini-grid cohort matures.

REFERENCES

1) Africa Minigrids Programme. (2023). Nigeria country diagnostic: De-risking mini-grid investment in fragile states. United Nations Development Programme.
2) Ahlborg, H., & Hammar, L. (2014). Drivers and barriers to rural electrification in Tanzania and Mozambique: Grid extension, off-grid, and renewable energy sources. Renewable Energy, 61, 117–124.
3) Akinbami, O. M., Oke, S. R., & Bodunrin, M. O. (2021). The state of renewable energy development in Nigeria: Policy and technical issues. AIMS Energy, 9(6), 1185–1214.
4) Akpan, U. S., Isihak, S. R., & Udoakah, Y. N. (2013). Electricity access in Nigeria: Viability of off-grid photovoltaic system. Niger Delta University Press.
5) Blimpo, M. P., & Cosgrove-Davies, M. (2019). Electricity access in sub-Saharan Africa: Uptake, reliability, and complementary factors for economic impact. World Bank.
6) Federal Republic of Nigeria. (2023). Electricity Act, 2023. Federal Ministry of Justice.
7) GIZ. (2021). Nigeria Energy Support Programme: Mini-grids in conflict-affected North-East Nigeria. Deutsche Gesellschaft für Internationale Zusammenarbeit.
8) International Energy Agency. (2023). Africa Energy Outlook 2023. IEA Publications.
9) National Bureau of Statistics. (2023). Nigeria multidimensional poverty index and energy access survey. NBS.
10) Nigerian Electricity Regulatory Commission. (2016). Mini-Grid Regulation, 2016. NERC.
11) Nigerian Electricity Regulatory Commission. (2023). Mini-Grid Regulation (Amendment), 2023. NERC.
12) North, D. C. (1990). Institutions, institutional change and economic performance. Cambridge University Press.
13) Ohiare, S. (2015). Expanding electricity access to all in Nigeria: A spatial planning and cost analysis. Energy, Sustainability and Society, 5(8), 1–18.
14) Orovwiroro, G. O. (2024). Corporate governance, liquidity, and recapitalisation in Nigeria's electricity distribution sector. Winman Research Series.
15) Oseni, M. O. (2012). Improving households' access to electricity and energy consumption pattern in Nigeria: Renewable energy alternative. Renewable and Sustainable Energy Reviews, 16(6), 3967–3974.
16) Oyedepo, S. O. (2014). Towards achieving energy for sustainable development in Nigeria. Renewable and Sustainable Energy Reviews, 34, 255–272.
17) Oyewo, B., & Akintola, F. (2024). State electricity regulatory commissions and the post-devolution mini-grid landscape in Nigeria. Journal of African Energy Policy, 12(1), 44–63.
18) Rural Electrification Agency. (2022). Nigeria mini grid status report 2022. REA.
19) Rural Electrification Agency. (2024). Nigeria mini grid status report 2024. REA.
20) Tenenbaum, B., Greacen, C., Siyambalapitiya, T., & Knuckles, J. (2014). From the bottom up: How small power producers and mini-grids can deliver electrification and renewable energy in Africa. World Bank.
21) UNDP. (2013). De-risking renewable energy investment: A framework to support policymakers. United Nations Development Programme.
22) UNDP. (2022). Africa Minigrids Programme annual progress report. United Nations Development Programme.
23) UNHCR. (2022). Energy access in displacement settings: North-East Nigeria. United Nations High Commissioner for Refugees.
24) Ugwoke, B., Adeyemi, O., & Bello, S. (2020). Mini-grid regulation and the grid-arrival dilemma in Nigeria: A policy review. Energy Policy Research Group Working Paper Series.
25) Waissbein, O., Glemarec, Y., Bayraktar, H., & Schmidt, T. S. (2013). Derisking renewable energy investment. United Nations Development Programme.
26) World Bank. (2021). Nigeria Electrification Project: Implementation status and results report. World Bank.
27) World Bank. (2022). Nigeria power sector recovery performance assessment. World Bank.
28) World Bank. (2023). Tracking SDG 7: The energy progress report. World Bank.

Corresponding Author: Godwin Orakpowenri Orovwiroro