

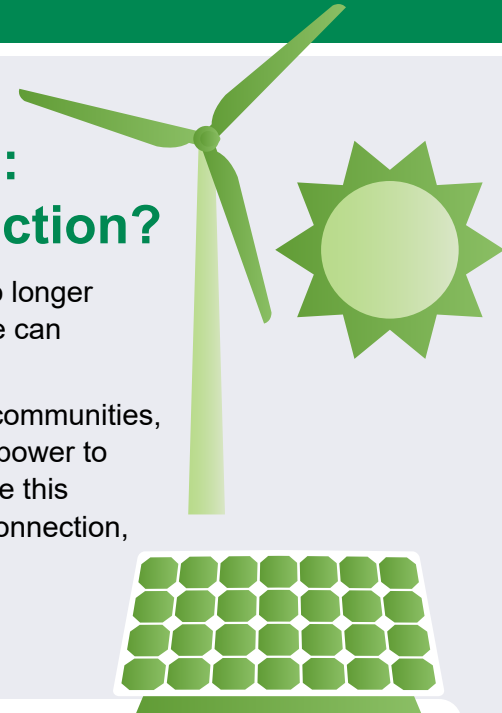
Developing Sustainable Interconnected Mini-Grids: Guidance for State Governments

Unlocking Nigeria's Mini-Grid Potential: Who's Driving the Future of Interconnection?

As Nigeria navigates a critical transition in energy access, the question is no longer whether mini-grids will play a central role; it is how quickly and effectively we can integrate them into our national and sub-national electricity systems.

The momentum behind decentralised energy is unmistakable. Across rural communities, capital-funded mini-grids are transforming lives by delivering clean, reliable power to schools, health centres, agricultural hubs, and small businesses. But to scale this transformation, stakeholders must rally around a common agenda for interconnection, anchored in sound technical standards, inclusive governance and practical implementation tools.

Who are the key actors making this possible?



01 State Governments and Sub-National Electrification Agencies

State actors are no longer passive observers. They are now vital players in rural energy access planning, infrastructure oversight, and implementation of public-private investment programmes. Their ability to create enabling frameworks, issue licences, and support local enforcement is central to sustainable interconnection.

02 Rural Electrification Agency (REA) Departments and Implementation Units

Within the REA, specialised departments are taking ownership of capital project execution, compliance monitoring, technical regulation, and operational guidance. These teams are critical in embedding updated evaluation criteria, integrating harmonised technical standards, and guiding developers and DisCos through grid-readiness processes.

03 Private Developers, EPCs, and O&M Operators

Across the country, private sector partners (developers, engineering-procurement-construction (EPC) firms, and operations and maintenance (O&M) providers) are turning technical standards into tangible infrastructure. Their engagement drives innovation and quality, from deployment to lifecycle management, while ensuring that mini-grids are interconnection-ready from day one.

04 REUCS and Community Governance Champions

State actors are no longer passive Rural Electricity Users Cooperative Societies (REUCS) and other community actors are not just passive beneficiaries. They are frontline custodians of energy infrastructure. Their participation in maintenance routines, tariff planning, and performance monitoring helps safeguard public investments and ensures social accountability.

05 Donor Programmes, Policy Advisors, and Technical Partners

The sector is also shaped by collaboration with partners such as the Nigeria Governors' Forum (NGF), German Corporation for International Cooperation GmbH (GIZ), Distributed Access through Renewable Energy Scale-up (DARES), the World Bank, Foreign, Commonwealth and Development Office (FCDO), and other technical or funding agencies. Their contributions, ranging from institutional capacity-building to co-developing standards and guidelines, have been instrumental in promoting coherence, rigour, and cross-governmental learning.

Mini-Grids in Transition

Capital-funded mini-grids in Nigeria have historically functioned as isolated rural electrification systems. However, emerging policy, regulatory evolution and practical learnings have created new opportunities to integrate these systems with their local distribution networks and, through the latter, with the national grid. This enables local communities and mini-grid operators to maximise energy access, reduce redundancy, improve system economics, and catalyse private investment. Ultimately, this offers a sustainable path to attaining the paramount policy objective of universal access.

REA supported by UKNIAF, conducted in-depth assessments of 46 mini-grids across 14 states and the FCT to evaluate their interconnection-readiness. These assessments informed the development of updated harmonised technical standards, interconnection evaluation frameworks, stakeholder capacity-building strategies, and a pipeline of interconnection-ready projects. The programme's close alignment with the World Bank's DARES initiative further enabled practical scale-up pathways, private co-financing readiness, and policy harmonisation at federal and state levels.

What Makes a Mini-Grid Interconnection-Ready?

A high-performing interconnected mini-grid project must demonstrate readiness and sustainability across the following six domains:

Technical Compatibility

Compliance with International Electrotechnical Commission (IEC) standards; SCADA control systems; inverter sync; protection systems; grid-synchronised infrastructure.



Regulatory Compliance

Valid permits; Mini-Grid Regulations 2023 adherence; utility-side agreements; compliance documentation with the Nigerian Electricity Regulatory Commission (NERC) and DisCos.



Financial Viability

Tariff modelling; presence of anchor loads; revenue forecasts; affordability thresholds; CAPEX/OPEX cost profiles; MST pipeline fit.



Operational Readiness

Commissioned O&M models; real-time monitoring (such as SCADA/loggers); trained staff; documented emergency protocols and customer service tools.



Environmental and Social

Completed ESIA/ESMPs; Greenhouse Gas (GHG) reduction analysis; GESI metrics (women/PWDs representation); social licence to operate.



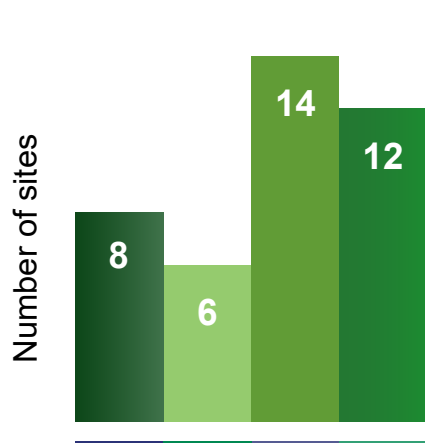
Capacity and Governance

Legalised REUCS with governance structure; evidence of community training; feedback mechanisms; regular reporting to REA dashboard.



Case Highlights: Evidence from the Field

Operational Status of Sites



✓ Fully Functional

Functional generation, active metering, operational REUCS.

! Barely Functional

Sites operational but experiencing downtime, missing spare parts, or vandalism.

✗ Non-Functional

Complete system failure due to aging components, theft, or incomplete commissioning.

🔧 Vandalised/Degraded

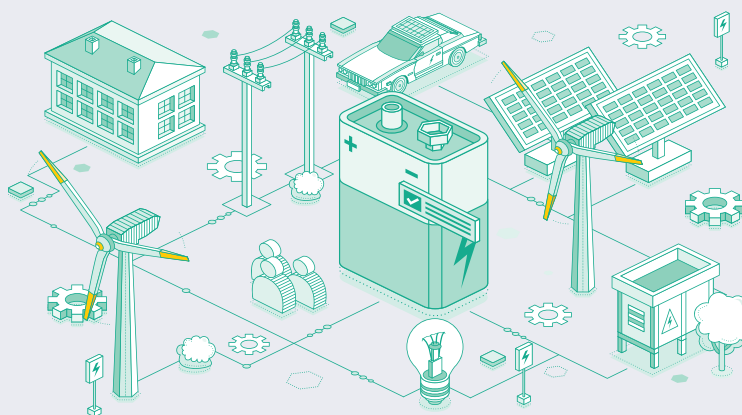
Physical degradation, missing PV panels/inverters, eroded infrastructure.

Summary of Sites Ready for Grid Integration:

Project Name	State	Size (kWp)	Tariff (\$)	Grant Required (%)	Notes
Eriwe Fish Farm	Ogun	100	0.12	25%	Agro-based; REUCS-led O&M
EV Charging Station – (Ibadan)	Oyo	15/30	0.10–0.12	40%	Dedicated EV load and hybrid assets
Assiga Cassava Centre	Cross River	100	0.12	60%	Strong productive-use case; clean ESMP
Amende Mini-Grid (Egoro Ikhide)	Edo	200	0.11	65%	Interconnection-ready with validated sync components
Uzano Agricultural Hub	Edo	175	0.12	50%	Agro-processing; economic viability; social licence present
Agro Solar Mini-Grid – Ukpenu PHC	Edo	300	0.09	50%	Community health anchor; strong billing; needs minor upgrades
EV Charging Station – (Kaduna)	Kaduna	30	0.10	100%	Commercial corridor; emerging productive potential
EV Charging Station – (Asaba)	Delta	30	0.12	60%	Adjacent to petrol station; underused but can be repurposed

Sites Needing Intervention:

- 12 sites classified as vandalised or severely degraded.
- 14 non-operational due to system failure, lack of commissioning, or missing components.
- REUCS inactivity observed in over 10 sites leading to gaps in fee collection and fault response.



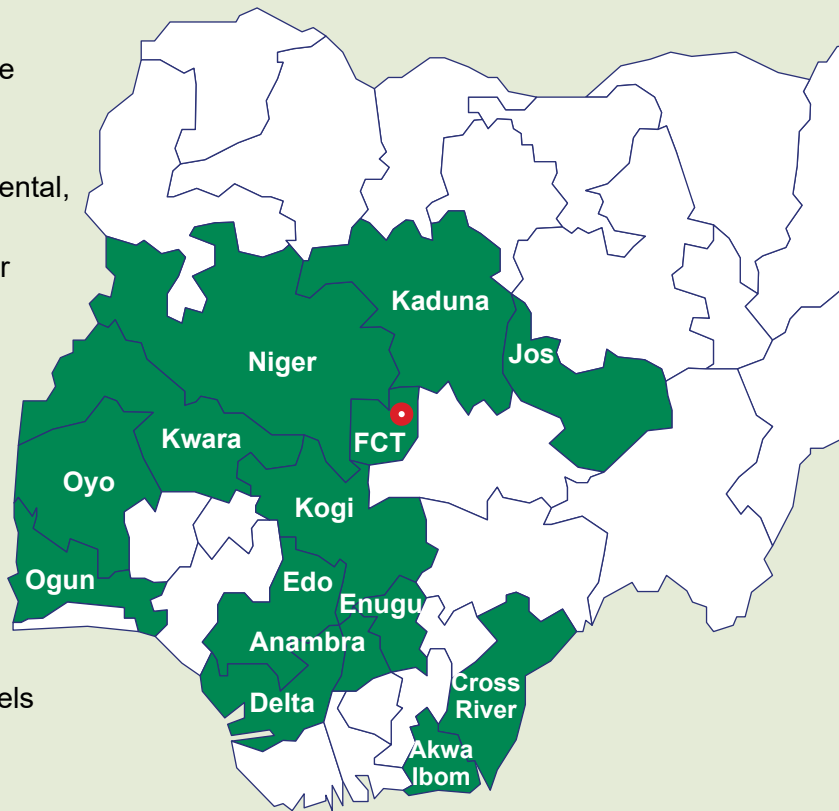
Evidence Base and Key Lessons

What Was Done:

- 40 capital mini-grid sites were assessed using the developed IMG evaluation criteria.
- Site conditions were scored across six domains: technical, financial, operational, social, environmental, and institutional.
- Evaluations used real-time field data, stakeholder interviews, asset condition audits, and proximity mapping.
- Collaboration with REUCS, local contractors, and community leaders provided contextual grounding and increased project ownership.

Key Tools and Frameworks Used:

- Interconnection Scorecard Template
- Site Assessment Evaluation Matrix
- Harmonised Technical Standards (2025 Edition)
- Hybrid (Government and Community) O&M Models
- Kobo Toolbox – digital field data
- VIDA – geo-mapping
- Excel – scoring, financial modelling, and diagnostics

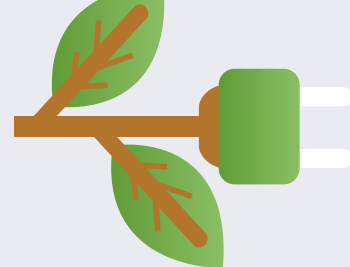


Key Lessons Learned:

- **Site Security and Infrastructure:** Grid-ready infrastructure is vulnerable to vandalism, underscoring the importance of site fencing, signage, and community oversight. Mini-grids with secure enclosures and defined physical perimeters scored highest.
- **Anchor Load Importance:** Viability was strongly linked to the presence of productive-use energy (PUE) anchors such as agricultural processors, water schemes, or health clinics. Sites with underutilised loads or no productive applications struggled with cost recovery.
- **Community Governance and REUCS Engagement:** Functional REUCS facilitated smoother O&M, improved payment discipline, and reduced vandalism. Several high-performing sites had REUCS-led performance reviews and fee-setting mechanisms (O&M charges).
- **Regulatory and Policy Alignment:** Sites that were aligned with the 2023 Electricity Act and compliant with NERC's Mini-Grid Regulations experienced fewer bottlenecks in obtaining interconnection permits or attracting private interest.



Recommendations for Action



For State Governments

- Apply the interconnection scorecard across legacy and future mini-grids to assess readiness.
- Use results to prioritise projects for inclusion in MST and State Electrification Plans.
- Invest in REUCS governance formalisation, GESI compliance, and operational training.

For Developers

- Align all mini-grid system designs with REA's updated harmonised technical standards.
- Ensure interconnection infrastructure (synchronisation relays, control panels, transformers) meets grid export protocols.
- Maintain active licensing documentation, safety logs, and signed agreements with REA and relevant DisCos.

For REA and DARES

- Expand MST-qualified project lists using insights from the site visits and evaluations.
- Publish technical guidance packs, site readiness dashboards, and financial templates.
- Revise evaluation tools regularly in consultation with DisCos, regulators, and state actors.



Conclusion: Scaling with Insight

- As Nigeria moves toward a more integrated energy future, sustained collaboration across these actors is essential. Interconnection is not just a technical process. It is a governance, institutional, and community-building endeavour.
- A shared commitment to knowledge dissemination, inclusive participation, and adaptive implementation will determine whether mini-grids remain isolated power islands, or become the backbone of Nigeria's resilient, decentralised energy system.
- Developing sustainable interconnected mini-grids is essential to Nigeria's energy future. With evidence-based tools, harmonised technical standards, and stakeholder alignment, states and their implementing partners can transition isolated rural projects into robust, economically viable grid-integrated systems.
- State actors are strongly encouraged to institutionalise the tools and recommendations presented herein into their rural electrification policies, investment screening processes, procurement evaluations, and licensing workflows.
- The REA–DARES collaboration presents an opportunity to scale good practices, mobilise co-financing, and close the rural electrification gap with speed and sustainability.





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