

Section 13

Case study – Nigeria

The Nigerian mini-grid market has in recent years generated growing interest from developers not just because of the size of its growth opportunities but because of its robust regulatory environment. A recently introduced results-based financing (RBF) mechanism showcased how governments elsewhere can potentially assist with bulk scaling and financing of mini-grids. The mechanism is straightforward, transparent and partially mitigates currency risk.

13.1 Overview

Nigeria has the largest population (200 million) and economy (USD 397 billion) in Africa. Only 36 percent of the rural population had access to electricity in 2018; nationwide the figure was 55 percent. Where the grid is available, consumers experience frequent power cuts ranging from four to 15 hours per day. Few interviewed by the authors hold out hope that expansion of the central grid planned

for the next five years will dramatically improve the situation. Hence consumers seeking uninterrupted service will continue to be compelled to take matters into their own hands with distributed energy systems.

By the end of 2019, Nigeria’s estimated installed mini-grid capacity was about 2.8MW, with 59 projects serving rural consumers. These are mostly residential-based mini-grids with some developed for specific productive uses. If fully commercial-served mini-grids are included, the number is expected to be significantly higher. Separately, Nigerians spent USD 16 billion in 2016 alone to fuel privately-owned diesel/petrol generators to meet the shortfall in demand.

Nigeria’s failure to provide stable grid power has fertilized the ground for strong off-grid development. In 2017, the country introduced a mini-grid regulation managed by the Nigerian Electricity Regulatory Commission (NERC) supporting isolated and grid-con-

Figure 111
Nigeria’s installed mini-grids, by project

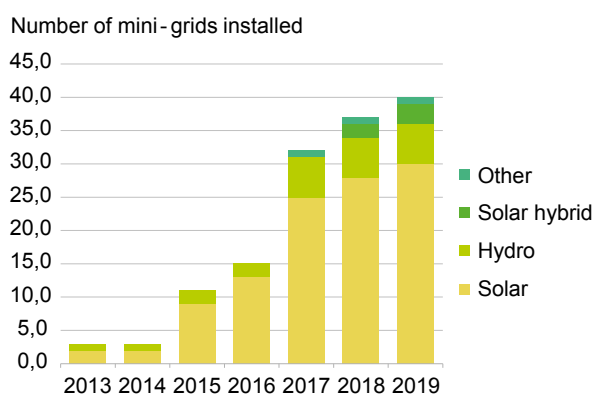
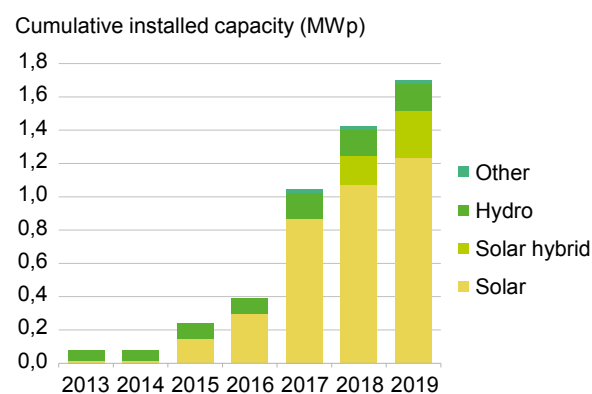


Figure 112
Nigeria’s installed mini-grids, by capacity



Source: BloombergNEF, GIZ, Carbon Trust, surveyed developers. **Note:** Operating projects without a specified commissioning year are not included.

nected mini-grids between 100kW and 1MW in size. To operate, these must obtain mini-grid permits from the NERC. Mini-grids below 100kW must register with the NERC, but obtaining the permit is optional. If Nigeria’s central grid is later extended to the site of the mini-grids, developers are to be paid for their depreciated assets plus any operating revenue generated over the prior 12 months.

These regulations are regarded as robust and have signaled the government’s commitment to distributed energy systems. Developers have responded but most have pursued smaller projects because building projects above 1MW often requires time-consuming approvals (e.g., a generating company licence).

13.2 Distributed power market structure

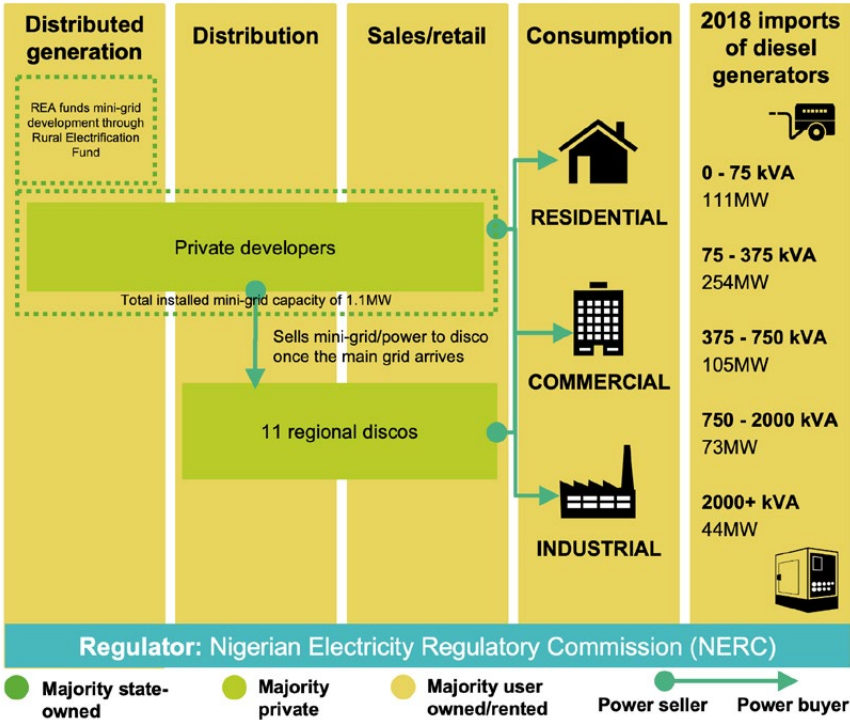
In Nigeria, private companies have installed and are operating the majority of mini-grids under public-private partnership models (Figure 113). They

usually own the generation equipment and bear the capex, meaning they develop the project with their own (or shareholder) capital and agree an off-take agreement with the government or a community. Developers can establish isolated mini-grids and set their own tariffs so long as they hold mini-grid permits; in this process, the tariff must be approved by the NERC.

Nigeria has 11 distribution companies (discos) with load allocated by region – Abuja, Benin, Eko, Enugu, Ibadan, Ikeja, Jos, Kaduna, Kano, Port Harcourt and Yola. Each owns and operates distribution grid assets that include transmission lines (mostly 11kV/33kV cables), substations, meters and other distribution equipment. While the regional discos are privately owned and managed, only one is permitted to operate per region.

The NERC issues and monitors generation, transmission and distribution licences. It also issues mini-grid permits, and sets and reviews retail electricity tariffs based on the Multi-Year Tariff Order (MYTO)

Figure 113
Nigeria’s distributed power market structure



Source: BloombergNEF.

policy. The Nigerian Electricity Management Services Agency (NEMSA) is charged with inspections and certifications of mini-grids, and inspections must take place in order for the NERC to approve the mini-grid permit. Nigerian developer GVE's mini-grids were the first to be inspected by NEMSA, and its projects were benchmarked against the grid code.

13.3 Current market status

In Nigeria, private-sector players primarily develop solar hybrid mini-grids with financial backing from DFIs and donor agencies. The mini-grid development sector is more crowded in Nigeria than elsewhere, reflecting the fact that the market has significant potential to provide electricity access and displace existing diesel generators, with 587MW of diesel generators imported into the country in 2018 alone (Figure 114).

The World Bank, the African Development Bank and Nigeria's Rural Electrification Authority (REA) have recently made major commitments to the country's mini-grids with a USD 550 million fund for the Nigeria Electrification Project (NEP) of which USD 220 million is dedicated to implementing an RBF programme through a performance-based grant (PBG) and minimum subsidy tender mechanism to help developers finance solar hybrid mini-grids.

The minimum subsidy tender process is part of the NEP, which aims to provide power to 300,000 homes

and 30,000 local businesses in 250 locations across four states (Niger, Ogun, Sokoto and Cross-River states). The goal is to scale mini-grid adoption at the least cost (see the Policy and regulation section for more details). The World Bank and REA will select developers with the experience and capability to install mini-grids at lowest cost. Developers will then build a portfolio of projects at designated sites. The winning bidders gain access to the technical information of the sites through the REA and will be able to build up their mini-grid portfolio, which will help them secure financing for future projects.

The PBG programme selects developers who submit mini-grid proposals on a first-come, first-served basis and provides a fixed grant of USD 350 per new connection for their mini-grid (where each mini-grid may contain about 29 or more connections). In December 2019, PowerGen Renewable Energy Nigeria, a subsidiary of PowerGen commissioned a solar hybrid mini-grid including 64kW PV with 360kWh batteries in Rokota community, Niger state, reaching 3,000 people. This is the first project to be commissioned under the NEP. PowerGen Nigeria plans to develop nine more projects under the NEP programme.

GVE, Nigeria's largest mini-grid developer that is also taking part in the NEP, already has a portfolio of 14 mini-grids in operation with a combined installed capacity of 589kW of PV and 4,200kWh of lead-acid batteries. It has 395kW of PV with 670kWh of lithium-ion batteries currently under construction. GVE

Figure 114

Mini-grid developer landscape in Nigeria



Source: BloombergNEF, company logos.

invested some USD 4 million in mini-grids in Nigeria between 2013 and 2019. As part of the *Energizing Economies* programme, GVE has recently signed a deal to develop a 1MW commercial renewable hybrid mini-grid project to provide power to the Wuse market in Abuja. The full list of participants in the NEP was not yet known at the end of 2019.

A few private financiers are active in Nigeria today. NEoT Offgrid Africa, an investment platform launched by France-based NEoT Capital and EDF in 2017, aims to invest hundreds of millions of dollars in distributed renewable energy projects in Africa through late 2021 (NEoT Capital, 2017). NEoT Offgrid Africa invested an undisclosed amount in Rensource's special purpose vehicle, Sabon Gari Energy Solutions. The investment was used to develop a mini-grid project consisting of 1.3MW of PV to supply reliable electricity to 12,000 shops in the Sabon Gari Market in Kano, the second-largest city in the country (Rensource, 2018).

In the commercial mini-grid segment, Rensource, a three-year-old off-grid solar energy firm, has raised USD 20 million in a Series A round equity funding jointly led by African venture capital fund CRE Venture Capital and impact investor the Omidyar Network in December 2019. The round also saw participation from Inspired Evolution, Proparco, EDPR, I&P, Sin Capital, and Yuzura Honda. Rensource's funding round follows sustained investor interest in Africa-focused off-grid and renewable energy start-ups seeking to plug electricity gaps. In June 2019, Arnergy, another solar mini-grid company, also raised USD 9 million in its Series A round equity funding.

Commercial banks have thus far been largely absent from Nigeria's mini-grid market. Developers regard commercial bank debt as too costly and too inflexible, with interest rates offered of reportedly over 25 percent and tenors lasting just two years, at best. There is no project financing product available in Nigeria allowing vendors to borrow solely against predictable cash flows, which is why it's good to see PowerGen Nigeria in the picture, since it managed to secure project finance debt in Tanzania. Instead, local banks require developers to provide physical assets as collateral. Even then, lenders tend not to accept solar equipment as collateral but instead re-

quire that borrowers own real estate that can be used for that purpose.

As a result of all of the above, developers have to date mostly financed projects off their own balance sheets, either in US dollars for multinational corporations or in Nigerian naira in the case of local developers. The Nigerian Bank of Industry (BOI) is the only institution able to provide naira-denominated financing for mini-grid developers under its '6 billion naira' solar fund.

13.4 Policy and regulations

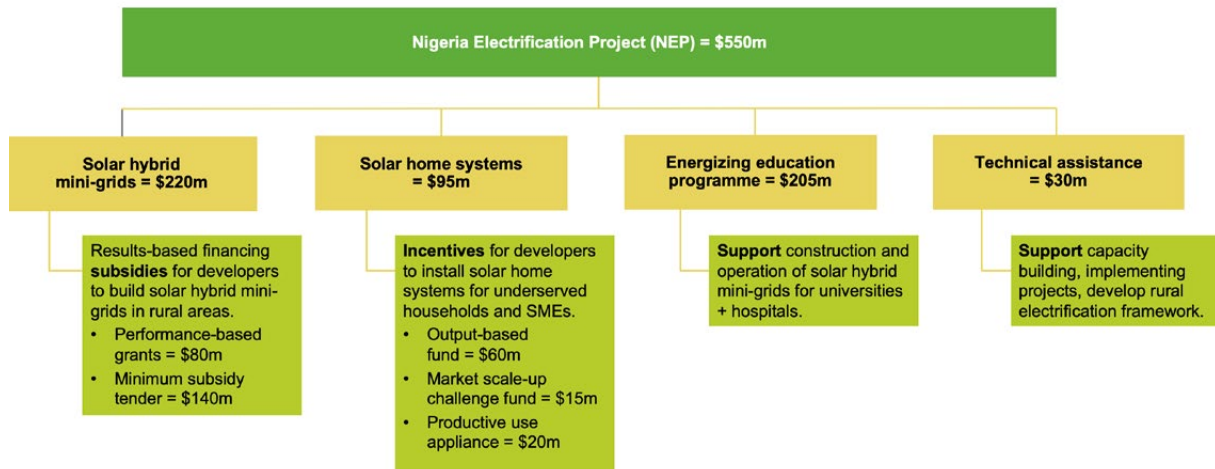
A turning point for Nigeria's mini-grid sector came with the ratification of a key regulation for Mini-Grids in May 2017. The new rule issued under Section 70 (8) of the Electric Power Sector Reform Act (EPSRA) sought explicitly to enhance private-sector electricity access activities.

At the end of 2019, NERC developed a [web-based tool](#) to streamline the mini-grid registration process for developers and released a downloadable simplified MYTO Excel-based model to help developers determine what cost-reflective tariffs to charge end-users. While many developers have in-house tools to make these calculations, they still found it reassuring to see the regulator take such a modern approach. Moreover, the downloadable mini-grid MYTO model allows developers to verify their own tariffs. This increases transparency and the chance that a proposed tariff will receive approval. Typically, the tariff a developer submits to the NERC must be in line with the mini-grid MYTO tariff calculator. If it is not in line with the NERC tool, developers must provide a valid reason for the difference when seeking mini-grid permit approval.

The World Bank issued a USD 350 million loan to the Federal Ministry of Finance to implement the five-year programme known as the [Nigeria Electrification Project](#) (World Bank, 2018). The programme consists of four components (Figure 115); its goal is to increase access to electricity services for households, public educational institutions and micro, small and medium enterprises throughout Nigeria.

Figure 115

NEP Overview



Source: BloombergNEF, REA.

In March 2020, the African Development Bank (AfDB) and Africa Growing Together Fund (AGTF) agreed to jointly provide USD 200 million for the NEP (AfDB, 2020). The fund focuses on helping the REA achieve its 100 percent electrification (or universal energy access) target by 2030 and help de-risk and scale-up private sector investment. The fund is focused on both mini-grid and other off-grid solutions. Combining this with the USD 350 million commitment from the World Bank brings the total commitment to USD 550 million for the NEP.

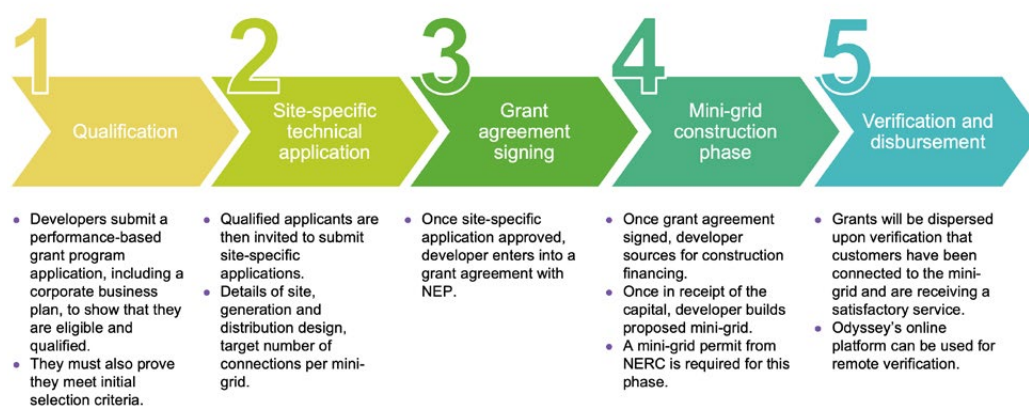
Results-based financing

Performance-based grant (PBG) programme

Nigeria achieved another important milestone when it launched an RBF mechanism for financing new solar hybrid mini-grid projects in 2018 within the NEP. The PBG programme aims to close the viability gap for mini-grids developed on a spontaneous basis. Grants of USD 350 per new connection are available on a first-come first-served basis, with a minimum total grant request of USD 10,000 per mini-grid (with about 29 connections per mini-grid at minimum). Isolated solar hybrid mini-grids are eligible for the grants, but grid-connected projects are not.

Figure 116

Overview of PBG process



Source: BloombergNEF, REA.

Developers need to carry out geospatial studies, energy audits and community surveys to select their proposed viable sites. The grants are available for qualified projects on a rolling basis until the funds are exhausted. Figure 116 gives an overview of the five phases of the PBG programme, from qualification to grant disbursement.

The PBG programme aims to help developers raise other sources of financing over the capital markets. Given these grants are denominated in US dollars, this also enables developers to source for US dollar-denominated financing as this partially mitigates risk for the lender, be it debt or equity. As a potential financing strategy, more risk-averse lenders can even cap the percentage of the construction capex they are willing to finance at the timing of post-construction payout of the grant as a percentage of the overall capex.

If successful, the programme has the potential to be a game changer and similar mechanisms could be rolled out across Sub-Saharan Africa.

Minimum subsidy tender programme

Separately, the World Bank and the REA are planning to implement minimum tenders to install 250 new mini-grids at least cost. The REA initially screened 2,000 sites, then narrowed them to 250, filtering projects out by choosing sites with a larger number of inhabitants, more economic activity and nearby infrastructure. The programme has two phases:

- Tender for 57 sites across four states: Niger, Sokoto, Ogun and Cross River.
- Scale-up to complete construction of the 250 sites across these four states, potentially adding more states in this phase.

Winning bidders of the minimum subsidy tender programme can potentially claim grants of more than the fixed USD 350 per connection that the PBG programme offers. However, the tender aims to drive this figure lower, if at all possible, although it may be higher depending on competition.

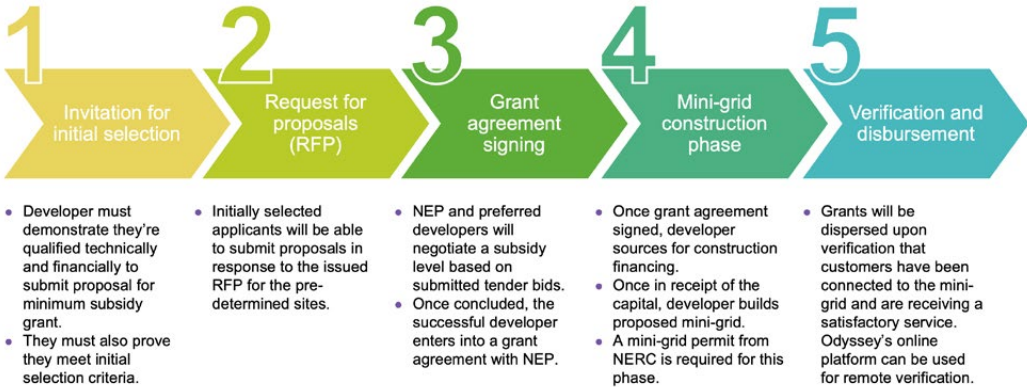
As of October 2019, the original list of 64 developers had been culled to 16. Five or six who can build mini-grids at the pre-selected sites at lowest grant cost per new connection will be awarded contracts.

Each winning bidder will have access to a database that includes technical information about each of the 250 sites to help them develop site-specific business models. These developers will need to develop multiple mini-grids (potentially 40–50 per developer) and will still need to raise capital from the financial markets, be it debt or equity.

Figure 117 shows the overall process of the minimum subsidy tender process. As with the PBG programme, once developers have built their mini-grids and connected their customers, the grants will be disbursed upon verification that customers have been connected to the network and have been provided satisfactory service (PV magazine, 2019).

Figure 117

Overview of minimum subsidy tender process



Source: BloombergNEF, REA.

Comparing the PBG and the minimum subsidy tender programme

While developers will always receive a fixed USD 350 per new connection in the PBG programme, the amount of the grant can be above or below USD 350 per new connection under the minimum subsidy programme. For example, if all bidders bid USD 500 per connection, the REA would need to increase the subsidy by USD 150 per connection above the PBG level. If the winning bid prices are below USD 350 per connection, the REA would successfully minimize the cost to install mini-grids.

In both cases, the grant typically is to be paid out three months after the project is commissioned and developers can prove to the REA that the end-users are receiving reliable power from their mini-grids.

Nigerian developers informed the authors that they prefer the minimum subsidy tender since the 250 sites are already defined for them, reducing upfront project development costs. All the developers need to do is to validate the information that the REA has given them regarding the pre-determined mini-grid sites. All project technical data for the REA's pre-determined sites are available on Odys-

Table 22

PBG versus minimum subsidy tenders

Key criteria	Performance-based grants (PBG)	Minimum subsidy tenders
Budget	\$80m	\$140m
Location	All 36 states, developer to submit proposed sites.	250 sites in five states designated by REA.
Subsidy per connection	Fixed at \$350 per new connection.	More or less than \$350 per new connection. Developers submit their bids to meet their hurdle IRRs.
Mini-grid development experience	Proof of designing and building at least one mini-grid of 10kW or larger within the past five years that is still operational.	Proof of two mini-grids of 10kW or larger.
Mini-grid operation experience	Proof of operating one mini-grid of 10kW or larger within the past five years, not necessarily continuously. The mini-grid needs to be still operational.	Proof of two mini-grids of 10kW or larger.
Experience in raising debt/equity financing	Experience of securing finance of amount of \$100,000 or larger, or naira equivalent, in equity, debt or both, for at least one infrastructure project in the past five years.	Proof of minimum \$5m is required for at least two infrastructure projects.
Liquid assets	Total assets must exceed liabilities for past two years.	Minimum of \$1m or its naira equivalent in liquid assets in financial statements.
Nigerian-registered business	Registered with the Corporate Affairs Commission and must have a certificate of incorporation in Nigeria. These need to be done prior to signing a grant agreement.	Same as PBG.
Registered taxpayer	Registered with the Federal Inland Revenue Service (FIRS) with a valid Tax Identification Number (TIN) through which deductible taxes shall be remitted to the Federal Government of Nigeria.	Same as PBG.
Qualified staff	Demonstrate a qualified team (with CVs) dedicated to environmental and social risk management.	Same as PBG.

Source: REA.

sey's NEP platform (discussed below). Table 23 lists key differences between the two RBF programmes.

While the minimum subsidy tenders cover only four states (Sokoto, Ogun, Niger and Cross River states), the PBG does not specify locations, hence, diversifying risk. This may even suit the developers' current business operations/plan. It is possible for developers to submit applications for both the PBG and the minimum subsidy tender programmes at the same time, which may increase their chances of receiving subsidies.

Mini-grid acceleration schemes

Mini-grid acceleration scheme (MAS) – isolated projects

The REA announced the results of a separate mini-grid acceleration scheme (MAS) on 20 October 2019 (Odyssey, 2019). The government agency stated that: *"MAS is a nationwide, non-site-specific, open competitive tender designed to select mini-grid companies."* It also noted that: *"The winners of the tender will be supported in deploying their proposed mini-grid projects with an in-kind partial capital grant – in the form of distribution and metering equipment – and technical assistance."* The successful bidders were Nayo Tropical Technology, Havenhill Synergy Ltd., GVE Projects Ltd. and ACOB Lighting Technology Ltd.

Odyssey partnered with the Nigeria Electricity Sector Programme (NESP) to host the MAS tender, which aims to promote productive-use business models for mini-grids electrifying 21,000 connections including residential, public, commercial and productive users at an affordable tariff by the end of July 2020.

The scheme is implemented by the REA, championed by the Federal Ministry of Power (FMP) and supported with EU funds plus backing from the German government via its Nigerian Energy Support Programme (NESP), implemented by the German Agency for International Development (GIZ). The REA did not state how many mini-grids will be developed by the winning bidders but the call for the tender concerned construction of *"isolated mini-grids up to 1 MW"* in generation capacity.

Once built, the mini-grids supported by the programme will be operated on a commercial, public-private partnership basis. By the end of 2020 some of Nigeria's remote rural and underserved communities will have access to reliable, clean electricity at an affordable tariff that, according to the REA, would have been economically unviable without the scheme.

Interconnected mini-grid acceleration scheme (IMAS) – grid-connected projects

The interconnected mini-grid acceleration scheme (IMAS) proposal call went out in May 2019 and applications were accepted up until 14 August 2019, the deadline set by the REA. Similar to the MAS (above), the IMAS is a nationwide non-site-specific open competitive tender and targets developers who can build a sustainable business model to provide stable electricity to grid-connected but poorly-served communities in Nigeria (a minimum of 15,000 customers), where such projects would have been unfeasible without the IMAS.

The difference between the two schemes is that in the IMAS, developers were invited to submit proposals to design, construct, commission and operate an interconnected solar-based mini-grid of up to 1MW on a commercial public-private partnership, partnering directly with the interested distribution company. The winners of the tender will be supported in deploying their proposed interconnected mini-grid projects with a partial capital grant (in the form of procured distribution and metering infrastructure equipment) and technical assistance.

In 2019, as proof of concept, the Nigerian government partnered with the Kaduna disco and Torankawa community in Sokoto state to build a 60kW PV hybrid mini-grid with 216kWh batteries and a 100kVA diesel generator. The project consisted of 4 kilometres of local distribution wires and 335 smart meters and was designed to operate as a grid-connected or isolated mini-grid, serving some 350 households and 20 small businesses. This was a government-funded project that was able to provide uninterrupted power with 0 percent collection loss using pre-paid meters. For its first commercial interconnected mini-grid, the private company Nayo Tropical Technology has partnered with the Ibadan disco in Mokoloki, Ogun state

to develop a 180kW PV hybrid mini-grid containing 144kWh of lead-acid batteries and a 62kW backup diesel generator . It is designed to serve up to 200 households, 28 small businesses and eight public institutions with a peak demand of 55kW. The project will be the first commercial tripartite contract where the mini-grid operator will pay a distribution usage fee to the disco.

On 3 April 2020, the REA announced the results of its IMAS tender (Table 23) and bidders (i.e., developers) were selected to partner with the seven discos listed. The REA aims to get these projects online by the end of September 2020, providing end-users with affordable electricity tariffs. This date may be impacted by the coronavirus pandemic.

Web-based REA data hub

Odyssey created an official [web-based NEP hub](#) that enables an efficient project evaluation process and data-driven decision making. Odyssey built the tool to manage data for thousands of feasibility studies. Developers and the REA use it to verify and track all connections installed under the NEP and project performance remotely, aiming to minimize the administrative costs associated with running the NEP. It is also used to support the MAS and the IMAS. The [Odyssey platform](#) enables developers to:

- Generate forecasted load profiles and simulate generation system sizes, optimized distribution designs for hundreds of potential mini-grid sites using the Homer Pro plugin.

- Run data queries and analytics across hundreds of mini-grid projects to understand customer loads and cost trends.
- Create more comprehensive proposals modelled via third-party tools such as HOMER Pro.
- Align commercial investors on the platform to help developers reach financial close.
- Streamline evaluation of project proposals in the tendering programmes and make evaluation transparent.
- Monitor performance of the projects after construction.

Licensing

Nigeria allows private companies to build projects and sell electricity to customers. Its regulations define mini-grids as being 1MW or smaller and either isolated or connected to the main grid. For an independent power producer (IPP) to supply electricity to two or more neighboring businesses/households using a mini-grid 100kW to 1MW in size, it must secure a mini-grid distribution permit from the NERC regardless of grid-connection status. For sub-100kW projects, a permit is optional. Steps required for permits vary slightly according to the size of the mini-grid and whether it is connected to the main grid or isolated (Table 24).

Isolated mini-grids

Isolated or off-grid mini-grids have been defined by Nigerian regulators as falling into two specific size categories: sub-100kW and 100kW–1MW. A

Table 23
Results of Nigeria's IMAS tender

Regional disco partner	Developer/Winner
Abuja disco	GVE Projects Ltd
Benin disco	Rubitec Solar
Ibadan disco	Nayo Tropical Technology
Ikeja disco	A4&T Power Solutions
Jos disco	ACOB Lighting Technology Ltd
Kaduna disco	Sosai Renewable Energies
Port-Harcourt disco	Darway Coast Nigeria

Source: REA, Nigeria.

Table 24

Steps required for permits for <1MW Nigeria mini-grids

How to get a Nigerian mini-grid permit?	Inter-connected	Isolated Mini-grids	Isolated Mini-grids
Intended mini-grid capacity	≥ 100 kW	≥ 100 kW	< 100 kW
Is a permit required?	Yes	Yes	No
Identify eligibility of unserved area	1	1	1
Contact community for operating agreement	2a		
Contact disco for operating agreement	2b		
Sign exclusivity period agreement with community	3a	2	2
Sign exclusivity period agreement with disco	3b		
Sign and register tripartite contract	4		
System design (i.e. mini-grid specs)	5	3	3
Sign commercial agreement with community	6a	4	4
Sign commercial agreement with disco	6b		
Acquire land and necessary building approvals	7	5	5
Apply to NERC for operating permit for intended area	8	6	
Construct, test then commission mini-grid	9	7	6
Register mini-grid with NERC			7
Submit two copies of supporting documents to NERC		8	
Number of key steps	12	8	7

Source: BloombergNEF, Rural Electrification Agency. Grey means step is 'not required'.

sub-100kW mini-grid can opt for either a registration with NERC or for a mini-grid permit. A permit is generally more desirable than a registration certificate as it confers on the operator the right to compensation when the main grid arrives at the site (i.e., there is no compensation if the project is just registered). To qualify, however, the project must adhere to minimum network technical and safety standards defined by the NEMSA. If the main grid gets built out by the regional disco to reach the mini-grid site, the operator can either:

- Convert the project into an interconnected mini-grid, or
- Transfer the asset to the disco and get paid in return.

These options mitigate the risk for developers.

Projects of 100kW–1MW are legally required to have mini-grid permits from the NERC before starting operations. Without an approved mini-grid permit, projects have no guaranteed protections should the central grid expand into their territory.

Interconnected mini-grids

While some mini-grids are built in remote areas lacking central grid access and then encompassed by the central grid when it is expanded outward, others are built from day one adjacent to the central grid. These interconnected mini-grids are linked to the regional disco but deliver power to areas where power delivery is particularly challenging. In these cases, developers must enter tripartite contracts with the local community to be served and the disco. The tripartite contract must then be approved

by the NERC to be official. Developers must also secure mini-grid permits.

Interconnected mini-grids are targeted at communities classified as ‘under-grid’, that is, grid-connected but with frequent/lengthy outages and usually relying on expensive diesel/gasoline gensets to meet demand during outages. The proven ability to pay for expensive fuel to meet demand is what really differentiates them from the isolated mini-grids where residents may not necessarily need or be able to pay for power.

Above 1MW projects

If the mini-grid exceeds 1MW in generating capacity, the developer must secure an Independent Electricity Distribution Networks (IEDN) licence (Table 25). Mini-grid developers in Nigeria with projects whose capacities exceed 1MW must hold NERC generation company licences. The mini-grid regulation does not protect these projects.

Tariffs

Before the mini-grid regulation was ratified, the mini-grid tariff structure was unregulated, whereby

the mini-grid developer can charge whatever the customer is willing to pay for their power.

NERC developed a [downloadable Excel-based tool](#) (made available in 2019) to help developers and communities agree on reasonable cost-reflective tariff rates mini-grid developers should be charging end-users. The downloadable mini-grid MYTO tariff calculator allows developers to input all their cost assumptions, customer load, grants etc into the model and get a tariff that they should be charging. If for some reason the developer’s internal (proprietary) mini-grid tariff model is not in line with this (above the MYTO tariff calculator), they need to provide a clear justification for why the tariff is different to NERC before submitting the application. Typically, if 60 percent of the potential customers in a community agree to a tariff proposed by the developer, NERC will approve this tariff.

Import restrictions

Nigeria offers tax exemptions on some clean energy equipment, but developers complain these are not being effectively implemented (Table 26). They also cite regular issues with bringing imports entirely into the country.

Table 25
Nigeria’s key mini-grid regulations at a glance

Policy	Description
Mini-Grid Regulation, 2016 100kW to 1MW	Isolated mini-grids require signed agreements between mini-grid operators and the communities they serve. If such projects have mini-grid permits from the NERC, the disco must pay off the mini-grid owner with 100 percent of the depreciated asset value (capex) plus one year of revenue. While the NERC has determined a depreciation schedule, it has not yet been published. Interconnected mini-grids require an agreement among the mini-grid operator, the community and the disco.
Independent Electricity Distribution Networks (IEDN) Regulation, 2012 1MW+	For any power project planning to distribute power above the 1MW threshold of the mini-grid regulation, the GENCO must hold an IEDN licence from the NERC.
Application for Licences (Generation, Transmission, System Operations, Distribution & Trading), 2010 1MW+	For any 1MW+ project to transmit, distribute or generate power for sale (i.e., when a PPA is involved) , the developer must apply for a generation licence at a cost of USD 10,000 for projects 1–10MW. The licence and operating fees regulation details fees involved with obtaining this generation licence. The application process timeline should not exceed six months, according to the NERC.

Source: NERC. Note: Renewal is guaranteed if the renewal fees are paid and all requirements met. Developers informed the authors that once a licence is granted, renewal is pretty much guaranteed.

Under the rules, PV modules with bypass diodes must pay a 5 percent import duty plus 5 percent VAT while the import duty on solar cells without bypass diodes is 0 percent. This is because the government wants to encourage locally assembled PV modules. However, these efforts have largely failed; no developer the authors spoke to has used locally assembled PV modules. Batteries are taxed a total of 27.5 percent, broken up as 20 percent import duty and 7.5 percent VAT.

There are also high transaction costs related to customs handling. Merchandise can often sit in port for weeks, at high cost to the importer. Developers complained about delays in removing merchandise from port after it arrives. Some developers reported they typically budget an additional 1–2 percent of the total value of imported goods as *settlement fees* to clear the goods quickly.

Table 26
Nigeria’s tariffs on solar and batteries

Code	Official Description	Interpretation	Import Duty	VAT	Total
8502 - 391000	Solar-powered generator	PV module with a bypass diode	5%	5%	10%
8541 - 401000	Solar cells whether or not in modules or made up into panels	PV module without a bypass diode	0%		0%
8506 - 500000	Primary cells and primary batteries made of lithium	Lithium-ion batteries.	20%	7.5%	27.5%
8507 - 100000	Lead-acid, of a kind used for starting piston engines	Lead-acid batteries.	20%	7.5%	27.5%

Source: BloombergNEF, Nigeria Customs Service (NCS). **Note:** A bypass diode makes the solar module have a constant energy wavelength, without a diode, it does not have a constant energy wavelength and cannot be used for power generation. However, solar modules ship with bypass diodes included and therefore incur duty 8502.