DERISKING INTERCONNECTED SOLAR MINI-GRID INVESTMENTS IN NIGERIA

A framework to support policymakers in selecting public instruments for the promotion of private financing

SD STRATEGIES

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November 2020

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Table of contents

Figures

Tables

Abbreviations

AEDC	Abuja Electricity Distribution Company
AfDB	African Development Bank
AFD	Agence Française de Développement
AMMB	Abuja Markets Management Board
BVN	Bank Verification Number
CBN	Central Bank of Nigeria
CO_2e	Carbon dioxide equivalent
DisCo	Distribution company
DREI	Derisking Renewable Energy Investment
EEI	Energising Economies Initiative
EPSRA	Electric Power Sector Reform Act
ERGP	Economic Recovery and Growth Plan
ESMAP	Energy Sector Management Assistance Program
GDP	Gross domestic product
GenCo	Generation company
GHG	Greenhouse gas
GIZ	Gesellschaft für Internationale Zusammenarbeit
GVE	Green Village Electricity
IMAS	Interconnected Mini-grid Acceleration Scheme
IMG	Interconnected mini-grid
IRENA	International Renewable Energy Agency
ITF	Industrial Training Fund
MG	Mini-grid
MW	Megawatt
MYTO	Multi-Year Tariff Order
NBET	Nigerian Bulk Electricity Trading Company
NCC	Nigerian Communications Commission
NDC	Nationally Determined Contribution
NDPR	Nigerian Data Protection Regulation

NELMCO	Nigerian Electricity Liability Management Company
NEMSA	Nigerian Electricity Management Services Agency
NERC	Nigerian Electricity Regulatory Commission
NERC-MGR	Nigerian Electricity Regulatory Commission Mini-Grid Regulation, 2016
NESP	Nigerian Energy Support Programme
NESREA	National Environmental Standards and Regulations Enforcement Agency
NGN	Nigerian Naira
NIPC	Nigerian Investment Promotion Council
NITDA	Nigerian Information Technology Development Agency
O&M	Operation & management
PHCN	Power Holding Company of Nigeria
PPP	Public-private partnership
PV	Photovoltaics
RBF	Results-based finance
REA	Rural Electrification Agency
REAN	Renewable Energy Association of Nigeria
SDG	Sustainable Development Goal
SON	Standard Organisation of Nigeria
TCN	Transmission Company of Nigeria
TVET	Technical, Vocational, and Entrepreneurial Training
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WUMATA	Wuse Market Traders Association

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The COVID-19 Pandemic has caused immense disruption all around the world, including in Nigeria. Still, the project team was able to complete this study – and the in-depth survey it builds on. Thank you Dennis Agelebe, Landysh Iarullina, Ieva Indriunaite, Uni Lee, Blanca Loaiza, Kate Vanderbraak, Maria van Veldhuizen, Hans Verolme, for never giving up despite difficult circumstances.

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Colleagues, please remain healthy and optimistic!

Alexander Ochs, Project Director
November 2020

Executive summary

Interconnected mini-grids (IMGs) rapidly gain traction as a high-potential stepping stone toward United Nations Sustainable Development Goal 7: "to ensure access to affordable, reliable, sustainable and modern energy for all." The government of Nigeria, Africa's most populous country and its largest economy, has long made better energy services for its citizens a key priority. More recently, it identified IMGs as a plausibly powerful solution to increase the share of renewables in the electricity mix; improve the reliability and flexibility of electricity supply; as well as provide electricity to low-income populations.

- For an overview of Nigeria's energy situation, the government's development goals, and the role IMGs can play towards them, see chapter 2. -

This report identifies and analyses key risks and barriers to private-sector investment in IMGs in Nigeria – and evaluates policy and financial instruments designed to address them. We focus on solar PV IMGs combined with batteries. The ultimate objective of the study is to contribute to accelerating private sector-led deployment of IMGs at scale.

The project team adapted the Derisking Renewable Energy Investment (DREI) methodology of the United Nations Development Programme (UNDP) to develop an expert survey that is specifically tailored to IMG investments. It assesses 10 risk categories: social acceptance, hardware, digital, labour, energy market, developer, end-user credit, financing, currency, and sovereign risk. Each risk category consists of one or more underlying barriers, adding up to 23 barriers in total; and each of these barriers has been paired with a specific policy and/or finance instrument that can effectively mitigate it.

- For a brief overview of the methodology, the barriers and instruments assessed, as well as the chapters of the report, see chapter 1.-

Fifteen experts of the IMG market provided in-depth insights through written survey answers, and in most cases, follow-up in-person interviews. This report provides and contextualises their quantitative ratings and qualitative commentary. "Volatility of local currency"; "capital scarcity - liquidity constraints in domestic banking"; and "low developer creditworthiness and cash flow strength" are the three highest rated barriers, respectively, in terms of first, likelihood of their occurrence, and second, their impact, should they occur. The three lowest ranking ones following the same assessment of likelihood and impact are "uncertainty or inflexibility in tariff regulations", "uncertainty related to technical requirements for mini-grids", and "resistance by general public, local communities, competing businesses" – with the last mentioned the least powerful barrier to IMG investment evaluated in this study.

A majority of barriers receive relatively high ratings in the assessments of surveyed experts. This result is, however, hardly surprising, given that the IMG market has just recently come into existence. Only two pilot projects have thus far gone online, and though several more are currently at different stages of development, all observers agree that what they are currently witnessing is still an exploratory period for most market participants. While this study for this very reason comes relatively early, it can also provide the government with concrete suggestions for what it can do to improve the investment environment and lead IMGs to market maturity without the need of excessive public subsidies.

The expert survey came to another very positive result: All barriers could be paired with concrete policy and finance instruments – and their impact, once implemented, was consistently evaluated as very high. The study provides concrete suggestions for how the individual assessed policies can be implemented in the existing market, policy, and finance landscape in Nigeria.

- Chapter 3 summarizes all major findings from the survey and the conclusions the authors draw from them. -

Based on the expert survey, the report presents a toolkit of priority interventions tailored to the Nigerian investment environment. A multitude of actions will allow the government to reduce, transfer, or compensate for, the identified risks and barriers. This study categorizes them in eight priority components:

1. Ensure successful implementation of pilot projects – and consider lessons learned
2. Enforce compliance with existing policies and regulations – and clarify responsibilities of authorities
3. Design and implement new policies and regulations
4. Minimize bureaucratic hurdles and provide governmental services to all key stakeholders
5. Build capacities and encourage knowledge transfer
6. Strengthen domestic manufacturing capacity and ease imports of components that cannot be produced domestically
7. Support access to international finance
8. Emphasise the government's commitment to advancing the IMG market.

- Chapter 5 presents concrete policies and measures the government can employ within the above eight priority action areas. -

It will be important to draw from the experiences currently made under the Interconnected Mini-grid Acceleration Scheme (IMAS) as well as Energising Economics Initiative (EEI). The recently launched first component of an IMG serving the traders of Abuja's Wuse market can provide important insights. They reach from the importance of stakeholder engagement and the communication of transparent project objectives to the negative impact of bureaucratic bottlenecks delaying the project permit approvals.

- Chapter 4 portraits the set-up of Wuse Market's first IMG installation and presents major lessons learned from the implementation of the project. -

1. Introduction

This report identifies and analyses key risks and barriers to private-sector investment in interconnected mini-grids (IMGs) in Nigeria – and evaluates policy and financial instruments designed to address them. The report presents a toolkit of interventions tailored to the Nigerian investment environment. Employing the recommended policies and measures will allow the government to reduce, transfer, or compensate for the identified risks and barriers. The objective is to accelerate the private sector-led deployment of IMGs at scale.

The project team designed a survey tailored to IMG investments adapted from the Derisking Matrix for Mini-Grids developed by the United Nations Development Programme (UNDP) as part of its Derisking Renewable Energy Investment (DREI) methodology (UNDP, 2018). The survey assesses 10 risk categories: social acceptance, hardware, digital, labour, energy market, developer, end-user credit, financing, currency, and sovereign risk (Table 1). Each risk category consists of one or more underlying barriers, adding up to 23 barriers in total.

Fifteen stakeholders—developers, investors, public-sector representatives, and leading market experts— with in-depth insight into the new IMG market in Nigeria participated in the survey. They were asked to rate each barrier in terms of a) likelihood of occurrence, and b) level of impact should it occur, on a scale of one (unlikely/low impact) to five (very likely/very high impact). Interviewees were also asked to rate the potential effectiveness of selected policy and finance instruments to address the identified barriers, on a scale from one (low) to five (very high). Interviewees provided qualitative feedback in addition to their ratings. Table 1 outlines the risk categories, barriers, and proposed instruments for each barrier.

Table 1. Assessed risk categories, barriers, and instruments

RISK CATEGORIES	BARRIERS	INSTRUMENTS
1. Social acceptance risk	Resistance by the general public, local communities, competing businesses	Develop and coordinate ongoing community impact and public awareness campaigns
		Pilot models for community involvement
2. Hardware risk	Cumbersome customs processes and high tariffs	Introduce streamlined and consistent customs procedures; reform punitive custom tariff systems
	Lack of information on quality of hardware/technical standards/warranties	Develop certification and standards for hardware; adopt internationally recognized standards and share best practices, where applicable
	Lack of a competitive market for buying hardware	Ensure an open, competitive marketplace for buying hardware

RISK CATEGORIES	BARRIERS	INSTRUMENTS
3. Digital risk	Poor cellular networks and low usage of mobile money	Adopt well-designed telecom regulations enabling universal, competitive coverage and mobile money
	Limited standardization of software and interfaces on mini-grid developers' back-end data and operations, and mobile money payment platforms	Provide government support to form industry associations for standard-setting and sharing of best practices
	Abuse of consumer data privacy on payments and usage, and a lack of understanding on uses of consumer information	Institute balanced consumer data protection regulations
4. Labour risk	Lack of a competitive labour market of qualified employees	Implement programmes to develop competitive, skilled labour market in renewable energy & mini-grids (all roles)
5. Energy market risk	Market uncertainty created by lack of political commitment	Build political will and develop realistic and transparent targets, using multi-tier electrification indicators
	Competing subsidies	Reform fossil fuel and grid-distributed electricity subsidies
	Uncertainty related to electricity market access, future competition, and grid expansion	Establish regulatory approach with two, co- existing regimes: (i) light-touch (no license) and (ii) comprehensive (licensed). Mini-grid developers may choose to operate under either regime. Light-touch regime does not provide exclusivity, nor access to government financing or grants
	Uncertainty or inflexibility in tariff regulations	
	Uncertainty related to technical requirements for mini-grids	
6. Developer risk	Lack of management capability	Provide government support to improve information flows and network effects
	Low developer credit worthiness and cash flow strength	Provide public loans, guarantees and/or equity to mini-grid operators
7. End-user credit risk	Lack of information on end-user credit worthiness	Facilitate growth of consumer credit data industry
	Poor credit worthiness and non-payment	Facilitate end-user's ability to improve creditworthiness over time
		Adopt government mandates to ensure creditworthy anchor tenants for mini-grids
8. Financing risk	Capital scarcity – liquidity constraints in domestic banking	Reform reserve requirements for domestic lending to businesses
	Capital scarcity – underdeveloped domestic financial sector	Liberalize domestic financial sector
		Provide public loans, guarantees and/or equity to mini-grid operators to address capital scarcity
	Capital scarcity – competing incentives and mandates	Reform financial sector incentives for investing in specific sectors
	Limited domestic investor experience with mini-grids	Strengthen domestic investors' (debt and equity) familiarity with and capacity regarding renewable energy mini-grids

RISK CATEGORIES	BARRIERS	INSTRUMENTS
9. Currency risk	Volatility of local currency	Provide government support for long-term development of liquid domestic FX derivative markets and develop financial products to transfer some or all currency risk to public sector
		Request development of risk-sharing products by development banks to address political risk
10. Sovereign risk	Limitations and uncertainty related to the political and economic situation, risk of natural disasters, quality of infrastructure, etc.	Request development of risk-sharing products by development banks to address political risk

Chapter 2 explores the potential of IMGs to relieve Nigeria's energy crisis and provides important background information on this new market segment. The expert survey findings are discussed in detail in Chapter 3. Chapter 4 provides a case study of Wuse Market, which has one of two IMGs currently operating in the country. Chapter 5 concludes the report with suggestions for policies and measures the government can consider to further advance the adoption of IMGs and create an attractive investment environment.

2. Interconnected mini-grids: a new approach to overcoming Nigeria's energy crisis

Nigeria has the largest economy in Africa, with a gross domestic product (GDP) of close to USD 400 billion and a population of approximately 200 million (The World Bank Data, 2018). The country's economy slipped into recession in 2016 when the global price of oil fell. The Nigerian government responded by introducing new policies to attract private investment and foreign companies. As a result, the country moved up 15 places in the World Bank's Doing Business Index between 2019 and 2020 (World Bank, 2020). However, the widespread lack of access to affordable and reliable energy services has hampered continuous economic growth.

2.1 Nigeria's ongoing electricity shortages

In 2005, the Federal Government of Nigeria passed the Electric Power Sector Reform Act (EPSRA) to improve productivity and efficiency levels in the power sector, (Federal Government of Nigeria, 2005). This Act resulted in the unbundling of the National Electric Power Authority which was subsequently renamed to the Power Holding Company of Nigeria (PHCN). The PHCN was then split into eighteen separate companies: six power generation companies (GenCos), eleven distribution companies (DisCos), and the government-owned Transmission Company of Nigeria (TCN). By 2014, all successor power generation and distribution companies had been privatized. In addition, the Nigerian Electricity Regulatory Commission (NERC), Nigerian Bulk Electricity Trading Company (NBET), and Nigerian Electricity Liability Management Company (NELMCO) were created to regulate and manage supply and demand of electricity.

Table 2. Electricity generation capacity in Nigeria by energy source

Capacity in 2019	MW	%
Non-renewable	10,937	81
Renewable	2,152	19
Hydro	2,111	19
Solar	28	0
Wind	3	0
Bioenergy	10	0
Total	**13,089**	**100**

Source: IRENA, 2020.

Since the implementation of the reforms, Nigeria's total electricity generation capacity has reached 13,089 megawatt (MW); approximately half of the capacity required to service the current national electricity demand (IRENA, 2020). Only 31% of the energy produced reaches end-users, due to weak transmission capacity. Fossil fuels (81%) and hydropower (19%) are

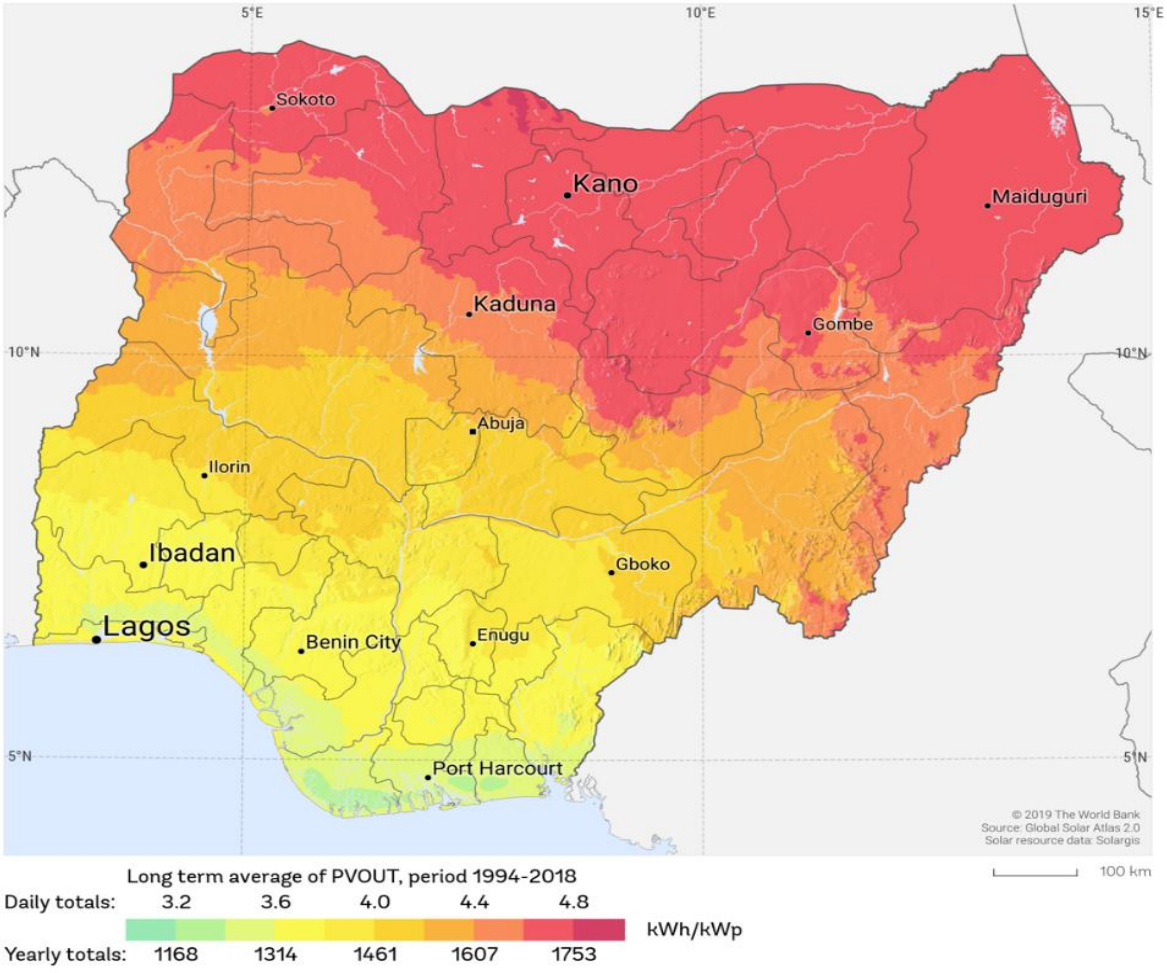
the two dominant energy sources, while solar PV capacity is negligible (28 MW, 0.002% of total generation capacity), see Table 2.

In 2018, 81.7% of Nigeria's urban population and 31% of its rural population had access to electricity (World Bank Data, 2018). Supply, however, in most areas is very unstable and often limited to just a few hours a day. Although the tariff remains relatively low compared to that of neighbouring West African countries, end-users feel the cost of electricity should not increase until there are significant quality of service improvements (AfDB, 2019).

Nigeria has connected almost 50 million people to electricity since 2005, but achieving universal energy access, as mandated by United Nations Sustainable Development Goal 7 (UN DESA, 2020), remains a complex challenge. National electricity supply is far below the level required to fuel economic growth, let alone deliver electricity access to all (Elum and Mjimba, 2020).

The country's inadequate energy infrastructure leaves its enormous potential for renewable energy generation underutilized. Central to this study is Nigeria's concentrated solar power and photovoltaic (PV) generation potential, which is estimated to be over 427,000 MW (Falobi, 2019). Figure 1 shows Nigeria's PV power potential. The northern regions in particular provide outstanding conditions for solar energy generation.

Figure 1. Nigeria's photovoltaic power potential

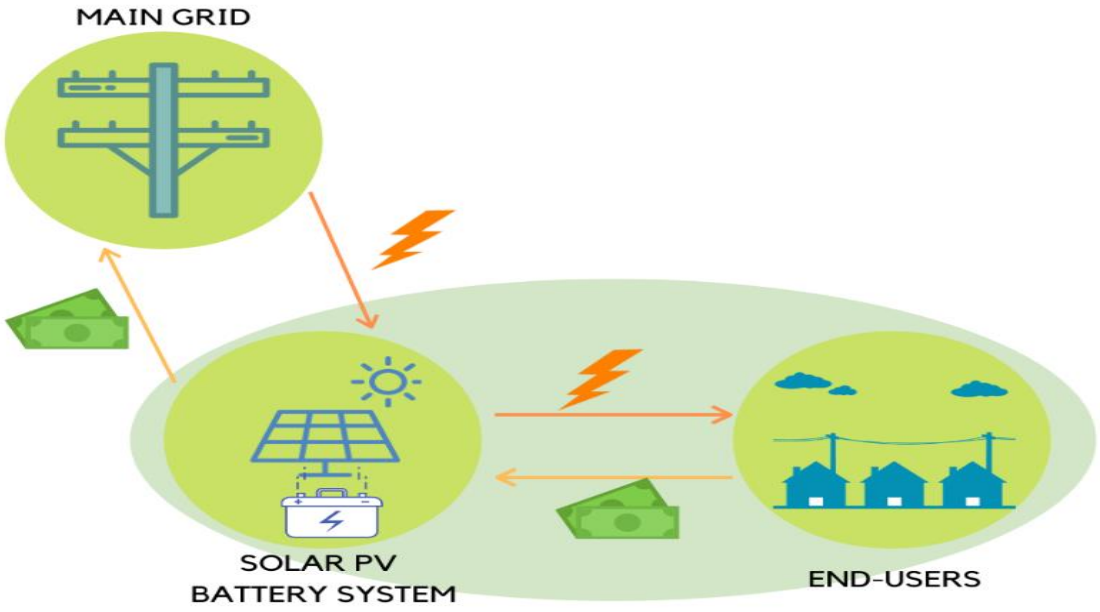


Source: World Bank's ESMAP, 2020, www.globalsolaratlas.info.

2.2 Benefits and potentials of IMGs

IMGs have gained traction in recent years as a solution to increase the share of renewables in the electricity mix, improve the reliability and flexibility of electricity supply, and provide electricity to low-income populations (IRENA, 2019). IMGs can use main grid power as back-up when renewable electricity generation is too low to meet demand. IMGs are small-scale, with capacities of up to 1 MW, and employed to electrify communities rather than individual households. Various sources of renewable energy – including solar, small-scale hydro, and biomass – can be used to power IMGs. This report focuses on interconnected solar PV mini-grids combined with energy storage devices (batteries). Most mini-grids in Nigeria are powered by diesel or – more recently, as the solar market is rapidly developed – solar PV-diesel hybrids.

Figure 2. Typical configuration of IMGs



© SD Strategies 2020, partly adapted from IRENA, 2019.

2.2.1 Contribution to universal energy access

Given Nigeria's enormous solar resource, IMGs have significant potential to relieve the country's energy supply problems. Especially in urban and semi-urban areas, they can provide more reliable access to electricity for millions of Nigerians. Connected to the main grid through DisCos, they can supply energy directly to end-users, whilst using the main grid as back-up when the supply from the solar PV panels is low.

The World Bank, African Development Bank (AfDB), United States Agency for International Development (USAID), and bilateral development organisations such as the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) have been promoting IMGs as one of the catalytic solutions to accelerate progress towards SDG 7, the United Nations' call to achieve "affordable, reliable, sustainable and modern energy for all" by the year 2030. It is

estimated that IMGs could provide energy access to up to 490 million people around the world, or more than half of all people currently without energy access, by 2030 (ESMAP, 2019).

In pursuit of delivering sustainable energy to its people, the Federal Government of Nigeria launched the Sustainable Energy for All (SE4ALL) Action Agenda. It aims at increasing on-grid renewable energy generation to 5,300 MW by 2020 and 13,800 MW by 2030, as well as total off-grid capacity to 8,000 MW by 2030 (NACOP, 2016). Nigeria's Rural Electrification Agency (REA) in its Rural Electrification Strategy and Implementation Plan (RESIP) envisions the development of 10,000 mini-grids by 2023 providing electricity to 14% of the population (Federal Ministry of Power Works and Housing, 2016).

2.2.2 Contribution to Nigeria's development agenda

PV-powered IMGs can play a key role in supporting Nigeria's development goals. In 2017, the Ministry of Budget and Planning launched the Economic Recovery and Growth Plan (ERGP). The plan is a medium-term development strategy with implementation spanning from 2017 to 2020. The plan has three major objectives: restoring growth through expansionary fiscal policies; improving the human capital base of the economy through investment in education; and creating a business-friendly environment to support the growth of the private sector (FGN, 2020).

To increase energy access and availability, the ERGP includes plans for the conclusion of the financial component of fifteen solar plants already agreed with investors. Also, electricity distribution companies (DisCos) are encouraged to procure embedded generation directly, while the government mobilizes investments to execute renewable off-grid power solutions. Following the COVID-19 pandemic, which has put severe strain on the economy and the health system of the country, the Federal Executive Council in June 2020 approved the Economic Sustainability Plan (ESP) to be implemented from 2020 to 2022. The plan, which integrates the ERGP rests on three pillars; the fiscal and monetary measures, the real sector measures and the implementation plan (FGN, 2020). Under the ESP, the Solar Power Strategy aims to deliver energy to five million households through the installation of Solar Home Systems and mini-grids by 2023.

Development of IMGs can contribute to the economic sustainability plan of all three of the development objectives of the ERGP and the measures suggested in the ESP. The creation of a new market for top-tier and innovative technology can attract foreign investment, create jobs, and improve access to low-carbon energy for underserved areas. Transfer of technology and knowledge through public- and private-sector interaction can also contribute greatly to learning and development. Improvements in energy supply will improve the investment environment across all economic sectors.

2.2.3 Contribution to climate mitigation

Under the Paris Agreement within the United Nations Framework Convention on Climate Change (UNFCCC), 197 states in 2015 committed to limiting the rise in average global temperatures to well below 2 degrees above pre-industrial levels. The Paris Agreement

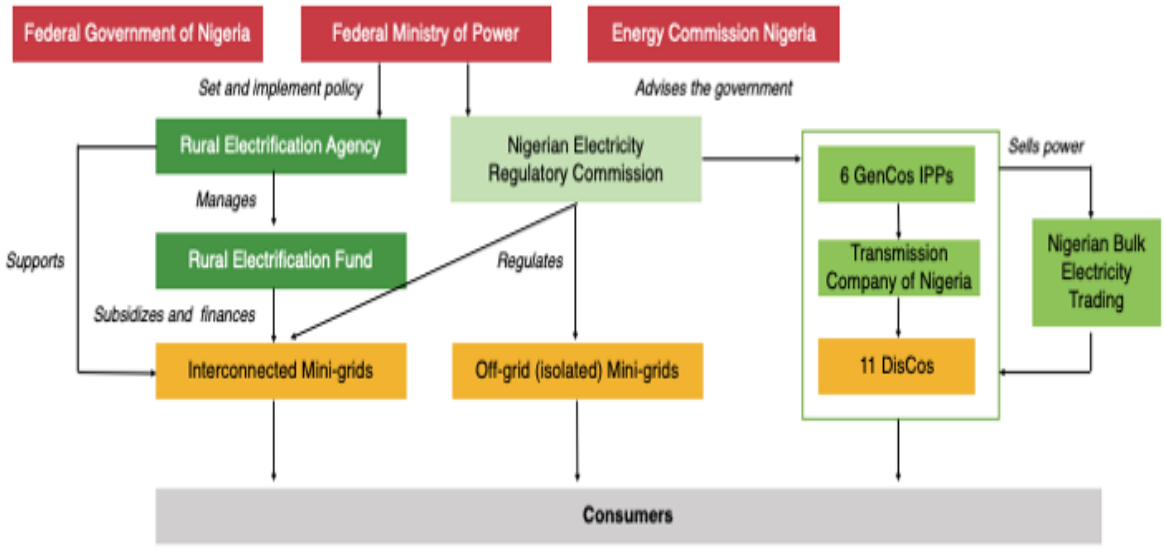
requires signatory states to set greenhouse gas (GHG) emission reduction goals, also known as Nationally Determined Contributions (NDCs), reflecting the differentiated situations and responsibilities of each nation.

As a signatory to the Paris Agreement, Nigeria has committed to reducing GHG emissions from 0.873 kg CO_2e (kilogramme carbon dioxide equivalent) to 0.491kg CO_2e per unit of GDP by the year 2030 (UNFCCC, 2015). To meet this goal, the Nigerian government aims to add 13,000 MW of off-grid solar energy generation capacity by that year. A scenario analysis found that to meet this ambitious goal, a "substantial transformation of the sector" needs to take place in conjunction with strong policy and financial support (Yetano Roche et al., 2019). Another study of the relationship between GHGs and new electrification revealed that off-grid renewables can contribute strong mitigation impact (Reiner Lemoine Institute, 2020). The growth of the IMG market will need to play a major role in meeting Nigeria's NDC targets.

2.3 Current policy, regulatory and institutional environment for IMGs

The administration of the Nigerian power sector is shaped by the Federal Government of Nigeria through the Federal Ministry of Power, the Energy Commission of Nigeria and other agencies (See Figure 3). The Nigerian mini-grid industry is primarily regulated by EPSRA and the Nigerian Electricity Regulatory Commission Mini-Grid Regulation of 2016 (NERC-MGR) EPSRA mandates the Rural Electrification Agency (REA) to design a strategy for the development of mini-grid systems and renewable energy power generation. The Act requires REA to present quarterly reports to the President of the Federal Republic of Nigeria on its progress in implementing this strategy. EPSRA also mandated the NERC-MGR, provides comprehensive guidelines for the process of obtaining permits to build and operate mini-grids with a generation capacity of up to 1 MW.

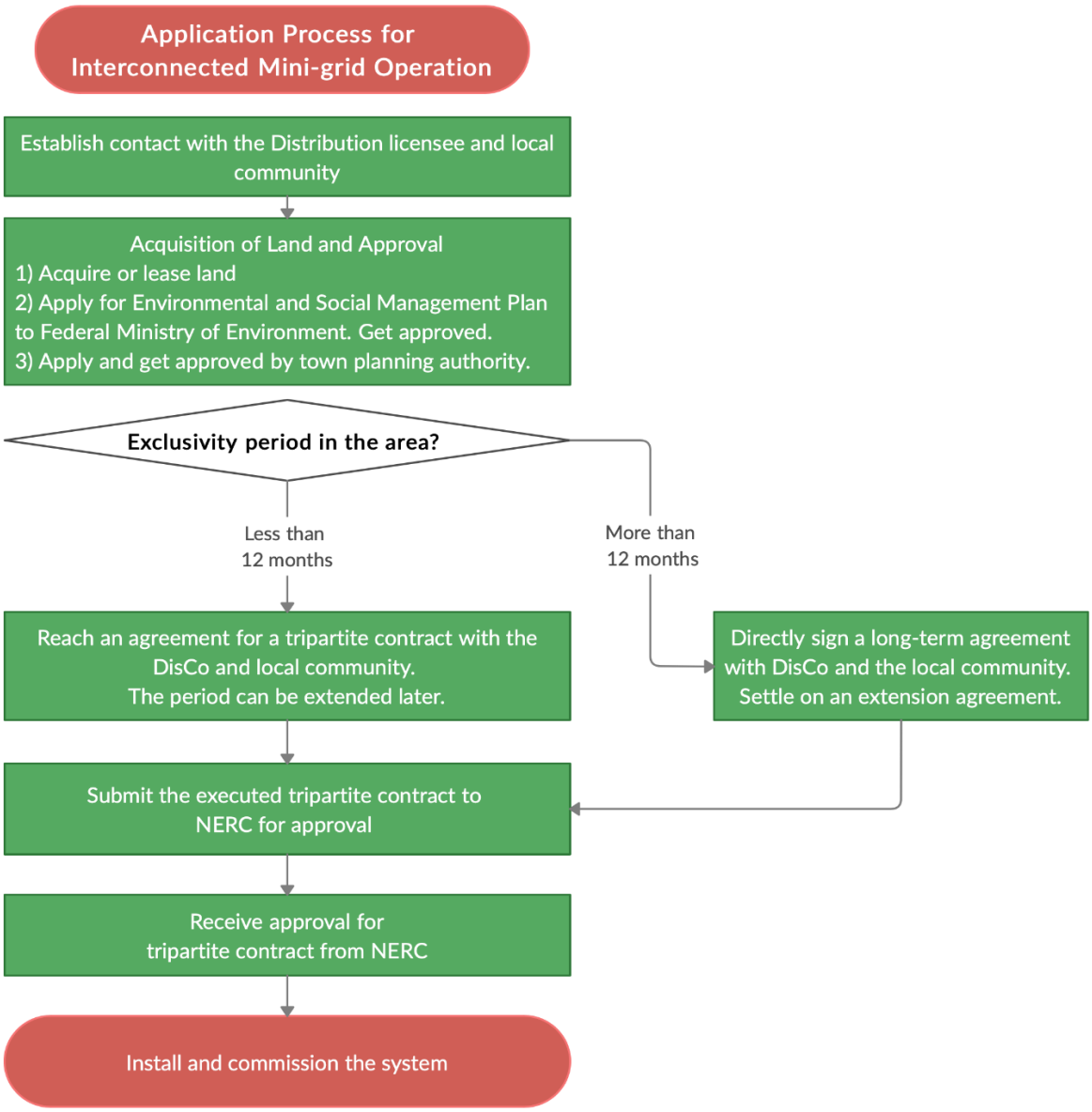
Figure 3. Structure of administration in Nigeria's power sector



NERC-MGR applies to both off-grid and interconnected mini-grids. Before the regulation was issued, there were no guidelines or regulatory frameworks for permitting the generation and distribution of electricity systems with capacity of less than 1 MW. The regulation filled that gap and provided clear definitions to help investors and developers navigate the permitting process from conception stage to commissioning. The regulation refers to mini-grids as systems with generation capacities between 0 kW and 1 MW.

The primary difference between isolated and interconnected mini-grids, as defined by the regulation, is the area each is meant to serve. Isolated mini-grids operate in unserved areas, while interconnected mini-grids serve underserved areas.

Figure 4. Application process for registering mini-grid businesses in Nigeria



NERC-MGR defines a mini-grid as follows:

“A mini-grid is an electricity supply system with its own power generation capacity, supplying electricity to more than one customer. A mini-grid can either operate in isolation from or be connected to a distribution licensee’s network” (NERC 2017, p. 8).

The Multi-Year Tariff Order (MYTO), which applies to the mini-grid sector, offers special advantages to developers. MYTO is an industry-wide methodology that fixes electricity prices for 15 years, establishing a fair price that ensures affordability for customers and profitability for producers. The MYTO allows mini-grid developers to negotiate tariffs directly with end-users within the price range pre-determined by the regulation, in order to ensure their profitability. Figure 4 shows the application process for obtaining permits for mini-grid developers.

2.3.1 The Interconnected Mini-grid Acceleration Scheme: A pilot project to benefit market development

In 2019, REA launched the Interconnected Mini-grid Acceleration Scheme (IMAS) to accelerate the deployment of IMGs in the country. The scheme is supported by the European Union and the German Government through the Nigerian Energy Support Programme, currently in its second phase (NESP II). It offers non-cash grants and technical assistance to developers and is currently under implementation by GIZ.

The main goals of IMAS are to:

- Extend electricity access to 15,000 customers across Nigeria, including residential, public, commercial, and productive users; and
- Provide reliable electricity supply at affordable prices.

In 2019, REA invited MG developers registered in Nigeria to participate in a tender organized as part of IMAS. They were asked to bid for the identification, development, partial financing, construction, as well as operation and management (O&M) of a solar IMG with capacity of up to 1 MW within the concession areas of seven participating DisCos.

As of April 2020, seven domestic companies were selected as winners of the tender: A4&T Power Solutions, ACOB Lighting Technology, Darway Coast Nigeria, GVE Projects, Nayo Tropical Technology, Rubitec Solar, and Sosai Renewable Energies. They were welcomed to participate in the IMAS and are offered technical support through NESP II. Upon completion, each IMG installed under IMAS is expected to operate as a for-profit commercial entity with a sustainable business model and provide reliable electricity supply.

So far, only one of the seven IMGs under the IMAS project has been commissioned and installed, at Mokoloki Community in Ogun State. The Mokoloki project has been developed by Nayo Tropical Technology and connected to the distribution network being managed by the Ibadan Electricity Distribution Company. Another IMG has been installed to provide power to Wuse Market (see the case study in chapter 4); however, this project is not being advanced under the NESP program.

3. Analysis of risks and barriers to IMG investment

This chapter presents the results of a survey of MG experts with particular knowledge of the IMG market. Their quantitative ratings and qualitative commentary are provided and contextualised.

3.1 Methodology and overview of the assessment of 23 barriers in 10 risk categories

UNDP's DREI methodology is a comprehensive framework for the identification and quantitative assessment of risks and barriers associated with private investment in the renewable energy sector in emerging economies (Waissbein et al., 2018). Based on UNDP's extensive experience with public-private partnerships (PPPs) for advancing renewable energy, the methodology also provides a list of policy and finance instruments that can be used to address each barrier. The methodology has been used for assessing clean energy markets in Belarus, Cambodia, India, Kazakhstan, Lebanon and Tunisia.

For this study, the project team developed a questionnaire based on the DREI methodology, and in particular on an earlier mini-grid assessment conducted in Kenya (UNDP, 2018). The team adapted the questionnaire to make it specific to the IMG market. The result was a survey of the likelihood of occurrence and the potential impact of 23 barriers in 10 risk categories. The questionnaire also asks respondents to rate the effectiveness of suggested policy and finance instruments. The presumption of the framework is that all the instruments are effective, but the level of their effectiveness differs.

For each barrier and instrument, the survey asks the following questions:

A: Rate the probability of the barrier occurring;

B: Rate the financial impact of the barrier should it occur;

C: Rate the effectiveness of these public instruments in addressing the identified risk.

Scores evaluated the likelihood and impact of barriers as well as the effectiveness of instruments along the following scale, respectively:

1 – unlikely / minimal impact / minimally effective;

2 – somewhat likely / low impact / slightly effective;

3 – moderately likely / moderate impact / moderately effective;

4 – likely / high impact / highly effective;

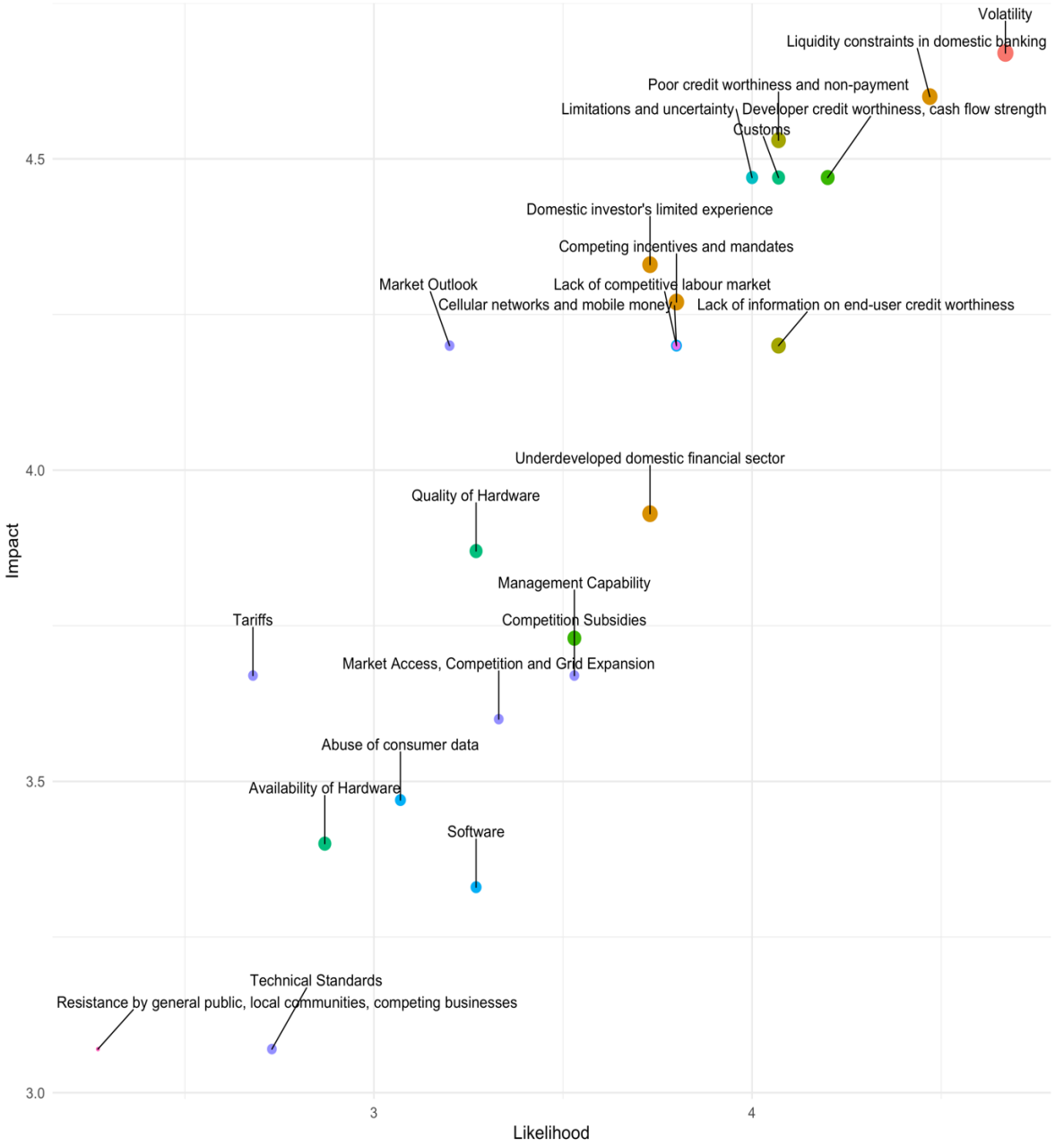
5 – very likely / very high impact / extremely effective.

Thirty-seven sector experts, project developers, investors, and government officials were invited to respond to the survey. For the selection of respondents, we considered their experience in the Nigerian MG market; their area of specialization; as well as their roles and responsibilities within their firm or agency.

Sixteen interviewees ultimately took part. The low response rate was expected since the survey was quite demanding: full delivery of all quantitative ratings and their qualitative rationales took about two hours. Since one contribution was incomplete, fifteen were ultimately evaluated. Among the respondents are five developers; six general experts such as consultants or scholars; two investors and two government officials.

Figure 5. Assessment of impact and likelihood of 23 IMG investment barriers

Top right barriers: High impact/most likely to occur →



← Bottom left barriers: low impact/least likely to occur

Figure 5 visualizes the impact and likelihood of 23 IMG investment barriers as they were perceived by respondents, using the average of ratings provided. Currency volatility at the top right is the most impactful barrier that is the most likely to occur. Resistance by general public, local communities, and competing businesses at the bottom left is the least impactful barrier that is the least likely to occur.

3.2 Discussion of individual risk categories and the barriers they entail

This subchapter describes the survey results for each individual risk category, its pertaining barriers and suggested policy and financial instruments, in order of most to least significant.

3.2.1 Currency risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Volatility of local currency	4.67	4.67	Provide government support for long-term development of liquid domestic FX derivative markets and develop financial products to transfer some or all currency risk to public sector	4.27
			Request development of risk-sharing products by development banks to address political risk	4.14

The consulted stakeholders ranked currency risk as the most significant risk because it can affect investments in IMG at the inception stage as well as when they are on-stream.

Volatility of local currency

The underlying barrier is rated as “likely (4.67)” to occur with a potential “high impact (4.67)”. Hence, policy makers should prioritize addressing this risk, which arises from uncertainty and fluctuations in the exchange rate between the local currency (Nigerian Naira, NGN) and international currencies, also known as volatility.

Due to Nigeria’s high dependence on oil exports, the value of its currency is sensitive to oil market changes. As domestic production of renewable hardware is yet to be developed, Nigeria’s mini-grid market relies on imports. Therefore, the IMG market is highly vulnerable to the volatility of the local currency. A sudden depreciation of the NGN can result in a developer’s inability to pay for foreign currency debt or equity. In addition, an investor may not be able to hedge exposure to the risk due to the illiquidity of foreign derivative markets. Targeted policy instruments need to be adopted to reduce this risk and attract investors and developers.

Effective policy and finance instruments

The DREI framework suggests the following instruments to address currency risk:

1) Provide government support for long-term development of liquid domestic FX derivative markets and develop financial products to transfer some or all currency risk to the public sector;
2) Request development of risk-sharing products by development banks to address political risk.

With an average rating above 4.0, both instruments were assessed as “highly effective” by respondents, with several experts assessing the instruments as “extremely effective” with a rating of 5. However, the government may not be able to provide sufficient financial products and support due to a lack of resources and capacity. An intervention by international development banks such as the World Bank and the African Development Bank is necessary to fill this capacity gap.

3.2.2 Financing risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Capital scarcity - liquidity constraints in domestic banking	4.47	4.60	Reform reserve requirements for domestic lending to businesses	3.93
Capital scarcity - underdeveloped domestic financial sector	3.73	3.93	Liberalize domestic financial sector	4.27
			Provide public loans, guarantees and/or equity to mini-grid operators to address capital scarcity	
Capital scarcity - competing incentives and mandates	3.80	4.27	Reform financial sector incentives for investing in specific sectors	4.33
Limited domestic investor experience with mini-grids	3.73	4.33	Strengthen domestic investors' (debt and equity) familiarity with and capacity regarding renewable energy mini-grids	4.53

The second-most significant risk category is financing risk. The severity of this risk depends on the state of the domestic financial sector and the investment climate of the country.

Liquidity constraints in domestic banking

The most significant financing barrier IMG projects in Nigeria face is the difficulty accessing finance from the domestic banking sector. This barrier scored well above 4 both in terms of likelihood and impact. This is due to several challenges such as liquidity constraints, the low level of development of the financial sector, competing incentives and mandates, and the limited experience of domestic investors.

Reform of reserve requirements is an effective instrument

To address this barrier, the DREI framework suggests *reforming reserve requirements for domestic lending to businesses*. This policy instrument was rated at 4, which corresponds to "highly effective". The Nigerian banking sector's previous experience supports this assessment. At the time of the reform of the Central Bank of Nigeria (CBN) in 2005, the banking sector underwent mandatory recapitalization. Research has shown that the post-reform period witnessed an increase in lending by banks (Okoye, 2011). An increase in the domestic banking reserve will reduce the competition for financing provided by the banking system.

Underdeveloped domestic financial sector

Respondents ranked the limited capacity of the domestic financial market as the 11th most important barrier overall. Knowledge gaps in mini-grid developers were also identified as a problem. Most developers are unaware of the available pre-financing options, such as crowd funding and the green bond, and of how to access these.

The DREI framework suggests two policy instruments to address this barrier:

1) Liberalize the domestic financial sector; and
2) Provide public loans, guarantees and/or equity to mini-grid operators to address capital scarcity.

Since the Nigerian financial sector is already liberalized, the first policy instrument is not applicable as a new reform project. The Federal Government of Nigeria in partnership with the World Bank, through the Nigeria Electrification Project is currently implementing the second policy instrument, which was rated as "highly effective (4.27)" by the survey respondents (The World Bank, 2018). In addition to making available more public loans and guarantees, the Nigerian government should create more awareness/sensitization to provide potential investors and developers with information on the availability of financing options and how to access them.

Competing incentives and mandates

This barrier exists because of conflicts of interest between policies and incentives, which may hinder the flow of capital to the IMG market. The barrier was ranked 10th most important overall. At the time of the survey, the Nigerian federal government had incentives in place that favoured investments in fossil fuel production and import over the renewable energy sector. The incentives have been phased out since the survey results were collected (Udo, 2020).

Reform of financial sector incentives must continue

The DREI framework recommends a *reform of financial sector incentives for investing in the IMG sector.* Respondents evaluated this policy as "highly effective", with an average score of 4.33. In line with the phase-out of incentives for the fossil fuel sector, the government must reallocate public funds to foster growth in the IMG market. Such reform will increase the potential profitability of companies in this sector and clearly signal the government's political will to develop the IMG market. The allocation can be justified easily, given IMGs' potential benefits and contribution towards the SDGs and NDC. Continued reform will increase lending institutions' willingness to issue loans to IMG developers.

Limited domestic investor experience with mini-grids

Domestic investors' lack of information on and experience with IMGs acts as a high-impact barrier (impact score 4.33). This barrier is to some extent unavoidable in nascent IMG markets. However, Nigeria's isolated (off-grid) mini-grid market has grown significantly in recent years, which has accelerated knowledge production and dissemination and improved economies of scale. Even though IMGs and off-grid mini-grids target different customer segments, the development of the off-grid mini-grid market has familiarized investors with the mini-grid concept. In addition, since IMGs target peri-urban communities, where customers are likely to have higher incomes than in rural communities, companies and their investors can expect higher returns on investment. These potential advantages must be clearly communicated to investors in order to attract investment.

Capacities of domestic investors need to be strengthened

The DREI framework advises governments to *strengthen domestic investors' (debt and equity) familiarity with and capacity* regarding renewable energy mini-grids. Respondents to the survey evaluated this instrument as "highly effective" with a score of 4.53.

The government and international development agencies can organize industry conferences and workshops, bringing various stakeholders together to share knowledge. REA and other international partners have made significant efforts in this area. For example, REA, in partnership with the World Bank, Climate Investment Funds and the Energy Sector Management Assistance Program (ESMAP), organized the 4th Mini Grid Action Learning Event in Abuja in December, 2017. It was attended by over 600 stakeholders, investors and industry players as well as the media. It helped stakeholders gain an understanding of how collaborations can help drive the mini-grid market. Investors were able to learn from developers about their challenges and about the market's prospects if the lack of access to financing is addressed.

3.2.3 Developer risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Lack of management capability	3.53	3.73	Provide government support to improve information flows and network effects	3.67
Low developer creditworthiness and cash flow strength	4.20	4.47	Provide public loans, guarantees and/or equity to mini-grid operators	4.47

Developer risk was perceived as the third most significant risk category. This risk category is connected to developers' capacity to deliver results and secure funding.

Lack of management capability

A lack of capacity in middle or senior management in IMG companies can result in failures in the design, execution and coordination of business plans. Respondents rated this barrier between 3 (moderately likely to occur/moderate impact) and 4 (likely to occur/high impact) and reported that highly qualified executives are primarily found in established markets where profitability and remuneration are higher.

Improve information flows and network effects

The DREI framework advises governments to *improve information flows and network effects.* Respondents evaluated this policy instrument as "moderately effective", with an average score of 3.67*.* The Renewable Energy Association of Nigeria (REAN) has been supporting local businesses by hosting industry conferences and training programmes. This should continue with more support from the public sector through enabling institutions like REA. Also, the performance of local businesses should be periodically assessed to identify and address knowledge gaps.

Low developer creditworthiness and cash flow strength

This barrier was ranked as the third most important barrier across all categories, scoring above 4 both in terms of likelihood and impact. Without high creditworthiness, significant collateral and evidence of strong cash flows, developers cannot access finance provided by the domestic financial sector. Since the IMG market is still nascent, developers in this sector are severely affected by this barrier.

Provide public loans, guarantees and/or equity to mini-grid operators

The DREI framework advises governments and international development banks to *provide public loans, guarantees and/or equity to mini-grid operators*. Respondents rated this instrument as "highly effective (4.47)". Multilateral international development institutions such as the World Bank and African Development Bank provide such assistance through the Rural

Electrification Fund, in the form of one-off grants or performance-based financing. As conventional one-off grants have been criticized for distorting the market and are deemed unsuitable for fostering long-term development, results-based financing(RBF) is often recommended as a smarter alternative (The Global Partnership on Output-Based Aid, 2018). RBF is a mechanism through which public grants are disbursed upon successful delivery of results. However, RBF does not address the cash flow problem developers face at the inception stage, as it disburses the money late – usually, at the earliest upon construction.

Continuous technical support and education for local businesses must be provided in parallel to allow businesses to deliver the results necessary for accessing the RBF funds. Meanwhile, the government and international development agencies can support developers' pre-financing needs by implementing policy and financial instruments for derisking the IMG market.

3.2.4 End-user credit risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFECTIVENESS
Lack of information on end-user creditworthiness	4.07	4.20	Facilitate growth of consumer credit data industry	4.33
Poor creditworthiness and non-payment	4.07	4.53	Facilitate end-user's ability to improve creditworthiness over time	4.27
			Government mandates to ensure creditworthy anchor tenants for mini-grids	3.29

End-user credit risk refers to uncertainties around the affordability of IMG energy services to target customers. In order for businesses to make a profit, the ability and willingness of the target customer group to pay for electricity as well as its payment culture must be thoroughly understood. Respondents stressed that no major investments can be made without addressing end-user credit risk. This risk can be broken down into two barriers:

Lack of information on end-user creditworthiness

This barrier occurs due to the lack of data available to developers to assess the financial capacity of their target customers. It was assessed to be the fifth most important barrier across all risk categories, and respondents rated it as "likely to occur (4.07)" with "high impact (4.20)". Developers and investors cannot make informed decisions based on unreliable or incomplete market projections, and thus better information provision is necessary.

Facilitating the growth of consumer credit data industry is a promising strategy

The DREI framework suggests that governments should *facilitate the growth of the consumer credit data industry.* This policy instrument was evaluated as "highly effective" with a score of 4.33. Nigeria has no database where information on end-user creditworthiness is collected.

To successfully develop the collection of consumer credit data, the government and private sector must collaboratively define a growth plan with several phases. First, customers in the formal sector that have Bank Verification Numbers (BVN) can have this data integrated with their customer data from the main grid. This stage can serve as a pilot phase to determine how the system will work. Customers in the informal sector with registered cellular phone numbers should be given the right to consent. To address data privacy concerns, consumer data should be collected anonymously.

Poor creditworthiness and non-payment

Ranked as the sixth most significant barrier overall, poor creditworthiness and non-payment refers to the high risk of payment failures. Respondents evaluated this barrier as "likely to occur (4.07)" with "high impact (4.53)". Respondents reported that non-payments tend to occur not because people are unwilling to pay, but because of the financial constraints they face. The risk of non-payment can hurt developers' profit margins and increase their risk of defaulting on bank loans. Hence, banks and investors are reluctant to lend to developers in businesses targeting customers in poor communities. In addition, this barrier can cause operational disruptions and lay-offs.

Improving end-users' creditworthiness is key to derisking investment

The DREI framework advises governments to *facilitate end-users' ability to improve creditworthiness over time.* This measure was rated as "highly effective (4.27)" by respondents. Two complementary approaches that can be explored are:

1) Facilitating access to consumer finance (e.g., government-sponsored digital ID scheme; general consumer finance reform; mobile money);

2) Promoting the productive use of electricity (e.g. by establishing a network of business development incubators and advisors to provide training and guidance in areas serviced by mini-grids).

Raising awareness of existing subsidy programmes and collaboration with communities ensure that local needs are reflected in policy design and can increase investor confidence by addressing end-user credit risk. For example, the Electric Power Sector Reform Act (EPSRA) contains provisions for the creation of a Power Consumer Assistance Fund, which provides subsidies to underprivileged end-users. Many stakeholders are not aware of this provision in the Act.

Government mandates for high-credit actors to purchase electricity from IMGs

The DREI framework also recommends *government mandates to ensure creditworthy anchor tenants for interconnected mini-grids.* For example, the government can make it mandatory for creditworthy actors, both private (e.g. cell phone towers) and public (e.g. health centres), to source their electricity from IMGs. Respondents rated this instrument as "moderately effective (3.29)". The government can explore this instrument as an alternative option.

3.2.5 Hardware risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Cumbersome customs processes and high tariffs	4.07	4.47	Introduce streamlined and consistent customs procedures; reform of punitive customs tariff systems	4.47
Lack of information on quality of hardware/technical standards/warranties	3.27	3.87	Develop certification and standards for hardware; adopt internationally recognized standards and share best practices, where applicable	3.80
Lack of a competitive market for buying hardware	2.87	3.40	Ensure an open, competitive marketplace for buying hardware	4.13

Hardware risk refers to the quality, availability, cost and ease of importing of mini-grid hardware components. Barriers in this category include the following.

Cumbersome customs processes and high tariffs

This barrier refers to the bureaucratic processes and high taxes that makes importing hardware cumbersome and expensive. Respondents evaluated this barrier as "likely to occur (4.07)" with "high impact (4.47)". Administrative requirements and complicated processes can lead to significant delays in the delivery of projects. High taxes add to the production cost for companies and reduce profit. The Nigerian government has granted customs waivers to local developers in the renewable energy industry. However, the respondents reported that these waivers are ineffective in speeding up the import process of renewable energy hardware, as the processes at the ports are overly complicated and poorly implemented.

Streamlining customs procedures and lowering import tariffs is a key de-risker

The DREI framework suggests introducing *streamlined, consistent customs procedures and reforming punitive customs tariff systems.* Respondents to the survey evaluated this policy as "highly effective", with an average score of 4.47. The renewable energy sector relies heavily on imported hardware and Nigeria is a transit country for goods destined for neighbouring land-locked countries. Customs process reforms are therefore very urgently needed to speed up the importation of hardware and reduce the administrative burden on developers. The punitive tariff system should be revised; as the domestic manufacturing industry it aims to protect currently lacks the capacity to service the market. Nigeria Customs Service currently 5% import duty on solar panels with diode; however, solar panels without diodes are exempted from paying import duties (ACE, 2019). Chapter 5 discusses how the conflict between low import tariffs and domestic industry protection can be resolved.

Lack of information on quality of hardware/technical standards/warranties

In the off-grid mini-grid industry, a lack of standards for hardware quality acts as a barrier. Respondents to the survey reported that the same barrier could affect the IMG market, though it is evaluated as "moderately likely to occur (3.27)" and "moderately impactful (3.87)". While developers know how and where to source good quality hardware, they lack information regarding government-established technical requirements for IMGs. Lack of information on quality of hardware can lead to poor quality hardware entering the market which can erode the confidence of end-users. Also, the government could establish guidelines at any time, which can lead to huge losses if developers have stocked or utilized hardware that does not meet the new standards.

Standards for hardware must be established and effectively communicated

The DREI framework advises the public sector to *develop certification and standards for hardware, adopting internationally recognized standards and sharing best practices where applicable*.

Government-issued guidelines on technical standards for the mini-grid industry will help developers adhere to hardware standards. The Standards Organization of Nigeria (SON) issues quality standards for hardware while NERC issues technical standards and guidelines. The Mini- Grid Regulation 2016 provided technical guidelines for mini-grids of up to 100kW, but none for mini-grids with higher capacity. The Standards Organization of Nigeria (SON) has information for required quality of hardware, but there is poor awareness in the mini-grid industry. However, developers will benefit from the guidelines for technical certifications recently issued by NEMSA in the course of this study.

The respondents assessed this measure as "moderately effective (3.80)". It will create awareness on the clear distinction between bad quality and good quality hardware. It will also help protect the reputation of the industry thereby increasing social acceptance.

Lack of a competitive market for buying hardware

The third barrier arises from the lack of a competitive international and domestic market for mini-grid hardware. Respondents evaluated this barrier to be one of the least significant overall – "moderately likely" to occur (2.87) with moderate impact (3.40). However, Nigeria's high dependence on imports should still be reduced to foster a sustainable domestic market for IMGs in the long run.

An open, competitive marketplace for hardware can increase hardware availability and quality

The DREI framework recommends that the government *ensures an open, competitive marketplace for buying hardware.* Respondents rated this instrument as "highly effective (4.13)". Despite the fact that respondents rated the likelihood of the barrier occurring as low, the government should promote the development of local manufacturing capacity for additional reasons such as to create jobs and other development benefits.

3.2.6 Sovereign risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Limitations and uncertainty related to the political and economic situation, risk of natural disasters, quality of infrastructure, etc.	4.00	4.47	Request development of risk-sharing products by development banks to address political risk	4.27

Sovereign risk refers to uncertainties arising from the (perceived) instability of a country's political and economic environment. Sovereign risk can impede investment at any stage of market development. This risk arises from the following barrier:

Limitations and uncertainty related to the political and economic situation, risk of natural disasters, quality of infrastructure, etc.

Ranked the seventh most important barrier overall, this barrier was evaluated as likely to occur (4.0) with high impact (4.47). This barrier can affect investment across all sectors in Nigeria. Though the country has been relatively politically stable for the past two decades, religious, ethnic and political conflicts have caused significant security concerns. Some areas are under siege by religious terrorists and are therefore not deemed safe environments for investment.

Risk-sharing with international development banks is crucial

The DREI framework recommends *requesting the development of risk-sharing products by development banks to address political risk.* Respondents rated this instrument as "highly effective (4.27)". Risk-sharing products should provide political risk insurance that hedges against risks of expropriation, political violence and currency inconvertibility (IRENA, 2016). However, for this instrument to be effectively applied to IMGs in Nigeria, international financing institutions will need to collaborate with enablers of the industry like REA and the financial sector to develop tailor-made products.

3.2.7 Digital risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Poor cellular networks and low usage of mobile money	3.80	4.20	Adopt well-designed telecom regulations enabling universal, competitive coverage and mobile money	3.60
Limited standardization of software and interfaces on mini-grid developers' back-end data and operations, and mobile money payment platforms	3.27	3.33	Provide government support to form industry associations for standard-setting and sharing of best practices	4.07
Abuse of consumer data privacy	3.07	3.47	Institute balanced consumer data protection regulations	3.93

Though it was ranked seven out of ten in order of importance, respondents stressed the need to address digital risk to improve the business environment for IMGs. Digital risk is composed of three specific barriers which significantly slow down the development of Nigeria's energy sector and economy-at-large.

Poor cellular networks and low usage of mobile money

Ranked eighth on the list of all barriers, respondents evaluated this barrier as "moderately likely" to occur (3.80) with "high impact (4.2)" on investment. Developers are off-site at times; during the times of their absence, they can monitor the performance of IMGs remotely using the internet. Internet banking and mobile payment systems are the most convenient way for customers to pay for electricity, and pre-paid metering and mobile money platforms or apps also require internet service to function. In parts of Nigeria that lack fibre-optic broadband connections, including most areas underserved by the main grid, internet is provided by cellular service providers. Coverage is a challenge even in some peri-urban areas, which can affect IMG operations. Mobile payment platforms in Nigeria experience frequent disruptions in payment processing due to poor network coverage, leading to loss of revenue for businesses using the platforms. Additional limitations are related to fees charged for mobile money transactions which many end-users view as extra charges.

In 2002, the Nigerian government launched a national service for mobile communication and technology. However, the availability and quality of digital technologies in Nigeria have not yet reached the standard required for potential commercially viable IMGs.

Well-designed telecom regulations are an enabling factor

The DREI framework recommends that the government establish *well-designed telecom regulations enabling universal, competitive coverage and mobile money.* Respondents

evaluated this policy instrument as “moderately effective (3.60)”. While the Nigerian Communications Commission’s (NCC) Nigerian Communications Act regulates the telecommunications industry, mobile transaction platforms are regulated by the Central Bank of Nigeria (CBN). The telecom is sector is not poorly regulated; however, more need to be done in the area quality of network and customer service by the network providers and mobile money operators. Overall, however, the telecommunication industry regulations allow for open and competitive coverage by cellular network providers in the country.

Limited standardization of software and interfaces for mini-grid developers' back-end data management and operations, and mobile money payment platforms

Without standardized software for processing mobile payments and managing back-end data, it can be challenging for mini-grid developers to ensure efficient business operations. In addition, unstandardized software is vulnerable to loss of data and interference by hackers. Disruption of metering software by malware or hackers can lead to loss of profit and consumer/investor confidence.

Industry associations can play a role in standard-setting and collaborative learning

The DREI framework advises the government to *support forming industry associations for standard-setting and sharing of best practices.* Respondents rated this instrument as “highly effective (4.07)”. Since renewable energy industry associations already exist in Nigeria, the government and development partners can facilitate discussions among stakeholders and lead the development of a shared standard.

Abuse of consumer data privacy

The third barrier contributing to digital risk is the threat of consumer data privacy abuses, such as privacy violations. Respondents rated this barrier as “moderate” in terms of likelihood (3.07) and of “moderate impact (3.47)”. Due to low awareness of data protection issues, consumer data are subject to frequent abuse. This can lead to loss of confidence in local businesses by consumers, thereby exacerbating the social acceptance risk, which is discussed later.

Compliance to existing consumer data protection regulations is necessary

The DREI framework recommends that the government *institute balanced consumer data protection regulations.* This instrument was rated as “highly effective (4.0)”. The Nigerian Information Technology Development Agency (NITDA) has issued the Nigerian Data Protection Regulation (NDPR). However, the level of compliance with this regulation is low due to a lack of awareness within the industry.

3.2.8 Labour risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Lack of a competitive labour market of qualified employees	3.80	4.20	Implement programmes to develop competitive, skilled labour market in renewable energy & mini-grids (all roles)	4.47

Labour risk relates to the availability of skilled and qualified potential employees needed for the scale up of IMG companies in Nigeria.

Lack of a competitive labour market of qualified employees

Respondents rated this barrier as “high-impact (4.20)” and “moderately likely to occur (3.80)”. A lack of human capital can impede the successful implementation of IMG projects, decrease consumer confidence and increase operational costs. As the IMG market has not yet been established, talent acquisition is a challenge. Highly-qualified workers are more attracted to more established sectors with higher remuneration and it will be very challenging to compete with these established sectors in offering attractive wages and benefits.

Programmes should be initiated to develop a competitive, skilled labour market

The DREI framework advises governments to initiate *programmes to develop a competitive, skilled labour market in renewable energy & mini-grids (all roles)*. Respondents rated this instrument as “highly effective (4.47)”. Several Nigerian institutions offer well-known and popular technical and engineering programmes. Most of these programmes, however, do not cover renewable energy engineering. Accredited programmes and institutionalized degrees specifically for renewable energy engineering should be developed by universities and polytechnics in Nigeria. NESP and impact investors such as All On have been targeting this area lately. For example, Rubitec has offered mini-grid designer courses, coupled with scholarships for indigenes and operators in the Niger-Delta.

3.2.9 Energy market risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Market uncertainty created by lack of political commitment	3.20	4.20	Build political will and develop realistic and transparent targets, using multi-tier electrification indicators	3.87
Competition from subsidized diesel/kerosene and grid electricity	3.53	3.67	Reform fossil fuel and grid-distributed electricity subsidies	3.87
Uncertainty related to electricity market access, future competition and grid expansion	3.33	3.60	Establish regulatory approach with two, co-existing regimes: (i) light-touch (no license) and (ii) comprehensive (licensed). Mini-grid developers may choose to operate under either regime. Light-touch regime does not provide exclusivity, nor access to government financing or grants	3.87
Uncertainty or inflexibility in tariff regulations	2.67	3.67	Establish co-existing (i) light-touch (no license) and (ii) comprehensive (licensed) approaches	3.40
Uncertainty related to technical requirements for mini-grids	2.73	3.07	Establish co-existing (i) light-touch (no license) and (ii) comprehensive (licensed) approaches	3.33

Energy market risk refers to limitations and uncertainty regarding the energy market outlook, market access, prices and competition. Though this category was ranked as relatively low in importance, the Nigerian IMG market is still sensitive to energy market risk. This risk category is comprised of four barriers.

Market uncertainty created by lack of political commitment

This barrier arises from inconsistencies in policies relevant to renewable energy development, especially for IMGs. National renewable energy targets provide the certainty businesses and investors need to enter the market. However, a lack of political will and mixed policy signals can reduce confidence in the market.

Sending consistent policy signals and political support through target setting builds investor confidence

The DREI framework recommends governments *build political will and develop realistic and transparent targets, using multi-tier electrification indicators.* Survey respondents rated this

instrument as “highly effective (4.0)”. The government has set targets but should demonstrate political will by making firm commitments to those targets. Consistency in policy design and implementation is key to increasing confidence among developers and investors.

Competition from subsidized diesel/kerosene and grid electricity

Subsidies to fossil fuels limit the flow of public funding to renewable energies and increase the relative cost of renewable energy. In addition, electricity tariffs that are set too low can make mini-grid companies unprofitable. Mini-grid electricity cannot attract customers if developers charge cost-reflective rates while the main grid charges subsidized (and therefore lower) tariffs.

Subsidies for distributed renewables level the playing field for IMG developers

The DREI framework advises the government to *reform fossil fuel and grid-distributed electricity subsidies.* Respondents of this survey rated this instrument as “highly effective (4)”. As mentioned previously, this instrument was implemented shortly after the survey was completed. In the first quarter of 2020, the Nigerian government announced the phase-out of subsidies, and in August the government announced an increase in the tariff for main grid electricity (Odutola, 2020; Udo, 2020). The reform must continue in order to ensure its effectiveness. It is important to note that the grid tariff subsidy still applies in areas with low grid reliability. Implementation of cost-reflective tariffs also depends on effective metering which is not the case in many places.

Uncertainty related to electricity market access, future competition and grid expansion

IMG developers’ access to the electricity market is limited due to the concession rights awarded to DisCos. The concession confers on the DisCos the right to grant or refuse access to the areas in which they operate. Since IMGs serve grid-connected but underserved peri-urban areas, they do not face the risk of being displaced through grid expansion plans.

Uncertainty or inflexibility in tariff regulations

The second barrier is related to electricity tariffs. With a rating of “somewhat likely (2.67)” to occur, respondents did not see this barrier as a high risk, though they rated it as having “moderate” impact (3.67). The existing Multi-Year Tariff Order (MYTO) system has allowed developers to negotiate cost-reflective tariffs directly with their customers.

Uncertainty related to technical requirements for mini-grids

NERC-MGR provides the technical standards for mini-grids of up to 100kW. However, NERC is yet to issue technical standards for mini-grids larger than 100kW. This creates a dangerous leeway for the development of sub-standard IMG which will adversely affect the level of social acceptance when quality of service is poor. Although NEMSA has recently issued guidelines for technical certification of mini-grids, the industry still awaits required technical standards to be established and published.

Ensuring compliance by providing developers with different options can keep IMG market risk low

For the last three barriers, the DREI framework recommends that the government *establish a regulatory approach with two, co- existing regimes: (i) light-touch (no license) and (ii) comprehensive (licensed)*.

This instrument was rated as a "moderately effective" approach to address all three barriers, and it has already been included in the ESPRA and NERC-MGR. These regulations have liberalized the Nigerian mini-grid market, thus improving accessibility for international/local investors and developers.

Under NERC-MGR, developers of isolated mini-grid of up to 100kW may choose to operate under either regime. The light-touch regime offers such developers flexibility but does not provide exclusivity, nor access to government financing or grants. Unlike under the light touch regime, under the comprehensive regime, the developer must complete the complicated bureaucratic processes required for full permitting before they can commence operations. The regulation did not provide same flexibility for IMG developers. The process for obtaining IMG permit is a comprehensive one. The Regulation will need to be amended for IMGs of up to 100kW to have the option of operating under a light touch regime. It also noteworthy that the Regulation did not expressly preclude an IMG of up to 100kW from registering as an operator under a light touch regime.

3.2.10 Social acceptance risk

BARRIERS	LIKELIHOOD	IMPACT	INSTRUMENTS	EFFECTIVENESS
Resistance by general public, local communities, competing businesses	2.27	3.07	Develop and coordinate ongoing community impact and public awareness campaigns	4.27
			Pilot models for community involvement	4.36

The least significant risk category, according to the respondents, is social acceptance risk. This risk category is characterized by the following barrier.

Resistance by the general public, local communities and competing businesses

Respondents rated the likelihood of occurrence of this risk as "somewhat likely (2.27)" and expected its impact to be moderate. Respondents to the survey assessed this risk category as the least important because they expected customers to be open to new solutions to the country's long-standing energy supply problems.

The MG Regulation effectively mobilizes communities of end-users as parties to tripartite agreements and places the responsibility of community support building with developers and DisCos. The experience of end-users in different clusters served by IMGs will determine future social acceptance levels.

Effective policy instruments

The DREI framework suggests two policy instruments to address this barrier:

1). Develop and coordinate ongoing community impact and public awareness campaigns;

2). Pilot models for community involvement.

Both instruments were rated as “highly effective (4.27, 4.36)”. The government should embark on awareness-raising campaigns to inform end-users of the benefits of IMGs, in terms of increased service quality and improved quality of life. The campaigns should also stress how the participatory provision in the NERC-MGR, which mandates the inclusion of customers as a party in the tripartite agreements, helps communities to influence matter such as tariffs and quality of service. The public enlightenment campaign agencies of the government, like the National Orientation Agency (NOA) should collaborate with enabling agencies like REA and ECN to drive public awareness.

Delivering tangible results of pilot models is an important component to the solution. Success of pilot projects provides a proof-of-concept, which will establish a foundation for gaining trust. The IMAS scheme is a good opportunity for REA, ECN and NOA to create a model community involvement strategy that can be used as a framework for other communities as the IMG market develops. The strategy should be reviewed periodically and improved upon. Service delivery and building coordinated developer-community engagement forum should be a core part of the strategy.

4. Case study: key observations regarding the first IMG project in Wuse Market

4.1 Background and project specification

The Wuse Market IMG, implemented under the Energising Economics Initiative (EEI) of REA, is the first partly completed IMG project. Wuse Market is located in Abuja, the Federal Capital Territory of Nigeria. It is an expansive market with booths accommodating over 5,000 traders. With 1-MW IMG, the ultimate goal of the project is to provide 24 hours of electricity year-round to all traders in the market. Once at full capacity, the IMG is expected to displace over 3,000 diesel- and premium motor spirit-powered generators. This will lessen traders' dependence on costly fossil fuels and significantly reduce GHG emissions.

Green Village Electricity (GVE), a Nigerian renewable energy firm, signed a tripartite agreement with the Abuja Electricity Distribution Company (AEDC) and the Wuse Market Traders Association (WUMATA) for the development of a one-megawatt interconnected mini-grid system. The Abuja Markets Management Board (AMMB), which is responsible for all markets in Abuja, has given its approval for the infrastructure to be installed in the market.

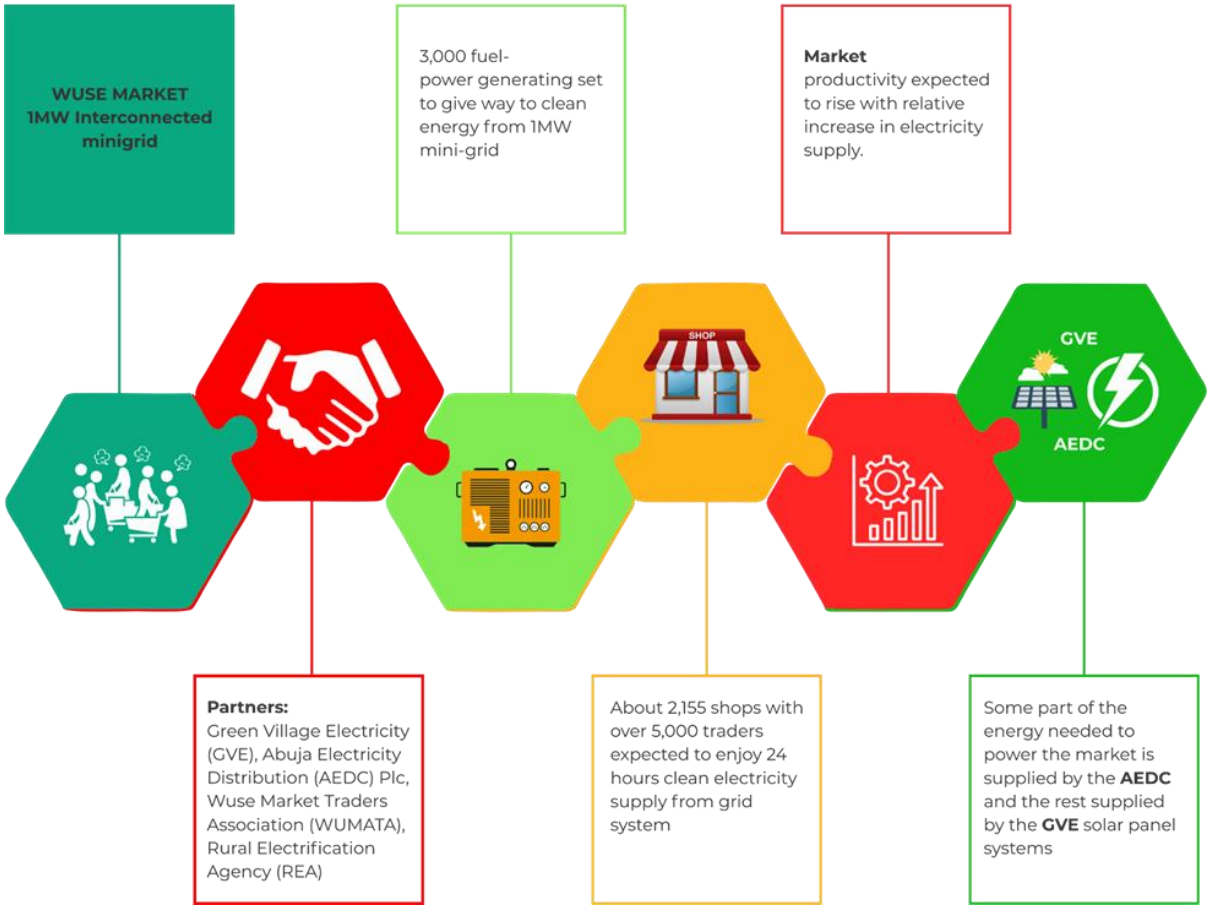
The 1-MW project will be implemented in phases. In Phase 1, a small portion of the grid will be constructed, serving 30 traders as a pilot phase. The first phase was successfully delivered. The 2nd Phase was scheduled to begin in October 2020, but the plan is presently on hold due to the COVID-19 pandemic.

Although the IMG project in Wuse Market is at an early stage of implementation, testimonials from the connected traders indicate a high level of satisfaction with the electricity services provided. Executives of Abuja's market association confirmed that the Wuse Market experience has already triggered the interest of other markets and shopping complexes in the city.

This case study identifies and explains the different stakeholders' roles in the implementation of the project, key lessons learned, and the main challenges stakeholders have encountered thus far. More details about the project are displayed in Figure 6.

The IMG in Wuse Market is independently operated by GVE in consultation with AEDC, the Market Traders' Association and other relevant stakeholders. This structure maximizes the developer's autonomy while limiting the risks and responsibilities of the DisCo-AEDC and traders throughout the project lifetime. The financial risk connected to the ownership of the system is also borne primarily by GVE. Interactions with traders have revealed that the introduction of the mini-grid has thus far increased productivity, income, and profitability from goods and services as a result of the provision of a reliable power supply.

Figure 6. Brief overview of Wuse Market IMG



The three parties to the tripartite agreement for the development of the Wuse Market IMG are: GVE, the developer; AEDC, the company holding the license for the Abuja distribution area; and the WUMATA, the party representing the end users (depicted in Figure 7). REA has facilitated the electricity audit, while NERC as the regulator approved the tripartite agreement. Traders connected to the IMG were interviewed and asked for feedback. All respondents shared positive comments about the services of the IMG.

Figure 7. Project structure and outcomes as of September 2020.

Developer - GVE

Role: Generation and storage, asset ownership and investment, mini-grid operation, and customer engagement.

Challenges: The COVID-19 pandemic has posed a major challenge to the continued efforts to connect more shops in the market beyond the pilot phase. However, work is likely to recommence in the near future.

Achievements so far:

- About 30 shops have been connected to the grid;
- Provision of 24-hour reliable power supply without disruptions caused by technical operations or adverse weather conditions;
- Customers do not pay a connection fee. This strategy has helped to build confidence amongst traders and buy-in for the project's objectives;
- Traders pay a cost-reflective tariff, which is more affordable than fuel for generators;
- An effective feedback mechanism has improved the relationship and communication with market traders;
- Revenue collection has been improved through efficient metering, billing, and collection processes.

DisCo – AEDC

Role: Distribution of asset ownership, service provision (partial supply of energy to the grid in order to power the PV batteries).
Challenges: Slow implementation of phase two due to COVID-19, engineering operations, bottlenecks causing delay in granting of permits, and commercial issues including complicated billing processes and the use of the distribution network.
Achievements so far:

- AEDC receives payments for the energy used by GVE and for the use of the network by GVE;
- The projected increase in revenue collection and minimal interaction with customers will provide the opportunity for the DisCo to recuperate funds faster;
- Customers show increased confidence in the DisCo's ability to provide a reliable and accessible power

Customers – Wuse Market traders

Role: WUMATA is responsible for organizing traders to mobilize support for the project. The association participates in monitoring, evaluating, and assessing the impact of the mini-grid.
Challenges: A number of customers have yet to embrace the project and have shown resentment and distrust. These customers may become targets of AEDC staff who could use them to sabotage the project because under the new system they are no longer able to "cut corners" with defaulting customers during compliance (metering and payment) monitoring activities.
Outcomes so far:

- Significant increase in the productivity, income and profitability of traders connected to the mini-grid;
- Traders have expressed a preference for connections to mini-grids as opposed to depending on power provided by AEDC because the mini-grid has been more efficient and reliable;
- Customers were able to negotiate an electricity tariff (N55/hr) that is lower than what they spent on fuel for generators and on grid electricity (on average N12592 or $32.70 per month);
- The negotiated tariff system provided customers the opportunity to weigh their options between the mini-grid system, the main grid and generator sets;
- Customers are saving money by using the mini-grid instead of fuel or diesel generating sets.

Figure 8. Wuse market traders' /customer testimonials

4.2 Lessons learned from the Wuse Market IMG

The challenges encountered and successes achieved so far in implementing Phase 1 of the Wuse Market IMG project offer important lessons for both the industry and the government. Overall, the pilot project has proven successful at providing a higher-quality and more reliable energy service than the main grid. It has done so at an affordable tariff, as agreed in the tripartite contract. This section summarizes main takeaways from the case study.

- **Stakeholder engagement and communication:** Transparent project objectives facilitated cross-sector engagement that helped cultivate the trust required for implementing the project. This engagement motivated all parties to the tripartite contract to collaborate closely and prevent misunderstandings that frequently occur in projects working in a novel market segment, such as IMGs.
- **Sustainable partnerships:** To facilitate the pursuit of mutual benefits, project stakeholders were encouraged to "put all their cards on the table" to ensure that standards, regulations and guidelines were followed. This strategy helped to shorten the project delivery time and reduce expenditure.
- **Governmental support:** REA is a key enabler of the project by providing non-financial support. The agency provided technical support by undertaking an energy audit of the market. The audit findings provided insights into electricity demand as well as the general support of the market traders for the IMG project.
- **Building customer trust:** Engagement with the WUMATA and AMMB ensured strong customer buy-in for the project. The fact that the developer/operator did not charge a connection fee particularly increased traders' confidence in the project's balance sheet. This strategy by GVE also helped boost the traders' perception of the DisCo's commitment to ensure higher service quality.
- **Contract term and period**: The 20-year contract period agreed by the stakeholders allows the IMG operator and the DisCo to achieve commercial viability. End-users emphasized that the long-term contract, to be reviewed every five years, offers them the opportunity to evaluate performance and determine periodically whether to continue working with the project.
- **Project phase segregation**: Implementing the project in phases allows for effective monitoring of the implementation by project partners. Their shared experiences will improve project development, operation, maintenance, and customer engagement in later phases when installations and connections are expanded. A phased roll-out of a project can help build customers' trust and appreciation of achievements while stimulating greater collaboration between partners.
- **Early permit approvals and negotiation**: Bureaucracy and bottlenecks delayed the permit approvals from NERC and affected the outcome of the commercial terms between the DisCo and the developer/operator, especially with regards to the pricing mechanisms and resulting tariff. Discussions to address these issues are ongoing. Fast-track permit approval processes and mediated comprehensive negotiations amongst the three parties would reduce time inefficiencies and enable quicker and cheaper project implementation.

5. From analysis to action: Key components of a programme to advance IMGs

The DREI survey has revealed that investment in the Nigerian IMG market is hindered by relatively high barriers across all risk categories, with the one exception of social acceptance. Most proposed policy and finance instruments were evaluated by respondents as effective and necessary. The findings of the analysis reflect the underdeveloped status of the IMG market in Nigeria.

No government can implement all instruments suggested by the DREI framework at once. To help the Nigerian government to embark on the next steps, this chapter focuses on eight key priorities for derisking investments in Nigeria's IMG market.

5.1 Ensure successful implementation of pilot projects – and consider lessons learned

Because of the successful uptake of off-grid mini-grids, the level of social acceptance of IMGs is relatively high and market projections are positive. Most urban and peri-urban customers in Nigeria are also unsatisfied with the current status of electricity service, which is frequently interrupted or even limited to a few hours per day. Therefore, IMGs are seen as a nothing-to-lose opportunity: either the service improves or not; it is unlikely to get worse. Because of the tripartite agreement structure, clients (through community representatives) are usually well informed about, and closely involved in, decision-making about the local IMG set-up.

This support for IMGs, however, should not be taken for granted. The pilot projects currently implemented under IMAS and EEI need to deliver significantly improved electricity services. Only then will IMGs be recognised as a viable alternative to conventional amplification of generation capacity, or self-generation through diesel generators (for customers who could afford to rely on the latter as back-up to the main grid). Public trust in the viability of IMG projects and understanding of their potential benefits will serve as a foundation for creating an investment-friendly environment.

Developers and investors also watch current pilots closely to see if they become successful, including for their own respective stakeholder group. Will those developers contracted under the current IMAS scheme succeed in turning their operations into a profitable business?

The government may want to consider taking on a more active role in promoting PPPs in the renewable energy industry. No single policy or actor can accelerate the expansion of a nascent market. The government can promote PPPs by creating a mechanism to bring together (or "match") IMG developers and DisCos – as well as to resolve conflicts between them where they arise, for example on issues such as grid interconnection, tariffs, and payment processing. The government should clearly define the division of roles and responsibilities among stakeholders and the mechanisms for dispute resolution.

An option to engage more communities and businesses in IMGs, including, potentially, in their financing, are co-ownership business models. They can be designed to serve the interests of

all parties. At a minimum, enhanced cooperation can mitigate financing risks, as stakeholders with high creditworthiness can share the risk burdens of those with low borrowing power.

Successful pilot projects will also increase the willingness of DisCos to cooperate with developers, which is crucial for achieving economies of scale in the IMG market. Ten of the eleven DisCos in Nigeria have agreed to be part of the IMAS project. To sustain collaboration with DisCos in the long run, pilot projects must demonstrate that the inclusion of private sector-run IMGs contribute to DisCos' efforts to meet their responsibility of providing quality service as stipulated in their concession agreement; that the integration of IMGs even leads to additional revenue for them.

It is important that policymakers understand the specifics of the pilot programme. GIZ has played a crucial role in the pilot projects by providing technical assistance, and thereby also significantly reduced the financial burden on developers. It will be important to know what further involvement GIZ sees for itself after the pilot phase – and if there is interest from other international assistance providers and funders to support the roll-out of new projects. To ensure market sustainability in the long run, the Nigerian government should explore all means to reduce the expenditure of developers and allow them to carry out as much of the project exploration and initiation phases as possible themselves.

It will be crucial to facilitate continuous learning from the experiences of key market stakeholders in the pilot phase, and to pair this with international best practices. The government should regularly consult with stakeholders involved in the pilot project and document their experiences. At the end of the current pilot phase, an updated version of the market risk analysis in this report might provide additional clarity about the barriers discussed.

Building on performance reports and market assessments, key lessons from the pilot projects should be documented and distributed among policymakers, developers, and industry associations, to inform further measures to improve the investment environment. It is also recommended that the pilot IMGs be assessed after two years of operation to draw lessons regarding their contribution to higher service quality and the individual performance of technical, business, ownership, and financing models.

5.2 Enforce compliance with existing policies and regulations – and clarify responsibilities of authorities

This study has revealed that the issue of non-compliance with existing standards and regulations creates significant risks, including hardware risk, digital risk, and end-user risk. Ensuring compliance mitigates these risks. The government should thus assess the level of compliance to current policies, regulations, and guidelines, including:

1) NERC-MGR;
2) EPSRA;
3) Environmental regulations made by Federal Ministry of Environment and enforced by the National Environmental Standards and Regulations on the Environment Agency (NESREA);
4) Guidelines on power infrastructure certification, enforced by the Nigerian Electricity Management Services Agency (NEMSA);

5) Regulations on hardware quality, enforced by the Standards Organization of Nigeria; and
6) The Nigerian Data Protection Regulation, enforced by the Nigerian Information Technology Development Agency (NITDA).

While the industry has demonstrated a high level of understanding of NERC-MGR, other regulations are poorly understood and have failed to achieve compliance. Awareness of and compliance with regulations can be enhanced through targeted communication with stakeholders, including developers and their associations.

To increase compliance with rules, the responsibilities of relevant ministries and agencies for monitoring and enforcement must be clearly defined. The government must enable regulators to meet their obligations by providing them with adequate human and financial resources, allowing them to offer regular training and pay competitive salaries. The ombudsman unit in Nigerian public institutions, known as Service Compact with All Nigerians (SERVICOM), needs to be enabled to respond effectively to petitions regarding corruption or poor service delivery.

REA should be tasked with periodically monitoring progress in IMG market development and include its findings and recommendation to the periodic report it submits to the President of the Federal Republic of Nigeria. It should receive all necessary means for designing strategies and policies for the renewable energy sub-sector, as mandated by EPSRA.

5.3 Design and implement new policies and regulations

Chapter 3 revealed several gaps in regulations and policies relevant to IMGs and discussed their effectiveness. A few additional regulatory actions are suggested:

The Mini Grid Regulation is a comprehensive legal instrument that encompasses almost all areas relating to the mini- grid industry. However, it is observed that the lack of guaranteed demand relating to energy market risk is a very strong negative gap inherent in the template for the tripartite agreement provided in the Regulation. The tripartite agreement places legal obligation on the host community to provide the land for the IMG infrastructure and also ensure security of the facilities. But, the agreement to purchase electricity from the IMG does not serve as a guaranteed purchase agreement. The implication of this is that members of the community can choose to buy or not to buy electricity from the IMG. If end-users find the tariff not favourable, they may choose not to buy electricity from the IMG and prefer private diesel powered generators. If they choose to buy electricity from the IMG, they may buy minimal units, such that will not make commercial sense to the IMG investment. To address this gap, the Regulation can be amended to include a mandate that will make commercial outlets to be mandatorily connected to the IMG alone and a requirement for minimum units to be purchased monthly for a certain period. Also, anchor tenants, like the telecommunication companies, banks, hospitals and government institutions operating in the community should be required to purchase electricity from the IMG alone and only use the generators when the IMG is not supplying energy.

Regulations related to mobile money are governed by two different organizations: the CBN has regulatory control over mobile money transactions and the NCC regulates the service

provision of cellular network providers. Two separate regulatory authorities can delay service delivery and conflict resolution, as two different bureaucratic processes need to be navigated. This can affect the quality of service provided by IMG operators, cause loss of revenue when there are payment disruptions, and impact negatively on the perception of end-users of IMGs. The NCC and CBN should together set up a helpdesk to receive and resolve issues relating to network disruptions and payment interruptions.

Network service must be extended to, or improved in areas where IMG projects are under implementation. Cellular companies should be made to become anchor customers of IMGs. This will also improve the quality of cellular network coverage in areas where there is poor cellular service. In order to minimize chances of disruption of payment while using mobile money application, an Unstructured Supplementary Service Data (USSD) code system can be introduced to allow end-users have an alternative to internet service. This flexibility in payment system will be beneficial to the developer and the end-users of IMG.

Another problem is the lack of software standards for data protection, payment methods, and energy metering. This increases digital risk for investors, developers and customers. NITDA can play a role in creating standards for software that can be used for various aspects of IMG operations.

Evaluation of the implementation of pilot projects might reveal further gaps in regulations, guidelines, and support policies.

5.4 Minimize bureaucratic hurdles and provide governmental services to all key stakeholders

Survey respondents reported that due to complicated bureaucratic processes, developers often face delays in obtaining permits or clearing hardware through customs. These administrative requirements create additional capacity burdens for companies and lead to uncertainties concerning project timelines.

The REA should be a one-stop shop for potential investors and developers, to reduce inefficiencies in permitting processes and provide user-centred public services. The one-stop shop should help in attending to pertinent issues such as permitting process, information on investment opportunities, matchmaking with DisCos, learning about government regulations, and customs issues. It will play a key role in building and deepening the strategic alliance between the public sector and private sector financiers. Beyond assisting with the inception processes for IMGs, the one-stop shop will gather and disseminate useful information on issues affecting the industry that developers wish to communicate to the government. There should be an online platform where stakeholders and potential investors can interface and access information from anywhere in the world. The platform should be managed by the one-stop shop office of the REA.

Import duties on renewable energy equipment or components are a matter of where conflicting interests hinder progress. On the one hand, governments want to reduce or eliminate barriers to encourage investment, but on the other hand, they also want to promote local production (Moinuddin & Bhattacharya, 2013).It has been noted that countries with well-developed hardware industries, such as India and China, choose a more protectionist approach, imposing

high import duties on renewable energy equipment, whereas countries which lack a well-developed hardware industry adopt policies to reduce customs barriers. An important example of the latter approach in Africa is the East African Community Customs Management Act, which stipulates that solar PV equipment and accessories are exempt from customs duty (BloombergNEF; SEforAll, 2020).

Generally, it is recommended, there should be clear and comprehensive rules and regulations regarding imports, which will ensure total clarity on licenses and permit requirements, import duties, VAT, and other possible aspects; moreover, all rules and regulations should be easily accessible and available(Franz et al., 2014)..

5.5 Build capacities and encourage knowledge transfer

To facilitate the growth of the IMG market and mitigate labour and developer risks for companies and investors, the government should strengthen the technical and managerial capacities of the Nigerian labour force. Several options should be explored:

- Standardized certifications for technical, vocational, and entrepreneurial training (TVET) for renewable energy and IMG installation and operation should be developed. This will enable those people with informal training to provide evidence of their knowledge and skills and ensure they are treated equally to people with formal training. Students will also be able to specialize in providing technical assistance to end-users and become independent contractors;
- Renewable energy engineering and mini-grid technology should be established as major academic fields at the undergraduate level of universities and polytechnics, while further specialized areas can be established at the graduate level;
- The Industrial Training Fund (ITF) should be utilized to encourage students to complete their mandatory internships (SIWES) at IMG companies;
- The government can facilitate knowledge sharing by engaging with industry associations. Cross-sectoral knowledge sharing is also effective for developing professional networks and fostering public-private partnerships. Peer-to-peer exchanges among developers should be adopted rather than one-way capacity building.

5.6 Strengthen domestic manufacturing capacity and ease imports of components that cannot be produced domestically

This study has revealed a potential conflict between the interest of the government in developing renewable energy and primary goals of the individual ministries of Finance, Commerce, as well as Labour and Employment. While the growth of the renewable IMG industry will require a rapid increase in hardware imports, the Ministries of Finance, Commerce, as well as Labour and Employment prioritize protecting domestic industries.

The government should strengthen local manufacturing capacity, while reducing barriers to imports of components and raw materials that cannot be produced domestically. The

government can encourage and attract foreign companies to develop manufacturing facilities in Nigeria. Nigeria has already established Export Free Trade Zones that can accommodate manufacturers of hardware destined for the Nigerian and other African markets.

Since the renewable energy industry is on the pioneer list of the NIPC, IMG manufacturers qualify for income tax waivers (Federal Government of Nigeria official Gazzette, 2017). These incentives have the potential to boost domestic manufacturing and thereby create employment. This will transfer technical knowledge to local skilled workers.

5.7 Support access to international finance

Due to liquidity constraints in Nigeria's domestic financial market and private investors' high perception of risk, IMG companies are struggling to find sources of funding. Unfortunately, the national budget is not sufficient to fill this financing gap. To break this vicious cycle of mutually enforcing financial gaps and perceived finance risks, gaining access to international public funding is crucial.

International development agencies and banks have taken a special interest in IMGs due to their dual impact on improving energy access and increasing the share of renewables in the energy mix. In 2017, 30 funders and financiers established the Mini-Grids Funders Group. As of March 2020, members of the group had approved USD 2.07 billion to drive the growth of MG markets in Africa (BloombergNEF; SEforAll, 2020). The World Bank has committed another USD 660 million to MG projects in 33 countries, including Nigeria, through 2025. Funders can channel funds through local banks, for on-lending; or provide guarantees. The SUNREF programme by Agence Française de Développement (AFD) is a good example of international funder driven approach that has worked in other countries like South Africa (SUNREF South Africa, 2017). Projects that advance the sustainable development goals can apply to the Green Climate Fund, which as of 2020 has USD 6.2 billion available (Green Climate Fund, 2020).

The Nigerian government can improve access to international public finance for IMG companies by providing technical and administrative assistance for application, certification and performance reporting. Research has shown that approved funding for mini-grids do not get delivered to mini-grid companies because many fail to report their performance based on data-driven evaluation. In addition, IMG companies have to prove that their business meets the international standard for sustainability. However, as there is no harmonized international standard for green investment, every organization applies different methodologies and standards. Government-backed certification that proves IMG companies' eligibility for sustainable funding can improve access to international finance.

Finally, the Nigerian government must continue its effort to engage international public financiers and facilitate local companies' participation. The IMAS marks a good start on this front. Without the government's initiative, local IMG companies would not have known or had access to these international funds. As suggested in 5.1, the Nigerian government must see the pilot project come to fruition and replicate such efforts based on the lessons learned.

5.8 Emphasise the government's commitment to advancing the IMG market

Uncertainties around policy changes and government support can lead to low confidence in the market. To build investor confidence, the government should send clear and consistent policy signals in support of IMGs. The government can set targets, establish incentives, and run public campaigns to increase public trust in the technology and developers. Specific IMG targets should be considered in addition to the overall renewable energy development target (13,000 MW by 2030). After implementing the above-mentioned steps, proper measurement, reporting and verification (MRV) systems must be set up to track progress.

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Annex I

The survey for developers, investors and experts.

1. SOCIAL ACCEPTANCE RISK

Description Risks arising from lack of awareness and resistance to renewable energy and mini-grids

SD STRATEGIES

UNDERLYING BARRIER	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on instrument
						ACTIVITY	DESCRIPTION		
1.1 Resistance by general public, local communities, competing businesses	Resistance due to unfamiliarity with renewable energy sources, mis-information, wrong perceptions and/or lack of awareness for mini-grid offerings; push-back from incumbent or prospect competitive technologies or businesses (e.g., diesel-based generation) and users (e.g., of SHS) who might feel challenged or disrupted by mini- grids				<->	Develop and coordinate ongoing community impact and public awareness campaigns	Public awareness campaigns; stakeholder dialogues and workshops between policymakers, NGOs, communities, community leaders and end users		
						Pilot models for community involvement	Piloting of community models such as revenue sharing or small equity stakes for households, plus employment prospects for individuals.		

2. HARDWARE RISK

Description Risks arising from limitations in the quality and availability of mini-grid hardware, as well as the customs treatment of hardv

UNDERLYING BARRIERS	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION		
2.1 Quality of hardware	Lack of access to information on quality, reliability (performance) and cost of hardware; lack of access to high-quality hardware; uncertainty regarding government technical standards to ensure safety of mini-grid hardware; lack of availability of warranties for components				<-->	Develop certification and standards for hardware; adopt internationally recognized standards and share best practices, where applicable.	Transparently develop, update, disseminate and enforce standards for technical performance and safety; mandate minimum warranties for components		
2.2 Availability of hardware	Lack of a competitive market for hardware (from both interenational and domestic suppliers); lack of locally tailored hardware				<-->	Ensure an open, competitive marketplace for buying hardware	Policy measures to ensure a competitive market for hardware; balanced industrial policy objectives (where applicable) for domestic manufacturers, with open markets for international manufacturers; government R&D support aimed at necessary technical hardware modifications to accommodate local conditions		
2.3 Customs	Cumbersome customs/clearing process for importing hardware, leading to delays in delivery; punitively high customs tariffs on mini-grid hardware, particularly in comparison to other sectors.				<-->	Streamlined and consistent customs procedures; reform of punitive custom tariff system	Effective recourse mechanisms; reduction of customs administrative steps; stipulated public response timelines (customs authority guarantees response within specified timeframe); full cost-benefit assessment and benchmarking of tariffs; phase-out/substantial reduction of punitive customs tariffs; introduction of import-tariff holidays and VAT exemptions.		

3. DIGITAL RISK

Description Risks arising from use of cellular networks for remote monitoring and payments; the use of software; and abuse of consumer dat

UNDERLYING BARRIERS	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION		
3.1 Cellular networks and mobile money	Lack/limitations of cellular coverage; over-dependence on a single operator for reliable cell service and payment processing; lack of mobile money; limitations relating to fees on mobile money transactions.				<-->	Well-designed telecom regulations enabling universal, competitive coverage and mobile money	Regulation on coverage areas and competition for cellular operators; regulations ensuring a competitive mobile money market, including reasonable fees for mobile money transactions.		
3.2 Software	Limited standardization of software and interfaces on mini-grid developers' back-end data and operations, and mobile money payment platforms.				<-->	Government support to form industry associations for standard-setting and sharing of best practices	Encourage engagement of mobile network operators, mobile money companies, mini-grid developers through industry associations, technology working groups to establish standards around the digitalization of energy services provision.		
3.3 Abuse of consumer data	Possible abuse of consumer data privacy on payments and usage; lack of understanding/clarity on uses of consumer information.				<-->	Institute balanced consumer data protection regulations	Facilitate the development of clear and transparent guidelines on data use by companies in the mini-grid ecosystem; raise awareness among consumers; government enforcement of data privacy laws.		

4. LABOUR RISK

Description Risks arising from the lack of skilled and qualified potential employees.

UNDERLYING BARRIER	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION		
4.1 Lack of a competitive labor market	Lack of educated, skilled and qualified (potential) employees, leading to higher costs, non-local staff, and suboptimal performance.				<-->	Programmes to develop competitive, skilled labour market in renewable energy & mini grids (all roles)	Apprenticeships, certificates and university programmes to build skills in renewable energy & mini grids (e.g., engineering, marketing, business management)		

5. ENERGY MARKET RISK

Description Risks arising from limitations and uncertainty in the energy market regarding market outlook, access, price and competition.

SD STRATEGIES

UNDERLYING BARRIERS	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		FINANCIAL DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION	ACTIVITY	DESCRIPTION		
5.1 Market outlook	Lack of political will and/or uncertainty regarding federal/state/local targets for electrification and renewable energy mini-grid investment.				<-->	Build political will and develop realistic and transparent targets, using multi-tier electrification indicators	Establish programmes to raise awareness and build political will with legislators (e.g., conferences, site visits, cross-ministerial committees); establish/strengthen energy statistics office; pursue a tiered approach to statistics for electrification; perform initial resource inventory and mapping, including through spatial planning; formulate realistic and transparent targets by tier, technology and demographics; ongoing monitoring of statistics				
5.2 Market access, competition and grid expansion	Inability or limitations of mini-grid developers to access the electrification market (including due to government regulations); uncertainty regarding (future) competition in electrification; unclarity regarding grid planning and expansion policies - or complete lack thereof.				<-->	Establish regulatory approach with two, co-existing regimes: (i) light-touch (no license) and (ii) comprehensive (licensed). Mini-grid developers may choose to operate under either regime. Light-touch regime does not provide exclusivity, nor access to government financing or grants (see later risk categories).	Light-touch regime (no license): Establish simple mechanism for mini-grid developers to self-register and provide basic annual reporting; self- registered mini-grid developers have right-of-first-refusal for concessions under the comprehensive regime. Comprehensive regime (licensed): Establish/develop capacity of institutions (e.g., rural electrification agency, regulator); determine national/state off-grid electricity service areas; define well-designed concessions (e.g, size, years, targets, bundling) for mini-grid developers; implement well-designed mechanism to grant exclusive concessions to mini-grid developers		Comprehensive regime (licensed): Establish compensation scheme (e.g., per kWh) in case of grid expansion		
5.3 Tariffs	Uncertainty or inflexibility in electricity tariff regulations for mini-grids.				<-->	Establish co-existing (i) light-touch (no license) and (ii) comprehensive (licensed) approaches.	Light-touch regime (no license): No tariff controls. Comprehensive regime (licensed) : Establish balanced and well-designed regulated tariffs to address monopoly risk, either through (i) tariff tables or (ii) price discovery, via auctions				
5.4 Technical standards	Lack of clarity, uncertainty and/or inconsistent government technical requirements for mini-grids regarding (i) quality of service and (ii) grid integration.				<-->	Establish co-existing (i) light-touch (no license) and (ii) comprehensive (licensed) approaches.	Light-touch regime (no license): Voluntary compliance with comprehensive regime standards. Comprehensive regime (licensed) : Develop balanced technical standards/requirements for quality of electricity and grid integration, with active enforcement				
5.5 Competing subsidies	Competition from subsidised diesel or kerosene; negative perceptions of mini-grid tariffs due to subsidised grid-distributed electricity.				<-->	Reform fossil fuel and grid-distributed electricity subsidies	Assessment of fuel and grid-distributed electricity subsidies; phase-out/down of subsidies*; awareness campaigns accompanying reform; design of transfer programs to vulnerable social groups				

6. DEVELOPER RISK

Description Risks arising from limitations in the mini-grid operator's management capability, creditworthiness and cash flow.

UNDERLYING BARRIERS	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		FINANCIAL DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION	ACTIVITY	DESCRIPTION		
6.1 Management capability	Lack or limited availability of C-suite talent and experience to ensure effective execution (business planning, financial structuring, plant design, resource & demand assessment, installation, operations & maintenance) and to manage challenges (e.g. limited information, unforeseen events).				<-->	Government support to improve information flows and network effects	Government support for establishing industry association and convening industry conferences; dissemination of top-level, national resource assessment; government-sponsored academic studies (e.g., on demand evolution).				
6.2 Developer credit worthiness and cash flow strength	Inability of developer to secure low-cost financing from investors due to lack of credit worthiness - or insufficient cash flows to meet investors' return requirements.				<-->			Public loans, guarantees and/or equity to mini-grid operators	Direct public loans to mini-grid operator; public guarantees to commercial banks that are lending to the mini-grid operator; public equity investments in mini-grid operator.		

7. End-user Credit

Description Risks arising from customers' willingness, ability, and methods of payment for electricity.

SD STRATEGIES

UNDERLYING BARRIERS	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		FINANCIAL DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION	ACTIVITY	DESCRIPTION		
7.1 Lack of information on end-user credit worthiness	Lack of end-user credit data with which to assess the ability of end-users to pay for the initial connection fees, ongoing electricity bills, as well as ancillary equipment (e.g., lights and appliances).				<-->	Facilitate growth of consumer credit data industry	Government-sponsored digital identity scheme; promotion of balanced privacy and financial regulations allowing for collection of credit data by the private sector; piloting of fintech solutions/platforms for credit data analysis.				
7.2 Poor credit worthiness and non-payment	Risk of delayed, reduced or non-payment by customers due to poor credit worthiness, lack of available funds, electricity theft, detrimental social dynamics.				<-->	Facilitate end-user's ability to improve creditworthiness over time	Two complementary approaches: (i) Facilitate access to consumer finance (e.g., government-sponsored digital ID scheme; general consumer finance reform; mobile money); (ii) Promote productive use of electricity (e.g. establish network of business development incubators and advisors providing training and guidance covering mini-grid areas).	Two possible approaches to address credit risk: (i) Public loans, guarantees and/or equity to mini-grid operators (ii) Government offtaker via PPA	(i) Direct public loans to mini-grid developer; public guarantees to commercial banks that are lending to the mini-grid developer; public equity investments in mini-grid developer. (ii) Government enters into PPA acting as an intermediary offtaker with mini-grid developer. Electricity is then onsold to end-users. This risk transfer/financial derisking approach can be combined with a per kWh subsidy* (direct financial incentive), addressing affordability concerns.		
						Government mandates to ensure creditworthy anchor tenants for mini-grids	Government targets and mandates require creditworthy actors, both private (e.g., cell phone towers) and public (e.g., health centres), to obtain their electricity from renewable energy mini-grids.				

8. FINANCING RISK

Description Risks arising from limitations and uncertainty in the energy market regarding market outlook, access, price and competition.

SD STRATEGIES

UNDERLYING BARRIERS	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		FINANCIAL DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION	ACTIVITY	DESCRIPTION		
8.1 Capital scarcity - liquidity constraints in domestic banking	Limited availability of long-term domestic loans due to high banking reserve requirements.				<-->	Reform reserve requirements for domestic lending to businesses .	Balanced approach to liquidity requirements, assessing trade-offs between financial stability and renewable energy/electrification objectives				
8.2 Capital scarcity - underdeveloped domestic financial sector	Low number of well-capitalised actors (debt, equity, insurance, pensions); lack of regulatory clarity on new types of financial products.				<-->	Liberalize domestic financial sector.	Liberalisation and introduction of competition into domestic financial sector; reforms to introduce and facilitate new types of finance (e.g., crowdfunding, peer-to-peer lending)	Public loans, guarantees and/or equity to mini-grid operators to address capital scarcity.	Direct public loans to mini-grid operators; public guarantees to commercial banks that are lending to mini-grid operators; public equity investments in mini-grid operators		
8.3 Capital scarcity - competing incentives and mandates	Existing policies incentivise or mandate domestic financial sector (banks, pension funds) to invest in alternative, competing sectors to mini-grids.				<-->	Reform financial sector incentives for investing in specific sectors.	Balanced approach to incentives across all sectors; introduce incentives, targets and mandatory lending requirements for renewable energy/minigrids/electrification.				
8.4 Limited domestic investor experience with minigrids	Lack of information, assessment skills and track-record for minigrid projects amongst domestic investor community; lack of network effects (investors, investment opportunities) found in established markets; lack of familiarity and skills with appropriate finance structures.				<-->	Strengthen domestic investors' (debt and equity) familiarity with and capacity regarding renewable energy mini-grids.	Mini-grid/electrification finance dialogues and conferences; workshops/training for investors on project assessment and financial structuring.				

9. CURRENCY RISK *

***Note this risk category only applies if financing is in hard currency.**

Description Risks arising from currency mismatch between domestic currency revenues and hard currency financing.

UNDERLYING BARRIER	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		POLICY DERISKING INSTRUMENT		FINANCIAL DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION	ACTIVITY	DESCRIPTION		
9.1 Volatility	Uncertainty due to volatile local currency; unfavourable currency exchange rate movements resulting in domestic currency revenues not being sufficient to cover hard currency debt/equity servicing; inability to economically hedge FX exposure due to illiquid FX derivative markets.				<-->	Government support for long-term development of liquid domestic FX derivative markets	Regulatory reforms enabling derivative trading for local securities exchanges; steering of large government FX hedging contracts to domestic FX markets.	Financial products to transfer some or all currency risk to public sector	Various design options exist, e.g. (i) The government enters into an intermediary PPA with minigrid operator, denominated in hard currency, and then onsells electricity to end-users at a fixed (or more stable) domestic currency tariff; (ii) Government-subsidised or -facilitated F/X hedging programmes (particularly for illiquid F/X trades).		
								Risk-sharing products by development banks to address political risk	Provision of political risk insurance (PRI) covering (i) expropriation, (ii) political violence, (iii) currency restrictions, (iv) breach of contract		

10. SOVEREIGN RISK

Description: Risks arising from a mix of cross-cutting political, economic, institutional and social characteristics in the particular country.

UNDERLYING BARRIER	DESCRIPTION	A: Rate the probability that the barrier occurs	B: Rate the financial impact of the barrier, should it occur	Comment on Barrier		FINANCIAL DERISKING INSTRUMENT		C: How would you rate the effectiveness of these public instruments in addressing your identified risk?	Comment on Instrument
						ACTIVITY	DESCRIPTION		
10.1 Limitations and uncertainty	Disruptions as a result of conflict, political instability, economic performance, weather events/natural disaster, legal governance, ease of doing business, crime and law enforcement, land tenure and infrastructure in the particular country.				<-->	Risk-sharing products by development banks to address political risk	Provision of political risk insurance (PRI) covering (i) expropriation, (ii) political violence, (iii) currency restrictions, (iv) breach of contract		

Annex II

The ranking of all barriers, from highest risk to lowest risk.

Rank	Barrier
1st	Volatility
2nd	Capital scarcity - liquidity constraints in domestic banking
3rd	Developer credit worthiness ad cash flow strength
4th	Poor credit worthiness and non-payment
5th	Customs
6th	Limitations and uncertainty
7th	Lack of information on end-user credit worthiness
8th	Capital scarcity - competing incentives and mandates
9th	Limited domestic investor experience with mini grids
10th	Cellular networks and mobile money
11th	Lack of competitive labour market
12th	Capital scarcity - underdeveloped domestic financial sector
13th	Market outlook
14th	Management capability
15th	Competition subsidies
16th	Quality of hardware
17th	Market access, competition, and grid expansion
18th	Software
19th	Abuse of consumer data
20th	Tariffs
21st	Availability of hardware
22nd	Technical standards
23rd	Resistance by general public, local communities, competing

Annex III

The average rating for each barrier, based on likelihood of occurring and the impact it would have if it were to occur.

1 – unlikely / minimal impact

2 – somewhat likely / low impact

3 – moderately likely / moderate impact

4 – likely / high impact

5 – very likely / very high impact

Risk	Barrier	Likelihood Rating	Impact Rating
Social Acceptance	Resistance by general public, local communities, competing businesses	2.27	3.07
Hardware	Quality of hardware	3.27	3.87
	Availability of hardware	2.87	3.40
	Customs	4.07	4.47
Digital Risk	Cellular networks and mobile money	3.80	4.20
	Software	3.27	3.33
	Abuse of consumer data	3.07	3.47
Labour Risk	Lack of competitive labour market	3.80	4.20
Energy Market	Market outlook	3.20	4.20
	Market access, competition, and grid expansion	3.33	3.60
	Tariffs	2.67	3.67
	Technical standards	2.73	3.07
	Competition subsidies	3.53	3.67
Developer Risk	Management capability	3.53	3.73

	Developer credit worthiness and cash flow strength	4.20	4.47
End User Credit	Lack of information on end-user credit worthiness	4.07	4.20
	Poor credit worthiness and non-payment	4.07	4.53
Financing Risk	Capital scarcity- liquidity constraints in domestic banking	4.47	4.60
	Capital scarcity- underdeveloped domestic financial sector	3.73	3.93
	Capital scarcity- competing incentives and mandates	3.80	4.27
	Limited domestic investor experience with mini-grids	3.73	4.33
Currency Risk	Volatility	4.67	4.67
Sovereign Risk	Limitations and uncertainty	4.00	4.47